4.0 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES CONSIDERED

All of the alternatives described in this document would apply only to fishermen on vessels that are required to have a Federal Atlantic limited access shark permit, a Federal Atlantic HMS charter/headboat permit, a Federal Atlantic HMS angling permit, or those fishermen interested in obtaining an exempted fishing or scientific research permit for sharks.

4.1 REBUILDING AND PREVENTING OVERFISHING OF ATLANTIC SHARKS

4.1.1 Rebuilding Targets and Status Determination Criteria in the HMS FMP

Under National Standard 1 (50 CFR 600.310) NOAA Fisheries is required to "prevent overfishing while achieving, on a continuing basis, the [Optimum yield (OY)] from each fishery for the U.S. fishing industry." In order to accomplish this, NOAA Fisheries must determine the maximum sustainable yield (MSY) and specify status determination criteria to allow a determination of the status of the stock. In cases where the fishery is overfished or where overfishing is occurring, NOAA Fisheries must take action to rebuild the stock (by specifying rebuilding targets) or take action to prevent overfishing. In the HMS FMP, NOAA Fisheries outlined these status determination criteria and a set of rebuilding targets. This Amendment does not change those status determination criteria or the rebuilding targets. The targets are summarized below and described fully in Chapter 3 of the HMS FMP.

The HMS FMP established the maximum fishing mortality threshold (MFMT) as F_{MSY}. F_{MSY} is defined as the fishing mortality level necessary to produce MSY on a continuing basis. When fishing mortality (F) exceeds MFMT, overfishing is occurring and remedial action must be taken. This is the current situation with the LCS complex, sandbar sharks, and finetooth sharks.

The HMS FMP established the minimum stock size threshold (MSST) as $(1\text{-}M)B_{MSY}$ when natural mortality (M) is less than 0.5. Most species of sharks have M less than 0.5. When the stock falls below MSST, the stock is overfished and remedial action must be taken to rebuild the stock. This is the current situation for the LCS complex.

Stocks are considered rebuilt when current biomass levels are equal to B_{MSY}. B_{MSY} is the level of stock abundance at which harvesting the resource can be sustained on a continual basis at the level necessary to support MSY. The current stock assessment for LCS indicates that the LCS complex as a whole is overfished. Additionally, the current LCS stock assessment indicates that sandbar and blacktip sharks have now reached or exceeded B_{MSY} and thus, are considered rebuilt.

Stock are considered healthy when F is less than or equal to 0.75 F_{MSY} and B is greater than or equal to B_{OY} (the biomass level necessary to produce OY on a continuing basis). Blacktip sharks are considered healthy.

The HMS FMP established that management measures for all HMS should have at least a 50-percent chance of reaching the target reference points used in developing rebuilding projections. This target is consistent with the technical guidelines for National Standard 1. However, as described in the HMS FMP, 50-percent is minimally acceptable for sharks. The 1997 quota rule used a 50-percent probability in order to ensure that the stock levels were maintained and did not decline further while a rebuilding plan was developed, but the HMS FMP used a 70-percent probability as a guide to ensure that the intended results of a management action are actually realized.

Compared to other HMS and other fish species, sharks are slow growing, take a long time to mature (e.g., sandbar sharks mature between 12 and 15 years), have few pups per brood, and generally reproduce every other or every three years (e.g., the sandbar shark has an average of eight to nine pups every other year). In other words, sharks have a low reproductive potential. Moreover, while there is data on certain shark species, there is not as much information on others. To ensure that all sharks in the LCS complex are taken into consideration, this Amendment re-aggregates the LCS complex; however, there is some degree of uncertainty in shark management because of the paucity of biological and/or fishing data available for some species. Additionally, a number of gear types catch sharks incidental to other target species. Many of those fisheries and gear types are managed by the Fishery Management Councils or States. Given these factors, in this Amendment as in the HMS FMP, NOAA Fisheries uses the 70-percent chance of success in order to ensure that the LCS complex rebuilds.

Thus, using these status determination criteria, NOAA Fisheries must take action to rebuild the LCS complex and prevent overfishing of the LCS complex, sandbar sharks, and finetooth sharks. The specific actions are fully described and analyzed throughout this document and below.

4.1.2 National Standard 1 and Determining the Rebuilding Time Frame

Under the National Standard 1 Guidelines, if a stock is overfished, NOAA Fisheries is required to "take remedial action by preparing an FMP, FMP amendment, or proposed regulation...to rebuild the stock or stock complex to the MSY level within an appropriate time frame" (50 CFR 600.310(e)(3)(ii)). Additionally, "in cases where a stock or stock complex is overfished, [the] action must specify a time period for rebuilding the stock or stock complex that satisfies the requirements of section 304(e)(4)(A) of the Magnuson-Stevens Act." The time frame to rebuild the stock or stock complex depends on a number of factors including:

- The status and biology of the stock or stock complex;
- Interactions between the stock or stock complex and other components of the marine ecosystem;
- The needs of the fishing communities;
- Recommendations by international organizations in which the United States participates; and

- Management measures under an international agreement in which the United States participates.

The lower limit of the specified time frame for rebuilding is determined by the status and biology of the stock and "is defined as the amount of time that would be required for rebuilding if fishing mortality were eliminated entirely" (50 CFR 600.310 (e)(4)(ii)(B)(1)).

The National Standard 1 Guidelines specify two strategies for determining the rebuilding time frame. The first strategy (50 CFR 600.310 (e)(4)(ii)(B)(2)) states that:

> "[i]f the lower limit is less than 10 years, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities and recommendations by international organizations in which the United States participates, except that no such upward adjustment can result in the specified time period exceeding 10 years, unless management measures under an international agreement in which the United States participates dictate otherwise."

The second strategy (50 CFR 600.310 (e)(4)(ii)(B)(3)) specifies that:

> "[i]f the lower limit is 10 years or greater, then the specified time period for rebuilding may be adjusted upward to the extent warranted by the needs of fishing communities....except that no such upward adjustment can exceed the rebuilding period calculated in the absence of fishing mortality, plus one mean generation time or equivalent period based on the species' life-history characteristics."

4.1.3 Large Coastal Shark Rebuilding Time Frame in the HMS FMP

Based on the model projections of the 1998 LCS stock assessment, in the HMS FMP, NOAA Fisheries determined that rebuilding the LCS complex would take longer than 30 years even if no fishing were permitted. Thus, because the lower limit of the rebuilding time period was greater than 10 years, NOAA Fisheries used the second strategy (50 CFR 600.310 (e)(4)(ii)(B)(3)) for determining the rebuilding period for LCS. Because of the severity of the possible reductions and because NOAA Fisheries was trying to manage sharks on a more species-specific basis, the HMS FMP specified rebuilding plans for ridgeback LCS and non-ridgeback LCS using sandbar and blacktip sharks, respectively, as proxies.

For ridgeback LCS, NOAA Fisheries considered the generation time of sandbar sharks (19 years) and other sharks that are easily confused with sandbar sharks such as dusky sharks (27.5 years). The 1998 stock assessment projections stated that sandbar sharks would have a 71-percent probability of reaching MSY in 20 years under a zero landings policy. Given this and the generation time for sandbar sharks, NOAA Fisheries determined that the time frame for rebuilding ridgeback LCS would be 39 years (20 years to rebuild under no fishing + 19 years for a generation).

For non-ridgeback LCS, NOAA Fisheries calculated the generation time of blacktip sharks to be 9.4 years. The 1998 stock assessment projections stated that blacktip sharks would have a 69-percent probability of reaching MSY in 20 years under a zero landings policy. Given this and the generation time for blacktip sharks, NOAA Fisheries determined that the time frame for rebuilding non-ridgeback LCS would be 30 years (20 years for rebuilding under no fishing + 9.4 years for a generation).

These rebuilding time frames, even though the rebuilding plan in the HMS FMP was not fully implemented, began in 1999. Rebuilding plans were not needed for pelagic sharks or SCS at that time because these species were not overfished and were not experiencing overfishing.

4.1.4 Revised Rebuilding Time Frame for Large Coastal Shark Complex

The need to revise the time frame

In 2001, under a court-approved settlement agreement, NOAA Fisheries had the 1998 LCS stock assessment peer-reviewed. Three of the four reviewers found that the scientific conclusions and scientific management recommendations contained in the 1998 LCS stock assessment were not based on scientifically reasonable uses of the appropriate fisheries stock assessment techniques and on the best available (at the time of the 1998 LCS stock assessment) biological and fishery information relating to LCS. Because of this conclusion, NOAA Fisheries determined that the projections from the 1998 LCS stock assessment should not be used as a basis for management decisions. Accordingly, because the 1999 rebuilding time frame was based on those projections, NOAA Fisheries must revise the rebuilding time frame based on the results of the 2002 LCS stock assessment.

Under the 1999 time frame, sandbar and blacktip sharks, as the primary species in the fishery, were used as proxies for the other species. At that time, this was appropriate because the stock assessment for those species indicated that, the LCS complex, sandbar sharks, and blacktip sharks were all overfished and experiencing overfishing. The latest stock assessment indicates, however, that while the LCS complex requires a rebuilding plan, sandbar and blacktip sharks do not. Therefore, keeping sandbar and blacktip sharks as proxies for the other species is inconsistent with the results of 2002 LCS stock assessment.

Under the 1999 time frame, calculating quotas and other management measures for the complex as a whole would result in some species within the complex potentially needing one level of quota in order to rebuild within 30 years and some species potentially needing another level of quota in order to rebuild within 39 years. If NOAA Fisheries manages LCS as an aggregate (the preferred management measure A3), the split in the rebuilding time frames could lead to confusion in calculating the quotas. Revising the time frame based on the aggregate could alleviate this confusion while still allowing NOAA Fisheries the flexibility to manage the fishery by species or species group, in the future.

The revised time frame

The 2002 LCS stock assessment found that the LCS complex is overfished and experiencing overfishing. The 2002 stock assessment found that a reduction in catch of 50 percent from the 2000 catch level has, on average, a 50-percent chance of rebuilding the LCS complex to MSY in 10 years. The stock assessment also found that under a zero landings policy, 10 years would give the LCS complex, on average, a 68-percent chance of rebuilding to MSY. Thus, in order to reach the 70-percent probability of rebuilding the stock, NOAA Fisheries would need to close the LCS fishery for more than 10 years. Because the amount of time required for rebuilding under no fishing is 10 years or greater under any of the three probabilities, as discussed below, NOAA Fisheries is using the second rebuilding time frame strategy in this Amendment.

Taking into account the biology of the stocks, the results of the 2002 LCS stock assessment, the requirements of the Magnuson-Stevens Act and the National Standard Guidelines, the criteria in the HMS FMP, and the status of the fishing communities that rely on these fish, NOAA Fisheries does not believe that a 10-year rebuilding period is appropriate for the LCS complex. If the rebuilding time frame were 10 years, then in order to reach the 70-percent probability of rebuilding within the rebuilding time frame, NOAA Fisheries would have to close the commercial fishery, place a no-retention limitation on the recreational fishery, and work with all Councils and States to prevent any take of sharks in non-HMS fisheries. Therefore, under this Amendment to the HMS FMP, the rebuilding time frame for the LCS complex will be based on the second strategy under the National Standard 1 Guidelines (time to rebuild under no fishing + one mean generation). This time frame takes into account all the items listed above including the needs of the fishing communities and the status of the stock.

The 2002 LCS stock assessment estimates that, on average, there is a 68-percent chance of reaching MSY with no fishing within 10 years and a 86-percent chance of reaching MSY with no fishing within 20 years. Assuming a linear relationship, the LCS complex has a 70-percent chance of rebuilding to MSY under a zero fishing policy in approximately 11 years.

Cortes (2002) lists the generation time for 38 species of sharks including several LCS species. The species in the paper were chosen based on their wide range of demographic traits and the availability of data. The generation times for the LCS listed in this paper range from 10 years to over 20 years. Specifically, the generation times in the paper for populations in the Atlantic Ocean or Gulf of Mexico were: tiger sharks = 10.9 years; silky sharks in the northwest Gulf of Mexico = 10.6 years; silky sharks in southern Gulf of Mexico = 16.1; scalloped hammerhead = 16.7 years; lemon sharks = 16.4 years; spinner sharks = 10.4 years; dusky sharks = 26.2 years[1]; sandbar sharks = 19.8 years; bull sharks = 21.6 years; sand tiger sharks = 10.6 years[1]; and blacktip sharks = 10 years. Using the average of the 10 LCS species included in this paper,

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[1] While dusky and sand tiger sharks are on the prohibited species list, the 2002 LCS stock assessment included those species that are on the prohibited species list that used to be on the LCS species list. Thus, the projections from the stock assessment include rebuilding of those species.

including the two populations of silky sharks studied in the paper, the mean generation time for the LCS complex is approximately 15.4 years. NOAA Fisheries used the average of the 10 species instead of picking one species because of the wide biological diversity of sharks and because the stock assessment did not state that there was any one species that was of particular concern.

Thus, the rebuilding time frame for the LCS complex is: 11 years (time to reach MSY under zero fishing) + 15.4 years (mean generation time of LCS species) = 26.4 years[2]. Because most of the management measures will be implemented in 2004, the LCS complex should be rebuilt in 2030. This time frame is almost the same time period projected for rebuilding non-ridgeback LCS sharks under the 1999 HMS FMP (2029) and is less than the 1999 HMS FMP rebuilding time period projected for ridgeback LCS sharks (2038).

During the public comment period, NOAA Fisheries heard that the proposed 16 years for a mean generation time seemed long and that NOAA Fisheries should use half of that time (8 years). However, given that sharks are slow growing, have a low reproductive potential compared to other fish, and that dusky sharks, one of the three shark species that is a candidate for listing under ESA, has a mean generation time of over 26 years, NOAA Fisheries feels that the full 16-year mean generation time is needed to ensure that all species in the LCS complex have a chance to rebuild while maintaining a viable commercial fishery.

Rebuilding measures in this Amendment based on time frame

The 2002 stock assessment states that, on average, reducing the catch by 50 percent gives a 61-percent chance of rebuilding the LCS complex to B_{MSY} in 20 years and a 67-percent chance of rebuilding the LCS complex in 30 years. Assuming a linear relationship, reducing the catch by 50 percent would give a 64-percent chance of rebuilding the LCS complex and preventing overfishing within the time frame outlined above. Thus, if this Amendment were only reducing the catch, reductions of greater than 50 percent would be needed to reach the guide of a 70-percent probability of rebuilding. However, NOAA Fisheries is implementing other measures, in addition to reductions in catch, that further increase the probability of rebuilding the LCS complex within the next 26 years by protecting juvenile sharks and pregnant females and minimizing mortality of those sharks that are caught and released. These measures include a time/area closure encompassing known nursery grounds (Alternative K2), gear restrictions that should reduce post-release mortality (Alternative J5), and a minimum size on recreationally-caught sharks (Alternative F2). Considering this and the other factors outlined in Chapter 2 regarding quota basis calculations, NOAA Fisheries believes that reducing the overall LCS catch by 45 percent, improving compliance with the recreational regulations, and implementing other

[2] In the draft EIS, NOAA Fisheries inadvertently missed one of the Atlantic LCS populations in Dr. Cortes' paper. This error led to a mean generation time of 16 years and a rebuilding time frame of 27 years. This error was corrected in this document.

measures such as the time/area closure will provide a 70-percent chance of rebuilding the LCS complex by 2030.

The HMS FMP requires NOAA Fisheries to conduct periodic stock assessments for species or species-groups. Thus, while this Amendment is based on the best available science at this time, NOAA Fisheries fully expects that as further information develops over the course of the rebuilding period, catch levels or other management measures will likely be changed depending on the results of future stock assessments, the subsequent likelihood of rebuilding the LCS complex by 2030, and other measures that could be taken besides reduction in catch (such as mandatory workshops - Alternative J8) that could result in reduced mortality on LCS. Based on new information, NOAA Fisheries will make appropriate adjustments to the rebuilding plan outlined in this document through rulekmakings to ensure that rebuilding occurs within the time frame established. Additionally, as more species-specific information becomes available, NOAA Fisheries will attempt to conduct species-specific assessments in order to ensure that any future management measure focuses on those species that are the most vulnerable or that need the most protection.

4.1.5 Preventing Overfishing on Sandbar Sharks

Under the National Standard 1 Guidelines, within one year of identifying a stock that is experiencing overfishing, NOAA Fisheries (in the case of HMS) must take remedial action by preparing an FMP, FMP amendment, or proposed regulations to end overfishing. In 2002, NOAA Fisheries conducted a stock assessment on LCS that showed sandbar sharks, for the first time since 1993, are not overfished ($B >= B_{MSY}$) but they are experiencing overfishing ($F > F_{MSY}$). The stock assessment states that, while reductions in catch are not needed to maintain or increase biomass levels, reductions in fishing mortality may be necessary to prevent overfishing.

Based on this Amendment, NOAA Fisheries will implement a number of measures that should reduce fishing mortality on sandbar sharks. For example, NOAA Fisheries will implement a time/area closure off of North Carolina that will protect juvenile sandbar sharks. Also, NOAA Fisheries is setting the commercial quota on the LCS aggregate. Because this quota is lower than the quota in recent years, the reduction in catch should also reduce fishing mortality on sandbar sharks. Additionally, NOAA Fisheries intends to work with enforcement and states to increase enforcement and consistency with Federal recreational bag and size limits and consider in another rulemaking requiring mandatory workshops to improve species identification and handling techniques. Babcock and Pikitch (2002) found that 84 percent of recreationally-caught sandbar sharks sampled at the dock were below the 4.5 ft size limit. Together, these management measures, if implemented and enforced, should be sufficient to end overfishing on sandbar sharks.

4.1.6 Preventing Overfishing on Finetooth Sharks

In 2002, NOAA Fisheries conducted a stock assessment on SCS that found that finetooth sharks are not overfished ($B>B_{OY}$) but are experiencing overfishing ($F>F_{MSY}$). Thus, as described above, under National Standard 1, NOAA Fisheries must take action to reduce F on finetooth sharks.

Preventing overfishing for finetooth sharks will be more difficult than preventing overfishing for sandbar sharks because the other species in the SCS complex are healthy. According to the SCS stock assessment, finetooth sharks are caught commercially almost exclusively in the South Atlantic region and mostly with gillnets (approximately 80 percent of finetooth landings) and longlines (approximately 20 percent). NOAA Fisheries is aware of approximately six vessels using gillnets to target sharks in the southeast. These vessels have 100 percent observer coverage during right whale calving season and approximately 50 percent observer coverage during the rest of the year. According to recent observer reports, these vessels do not catch as many finetooth sharks as are reported commercially. For instance, the SCS stock assessment estimates 16,658 finetooth sharks were landed commercially in 2000. According to observer reports, 1,230 finetooth sharks were observed caught during right whale calving season in 2000 (Carlson, 2000) and 168 were observed caught during non-right whale calving season in 2000 and 2001 (Carlson and Baremore, 2002). Thus, in 2000, approximately eight percent of all finetooth commercial landings ((1,230+168)/16,658) were landed by HMS fishermen directing on SCS with gillnets. The bottom longline observer program did not observe any finetooth catches in 2000 (Burgess and Morgan, 2003).

Most recreational landings of finetooth sharks occur in the Gulf of Mexico. In 2000, approximately 1,201 finetooth sharks were landed recreationally. Generally, the average weight of recreationally-caught finetooth sharks appear to be below 5 lb dw.

Thus, most of the finetooth landings appear to come from fishermen in non-HMS fisheries. In light of this and given the uncertainty stated in the stock assessment regarding the data and resulting status of finetooth sharks, NOAA Fisheries will take certain actions to identify sources of and to reduce fishing mortality on finetooth sharks. In the short term, increasing enforcement of the recreational minimum size and improving outreach to recreational fishermen should reduce fishing mortality to some extent. Additionally, reducing the SCS quota from 1997 levels based on either MSY levels for the complex or average landings of the complex should prevent the expansion of the SCS fishery. Over the next few years, NOAA Fisheries will work with states and Fishery Management Councils to identify fisheries that are landing finetooth sharks in order to reduce fishing mortality and consider requiring mandatory workshops for all fishermen. Additionally, NOAA Fisheries will continue to collect data on finetooth sharks in order to improve the data and therefore the results of future finetooth shark stock assessments.

4.2 COMMERCIAL MANAGEMENT MEASURES

4.2.1 Large Coastal Shark (LCS) Classification

As described in Chapter 2, the alternatives considered for shark classification are:

A1 Separate LCS groupings (Ridgeback/Non-ridgeback), different closure dates possible - (No Action),
A2 Separate LCS groupings (Ridgeback/Non-ridgeback), same closure date,
A3 *Aggregate LCS, one closure date - Preferred Alternative*,
A4 Species specific groupings, different closure dates possible.

Alternative A3 is the preferred alternative.

Ecological Impacts

Alternative A1 (no action) would separate the LCS complex into ridgeback and non-ridgeback shark groupings, on the basis of the mid-dorsal ridge characteristic. Under A1 it is possible to have different closure dates in the event that one group quota is filled before the other. This alternative was finalized in 1999 but not implemented until 2003 via emergency rule. Dividing the LCS complex into separate groupings was implemented on the basis that the mid-dorsal ridge provided an easy means by which fishermen, dealers and enforcement agents could identify different shark species and in order to move towards more species-specific management, as requested by fishermen and scientists. NOAA Fisheries received numerous comments on the 2003 emergency rule (68 FR 31987, May 29, 2003) as well as during scoping and public hearings for Amendment 1 that noted concerns about bycatch, the inability of fishermen/gear to target specific species or shark groups given the mixed nature of the shark fishery, continuing difficulties in identifying species and shark groups, and enforcement of two separate closure dates for LCS groupings (See Appendices 2 and 5).

While separate closures for ridgeback and non-ridgeback shark groups may allow managers to be more responsive to species management requirements within each group, partial closures of a mixed fishery could result in increased regulatory discards. To the extent that fishermen can target specific species, separate closures may not increase regulatory discards. However, to the extent that not all fishermen or enforcement officers can readily identify or target specific species, separate closures can increase regulatory discards and confusion as well as hinder rebuilding. According to observer data from 2000-2001, LCS comprise 66.2 percent of total shark catches (Burgess and Morgan, 2003). Of LCS catches, sandbar, tiger, and blacktip sharks represented 59 percent, 19 percent, and 8 percent respectively (Burgess and Morgan, 2003). Additionally, increased interactions with protected resources and associated mortality of non-target species may result if fishermen are fishing harder/longer to subsidize lost catches during a partial closure.

By comparison, alternative A2 would separate the LCS complex into ridgeback and non-ridgeback shark and establish commercial quotas for each group, but both groups would close when the first of the two quotas is filled. NOAA Fisheries currently accounts for overharvest and underharvest when setting the Federal commercial quotas. Thus, any underharvest of quota would be added to the same season of the following year. Under alternative A2, it is possible that the quota for one grouping could continue to increase over time, should underharvest in the previous season continue to occur. Under this scenario and similar to A1, fishermen would need to increase effort or fishing efficiency, particularly for one species group, in order to catch the available quota. Unless fishermen improve their species-targeting skills, this increase in effort could result in increases in bycatch of non-targeted species and/or increases in fishing mortality on LCS. It is possible that alternatives presented in Section 4.6 of this document could help to mitigate bycatch or bycatch mortality of non-target species. According to the 2002 LCS stock assessment, the LCS complex is overfished and overfishing is occurring (Cortes *et al.*, 2002).

Alternative A3 (preferred) will aggregate LCS species, and establish one commercial quota for the complex. Since only one quota exists under alternative A3 there will be only one closure date possible. NOAA Fisheries recognizes that alternative A3 offers lower resolution for quota and species-specific management, however this alternative seeks to minimize bycatch (i.e., regulatory discards) resulting from partial closures of a mixed fishery and allow fishermen the opportunity to catch the entire quota. These goals are consistent with public comment received by NOAA Fisheries during scoping and public hearings for the draft Amendment (See Appendices 2 and 5). Additionally, the number of protected resource interactions may decrease, or at least not increase, if fishermen do not have to increase effort in order to make up for lost catch during partial closures and if quotas are lower for LCS as a result of combining A3 with other preferred alternatives outlined in the quota basis section of this document. Because this alternative groups all species, this alternative will generally lead to lower overall quotas in order to protect the more vulnerable species.

Alternative A4 would establish species-specific commercial quotas. Closures would occur when the quotas for each individual species are filled. Since multiple species of shark are defined within the management unit and given that market demands for individual species differ, it is likely that multiple, differing closure dates will occur. While alternative A4 offers higher resolution for quota and species-specific management, it also increases the necessity for identification and targeting ability of shark to the species level. Accurate identification of shark species is often times difficult due to morphological similarities between species. Also, during scoping, NOAA Fisheries heard that many fishermen and dealers report species by whatever species is on top of the bucket (See Appendix 2). Additionally, this alternative may result in substantial increases of regulatory discards, especially considering that multiple closures would likely occur in a mixed fishery. Fishermen would likely need to increase effort in order to make up for lost catches during partial closures. This increase in effort may result in increased protected resource interactions and mortality on non-targeted species.

All of these alternatives would have additional ecological impacts depending upon the quota basis that is selected. Further discussion of these impacts is provided in Section 4.2.3 of this document.

Social and Economic Impacts

Alternatives A1 and A4 may result in the disruption of normal/historic fishing practices. Although A1 was established in the 1999 HMS FMP, it was not implemented due to litigation until the December 2002 emergency rule (67 FR 78990, December 27, 2002). When the rule entered into effect, concerns were raised by both fishermen and dealers during public hearings (See Appendix 2). In the event that one LCS grouping remains open while the other is closed, longer sorting times per set are likely to increase opportunity costs to fishery participants. Additionally lengthening of trips may occur in order for fishermen to compensate for lost catches during a partial closure. Increased time at sea reduces the profits fishermen gain due to increased costs for fuel, bait and ice. Safety at sea concerns are also of interest, given that fishermen must fish longer or harder to counteract for lost revenues.

Alternatives A2 and A3, by comparison, will maintain historic fishing practices (as finalized in 1999, but not under emergency rule in 2003) and food availability in the market place, given that both implement a single closure date for the season. Alternative A3, further addresses concerns from fishermen and dealers regarding inefficiencies, difficulties, and additional burden associated with having to distinguish between LCS species where group or species-specific management measures are employed. Under A2, fishermen would continue to experience inefficiencies due to the need to sort catch (i.e., mid-dorsal ridge identification between ridgeback and non-ridgeback). See Chapter 6 for additional economic information related to these alternatives.

All of these alternatives would have additional economic and social impacts depending upon which quota basis is selected. Further discussion of these impacts is provided in Section 4.2.3 of this document.

Conclusion

Alternative A3 (i.e., aggregate LCS, one closure date) is the preferred alternative because, in combination with the other preferred alternatives, it is:

1. Expected to maintain historic fishing practices (since 1999) and food availability in the market place;
2. Expected to reduce burden on fishermen for sorting;
3. Expected to decrease, or at least not increase, the number of protected resource interactions; and
4. Not expected to increase regulatory discards.

Embedded within species-based management is the necessity for accurate identification of the various species of sharks that may be commonly caught in mixed fisheries. NOAA Fisheries has received public comment regarding the inability of fishery participants to accurately identify and effectively target individual shark species (See Appendices 2 and 5). As such, NOAA Fisheries does not believe that a species-based classification is warranted at this time. However, some comments on draft Amendment 1 noted disappointment that management appeared to be dropping the species-specific approach. NOAA Fisheries may consider implementation of species-based LCS classifications when the ability to accurately identify and effectively target shark species improves. As such, NOAA Fisheries is also considering mandatory workshops to facilitate these improvements in another rulemaking.

4.2.2 Quota Administration

As described in Chapter 2, the alternatives considered for quota administration are:

B1 Semi-annual season - (No Action),
B2 No regional quotas - (No Action),
B3 *Regional quotas - Preferred Alternative*,
B4 *Trimester season - Preferred Alternative*,
B5 Quarterly season.

Alternatives B3 and B4 are the preferred alternatives.

Ecological Impacts

Alternative B1 (no action) would implement a semi-annual season (i.e., two per year) for commercial shark fisheries. Observer data suggest that there are temporal differences in catch. For example, observed catches of LCS during 2000, 2001, and mid-2002 reflect that sandbar sharks were more commonly taken off both coasts of Florida in winter (30 percent of all species total catch) as opposed to summer (5 percent of all species total catch) (Burgess and Morgan, 2003), whereas blacktip sharks were more commonly taken in summer as opposed to winter (Burgess and Morgan, 2003). The commercial shark fishery has been managed under semi-annual seasons since 1993. Concerns about semi-annual seasons extending into shark pupping seasons were raised during scoping and public hearings on draft Amendment 1. As such, NOAA Fisheries believes that while semi-annual seasons themselves do not result in over-exploitation, the continuation of semi-annual seasons for shark fisheries may result in ecological impacts, should open seasons extend into pupping time-frames and measures are not taken to protect juvenile and reproductive female sharks.

Alternative B1 was implemented on the basis of spreading out commercial fisheries in both southern and northern areas equally throughout the year, however NOAA Fisheries has learned via public comment (See Appendices 2 and 5) that this alternative continues to prompt bycatch and pupping season concerns. For example, shark pupping seasons range from March to September in any given calendar year (See Table 4.1; NMFS, 1999). As such, a semi-annual season approach could overlap with pupping seasons in every year absent significant closures (~

½ of each period) (See Table 1.3 for a list of closure dates). Protection of juveniles and reproductive females is recommended in the 2002 LCS stock assessment (Cortes *et al.*, 2002) primarily due to late maturation schedules (sexual maturity between 5-20 years of age) for sharks (Burgess and Morgan, 2003) and potentially significant mortality on neonates (Branstetter 1990; Manire and Gruber 1993).

Alternative B2 (no action) would not implement regional quotas for commercial Atlantic shark fisheries. Under this alternative, fishermen would continue to catch LCS along the Atlantic coast and in the Gulf of Mexico throughout the open season. Regional quotas have not been implemented in the past due to data limitations. Because this alternative has been in place since 1993, continuation of this alternative would be unlikely to result in any additional ecological impacts although changing it could result in both positive and negative impacts.

Alternative B3 (preferred) will implement regional quotas for the Gulf of Mexico (Texas - West coast Florida), South Atlantic (East coast Florida - North Carolina and the Caribbean), and North Atlantic (North Carolina - Maine) commercial shark fisheries (See Tables 2.1 and 2.2). Catch data, which are broken down by region, suggests that spatial differences in fishery practices and catches warrant further consideration of this alternative at this time. Fishing effort (i.e., hook hours and soak time) in North Carolina is greater than that of Florida's west coast fisheries. For example, North Carolina fishermen fished longer (i.e., 13.6 hr/set) and set more hooks (i.e., 639 hooks/set) than did Gulf of Mexico fishermen (i.e., 12.3 hr/set; 599 hooks/set) (Burgess and Morgan, 2003). As such, fluctuations in fish availability between regions results in variable catch-per-unit-effort (CPUE) estimates. Similar to catch data, shark pupping data indicate that spatial differences exist between species utilization of various shark pupping grounds. For instance, species within the SCS complex utilize pupping grounds between South Carolina and the Gulf of Mexico, whereas some species within the LCS complex utilize only the Atlantic coast for pupping grounds. Alternative B3 in accordance with pupping season information will provide managers with flexibility to adjust regional quotas, where necessary, to reduce mortality on juveniles and reproductive female sharks.

Alternative B4 (preferred) will implement a trimester season (i.e., three per year) for commercial shark fisheries. Limited data exist regarding shark catch composition when analyzed on a trimester time scale because shark fisheries have historically operated in semi-annual seasons and have been closed during what would equate to half of the second (May - June) and entire third (September - December) trimesters under semi-annual seasons. Nonetheless, alternative B4 will provide a higher degree of resolution on which to manage seasonal fisheries and as such this option better addresses pupping and bycatch concerns, while minimizing the economic and social impacts to the fishery and its participants (see economic and social impacts as discussed below). For example, a closure of the second trimester season (May - August) would concentrate fishing effort and associated mortality during non-pupping months of the year (See Table 4.1). Unlike semi-annual or quarterly seasons, trimester seasons would aggregate the majority of shark pupping into one fishing season (i.e., second trimester). Thus, if warranted, managers could close the entire second trimester in a particular region to protect juveniles and reproductive females. The quota that would normally be assigned to that trimester season would be split, as appropriate, amongst the other two trimesters.

Lastly, alternative B5 would implement a quarterly season for commercial shark fisheries. Limited data exist regarding shark catch composition when analyzed on a quarterly time scale because shark fisheries have historically operated in semi-annual seasons and have been closed during what would equate to the second and fourth quarters. Nonetheless, alternative B5 may provide a higher degree of resolution with which to manage seasonal fisheries and as such this option may better address/mitigate pupping and bycatch concerns, while minimizing the economic and social impacts to the fishery and its participants (see economic and social impacts as discussed below). For example, a closure of the second quarter season (April - June) would concentrate fishing effort and associated mortality during non-pupping months of the year. Quarterly seasons would, however separate the pupping season into several fishing seasons (i.e., quarters 2 and 3) as opposed to aggregating pupping into one season under preferred alternative B4.

NOAA Fisheries is unaware of any ecological impacts on protected resources associated with implementation of any of the alternatives discussed above. Few observed takes of protected resources and finfish have occurred in shark fisheries (See Chapter 3) to date. Of these observations, sea turtle takes have most commonly occurred in the first semi-annual season (January - June). Because shark fisheries have been closed during what would equate to half of the second (May - June) and entire third (September - December) trimesters under semi-annual seasons, NOAA Fisheries is unable to quantify the impacts on protected species with the preferred change in seasons. NOAA Fisheries will continue to monitor shark fishery interactions with protected resources and non-targeted finfish and will work to resolve any issues that may arise.

Social and Economic Impacts

Alternative B1 could have negative social and/or economic impacts should semi-annual seasons extend into pupping seasons. Given that LCS are overfished and overfishing is occurring, continued mortality of juvenile and reproductive females could cause the complex to decline further over time. Further declines in LCS stock status could result in additional reductions in available quota and/or other management measures, which could impact fishermen and fishing communities both economically and socially. Additionally, NOAA Fisheries has learned, via comments received during public hearings on draft Amendment 1, that a July 1st opening for the second semi-annual season makes it difficult for fishermen to establish markets with the forthcoming July 4th holiday.

Alternative B2 is unlikely to have any additional social or economic impacts because this alternative does not change quota calculation processes or fishing practices. By comparison, alternative B3 will likely enhance equity amongst regional user groups, given that access to fish available at different times of the year in different locations will occur. Because this alternative will divide available quota based on historical landings, no significant economic impacts are anticipated. This alternative seeks to maintain historical, regional catches. See Chapter 6 for additional economic information.

Historically, markets for shark products have been closed during the late spring and late summer (See Table 1.3). As such, limited information exists on which to evaluate the social and economic affects that alternatives B4 and B5 may have on fishery participants. Under alternatives B4 and B5 fishermen and associated communities (e.g., dealers, processors, retail agents) will likely need time to adapt, given that new markets will need to be established at different times of the year. Fishery participants will need time (i.e., between two weeks and a month) to work with grocers to advertise shark products, and under the preferred alternative (i.e., B4), the time available for such advertisements may be further limited, as compared with the no action alternatives. Additionally, since fishermen will be able to land sharks at the same time as other fish, there could be fluctuations in markets for other fisheries.

Variation in open seasons could result in short-term social and economic burdens, given that fishermen will need to adjust fishing practices, including but not limited to, re-rigging gear more often to fish for shark, as opposed to other species, during what would otherwise be a closed season. Social and economic costs associated with switching gear more often may be minimized, if shark fishery participants use the same gear in other fisheries (e.g., similar gear is used to fish for shark, grouper, and tuna). Trimester seasons will minimize, compared to quarterly seasons, the costs of switching gear (i.e., only three times as opposed to four per year) and give a higher percentage of the quota to each open season than would occur under a quarterly season approach.

While it is likely that open seasons under the preferred alternative (i.e., B4) will be shorter, as compared to the no action alternatives, there will also be more open seasons (i.e., three as opposed to two) spread across the calendar year. Increasing the number of open seasons and effectively spreading open seasons out more evenly over the calendar year will, in the long-term, result in greater economic stability for fishermen and associated communities. This is primarily because the amount of “no-fishing” time between open and closed seasons will be reduced. If at a late date, NOAA Fisheries closes one trimester due to pupping concerns, the quota would be added to the remaining trimesters for that region. This occurrence would lead to longer seasons and greater market opportunities as well as reduced necessity for switching gear throughout the year. The specific economic impacts of such a closure would be analyzed at the time of consideration.

Conclusion

Alternatives B3 (i.e., regional quotas) and B4 (i.e., trimester seasons) are preferred alternatives because they will allow managers the flexibility to open and close seasons to match species requirements such as pupping season as well as ensure that historical, regional catches are maintained. Additionally, trimester seasons will give fishermen a greater chance to build markets for sharks. However, NOAA Fisheries recognizes that in the short-term these alternatives could cause some social and economic impacts, as discussed in Chapters 6, 7, and 8. As such, NOAA Fisheries will delay implementation of trimester seasons until 2005 in order to give fishermen time to work with dealers to enhance market prices and plan out advertising strategies with grocers.

4.2.3 Quota Basis

As described in Chapter 2, the alternatives considered for quota basis are:

C1 Quota based on 1999 HMS FMP - (No Action),
C2 *Quota based on percentage of Maximum Sustainable Yield (MSY) - Preferred Alternative*,
C3 Quota based on average landings for past three years.

Alternative C2 is the preferred alternative.

Ecological Impacts

Alternative C1 would implement commercial quota levels for LCS (i.e., 620 mt dw for ridgeback LCS and 196 mt dw for non-ridgeback LCS), SCS (i.e., 359 mt dw), and pelagic sharks (e.g., 92 mt for porbeagle, 273 mt for blue, and 488 mt for other pelagic sharks). The LCS quota levels were established in the 1999 HMS FMP based on projection models in the 1998 LCS stock assessment. These LCS quotas used sandbar and blacktip sharks as proxies for ridgeback and non-ridgeback sharks, respectively. While NOAA Fisheries felt these LCS quota levels were appropriate in 1999, given the peer reviews of the 1998 LCS stock assessment and the results of the 2002 LCS stock assessment, these quota levels are no longer acceptable. The results of the 2002 LCS stock assessment indicate that blacktip sharks are fully rebuilt. Therefore a reduction of the magnitude proposed in this alternative is not necessary. Likewise, the 2002 LCS stock assessment also indicates that while overfishing is still occurring, sandbar sharks are no longer overfished and that further reductions are not necessary at this time to rebuild the biomass to optimum yield. While the 2002 stock assessment does indicate that the complex as a whole is overfished and that reductions are necessary to rebuild the complex, the 2002 LCS stock assessment also indicates that these results are related to declines in other species (i.e., dusky, hammerhead, and sand tiger sharks) within the complex.

The basis for the SCS quota, under alternative C1, was established in the 1999 HMS FMP. At that time, the quota was set at 10-percent higher than the highest commercial SCS landings in the time series available. The results of the 2002 SCS stock assessment suggests that biomass levels are at or above those which could produce MSY. This said, the HMS FMP sets $F_{target} = 0.75F_{MSY} = F_{OY}$ as the target control rule for healthy stocks. Under alternative C1, the quota would be twenty-percent lower than that of an MSY-based, healthy stock quota (See Table 2.3).

Similarly, the basis for pelagic shark quotas, under alternative C1, was established in the 1999 HMS FMP. Specifically, the porbeagle shark quota was approximately 10-percent higher than the highest annual porbeagle landings (1990-1998). The blue shark quota was equivalent to the average weight of blue sharks discarded dead by longline fisheries targeting tunas and swordfish for the period 1987 to 1997. Since a stock assessment has not been conducted for pelagic sharks since these quotas were implemented, NOAA Fisheries has no basis for which to change these quotas at this time. Once a stock assessment is conducted, NOAA Fisheries would either implement pelagic shark quotas consistent with an ICCAT recommendation, if applicable, or set pelagic shark quotas using the same method as described herein for LCS and SCS.

By comparison, alternative C2 (preferred) would implement commercial quotas for LCS, SCS, and pelagic sharks based on MSY, as modified to produce OY. LCS quotas vary under this alternative depending upon which classification alternative is selected (See Table 2.3 of Chapter 2 for quota calculation methodologies). Specifically, if alternative C2 was combined with alternative A1 or A2, then the LCS Ridgeback quota would be 1,017 mt dw and the LCS Non-ridgeback quota would be 509 mt dw. Combination of alternative C2 with alternative A3 (preferred), will result in an LCS complex quota of 1,017 mt dw. If alternative C2 was combined with alternative A4, then the sandbar quota would be 991 mt dw, the blacktip quota would be 1,473 mt dw, and the other LCS quota would be 95 mt dw. The quota for SCS will be 454 mt dw under alternative C2. At this time, the pelagic shark quotas, which were approved in the 1999 HMS FMP, will not change.

Unlike the previous alternative, C2 incorporates a wealth of information including, but not limited to, total catch, landings, and discards. Consideration of all fisheries related mortalities and the effects on the status of the stock, as opposed to considering landings alone, will minimize uncertainty.

As noted earlier in Chapter 4, NOAA Fisheries must determine the maximum sustainable yield (MSY) as well as optimum yield (OY) and specify status determination criteria to allow a determination of the status of the stock. As such, the 1999 HMS FMP defined fishing mortality and biomass levels necessary to produce MSY and OY on a continuing basis. Given that these definitions are not subject to change in this Amendment, MSY based quotas provide a direct means for determining appropriate fishery management action. MSY and OY estimates are readily available from stock assessment outputs and can be updated annually if necessary. Because MSY can be used to set OY as a total allowable catch (TAC) level under this alternative, it is important that recreational landings and fishery related dead discards be reduced proportionately to that of commercial landings, otherwise the TAC could be exceeded. Refer to Chapter 2 and other sections in this chapter for further discussion of alternatives to achieve this goal.

Alternative C3 will implement commercial quotas for LCS, SCS, and pelagic sharks on the basis of average landings for the past three years, while taking into account dead discards and state landings after a Federal closure. LCS quotas vary under this alternative depending upon which LCS classification alternative is selected (See Table 2.3 for quota calculation methodologies). Specifically, if alternative C3 was combined with alternative A1 or A2, then the LCS Ridgeback quota would be 794 mt dw and the LCS Non-ridgeback quota would be 931 mt dw. Combination of alternative C3 with alternative A3, would result in a LCS complex quota of 931 mt dw. If alternative C3 was combined with alternative A4, then the sandbar quota would be 635 mt dw, the blacktip quota would be 740 mt dw, and the other LCS quota would be 221 mt dw. The quota for SCS would be 300 mt dw under alternative C3. No change is proposed to the pelagic shark quotas, which were approved in the 1999 HMS FMP.

While alternative C3 incorporates the best available landings information into the process of setting annual quotas, landings data may be inaccurate due to under-reporting. This concern is especially important if fishermen view current accounting strategies (i.e., addition of any under-harvests to the same season quota in the following year) as an incentive to under-report. Alternatively, if fishermen over-report, it is possible that this alternative could lead to increased quotas regardless of the results of the stock assessment.

Under all three alternatives (i.e., C1, C2, and C3), the LCS complex would likely rebuild but on different time scales (See Section 4.1). Under alternative C1 the LCS complex would likely rebuild the fastest. Additionally, there would likely be less effort and therefore fewer interactions with protected species and non-target finfish as compared with the other alternatives. Under both alternatives C2 and C3, particularly C3, effort would be greater as compared to the no action alternative (i.e., C1) and reduced as compared to the existing effort under the current emergency rule. Considering the combination of preferred alternatives (i.e., C2 and A3), the commercial LCS quota levels will be higher for commercial fishermen as compared with the no action alternative (i.e., C1) and lower for commercial fishermen as compared with the current emergency rule (1,714 mt dw) or compared to the quotas that were in place from 1997 to 2002 (1,285 mt dw). As such, these preferred alternatives will neither result in additional interactions with protected resources and non-target finfish due to the decrease in quota, nor cause fewer interactions with protected resources due to maintained effort in the fishery, as compared with the quota and effort existing under the current emergency rule.

Under all three alternatives (i.e., C1, C2, and C3), the SCS complex would be managed for optimum yield to the commercial fishery. Given that the preferred quota level for SCS is thirty-percent higher than the highest average landings taken to date (i.e., 320 mt dw in 1997), NOAA Fisheries does not anticipate that an increase in effort would occur. As such, these alternatives would be less likely to result in any additional interactions with protected resources, but would also not reduce current level of interactions.

There are no ecological impacts associated with pelagic shark quotas under any of these alternatives, given that these quotas will not change from those implemented under the 1999 HMS FMP.

Social and Economic Impacts

In order for LCS to rebuild, reductions in catch must occur. Reducing the commercial quota will have a direct influence on the amount of catch. NOAA Fisheries recognizes that reductions in available quota would increase the likelihood of negative economic impacts to fishery participants during the rebuilding time frame (See Section 4.1). Specifically, alternatives C1, C2, and C3 will result in reductions in total revenues for directed LCS fishery participants (See Chapter 6). The preferred alternative (i.e., C2) seeks to minimize the economic impacts associated with LCS rebuilding. NOAA Fisheries anticipates that economic impacts associated with the preferred alternative will be reduced as the stock rebuilds and fewer reductions in quota are necessary to "convert" MSY to OY.

SCS fishery participants could experience both negative and positive economic impacts under these alternatives. Under alternatives C1 and C2, particularly C2, directed SCS fishery participants will experience positive economic impacts. Because quota levels for SCS will either remain the same or have the potential to increase under these alternatives, fishermen will have the opportunity to maintain current income levels or possibly increase total revenues. Therefore, it is unlikely that any negative economic impacts will be incurred. Stable or higher incomes for fishermen will reduce economic burdens in associated communities as well (i.e., economy stimulation, reduced seafood prices for consumers). By comparison, alternative C3 would reduce the available quota for SCS, thereby reducing total revenues accordingly.

There are no economic or social impacts associated with pelagic quotas under any of these alternatives, given that these quotas will not change from those implemented under the 1999 HMS FMP.

Conclusion

Alternative C2 (i.e., quota based on percentage of MSY) is the preferred alternative because, in combination with the other preferred alternatives, it will allow the LCS complex to rebuild, will promote management of sharks to produce optimum yield to the commercial fishery, will eliminate confusion about when to count discards because it sets a TAC and subsequent landings quota, will provide managers and fishermen with a comprehensive method of setting the landings quota after each stock assessment, and will minimize, to the extent practicable, economic and social impacts.

4.2.4 Commercial Minimum Size

As described in Chapter 2, the alternatives considered for commercial minimum size are:

D1 4.5 feet fork length for Ridgeback LCS - (No Action),
D2 *No minimum size - Preferred Alternative*,
D3 5 feet fork length for all LCS,

D4 5 feet fork length for Ridgeback LCS; 4.5 feet fork length for Non-ridgeback LCS,
D5 4.5 feet fork length for Atlantic Non-ridgeback LCS; 4 feet fork length for Gulf of Mexico Non-ridgeback LCS,
D6 Minimum size for overfished species *(or where overfishing is occurring)* only.

Alternative D2 is the preferred alternative.

Ecological Impacts

Alternatives D1, D3, D4, D5, and D6 present options for establishing minimum sizes for commercially caught shark species. The 2002 LCS stock assessment indicates that population growth is particularly sensitive to fishing mortality on juvenile and sub-adult sharks. As described in Chapter 2, alternatives D1, D3, D4, and D5 all propose minimum sizes designed to protect certain species by allowing those shark species to reach sexual maturity. Alternative D6 would implement this type of minimum size for all overfished species.

A minimum size of 4.5 feet fork length for ridgeback LCS was finalized, but never implemented due to a court settlement, in the 1999 HMS FMP based upon demographic analyses for sandbar sharks that indicated that juvenile and sub-adult stages or sizes were the most sensitive to fishing mortality. NOAA Fisheries felt that a minimum size would act as a type of moving time/area closure and would protect juvenile or sub-adult ridgeback LCS wherever they were located. NOAA Fisheries has new information via the 2002 LCS stock assessment which suggests that sandbar sharks are recovering despite the absence of a minimum size in the commercial fishery.

While alternatives D1, D3, D4, D5, and D6 would seek to protect and reduce fishing mortality on juvenile sharks, any conservation benefits gained under the alternatives may be offset by increases in regulatory discards and associated post-release mortality given that commercial fishermen may be unable to avoid mixed size aggregations of some shark species. For instance, while sandbar sharks tend to segregate by size, blacktip sharks and other species do not. Regulatory discards may also result in effort increases by fishermen in order to make up for lost catches, which could also result in increased interactions with protected (i.e., sea turtles and marine mammals) and non-targeted (i.e., prohibited sharks and other finfish) species. Additionally, regulatory discards are not counted against the 4,000 pound trip limit. Thus, if a fisherman should catch a set full of undersized sharks, those sharks would be discarded and the fisherman could set the gear again, possibly in another school of small sharks.

By comparison, alternative D2 (preferred) will not implement a minimum size for any commercially caught LCS. This alternative has been implemented in commercial fisheries since 1993. While D2 does not offer any additional protection for juvenile LCS, this alternative does not increase regulatory discards or effort. As mentioned earlier, any conservation benefits gained by implementing a minimum size would need to be balanced by increases in regulatory discards, post-release mortality, and effort. Furthermore, the 2002 LCS stock assessment noted that sandbar sharks are recovering and that blacktip sharks are rebuilt despite the absence of a minimum size on these species to date. While the best available data indicate that LCS continue to be overfished and overfishing is occurring, sandbar and blacktip sharks continue to comprise the majority of the LCS landings and no further advice is offered in the 2002 LCS stock assessment about which species could benefit most from a minimum size. Additionally, with the implementation of a time/area closure (See alternative K2), juvenile LCS, particularly sandbar and dusky sharks, will have some protection.

Social and Economic Impacts

As described in the 1999 HMS FMP and noted in Chapter 6 of this document, the implementation of a minimum size on commercially caught sharks (alternatives D1, D3, D4, D5, and D6) could increase the cost of fishing because, to avoid smaller ridgeback LCS, fishermen would have to fish farther offshore which requires more fuel, groceries, and time. An alternative for fishermen who cannot fish farther out would be to set additional gear inshore. However, in order to land as much fish, the fisherman would have to set more gear (i.e., to increase effort) which would require additional bait and fuel. Thus, these alternatives could have a negative economic impact on fishermen.

Implementation of either alternative D1, D3, D4, D5, or D6, however could increase the ex-vessel price for the fish that are landed because these fish will have more meat and have larger fins. This increase in ex-vessel price might offset some of the increased fishing costs associated with implementing minimum sizes under these alternatives. National Standard 8 requires that conservation and management measures take into account the importance of fishery resources to fishing communities and, to the extent practicable, minimize adverse economic impacts on such communities. It is important to note that the lack of a minimum size does not prohibit fishermen from targeting larger sharks for which they could get a higher price in the market. Rather current market conditions have created an economic incentive to focus on larger sharks thereby providing an additional economic incentive to conserve juveniles.

Additionally, under alternatives D1, D3, D4, D5, and D6, if fishermen decide to fish farther offshore, captains and crew could be at sea for a longer period of time. This could result in increased stress on families and increased safety risk. Thus, alternatives D1, D3, D4, D5, and D6 could have negative social impacts, beyond economic, for communities that rely on the fishermen.

Under alternative D2, social and economic costs are not expected to change given that this management measure has been in place since 1993.

Conclusion

Alternative D2 (i.e., no minimum size) is the preferred alternative because, in combination with the other preferred alternatives, most notably the time/area closure offshore North Carolina, it will minimize regulatory discards as well as minimize economic and social impacts to commercial fishermen. The preferred alternative is consistent with National Standard 8.

4.3 Recreational Management Measures

4.3.1 Recreational Retention Limits

As described in Chapter 2, the alternatives considered for recreational retention limits are:

E1 One shark per vessel per trip plus one Atlantic sharpnose shark per person per trip (No Action)
E2 Existing catch limits (E1) plus the addition of one bonnethead shark per person per trip - Preferred Alternative
E3 Existing catch limits (E1) plus the addition of one pelagic shark per vessel per trip
E4 Existing catch limits (E1) plus an allowance for vessels with HMS Angling permits participating in registered tournaments or HMS CHB permit holders on for-hire trips to retain one shark per person, up to two sharks per vessel, per trip, as well as one bonnethead shark per person per trip.
E5 Other retention limit that considers existing state recreational retention limits
E6 No retention, catch-and-release fishing for all recreational shark fisheries, inclusive of all LCS, SCS, and pelagic species.
E7 No retention limit

Ecological Impacts

As described in Chapter 3, U.S. recreational shark harvests of LCS have declined by 80 percent from the peak recorded catches in 1983 (See Table 3.18). Blacktip and sandbar sharks dominate the recreational catches of LCS by 36 and 27 percent, respectively (See Table 3.19). Recreational harvests of SCS have fluctuated between 34,900 and 189,500 fish per year since the mid 1980s, with Atlantic sharpnose comprising about 60 percent of the catch in recent years (See Tables 3.18 and 3.20). For pelagic species, recreational harvests have fluctuated from a peak of approximately 93,000 fish in 1985 to a low of about 6,200 fish in 1994. Recreational harvests of blue sharks accounted for 47 and 53 percent of the total catches of pelagic sharks in 1999 and 2000. The recreational fishing community has voiced concern about an apparent decline of shortfin mako sharks; however, until an international stock assessment is conducted in 2004, NOAA Fisheries cannot determine if an apparent decline in one area is indicative of regional distributions, migratory patterns, or an overall stock decline.

From 1991 through 2001, the Marine Recreational Fishing Statistics Survey (MRFSS) intercept survey sampled 13,056 shore- and vessel-based fishing trips which reported catching a shark listed in the management unit. These sampled trips caught a total of 40,960 sharks. The number of sharks caught per total trips sampled shows no trend, but the percentage of sharks released by private and party boats has increased as retention limits have been reduced. The percentage of sharks released from shore-based fishing trips has remained constant (Babcock and Pikitch, 2002). Babcock and Pikitch (2002) also found that a significant fraction of trips are still harvesting more than one shark per trip and determined that if problems in the implementation of the current regulations could be resolved, mortality of sharks in the recreational fishery could be reduced significantly. Unless otherwise noted, for the purposes of the analyses below, NOAA Fisheries presumes compliance with the existing catch limits.

Alternative E1, the no action alternative, would maintain the current recreational retention limits finalized in the HMS FMP of one shark per vessel per trip, inclusive of LCS, SCS, and pelagic sharks, and the allowance for one Atlantic sharpnose shark per person per trip. While this retention limit (E1) was implemented in the HMS FMP, in part, to reduce the harvest of sandbar and blacktip sharks in recreational fisheries and, to address the problem of continued misidentification of juvenile LCS and SCS, the results of the 2002 LCS stock assessment indicate that blacktip sharks are fully rebuilt and that sandbar sharks are rebuilding. However, the 2002 LCS stock assessment indicates that the LCS complex is overfished, overfishing is occurring, and reductions are needed to rebuild the complex. These results are due to species in the complex other than sandbar and blacktip sharks.

Under alternative E1, the current trends regarding increased catch-and-release fishing by party boats would likely continue and, because all sharks are combined under one retention limit except Atlantic sharpnose sharks which are easily identified, misidentification problems should be minimized. Additionally, under this alternative, it is unlikely that LCS landings would increase and, with additional public outreach and the recent implementation of the HMS Angling category permit, increased compliance with existing catch limits and subsequent reductions in LCS landings could occur. NOAA Fisheries can use the HMS Angling category permit database to distribute educational, regulatory, and outreach materials to this known universe of anglers. A reduction is needed in order to rebuild the LCS complex within the rebuilding time-frame (See Section 4.1). The existing recreational limits implemented in the HMS FMP were intended to reduce the harvest of sandbar and blacktip sharks by 82 and 81 percent in numbers of fish, respectively. This level of reduction was not achieved because of compliance issues. Under the current rebuilding plan established in this Amendment, NOAA Fisheries estimates that an 80 to 85-percent reduction in numbers of fish, relative to recent recreational harvest levels, is needed. Assuming increased compliance, alternative E1 in combination with alternative F1 could reduce the mortality of sharks in the recreational fishery by more than 81 - 82 percent (Babcock and Pikitch, 2002). Maintaining this alternative would be unlikely to change the status of pelagic or small coastal sharks. The 2002 SCS stock assessment indicates that the current level of removals is sustainable for the SCS aggregate and the individual species, except finetooth sharks. The assessment predicted that the stock biomass of Atlantic sharpnose sharks in any given year from 1972-2000 exceeded the biomass producing MSY (Cortes, 2002), and reductions in the retention limit for Atlantic sharpnose sharks are not necessary at this time. This alternative would maintain current finetooth shark mortality levels although increased compliance with recreational minimum sizes (See Section 4.3.2) may reduce finetooth shark landings.

Alternative E1 would also maintain a combination of a per vessel and a per person retention limit, which has been identified as confusing for anglers and problematic for enforcement (especially for species that are difficult to identify), and may lead to increased landings of some species. However, Atlantic sharpnose sharks are relatively easy to identify and increased outreach efforts should reduce angler confusion and decrease any landings of non-Atlantic sharpnose sharks due to misidentification.

Alternative E2, the preferred alternative, would allow the retention of one bonnethead shark per person per trip in addition to the existing catch limits (alternative E1). Like Atlantic sharpnose sharks, bonnethead sharks are an important recreational SCS catch in some regions, are easy to identify, are not experiencing overfishing, and are not overfished. Recent estimates indicate that bonnethead sharks comprise approximately 30 percent of recreational SCS harvest (Atlantic sharpnose sharks comprise over 58 percent; Cortes and Neer, 2002). While many bonnethead sharks are likely released under the no action alternative, many are harvested legally from state waters or are harvested from Federal waters despite current Federal regulations. The combination of alternatives E2 and F2 would allow these sharks to be landed legally. While the allowance for one bonnethead per person per trip could likely result in increased mortality of bonnethead sharks, the 2002 SCS stock assessment indicates that the biomass level is above MSY and fishing mortality is below F_{OY} (Cortes, 2002). Only in 1995 was fishing mortality estimated to exceed that producing MSY (Cortes, 2002). NOAA Fisheries does not believe that this alternative would increase mortality of bonnethead sharks to the point where the stock would be experiencing overfishing or would be considered overfished. This species primarily inhabits inshore waters and is currently experiencing fishing levels near those expected under alternative E2. Impacts to LCS and other SCS would be similar to those expected under alternative E1.

Alternative E3 would allow the addition of one pelagic shark per vessel per trip to the existing catch limits (alternative E1). This limit would require anglers to identify species in the pelagic species group and would likely result in increased mortality of pelagic sharks. This limit may also increase mortality of LCS if anglers are unable to correctly identify pelagic sharks. Recreational harvest of pelagic sharks have fluctuated from a peak of approximately 93,000 fish in 1985 to a low of about 6,200 fish in 1994. At this time, because an international stock assessment is needed to account for the migratory nature of pelagic sharks, NOAA Fisheries does not have a current stock assessment for these species. ICCAT is scheduled to conduct an assessment in 2004 and has been collecting the information necessary to do this for several years. The 1993 FMP for Sharks of the Atlantic Ocean concluded that pelagic sharks were fully fished. Because NOAA Fisheries cannot determine the impacts of additional mortality on pelagic shark stocks and because this alternative could result in increased LCS mortality, this alternative is not preferred at this time. NOAA Fisheries may consider this alternative after ICCAT conducts the international stock assessment and if species identification of sharks by anglers improves. Impacts to LCS and other SCS would be similar to those expected under alternatives E1 and E2.

In addition to the existing catch limits (alternative E1), alternative E4 would allow permitted charter/headboat vessels carrying multiple paying passengers or vessels with HMS Angling permits competing in registered tournaments to retain one shark per person, up to two sharks per vessel, per trip, as well as one bonnethead shark per person per trip. This alternative would create a retention limit similar to that in effect in the recreational swordfish fishery. It would likely result in greater mortality levels than those expected from alternatives E1, E2, and E3. This greater mortality level is not consistent with the 2002 LCS stock assessment results which indicate that the LCS complex needs a reduction in fishing mortality. Additionally, without more information regarding the status of pelagic sharks, this alternative may be detrimental to pelagic sharks. Also, although the SCS complex is estimated to be at biomass levels at or above those which could produce MSY, increased landings resulting from this alternative may increase mortality of finetooth sharks and could lead to an overfished status (Cortes, 2002). However, this alternative could be combined with other fishing controls such as increased minimum sizes, such that overall mortality is not increased; NOAA Fisheries may consider this approach in the future.

Alternative E5 would identify a retention limit that considers existing state recreational retention limits. A Federal retention limit similar to those that exist in most states could minimize confusion with Federal regulations and make enforcement less complicated. However, the requirements for recreational shark fisheries vary widely from state to state, from retention limits similar to Federal regulations to those far exceeding current Federal retention limits (Appendix 3). At this time NOAA Fisheries cannot identify a limit that would be consistent with state regulations as there is little consistency between states. Ecological impacts would vary depending on the actual limit.

Alternative E6 would implement catch-and-release fishing for all recreational shark fisheries in Federal waters, inclusive of all LCS, SCS, pelagic species, prohibited species, and deepwater/other species. Under this alternative, no sharks could be retained and all sharks subject to Federal management would have to be released in a manner that maximizes the probability of survival. Alternative E6 would result in the fastest rebuilding to MSY levels by reducing recreational fishing mortality to post-release mortality only. As no quantitative estimates for post-release mortality of sharks caught in recreational fisheries (in general or for individual species) are currently available, only qualitative impacts can be discussed at this time. However, assuming a low post-release mortality, this alternative would be expected to provide for the fastest rebuilding possible with highest probabilities that LCS stocks will increase from the 2002 levels. This alternative would be expected to meet NS 1 to prevent overfishing and rebuild overfished fisheries for LCS, and would also enhance stock status for the fully fished pelagic and rebuilt small coastal sharks.

Under alternative E7, there would be no retention limit for recreational shark fisheries in Federal waters, inclusive of all LCS, SCS, and pelagic species, and anglers would not be restricted in the number of LCS, SCS, or pelagic sharks that could be possessed or retained. This alternative would likely result in large increases in mortality of sharks in the management unit and would result in continued overfishing of LCS stocks and could lead to overfishing of SCS and pelagic sharks. It would likely result in greater mortality levels than those expected from alternatives E1, E2, E3, E4, and E6, and does not meet NS 1 to rebuild overfished fisheries for LCS or prevent overfishing of the fully fished pelagic sharks and SCS.

Under alternatives E1 through E6, NOAA Fisheries does not anticipate any adverse impacts to finfish or protected resources because recreational fishing patterns and effort are unlikely to change. Alternatives E1 through E5 would either maintain existing catch limits or allow slightly increased shark landings because more sharks that are currently discarded may be retained, but NOAA Fisheries does not expect this increase to result in increased fishing effort. Alternative E6, which would not allow any retention of sharks, may result in increased fishing effort on other finfish as fishermen redirect on other species but may reduce shark fishing effort and therefore may reduce interactions with protected resources. Under Alternative E7, catches of finfish or protected resources may increase because recreational fishing effort may increase due to the lack of shark fishing retention limits and more shark directed trips may occur with related bycatch of finfish or protected species. However, recreational fishing gear is generally believed to have high post-release survival rates such that bycatch mortality may not increase even though bycatch rates may increase.

Under alternatives E1 through E7, NOAA Fisheries does not expect any adverse impacts to EFH because recreational fishing gear is not believed to interact with bottom structures or otherwise damage habitat.

Social and Economic Impacts

Under the no action alternative, E1, NOAA Fisheries does not anticipate any substantive change, either positive or negative, in social or economic impacts than shark fishermen currently experience. In light of the 2002 SCS stock assessment estimates, this alternative used in combination with a minimum size does not allow for full utilization of SCS stocks.

Alternative E2, the preferred alternative, would have more positive social impacts than E1 as anglers would not be constrained by the more restrictive regulations currently in place. Alternative E2 would allow the addition of one bonnethead shark per person per trip to the existing retention limits. Bonnethead sharks are easy to identify and are an important catch in some regions, but do not reach the minimum size presently in effect. Although this limit would provide an allowance for bonnethead and Atlantic sharpnose sharks, the allowances may not be available to anglers who fish outside of their ranges. This alternative would give anglers aboard headboats and charter vessels a greater opportunity to land a shark.

Fisher and Ditton (1992) found that anglers spent an average of $197 per trip and were willing to spend on average an additional $105 rather than stop fishing for sharks. Given the fact that most anglers release the fish they catch and that the catch and release fishing ethic is growing, it is unlikely that these estimates have changed substantially since 1992. Fisher and Ditton (1992) also found that 32 percent of shark anglers said that no other species would be an acceptable substitute for sharks. The additional bonnethead allowance in this alternative may slightly increase current revenues to charterboat owners, captains, and others who rely on the recreational shark fishery.

Alternative E3 may have positive social impacts in that it could allow anglers who fish outside the range for Atlantic sharpnose sharks the opportunity to land an additional shark. This could lead to greater overall fishing satisfaction and an increased participation in directed pelagic fisheries. This alternative would require anglers to possess a greater ability to identify sharks, especially pelagic species. NOAA Fisheries is developing an identification guide to increase public education and awareness. Problems with shark identification could likely be mitigated by alternative J8 which would require fishermen to attend workshops discussing identification and current regulations. Alternative E3 could also result in positive economic impacts. The additional pelagic shark allowance in this alternative could increase tournament participation, increase current revenues to charterboat owners/captains and others who rely on the recreational shark fishery, lead to an increase in willingness to pay, and an increased angler consumer surplus.

Under alternative E4, positive social impacts could be expected to accompany the allowance for an additional shark per vessel per trip. This could lead to greater overall fishing satisfaction and an increased participation in shark fisheries. Positive economic impacts could also be expected as business and associated profits within the charter/headboat industry may increase. Tournament anglers would be able to land more than one shark per vessel for points and or weight competition. This could lead to increased tournament participation, an increase in willingness to pay, and increased angler consumer surplus. NOAA Fisheries may be able to address misidentification problems with outreach to this smaller universe of anglers.

Under alternative E5, if a limit that could minimize confusion with various state and Federal regulations could be identified, the social impacts would be generally positive. Currently, anglers appear to be unsure as to which regulations to follow depending on where they are fishing (state or Federal waters). This could lead to greater satisfaction and therefore greater willingness to pay. However, satisfaction could also decrease if the retention limit is lower than the current limit.

Alternative E6 may have substantial negative social impacts by eliminating recreational harvests of all sharks. This alternative would eliminate the opportunities for trophy and tournament anglers to bring in their catches and may significantly reduce an angler's willingness to pay if no sharks can be retained. This alternative may be perceived as "unfair" to recreational fishing interests if the commercial fishery is allowed to continue. It is important to note that this alternative would not prevent anglers from fishing and gaining the benefits of the fishing experience but it would prevent anglers from retaining any of their catch. The adverse social impacts of this alternative may be reduced to the extent that there is a growing public opinion that catch-and-release fishing is the preferable recreational fishery for sharks.

The economic impacts of alternative E6 would depend on the willingness for shark anglers to substitute other fish and release sharks caught. This is especially true as anglers would be forced to release all sharks caught, and tournaments would be unable to harvest any trophy fish. Fisher and Ditton (1992) found that over 70 percent of the anglers surveyed said they would be just as happy releasing the fish they caught (rated as "agree" and "strongly agree"). However, it is possible that anglers may not pay to only catch and release or tag and release sharks. Fisher and Ditton (1992) found that 27 percent of the anglers surveyed fish in order to obtain fish for eating and 18 percent fish in order to obtain a trophy. Given the evidence that shark anglers do not necessarily fish in order to obtain a trophy or for consumption, it is unlikely this alternative would reduce angler consumer surplus or the willingness to pay significantly for private vessels. However, angler consumer surplus may be reduced at the tournament level, in directed pelagic shark fisheries, and in those fisheries whose participants are unwilling to substitute fishing for species other than sharks.

Under alternative E7, anglers would not be restricted in the number of LCS, SCS, or pelagic sharks that could be possessed or retained. This alternative would likely result in an increase in participation in the recreational shark fishery and have positive social and economic impacts, at least in the short-term. However, in the long-term, if LCS, SCS, and pelagic shark stocks decline, more fishing effort will be required to catch sharks, which would likely result in reduced revenues and increased costs for charterboat and headboat operations. Angler consumer surplus may also decline for shark-targeted trips.

Conclusion

Alternative E2 is preferred because, if combined with alternative F2, it will allow rebuilding of LCS shark stocks within the rebuilding time frame. In addition, alternative E2 is expected to have positive social and economic impacts by allowing increased retention of one additional bonnethead shark without increasing fishing mortality of this species beyond sustainable levels. Bonnethead sharks are not overfished and are not experiencing overfishing, and are a regionally important species in recreational fisheries. Bonnethead sharks are also an easily identified species so misidentification problems should be minimized.

4.3.2 Recreational Minimum Sizes

As described in Chapter 2, the alternatives considered for recreational minimum sizes are:

- F1 4.5 feet fork length for all sharks, no size limit for Atlantic sharpnose sharks (No Action)
- *F2 Existing size limits (F1) plus no size limit for bonnethead sharks - Preferred Alternative*
- F3 5.0 feet fork length for all sharks, no size limit for Atlantic sharpnose and bonnethead sharks
- F4 5.0 feet fork length for all ridgeback LCS, 4.5 feet fork length all non-ridgeback LCS, SCS, and pelagic sharks, no size limit for Atlantic sharpnose and bonnethead sharks
- F5 Existing size limits (F1) plus regional non-ridgeback shark minimum sizes (4.5 feet fork length for all Atlantic non-ridgeback LCS, 4.0 feet fork length for all Gulf of Mexico non-ridgeback LCS) and no size limit for bonnethead sharks

F6 No size limit for any sharks

From 1991 through 2001, the Marine Recreational Fishing Statistics Survey (MRFSS) intercept survey sampled 13,056 shore- and vessel-based fishing trips which reported catching a shark in the management unit. These sampled trips caught a total of 40,960 sharks. The percentage of sharks released from shore-based fishing trips has remained constant (Babcock and Pikitch, 2002). Babcock and Pikitch (2002) found that a significant fraction of trips harvest sharks under the current minimum size limit and determined that if problems in the implementation of the current regulations could be resolved, mortality of sharks in the recreational fishery could be reduced significantly. Unless otherwise stated, for the purposes of the analyses below, NOAA Fisheries presumes compliance with the existing catch limits.

Ecological Impacts

The no action alternative, F1, would maintain the existing size limit of 4.5 feet (137 cm) fork length for all sharks except for Atlantic sharpnose sharks as finalized in the HMS FMP. The 4.5 feet fork length size limit approximates the size of first maturity for female sandbar sharks. Sminkey and Musick (1995) found that female sandbar sharks reach first maturity at approximately 140 cm fork length. Shark population studies have shown that most of the species in the LCS complex have low population growth rates, and that for those species, juvenile survival is the vital rate that most effects overall population growth rates (Cortes *et al.*, 2002). Sharks caught in recreational fisheries are thought to have low post-release mortalities and the current 4.5 feet fork length size limit should minimize fishing mortality on the stages that contribute the most to population growth by maintaining catch-and-release fishing on juvenile and subadult sharks. This alternative continues to shift recreational mortality primarily onto larger fish (some post-release mortality of undersized fish will still occur), while still allowing the recreational fishing experience and limited harvest of some sharks. However, because some species such as sandbar sharks segregate by size, this size limit would maintain fishing effort directed toward pregnant females as they enter pupping grounds in coastal bays and estuaries. The 2002 LCS stock assessment recommended protecting juveniles and reproductive females (Cortes *et al.*, 2002).

The 2002 SCS stock assessment indicated that the current level of removals is sustainable for the SCS aggregate and the individual species, except finetooth sharks. The assessment predicted that the stock biomass of Atlantic sharpnose sharks in any given year from 1972-2000 exceeded the biomass producing MSY (Cortes, 2002) and reductions for Atlantic sharpnose sharks are not necessary at this time. Under this alternative, recreational fishing for SCS is mainly catch-and-release, except for Atlantic sharpnose sharks, because some SCS like Atlantic sharpnose and bonnethead sharks do not reach 4.5 feet (137 cm fork length) at full maturity. Atlantic sharpnose and bonnethead sharks reach maximum lengths of about 110 cm total length and 150 cm total length, respectively (Compagno, 1984). Blacknose and finetooth sharks are larger species that may reach maximum sizes of 200 cm total length (Compagno, 1984). Mature individuals of these species may reach the current minimum size on occasion. This alternative would maintain protection for finetooth sharks, which are currently experiencing overfishing.

Substantial recreational fisheries target pelagic sharks, especially shortfin mako, thresher, and blue sharks. Maintaining the current 4.5 feet fork length minimum size will have little ecological impact on pelagic sharks, because most of the pelagic sharks currently retained exceed the 4.5 feet fork length minimum size. This minimum size is smaller than the length equivalent of the 100-pound minimum size (approximately 162 cm fork length) for mako sharks that has been suggested in the past and that many tournaments often require. Therefore, this alternative is supportive of voluntary restrictions on the harvest of juvenile and subadult sharks.

Alternative F1 could result in the continued misidentification of juvenile LCS and other shark species such as Atlantic sharpnose sharks. NOAA Fisheries established a separate allowance for Atlantic sharpnose sharks in part because Atlantic sharpnose sharks were thought to be readily identifiable from other species due to the presence of white spots on the back. However, members of the public have raised concerns that species-specific identification continues to be a significant problem and that juvenile LCS are frequently misidentified, sometimes as Atlantic sharpnose sharks. NOAA Fisheries believes that, with additional education and outreach, problems with misidentification of Atlantic sharpnose sharks can be adequately addressed. NOAA Fisheries has also received public comment regarding concerns for the safety of anglers who are required to measure live sharks in order to retain them. NOAA Fisheries recommends that anglers mark areas on the outside of fishing vessel hulls (e.g., at the waterline or boot stripe) with the minimum size. If a shark is smaller than this measurement, it should be released. If a shark is larger than the measurement and not a prohibited species, it could be retained and killed before bringing it onboard.

Alternative F2, the preferred alternative, would allow the retention of bonnethead sharks with no minimum size in addition to the existing size limits (alternative F1). Bonnethead sharks are an important recreational catch in some regions, do not commonly reach the current 4.5 feet fork length minimum size, and according to the 2002 SCS stock assessment, are not experiencing overfishing and are not overfished. Between 1995 and 2000, bonnethead sharks were consistently the second-most important SCS species caught recreationally (Cortes, 2002). While many bonnethead sharks are likely released under the no action alternative, many are harvested legally from state waters or are harvested from Federal waters despite current Federal regulations. This alternative may increase mortality of bonnethead sharks relative to alternative F1 by allowing landings (because bonnethead sharks do not reach the existing minimum size, they cannot currently be landed and are subject to catch-and-release fishing only). Given that bonnethead sharks are not overfished and are not experiencing overfishing, NOAA Fisheries does not believe that this alternative would increase mortality of bonnethead sharks to the point where the stock would be considered overfished or would experience overfishing. This species primarily inhabits inshore waters and is currently experiencing fishing levels near those expected under alternative F2. Mortality reductions projected under alternatives F2 and E2 combined achieve mortality reduction levels required by the rebuilding plan in this Amendment

Alternative F3 would increase the existing size limit to 5.0 feet fork length for all sharks, except for Atlantic sharpnose sharks, and allow the retention of bonnethead sharks with no minimum size. The 5.0 feet fork length (152.4 cm) minimum size approximates the size above which all female sandbar sharks have been found to be mature. All female sandbar sharks over 149.0 cm fork length sampled by Sminkey and Musick (1995) were mature. This limit would allow all female sandbar sharks to be sexually mature before recruiting to the recreational fishery. The 2002 LCS stock assessment recommended protecting juveniles and reproductive females (Cortes *et al.*, 2002). Relative to alternative F1, this alternative would provide increased protection for other shark species such as dusky and finetooth sharks by essentially creating a catch-and-release fishery for a higher percentage of juvenile and subadult stages. Sharks caught in recreational fisheries are thought to have low post-release mortalities and the 5.0 feet fork length size limit could increase protection for many sensitive stages/sizes as recommended in the 2002 LCS stock assessment. However, relative to alternative F1, this size limit could increase fishing effort directed toward pregnant females as they enter pupping grounds in coastal bays and estuaries. According to Babcock and Pikitch (2002) the majority of sharks sampled by the MRFSS survey are below the current 4.5 feet fork length minimum size limit. Impacts to bonnethead sharks would be similar to those expected under alternative F2.

Alternative F4 would increase the existing size limit to 5.0 feet fork length for all ridgeback sharks, retain the 4.5 feet fork length size limit for all non-ridgeback sharks, maintain the no size limit for Atlantic sharpnose sharks, and allow the retention of bonnethead sharks with no minimum size. This alternative would have similar impacts as alternative F3 for ridgeback sharks and alternatives F2 and F3 for bonnethead sharks. The 4.5 feet fork length (137 cm) minimum size limit for non-ridgeback is slightly larger than the median size at which female blacktip sharks become mature in the Atlantic (126.6 cm fork length; Carlson and Baremore, 2002) so that the majority of female blacktip sharks would be sexually mature before recruiting to the recreational fishery. These limits may provide increased protection for other shark species such as dusky sharks by essentially creating a catch-and-release fishery for a higher percentage of juvenile and subadult stages. This alternative would not afford additional protection for finetooth sharks, which are currently experiencing overfishing, as do alternatives F1 and F2, because finetooth sharks are a non-ridgeback shark. This alternative would have similar impacts to alternative F3 for ridgeback pregnant females by increasing directed effort on them as they enter pupping grounds in coastal bays and estuaries. Similar to previous alternatives, alternative F4 could result in continued misidentification of juvenile LCS and other shark species as Atlantic sharpnose sharks.

Alternative F5 would, in addition to existing size limits on all ridgeback and Atlantic sharpnose sharks (alternative F1), retain the 4.5 feet fork length minimum size limit for all non-ridgeback sharks in the Atlantic region, reduce the minimum size to 4.0 feet fork length for non-ridgeback sharks in the Gulf region, and allow the retention of bonnethead sharks with no minimum size. This alternative allows for a smaller size limit for non-ridgeback sharks in the Gulf region while still allowing the majority of female blacktip sharks to be sexually mature in both the Atlantic and Gulf region before recruiting to the recreational fishery. Carlson and Baremore (2002) found that the median sizes at which female blacktip sharks become mature in the Atlantic and Gulf regions are 126.6 cm fork length and 117.3 cm fork length, respectively. The 4.5 feet fork length (137 cm) minimum size limit for Atlantic non-ridgeback sharks is slightly larger than the median size in the Atlantic region (126.6 cm) and the 4.0 feet fork length (122 cm) minimum size limit for Gulf region non-ridgeback sharks approximates the median size in the Gulf region (117.3 cm). This alternative would have similar impacts to alternatives F1 and F2 for ridgeback and Atlantic sharpnose sharks, alternatives F1, F2, and F4 for non-ridgeback sharks in the Atlantic region, and alternatives F2, F3, and F4 for bonnethead sharks.

Under alternative F6, sharks of any size could be landed. This would allow anglers to land shark species that do not commonly reach the current minimum size limit (e.g., SCS). This alternative would likely result in large increases in mortality of sharks in the management unit and would result in continued overfishing of LCS stocks and finetooth sharks, and could lead to overfishing of SCS and pelagic sharks. It would likely result in greater mortality levels than those expected from alternatives F1, F2, F3, F4, and F5, and would not meet NS 1 to rebuild overfished fisheries for LCS or prevent overfishing of finetooth sharks or the fully fished pelagic sharks.

During the public comment period, many commenters stated that the commercial and recreational minimum sizes should be the same. NOAA Fisheries believes that a recreational minimum size limit is appropriate and will be effective at protecting juvenile sharks in the recreational fishery. Sharks caught recreationally are thought to have low post-release mortalities as compared to those captured on commercial gears. A minimum size is not being implemented in the commercial fishery because other measures, including commercial quotas, will limit overall commercial shark fishing effort and landings, and a time/area closure for directed shark bottom longline vessels will protect juvenile sharks in a known pupping and nursery area.

Under alternatives F1 through F5, NOAA Fisheries does not anticipate any adverse impacts to finfish or protected resources. Recreational fishing gear is generally believed to have high post-release survival rates such that bycatch mortality may not increase even though bycatch rates could increase. Alternatives F1 through F4 would either maintain existing catch limits or slightly decrease shark landings because increased size limits would decrease the percentage of sharks that could be retained, except for bonnethead sharks. NOAA Fisheries does not expect the allowance to land bonnethead sharks without a minimum size to result in increased fishing effort. Alternative F5, which would decrease the size limit for non-ridgeback sharks in the Gulf of Mexico, may result in slightly increased fishing effort in one region but NOAA Fisheries does not expect any increase to be large, if it occurs at all. Under Alternative F6, catches of finfish or protected resources may increase because recreational shark fishing effort may increase due to the lack of shark size limits. However, as noted above, recreational fishing gear is generally believed to have high post-release survival rates such that bycatch mortality may not increase even though bycatch rates could increase.

Under alternatives F1 through F6, NOAA Fisheries does not expect any adverse impacts to EFH because recreational fishing gear is not believed to interact with bottom structures or otherwise damage habitat.

Social and Economic Impacts

Under the no action alternative, F1, NOAA Fisheries does not anticipate any substantive change, either positive or negative, in social or economic impacts. Recreational fishermen have been operating under the present minimum size limit and allowance for Atlantic sharpnose sharks since it was finalized in the HMS FMP in 1999. The current size limit essentially maintains a catch-and-release only fishery for sharks in nearshore waters. While this size limit applies to fishing within and fish from Federal waters, it may have differentially impacted anglers who were unable to expand their fishing into deeper waters where larger fish predominate. To the extent that anglers want to retain their catch, those anglers who could not expand to offshore fishing may have experienced reductions in their harvest levels. Any reductions may have been mitigated by the allowance for the retention of Atlantic sharpnose sharks with no minimum size. This action likely had minor social impacts for offshore anglers because most of these anglers were already operating within these restrictions. Additionally, the increasing conservation ethic among anglers towards catch-and-release fishing may have mitigated any adverse social impacts of this limit. This alternative may continue to raise safety concerns for recreational fishermen who will have to determine the length of sharks relative to the minimum size.

Alternative F1 would require anglers to release most of the sharks currently caught. Babcock and Pikitch (2002) found that the fraction of management unit sharks released by party and private boats has increased as limits were reduced. Fisher and Ditton (1992) note that most anglers release the fish they catch (over 70 percent of the anglers surveyed said they would be just as happy releasing the fish they caught) and that anglers spent an average of $197 per trip and were willing to spend on average an additional $105 rather than stop fishing for sharks. Fisher and Ditton (1992) also found that 32 percent of shark anglers said that no other species would be an acceptable substitute for sharks.

While it is possible that some anglers may not pay to only catch and release or tag and release sharks, it is also possible that anglers may pay additional money for the challenge of catching a large, adult shark. This is especially true in the long-term as the stock rebuilds and large sharks become more abundant. Over 60 percent of those surveyed said they would rather catch one or two big fish than 10 smaller fish. Also, 76 percent of those surveyed said that they fish in the saltwater for the challenge (Fisher and Ditton, 1992). Fisher and Ditton (1992) state that "shark anglers are intimately involved in fishing for big fish, and for many it is probably a central life interest." Based on the above considerations, NOAA Fisheries does not believe that maintaining the current minimum size limit will affect angler consumer surplus significantly in LCS or SCS recreational fisheries. This limit is unlikely to reduce pelagic shark tournament landings as most tournaments have self-imposed species-specific minimum weight requirements which limit landings to fish exceeding this limit. In the short-term, this alternative will allow for the continuation of current revenues to charterboat owners and captains and others who rely on the recreational shark fishery. In the long-term, as shark stocks rebuild, revenues may increase as less time would be required to catch sharks and as larger sharks become more abundant.

Alternative F2, the preferred alternative, would allow the retention of bonnethead sharks with no minimum size in addition to the existing size limits (alternative F1). NOAA Fisheries expects this alternative to have positive social and economic impacts because the current fishery regulations are more restrictive. The rationale for this alternative is that bonnethead sharks are easy to identify and are an important catch in some regions, but do not reach the minimum size presently in effect. This alternative would give anglers aboard headboats and charter vessels a greater opportunity to land a shark. Between 1995 and 2000, bonnethead sharks were consistently the second-most important small coastal shark species caught recreationally (Cortes, 2002). Allowing the retention of bonnethead sharks with no minimum size may increase willingness to pay, angler consumer surplus, and current revenues to charter/headboat owners/captains and others who rely on the recreational shark fishery.

Alternative F3 would increase the existing size limit to 5.0 feet fork length for all sharks and may have negative social and economic impacts on nearshore anglers and the supporting recreational industry. It would expand the catch-and-release fishery for sharks in nearshore waters, where juvenile and subadult sharks predominate, and may reduce recreational landings from offshore waters. While this alternative would apply to fishing within and fish from Federal waters, it may differentially impact anglers who are unable to expand their fishing into deeper waters where larger fish are more common. To the extent that anglers want to retain their catch, those anglers who cannot expand to offshore fishing may experience reductions in harvest levels. Any reductions in harvest could be mitigated by the allowances for the retention of bonnethead and Atlantic sharpnose sharks with no minimum size. This alternative would likely have minor social impacts for offshore anglers because they are currently operating under the 4.5 feet fork length minimum size and are already targeting large, adult fish. This alternative may have variable economic impacts depending on the willingness of anglers to release sharks caught and substitute other fish for sharks. It will require anglers to release most of the sharks currently caught. Fisher and Ditton (1992) note that most anglers release the fish they catch (over 70 percent of the anglers surveyed said they would be just as happy releasing the fish they caught). Given this evidence, NOAA Fisheries does not believe this minimum size would have a large adverse impact on angler consumer surplus in LCS, SCS, or pelagic shark recreational fisheries. In the short-term, this alternative could allow for the continuation of current revenues to charterboat owners, captains, and others who rely on the recreational shark fishery. In the long-term, as shark stocks rebuild, revenues may increase as less time would be required to catch sharks and as larger sharks increase in abundance. This alternative may continue safety concerns for recreational fishermen who will have to determine the length of sharks relative to the minimum size.

NOAA Fisheries expects alternative F4 to have similar social and economic impacts as alternative F3. Alternative F4 allows for the retention of non-ridgeback LCS with a 4.5 feet fork length minimum size, while still requiring the 5.0 feet fork length minimum size for ridgeback sharks. The 4.5 feet fork length size limit for non-ridgeback sharks, combined with the allowances for the retention of bonnethead and Atlantic sharpnose sharks with no minimum size, could potentially mitigate some of the negative social and economic impacts associated with the 5.0 feet fork length size limit in alternative F3. However, many anglers may find these size limits difficult to comply with if they are unable to differentiate between ridgeback and non-ridgeback sharks. These limits may also be more difficult to enforce than one size limit for all sharks. According to Babcock and Pikitch (2002), the majority of sharks sampled by the MRFSS are below the present 4.5 feet fork length size limit.

NOAA Fisheries expects alternative F5 to have similar social and economic impacts as alternative F3. Alternative F5 allows for the retention of Atlantic region non-ridgeback LCS with a 4.5 feet fork length minimum size, allows for the retention of Gulf region non-ridgeback LCS with a 4.0 feet fork length minimum size, while still requiring the 5.0 feet fork length minimum size for all ridgeback sharks and allowing the retention of Atlantic sharpnose and bonnethead sharks with no minimum size. The smaller size limits for non-ridgeback sharks and no size limits for Atlantic sharpnose and bonnethead sharks could potentially mitigate some of the negative social and economic impacts that may be associated with the 5.0 feet fork length all shark minimum size limit in alternative F3. However, many anglers may find these size limits difficult to comply with if they are unable to differentiate between ridgeback and non-ridgeback sharks. These limits may also be more difficult to enforce than one size limit for all sharks. This alternative also requires anglers to know the region in which they are fishing. This could be confusing for anglers fishing in the Florida Keys and could create enforcement problems.

Under alternative F6, LCS, SCS, and pelagic sharks would not be subject to a minimum size for landing. This alternative would likely result in an increase in participation in the recreational shark fishery and have positive social and economic impacts, at least in the short-term. However, in the long-term, if mortality of LCS, SCS, and pelagic sharks increase, the stocks may decline. If stocks decline, more fishing effort will be required to catch sharks, which would likely result in reduced revenues and increased costs for charterboat and headboat operations. Angler consumer surplus may also decline for shark-targeted trips.

Conclusion

Alternative F2 is preferred because, if combined with alternative E2, it will allow rebuilding of LCS shark stocks within the rebuilding time frame. In addition, alternative F2 increases positive social and economic impacts by allowing retention of bonnethead sharks without a minimum size and without increasing fishing mortality beyond sustainable levels. Bonnethead sharks are not overfished and are not experiencing overfishing. Additionally, they are a regionally important species in recreational fisheries and are also an easily identified species so misidentification problems should be minimized.

4.3.3 Authorized Gears for Recreational Shark Fishing

As described in Chapter 2, the alternatives considered for authorized gears in recreational shark fisheries are:

G1 Any authorized gear (No Action)
G2 Only allow handline and rod and reel gear in the recreational shark fishery - Preferred Alternative

Ecological Impacts

The no action alternative, G1, would continue to allow any authorized gear to be used to fish for sharks recreationally. Under the no action alternative, recreational fishermen would be allowed to continue using fishing gears traditionally used in commercial fishing operations and which are thought to have higher bycatch and post-release mortality rates for sharks, finfish, and protected species than handline and rod and reel gear. NOAA Fisheries believes that this alternative could allow higher rates of bycatch and bycatch mortality to continue.

Alternative G2, the preferred alternative, would limit the allowable gears in the recreational shark fishery to handline and rod and reel gear and would promote greater consistency within recreational HMS fisheries. Presently, fishermen may use gears traditionally considered to be commercial gears to land sharks recreationally. This alternative may increase discards if fishermen are not allowed to retain sharks caught incidentally with other gears. However, this alternative may promote the use of gears with lower bycatch and bycatch mortality of sharks, finfish, and protected species, and therefore may have positive ecological impacts.

NOAA Fisheries has received public comment that alternative G2 would not allow recreational fishermen using gillnets, spearguns, bandit gear, and harpoons to retain sharks. This is correct, however, the vast majority of recreational fishermen use rod and reel or handline gear. Sharks taken recreationally in Federal waters with gears other than rod and reel and handline would be required to be released. Anglers cannot retain sharks taken with spearguns currently, thus, this alternative will not affect those fishermen. This alternative is not likely to increase discards substantially.

Under alternatives G1 and G2, no changes to impacts on EFH are expected because neither commercial or recreational shark fishing gears are believed to cause more than minimal adverse impacts, if any adverse impacts at all, to EFH.

Social and Economic Impacts

Under the no action alternative, G1, NOAA Fisheries does not anticipate any change, either positive or negative, in social or economic impacts because fishermen would not need to adjust or convert to new forms of fishing gear.

NOAA Fisheries does not expect alternative G2 to have any substantive social or economic impacts because the majority of recreational fishermen already use rod and reel and handline gear. Fishermen who are unable to hold or operate rod and reel or handline gear may apply for an exempted fishing permit (EFP) that would allow them to fish for sharks recreationally with an alternative gear. Fishermen who do not use rod and reel or handline gear generally use commercial gears and land sharks incidentally. No economic costs are expected because this alternative would restrict gears used for recreational shark fishing, and sharks retained recreationally cannot be sold. However, if this alternative results in increased discards relative to alternative G1, then negative social impacts may result as fishermen may be forced to discard sharks and increase waste.

Conclusion

Alternative G2 is preferred to promote uniformity within recreational HMS fisheries and to promote recreational fishing gears, which are thought to have lower post-release mortality rates.

4.4 DEEPWATER AND OTHER SHARKS

As described in Chapter 2, the alternatives considered for the deepwater/other species group are below. Note that alternatives described in Section 4.5 (prohibited species) also discuss deepwater and other sharks.

H1 Retain established species group (No Action)
H2 Remove species group from management unit; data collection only - Preferred Alternative

Ecological Impacts

The species in this group include the catsharks, lanternsharks, and smooth dogfish. In general, these species are slow growing compared to other sharks and are occasionally caught in deepwater trawls. At this time, there are no known fishermen who target these species.

The no action alternative, H1, would maintain the current deepwater and other species group in the management unit. This alternative would have no measurable ecological impacts because there are no known significant landings of these species and they are not subject to the permit and reporting requirements, retention limits, or quotas established in the HMS FMP. Morever, this group was added to the management unit to protect these species from being finned (see pages 3-177 and 3-178 of the HMS FMP), and the Shark Finning Prohibition Act now bans shark finning (67 FR 6194, February 11, 2002).

Alternative H2, the preferred alternative, would remove the deepwater and other species group from the management unit and require data collection only. This alternative would likely have no significant ecological impacts as there are no known significant landings of species in this group and the Shark Finning Prohibition Act now protects these species from being finned (67 FR 6194, February 11, 2002). If directed fisheries started, NOAA Fisheries would evaluate data available at that time to see if an FMP amendment or other regulatory measures would be warranted. During the public comment period, NOAA Fisheries received comments concerned with the amount of time it may take to re-establish these species in the management unit. NOAA Fisheries believes it could re-establish the deepwater and other species group in the management unit within a short time frame. Additionally, to the extent that deepwater and other sharks are not caught by HMS fishermen, action to protect deepwater and other sharks may be needed from or in coordination with the Fishery Management Councils. NOAA Fisheries has received public comment that data collection should continue for these species until they can be assessed or until a fishery develops.

Under alternatives H1 and H2, no impacts on finfish, protected species, or EFH are expected because no changes to fishing patterns or effort would result.

Social and Economic Impacts

NOAA Fisheries does not expect alternative H1 or H2 to have significant social or economic impacts because there are no known significant landings of species in this group and no known fishermen target these species.

Conclusion

Alternative H2 is preferred because the only protection afforded under the HMS FMP, a ban on finning, is now afforded nationally under the Shark Finning Prohibition Act. Given the national protection, NOAA Fisheries believes that maintaining data collection only on these species is sufficient.

4.5 PROHIBITED SPECIES

As described in Chapter 2, the alternatives considered for prohibited species are:

I1	Retain established species group (19 species) (No Action)
I2	Return to the five species in 1997; white, sand tiger, bigeye sand tiger, whale, and basking shark
I3	Retain established prohibited species group (I1) and add finetooth shark
I4	Retain established species group (I1) and remove dusky shark
I5	Add the deepwater/other species group to the prohibited species group
I6	*Retain established prohibited species group (I1) and establish criteria for the addition and removal of species to/from the prohibited species group - Preferred Alternative*

Ecological Impacts

The no action alternative, I1, would have minor ecological impacts as it maintains the current prohibited species group with the 19 species identified in the HMS FMP. The HMS FMP prohibited the retention of these species because they were known to be vulnerable to overfishing, uncommon, or seriously depleted. NOAA Fisheries has afforded these species the maximum protection possible within its fisheries management jurisdiction. However, many species currently in the prohibited species group have high bycatch mortalities and may not survive the capture experience so that they would be discarded dead. This action may not be fully effective in that prohibited species may be improperly identified and landed in commercial and recreational fisheries. These identification problems could be mitigated with increased education and outreach efforts.

Alternative I2 would return to the 1997 prohibition on the possession of whale, basking, sand tiger, bigeye sand tiger, and white sharks within Federal waters. These five species were identified as highly susceptible to overexploitation and the prohibition on possession was a precautionary measure to ensure that directed fisheries did not develop. Compared to alternative I1, this alternative could have significant ecological impacts in that it could allow dusky and other sharks currently in the prohibited species group to be landed, which could potentially increase mortality, substantially, of dusky and other overfished/vulnerable sharks that have market value. The effects of this alternative may be mitigated by the reduction in fishing effort that may occur if these species are retained and counted against trip limits, quotas, and other management measures.

Alternative I3 would retain the established prohibited species group and add finetooth sharks. The 2002 SCS stock assessment indicated that finetooth sharks, although not overfished, are experiencing overfishing (Cortes, 2002). This alternative would have limited ecological impacts as finetooth sharks are common bycatch in non-HMS fisheries and prohibiting them will not prevent their capture. A reduction in finetooth shark landings in HMS fisheries may not significantly reduce mortality because they are only a small component of total landings. This alternative may help to reduce mortality of this species but could also increase waste and discards. Impacts to other species would be similar to alternative I1. In regard to alternative I6, finetooth sharks are not depleted and are commonly caught in HMS and non-HMS fisheries. Therefore, this species does not appear to meet the criteria selected under alternative I6, at this time.

Alternative I4 would remove the dusky shark from the current prohibited species group and would likely have significant ecological impacts. Dusky shark catch rate data indicate large population declines since the early 1970s. Dusky sharks have a high bycatch mortality, approximately 80 percent, and are usually dead when gear is retrieved. Although commercial shark fishery observer data show that dusky sharks comprise approximately one percent of total catch in recent years, this alternative could result in increased mortality of this overfished species by allowing the retention of individuals that may otherwise be released alive. However, allowing dusky sharks to be retained and counted against trip limits and quotas could reduce overall effort in the fishery and may help to reduce waste. Impacts to other species would be similar to alternative I1. In regard to alternative I6, dusky shark data indicate that the species is still depleted and compared to other species is rarely observed caught in the bottom longline fishery (less than one percent of total catch). However, anecdotal evidence indicates more dusky sharks are being caught. NOAA Fisheries may conduct a stock assessment in the near future and will reconsider removing the dusky shark based on the results of that stock assessment.

Alternative I5 would add the species presently in the deepwater and other group to the prohibited species group (this alternative would require implementation of alternative H1). This alternative would likely have only minor ecological impacts because there are only minor landings of these species through bycatch in other non-HMS fisheries and that bycatch would likely continue regardless of a prohibition. Current regulations only protect these species against finning. However, this alternative takes a precautionary approach to managing these species. Further, prohibiting the landing of these species in HMS fisheries may limit the availability of data pertaining to them because the few deepwater sharks that are caught would need to be released. Impacts to other species would be similar to alternative I1. In regard to alternative I6, there are no data indicating stock declines at this time, and while the species are rarely caught in any fisheries, NOAA Fisheries believes there are no fisheries targeting them.

Alternative I6, the preferred alternative, would establish criteria for the addition and removal of species to/from the prohibited species group and would not likely result in significant ecological impacts, at least in the short-term because this alternative would not make any changes to the prohibited species group at this time. However, in the long-term, this alternative could allow for faster rebuilding and stock maintenance for species meeting these criteria, if bycatch mortality is not too large. For those species that may be removed from the group in the future, impacts would vary depending on fishing patterns and effort at that time. While alternative I6 lays out criteria for the inclusion and removal of species from the prohibited species list, species will be considered on a case by case basis in future rulemaking, as needed or as petitioned by the public.

As described in Chapter 2, a species could be added to the prohibited species list if at least two of the following criteria are met: (1) There is sufficient biological information to indicate the stock warrants protection, such as indications of depletion or low reproductive potential or the species is on the ESA candidate list; (2) the species is rarely encountered or observed caught in HMS fisheries; (3) the species is not commonly encountered or observed caught as bycatch in fishing operations; or (4) the species is difficult to distinguish from other prohibited species (i.e., look-alike issue). Alternatively, a species could be removed from the prohibited species list if it meets only one criterion.

Under alternatives I1 through I6, NOAA Fisheries does anticipate any adverse impacts on finfish, protected species, or EFH at this time. Alternatives I1, I3, and I5 are not expected to change fishing patterns or effort. Alternatives I2 and I4 could potentially reduce fishing effort, although this reduction would likely be minimal. While alternative I6 would establish criteria for addition and removal of species to/from the prohibited species group, it would not make any changes to the group at this time. Accordingly, fishing patterns and effort are not expected to change. Specific impacts to finfish, protected species, or EFH would be considered in future rulemaking that applies the alternative I6 criteria.

Social and Economic Impacts

Under the no action alternative, I1, NOAA Fisheries does not anticipate any substantive change, either positive or negative, in social or economic impacts because fishermen are already operating under these restrictions.

Alternative I2 could have positive social and economic impacts for both commercial and recreational fishermen in the short-term, and negative social and economic impacts in the long-term. In the short-term, it could allow dusky sharks and other occasionally-caught sharks to be landed commercially, marketed, and utilized. This could reduce the time at sea needed to reach trip limits and may increase revenues for commercial fishermen and dealers. This alternative may increase recreational angler participation because dusky sharks used to be targeted as a large game fish in recreational fisheries. Business and associated profits within the recreational charter/headboat industry and consumer angler surplus may increase. However, in the long-term, if these overfished/vulnerable shark stocks decline, more fishing effort will be required to catch these species, and would likely result in increased costs and reduced revenues for commercial fishermen and charterboat and headboat operations. Angler consumer surplus may also decline for shark-targeted trips.

Alternative I3, would add finetooth sharks to the established prohibited species list and would likely have negative social and economic impacts in both commercial and recreational fisheries. Finetooth sharks are a common catch in both commercial and recreational fisheries and prohibiting their possession could likely result in increased costs and reduced revenues for commercial fishermen and charterboat and headboat operations, relative to alternative I1. Finetooth sharks accounted for over one-third of all commercial SCS landings in 1998 - 2000 (Cortes, 2002) and are a regionally important recreational species (Cortes and Neer, 2002).

Alternative I4 would likely have positive social and economic impacts similar to alternative I2. Due to the multispecies nature of the fishery, many fishermen find it difficult to avoid interacting with dusky sharks. This alternative could allow dusky sharks to be landed commercially, marketed, and utilized. This could reduce the time at sea needed to reach trip limits and may increase revenues for commercial fishermen, fish dealers, and processors. This alternative may increase recreational angler participation because dusky sharks used to be targeted as a large game fish in recreational fisheries. Business and associated profits within the recreational charter/headboat industry and consumer angler surplus may increase. However, in the long-term, if the overfished dusky stocks decline further, more fishing effort would be required to catch this species, and would likely result in increased costs and reduced revenues for commercial fishermen and charterboat and headboat operations. Angler consumer surplus may also decline for shark-targeted trips.

NOAA Fisheries expects alternative I5 to have only *de minimis* (negligible) social or economic impacts as there are only minor landings of the deepwater/other species through bycatch in other fisheries.

Alternative I6, the preferred alternative, could have positive social impacts as it would clarify reasons for prohibiting species, ease the administrative burden associated with the addition and removal of species, and could allow for more rapid and adaptive management. Alternative I6 could have variable economic impacts as species are added/removed to/from the prohibited species group. Negative economic impacts could result if species that are important commercially or recreationally are added to the prohibited species group, and positive economic impacts could result if commercially valuable species or species valued by the recreational sector are removed from the prohibited species group.

Conclusion

Alternative I6 is preferred because it would clarify the reasons and criteria for adding or removing species to the prohibited species group. Until such a mechanism is finalized and fully implemented, NOAA Fisheries does not feel justified in making changes to the prohibited species list. Additionally, alternative I6 could ease the administrative burden of addition and removal of species and would allow for more rapid and adaptive management.

A petition for rulemaking should contain sufficient information for NOAA Fisheries to consider the substance of the petition. For a petition regarding changes to the prohibited species list, the petition should at a minimum:

- Indicate what species are proposed to be added to or removed from the list
- Identify which criteria warrant the addition or removal of the species
- Provide data, information, etc., relevant to those identified criteria
- State the resources necessary to develop the proposed regulations
- Explain the interest of the petitioner in the action requested
- Indicate the size of the population affected (i.e., who is affected by action)
- Indicate the public interest in the proposed regulation
- Explain the importance of the action requested to promoting established NOAA Fisheries' priorities and policies

4.6 BYCATCH REDUCTION MEASURES

Under the National Standard 9 guidelines, NOAA Fisheries is required to consider 10 factors when considering measures to minimize bycatch and bycatch mortality to the extent practicable. These factors are below. NOAA Fisheries considered all of these factors for each alternative below.

(A) Population effects for the bycatch species;
(B) Ecological effects due to changes in the bycatch of that species (effects on other species in the ecosystem);
C) Changes in the bycatch of other species of fish and the resulting population and ecosystem effects;
(D) Effects on marine mammals and birds;
(E) Changes in fishing, processing, disposal, and marketing costs;
(F) Changes in fishing practices and behavior of fishermen;
(G) Changes in research, administration, and enforcement costs and management effectiveness;
(H) Changes in the economic, social, or cultural value of fishing activities and nonconsumptive uses of fishery resources;
(I) Changes in the distribution of benefits and costs; and,
(J) Social effects.

4.6.1 Gear Restrictions

As described in Chapter 2, the alternatives considered for bycatch reduction measures are:

J1	Gillnet - net checks, Atlantic Large Whale Take Reduction Plan (ALWTRP), observers; Bottom longline - post guidelines (No Action)
J2	Existing bycatch reduction measures (J1) plus closing the shark gillnet fishery permanently/Remove gear from list of authorized gear types
J3	Existing bycatch reduction measures (J1) and allow only strikenet method in shark gillnet fishery
J4	*Existing bycatch reduction measures (J1) plus requiring VMS on shark gillnet vessels during right whale calving season and requiring VMS on directed bottom longline shark fishing vessels operating near the time/area closure off North Carolina - Preferred Alternative*
J5	*Existing bycatch reduction measures (J1) plus requiring the use of non-stainless steel corrodible hooks, the possession of release equipment on vessels with shark bottom longline gear (line cutters, dipnets, and, when approved, dehooking devices), and that bottom longline vessels move 1 nautical mile after an interaction with a protected species - Preferred Alternative*
J6	Existing bycatch reduction measures (J1) plus limiting shark bottom longline gear to a maximum of 10 miles of mainline, limiting soak time to 10 hours or less, and requiring the use of non-stainless steel corrodible circle hooks

J7	Existing bycatch reduction measures (J1) plus requiring the retention of all sharks caught in commercial shark fisheries; no discards allowed
J8	Existing bycatch reduction measures (J1) plus requiring commercial and recreational fishermen to attend workshops on present regulations, species identification, and release techniques

Ecological Impacts

The no action alternative, J1, would maintain the existing requirements on shark gillnet and bottom longline vessels. These requirements were put in place, for the most part, to reduce interactions and mortalities of protected species. Removal of these restrictions could have negative ecological impacts on protected species. This alternative would continue to provide some positive ecological impacts by maintaining measures to monitor fishery operations and reduce the mortality of protected resources. Currently, vessels participating in the shark gillnet fishery have observer, net check, and ALWTRP requirements. Bottom longline vessels are required to post handling and release guidelines.

A total of 43 sea turtles (31 loggerhead, 4 leatherback, and 8 unidentified sea turtles), two delphinids, and seven sawfish have been observed caught in the shark bottom longline fishery from 1994 to 2002 (Burgess and Morgan, 2003; G. Burgess, pers. com., 2003). Based on observer data, NOAA Fisheries estimates that a total of 2,003 loggerhead sea turtles, 269 leatherback sea turtles, and 503 unidentified sea turtles were taken in the shark bottom longline fishery from 1994 through 2002. Average annual takes are estimated to have been 222 loggerhead sea turtles, 30 leatherback sea turtles, 56 unidentified sea turtles, and 52 sawfish (NOAA, 2003b).

Over a five year period, the expected take of sea turtles from the shark bottom longline fishery would be 1,360 total loggerhead sea turtle captures with 754 mortalities; 150 total leatherback sea turtle captures with 85 mortalities; and, 30 total green, Kemp's ridley, or hawksbill turtle captures, combined, of which five mortalities for each species would be expected. Additionally, 260 smalltooth sawfish would be expected to be captured and released with no mortalities (NOAA, 2003b).

Since 1999, 21 sea turtles (1 hawksbill, 4 loggerhead, and 16 leatherback sea turtles) and 14 marine mammals (4 spotted dolphins, and 10 bottlenose dolphins) have been observed caught in the shark drift gillnet fishery (NOAA Fisheries, 2000, 2001, 2002, 2003a). In addition, one smalltooth sawfish was observed caught in a shark drift gillnet in July 2003 and was released alive (J. Carlson, pers. comm., 2003). Extrapolated observations from these data suggest serious injury and mortality of 25 bottlenose dolphin and one Atlantic spotted dolphin in the shark gillnet fishery from 1999 through 2002 (Garrison, 2003). The estimated takes of loggerhead sea turtles by year are: 1999 - none; 2000 - one mortality and 4.4 live takes; 2001 - one live take; and 2002 - 1.7 live takes. The estimated takes of leatherback sea turtles by year are: 1999 - none; 2000 - none; 2001 - 2 mortalities and 12 live takes; and 2002 - 3.4 live takes.

NOAA Fisheries estimates that, over a 5-year period, the expected take of sea turtles from the shark gillnet fishery would be 10 total loggerhead sea turtle captures with one mortality, and 22 total leatherback sea turtle captures with three mortalities. Additionally, one smalltooth sawfish would be expected to be captured and released alive during the same period (NOAA Fisheries, 2003b).

In the BiOp conducted for this rulemaking, NOAA Fisheries determined that the continued operation of the shark fisheries would not adversely affect marine mammals, and is not likely to jeopardize the continued existence of the endangered Kemp's Ridley, green, hawksbill, and leatherback sea turtles, and the threatened loggerhead sea turtle (NOAA Fisheries, 2003b).

The bycatch of non-target species and expanded take estimates of protected resources in the shark bottom longline and shark gillnet fisheries are discussed in Section 3.5. Catches and landings of target species are discussed in Section 3.3.

Alternative J2 would close the shark gillnet fishery permanently and would remove gillnet gear from the list of authorized gear types. This alternative would likely have positive ecological impacts. It may reduce bycatch and bycatch mortality of protected resources, other HMS and non-HMS species, and could reduce fishing effort in right whale critical habitat. This would support the goals of NS 9. Currently, only five vessels use gillnets to target sharks but other vessels use gillnets to target other species and catch sharks incidental to their activities. As such, any potential reductions in associated mortalities may not be large. A permanent closure of the shark gillnet fishery may also displace effort into other fisheries where bycatch and bycatch mortality may be as great or greater. The impacts to shark species would likely be positive, especially for SCS (since the shark gillnet fishery lands mostly SCS), but may be negated if other authorized gears/fisheries increase their landings respectively. However, to the extent that the fishermen who land sharks incidental to their other activities need to increase effort to offset the loss of sharks, bycatch of sharks may increase.

Alternative J3 would require that vessels operating in the shark gillnet fishery set gear using the strikenet method only. This alternative would likely result in positive ecological impacts as the shark strikenet fishery produces little bycatch (no observed protected species interactions/the majority of catch is target species). The strikenet fishery produces little bycatch because strikenet fishermen actively set their gear around aggregations of sharks and retrieve the gear quickly. This alternative could minimize protected resource interactions and the bycatch of non-target species within the shark gillnet fishery while still supporting the goals of NS 9. Alternative J3 would allow incidental shark landings from vessels participating in other gillnet fisheries, such as the mackerel fishery, to minimize discards

Alternative J3 was preferred in the draft Amendment because NOAA Fisheries believed there would be ecological benefits due to reduced bycatch of protected species and non-target finfish (e.g., red drum, tarpon, and other game fish). However, this alternative is not preferred in this final document. Upon closer examination, NOAA Fisheries found that, in terms of actual numbers, relatively few sea turtles have been captured in the shark gillnet fisheries compared to other fisheries. This has been further substantiated by recent studies performed by NOAA's Southeast Fisheries Science Center indicating that interactions with protected species in the shark gillnet fishery are a rare event (Garrison, 2003). In the October 29, 2003 BiOp, NOAA Fisheries estimated that the expected take of sea turtles and sawfish in the shark gillnet fishery over a five-year period would be 10 total loggerhead sea turtle captures with one mortality, 22 total leatherback sea turtle captures with three mortalities, and one smalltooth sawfish released alive (NOAA Fisheries, 2003b). In addition, some fishermen who use shark drift gillnet gear claim to have modified their gear in efforts to reduce interactions with protected resources. One commenter reported that he has modified his nets to float higher in the water column and use less weight, in an attempt to allow any entangled sea turtles to reach the surface and better survive. Another commenter reported that he has switched to nets with a smaller mesh size and claims to have increased his Atlantic sharpnose shark catch and decreased his interactions with protected resources.

Some commenters expressed concern regarding the ecological impacts of shark gillnets on non-target species including, red drum, tarpon, and other game fish. As discussed in Section 3.5, observer data indicate that the shark gillnet fishery does not catch large numbers of these species. In regard to red drum in particular, 28 fish were observed caught in 2002, of which 50 percent were released alive. One commenter stated that while targeting SCS with driftnet gear, one of the biggest discard species is king mackerel. The net fishermen have petitioned the South Atlantic Fishery Management Council to allow more of these fish to be retained, thereby reducing regulatory discards. Many commenters stated that NOAA Fisheries should consider gear modifications to reduce bycatch of protected resources and non-target species.

With regards to impacts on sharks, some commenters indicated that Atlantic sharpnose and blacktip sharks make up the majority of the drift gillnet landings and that these species are not overfished and overfishing is not occurring according to the latest stock assessments

NOAA Fisheries believes that gear modifications or other measures may be effective to reduce protected resource interactions and bycatch and bycatch mortality of non-target species while allowing the shark gillnet fishery to continue. NOAA Fisheries may consider gear modification or other options for this fishery in a future rulemaking and encourages fishermen to submit comments regarding suitable gillnet gear modification options.

Alternative J4, a preferred alternative, would require VMS on shark gillnet vessels during right whale calving season and would require VMS on directed bottom longline shark fishing vessels near the selected time/area closure or any future closures. This alternative is consistent with the rationale for requiring VMS on pelagic longline vessels (i.e., enforcement of time/area closures). If used in conjunction with closed areas, alternative J4 could enhance rebuilding to MSY levels for LCS. The ecological cost of not enforcing a time/area closure effectively is further depletion of fully or overfished stocks with longer times to rebuilding.

Alternative J5, a preferred alternative, would require the use of non-stainless steel corrodible hooks aboard shark bottom longline fishing vessels, require the possession of release equipment (line cutters, dipnets, and, when approved, dehooking devices) on vessels with shark bottom longline gear, and require bottom longline vessels to move one nautical mile after an interaction with a protected species. Both corrodible hooks and release equipment may reduce post-release mortality of protected species, sharks, and finfish, however, impacts are not quantified at this time. Release equipment is inexpensive and relatively simple to use and the pelagic longline fishery has similar release equipment requirements. The requirement to move one nautical mile after an interaction with protected species such as a marine mammal, sea turtle, or sawfish would reduce the probability of another interaction with a protected species because these species often aggregate in clusters. By requiring vessels to move after an interaction, the vessel would increase the likelihood of avoiding additional animals in a cluster when setting subsequent gear. This alternative would likely have positive ecological impacts and would support the goals of NS 9. The positive ecological impacts of this alternative could be enhanced by providing educational workshops where, in addition to other topics, NOAA Fisheries could demonstrate release techniques and ensure that fishermen were trained in the proper use of release equipment.

Alternative J6 would cap the allowable length of each shark bottom longline gear in the water to 10 miles, establish a 10 hour maximum soak time, and require that all shark bottom longlines be rigged with non-stainless steel corrodible circle hooks in order to limit effort and decrease mortality and waste. This alternative would likely have positive ecological impacts and would support the goals of NS 9. Periodically, fishermen are forced to cease gear haul-back operations, leave the remainder of their longline gear and catch in the water, and return to port for offloading because they have reached the 4,000 lb trip limit or for other reasons. By capping the allowable length of shark bottom longline gear, this alternative may reduce the chances of one set catching more than the 4,000 lb trip limit and could reduce the mortality of species remaining attached to the gear. The Commercial Shark Fishery Observer Program (CSFOP) observed nine trips from 1994 - 2002 that reached the 4,000 lb trip limit with one set. Of those nine trips, three could only be partially retrieved due to reaching the trip limit. The mainlines of these sets were 12.0, 6.0, and 13.3 miles long, with an average of 10.4 miles. (G. Burgess, pers. comm., 2003).

Alternative J6 would also establish a 10 hour maximum soak time. Shorter soak times could allow incidental catch and bycatch to be released sooner and with less injury, which could lead to increased survivability of protected and non-target species. However, reductions in soak time could cause fishermen to increase the number of sets fished per trip, or the number of hooks fished per set, and may result in increased effort and unsafe conditions. In a recent analysis conducted by the Virginia Institute of Marine Science, researchers found that soak time influenced hooking mortality of dusky sharks. The researchers found that hooking mortality for dusky sharks was 85 percent for soak times greater than 20 hours, 79 percent for soak times greater than 15 hours, and 57 percent for soak times less than 15 hours. Dusky sharks were found to have the lowest hooking mortality (five percent) on sets with soak times less than 10 hours (Romine *et al.*, 2001). According to observer data (GSAFDF, 1997), average shark bottom longline sets generally last between 10.1 and 14.9 hours, with some areas having a much smaller average. Burgess and Morgan (2003) report average shark bottom longline soak times for 2000 - 2002 as 9.0 hours in the Florida East Coast region, 12.3 in the Florida Gulf Coast region, and 13.6 hours in the Carolina region.

Alternative J6 would also require that all shark bottom longlines be rigged with non-stainless steel corrodible circle hooks. The use or possession of straight shank (“J”) hooks, or any variation of stainless steel hook, would be prohibited on shark bottom longline vessels. Circle hooks generally lodge in the corner of the mouth rather than in the throat or gut. Sharks and finfish that are not retained are more likely to be released with less injury. Protected species would also likely benefit from reduced injuries, as circle hooks are less likely to hook in the throat or gut. Although no specific research on circle hook use in shark bottom longline fisheries is available, circle hooks have been found to significantly reduce the rate of hook ingestion by loggerhead turtles and reduce the associated post-hooking mortality (Watson, *et al.*, 2003).

Alternative J7 would require all sharks caught in commercial shark fisheries to be retained and landed. This alternative could have both positive and negative ecological impacts. It could virtually eliminate the bycatch of sharks in the commercial shark fishery and reduce the fishing effort needed to reach trip limits and fill quotas, thus reducing potential interactions with protected species. However, it could increase mortality of juvenile sharks, prohibited species, and other sharks normally not retained. Fishermen may also high-grade and discard less marketable species to avoid reaching the trip limit, increasing waste.

Alternative J8, would require both commercial and recreational fishermen to attend educational workshops and would likely result in positive ecological impacts. This alternative could: (1) reduce bycatch mortality by demonstrating handling and release techniques for finfish, sea turtles, and marine mammals; (2) improve shark (and possibly other) species identification; (3) improve compliance with current regulations; and (4) improve the accuracy of reported data. This alternative would likely benefit overfished stocks of HMS by increasing post-release survival of all species discarded. During the public comment period, commenters stated that the development of educational programs could improve shark species identification which may improve compliance and rebuilding efforts. The commenters also claimed that the proper use of release equipment, taught in a controlled environment, may reduce bycatch mortality and should be available to both commercial and recreational fishermen. Further, one commenter stated that educational workshop training should be a prerequisite for obtaining an HMS Angling category permit.

Alternative J1 would likely have no impacts on EFH because it would not change fishing patterns or effort. Alternatives J2 and J3 may have positive impacts on EFH by eliminating and substantially restricting, respectively, fishing effort. However, neither shark drift gillnets nor shark strikenets are believed to have adverse impacts on EFH so that any positive impacts would likely be small. Alternatives J4, J5, and J8 are largely administrative in nature and would not change fishing patterns or effort, and subsequently would not impact EFH. Alternatives J6 and J7 would likely reduce fishing effort and may have positive impacts on EFH. Alternative J6 may have measurable positive impacts to EFH because it would limit the amount of bottom longline allowed per set. However, shark bottom longline gear is not believed to adversely affect EFH so positive impacts may not be large.

Social and Economic Impacts

Under the no action alternative, J1, NOAA Fisheries does not anticipate any substantive change, either positive or negative, in social impacts, or any significant change in ex-vessel prices or economic benefits, primarily because this alternative does not change current fishing practices.

All of the alternatives listed above (J1-J8) could have minimal economic benefits if consumers perceive shark fishing vessels as conservation minded or if LCS stocks improve.

Alternative J2 would likely result in significant negative social and economic impacts for the five vessels actively fishing in the shark gillnet fishery or those vessels that land sharks incidental to their other activities but, overall, would not directly affect the vast majority of the entire shark fishing fleet. It would likely cause economic dislocation of affected individuals or small entities, and may put many of them out of business. This alternative would eliminate the need for observer coverage in the shark gillnet fishery and eliminate the associated administrative burden on NOAA Fisheries.

Alternative J3 would likely result in significant negative social and economic impacts for the five vessels actively fishing in the shark gillnet fishery but, overall, would not directly affect the vast majority of the entire shark fishing fleet. It may result in large decreases in revenues for fishermen who traditionally fished in the drift gillnet fishery and place financial burdens on those fishermen who may need to purchase a second smaller vessel and outfit it for strikenet fishing. NOAA Fisheries estimates that the smaller vessel could cost between $2,000 and $14,000 to purchase. The use of a second vessel for strikenet fishing may also increase associated operating costs. Additionally, several fishermen that currently strikenet fish also use a spotter plane to locate schools of sharks, which may further increase operating costs for fishermen that would be required to strikenet under this alternative. For those fishermen that currently strikenet fish, this alternative would have less of an impact but may still increase costs if they drift gillnet fished part of the time. Recently, some strikenet vessels have begun striking behind other vessels such as trawl vessels (e.g. shrimp vessels) without a second vessel (Carlson and Baremore, 2002c). This negates the need for a spotter plane and could reduce the variable costs substantially. Their efforts are moderately successful and could reduce the costs of fishing in a strikenet method substantially. Alternative J3 would allow for a reduction in the current observer coverage levels in gillnet fisheries outside right whale calving season. This could reduce the costs associated with observer coverage and the administrative burden on NOAA Fisheries.

During the public comment period, NOAA Fisheries received comments stating that the shark gillnet fishermen generally target Atlantic sharpnose sharks from April 1 through November 15 with drift gillnet gear. The commenters claim that strikenet gear has not been effective at catching Atlantic sharpnose sharks and they feel that drift gillnet gear is the only effective method of targeting this resource. The commenters wrote that strikenet gear cannot be used to target SCS or LCS during the summer months because these species do not aggregate during those months. Comment was received from fishermen currently active in the shark gillnet fishery stating that if they were not allowed to use drift gillnet gear, their businesses would no longer be viable and that even allowing strikenet gear would put vessels currently using strikenet gear out of business because they could only fish in the winter for LCS.

NOAA Fisheries has also received comments about possible enforcement difficulties associated with allowing strikenets only, stemming from the subtleties of gear deployment. Further comment was received from a state agency supporting the prohibition of shark gillnets in Federal waters to complement similar prohibitions in state waters, thereby minimizing drains on state law enforcement resources.

The intent of this alternative was to allow the commercial shark gillnet fishery to continue while minimizing interactions with protected resources as well as reducing bycatch of non-target species. Through public comment it has been brought to the attention of NOAA Fisheries that allowing the use of strikenets only would not accomplish this objective. Therefore, the final regulations will permit the use of drift gillnets with possible gear modifications or other measures being implemented through a future rulemaking, based upon further study.

Alternative J4, a preferred alternative, would require VMS on shark gillnet vessels during right whale calving season and would require VMS on directed bottom longline shark fishing vessels operating near the time/area closure off of North Carolina. This alternative may result in significant negative economic impacts on small entities but will have minor economic impacts on the fishery as a whole because it would only be required for a few select vessels participating in the shark fishery.

The costs of a VMS unit may be considered burdensome by fishing vessel owners, particularly by those vessels operating at the margin. However, the economic impacts of the VMS program would be necessary to implement the preferred time/area closure effectively. If implemented in conjunction with alternative K2, this alternative could result in five shark gillnet vessels and approximately seven directed bottom longline shark vessels (see analysis in Appendix 4) having to install VMS units at an initial average cost of approximately $1,300 - $3,250 ($1,000 - $2,500 per unit and $300 - $750 installation fee), an average annual maintenance cost of approximately $500/year, and approximately $1.44/day for position reports. NOAA Fisheries believes that requiring VMS for only that sub-population of the shark fishing fleet that fishes in the vicinity of the time/area closures is appropriate because the intent of the measure is to monitor vessel activity to ensure that time/area closures are effective. If other time/area closures are implemented, additional vessels would likely be affected. In an attempt to provide vessel owners with some flexibility and help minimize costs, NOAA Fisheries has type-approved four VMS units from two manufacturers for use in the pelagic longline fisheries. No VMS units have been type-approved specifically for use in the Atlantic shark fisheries as of this date. Based on a range of VMS units commercially available, NOAA Fisheries expects any VMS unit type-approved for Atlantic shark fisheries to be similar or identical to those type-approved for the pelagic longline fisheries.

VMS has several social and economic benefits, namely that it provides a secure communication system and an emergency beacon and position report (immediate global positioning system distress signal), if needed. VMS would benefit fishermen, and safety of human life at sea, by increasing communication with markets, family members, vessel owners, and the Coast Guard. VMS can show that vessels are not operating in closed areas, may allow vessels to transit closed areas without special gear stowage procedures, and allows for the collection of real-time data. Fishermen may also be eligible for benefits for cooperating with the NOAA Weather Service via their VMS. In addition, VMS could allow confidential real-time logbook reporting if a personal computer is linked to the system which could decrease the paperwork burden on fishermen, observers, and NOAA Fisheries. VMS may increase revenues by allowing less burdensome regulations and more fishing time (up to the time of a closure instead of being in port by the closure).

VMS offers an administrative benefit to NOAA Fisheries as well. The VMS would allow managers to coordinate for observer sampling and coverage in order to achieve coverage goals. It may reduce the need for observer coverage and lessen associated administrative costs, including enforcement costs. Also, with VMS, NOAA Fisheries can identify trips that have started without the required observer and can seek further enforcement of observer regulations.

Alternative J5, a preferred alternative, is designed to reduce bycatch mortality and would likely have only minor social and economic impacts. In addition to existing bycatch reduction measures (alternative J1), vessels with longline gear onboard would be required to possess and use only non-stainless steel corrodible hooks and to possess release equipment (line cutters, dipnets, and, when approved, dehooking devices). Line cutters, dipnets, and dehooking devices are relatively simple to use, but may require training to use effectively. The purchase of release equipment would likely only be a minor expense to most fishermen. The design specifications from the Hawaii pelagic longline fishery, from which the pelagic longline dipnet and line clipper standards were taken, were estimated to cost approximately $250.00 for both devices (65 FR 16346, March 28, 2000). While hook removal devices are commercially available from several vendors, NOAA Fisheries has not implemented specifications like those for line clippers and dipnets and would delay the effective date of this requirement until such time as specifications are developed. Hook removal devices range in price depending on the application, but could cost between $6.00 and $210.00. Fishery participants have largely supported the use of hook removal devices in some applications in HMS fisheries. There are currently similar release equipment requirements in the pelagic longline fishery. Although many shark fishermen may already use non-stainless steel corrodible hooks, this may increase the financial burden on fishermen who will have to purchase new hooks. The requirement to move one nautical mile after an interaction with a protected species could increase fuel costs due to increased time transiting to another fishing area and increase the time needed to fish if alternate fishing grounds are not as productive for target species. However, because few protected species have been observed caught, NOAA Fisheries does not believe that this requirement would affect more than a few trips for all vessels combined, each year.

NOAA Fisheries has received comment that the use of dehooking devices and disentanglement gear may not only save fishermen money by retrieving hooks, but it may also increase efficiency by reducing the time and effort spent re-rigging gear and removing hooks and line from target and non-target species. One commenter also stated that the use of dehooking and disentanglement gear may speed up fishing operations.

Enforcement of alternative J5 could be challenging. Dockside inspections would identify the presence or absence of release equipment and corrodible hooks, but would not address whether or not they were actually used or whether or not a vessel moved after an interaction with a prohibited species. This alternative could have high administrative costs due to enforcement efforts that would be necessary as well as management efforts to define allowable hooks and dehooking device(s). One commenter noted that NOAA Fisheries could require vessel operators to display certificates documenting their attendance at a workshop indicating to enforcement that they were trained in the proper use of the release equipment.

Alternative J6 would cap the allowable length of shark bottom longline gear to 10 miles, establish a 10 hour maximum soak time, and require that all shark bottom longlines be rigged with non-stainless steel corrodible circle hooks. This alternative could be challenging to enforce and would likely result in minimal negative social and economic impacts. Limits on soak time and length of bottom longline gear could also pose safety concerns. In bad weather, fishermen may not be able to safely retrieve fishing gear within the 10 hour limit. The 10 mile gear restriction and the 10 hour soak time limit may cause fishermen to increase the number of sets fished per trip or the number of hooks fished per set and could result in increased effort. Many shark fishermen may already use non-stainless steel circle hooks, but those who do not would incur the costs of replacing hooks and re-rigging gear.

Under alternative J7, fishermen would be required to retain all sharks caught. This alternative could result in minimal negative social and economic impacts. If no discards were allowed, trip limits and quotas could be reached more quickly and may result in derby fishing conditions. Derby conditions may result in depressed ex-vessel prices, reduced revenues, market gluts, and concerns for the safety of fishermen at sea. Additionally, revenues may also decline if lower market value species were required to be retained instead of allowing continued fishing for higher market value species.

Under alternative J8, commercial and recreational fishermen would be required to attend workshops discussing shark (and possibly other) species identification, marine mammal, sawfish, and sea turtle release techniques, and current regulations. This alternative would likely result in positive social impacts. NOAA Fisheries would conduct the educational workshops, the only costs incurred by fishermen would be related to travel and time to attend the workshops. To minimize costs to fishermen, NOAA Fisheries could offer workshops at several locations near recreational and commercial shark fishing ports. NOAA Fisheries would also try to hold workshops during non-fishing seasons to minimize lost fishing time. The administrative costs for workshops is high, but may be exceeded by the benefits associated with the possible impacts from increased education. Before implementation, NOAA Fisheries would attempt to identify ways to minimize costs such as video conferencing or internet based training.

While comments during scoping indicated that workshops would be more beneficial if fishermen attended on a voluntary basis instead of as the result of a requirement, comments received on the draft Amendment indicated some preference for mandatory workshops. The commenters claimed that educational workshops could be beneficial to both recreational and commercial fishermen. One commenter stated that the educational workshops could serve as a forum where fishermen could learn about current research, regulations, and share information about their fishery that could be transferred to other fisheries (e.g., recreational to commercial). The commenters indicated that this atmosphere could give the attendees a feeling of stewardship of the environment and their fishery, and that this could lead to better working relationships with NOAA Fisheries.

While it appears that mandatory workshops would be beneficial, because over 20,000 permit holders would be involved, NOAA Fisheries realizes that there are implementation and operational issues that need to be addressed. NOAA Fisheries is currently investigating the following issues, including but not limited to: (1) types of penalties for not attending a workshop (e.g., loss of permit); (2) implementation concerns (e.g., test specifics, access to online media, course certificates); (3) specifically who would be required to attend workshops (e.g., permit holders, vessel operators, crew members); and (4) the fact that the recreational community did not submit comments regarding the workshops. NOAA Fisheries believes that alternative J8 may have been overlooked by the recreational community because it was analyzed in the bycatch section.

Based on these issues, and the fact that NOAA Fisheries would need to delay the implementation of this measure in order to receive Paperwork Reduction Act (PRA) approval, address any implementation difficulties, and receive a full range of public comment, NOAA Fisheries intends to move forward with this measure in a future rulemaking in order to assure that all aspects of the alternative are fully analyzed. In the interim, NOAA Fisheries will attempt to make voluntary workshops available to the public.

Conclusion

Alternative J4 is preferred because, with the implementation of time/area closures, it could allow vessels to transit closed areas without special gear stowage procedures, it would allow for the collection of real-time data, it could enhance rebuilding to maximum sustainable yield levels for LCS, and may also allow more finely defined closure areas. Alternative J5 is preferred because it would reduce post release mortality of protected species, sharks, and finfish by reducing the amount of time a hook remains embedded in an animal, and would reduce the probability of multiple interactions with protected species.

4.6.2 Time/Area Closures

As described in Chapter 2, the alternatives considered for time/area closures are:

K1 No time/area closures - (No Action)
K2 *Time/area closure for sandbar and dusky shark nursery and pupping areas off of North Carolina during the winter fishery - Preferred Alternative*
K3 Time/area closure for all shark nursery and pupping areas during pupping season based on EFH identifications for neonate and juvenile sharks

The preferred alternative is Alternative K2.

Ecological Impacts

Under alternative K1 (no action), NOAA Fisheries would not implement any time/area closures to protect sharks. This alternative has been in effect since the 1993 FMP. The 1999 HMS FMP did not implement any time/area closures because most shark nursery and pupping areas are within state waters; the State of North Carolina had recently closed state waters which, at the time, was estimated to be sufficient to reduce juvenile sandbar and dusky shark mortality; and the commercial minimum size finalized in the HMS FMP was intended to further reduce the incidental catch of juvenile sharks by acting as a type of moving time/area closure. Based on new information, NOAA Fisheries is analyzing time/area closures in different areas which include Federal waters as discussed below for Alternatives K2 through K3.

Alternative K1 would take no additional action to reduce the bycatch of juvenile sharks or pregnant females in pupping areas during the pupping season, and in combination with alternative D2, would continue to have a negative effect on these vulnerable life stages. Under this alternative bycatch issues would have to be addressed through other measures and neonates and juveniles of all species could continue to be caught. This alternative could have a negative ecological impact by allowing the continued harvest and discard of juvenile and neonate sharks and prohibited species such as the dusky shark. The 2002 LCS stock assessment indicated that the LCS complex continues to be overfished, and recommended protecting juvenile and pregnant females. Data from the shark observer program indicate that there are high catch rates of juvenile sharks and dusky sharks in the shark bottom longline fishery. This alternative would do nothing to reduce the catch of these species.

Alternative K1 could have a negative impact on the bycatch of other fish species by allowing for continued fishing during shark pupping season in areas that may have high numbers of neonate and juvenile sharks and prohibited species. This alternative is not expected to have any additional negative impacts on marine mammals and seabirds. Since bottom longline gear is set on the bottom, there are few interactions involving marine mammals or seabirds (See Section 3.5).

Alternative K2 would close an area from Oregon Inlet, North Carolina at 35°41' North offshore to 74°51' West, then following the 60 fathom contour to 35°30' North and 74°46' W and continuing along the 60 fathom contour south to 33°51' North and 76°24' West to all directed shark LAPs with bottom longline gear on board from January through July (Figures 2.2 and 4.1). The closure encompasses approximately 4,490 nm^2.

This action would protect an area where neonate and juvenile dusky and sandbar sharks are most abundant and would have a positive ecological impact by reducing discards and preventing bycatch of prohibited species. The area has been identified as EFH for both sandbar and dusky sharks and as a Habitat Area of Particular Concern (HAPC) for sandbar sharks due to important nursery and pupping grounds in areas adjacent to Hatteras and Ocracoke Islands and offshore of those islands (Chapter 10). Other areas identified as HAPC for similar reasons such as the mouth of Great Bay, NJ, lower and middle Delaware Bay, and lower Chesapeake Bay, MD, were not included in the time/area closure because they are predominantly in state waters and fishing effort is low in those areas. The HAPC off North Carolina is one of only four areas identified as HAPC, and is the only area that extends significantly into Federal waters. The HAPC in Chesapeake Bay has a slight overlap with Federal waters near the mouth of the Bay. Both alone and in combination with other management actions such as seasonal quotas, trip limits, gear restrictions, and a recreational minimum size, this action will have a positive ecological impact by increasing survival of neonate and juvenile dusky and sandbar sharks and helping to rebuild stocks.

For dusky sharks, a prohibited species, the ecological impact of a time/area closure would be positive. This species is highly susceptible and vulnerable to overfishing and is currently a candidate for listing under the ESA. Female dusky sharks do not reach sexual maturity until age 17 years (~300 cm or 10 feet total length), and male dusky sharks mature at 290 cm (~9.5 feet). Additionally, dusky sharks caught on longlines are seldom released alive. Of the observed catch of dusky sharks, only 18.8 percent were alive when brought to the vessel.

Like the dusky shark, the sandbar shark is a slow growing species that reaches sexual maturity at 15 to 16 years. Both sexes reach maturity at about 147 cm or approximately five feet total length. The 2002 LCS Stock Assessment indicated that sandbar sharks are still experiencing overfishing, and recommended reducing juvenile mortality. The time/area closure would have a positive impact on both neonate and juvenile life stages. A high percentage of neonates and juveniles were observed caught in the time/area closure whereas very low percentages of juveniles and no neonates were observed caught outside the time/area closure. Without the time/area closure the potential for continued harvest of large numbers of these vulnerable life stages would remain high.

In the draft Amendment, NOAA Fisheries proposed closing approximately 31,487 nm^2 from Virginia to South Carolina to all shark bottom longline fishing from January through July. Based on public comments, NOAA Fisheries re-examined the data and refined the area. Analyses and data presented below indicate the expected impacts of the revised area and, where appropriate, comparisons between the original and revised areas are provided. The seaward boundary of the revised area follows the 60 to 80 fathom contour, and was selected to include all observed catches of dusky sharks and sandbar sharks. No dusky or sandbar sharks were observed caught east of approximately 50 fathoms. Since large numbers of sharks appear to be caught in a line along the 50 fathom contour, a buffer of approximately two miles was included thus extending the boundary to 60 to 80 fathoms (See Figure 4.1). The northern boundary was selected to include the Habitat Area of Particular Concern (HAPC) for sandbar sharks off Cape Hatteras and because areas north of Cape Hatteras have historically had low catches of both dusky and sandbar sharks. The southern boundary was selected based on low numbers of dusky sharks that have been observed caught there in recent years, and because the proportion of juvenile and neonate sandbar sharks is much lower there than in the time/area closure.

In assessing the ecological impacts of the revised time/area closure, NOAA Fisheries analyzed two different time series of data from the Commercial Shark Fishery Observer Program for dusky sharks. The first time series was from 1994-2002, and the second was from 2001-2002. A Geographic Information System (GIS) program was used to plot all observed catches of dusky, sandbar, and LCS, and spatial analyses were performed to determine the number of each species (and life stage) observed caught in the time/area closure in comparison to the rest of the Atlantic. NOAA Fisheries conducted a separate analysis of the shorter time period after receiving public comments that the catch of dusky sharks has declined since they were prohibited (65 FR 38440, June 21, 2000), and that fishermen are no longer targeting them. No trips were observed in the time/area closure in 2000 due to lack of observer program funding, and the data for 2001-2002 had to be aggregated due to the low number of observed trips and confidentiality issues. The data were analyzed with and without redistribution of effort for both the shorter and longer time periods.

For sandbar sharks, only the longer time period was analyzed with and without redistribution of effort. NOAA Fisheries did not feel it was appropriate to look at the shorter time frame for sandbar sharks because they are not prohibited. Results for both species and the LCS complex are provided below and summarized in Tables 4.1 to 4.13 and in Figures 4.2 to 4.7. Since the preferred alternative is to close the area from January through July, the numbers and percentages of sharks provided in the text are for those months only, unless noted otherwise. Data for all months are provided in Tables 4.2 to 4.13.

For the redistribution of effort analyses, only data from the Atlantic were used and results are given for the Atlantic only since displaced fishing vessels off North Carolina are more likely to remain in the Atlantic than to move to the Gulf of Mexico. In addition, catches of dusky sharks in the Gulf of Mexico have historically been low; since 1994 only 29 dusky sharks or 2 percent of all observed catch of dusky sharks was from the Gulf of Mexico. The redistribution of effort analysis assumes that all effort currently in the time/area closure will be redistributed to open areas of the Atlantic. While some fishermen will continue fishing in open areas of the Atlantic, others may choose to leave the fishery as a result of the closure, and thus the actual percentage reduction resulting from the time/area closure will likely fall between the results of the redistribution and no redistribution of effort estimates. Figures comparing catches of dusky and sandbar sharks in the time/area closure with all observed catches in the Atlantic and Gulf of Mexico are provided (Figures 4.2 to 4.4).

Time/Area analysis with no redistribution of effort

The effectiveness of the time/area closure along the mid-Atlantic coast was evaluated by determining the percent reduction in total U.S. Atlantic shark bottom longline catch of dusky, sandbar, and LCS for each month. Data from the longer time series (1994-2002) indicated that of the 1,392 dusky sharks observed caught in the Atlantic from 1994-2002, 1,099 (79 percent) were caught in the time/area closure from January through July (See Table 4.3). Of these, 1,016 (92 percent) were neonates or juveniles. Only 292 (21 percent) of all other dusky sharks were caught outside of the time/area closure (See Figure 4.2). Thus, without redistribution of effort, the total catch of dusky sharks from January through July would be reduced by 79 percent (See Tables 4.2 and 4.3).[3]

For the shorter time period, fewer dusky sharks were caught (68 from 2001-2002), but the percentage of total observed catch of dusky sharks remained high in comparison to the rest of the Atlantic and Gulf (62 percent). Thus, based on the shorter time frame, and without redistribution of effort, the catch of dusky sharks would be reduced by 62 percent (See Figure 4.3).

The number of dusky sharks observed caught and the CPUE have declined in recent years (See Table 4.5). Observed catches of dusky sharks peaked in 1998 at 298, and reached a low of 68 in 2001-2002. Although the overall number of dusky sharks observed caught in recent years has declined, the actual number caught based on expanded take estimates is much higher (See Table 4.6). The estimates of expanded takes reported in the table are similar to landings estimates for 2000-2001 from Cortes and Neer (2002) which are also shown in the table.

Of the 12,445 sandbar sharks observed caught in the Atlantic from 1994-2002, 6,755 (54 percent) were caught in the time/area closure from January through July (See Table 4.7). Of these, 4,149 (61 percent) were neonates or juveniles. When compared to the rest of the Atlantic and Gulf of Mexico, 2,647 (24 percent) of adults, 4,118 of 5,055 (81 percent) of juveniles, and 31 of 31 (100 percent) of neonate sandbar sharks were caught inside the time/area closure (See Figure 4.5). Of the sandbar sharks observed caught outside of the time/area closure, 76 percent were adults, 19 percent were juveniles and 0 percent were neonates (See Figure 4.4).

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[3] The overall number of observed dusky sharks reported in the draft Amendment was higher due to inadvertent inclusion of catches of dusky sharks in state waters. A total of 117 dusky sharks were observed caught in state waters from 1994-2002, and are not included in the present analyses.

Of the 23,814 LCS observed caught in the Atlantic from January through July 1994-2003, 10,070 (42 percent) were caught in the time/area closure (See Table 4.8). The majority of those catches occurred in January, March, and July (See Figure 4.5).

As discussed below, a potential ecological consequence of the closure may be the redistribution of fishing effort to areas adjacent to, or seaward of the closure.

Time/Area analysis with redistribution of effort

The ecological effects of redistribution of fishing effort were evaluated by determining the percent reduction in total observed Atlantic shark bottom longline catch of dusky and sandbar shark, and LCS inside and outside of the time/area closure. The method used to calculate percent changes in catch rates of dusky sharks with redistribution of effort is discussed below. The results for dusky and sandbar sharks are summarized in Tables 4.9 to 4.11 and for LCS in Tables 4.12 and 4.13. Redistribution of effort was analyzed for both the longer (1994-2002) and shorter (2001-2002) time periods.

The first step was to determine the monthly catch and effort (number of hooks) in the time/area closure and the Atlantic Ocean based on observer data in the shark bottom longline fishery. The next step was to determine the number of dusky sharks caught in the remaining open areas (E of Table), calculated by subtracting the number caught in the closed area from the entire Atlantic Ocean (B-D), excluding the Gulf of Mexico. The next step was to determine the catch-per-unit-effort (CPUE) for dusky sharks in the remaining open area. This was accomplished by dividing the number of dusky sharks caught in the open area (E) by the number of hooks fished in the open area (calculated by subtracting the number of hooks in the closed area from those Atlantic-wide; A-C). The open-area CPUE was then multiplied by the number of hooks that were used in the closed area to determine the number of additional fish that would be caught in the open fishing areas by the displaced effort (C*F), which was then added to the existing open area catch (E+G) to give a new open area total catch (I). The estimated total catch (I) was then subtracted from the original total number caught in the time/area closure (B-H) to estimate the change in number of dusky sharks that would be caught as a result of the relocated effort. Columns J and K show the cumulative number of dusky sharks avoided by the time/area closure, and the percent reduction in overall dusky shark catch as a result of the closure, respectively.

The redistribution of effort analysis indicates that despite an increase in fishing effort outside the time/area closure, the overall catch of dusky sharks would be reduced by the time/area closure. Based on the longer time period, 1,036 (74 percent) fewer dusky sharks would have been caught with the time/area closure in effect (See Table 4.9). Based on the shorter time period, 64 (55 percent) fewer dusky sharks would have been caught (See Table 4.10).

This same procedure was performed on observer data for sandbar sharks and the LCS complex. Based on observer data from 1994-2003, the catch of sandbar sharks is predicted to be reduced by 46 percent (See Table 4.11), and LCS by 28 percent (See Table 4.12). Numerically, 6,406 fewer sandbar sharks and 6,712 fewer LCS would have been observed caught during the period 1994-2003 with the time/area closure in effect. Based on the shorter time period, LCS catch would have decreased by three percent outside of the time/area closure (See Table 4.13).

Although the redistribution of effort analysis indicates that overall catch of LCS will decrease as a result of the closure, there will most likely be an increase in fishing effort outside of the closure which may result in higher catches of adult sandbar as well as other LCS in those areas, and a decline in the number of dusky sharks and juvenile sandbars being caught. The number of prohibited species caught outside of the closure is low compared to the number of prohibited species currently being caught inside the closure (See Table 4.14). Thus, prohibited species such as the sand tiger, night, and bignose sharks could potentially benefit from the closure as well.

Comparison of the original vs. the revised time/area closure

NOAA Fisheries decided to revise the time/area closure after receiving public comments that the original time/area closure did not accurately reflect declining trends in dusky shark catches and that the closure would have severe economic consequences resulting in many fishermen going out of business. NOAA Fisheries re-analyzed the data and revised the boundary as described above. NOAA Fisheries also analyzed the catches in the original time/area closure versus the revised time/area closure to determine whether the revised closure would have the intended effect of reducing dusky shark bycatch and the catch of neonate and juvenile sandbar sharks. The following data are provided to demonstrate that the revised time/area closure will still be effective in reducing the catch of dusky sharks and neonate and juvenile sandbar sharks, while allowing fishermen to continue fishing in open areas off North Carolina from January through July.

From 1994-2002, 1,103 of 1,232 (90 percent) of dusky sharks caught in the original time/area closure were also caught within the boundary of the revised time/area closure. For neonate dusky sharks, 324 of 340 (95 percent) were also caught in the revised time/area closure, 692 of 793 or 87 percent of juveniles, and 87 of 99 (88 percent) of adults were also caught in the revised time/area closure (See Table 4.15 and Figure 4.7).

For sandbar sharks, 6,796 of 8,722 (78 percent) caught in the original time/area closure were also caught in the revised time area closure. For neonate sandbar sharks, 31 of 31 (100 percent) were caught in the revised time/areas closure, 4,118 of 4,321 (95 percent) of juveniles, and 2647 of 4,370 (61 percent) of adults were caught in the revise time/area closure (See Table 4.15 and Figure 4.8). The data indicate that open areas north and south of the revised time/area closure have much lower percentages of juveniles and much higher percentages of adult sandbar sharks.

Although not very high, there is some bycatch of other species such as stingrays and teleosts associated with the bottom longline fishery. Alternative K2 would result in a decrease in bycatch of other species which would have a positive impact on their populations and the ecosystem as a whole. Although the number of marine mammals, sea turtles, and seabirds caught incidentally in the bottom longline fishery is not high, the likelihood of an encounter would be reduced by the time/area closure (See Section 3.5). This alternative is expected to have a positive effect on protected species such as sea turtles, marine mammals and seabirds.

Alternative K3 would implement the largest time/area closure(s) of all the alternatives in this document, and could result in a large reduction in the catch of neonate and juvenile sharks. It would provide less protection for juvenile sharks and pregnant females than a year-round closure in those areas identified as EFH but would still enhance rebuilding. This alternative could have a positive ecological impact on shark populations by enhancing survival of neonate, juvenile, and pregnant sharks. Although many of the areas identified as EFH are in state waters, some are located in Federal waters, and the extent of the time/area closure(s) would be considerable. This alternative could also have a positive impact on the bycatch of other fish species by closing large areas of the coast to bottom longlining during the spring pupping season. The bycatch of fish species commonly associated with the bottom longline fishery would be reduced.

Alternative K3 could also have a positive effect on marine mammals, sawfish, and seabirds. Although interactions with marine mammals, sawfish, and seabirds are rare in the shark bottom longline fishery, the possibility of an accidental encounter would be reduced if portions of the coast were closed to fishing for several months.

Social and Economic Impact

Since Alternative K1 would not impact the way fishing activities have been conducted in the past, this alternative is not expected to cause short-term social or economic impacts. There could be long-term economic impacts if the LCS stock does not rebuild and NOAA Fisheries implements measures to conserve or enhance EFH for rebuilding purposes.

Alternative K2 could have a negative social and economic impact, particularly for those fishermen in states bordering the time/area closure. The original time/area closure would have closed a significantly larger area (31,487 nm^2) to all commercial bottom longline fishing. NOAA Fisheries re-examined the data as a result of public comments that indicated the original closure was overly large and would have had severe economic impacts. NOAA Fisheries believes that the revised closure, while significantly smaller than the original area proposed (4,490 nm^2), will still be effective in reducing the overall mortality of dusky and juvenile sandbar sharks, and will also provide an opportunity for fishermen to continue fishing in North Carolina waters north and south of the closure. As a result, NOAA Fisheries believes that some of the economic impacts of the proposed closure will be mitigated.

Data from the shark observer program indicates that 99 percent of sandbar sharks caught within the closure, including juveniles, are landed and less than one percent are tagged or released as bycatch. This indicates that fishermen are selling the carcasses and deriving economic benefit, even from juvenile sharks. Fishermen could potentially benefit from catching fewer, larger sharks outside the time/area closure which would have more meat and larger fins and could command a higher price. Disposal of shark carcasses would be expected to decrease with the reduction in bycatch. However, by requiring fishermen to travel farther to fish, the cost of fuel, food and labor may increase. These increased costs may also result in higher marketing costs. The reduction in shark landings could also affect dealers, especially those who are supplied by the vessels which have historically fished in the time/area closure.

The seaward boundary of the time/area closure is approximately 20 miles from shore its closest point off Cape Hatteras, and approximately 90 miles offshore at its farthest point off Cape Fear. Based on the number of hooks observed in the Atlantic from 1994-2003, 22 percent of the fishing effort was located in the time/area closure during the months of January through July. This indicates a substantial percentage of fishermen who targeted fish in the time/area closure.

Analysis of data from the shark observer program indicates that few if any sharks have been observed caught by bottom longline vessels seaward of the time/area closure, but that sharks have been caught north and south of the time/area closure. Data from tagging studies indicates that there may be large numbers of sharks north of the time/area closure however, fishing effort has historically been low in this area. Thus, fishermen will likely choose to travel north or south, not farther offshore, to avoid the closure. Fishermen have traditionally targeted areas closest to shore near Cape Hatteras where shark concentrations are highest, and the closure would require them to adjust their fishing practices accordingly. Traveling farther from a homeport may also increase safety risk.

This alternative could impact social, economic, or cultural values of the fishing communities. North Carolina has a total of 23 directed shark fishing permits, or 9 percent of the total number of directed shark fishing permits (256 issued in 2003). In 2002, there were five directed shark fishing permits issued to vessels in Virginia, 7 in South Carolina, and 23 in North Carolina. Of these, only 8 vessels with a homeport located in North Carolina reported landings in 2001. All of these vessels and their owners, and potentially others from adjacent states who have traditionally targeted sharks in the winter fishery off of Cape Hatteras, could be impacted by the closure (See Chapter 6.9). By contrast, there are two directed shark permits in Georgia and 55 on the East coast of Florida for a combined total of 23 percent of all directed permits. Fishermen would have several alternatives: (1) leave the fishery; (2) relocate to a different homeport during the period of the closure from January to July; (3) permanently move to a new home port; or, (4) continue to fish from their current homeport with the imposed burden of further travel and increased costs.

The time/area closure does not affect incidental shark permit holders because they are having minimal or no impact on shark catches in the time/area closure. As of October 2003, a total of 37 incidental shark permits had been issued to vessels in North Carolina, Virginia, and South Carolina, and none of these vessels reported shark landings in 2001 or 2002. All of these vessels have multiple permits, and a majority (25) did not have a swordfish permit, indicating that they were targeting species such as king mackerel, Spanish mackerel, or had charter vessel permits for snapper grouper or coastal migratory pelagic species such as king and Spanish mackerel. The predominant gear types being used by these vessels are rod and reel (including downriggers), bandit gear, and/or handline gear. Based on the landings data, the species being targeted, and the gear types being used, NOAA Fisheries does not believe it would be appropriate to exclude these vessels from the time/area closure. Doing so would create additional negative economic impact that is not warranted. NOAA Fisheries may include these gear types in the future if information becomes available to indicate that they are having a negative impact on the rebuilding of LCS as a result of fishing in the time/area closure.

Fishing communities, suppliers, and dealers in the region might also be impacted by lower landings resulting in declining sales. Two fishing-dependent communities, Hatteras and Wanchese, will be directly affected by the closure (See Chapter 9). Since sharks are a relatively small component of all fish catches for these communities and the commercial fleet already fishes in areas other than the closed area, the social and cultural impacts on commercial fishermen in general, their families and communities may be mitigated to some degree. The recreational fishery and charter/headboats catch sharks as an incidental species in troll fishing, and since they are not affected by the closure, there are unlikely to be any social and cultural impacts on this fishery.

Fishermen have commented on, and observer data supports the fact that most dusky sharks are dead when caught which results in unnecessary waste when discarding carcasses. Since current regulations prohibit retention of dusky sharks there is not likely to be a major economic impact as a result of decrease in dusky shark landings. However, there may be an economic impact as a result of the reduction in catch of other LCS, particularly sandbar sharks, which are also caught in large numbers in the time/area closure.

The alternative could have an impact on enforcement costs and management effectiveness. Implementation of a Vessel Monitoring System (VMS, Alternative J4) should address potential enforcement issues involving the time/area closure. In order to effectively manage the time/area closure, a reliable enforcement system will need to be established. Costs associated with the implementation of VMS in the bottom longline fishery are discussed in a separate section (See Section 4.6.1).

Alternative K3 would result in a time/area closure for all shark nursery and pupping areas during pupping season based on EFH identifications for neonate and juvenile sharks. Due to the areas that would be closed to fishing, alternative K3 would be expected to have greater negative social and economic impacts than alternative K1 or K2. Many areas that fishermen have traditionally relied upon would be closed during peak fishing periods. This would require fishermen to travel further to fish and would increase costs associated with the fishery.

Although alternative K3 would reduce the catch of bottom longline caught neonate and juvenile sharks during the spring pupping season, it would also have a considerable negative economic impact on fishermen by closing large sections of coastal waters to shark fishing. Fishermen would be directly impacted by a reduction in catch and income from areas that they have traditionally relied upon. Since most pupping and nursery areas are nearshore, fishing practices and behavior of fishermen would also be affected by requiring fishermen to travel further offshore. Due to greater distances traveled, fishermen would spend more time at sea, and associated costs of food, fuel, and labor could increase. This could cause some fishermen to go out of business, move to new areas, or alter fishing patterns in other ways. This alternative could result in a change in the distribution of benefits and costs, with the financial costs of operating in the fishery increasing and benefits decreasing.

Conclusion

Alternative K2 is the preferred alternative because it significantly reduces the bycatch of dusky sharks and the catch of neonate and juvenile sandbar sharks and is expected to help rebuild overfished LCS consistent with the LCS stock assessment recommendations and National Standard 9 of the Magnuson-Stevens Act. Certain management measures have been implemented for the LCS complex as a whole, such as counting dead discards and state landings after Federal closures against Federal quotas, trip limits, and prohibiting possession of certain shark species including dusky sharks. However, the time/area closure is a specific measure to reduce fishing impacts in a known shark nursery and pupping area. The action would reduce the landings, bycatch, and discards of neonate and juvenile dusky and sandbar sharks, as well as other prohibited species. Although the closure could have substantial economic impacts on fishermen in states adjacent to the area, overall economic impacts may be mitigated by fishermen traveling outside of the closed area to fish.

The time/area closure is one of the few areas in the Atlantic and Gulf of Mexico where large numbers of juvenile sharks of more than one species are caught in EFH and HAPC areas in Federal waters. Additionally, given the limited degree of nursery and pupping areas in Federal waters, this action is necessary to reduce the level of fishing mortality on these vulnerable life stages. Many Atlantic and Gulf of Mexico states have recently implemented or are considering implementing more restrictive shark harvest regulations, including fishery closures. NOAA Fisheries intends to keep working with the Atlantic and Gulf states to implement sharks harvest regulations that will meet conservation objectives.

Based on public comments that NOAA Fisheries should consider a clear exit strategy for the time/area closure, NOAA Fisheries will be reviewing the status of both dusky and sandbar sharks, the two species most affected by the time/area closure, in the near future. Based on the status of those stock assessments, NOAA Fisheries may consider revising the size and scope of the closure, the duration of the closure, and potentially elimination of the closure.

4.7 ESSENTIAL FISH HABITAT

As described in Chapter 2, the alternatives considered for identification of Essential Fish Habitat are:

L1 Maintain current EFH identified areas (No Action)
L2 Identify EFH for the fishery management unit (FMU) based on the entire geographic range of the species
L3 Existing EFH and, as appropriate, identify EFH for the FMU for each species and life stages as those habitats necessary for spawning, breeding, feeding, or growth to maturity
L4 *Existing EFH and, as appropriate, increase or decrease the EFH areas identified for individual species in the FMU based on special needs* **-** *Preferred Alternative*

The preferred alternatives is L4.

Ecological Impacts

There are no direct ecological impacts associated with the designation of EFH. However, depending on the alternative selected, and the actions taken by NOAA Fisheries to improve the conservation and enhancement of EFH, the range of positive ecological impacts may vary. The geographic size and location of EFH could influence the number of Federal agency actions that may adversely affect EFH and hence trigger the consultation process. For example, alternative L2 would result in a larger EFH area than either alternative L3 or L4, and as a result a greater number of Federal Actions might require consultation under L2 than L3 or L4. The resulting actions taken to minimize impacts based on the conservation recommendations provided in Chapter 10 could have important ecological consequences on EFH. Similarly, if NOAA Fisheries were to take actions to conserve or enhance EFH based on alternative L2, the ecological impact would be greater, in a positive sense, than it would be under alternative L3 or L4.

Alternative L1, the no action alternative, would maintain the current EFH identified areas. This is the alternative the fishery has been operating under since the 1999 HMS FMP. Since the 1999 HMS FMP, several shark species have had a change in stock status. For instance, the stock assessment for sandbar sharks indicated that the stock was overfished in 1998 but not overfished in 2002. Similarly the stock assessment for blacktip shark indicated that the stock was overfished in 1998 and rebuilt in 2002. The change in status of these species and the availability of new information justifies a review and update of areas currently identified as EFH. The geographic scope of EFH identified under this alternative would be less than either alternative L2 or L3 and potentially similar to L4. As discussed below, alternative L4 would not change the current EFH area unless new information indicated that a change was necessary. Thus, the positive ecological impacts associated with this alternative would be less than alternative L2 and L3, and potentially similar to L4, depending upon geographic scope of EFH identified under alternative L4 and potential future actions taken by NOAA Fisheries to conserve and enhance EFH.

Alternative L2 would identify EFH for the fishery management unit (FMU) based on the entire geographic range of the species. This alternative would implement the most precautionary approach to identifying EFH, and if future management measures were based on EFH identifications, would result in the largest area to be considered. This alternative would not be as effective as alternatives L3 and L4 because information is available to narrow the geographic extent of EFH. Information from fishery dependent and independent datasets such as research and tagging studies, the shark observer program, and expert opinion are available with which to refine the areas identified as EFH, and which represent a subset of the geographic range of the species. However, this alternative could potentially result in the largest positive ecological impacts because the area encompassed is greater than any other area. Under this alternative a large portion of the EEZ could be identified as EFH.

Alternative L3 would identify EFH for each species and life stage as those habitats necessary for spawning, feeding, breeding, or growth to maturity, based on new information made available since the 1999 HMS FMP. If no new information is available, then the existing EFH areas (Alternative L1) would be retained. This alternative would include 100 percent of the species' observed distribution, as opposed to alternative L2 which represents 100 percent of the entire geographic range. Thus, this alternative represents an area reduced in size from alternative L2. The basis for this alternative is to evaluate each species and life stage individually to ultimately comprise the EFH identification for the fishery. This alternative would identify a subset of the entire geographic range of the species which encompasses those habitats considered most important to spawning, breeding, feeding and growth to maturity. This would result in a higher degree of confidence that the area is EFH and does not include marginal habitat. From a management perspective, a narrowing of EFH as described above, could result in a higher level of protection and a greater ability to enhance and conserve EFH.

Alternative L4 would begin with 100 percent of the observed distribution in alternative L3 and increase or decrease the geographic scope of EFH for each species in the FMU based on the specific needs of the species. If no new information is available, the existing EFH identifications would be maintained. Under this alternative, flexibility would be provided to increase or decrease the geographic extent of EFH based on the status of the stock. Since overfished resources are considered to be at greater risk, the percentage of habitat identified as EFH would be greater than that of fully fished or not overfished species. For species that are not overfished, the EFH area could be refined to those areas considered essential and not beyond. In some cases, this alternative could result in the same identifications as alternative L3. NOAA Fisheries believes that a more refined approach to identifying EFH would afford greater protection because conservation measures could be better tailored to meet the needs of particular species.

The method used to identify EFH under alternative L4 is described in detail in Chapter 10. In summary, the observed distribution points for each species and life stage were plotted on a 10 by 10 minute grid covering the Atlantic and Gulf of Mexico and analyzed using a Geographic Information System. The number of observations per grid was used as a guide to identify potential EFH, and the resulting percentages of observed distribution points included in EFH under alternative L4 are provided in Table 10.1. The percentages indicate that this alternative resulted in an average of 77 percent of all species' observed distributions being identified as EFH. For all species, the percentage of observed distribution included in EFH was highest for neonate and juvenile life stages and lowest for adults. This is believed to be the result of neonate and juvenile shark tendency to aggregate in coastal pupping and nursery areas, whereas adults are more widely dispersed in coastal and offshore areas. Although there are no direct ecological impacts resulting from this alternative, the methodology used here to identify EFH could be important in providing the basis for future management actions taken to conserve and enhance EFH.

Alternative L4 is preferred because it provides an objective way of identifying EFH, and because it allows for the expansion or contraction of EFH for a vulnerable life stage or species based on the status of a particular species or life stage. For example, for overfished species, 90 percent of the range of distribution could hypothetically be identified as EFH, and for a species that is not overfished, 75 percent of the range of distribution might be identified as EFH. Using a similar approach, the frequency of occurrence of a particular species or life stage in a particular habitat type could be established to further refine and narrow the range of EFH and possibly form the basis for identifying Habitat Areas of Particular Concern (HAPCs). Even though assigning percentages or frequency of occurrence to a given species' distribution provides an objective way of identifying EFH, depending upon the frequency of distribution selected, important habitat could be excluded, or marginal habitat could be included. The former could have a negative impact on the species if management actions were taken to conserve EFH, and the latter could potentially have a slightly positive but no negative impact.

Alternative L4 would likely result in smaller EFH areas than either alternatives L2 or L3. However, as described in more detail in Chapter 10, the areas identified as EFH under this alternative are still quite large and are based upon the best scientific information available and expert opinion. All of the alternatives would have a positive ecological impact once management actions are taken to conserve, enhance, and minimize fishing and non-fishing impacts on EFH.

Social and Economic Impacts

There are no direct social or economic impacts associated with the alternatives for identifying EFH. Similar to the discussion above on ecological impacts, there may be social and/or economic impacts that result from management actions (i.e. time/area closures) taken to conserve, enhance, or mitigate fishing impacts on EFH. Depending on the geographic scope of the area identified as EFH, the potential management measures could have social and economic impacts to a greater or lesser degree. For example, the number of Federal actions that may adversely affect EFH and thus trigger consultation and/or conservation recommendations would likely be greater if larger areas were identified as EFH. Conversely, by refining the scope of EFH, management measures could be tailored to specific areas and would result in less negative economic impact, or potentially positive economic impacts depending on the outcome of the action. The nature and degree of economic and/or social impacts would not be known until specific management actions are proposed and analyzed.

Conclusion

Alternative L4 is the preferred alternative because it provides the full range of options that NOAA Fisheries believes are necessary to thoroughly and accurately identify EFH. Under this alternative, the existing EFH identifications would remain in effect until NOAA Fisheries completes the five year review in 2004 of EFH for all HMS not covered under this FMP Amendment. Alternative L4 provides NOAA Fisheries with the flexibility to update and refine EFH identified in the 1999 HMS FMP based on the latest scientific information. NOAA Fisheries does not believe that this alternative will have negative ecological, economic, or social impacts. These actions would help identify EFH areas for managed species and thus lead to measures that may reduce impacts to EFH, particularly for neonate and juvenile life stages, but also prohibited species.

4.8 EXEMPTED FISHING PERMITS (EFP) ADMINISTRATION

As described in Chapter 2, the alternatives considered for EFP administration are:

M1 Maintain combined permitting system for scientific research and display - (No Action),
M2 *Develop separate display permitting system, apart from research - Preferred Alternative.*

Alternative M2 is the preferred alternative.

Ecological Impacts

Alternatives M1 and M2 propose different EFP administration systems. Alternative M1 would maintain a combined permitting system for scientific research and educational/public display. This alternative has been in place since 1999. By comparison, alternative M2 will require creation and implementation of a separate display permitting system, which will operate apart from exempted fishing activities focusing on scientific research. Under both alternatives, the quota of 60 mt ww for the purpose of public display and exempted fishing activities would remain. NOAA Fisheries will continue to examine the appropriate nature of this quota over time.

Since neither of these alternatives are anticipated to result in a change in fishing practices or fishing effort, there are no anticipated ecological impacts associated with implementation.

Social and Economic Impacts

No social or economic impacts are anticipated to result from implementation of either of the alternatives listed above as these options deal primarily with the administration system under which the activities will be permitted.

Conclusion

Alternative M2 (i.e., develop separate display permitting system, apart from research) is the preferred alternative because administration of public display permits will be streamlined. Implementation of this alternative will not result in any ecological, economic, or social impacts.

4.9 IMPACTS ON ESSENTIAL FISH HABITAT

The Magnuson-Stevens Act requires that NOAA Fisheries evaluate the potential adverse effects of fishing activities on EFH and must include management measures that minimize adverse effects to the extent practicable. At this time, there is no evidence that physical effects caused by fishing under this FMP are adversely affecting shark EFH to the extent that detrimental effects can be identified on the habitat or the fisheries. Most of the preferred alternatives, such as shark classification (aggregating LCS and having one closure date), quota administration (establishing regional quotas and trimester seasons), quota basis, and recreational management measures will have no direct impact on EFH. The time/area closure will reduce fishing mortality on the prohibited dusky shark and juvenile sandbar sharks, but is not expected to have a direct impact on EFH. Further discussion of EFH is provided in Chapter 10.

4.10 IMPACTS ON PROTECTED SPECIES

Management measures selected in Amendment 1 are not expected to have an adverse impact on protected species. Protected resources of greatest concern in the shark fishery are endangered right whales and sea turtles. Several management actions are being taken to minimize impacts and reduce the bycatch of these species. For example, non stainless steel corrodible hooks are selected for the directed shark bottom longline fishery which will minimize impacts to protected species such as sea turtles if they are accidentally hooked. De-hooking equipment designed to safely release incidentally caught sea turtles is also being selected. Finally, although the time/area closure should reduce the bycatch of prohibited species such as the dusky shark, it may have the added benefit of reducing potential encounters with protected species as well. A requirement to have VMS on directed shark bottom longline vessels should aid NOAA enforcement of the time/area closure.

4.10.1 Conclusions of the October 2003 Biological Opinion

A new Biological Opinion for Atlantic shark fisheries was prepared in October of 2003 in response to the proposed measures in Amendment 1 (NOAA Fisheries, 2003). It concluded that the continued operation of the shark fisheries as amended by the actions in Amendment 1 would not adversely affect marine mammals. However, other protected resources, specifically sea turtles and smalltooth sawfish, may be affected by the selected actions in Amendment 1, although the actions are not likely to appreciably reduce either the survival or recovery of loggerhead, Kemp's ridley, green, hawksbill or leatherback sea turtles in the wild by reducing their reproduction, numbers, or distribution (NOAA Fisheries, 2003). These species are found throughout all or a portion of the action area, defined as the U.S. Atlantic, Gulf of Mexico, and Caribbean EEZ. Sea turtles and smalltooth sawfish have been documented as taken incidentally in one or more components of the Atlantic shark fishery. Background information on the range-wide status of these species can be found in a number of published documents, including: recovery plans for loggerhead sea turtle (NMFS and USFWS, 1991a), Kemp's ridley sea turtle (USFWS and NMFS, 1992), green sea turtle (NMFS and USFWS, 1991b) and leatherback sea turtle (NMFS and USFWS, 1992); sea turtle status reviews and biological reports (NMFS and USFWS, 1995; Marine Turtle Expert Working Group (TEWG), 1998 & 2000; NMFS, 2001a), and the smalltooth sawfish status review (available online at http://www.nmfs.noaa.gov/prot_res/PR3/status_reviews.html).

The species of sea turtles that are expected to be affected by the selected alternatives in Amendment 1 are all highly migratory. NOAA Fisheries believes that no individual members of any of the species are likely to be year-round residents of the action area. Individual animals will make migrations into nearshore waters as well as other areas of the North Atlantic Ocean, Gulf of Mexico, and the Caribbean Sea. Therefore, the range-wide status of the affected species of sea turtles most accurately reflects the species' status within the action area.

Smalltooth sawfish are not highly migratory species, although some large, mature individuals may engage in seasonal north/south movements. The U.S. Distinct Population Segment (DPS) of smalltooth sawfish is confined to only a small portion of the action area, mainly waters off Florida and possibly occasionally off Georgia. Only large, mature individuals are known to occur in the action area. Information is not available regarding how much time smalltooth sawfish of different sizes spend at different depths. Generally smaller (younger) animals are restricted to shallower waters, whereas large animals are believed to roam over a larger depth range. The smalltooth sawfish may only be present in the U.S. EEZ intermittently, spending the rest of their time in shallower waters. Based on this information, the range-wide status of smalltooth sawfish most accurately reflects the species' status within the action area.

Sea turtles can be captured as a result of the use of bottom longlines, gillnets and rod and reel/handline fishing gear. Captured turtles can be released alive uninjured or can be killed as a result of the interaction. Some turtles that are released alive from bottom longline gear may die later as a result of the ingestion of a hook, endangerment in the gear, or the trailing of gear that was not cut away prior to release. There are detailed descriptions of how these gears affect sea turtles including a detailed discussion on post release mortality of sea turtles in the June 19, 2001, Opinion on the Reinitiation of Consultation on the Atlantic Highly Migratory Species Fishery Management Plan and its Associated Fisheries (NMFS, 2001b).

Smalltooth sawfish can also be captured as a result of the use of bottom longlines, gillnets and rod and reel/handline. The October 2003 Biological Opinion for Atlantic shark fisheries represents the first federal fishery to undergo formal consultation for this species (NOAA Fisheries, 2003).

4.10.2 Protected Species Takes in the Shark Bottom Longline Fishery

In the bottom longline fishery a total of 43 sea turtles were observed caught from 1994 through 2002 based on 862 observed sets (Figures 3.9 and 3.10) (Burgess and Morgan, 2003; NOAA Fisheries, 2003). Of the 43 sea turtles observed, 31 were loggerhead sea turtles of which 17 were released alive. Another nine loggerheads were released in an unknown condition and five were released dead. Based on extrapolation of observer data and reported effort from the logbook data, it was estimated that a total of 2,003 loggerhead sea turtles were taken in the shark bottom longline fishery from 1994 through 2002 (NOAA Fisheries, 2003). An additional 503 unidentified sea turtles were estimated to have been taken. On average, 222 loggerhead sea turtles and 56 unidentified sea turtles were taken annually during this time period in the shark bottom longline fishery.

The estimated takes in the 2003 BiOp do not discriminate between live and dead releases. However, of the observed takes, 23 percent were lethal. Based on this information it is estimated that 51 loggerhead turtles (222 x 0.23) will be killed as a result of an interaction with a bottom longline. The highest estimate of post release mortality is 42 percent (NMFS, 2001b). This is for turtles that ingested a hook (the percent mortality is lower depending on how the animal was hooked). Being conservative and assuming that all animals ingest the hook, 42 percent of the animals released alive will die as a result of their interaction with the longline. This means that another 72 loggerhead sea turtles (222-51=171, then 171 x 0.42) will be killed. Therefore, it is estimated that 123 loggerheads (72 + 51) will be killed per year (NOAA Fisheries, 2003).

Four of the 43 observed sea turtles taken in the bottom longline fishery were leatherback sea turtles; three of these were released in an unknown condition and one was released dead. Based on these observations, it was estimated that 269 leatherback sea turtles were taken in the shark bottom longline fishery during 1994 through 2002 (NOAA Fisheries, 2003). On average, 30 leatherback sea turtles each year were taken by the shark bottom longline fishery during 1994 through 2002. These take estimates do not discriminate between live and dead releases. Of the observed leatherback takes, 25 percent were lethal. Applying the observed leatherback mortality rate of 25 percent to the total leatherback takes and an additional 42 percent for post-release mortality to the remaining, results in a total of 17 leatherbacks killed per year. The leatherback mortality is very conservative because it is known that leatherbacks rarely ingest or bite hooks, but are usually foul hooked on their flippers or carapaces, reducing the likelihood of post-hooking release mortality. However, leatherback-specific data for this fishery are not available and therefore the most conservative estimate is used.

Smalltooth sawfish have also been observed caught (seven known interactions, six released alive, one released in unknown condition) in shark bottom longline fisheries from 1994 through 2002 (See Figure 3.11) (Morgan pers. comm., 2003). Based on extrapolation of these observations, expanded sawfish take estimates for 1994 through 2002 were developed for the shark bottom longline fishery (NOAA Fisheries, 2003). A total of 466 sawfish were estimated to have been taken in this fishery during 1994-2002, resulting in an average of 52 per year. Additionally, it is important to note that all of the sawfish takes observed, except for one, were released alive. Under current observer coverage, an observed interaction with a sawfish is a rare event. The observer data, in combination with anecdotal information collected in databases, indicate that lethal takes may be extremely rare, but more data is needed to confirm such a finding. The estimates of lethal and non-lethal takes would be greatly improved with more observer coverage. NOAA Fisheries presently has no data to indicate that lethal takes occur. Based on this information NOAA Fisheries expects no smalltooth sawfish will be killed as a result of the measures selected in Amendment 1 over the next five years.

4.10.3 Protected Species Takes in the Shark Gillnet Fishery

In the shark gillnet fishery, loggerhead sea turtles are rarely caught. During the 1999 right whale calving season no loggerhead sea turtles were caught in this fishery (Carlson and Lee, 1999). No loggerhead sea turtles were observed caught with strikenets during the 2000-2002 right whale calving seasons (Carlson, 2000; Carlson and Baremore, 2001; Carlson and Baremore, 2002a). However, three loggerhead sea turtles have been observed caught with drift gillnets during right whale calving season, one each year from 2000 to 2002 (See Table 3.39) (Carlson, 2000; Carlson and Baremore, 2001; Carlson and Baremore, 2002a; Garrison, 2003).

During the 2000 and 2001 non-right whale calving seasons, no loggerhead sea turtles were observed caught in gillnets fished in a strikenet method while one loggerhead sea turtle was observed caught and released alive in gillnets fished in a driftnet method (See Table 3.39) (Carlson and Baremore, 2001). No loggerhead sea turtles were caught outside of the right whale calving season in 2002 (Carlson and Baremore, 2002b).

Expanded take estimates for sea turtles were developed for the shark drift gillnet fishery. Estimates were based on the analysis of observer data from the NOAA Fisheries' Southeast Fisheries Science Center. Observer data gathered from 1999-2002 were used to estimate takes in the drift gillnet fishery. Prior to 1999, observer coverage was limited and inconsistent, but since 1999, a much higher degree of observer coverage has occurred, including very high coverage in the southern Florida area during the right whale calving season (November 15 - March 30) when sea turtle takes are known to be much more likely. The estimated takes of loggerhead sea turtles by year, were as follows: 1999 - none; 2000 - one mortality and 4.4 live takes; 2001 - one live take; and 2002 - 1.7 live takes (NOAA Fisheries, 2003).

Because of the high degree of variability in takes which is associated with variability in water temperatures, sea turtle abundances, and other factors that cannot be predicted, a 5-year estimated take was utilized for the incidental take statement (ITS) instead of a 1-year average estimated take. Over a 5-year period the expected take of loggerhead sea turtles from the drift gillnet fishery would be 10 total captures of which one would be expected to be killed (NOAA Fisheries, 2003).

In the shark gillnet fishery, leatherback sea turtles are sporadically caught. During the 1999 right whale calving season, two leatherback sea turtles were caught in this fishery, and both were released alive (Carlson and Lee, 1999). No leatherback sea turtles were observed caught with strikenets during the 2000 - 2002 right whale calving seasons (Carlson, 2000; Carlson and Baremore, 2001; Carlson and Baremore, 2002a). Leatherback sea turtles have also been observed caught with gillnets including fourteen in 2001 and two in 2002 (See Table 3.39) (Carlson, 2000; Carlson and Baremore, 2001; Carlson and Baremore, 2002a; Garrison, 2003). NOAA Fisheries temporarily closed the shark gillnet fishery (strikenetting was allowed) from March 9 to April 9, 2001, due to the increased number of leatherback interactions that year (66 FR 15045, March 15, 2001).

During the 2000 and 2001 non-right whale calving seasons, no leatherback sea turtles were observed caught in gillnets fished in strikenet or driftnet methods (Carlson and Baremore, 2001). No leatherback sea turtles were caught outside of the right whale calving season in 2002 (Carlson and Baremore, 2002b).

The estimated takes of leatherback sea turtles by year were as follows: 1999 - none; 2000 - none; 2001- two mortalities and 12 live takes; and 2002 - 3.4 live takes (NOAA Fisheries, 2003). Because of the high degree of variability in takes which is associated with variability in water temperatures, sea turtle abundances, and other factors that cannot be predicted, a 5-year estimated take was utilized for the incidental take statement (ITS) instead of a 1-year average estimated take. Over a 5-year period the expected take of leatherback sea turtles from the drift gillnet fishery would be 22 total captures of which three would be expected to be killed (NOAA Fisheries, 2003).

To date there has been only one observed catch of a smalltooth sawfish in shark gillnet fisheries. The sawfish was taken on June 25, 2003 in a gillnet set off of southeast Florida and it was released alive (Carlson pers. comm., 2003). The set was characteristic of a typical drift gillnet set, with gear extending 30 to 40 feet deep in 50 to 60 feet of water. Prior to this event it was speculated that the depth at which drift gillnets are set above the sea floor may preclude smalltooth sawfish from being caught. Although sometimes described as a lethargic demersal species, smalltooth sawfish feed mostly on schooling fish, thus they would occur higher in the water column during feeding activity. In fact, smalltooth sawfish and Atlantic sharks may be attracted to the same schools of fish, potentially making smalltooth sawfish quite vulnerable if present in the area fished. The previous absence of smalltooth sawfish incidental capture records is more likely attributed to the relatively low effort in this fishery and the rarity of smalltooth sawfish, especially in Federal waters. These factors may result in little overlap of the species with the gear.

The recently observed smalltooth sawfish was cut from the net and released alive with no visible injuries. This indicates that smalltooth sawfish can be removed safely if entangled gear is sacrificed.

As discussed in the proposed action, gillnets are also used to “strikenet”. When strike gillnetting fishers target and encircle specific schools of sharks after visually detecting them (usually by spotter pilot). Given the large and or distinct morphology of smalltooth sawfish, this species would likely be detected visually, as well as distinguished from shark species, thus avoided. This fishing method has been shown to also reduce potential encounters by limiting the time that gear is in the water. Strike gillnet sets are typically only one to two hours in contrast to six to 10 hours for each drift gillnet set. Endangered and threatened species, or protected marine mammals for that matter, have never been observed taken in strikenet sets.

Given the high rate of observer coverage in the shark gillnet fishery, NOAA Fisheries believes that smalltooth sawfish takes in this fishery are very rare. The fact that there were no smalltooth sawfish caught during the year 2001, when 100 percent of the fishing effort was observed, indicates that smalltooth sawfish takes (observed or total) most likely do not occur on annual basis. Based on this information, NOAA Fisheries believes that one incidental capture of a sawfish (released alive) over the next five years, will occur as a result of the use of gillnets in this fishery (NOAA Fisheries, 2003).

4.10.4 Protected Species Taken in Rod and Reel/Handline Fisheries

Sea Turtles

Recreational fishermen targeting sharks generally use bait and hook. Sea turtles are known to take baited hooks. NOAA Fisheries has no data specifically showing that sea turtles are taken by recreational anglers fishing for sharks. Most recorded sea turtle captures by recreational fishermen occur off fishing piers where sea turtles are known to frequent due to lighting and the concentration of bait. There were no sea turtles caught during the June Gulf Coast Shark Census held each year between 1991 and 1999 (operating out of Sarasota) which happens offshore and not on fishing piers. The selected measures in Amendment 1 pertain to recreational shark fishing in Federal waters. Based on the information above NOAA Fisheries believes that the chances of a recreational shark fishermen catching a sea turtle in Federal waters is discountable (NOAA Fisheries, 2003).

Smalltooth Sawfish

Smalltooth sawfish are known to be occasionally hooked with rod and reel and/or handline during recreational fishing. These captures occur most frequently in state waters in the vicinity of the Everglades National Park and Florida Bay, where the current population is concentrated. North of this area, the number of reported captures declines greatly. The National Park Service, Everglades National Park, monitors fishing activity and harvest in this area in part by conducting interviews with anglers and fishing guides at local boat ramps. These interviews indicate that the majority of anglers do not try to catch any particular kind of fish. Target species of the minority group that did try to catch a particular type, however, included snook, spotted sea trout, red drum, and tarpon. Thus the vast majority of incidental smalltooth sawfish captures are not from shark fishing.

The only indication that smalltooth sawfish may be occasionally hooked by a fishermen targeting sharks stems from the June Gulf Coast Shark Census between 1991 and 1999. Five smalltooth sawfish were captured and released in 20,000 line hours of recreational fishing effort. The captures, however, were all from either inside the barrier islands or just offshore from barrier islands, along the southwest Florida coast between Cape Romano and Saint Petersburg; thus all within state waters.

Given the overall scarcity of smalltooth sawfish encounters in state waters where this species is believed to occur in greater abundance and density, the chances of a smalltooth sawfish being encountered during recreational fishing in Federal waters are extremely rare. The MRFSS database has no records of smalltooth sawfish captured in Federal waters, let alone one during fishing targeting sharks. Therefore, NOAA Fisheries believes that the chances of a recreational shark fisherman catching a smalltooth sawfish in Federal waters are discountable (NOAA Fisheries, 2003).

4.10.5 Effects of the Selected Measures

The selected alternative to reduce the LCS commercial quota from 1997-2002 levels, resulting in a 45 percent reduction, is expected to reduce fishing effort for the shark bottom longline fishery. Effort reductions are not expected in the shark gillnet fishery because it primarily targets SCS and drift gillnet fishing will not be eliminated under Amendment 1. The 2003 Biological Opinion for the Atlantic shark fishery found that the reduction in bottom longline effort may result in a reduction of the number of sea turtle interactions (NOAA Fisheries, 2003). NOAA Fisheries has no way of quantifying the effect on sea turtles at this time. Any such effort reductions will only reduce smalltooth sawfish interactions if effort reductions occur in the southern fishing areas where smalltooth sawfish are known to occur.

NOAA Fisheries has also selected alternatives to implement a time/area closure off of North Carolina and require vessel monitoring systems on gillnet and bottom longline vessels. Although the time/area closure is expected in part to reduce the bycatch of prohibited species such as the dusky shark, the 2003 BiOp found it may have the added benefit of reducing potential sea turtle interactions (NOAA Fisheries, 2003). This benefit depends however, on how much effort reduction actually results from this action. Most bottom longline fishermen tend to fish close to their home port, so if redistribution of effort does occur, the effort is expected to redistribute to areas adjacent to or seaward of the closure. Sea turtle interactions may occur in these areas as well, thus reduced sea turtle interactions may not be realized if effort is merely redistributed. The time/area closure occurs north of where smalltooth sawfish occur, thus will provide no benefit to smalltooth sawfish. Conversely, should effort redistribute to the southern fishing grounds, smalltooth sawfish interactions could potentially increase as a result of the time area closure. Based on the expected area of any effort redistribution, however, NOAA Fisheries believes the time/area closure will have no smalltooth sawfish impacts (NOAA Fisheries, 2003).

The requirement to have VMS on directed shark gillnet and bottom longline vessels will aid in enforcement of the time/area closure. Additionally, this measure could lead to improvements in effort data in this area which is used in estimating takes of protected species. Any such improvements however, would only potentially benefit sea turtles, as again this would be in areas outside the range of smalltooth sawfish.

NOAA Fisheries is not reducing the recreational bag limit but is working towards increasing compliance with existing regulations. NOAA Fisheries is also restricting the authorized gear in the recreational fishery to handline and rod and reel. Post-release mortality of these gear types is lower than that of traditional commercial gears such as bottom longline or gillnet. Since these gears are presently not used in recreational fishing, little benefit to sea turtles and smalltooth sawfish is expected.

Some of the regulations in Amendment 1 were specifically designed to reduce, to the extent practicable, bycatch and bycatch mortality of sea turtles and marine mammals. These alternatives include; requiring the use of corrodible hooks, de-hooking devices (once a de-hooking device is approved), dipnets, and line cutters on bottom longline vessels (similar to the requirements for pelagic longline vessels); and requiring bottom longline vessels to move 1 nmi after an interaction with a protected species (also similar to the requirement for pelagic longliners). The 2003 BiOp found these measures are expected to have a positive impact on protected species (NOAA Fisheries, 2003). Additionally, the 2003 BiOp concluded that non-stainless steel corrodible hooks for the directed shark bottom longline fishery will minimize impacts to sea turtles and smalltooth sawfish if they are accidentally hooked. De-hooking equipment should also safely release incidentally caught sea turtles.

4.10.6 Cumulative Effects

Cumulative effects are the effects of future state, local, or private activities that are reasonably certain to occur within the action area and were considered in the 2003 BiOp (NOAA Fisheries, 2003). Federal actions that are unrelated to the proposed action were not considered in the 2003 BiOp because they require separate consultation pursuant to Section 7 of the ESA.

The 2003 BiOp found that within the action area, major future changes are not anticipated in the ongoing human activities described in the environmental baseline (NOAA Fisheries, 2003). The present, major human uses of the action area–commercial and recreational fishing (that affect sea turtles and smalltooth sawfish) and recreational beach use and boating (that affect sea turtles)–are expected to continue at the present levels of intensity in the near future.

Beachfront development, lighting, and beach erosion control are ongoing activities along the Atlantic and Gulf coasts. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, as conservation awareness spreads, more and more coastal cities and counties are adopting more stringent measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

State-regulated commercial and recreational fishing activities in Atlantic Ocean and Gulf of Mexico waters currently result in the incidental take of threatened and endangered species. It is expected that states will continue to license/permit large vessel and thrill-craft operations which do not fall under the purview of a Federal agency, and issue regulations that will affect fishery activities. Any increase in recreational vessel activity to include fishing in inshore and offshore waters of the Gulf of Mexico and Atlantic Ocean will likely increase the number of turtles and sawfish taken by injury or mortality in vessel collisions (in the case of turtles). Recreational hook-and-line fisheries have been known to lethally take sea turtles and smalltooth sawfish (when intentional, otherwise non lethal). Future cooperation between NOAA Fisheries and the states on these issues should help decrease take of sea turtles and sawfish caused by recreational activities. NOAA Fisheries will continue to work with coastal states to develop and refine ESA Section 6 agreements and Section 10 permits to enhance programs to quantify and mitigate these takes.

4.10.7 Conclusion of the 2003 HMS Biological Opinion

Sea Turtles

With the exception of the northern nesting population of loggerheads, nesting for loggerheads, Kemp's ridley, green, and leatherback sea turtles have been increasing or remaining stable in the southeastern United States and Rancho Nuevo, Mexico (in the case of Kemp's ridleys). These population increases have occurred despite the take levels associated with the shark fisheries. The 2003 BiOp found that Amendment 1 is not expected to significantly change this fishery's effects on sea turtles (it most likely will decrease the number of lethal takes to an as of yet undetermined level) (NOAA Fisheries, 2003). Based on information presented in the Environmental Baseline section of the 2003 BiOp and the analysis in the December 2, 2002, BiOp on the shrimp fishery (for which the entire HMS fishery was part of the baseline), the increase in TED opening sizes associated with the final TED rule, published in the *Federal Register* on February 21, 2003 (68 FR 8456), is expected to allow the northern nesting population of loggerheads, as well as the other turtle populations, to increase. Therefore, the 2003 BiOp found that the effects of the actions are not likely to appreciably reduce either the survival or recovery of loggerhead, Kemp's ridley, green, hawksbill or leatherback sea turtles in the wild by reducing their reproduction, numbers, or distribution (NOAA Fisheries, 2003). In particular, the 2003 BiOp determined that the activities associated with the selected actions, when added to ongoing activities affecting these species in the action area and the cumulative effects (See

Section 4.10.6), to affect sea turtles in a way that reduces the number of animals born in a particular year (i.e., a specific age-class), the reproductive success of adult sea turtles, or the number of young sea turtles that annually recruit into the adult breeding population. Based on these facts, the 2003 BiOp concluded that the selected actions are not likely to jeopardize the continued existence of the endangered Kemp's ridley, green, hawksbill, and leatherback sea turtles, and the threatened loggerhead sea turtle (NOAA Fisheries, 2003). Critical habitat has not been designated for these species in the action area; therefore, none will be affected.

Smalltooth sawfish

The 2003 BiOp found that although Atlantic shark fisheries would result in the temporary disturbance of behavior and short term injury (in the case of bottom longline hooking) of smalltooth sawfish, based on available information, the activities are not expected to affect the reproduction of the individuals that are caught, nor result in mortality (NOAA Fisheries, 2003). Based on this information, Atlantic shark fisheries would not affect reproduction, numbers, or distribution of wild populations of smalltooth sawfish. Therefore the selected actions will not reduce the smalltooth sawfish populations' likelihood of surviving and recovering in the wild. Thus, the 2003 BiOp concludes that the selected actions in Amendment 1 are not likely to jeopardize the continued existence of smalltooth sawfish (NOAA Fisheries, 2003).

4.10.8 Incidental Take Statement

Anticipated Amount or Extent of Incidental Take

Based on observer data, observed and self-reported effort data, and the distribution and density of sea turtles in the action area, NOAA Fisheries anticipates that the continued prosecution of the Atlantic shark fisheries under the HMS FMP, including implementation of Amendment 1 may result in take (NOAA Fisheries, 2003). Currently available information on the relationship between sea turtles and sawfish and the Atlantic shark fishery indicates that injury and/or death of sea turtles and smalltooth sawfish is likely to occur. Therefore, pursuant to section 7(b)(4) of the ESA, the 2003 BiOp anticipates an actual 5-year total incidental take for the Atlantic shark fishery of:

- 172 leatherback turtles, of which 88 will be lethal.
- 1370 (1120 + 250 of the expected 280 unidentified, which are most likely loggerhead turtles) loggerhead turtles of which 755 will be lethal.
- 30 total in any combination of hawksbill, green, and Kemp's ridley (remaining 30 of the expected 280 unidentified), with 5 lethal takes per species.
- 261 smalltooth sawfish, of which no lethal takes are expected.

The above take estimates were further broken down by gear type. These limits represent the number of total estimated takes, based on observed takes extrapolated across total effort levels for this fishery. Each gear type must be considered independently, and if the actual calculated incidental captures or mortalities exceed the amount estimated below for a gear type, the 2003 BiOp specifies that formal consultation for that gear type must be re-initiated immediately (NOAA Fisheries, 2003). The take estimates by gear type are as follows:

Bottom Longline Gear

Species	Total Takes (5-year)	Mortalities (5-year)
Loggerhead sea turtle	1360	754
Leatherback sea turtle	150	85
Other sea turtle species (green, Kemp's ridley, or hawksbill)	30 (combined for all species)	5 (5 per species)
Smalltooth sawfish	260	0

Drift Gillnet Gear

Species	Total Takes (5-year)	Mortalities (5-year)
loggerhead sea turtle	10	1
leatherback sea turtle	22	3
smalltooth sawfish	1	0

4.11 ENVIRONMENTAL JUSTICE CONCERNS

Executive Order 12898 requires agencies to identify and address disproportionately high and adverse environmental effects of its regulations on the activities of minority and low-income populations. In particular, the environmental effects of the regulations should not have a disproportionate effect on minority and low-income communities. The communities of Dulac, LA, and Fort Pierce, FL, have significant populations of Native Americans and Black-Americans respectively. These two communities also have significant populations of low-income residents. None of the preferred alternatives for proposed management measures are expected to have a disproportionate impact on these minority populations and low-income populations.

The time/area closure off the coast of North Carolina has the potential to have adverse economic and social impacts, however NOAA Fisheries does not anticipate that these effects will fall disproportionately on minority or low-income populations. The time/area closure is designed in part to reduce the bycatch of a prohibited species, the sale and marketing of which is already prohibited under current regulations. However, substantial numbers of sandbar shark are caught in the time/area closure, and the reduction in income from this fishery may have a negative economic impact. This and other management measures are designed to rebuild the LCS complex and prevent other species of sharks from becoming overfished. NOAA Fisheries believes that this will provide long-term economic stability for the fishery and communities that are dependent upon the fishery.

4.12 COASTAL ZONE MANAGEMENT CONCERNS

The Coastal Zone Management Act (CZMA, 1972, reauthorized 1996) requires that Federal actions be consistent to the extent practicable, with the enforceable policies of all state coastal zone management programs. NOAA Fisheries has determined that the list of current preferred alternatives which seek to rebuild the LCS complex, prevent overfishing of the LCS complex, and prevent overfishing of other species of sharks will be implemented in a manner consistent to the maximum extent practicable with the enforceable policies of the coastal states in the Atlantic, Gulf of Mexico, and Caribbean that have Federally approved coastal zone management programs. NOAA Fisheries asked for states' concurrence with this determination during the proposed rule stage. As of October 31, 10 states had replied affirmatively regarding the consistency determination. NOAA Fisheries presumes that the remaining states that have not yet responded also concur with the determination. One state, Georgia, replied that allowing the use of gillnets, including the strikenet method, is not consistent with the State's CZMA program.

The State of Georgia objects to the consistency determination due to the continuing operation of the shark gillnet fishery in Federal waters impacting resources shared by adjacent state waters. NOAA Fisheries shares the State of Georgia's concern regarding the impact of the shark gillnet fishery on sea turtles, marine mammals, and sport fish. However, data currently available indicate relatively low rates of bycatch and bycatch mortality of protected species and other finfish in this fishery (See Section 3.5). The incidental capture of endangered species in the shark gillnet fishery is regulated under the ESA and the October 29, 2003, BiOp did not conclude that continuation of the shark gillnet fishery would jeopardize any endangered or threatened resources and issued a new incidental take statement for the fishery. Therefore, NOAA Fisheries is not prohibiting the use of this gear at this time. This finding is consistent with National Standard 2 which requires that management measures be based on the best scientific information available including the BiOp. In this document, NOAA Fisheries is preferring a measure that will require all shark gillnet vessels to install and activate a VMS during right whale calving season, and is making a commitment to examine in a future rulemaking, gear modifications or other alternatives that will reduce bycatch and bycatch mortality in this fishery. NOAA Fisheries will also work with existing take reduction teams and relevant Fishery Management Councils to examine methods of reducing bycatch. Thus, NOAA Fisheries finds that the final regulations implemented in the FMP Amendment are consistent with Georgia's Coastal Zone Management Program to the maximum extent practicable.

The State of Georgia objects to the consistency determination due to the continuing operation of the shark gillnet fishery in Federal waters impacting resources shared by adjacent state waters. Specifically, the State of Georgia raises a concern regarding the impact of the shark gillnet fishery on sea turtles, marine mammals, and sport fish. NOAA Fisheries acknowledges the concern raised; however, under the Magnuson-Stevens Fishery Conservation and Management Act's (16 U.S.C. § 1801 et seq.) (Magnuson-Stevens Act) National Standards, the Agency must, among other things, implement conservation and management measures to prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery; base its actions upon the best scientific information available; manage stocks throughout their range to the extent practicable; minimize adverse economic impacts on fishing communities to the extent practicable; and minimize bycatch and bycatch mortality to the extent practicable. 16 U.S.C. §§ 1851(a)(1), (2), (3), (8), and (9).

At this time, there is not sufficient information to support a closure, pursuant to the Magnuson-Stevens Act, of the shark gillnet fishery in Federal waters adjacent to Georgia. Gillnets are the commercial gear that are used to target small coastal sharks (SCS), a complex that is not, according to the latest SCS stock assessment, overfished. See Section 3.2.2. Based on the best scientific information available, this Amendment would manage the fishery for optimum yield by preferring a quota level that would increase the SCS commercial quota from the level in the 1999 HMS FMP. See Section 4.2.3. Given that a quota increase is warranted under the stock assessment, closing the shark gillnet fishery in Federal waters off Georgia would not facilitate achieving, on a continuing basis, the optimum yield from the fishery and managing the stocks through their range.

With regard to bycatch, this Amendment minimizes bycatch and bycatch mortality to the extent practicable. Incidental capture of threatened and endangered species is regulated under the ESA. As discussed in Section 4.10, according to an October 29, 2003, BiOp prepared pursuant to the ESA, there are relatively low rates of bycatch and bycatch mortality in the shark gillnet fishery. The BiOp concludes that continuation of the shark gillnet fishery would not jeopardize any endangered or threatened resources and issued a new incidental take statement for the fishery. Thus, NOAA Fisheries is not prohibiting the use of gillnet gear at this time.

While this Amendment does not prohibit the use of gillnet gear, it does consider permanent closure of the shark gillnet fishery (alternative J2) and allowing only the strikenet method in the shark gillnet fishery (alternative J3) in its discussion of bycatch alternatives. See Section 4.6.1. Alternative J2, in particular, would make this Amendment fully consistent with Georgia's CZMA program, as it would result in removal of gillnets as an authorized gear in the Federal shark fishery. However, NOAA Fisheries is not preferring alternatives J2 and J3 at this time, due to the significant, negative social and economic impacts on the five vessels actively fishing in the shark gillnet fishery. Rather, NOAA Fisheries is preferring a measure that will require all shark gillnet vessels to install and activate a VMS during right whale calving season, and, in future rulemaking, will examine additional gear modifications or other alternatives to reduce bycatch and bycatch mortality in this fishery. NOAA Fisheries will also work with existing take reduction teams and Fishery Management Councils to examine methods of reducing bycatch. Thus, NOAA Fisheries finds that this FMP Amendment is consistent to the maximum extent practicable with Georgia's CZMA program.

4.13 CUMULATIVE IMPACTS

Cumulative impact is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7). A cumulative impact includes the total effect on a natural resource, ecosystem, or human community due to past, present, and future activities or actions of Federal, non-Federal, public, and private entities. Cumulative impacts may also include the effects of natural processes and events, depending on the specific resource in question. Cumulative impacts include the total of all impacts to a particular resource that have occurred, are occurring, and will likely occur as a result of any action or influence, including the direct and reasonably foreseeable indirect impacts of a Federal activity. The goal of this section is to describe the cumulative ecological, economic and social impacts of past, present and reasonably foreseeable future actions with regard to the Atlantic shark fishery.

Past, Present, and Reasonably Foreseeable Actions

One of the primary goals of the 1993 Shark FMP and the 1999 HMS FMP was to establish management measures intended to reduce overfishing, rebuild U.S. Atlantic shark populations, and to prevent overfishing of fully fished stocks. Alternatives to rebuild and manage the Atlantic shark fisheries included, among other things, quotas for LCS, SCS, and pelagic sharks, a public display and scientific quota, retention and size limits, a prohibition on shark finning, overharvest and underharvest adjustment authority, and permitting and reporting requirements, including a limited access system. The limited access system was intended to prevent overcapitalization and reduce latent effort in the fishery. The 1999 HMS FMP also established ridgeback and non-ridgeback LCS categories and a commercial minimum size requirement for ridgeback LCS, as well as retention and size limits for recreational shark fishermen (See Chapter 1). Due in part to litigation, certain management measures for LCS and SCS were suspended, including commercial quotas, the commercial minimum size, and some accounting methods.

Since the HMS FMP, NOAA Fisheries has finalized two supplemental environmental impact statements where final actions were designed to reduce impacts on both target and non-target species. The first one, published in June 2000, analyzed management measures, particularly time/area closures, to reduce bycatch, bycatch mortality, and incidental catch in the pelagic longline fishery. The final actions were expected to have negative direct, indirect, and cumulative economic and social impacts for pelagic longline fishermen and were expected to have positive ecological impacts regarding reduction in bycatch and bycatch mortality. This rulemaking was expected to have little impact on directed shark fishermen but could impact fishermen who catch and land sharks incidentally.

The second supplemental environmental impact statement, published in July 2002, analyzed the management measures contained in a June 14, 2001, Biological Opinion addressing sea turtle bycatch and bycatch mortality in HMS fisheries. Certain measures in that rulemaking, such as the closure of the Northeast Distant Area (NED) to pelagic longline vessels, are expected to have negative direct, indirect, and cumulative economic and social impacts on pelagic longline fishermen. These effects however, have been mitigated in the short-term because vessels are able participate in an experimental fishery in the NED. The rulemaking also implemented measures in the shark gillnet fishery. The management measures for the shark gillnet fishery (required net checks for sea turtles and other marine mammals at least every two hours and ceasing of fishing and notification to NOAA Fisheries if a whale is taken) are anticipated to have little to no adverse impacts on shark fishermen and are expected to have some positive impact in regard to possible reductions in sea turtle mortality.

As discussed in Chapter 1 of this document, the LCS and SCS quotas and certain measures from the 1999 final rule were never implemented due to litigation. Several emergency rules were implemented as interim measures pending completion of this FMP Amendment. Moreover, the 2002 stock assessments for LCS and SCS indicated that, under past and present management measures, some shark stocks continue to be overfished but are rebuilding (e.g., the sandbar shark), some shark stocks are fully rebuilt (e.g., the blacktip shark), and some shark stocks remain healthy (e.g., the Atlantic sharpnose shark). The emergency measures were put into place to maintain biomass levels until a rebuilding plan was implemented. In all, the final actions of the emergency rules, both individually and in combination with each other, were designed to prevent overfishing and facilitate rebuilding of the stocks without adverse economic or social impacts pending an amendment to the HMS FMP.

Other actions that were taken subsequent to the 1999 HMS FMP include making the shark observer program mandatory in 2002, and mandatory cost earnings reporting, a new requirement for shark recreational anglers to obtain the HMS Angling category permit, and new regulations on shark exempted fishing permits in 2003. Further actions NOAA Fisheries may consider in the future include bycatch reduction measures, commercial trip limits, allocation between directed, incidental, and recreational permit holders, season openings and closings, limited access streamlining, recreational reporting, and pelagic shark quotas and adjustments based on assessments. NOAA Fisheries may address some or all of these issues in a forthcoming rulemaking.

While the 2002 SCS stock assessment does indicate that overfishing is occurring on finetooth sharks, the biomass of the stock is still above the level at which it would be overfished. The selected alternatives described in this FMP Amendment are intended to address this and other issues. Several of the most significant measures are listed below:

(1) Aggregate LCS into one complex with one closure date to reduce bycatch and reduce dead discards;
(2) Establish a trimester season to address temporal differences in fishing practices, fish availability, and pupping seasons;
(3) Establish commercial shark quotas based on a percentage of MSY;
(4) No minimum size requirement for commercially harvested sharks;

(5) Maintain existing recreational shark catch limits of one shark per vessel per trip and one Atlantic sharpnose shark per person per trip, with addition of one bonnethead shark per person per trip; and,
(6) Establish a time/area closure for dusky and sandbar shark pupping and nursery areas.

Cumulative Ecological Impacts

The HMS FMP concluded that the cumulative long-term impacts of management measures implemented in the FMP would be to rebuild overfished fisheries; minimize bycatch and bycatch mortality, to the extent practicable; identify and protect essential fish habitat; and minimize adverse impacts of fisheries regulations on fishing communities, to the extent practicable.

Although past management actions may have had some negative economic and social impacts, these actions have promoted the long-term sustainability and continued economic viability of the shark fishery. The two dominant species, blacktip and sandbar, are no longer overfished. Blacktip sharks are now listed as rebuilt, and sandbar sharks are no longer overfished, although overfishing is still occurring. Finetooth sharks are experiencing overfishing, but are not yet at a point where they are overfished.

Annual harvest of Atlantic sharks peaked at approximately 8,000 mt dw in the late 1980s. The 1993 Shark FMP established a quota of 2,463 mt dw for LCS for 1993 and 2,570 mt dw for LCS for 1994. The quota of 2,570 mt dw was reduced by 50 percent to 1,285 mt dw in 1997, and further reduced to 816 mt dw in the 1999 HMS FMP (See Chapter 1, Table 1.2). The 1999 quotas were never implemented due to litigation, and the 1997 quotas remained in effect until the temporary emergency rule increased the quotas in 2001. More recently (1997-2001), annual harvests of Atlantic sharks have averaged approximately 2,300 mt dw due to overharvests in Federal landings and landings in state waters after Federal closures. The overall trend has been a reduction in the quotas established for Atlantic sharks, with a concomitant decline in harvest, which has lead to positive impacts for Atlantic sharks by reducing overfishing and allowing two key species to be rebuilt (blacktip) or no longer overfished (sandbar). Blacktip and sandbar sharks combined account for approximately 64 percent of the observed catch, and an even larger percentage of landings. The quotas selected in this final Amendment reduce the LCS quota by 268 mt dw from 1,285 mt dw to 1,017 mt dw, which should rebuild LCS populations within the rebuilding time frame and prevent overfishing.

For non-target species, which include a wide variety of finfish species, rays, invertebrates, and protected species such as sea turtles, the cumulative impact of reducing overall fishing effort has been positive. Measures that have been taken to reduce the bycatch of protected species in HMS Fisheries include implementation of the NED closed area to pelagic longlining, a requirement to post handling and release guidelines for incidentally captured sea turtles on vessels, and in this final Amendment, requiring the use of non-stainless steel corrodible hooks, line cutters, dipnets, and dehooking devices to mitigate impacts on incidentally caught sea turtles. Measures have also been taken to reduce interactions with endangered right whales during the calving season by requiring 100 percent observer coverage. Additionally, new regulations on shrimp turtle excluder devices should reduce shark bycatch in shrimp fisheries and have a positive ecological impact.

Since the EFH provisions were added to the Magnuson-Stevens Act in 1996, action has been taken to identify and protect shark EFH. Additional research delineating important shark nursery and pupping areas has been undertaken and this information has contributed to the time/area closure for dusky and sandbar shark nursery habitat in EFH and HAPC areas in this FMP Amendment (See Section 4.6.2). The management measure to require VMS on shark bottom longline fishing vessels will further assist NOAA Fisheries in enforcement of the time/area closure, and protection of these vulnerable life stages of sharks. Several time/area closures have been implemented as part of HMS fisheries to reduce discards, protect other HMS species such as juvenile swordfish, and to reduce bycatch of protected species. Currently, approximately 3 million square miles of ocean are closed to HMS fishing at various times of the year. Cumulatively, these actions have had a positive ecological impact on HMS fisheries as a whole as well as on non-target species.

Actions NOAA Fisheries may consider in the future include commercial trip limits, bycatch reduction measures, allocation between directed, incidental, and recreational permit holders, season openings and closings, limited access streamlining, recreational reporting, and pelagic shark quotas and adjustments based on assessments. These measures, if considered, would be designed to address specific needs of the fishery, and as such, would be intended to have positive ecological impacts. Presently, there are no known third party planned actions that may affect target species.

In summary, the past, present, and reasonably foreseeable future actions have had a positive ecological impact by reducing fishing pressure and allowing stocks to rebuild.

Cumulative Economic and Social Impacts

The cumulative economic and social impact of actions taken since the 1993 Shark FMP, the 1999 HMS FMP, and the current HMS FMP Amendment has been to reduce the number of participants and overall latent effort in the shark fishery. By reducing the number of permitted vessels in the fishery, the overall quotas, implementing trip limits, expanding the list of prohibited species, and a variety of other commercial and recreational management measures, the fishery has had to deal with regulatory impacts and adapt to economic changes.

Since 1993, there has been a substantial decline in the number of vessels fishing for Atlantic sharks. With the implementation of the FMP in 1993, both the number of vessels and fishing effort were reduced. The limited access permit system for directed and incidental shark fishing in 1999 further reduced the number of vessels to 878. The number of directed and incidental shark permits has continued to decline and numbered 627 as of October 2002. Of these, only 251 have directed shark permits. Recent analysis indicates that of the 251 vessels, only 85 reported landings in 2001 (See Chapter 6). As of March 1, 2003, anglers fishing for any HMS are required to have an HMS angling permit. This permit and the HMS Charter headboat permit allow fishermen to catch HMS recreationally and are not species specific. As of May 2003, approximately 9,372 recreational fishermen had been issued an Atlantic HMS Angling permit and 2,412 charter/headboat permits had been issued (See Chapter 6).

As a result of management actions, vessels that used to fish for sharks may have moved to other fisheries, may have gone out of business, or experienced other adverse economic impacts. Approximately 98 percent of these vessels hold permits in other fisheries because the short seasons require them to fish in other fisheries. Average ex-vessel prices for shark have remained fairly constant, and have not increased enough to offset potential declines in landings. The average ex-vessel price of LCS across all regions was approximately $0.91 per lb dw in 2001 (See Chapter 6). Some of the selected alternatives in this Amendment, while not directly reducing the number of participants in the fishery further, may have negative economic impacts by further reducing LCS commercial quotas, and in particular, establishing a time/area closure for dusky and sandbar shark pupping and nursery areas off the coast of North Carolina. Other actions, such as raising the SCS commercial quotas, are expected to have a positive economic impact.

Many of the economic impacts experienced by the fishery are not solely the result of Federal actions. Many coastal states have implemented, or are in the process of implementing, shark regulations. Several states have begun to develop regulations consistent with federal regulations. In 1999, the Mid-Atlantic Fishery Management Council passed a motion encouraging all the states from Maine to Texas to close their state waters to all directed fishing for large coastal sharks in order to protect pupping and nursery areas. The New England Fishery Management Council supported the Mid-Atlantic Council's recommendation and requested that NOAA Fisheries do everything possible to facilitate the closing (NMFS, 1999). While no Atlantic states have closed state waters entirely to shark fishing, many require closures to go into effect with the Federal closure, and other state regulations such as trip and size limits and landing requirements have been implemented to curtail fishing effort.

With regard to trip limits, NOAA Fisheries has received comments that fishermen would like to see a higher trip limit for incidental landings during a directed fishery closure to prevent regulatory discards. With regard to allocation, there currently is no quota for the recreational shark fishery which caught 142,000 LCS in 2001, compared to 99,000 LCS landed in the commercial fishery. The recreational LCS catch declined from a high of 426,000 in 1986 to 142,000 LCS (NOAA Fisheries, 2003). With the recreational sector catching such a large number of sharks, there is a need to examine whether quotas in the recreational fishery are warranted. As described above, allocation between directed, incidental, and recreational permit holders is one of several options NOAA Fisheries may consider in the future. In terms of commercial quota allocation, the directed and incidental shark fisheries are currently operating under a single quota, and this approach may need to be re-examined also. Finally, season openings and closings are crucial for both economic and ecological reasons. Economically, the timing of openings and closings can impact the marketing and sale of product. Fishermen have commented that there are times of the year when consumer demand for sharks is greater and prices consequently higher. A change in the opening date for the fishery may thus improve profit margins. Ecologically, shark populations could potentially benefit from a reduction in fishing effort during vulnerable developmental stages.

The overriding goal of shark management has been to provide a sustainable harvest that will provide the greatest economic benefit to the largest number of individuals. The management strategy for sharks has been consistent with the National Plan of Action (NPOA) for the conservation and management of sharks. The NPOA requires NOAA Fisheries to undertake extensive data collection, analysis, and management measures in order to ensure long-term sustainability of U.S. shark fisheries.

4.14 COMPARISON OF THE ALTERNATIVES

The ecological, social, and economic impacts compared in Table 4.16 are for the foreseeable short-term future. However, NOAA Fisheries expects that many of the short-term, negative social and economic impacts associated with the alternatives could translate into positive long-term social and economic impacts as shark stocks continue to rebuild. Table 4.16 represents a summary of impacts associated with each of the alternatives, however, there are competing impacts associated with many of the alternatives listed. As such, please reference the individual alternatives as analyzed in chapters 4, 6, 7, 8 and 9.

Table 4.1 Summary of Shark Pupping Seasons for Some Species. Source: NMFS, 1999.

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="12">Month of the Year</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th></tr>
<tr><td>Ridgeback</td><td>Sandbar</td><td></td><td></td><td colspan="5">Florida - New Jersey</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Non ridgebacks</td><td>Blacktip</td><td></td><td></td><td></td><td></td><td colspan="2">Georgia - Florida</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Spinner</td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Gulf of Mexico</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bull</td><td></td><td></td><td></td><td></td><td colspan="4">Florida and Gulf of Mexico</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Lemon</td><td></td><td></td><td></td><td></td><td>Florida</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Scalloped hammer head</td><td></td><td></td><td></td><td></td><td></td><td colspan="2">South Carolina and Gulf of Mexico</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="4">SCS</td><td>Atlantic sharpnose</td><td></td><td></td><td></td><td colspan="4">South Carolina and Gulf of Mexico</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Finetooth</td><td></td><td></td><td></td><td colspan="3">South Carolina and Gulf of Mexico</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Blacknose</td><td></td><td></td><td></td><td colspan="4">South Carolina and Gulf of Mexico</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bonnethead</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">Florida and Gulf of Mexico</td><td></td><td></td><td></td></tr>
<tr><td>Prohibited</td><td>Dusky</td><td></td><td></td><td></td><td colspan="4">South Carolina through Maryland</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Table 4.2 Percent Change in Catch of Dusky, Sandbar, and LCS Complex in the Revised Time/Area Closure under Different Scenarios With and Without Redistribution of Effort 1994-2002.

	Without redistribution of effort from 1994-2002		With redistribution of effort based on data from 1994-2002		With redistribution of effort based on data from 2001-2002	
	Original	Revised	Original	Revised	Original	Revised
Dusky shark	-85%	-79%	-79%	-74%	-60%	-55%
Sandbar shark	-66%	-51%	-48%	-46%	Not available	
LCS	-58%	-42%	-27%	-28%	+30%	-3%

Table 4.3 Example of Temporal Variations in Effectiveness of Closing Revised Area on Dusky Shark Catches. Source: shark observer program data from 1994 through 2002. * Indicates months that the fishery has always been closed.

Month (1994-2003)	Number of dusky sharks observed caught inside the time/area closure	Number of dusky sharks observed caught outside the time/area closure	Percentage reduction in dusky sharks caught if time/area is closed
January	340	52	87%
February	162	70	70%
March	339	28	92%
April	103	18	85%
May	15	1	94%
June*	0	0	0%
July	140	54	72%
August	1	3	25%
September	0	52	0%
October	0	13	0%
November*	0	1	0%
December*	0	0	0%
Total	**1,100**	**292**	
Total (Jan-July)	**1,099**	**223**	**79%** ++

++ calculated by dividing the number of dusky sharks caught from Jan-July by the total number of dusky sharks caught during the entire fishing year [1,099/(1100+292)=79%].

Table 4.4 Example of Temporal Variations in Effectiveness of Closing Revised Area on Dusky Shark Catches. Source: shark observer program data from 2001-2002. * Indicates months that the fishery has always been closed.

Month (1994-2003)	Number of dusky sharks observed caught inside the time/area closure	Number of dusky sharks observed caught outside the time/area closure	Percentage reduction in dusky sharks caught if time/area is closed
January	30	4	88%
February	2	1	67%
March	29	1	97%
April	1	0	100%
May	0	0	0%
June*	0	0	0%
July	5	8	38%
August	1	2	33%
September	0	24	0%
October	0	0	0%
November*	0	0	0%
December*	0	0	0%
Total	**68**	**40**	
Total (Jan-July)	**67**	**14**	**62%** ++

++ calculated by dividing the number of dusky sharks caught from Jan-July by the total number of dusky sharks caught during the entire fishing year [67/(68+40)=62%].

Table 4.5 Catch and CPUE Estimates for Dusky Sharks Based on Data from the Shark Observer Program in the Time/Area Closure by Year.

Year	Number of dusky sharks observed caught inside the time/area closure	Number of hooks observed inside the time/area closure	CPUE in time/area closure
1994	5	4,522	0.00111
1995	211	18,646	0.01132
1996	158	14,137	0.01118
1997	110	16,543	0.00665
1998	298	20,820	0.01431
1999	250	12,357	0.02023
2000	0	0	-
2001-2002	68	15,439	0.00440
Total	**1,100**	**102,464**	

Table 4.6 Expanded Take Estimates for Dusky Sharks Based on Data from the Shark Observer Program for the Commercial Shark Bottom Longline Fishery by Year.

Year	Number of dusky sharks observed caught in Atlantic and Gulf of Mexico	Expanded take estimate for commercial fishery	Commercial landings estimate from Cortes and Neer (2002)+	Recreational landings estimate
1994	66	4,567	--	--
1995	387	19,250	--	--
1996	208	14,417	--	--
1997	138	11,246	--	--
1998	306	18,707	--	--
1999	286	18,667	--	5,570
2000-2002*	115	6,063	5,755	8,100
Total	**1,506**	**92,917**		

*Data for these years had to be aggregated due to low observer coverage and confidentiality issues.
+ Data are for 2001-2002 only, and do not include 2000

Table 4.7 Example of Temporal Variations in Effectiveness of Closing Area on Sandbar Shark Catches. Source: shark observer program data from 1994 through 2003.* Indicates months that the fishery has always been closed.

Month (1994-2003)	Number of sandbar sharks observed caught inside the time/area closure	Number of sandbar sharks observed caught outside the time/area closure	Percentage reduction in sandbar sharks caught if time/area is closed
January	2,239	1,670	57%
February	632	969	39%
March	2,156	534	80%
April	427	12	97%
May	61	56	52%
June*	0	0	0%
July	1,240	1,440	46%
August	28	316	8%
September	13	558	2%
October	0	94	0%
November*	0	0	0%
December*	9	0	0%
Total	**6,805**	**5,649**	
Total (Jan-July)	**6,755**	**4,681**	**54%** ++

++calculated by dividing the number of sandbar sharks caught from Jan-July by the total number of sandbar sharks caught during the entire fishing year [6,755/(6,805+5,649)=54%].

Table 4.8 Example of Temporal Variations in Effectiveness of Closing Area on LCS Complex. Source: shark observer program data from 1994 through 2003. Data includes sandbar and dusky sharks. * Indicates months that the fishery has always been closed.

Month (1994-2003)	Number of large coastal sharks observed caught inside the time/area closure	Number of large coastal sharks observed caught outside of time/area closure	Percentage reduction in large coastal sharks caught if time/area closed
January	2,778	3,483	44%
February	893	2,140	29%
March	2,958	1,996	60%
April	1,157	546	68%
May	88	215	29%
June*	0	0	0%
July	2,101	3,067	41%
August	68	1,010	6%
September	27	1,153	2%
October	0	134	0%
November*	0	0	0%
December*	0	0	0%
Total	**10,070**	**13,744**	
Total (Jan-July)	**9,975**	**11,447**	**42%** ++

++ calculated by dividing the number of LCS caught from Jan-July by the total number of LCS caught during the entire fishing year [9,975/(10,070+13,744)=42%].

Table 4.9 Redistribution of Fishing Effort for Dusky Sharks in the Revised Time/Area Closure Alternative for Years 1994-2003. Source: shark observer program data from 1994 through 2003. * Indicates months in which fishery has always been closed.

	A	B	C	D	E	F	G	H	I	J	K
Month (1994-2003)	Number of hooks in Atlantic	Number of dusky sharks caught in Atlantic	Number of hooks in time/area closure	Number of dusky sharks caught in time/area closure	Number of dusky sharks caught in open Atlantic (B-D)	Dusky shark CPUE in Atlantic (E/(A-C))	Number of additional dusky sharks caught in open Atlantic by displaced effort (C*F)	Dusky shark catch from open Atlantic with displaced fishing effort (E+G)	Number of dusky sharks avoided by area closure (B-H)	Cumulative catch avoided by month (sum of I)	Percent of total dusky discards avoided by closure (J/14.0)
Jan	122,245	392	24,935	340	52	5.34e-04	13	65	327	327	23.33
Feb	53,071	232	11,502	162	70	1.68e-03	19	89	143	470	10.19
Mar	100,332	367	24,853	339	28	3.71e-04	9	37	330	799	23.56
Apr	27,135	121	4,846	103	18	8.08e-04	4	22	99	898	7.08
May	15,599	16	967	15	1	6.83e-05	0	1	15	913	1.07
June*	1,163	1	0	0	1	0.00e+00	0	1	0	913	0.00
July	134,301	194	32,727	140	54	5.32e-04	17	71	123	1,036	8.76
Aug	35,975	4	1,245	1	3	8.64e-05	0	3	1	1,037	0.06
Sept	37,963	52	1,642	0	52	0.001432	2	54	-2	1,035	-0.17
Oct	6,448	13	0	0	13	0.002016	0	13	0	1,035	0.00
Nov*	0	1	0	0	1	0	0	1	0	1,035	0.00
Dec*	3,149	9	0	9	0	0	0	0	9	1,044	0.64
Total	**537,381**	**1,402**	**102,717**	**1,109**	**293**	**0**	**66**	**359**	**1,043**	**10,542**	
Total Jan-July	**453,846**	**1,323**	**99,830**	**1,099**	**224**	**0**	**63**	**287**	**1,036**		

Percent reduction in catch calculated by dividing the number of sharks avoided caught from Jan-July (J8) by the total number of sharks caught during the entire fishing year (B14).

Table 4.10 Redistribution of Fishing Effort for Dusky Sharks in the Time/Area Closure Alternative for Years 2001-2002. A total of 216 dusky shark were observed caught from 2000-2003 in the shark bottom longline fishery. Source: shark observer program data from 1994 through 2003. * Indicates months in which fishery has always been closed.

	A	B	C	D	E	F	G	H	I	J	K
Month (1994-2003)	Number of hooks in Atlantic	Number of dusky sharks caught in Atlantic	Number of hooks in time/area closure	Number of dusky sharks caught in time/area closure	Number of dusky sharks caught in open Atlantic (B-D)	Dusky shark CPUE in Atlantic (E/(A-C))	Number of additional dusky sharks caught in open Atlantic by displaced effort (C*F)	Dusky shark catch from open Atlantic with displaced fishing effort (E+G)	Number of dusky sharks avoided by area closure (B-H)	Cumulative catch avoided by month (sum of I)	Percent of total dusky discards avoided by closure (J/1.17)
Jan	30,968	38	3,940	30	8	2.96e-04	1	9	29	29	24.64
Feb	20,266	3	1,560	2	1	5.35e-05	0	1	2	31	1.64
Mar	54,713	32	4,482	29	3	5.97e-05	0	3	29	60	24.56
Apr	14,693	2	0	1	1	6.81e-05	0	1	1	61	0.85
May	0	0	0	0	0	0.00e+00	0	0	0	61	0.00
June*	153	0	0	0	0	0.00e+00	0	0	0	61	0.00
July	31,862	15	5,095	5	10	3.74e-04	2	12	3	64	2.65
Aug	24,471	3	897	1	2	8.48e-05	0	2	1	65	0.79
Sept	793	24	0	0	24	0	0	24	0	65	0.00
Oct	0	0	0	0	0	0	0	0	0	65	0.00
Nov*	0	0	0	0	0	0	0	0	0	65	0.00
Dec*	2,369	0	0	0	0	0	0	0	0	65	0.00
Total	**180288**	**117**	**15974**	**68**	**49**	**9.36e-04**	**3**	**52**	**65**	**689**	
Total Jan-July	**152655**	**90**	**15077**	**67**	**23**	**8.51e-04**	**3**	**26**	**64**		

Percent reduction in catch calculated by dividing the number of sharks avoided caught from Jan-July (J8) by the total number of sharks caught during the entire fishing year (B14).

Table 4.11 Redistribution of Fishing Effort for Sandbar Sharks in the Revised Time/Area Closure Alternative for Years 1994-2003. Source: shark observer program data from 1994 through 2003. * Indicates months in which fishery has always been closed.

	A	B	C	D	E	F	G	H	I	J	K
Month (1994-2003)	Number of hooks in Atlantic	Number of sandbar sharks caught in Atlantic	Number of hooks in time/area closure	Number of sandbar sharks caught in time/area closure	Number of sandbar sharks caught in open Atlantic (B-D)	Sandbar shark CPUE in Atlantic (E/(A-C))	Number of additional sandbar sharks caught in open Atlantic by displaced effort (C*F)	Sandbar shark catch from open Atlantic with displaced fishing effort (E+G)	Number of sandbar sharks avoided by area closure (B-H)	Cumulative catch avoided by month (sum of I)	Percent of total sandbar discards avoided by closure (J/124.45)
Jan	122,245	3,909	24,935	2,239	1,670	1.72e-02	428	2098	1811	1811	14.55
Feb	53,071	1,601	11,502	632	969	2.33e-02	268	1237	364	2175	2.92
Mar	100,332	2,690	24,853	2,156	215	2.85e-03	71	286	2404	4579	19.32
Apr	27,135	439	4,846	427	12	5.38e-04	3	15	424	5004	3.41
May	15,599	117	967	61	56	0.00e+00	0	56	61	5065	0.49
June*	1,163	0	0	0	0	0.00e+00	0	0	0	5065	0.00
July	134,301	2,680	32,727	1,240	1,012	9.96e-03	326	1338	1342	6406	10.78
Aug	35,975	344	1,245	28	183	5.27e-03	7	190	154	6561	1.24
Sept	37,963	571	1,642	13	31	8.54e-04	1	32	539	7100	4.33
Oct	6,448	94	0	0	0	0	0	0	94	7194	0.76
Nov*	0	0	0	0	0	0	0	0	0	7194	0.00
Dec*	3,149	0	0	0	0	0	0	0	0	7194	0.00
Total	**537,381**	**12,445**	**102,717**	**6,796**	**4,148**	**0**	**1,103**	**5,251**	**7,194**	**65,345**	
Total Jan-July	**453,846**	**11,436**	**99,830**	**6,755**	**3,934**	**0**	**1,096**	**5,030**	**6,406**		

Percent reduction in catch calculated by dividing the number of sharks avoided caught from Jan-July (J8) by the total number of sharks caught during the entire fishing year (B14).

Table 4.12 Redistribution of Fishing Effort for LCS in the Time/Area Closure Alternative for Years 1994-2003. Source: shark observer program data from 1994 through 2003. * Indicates months in which fishery has always been closed.

	A	B	C	D	E	F	G	H	I	J	K
Month (1994-2003)	Number of hooks in Atlantic	Number of LCS caught in Atlantic	Number of hooks in time/area closure	Number of LCS caught in time/area closure	Number of LCS caught in open Atlantic (B-D)	LCS CPUE in Atlantic (E/(A-C))	Number of additional LCS caught in open Atlantic by displaced effort (C*F)	LCS catch from open Atlantic with displaced fishing effort (E+G)	Number of LCS avoided by area closure (B-H)	Cumulative catch avoided by month (sum of I)	Percent of total LCS reduced by closure (J/238.14)
Jan	122,245	6,261	24,935	2,778	3,483	3.58e-02	892	4375	1886	1886	7.92
Feb	53,071	3,033	11,502	893	2,140	5.15e-02	592	2732	301	2186	1.26
Mar	100,332	4,954	24,853	2,958	1,996	2.64e-02	657	2653	2301	4487	9.66
Apr	27,135	1,703	4,846	1,157	546	2.45e-02	119	665	1038	5525	4.36
May	15,599	303	967	88	215	1.47e-02	14	229	74	5599	0.31
June*	1,163	0	0	0	0	0.00e+00	0	0	0	5599	0.00
July	134,301	5,168	32,727	2,101	3,067	3.02e-02	988	4055	1113	6712	4.67
Aug	35,975	1,078	1,245	68	1,010	2.91e-02	36	1046	32	6744	0.13
Sept	37,963	1,180	1,642	27	1,153	3.17e-02	52	1205	-25	6719	-0.11
Oct	6,448	134	0	0	134	0	0	134	0	6719	0.00
Nov*	0	0	0	0	0	0	0	0	0	6719	0.00
Dec*	3,149	0	0	0	0	0	0	0	0	6719	0.00
Total	**537,381**	**23,814**	**102,717**	**10,070**	**13,744**	**2.44e-01**	**3,351**	**17,095**	**6,719**		
Total Jan-July	**453,846**	**21,422**	**99,830**	**9,975**	**11,447**	**1.83e-01**	**3,263**	**14,710**	**6,712**		

Percent reduction in catch calculated by dividing the number of sharks avoided caught from Jan-July (J8) by the total number of sharks caught during the entire fishing year (B14).

Table 4.13 Redistribution of Fishing Effort for LCS in the Time/Area Closure Alternative for Years 2001-2002. Source: shark observer program data from 1994 through 2003. * Indicates months in which fishery has always been closed.

	A	B	C	D	E	F	G	H	I	J	K
Month (1994-2003)	Number of hooks in Atlantic	Number of LCS caught in Atlantic	Number of hooks in time/area closure	Number of LCS caught in time/area closure	Number of LCS caught in open Atlantic (B-D)	LCS CPUE in Atlantic (E/(A-C))	Number of additional LCS caught in open Atlantic by displaced effort (C*F)	LCS catch from open Atlantic with displaced fishing effort (E+G)	Number of LCS avoided by area closure (B-H)	Cumulative catch avoided by month (sum of I)	Percent of total LCS reduced by closure (J/6.03)
Jan	30,968	163	3,940	23	140	5.18e-03	20	160	3	3	0.43
Feb	20,266	91	1,560	7	84	4.49e-03	7	91	0	3	0.00
Mar	54,713	89	4,482	21	68	1.35e-03	6	74	15	18	2.48
Apr	14,693	29	0	0	29	1.97e-03	0	29	0	18	0.00
May	0	6	0	0	6	0.00e+00	0	6	0	18	0.00
June*	153	0	0	0	0	0.00e+00	0	0	0	18	0.00
July	31,862	128	5,095	23	105	3.92e-03	20	125	3	21	0.50
Aug	24,471	81	897	4	77	3.27e-03	3	80	1	22	0.18
Sept	793	16	0	0	16	2.02e-02	0	16	0	22	0.00
Oct	0	0	0	0	0	0	0	0	0	22	0.00
Nov*	0	0	0	0	0	0	0	0	0	22	0.00
Dec*	2,369	0	0	0	0	0	0	0	0	22	0.00
Total	**180,288**	**603**	**15,974**	**78**	**525**	**4.04e-02**	**56**	**581**	**22**		
Total Jan-July	**152,655**	**506**	**15,077**	**74**	**432**	**1.69e-02**	**53**	**485**	**21**		

Percent reduction in catch calculated by dividing the number of sharks avoided caught from Jan-July (J8) by the total number of sharks caught during the entire fishing year (B14).

Table 4.14 List of LCS Species Caught Inside and Outside the Original Time/Area Closure. Source: shark observer program data from 1994 through 2003. The numbers presented below were based on the original time/area closure. Data were not available to provide estimates for the revised closure.

	Inside Closed Area		Outside Closed Area	
	Total	Percent of Category	Total	Percent of Category
Sandbar	11,828	0.72	3,840	0.42
Tiger	1,856	0.11	2,652	0.29
Dusky	1,489	0.09	161	0.02
Scalloped Hammerhead	307	0.02	216	0.02
Blacktip	374	0.02	1,589	0.17
Sand tiger	355	0.02	26	0.00
Silky	47	0.00	161	0.02
Bull	46	0.00	66	0.01
Great Hammerhead	36	0.00	92	0.01
Night	30	0.00	1	0.00
Spinner	34	0.00	102	0.01
Bignose	26	0.00	3	0.00
Lemon	11	0.00	29	0.00
Nurse	7	0.00	279	0.03
Caribbean reef	3	0.00	1	0.00
Smooth Hammerhead	1	0.00	6	0.00
White	1	0.00	13	0.00
TOTAL	16,451	1.00	9,237	1.00

Table 4.15 Comparison of the Number and Percentage of Dusky and Sandbar Sharks Caught in the Original vs. the Revised Time/Area Closure.

Species	Life Stage	Number in Revised Time/Area	Number in Original Time/Area	Percent in Revised Time/Area
Dusky	Neonate	324	340	95%
	Juvenile	692	793	87%
	Adult	87	99	88%
	Total	1,103	1,232	90%
Sandbar	Neonate	31	31	100%
	Juvenile	4,118	4,321	95%
	Adult	2,647	4,370	61%
	Total	6,796	8,722	78%

Table 4.16 Comparison of the Alternatives Considered. + denotes positive impact; - denotes negative impacts; 0 denotes no impact.

ALTERNATIVE		ECOLOGICAL IMPACTS	SOCIAL IMPACTS	ECONOMIC IMPACTS
Commercial Management Measures				
Shark Classification				
Alternative A1 (No Action)	Separate LCS groupings (Ridgeback/Non-ridgeback), different closure dates possible	(-)	(-)	(-)
Alternative A2	Separate LCS groupings (Ridgeback/Non-ridgeback), same closure date	(-)	(-)	(-)
Alternative A3 (Preferred)	*Aggregate LCS, one closure date*	(+)	(+)	(-)
Alternative A4	Species specific groupings, different closure dates possible	(- -)	(-)	(-)
Quota Administration				
Alternative B1 (No Action)	Semi-annual season	(-)	(-)	(-)
Alternative B2 (No Action)	No regional quotas	(0)	(0)	(0)
Alternative B3 (Preferred)	*Regional quotas*	(0)	(+)	(0)
Alternative B4 (Preferred)	*Trimester season*	(+)	(-)	(-)
Alternative B5	Quarterly season	(+)	(-)	(-)
Quota Basis				
Alternative C1 (No Action)	Quota Basis from 1999 HMS FMP	(+)	(-)	(-)

Alternative C2 Combined with A3 (Preferred)	*LCS complex quota based upon percentage of Maximum Sustainable Yield (MSY)*	(+)	(-)	(-)
Alternative C2 Combined with A1/A2	LCS group quota based upon percentage of MSY	(-)	(+)	(+/-)
Alternative C2 Combined with A4	LCS species-specific quota based upon percentage of MSY	(-)	(+)	(+/-)
Alternative C3 Combined with A3	LCS complex quota based upon average landings for past three years	(+)	(-)	(-)
Alternative C3 Combined with A1/A2	LCS group quota based upon average landings for past three years	(-)	(+)	(+/-)
Alternative C3 Combined with A4	LCS species-specific quota based upon average landings for past three years	(-)	(+)	(+/-)
Minimum Size				
Alternative D1 (No Action)	4.5 ft for Ridgeback LCS	(-)	(-)	(-)
Alternative D2 (Preferred)	*No minimum size*	(0)	(0)	(0)
Alternative D3	5 ft for all LCS	(-)	(-)	(-)
Alternative D4	5 ft for Ridgeback; 4.5 ft for Non-ridgeback LCS	(-)	(-)	(-)
Alternative D5	4.5 ft for Atlantic Non-ridgeback; 4 ft for Gulf of Mexico Non-ridgeback LCS	(-)	(-)	(-)
Alternative D6	Minimum size for overfished species (or where overfishing is occurring) only	(-)	(-)	(-)

Recreational Management Measures

Retention limits				
Alternative E1 (No action)	One shark per vessel per trip plus one Atlantic sharpnose shark per person per trip	(+)	(0)	(0)
Alternative E2 (Preferred)	*Existing catch limits (E1) plus the addition of one bonnethead shark per person per trip*	(+)	(+)	(+)
Alternative E3	Existing catch limits (E1) plus the addition of one pelagic shark per vessel per trip	(-)	(+)	(+)
Alternative E4	Existing catch limits (E1) plus an allowance for vessels with HMS Angling permits participating in registered tournaments or HMS CHB permit holders on for hire trips to retain one shark per person, up to two sharks per vessel per trip as well as one bonnethead shark per person per trip	(- -)	(+)	(+)
Alternative E5	Other retention limit that considers existing state recreational retention limits	variable	variable	variable
Alternative E6	No retention, catch-and-release fishing for all recreational shark fisheries, inclusive of all LCS, SCS, and pelagic species.	(+ + +)	(- - -)	(- -)
Alternative E7	No retention limit	(- - -)	(+ +)	(+)
Minimum Size				

Alternative F1 (No Action)	4.5 ft FL for all sharks, no size limit for Atlantic sharpnose sharks	(+)	(0)	(0)
Alternative F2 *(Preferred)*	*Existing size limits (F1) plus a no size limit for bonnethead sharks*	(+)	(+)	(+)
Alternative F3	5.0 ft FL for all sharks, no size limit for Atlantic sharpnose and bonnethead sharks	(+ +)	(-)	(-)
Alternative F4	5.0 ft FL for all ridgeback sharks, 4.5 ft FL all non-ridgeback LCS, SCS, and pelagic sharks, no size limit for Atlantic sharpnose and bonnethead sharks	(+ +)	(-)	(-)
Alternative F5	4.5 ft FL for all sharks except no size limit for Atlantic sharpnose and bonnethead sharks and regional non-ridgeback LCS minimum sizes (4.5 ft FL all Atlantic non-ridgeback LCS, 4.0 ft FL for all Gulf of Mexico non-ridgeback LCS)	(+)	(-)	(-)
Alternative F6	No size limit for any sharks	(- -)	(+ +)	(+)
Authorized Gear				
Alternative G1 (No Action)	Any authorized gear	(-)	(0)	(0)
Alternative G2 *(Preferred)*	*Only allow handline, rod and reel, and bandit gear in the recreational shark fishery*	(+)	(0)	(0)

Deepwater and other sharks

Alternative H1 (No Action)	Retain established species group	(0)	(0)	(0)
Alternative H2 (Preferred)	*Remove species group from management unit; data collection only*	(0)	(0)	(0)

Prohibited Species

Alternative I1 (No Action)	Retain established species group (19 species)	(+)	(0)	(0)
Alternative I2	Return to the five species in 1997; white, sand tiger, bigeye sand tiger, whale, and basking sharks	(- - -)	(+)	(+)
Alternative I3	Retain established prohibited species group (I1) and add finetooth shark	(+)	(-)	(-)
Alternative I4	Retain established species group (I1) and remove dusky shark	(- - -)	(+)	(+)
Alternative I5	Retain established species group (I1) and add the deepwater/other species	(+)	(0)	(0)

Alternative I6 (Preferred)	*Existing regulations and, as appropriate, retain established prohibited species group (I1) and establish criteria for the addition and removal of species to/from the prohibited species group*	(+)	(+)	variable

Bycatch Reduction Measures

Gear Restrictions - Gillnet and Bottom Longline Gear Only				
Alternative J1 (No action)	Gillnet - net checks, LWTRT, observers; Bottom longline - post guidelines	(+)	(0)	(0)
Alternative J2	Existing bycatch reduction measures (J1) plus closing the shark gillnet fishery permanently/Remove gear from list of authorized gear types	(+)	(-)	(-)
Alternative J3	Existing bycatch reduction measures (J1) and allow only strikenet method in shark gillnet fishery	(+)	(-)	(-)
Alternative J4 (Preferred)	*Existing bycatch reduction measures (J1) plus requiring VMS on shark gillnet vessels during right whale calving season and requiring VMS on directed bottom longline shark fishing vessels operating near the time/area closure off North Carolina*	(+)	(+)	(-)

Alternative J5 (Preferred)	*Existing bycatch reduction measures (J1) plus requiring the use of non-stainless steel corrodible hooks, the possession of release equipment on vessels with shark bottom longline gear (line cutters, dipnets, and, when approved, dehooking devices), and that bottom longline vessels move 1 nautical mile after an interaction with a protected species*	(+ +)	(-)	(-)
Alternative J6	Existing bycatch reduction measures (J1) plus limiting shark bottom longline gear to a maximum of 10 miles of mainline, for each gear in the water, limiting soak time to 10 hours or less, and requiring the use of non-stainless steel corrodible circle hooks	(+ +)	(-)	(-)
Alternative J7	Existing bycatch reduction measures (J1) plus requiring the retention of all sharks caught in commercial shark fisheries; no discards allowed	variable	(-)	(-)
Alternative J8	Existing bycatch reduction measures (J1) plus requiring commercial and recreational fishermen to attend workshops on present regulations, species identification, and release techniques.	(+)	(+)	(-)

Time/Area Closures				
Alternative K1 (No Action)	No time/area closures	(-)	(0)	(0)
Alternative K2 (Preferred)	*Time/area closure for sandbar and dusky shark nursery and pupping areas off of North Carolina during the winter fishery*	(+ +)	(-)	(-)
Alternative K3	Time/area closure for all shark nursery and pupping areas during pupping season based on EFH identifications for neonate and juvenile sharks	(+ + +)	(--)	(--)

Essential Fish Habitat

Alternative L1 (No Action)	Maintain current EFH identified areas	(0)	(0)	(0)
Alternative L2	Identify EFH for the fishery management unit (FMU) based on the entire geographic range of the species	(+ +)	(0)	(0)
Alternative L3	Existing identification and, as appropriate, identify EFH for the FMU for each species and life stages as those habitats necessary for spawning, breeding, feeding, or growth to maturity	(+)	(0)	(0)

Alternative L4 (Preferred)	*Existing EFH and, as appropriate, increase or decrease the EFH areas identified for individual species in the FMU based on special needs*	(+)	(0)	(0)

Exempted Fishing Permits

Alternative M1 (No Action)	Maintain combined permitting system for scientific research and display	(0)	(0)	(0)
Alternative M2 (Preferred)	*Develop separate display permitting system for sharks, apart from research or exempted fishing permits*	(0)	(0)	(0)

Figure 4.1 Close-up view of the time/area closure off North Carolina showing bathymetry and coordinates.

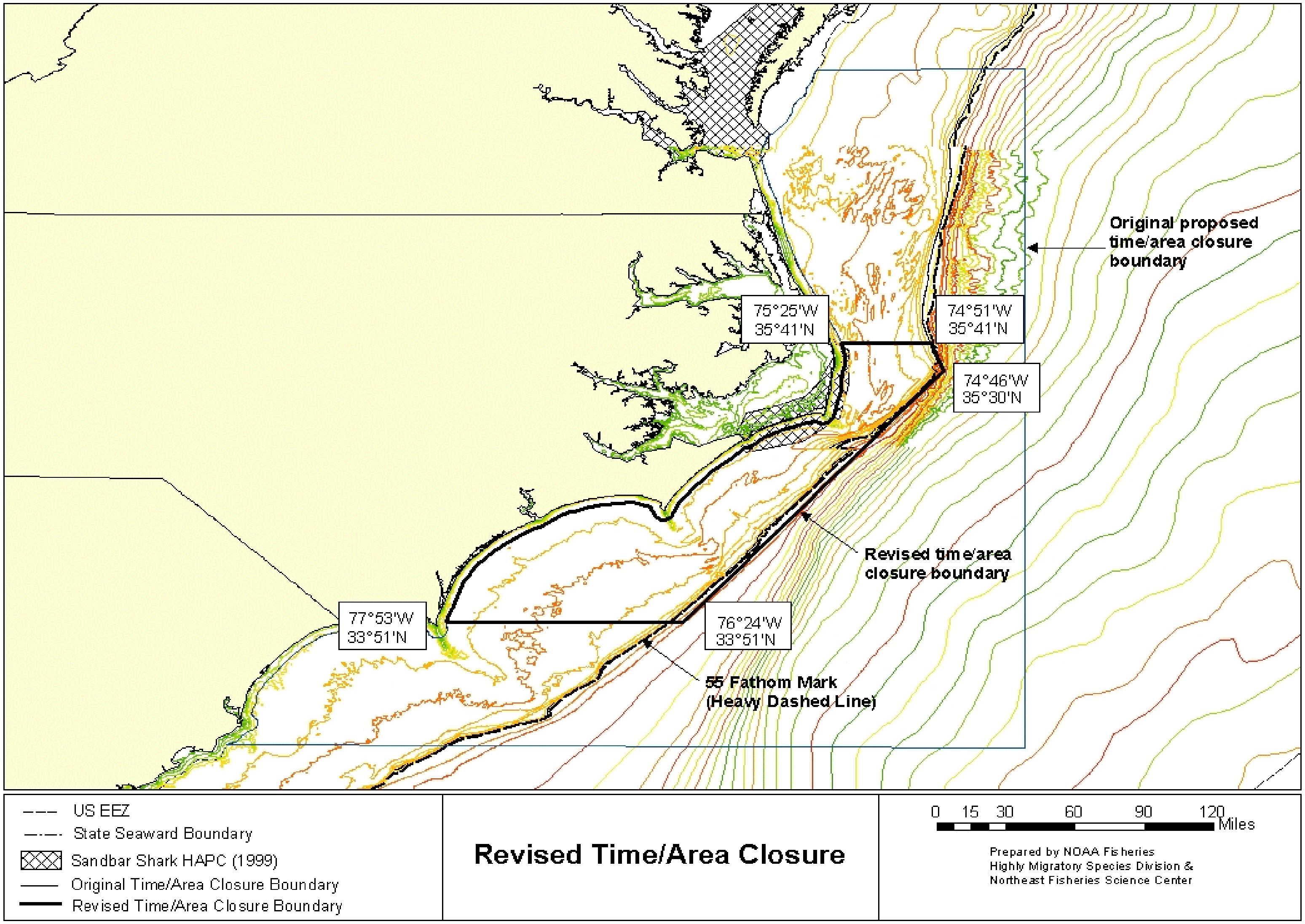


Figure 4.2 **Map of the time/area closure showing observed catches of dusky sharks in the revised and original time/area closure vs. all observed dusky sharks caught in the Atlantic and Gulf of Mexico from 1994-2002.**

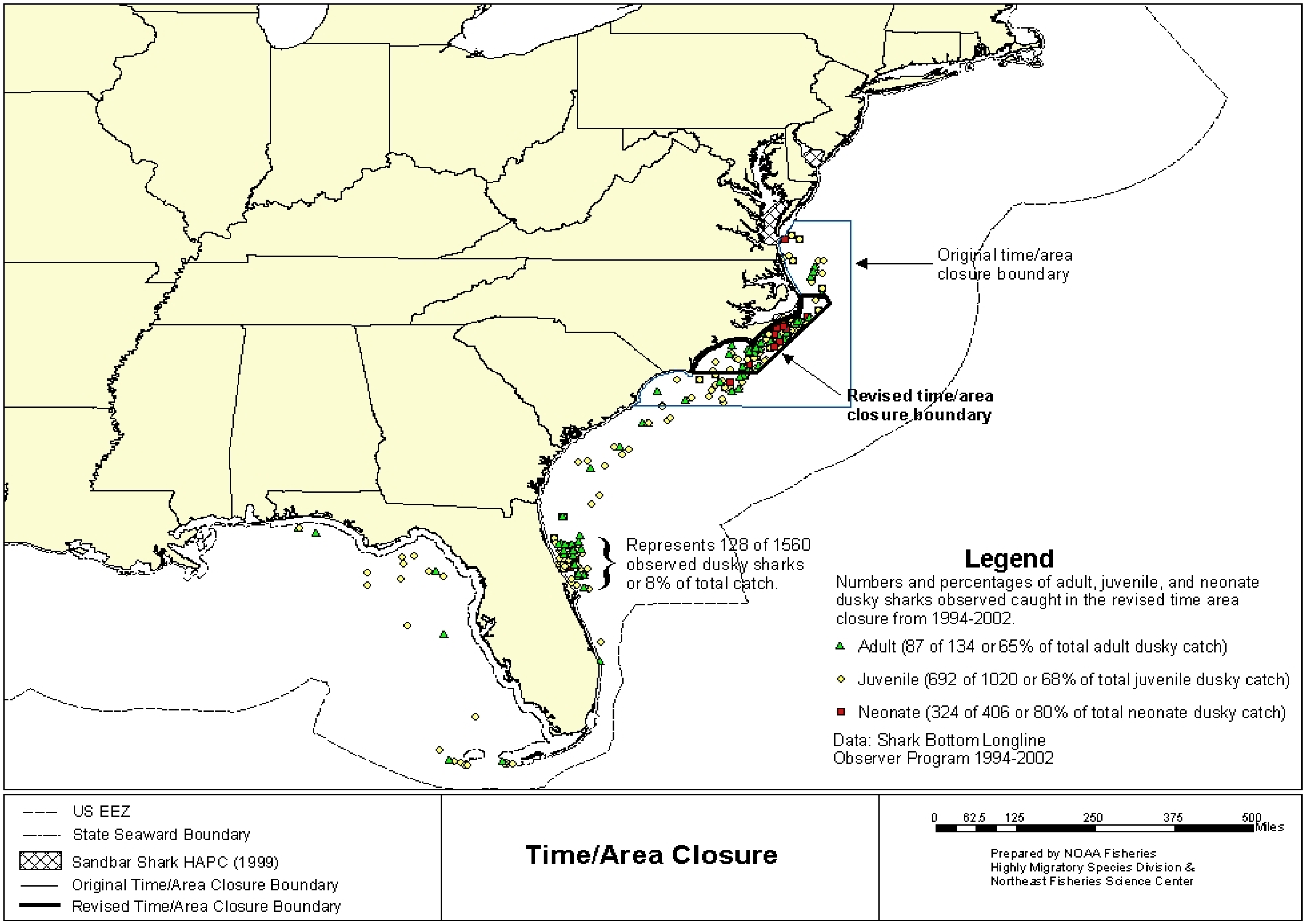


Figure 4.3 **Map of the time/area closure showing observed catches of dusky sharks in the revised and original time/area closure vs. all observed dusky sharks caught in the Atlantic and Gulf of Mexico from 2001-2002.**

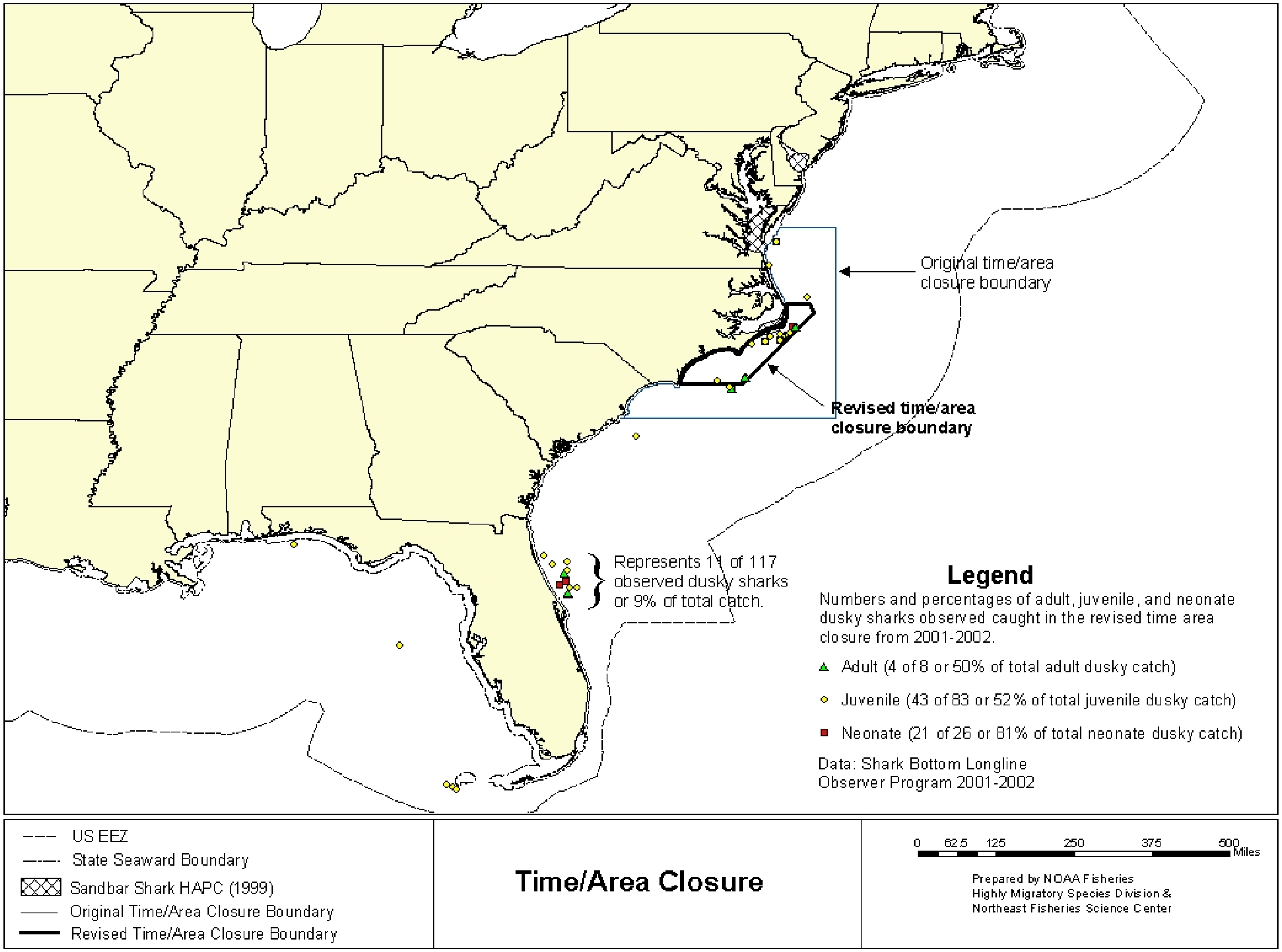


Figure 4.4 **Map of the time/area closure showing observed catches of sandbar sharks in the revised and original time/area closure vs. all observed sandbar sharks caught in the Atlantic and Gulf of Mexico from 1994-2002.**

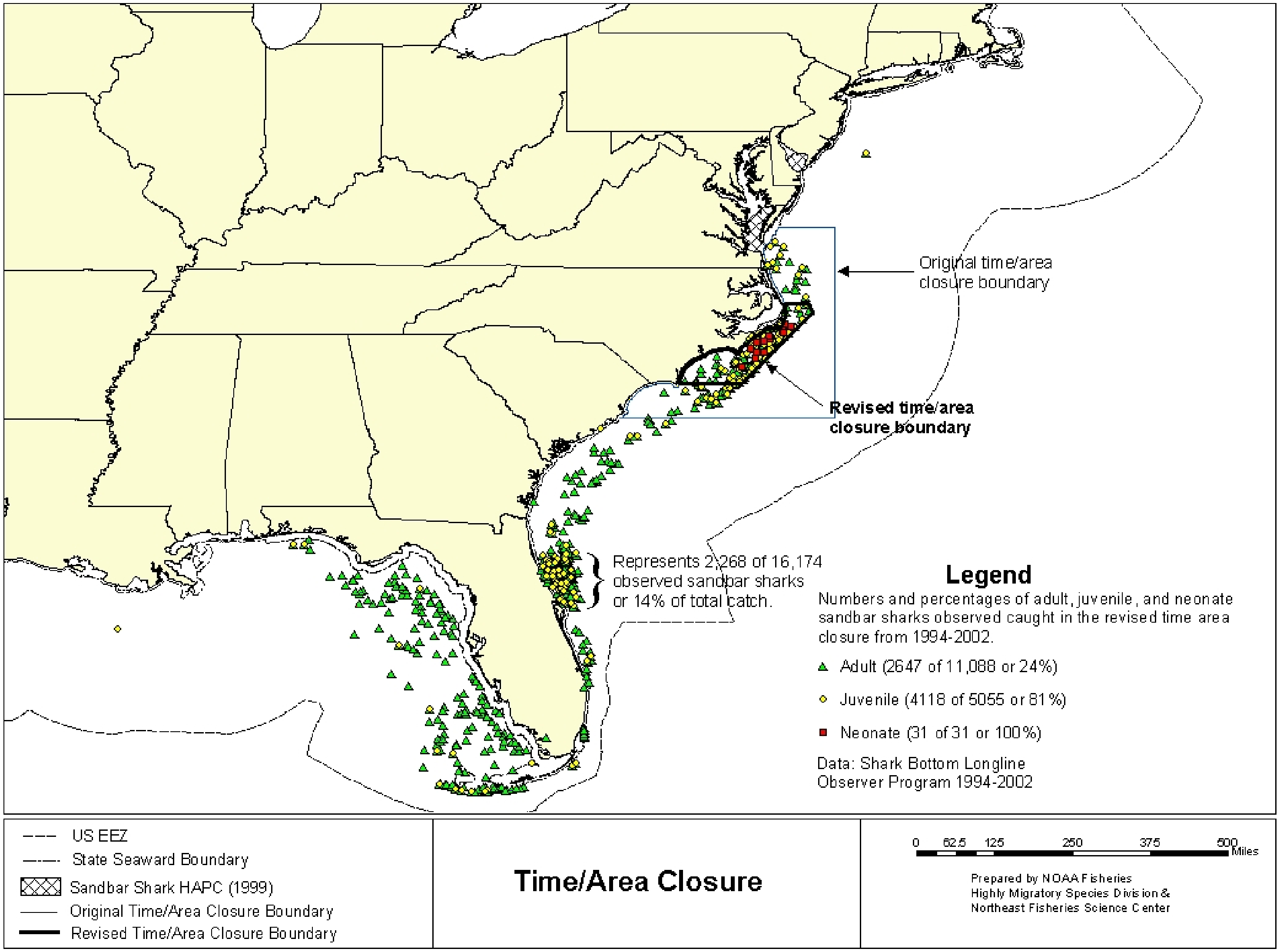


Figure 4.5 Map of the time/area closure showing observed catches of LCS in the revised and original time/area closure vs. all observed LCS caught in the Atlantic and Gulf of Mexico from 1994-2003.

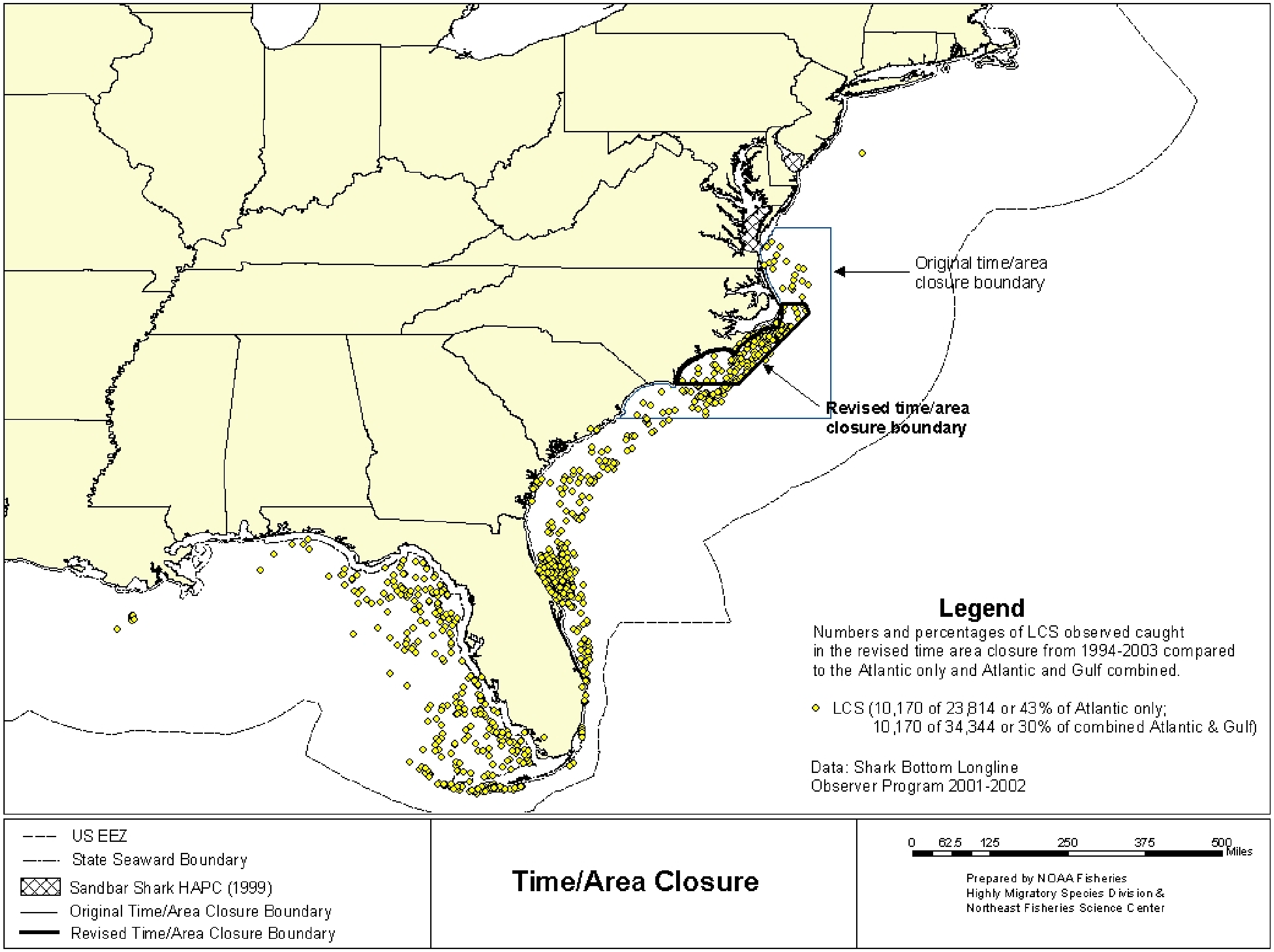


Figure 4.6 **Comparison of the original vs. revised time/area closure showing all observed catches of dusky sharks by life stage in the two areas.**

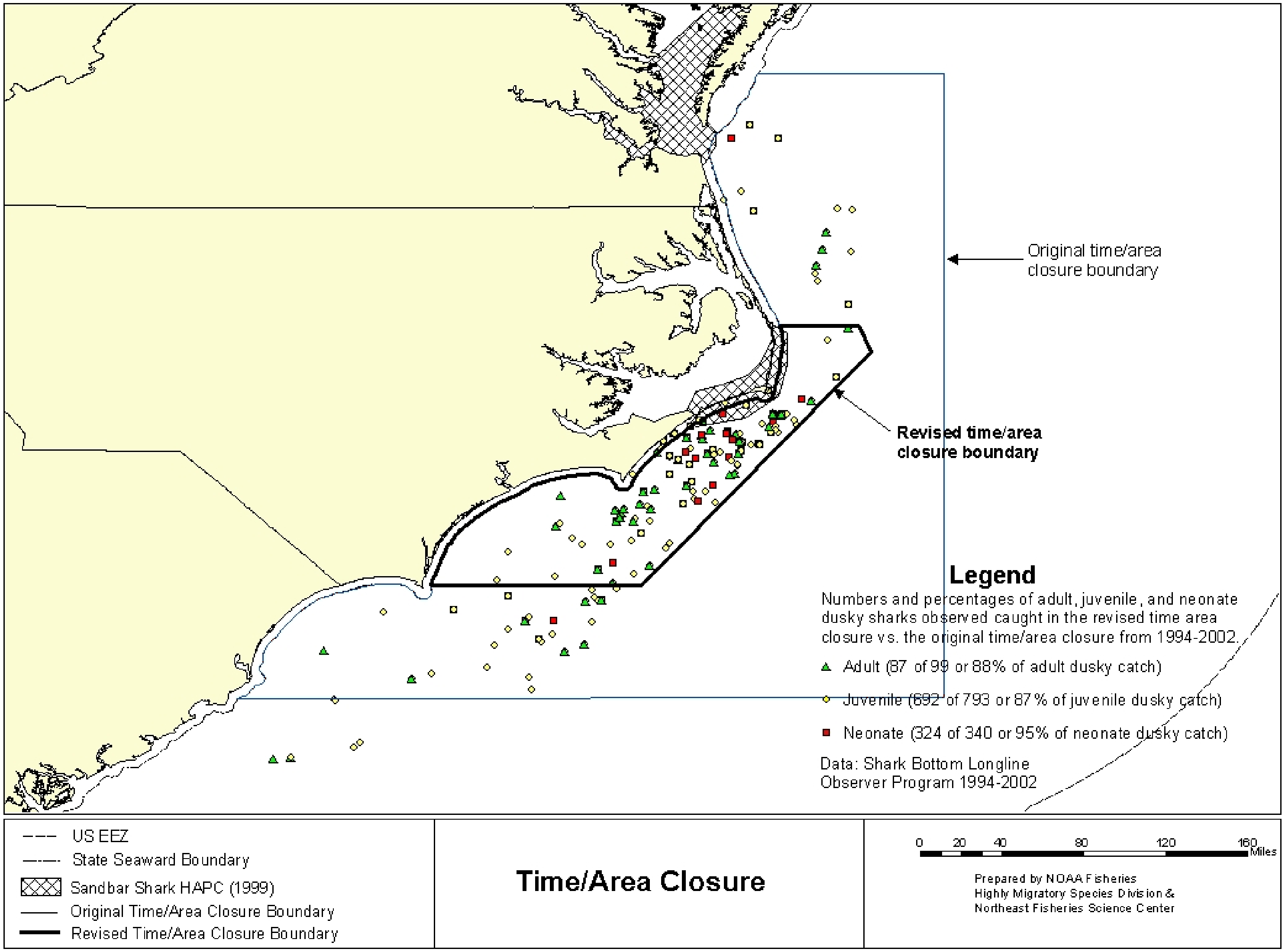
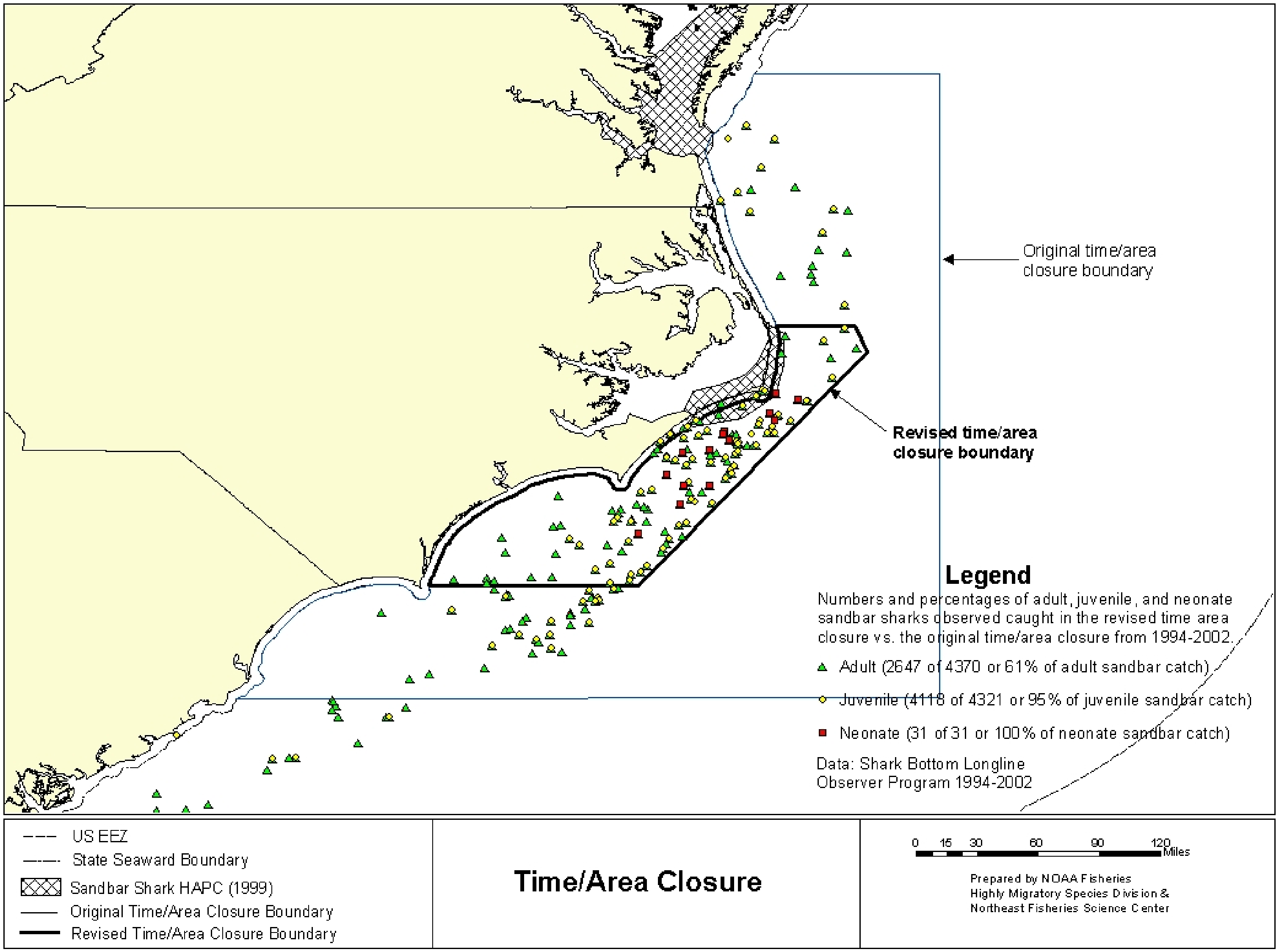


Figure 4.7 Comparison of the original vs. revised time/area closure showing all observed catches of sandbar sharks by life stage in the two areas.



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