DRAFT ENVIRONMENTAL IMPACT STATEMENT TO REDUCE INCIDENTAL BYCATCH AND MORTALITY OF SEA TURTLES IN THE SOUTHEASTERN U.S. SHRIMP FISHERIES

April 17, 2012

TYPE OF STATEMENT:

(X) DRAFT ( ) FINAL

AREA OF POTENTIAL IMPACT:

Areas of tidally influenced waters and substrates of the Gulf of Mexico and its estuaries in Louisiana, Mississippi, and Alabama, as well as tidally-influenced waters and substrates of the South Atlantic and its estuaries in North Carolina, and extending out to the limit of the U.S. Exclusive Economic Zone (EEZ).

ABSTRACT:

This environmental impact statement (EIS) analyzes a range of potential alternatives to reduce incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries. The EIS contains a description of the purpose and need for evaluating the potential alternatives, the scientific methodology and data used in the analyses, background information on the physical, biological, human, and administrative environments, and a description of the effects of the potential alternatives on the aforementioned environments.

RESPONSIBLE AGENCY:

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Regional Office
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GUIDANCE FOR SUBMITTING COMMENTS:

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ACRONYMS AND ABBREVIATIONS

The following are standard abbreviations for acronyms and terms found throughout this document:

ALDCNR	Alabama Department of Conservation and Natural Resources
APA	Administrative Procedure Act
BRD	bycatch reduction device
CEA	cumulative effects analysis
CEQ	Council on Environmental Quality
CPUE	catch per unit effort
CZMA	Coastal Zone Management Act
DEIS	draft environmental impact statement
DWH	DEEPWATER HORIZON (semi-submersible drilling rig)
DOC	U.S. Department of Commerce
DOI	U.S. Department of Interior
DPS	distinct population segment
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIS	environmental impact statement
E.O.	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FFWCC	Florida Fish and Wildlife Conservation Commission
FMP	fishery management plan
FTEV	full-time equivalent vessel
GMFMC	Gulf of Mexico Fishery Management Council
GMT	Gear Monitoring Team
GSMFC	Gulf States Marine Fisheries Commission
GSS	Gulf Shrimp System
HAPC	habitat area of particular concern
HMS	highly migratory species
IAI	Impact Assessment, Inc.
ICW	Intracoastal Waterway
IMMS	Institute for Marine Mammal Studies
IRFA	initial regulatory flexibility analysis
ITS	incidental take statement
LADWF	Louisiana Department of Wildlife and Fisheries
MDMR	Mississippi Department of Marine Resources
MMPA	Marine Mammal Protection Act
MPA	marine protected area
MRFSS	Marine Recreational Fishery Statistics Survey
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NCDMF	North Carolina Division of Marine Fisheries
NEPA	National Environmental Policy Act

NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
NOI	notice of intent
NRDA	Natural Resources Damage Assessment
OLE	Office of Law Enforcement
OMB	Office of Management and Budget
PRA	Paperwork Reduction Act
RA	Regional Administrator of NMFS
RFA	Regulatory Flexibility Act
RIR	regulatory impact review
SAFMC	South Atlantic Fishery Management Council
SBA	Small Business Administration
SEFSC	Southeast Fisheries Science Center of NMFS
SERO	Southeast Regional Office of NMFS
SMZ	special management zone
SST	sea surface temperature
STSSN	Sea Turtle Stranding and Salvage Network
TED	turtle excluder device
TEWG	Turtle Expert Working Group
USFWS	U.S. Fish and Wildlife Service
VEC	valued environmental component
YOY	young-of-year

EXECUTIVE SUMMARY

Purpose and Need

The need for the proposed action and alternatives is to aid in the protection and recovery of listed sea turtle populations. Under the Endangered Species Act of 1973 (ESA) (16 USC. 1531 et seq.), the National Marine Fisheries Service (NMFS) has the responsibility to implement programs to conserve marine life listed as endangered or threatened. Section 9 of the ESA prohibits the take (including harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting or attempting to engage in any such conduct), including incidental take, of endangered sea turtles. Pursuant to section 4(d) of the ESA, NMFS has issued regulations extending the prohibition of take, with exceptions, to threatened sea turtles (50 CFR 223.205and 223.206). Section 11(f) of the ESA authorizes the issuance of regulations to enforce the take prohibitions. The purpose of the proposed action is to aid in the protection and recovery of listed sea turtle populations by reducing incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries.

Range of Alternatives

Alternative 1: No action

Alternative 2a: Amend alternative tow time restriction, which would require vessels 30 feet and greater in length using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) to use turtle excluder devices (TEDs)

Alternative 2b: Amend alternative tow time restriction, which would require vessels 20 feet and greater in length using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) to use TEDs

Alternative 2c: Withdraw alternative tow time restriction, which would require all vessels using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) to use TEDs

Alternative 3a: Close all shrimp fishing in state waters from the Texas-Louisiana state boundary, eastward to the Alabama-Florida state boundary from March 1 through May 31

Alternative 3b: Close all shrimp fishing in state waters from the Louisiana-Mississippi state boundary, eastward to the Alabama-Florida state boundary from March 1 through May 31

Alternative 3c: Close all shrimp fishing in state waters from the Texas-Louisiana state boundary, eastward to the Alabama-Florida state boundary from April 1 through May 15

Alternative 3d: Close all shrimp fishing in state waters from the Louisiana-Mississippi state boundary, eastward to the Alabama-Florida state boundary from April 1 through May 15

Preferred Alternative

Alternative 2c: Withdraw alternative tow time restriction. This alternative would withdraw the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*), and require all vessels using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) to use TEDs.

Controversy

During the scoping process, numerous comments were received from the public, particularly from shrimp fishermen, suggesting the DEEPWATER HORIZON (DWH) oil spill event was likely responsible for the elevated stranding events. They noted the apparent low turtle strandings prior to the DWH oil spill event as support for this assertion. Therefore, they felt any additional regulations for the shrimp fisheries in response to these stranding events were unwarranted. Significant comment was submitted from industry, as well as state representatives, on the potential impact of any additional regulations on the shrimp fisheries. Due to the effects of increased fuel prices, increased foreign imports that have depressed prices received for domestic product, the impact of the DWH oil spill event, and the lingering effects on infrastructure stemming from previous hurricane seasons, several of those who submitted comments believed that any additional burden on the shrimp fisheries could cripple the industry.

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1 INTRODUCTION

This Draft Environmental Impact Statement (DEIS) evaluates the potential environmental impacts associated with a NMFS proposed rule under the ESA to reduce incidental bycatch and mortality to endangered and threatened sea turtles resulting from take[1] in the southeastern U.S. shrimp fisheries. Specifically, the proposed rule, if implemented, would require all vessels using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) to use TEDs in their nets.

Over the past two years NMFS has documented elevated sea turtle strandings in the Northern Gulf of Mexico, particularly throughout the Mississippi Sound area. In the first three weeks of June 2010, over 120 sea turtle strandings were reported from Mississippi and Alabama waters, none of which exhibited any signs of external oiling to indicate effects associated with the DWH oil spill event. A total of 644 sea turtle strandings were reported in 2010 from Louisiana, Mississippi, and Alabama waters, 561 (87 percent) of which were Kemp's ridley sea turtles. During March through May of 2011, 267 sea turtle strandings were reported from Mississippi and Alabama waters alone. A total of 525 sea turtle strandings were reported in 2011 from Louisiana, Mississippi, and Alabama waters, with the majority (455) occurring from March through July, 390 (86 percent) of which were Kemp's ridley sea turtles. These stranding numbers are significantly greater than reported in past years; Louisiana, Mississippi, and Alabama waters reported 42 and 73 sea turtle strandings for 2008 and 2009, respectively, however, it should be noted that stranding coverage has increased considerably due to the DWH oil spill event as discussed in more detail in Section 2.1.2. Nonetheless, considering that strandings typically represent only a small fraction of actual mortality, these stranding events potentially represent a serious impact to the recovery and survival of the local sea turtle populations. Necropsy results indicate a significant number of stranded turtles from both the 2010 and 2011 events likely perished due to forced submergence, which is commonly associated with fishery interactions (B. Stacy, NMFS, pers. comm.). Because of the elevated strandings in 2010 and 2011, as well as issues identified within the southeastern U.S. shrimp fisheries, notably issues with TED compliance within the otter trawl sector and new information indicating an evaluation of alternative tow time restrictions within the skimmer trawl sector was warranted, NMFS initiated the development of this DEIS.

NMFS has recently noticed compliance issues with TED requirements in the shrimp fisheries. During numerous evaluations conducted in both the Gulf of Mexico and Atlantic Ocean over the past two years, NMFS gear experts have noted a variety of compliance issues ranging from lack of TED use, TEDs sewn shut, TEDs installed improperly, and TEDs being manufactured that do not comply with regulatory requirements. Two issues of great concern are TEDs with excessively steep grid angles (i.e., installed at angles above the 55-degree maximum angle) and escape openings with insufficient measurements (i.e., less than the required minimum measurements). Steep TED-grid angles are of particular concern to small, juvenile sea turtles, as TED testing by NMFS has documented even small variances above the 55-degree maximum angle will prevent sea turtles from escaping the net. In contrast, escape openings with insufficient measurements will prevent larger, adult sea turtles from escaping the net. Aside from these two critical issues, NMFS has also noted a host of other discrepancies with TED requirements, including excessive overlap of double-cover escape opening panel flaps, bar spacing in excess of the 4-inch maximum, improper flotation,

[1] Under the ESA, the term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in such conduct.

excessive escape panel flap length beyond 24 inches, and other technical issues. While these issues may not represent as significant a threat as steep TED angles and insufficient escape openings, they still can hinder turtle escapement from a trawl net.

Additionally, information from NMFS and Mississippi Department of Marine Resources (MDMR) enforcement, stemming from the monitoring of Mississippi Sound skimmer trawl vessels in 2010, indicates the alternative tow time requirements are exceeded by vessels in the skimmer trawl fleet. Furthermore, it has been over 10 years since this segment of the fishery has been evaluated and, given the apparent increased abundance of sea turtles in the Northern Gulf of Mexico, particularly Kemp's ridley sea turtles, NMFS has determined that a review on the efficacy of alternative tow time restrictions used by skimmer trawls to reduce sea turtle mortality is prudent.

Ultimately, NMFS does not have data that provides a definitive answer for the cause of the elevated sea turtle strandings in the Northern Gulf of Mexico that occurred in 2010 and 2011; available information provides several potential scenarios that are discussed later in this DEIS. Yet, the analysis encompassed within this DEIS indicates the withdrawal of the alternative tow time restriction would be an effective action to reduce incidental bycatch and mortality of sea turtles within the southeastern U.S. shrimp fisheries due to: increased abundance of sea turtles in the Northern Gulf of Mexico that is likely to lead to increased interactions with skimmer trawl gear; violations of alternative tow time restrictions; and general difficulties with the enforcement of alternative tow time restrictions to insure compliance within the fisheries.

1.1 PURPOSE AND NEED

The need for the proposed action and alternatives is to aid in the protection and recovery of listed sea turtle populations. Under the ESA (16 USC. 1531 et seq.), NMFS has the responsibility to implement programs to conserve marine life listed as endangered or threatened. Section 9 of the ESA prohibits the take (including harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting or attempting to engage in any such conduct), including incidental take, of endangered sea turtles. Pursuant to section 4(d) of the ESA, NMFS has issued regulations extending the prohibition of take, with exceptions, to threatened sea turtles (50 CFR 223.205and 223.206). Section 11(f) of the ESA authorizes the issuance of regulations to enforce the take prohibitions. The purpose of the proposed action is to aid in the protection and recovery of listed sea turtle populations by reducing incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries.

1.2 BACKGROUND

All sea turtle species occurring in the Atlantic Ocean are listed as either endangered or threatened under the ESA. The leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*) are listed as endangered. Loggerhead (*Caretta caretta*)[2] and green (*Chelonia mydas*) sea turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific coast of Mexico, which are listed as endangered.

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[2] NMFS and USFWS published a final rule designating nine DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011; effective October 24, 2011); the DPS potentially affected by this DEIS is the threatened Northwest Atlantic Ocean DPS.

Sea turtles are affected by natural and human interactions on nesting beaches and in the water. Poaching, habitat loss, light pollution, marine debris, oil and gas pollution, and nesting predation by native and introduced species affect hatchlings and nesting females while on land. Fishery interactions, marine debris, marine pollution including that caused by oil and gas development and vessel operations, power plant entrainment/impingement, vessel interactions, and (non-fishery) dredging operations affect sea turtles in the neritic zone[3]. Fishery interactions, marine debris, and marine pollution also affect sea turtles when these species and the fisheries overlap in the oceanic zone[4]. Sea turtles still face many of the original threats that were the cause of their listing under the ESA.

As discussed in more detail below, in the Northwest Atlantic (including the Gulf of Mexico), sea turtle populations, as determined by nesting data, remain greatly reduced from historical levels. There is cautious optimism based on the limited data available that some of the sea turtle populations in U.S. Atlantic waters appear to be stable, or in some cases, to be increasing. Kemp's ridley nesting has experienced significant increases in the past 10 years. In contrast, loggerhead nest numbers have been declining since 1998 despite preliminary increases under the protections of the ESA. As loggerheads are still the most abundant sea turtle found in Northwest Atlantic waters, they are also the species most commonly captured incidental to fishing operations. Much of the focus of this EIS is on assessing and reducing the incidental capture and mortality of Kemp's ridley sea turtles, as this species has dominated strandings in the Northern Gulf of Mexico over the past two years. Information indicates the southeastern U.S. shrimp fisheries may be contributing to these strandings. Therefore, this EIS focuses on the effects of potential alternatives to reduce sea turtle bycatch and mortality from these fisheries.

A Section 7 consultation on the effects of the proposed action on listed species will be completed prior to final rulemaking. Additional information on sea turtle recovery plans, status reviews, and interagency coordination can be found in Appendix I.

1.2.1 Skimmer Trawls and Alternative Tow Time Exemptions

Skimmer trawls are used in Louisiana, Mississippi, Alabama, Florida, and North Carolina. Florida is the only state that currently requires TED use by skimmer trawlers working in state waters and, therefore, would not be impacted by a new TED requirement for this gear type. Louisiana hosts the vast majority of skimmer boats, with 2,248 skimmer and butterfly trawlers reporting landings in 2008 (GSS statistics). In 2008, Mississippi had approximately 62 active skimmer, butterfly, and chopstick boats (M. Brainard, MDMR, pers. comm.), Alabama had 60 active skimmer boats (GSS statistics), and North Carolina had 97 skimmer vessels (NCDMF statistics).

During evaluation of Louisiana skimmer trawl fishery catch, Scott-Denton et al. (2006) documented no sea turtle interactions over 517 hours of skimmer trawl fishing effort. The incidental capture of sea turtles in skimmer trawls has been documented in North Carolina (Coale et al. 1994; Price and Gearhart 2011), however, and captures likely occur in the Northern Gulf of Mexico as well. Yet, skimmer trawls, as well as pusher-head (chopstick) trawls and wing nets (butterfly trawls), are

[3] Defined as the marine environment extending from mean low water down to 200 m depths, generally corresponding to the continental shelf (Lalli and Parsons 1997).
[4] Defined as the open ocean environment where bottom depths are greater than 200 m (Lalli and Parsons 1997).

currently authorized to fish without TEDs if they operate under alternative tow time restrictions[5]. These gear types were granted the tow time exemption under the assumption that the trawl bags were typically retrieved at intervals that would not be fatal to any sea turtles that were captured in the net. The December 2, 2002 biological opinion noted tow time restriction was for fisheries that, "out of physical, practical, or economic necessity, require fishermen to limit their tow times naturally." But information from MDMR indicates that some participants in the skimmer trawl fishery are not even aware of the tow time restrictions, and violations of the tow time restrictions are occurring within the fishery. There are also concerns repeated captures may result in turtle mortality in times and areas where sea turtle abundance and skimmer trawl fishing effort is high, particularly given the information indicating the Kemp's ridley sea turtle population is increasing (see Section 3.2.3).

The alternative tow time restrictions specify tow times are not to exceed 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 (50 CFR 223.206(d)(3)(i)(A) and (B)). Some publications (e.g., Price and Gearhart 2011) cite Scott-Denton et al. (2006) as evidence of observations that tow times are often exceeded within the skimmer trawl fishery. Scott-Denton et al. (2006) evaluated catch characteristics of the Louisiana skimmer trawl fishery in 2004 and 2005, and they stated "tow time ranged from 0.2 to 4.3 h, with an average tow time of 1.7 h (+/- 0.4 s.d.)." Per the TED requirements at 223.206(d)(3)(i), the tow time for a skimmer trawl is measured "from the time the codend enters the water until it is removed from the water." Tow times in the study were recorded from the time the codend entered the water to the time the codend was retrieved to dump the catch, ending the tow. The times associated with lifting the codend for periodic checking for crab traps and possibly other debris were not recorded (E. Scott-Denton, NMFS, pers. comm.). Therefore, it is unclear to what extent the average tow times reported by Scott-Denton et al. (2006) might represent regulatory violations of the alternative tow time restrictions. These observations also raise the question of the sufficiency of the existing regulatory structure of the tow time definition in protecting sea turtles. If skimmer trawls can technically comply with the tow time limits without actually inspecting the entire net for potentially captured sea turtles, the conservation value of the alternative tow time restrictions may be reduced. Regardless, violations of tow times have been documented in 2010 and 2011, specifically one violation in 2010 and one in 2011 (R. Pittman, MDMR, pers. comm.). At this time, the extent tow time restrictions are exceeded by the skimmer trawl fleet in the Northern Gulf of Mexico and in North Carolina is unclear. Tow times restrictions are difficult to enforce. Documentation of a tow time violation requires enforcement personnel to be in close proximity of a skimmer trawl to monitor gear deployment and recovery, and to record the time when the codend enters the water until it is removed (50 CFR 223.206(d)(3)(i)). Also, enforcement personnel need to remain undetected for at least 55 minutes – practically an impossibility at sea – or else their presence may bias a vessel captain's operational procedure. Similarly, NMFS observers may also result in biased operational procedurals (i.e., the "observer effect"). Thus, it is likely that most tow time violations go undetected.

Epperly et al. (2002) stated that because skimmers are typically rigged to fish higher in the water column, the potential for turtle capture may be greater than a lower opening otter trawl. A typical 40-foot, non-bib shrimp trawl has an average headrope height of 2.8 to 3.5 feet depending on trawl

[5] Florida requires all trawls to use TEDs while fishing in Florida state waters; due to operational constraints (i.e., water depth), skimmer trawls do not operate in the EEZ.

design, while a skimmer trawl, with a maximum frame height of 12 feet, may have a vertical spread of approximately 9 to 10 feet. Skimmer trawl gear typically works in shallower water than an otter trawl, however, where water depth would limit the vertical profile of the net. For example, Scott-Denton et al. (2006) documented the average depth of all tows by Louisiana skimmer trawls in their study was 7.8 feet (+/- 1.2 feet s.d.). Likewise, Hines et al. (1996) recorded water depths of 1.9 to 6.0 feet (0.58 to 1.83 m) in the Newport River and 1.6 to 4.4 feet (0.5 to 1.33 m) in the North River, which were consistent with the fishing patterns of the local North Carolina inshore fleet. In these depth ranges, skimmer trawls can fish the entire water column.

There is a general paucity of information documenting the effects of skimmer trawl gear on sea turtles. The December 2, 2002 biological opinion included some discussion on skimmer trawls. Furthermore, a non-discretionary term and condition of the opinion stated NMFS "will monitor activities (e.g., bait shrimping) and gear (e.g., skimmer trawls) that are exempted from TED use and rely on tow time restrictions to determine their compliance with tow times and to determine if there are any effects on sea turtles from the use of these gears or the continuation of these activities that were not previously known" (NMFS 2002). Due to the above factors, coupled with the apparent increased abundance of sea turtles in the Northern Gulf of Mexico, particularly Kemp's ridley sea turtles, NMFS is re-evaluating the efficacy of the alternative tow time restrictions used with skimmer trawl gear.

Consideration of potentially requiring TEDs in skimmer trawls has not been limited to this DEIS. On May 8, 2009, NMFS published a NOI to prepare an EIS and conduct public scoping meetings, and made available a scoping document presenting various approaches to regulating trawl fisheries in the Atlantic Ocean (74 FR 21627). The scoping document suggested a phased approach in a sequence of implementation of regulations to reduce sea turtle captures by requiring capture mitigation strategies (i.e., TEDs) as technology becomes available. "Phase I" would further regulate the summer flounder and Atlantic sea scallop fisheries, as well as introduce regulations for the whelk, croaker/weakfish, and calico scallop trawl fisheries. Regulation of fisheries in "Phase II," which included sheepshead, black drum, king whiting, porgy, southeastern U.S. shrimp (skimmer trawl and trynets), Spanish sardine, scad, ladyfish, squid, mackerel, butterfish, and Northeast multispecies (large- and small-mesh) trawl fisheries, would be evaluated for subsequent rulemaking. Finally, "Phase III" regulations would be developed for the skate, horseshoe crab, monkfish, bluefish, spiny dogfish, and herring trawl fisheries, and any other trawl fisheries not previously identified or considered. The NOI and scoping document acknowledged, however, that the implementation sequence could shift as testing results are obtained and new information about additional trawl fisheries is received. Furthermore, in June 2010, NMFS prepared but never published an emergency rule in accordance with Section 4(b)(7) of the ESA (16 U.S.C. 1533(b)(7)) to require TEDs for all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing in Mississippi and Alabama state waters. Before the emergency rule could be implemented, however, oil from the DWH oil spill event reached Mississippi Sound, and the states closed their waters to all fishing.

1.2.2 TED Compliance Issues

Based on evaluation and testing of various TED designs, NMFS has determined that a well installed and maintained TED will result in an approximate 95 to 98 percent turtle exclusion efficiency rate

(J. Gearhart memo to S. Epperly, NMFS, March 29, 2011); the lower efficiency rate was documented for smaller turtles used in NMFS' small turtle testing protocol between 2001-2010, which relies on 2- to 3-year old juvenile turtles, while the higher efficiency rate was documented in NMFS' wild turtle testing protocol between 2002-2007, which typically witnesses larger turtles on average (as compared to the small turtle testing protocol). That is, even a fully-compliant TED may experience incidental catch of sea turtles due to a variety of factors including environmental conditions, individual turtle behavior, etc.

Over the past two years, NMFS has documented significant compliance issues with TED requirements in the shrimp fisheries (i.e., otter trawl fisheries that currently require TEDs). During numerous evaluations conducted in both the Gulf of Mexico and Atlantic Ocean, NMFS gear experts have noted two issues of utmost concern: TEDs with excessively steep grid angles (i.e., installed at angles above the 55-degree maximum angle) and escape openings with insufficient measurements (i.e., less than the required minimum measurements). Steep TED-grid angles are of particular concern to small, juvenile sea turtles, as past evaluation by gear experts from the NMFS Southeast Fisheries Science Center (SEFSC) Harvesting Systems Branch in Pascagoula, Mississippi, documented even small variances above the 55-degree maximum angle will prevent sea turtles from escaping the net. In many instances, fishermen may not realize these steep angles are resulting in sea turtle capture, and likely sea turtle mortality, as the turtles may fall off the grid and out of the net during haul-back and never be observed. In contrast, escape openings with insufficient measurements will prevent larger, adult sea turtles from escaping the net. NMFS has observed issues with both single- and double-cover escape opening cuts. For example, one particular net inspected with a single-cover escape opening had a horizontal forward cut that would only stretch to 55 inches (71-inch regulatory minimum), and possessed side cuts that were only 11 inches in length (26-inch regulatory minimum). Aside from these two critical issues, NMFS has also noted a host of other discrepancies with TED requirements, including excessive overlap of double-cover escape opening panel flaps, bar spacing in excess of the 4-inch maximum, improper flotation, excessive escape panel flap length beyond 24 inches, and other technical issues. While these issues may not represent as significant a threat as steep TED angles and insufficient escape openings, they still can hinder turtle escapement from a trawl net.

During inspections over the past two years, NMFS documented some fleets were more compliant with TED regulations than others. In some cases, NMFS' gear experts were hard pressed to find vessels possessing a single fully-compliant TED. For instance, during April 2011 evaluations in Biloxi, Mississippi, NMFS' gear experts only found 1 vessel out of 14 that was outfitted with completely legal TEDs in its nets (M. Barnette, NMFS, May 2, 2011, memorandum to D. Bernhart, NMFS). While NMFS acknowledges that fishing gear constantly needs mending due to attrition, these findings are extremely troubling. Deficiencies in TED installation were not limited to shrimp vessels, however, as inspections have revealed numerous net shops manufacturing and selling deficient TEDs. Per 50 CFR 223.205(b)(14), it is unlawful for any person to sell, barter, trade or offer to sell, barter, or trade, a TED that is not an approved TED. While fishermen are ultimately responsible for the gear they fish, the selling of brand-new gear that violates federal TED requirements demonstrates the significance and extent to which the shrimp fisheries were plagued with TED compliance issues. Due to all these compliance issues, NMFS increased efforts to improve compliance via TED workshops with fishermen, increased enforcement patrols from the

NMFS Office of Law Enforcement (OLE), as well as increased outreach efforts and courtesy inspections from the GMT.

Observed compliance has been improving as a result of these increased TED inspections and enforcement activities, as well as through outreach efforts and TED workshops conducted by the GMT and the industry groups Southern Shrimp Alliance and Gulf and South Atlantic Fisheries Foundation. When the increased inspection effort was initiated, observed compliance was very low. Since that time, OLE and GMT have received numerous requests to conduct courtesy TED inspections to verify compliance with TED requirements prior to fishing. In early May 2011, the observed compliance rate rose quickly to approximately 60 percent, then upwards to about 68 percent at the beginning of June 2011. By mid-July 2011, inspection data shows an observed compliance rate of nearly 87 percent.

NMFS' OLE has only 13 special agents and 1 enforcement officer in six duty stations (Harlingen, Texas; Galveston, Texas; Slidell, Louisiana; Niceville, Louisiana; St. Petersburg, Florida; and Marathon, Florida) to address all NOAA enforcement concerns in the Gulf of Mexico region. As a result, NMFS relies heavily on the U.S. Coast Guard and state law enforcement agencies for patrol and monitoring enforcement services. Gulf of Mexico coastal states are authorized to enforce NMFS' laws and regulations through the Cooperative Enforcement Program, and funding for patrol services related to federal laws is received through the Joint Enforcement Agreement (JEA) program. The one exception is Louisiana, which participates in all aspects of the JEA except for TED enforcement; Louisiana Revised Statutes 56:57.2 prohibits state agents from enforcing federal TED regulations.

Over the past two years, it has become apparent that TED inspection efforts by the U.S. Coast Guard and some state enforcement agencies have been sub-optimal. Inconsistent inspection protocol, and in some instances, improper inspection protocol, have led fishermen to believe they possessed adequate TEDs when, in actuality, they were deficient. In some cases, this has led to inaccurate TED compliance statistics that did not reflect true compliance within the fisheries. NMFS is working with its enforcement partners to resolve these issues, and in the interim, is depending on OLE and GMT inspections to determine compliance within the fisheries.

Adequate enforcement is needed to insure compliance with federal TED requirements. This issue is particularly important should TEDs be required for inshore vessels currently operating under alternative tow time restrictions, given that the majority of all skimmer trawl vessels in the southeastern U.S. operate in Louisiana waters, where state law prohibits the enforcement of TED regulations by state law enforcement officers. The Louisiana Revised Statutes (56:57.2) state, "The department shall not enforce any federal law which requires the use of turtle exclusion devices by commercial fishermen in Louisiana waters until such devices have been thoroughly and scientifically tested; have been proven to work efficiently with an acceptable amount of loss of commercial catch; have been shown not to cause damage to the state's waterbottoms or other fishery structures or resources; and it has been demonstrated that the use of such devices will appreciably contribute to the attainment of a specific goal." While NMFS has offered to present information to adequately satisfy these criteria, Louisiana has not revisted the issue.

1.2.3 Analysis of Background Information

Based on the available information discussed in this DEIS, potential explanations or scenarios for the elevated sea turtle strandings include the following, either individually or in concert: (1) increased sea turtle strandings are an artifact of increased Sea Turtle Stranding and Salvage Network (STSSN) effort, and sea turtle strandings have not substantially changed in the past few years; (2) increased sea turtle strandings are due to undocumented/undetermined effects of the DWH oil spill event; (3) increased sea turtle strandings are a result of increased sea turtle abundance (i.e., Kemp's ridley sea turtles) based on increased nesting numbers; (4) increased sea turtle strandings are due to incidental bycatch in shrimp trawls stemming from poor compliance with TED requirements and/or alternative tow time restrictions; and/or (5) increased sea turtle strandings are a result of some other unknown cause.

1.3 SCOPING

On June 24, 2011, NMFS published in the *Federal Register* notice of its intent to prepare an environmental impact statement and to conduct scoping meetings, and made available a scoping document presenting various approaches to addressing incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries (76 FR 37050); the scoping period ended on August 23, 2011. Six public scoping meetings were conducted to discuss recent sea turtle strandings, potential issues within the southeastern U.S. shrimp fisheries that may relate to these strandings, and potential management alternatives to reduce incidental sea turtle bycatch and mortality in the shrimp fisheries. Estimated attendance was approximately 100-150 individuals at the July 12 Gray, Louisiana meeting; 350-400 at the July 12 Belle Chasse, Louisiana meeting; 100-150 individuals at the July 13 Biloxi, Mississippi meeting; 100 individuals at the July 14 Bayou La Batre, Alabama meeting; and 50 individuals at the July 18 Morehead City, North Carolina meeting. State Representatives and/or legislative aides were in attendance at all the Gulf state meetings. Due to a large turnout of Vietnamese fishermen and a lack of adequate translation services at the July 13 Biloxi, Mississippi meeting, an additional meeting with full translation services was scheduled at Biloxi, Mississippi on July 26, which resulted in about 50 individuals in attendance.

Public comment offered at all of the scoping meetings conducted in Gulf states favored the no action alternative. Most commenters expressed significant anger at NMFS for blaming sea turtle strandings on the shrimp fisheries, particularly with the perceived lack of evidence and absence of any evaluation on the effects of the DWH oil spill event and subsequent oil dispersant use. Commenters pointed out strandings were relatively low prior to the DWH oil spill event in 2010, and fishing effort was basically non-existent during the spring 2011 strandings spike. Comments specific to TEDs in skimmer trawls asserted that TEDs would not work in the shallow (e.g., 4 feet of water) and muddy Louisiana waters, and that NMFS has yet to conduct any work to evaluate that fishery, particularly TED viability, in Louisiana. There were also numerous comments addressing potential safety at sea issues should TEDs be required on small skimmer boats. Additional comments discussed the hardships facing the shrimp fisheries, such as high fuel prices, imports, etc., and that overall effort has been radically reduced; any further regulations would jeopardize the fishery. Comments received by the state of North Carolina focused on the differences of their skimmer fishery (e.g., declining skimmer effort, small skimmer boats not working in deeper water) and confusion as to why they were being included in an issue that appeared largely focused to the Northern Gulf of Mexico (i.e., elevated sea turtle strandings in the Northern Gulf of Mexico).

Over 83,200 responses on the June 2011 NOI and scoping document, including approximately 26 unique comments and submitted information, 199 form letters from commercial fishermen, approximately 2,870 form e-mails from environmental groups, 37,998 signatures on a sign-on response from Oceana, and 42,130 signatures on a sign-on response from Defenders of Wildlife were received in writing or e-mail during the scoping period that ended on August 23, 2010. These responses, as well as comments received during the six scoping meetings, are summarized and listed below in Table 1. The comments received during the scoping period, along with the best available information regarding the current status of listed sea turtles species and new information on the effects of the shrimp fisheries on sea turtles, as well as other factors potentially contributing to the recent sea turtle stranding events, have informed the preferred alternative and the range of alternatives considered in this DEIS.

Table 1. Summary of Public Comments Received on June 2011 NOI and Scoping Document

COMMENT	CATEGORY
Make TEDs mandatory in all trawl nets, especially skimmer trawls.	Proposed Alternative
Implement shrimp trawl fishery time and area closures April through July out to the EEZ when sea turtle breeding and nesting takes place and/or when sea turtle abundance in shrimping zones is highest.	Proposed Alternative
Conduct a detailed analysis of sea turtle abundance, fishing effort, and stranding patterns to determine hotspots of sea turtle mortality in the fishery.	Rejected Alternative (Dynamic Area Management)
Increase TED enforcement to ensure 100 percent compliance with all laws at all times in all states.	Outside of Scope
Ensure increased efforts to enforce proper use of required TEDs on all shrimp trawl nets over the entire shrimping season.	Duly Noted
Take immediate action to enforce tow times, and ideally, reduce tow times for skimmers.	Duly Noted; Rejected Alternative
Increase observer coverage on shrimp trawl vessels to 50 percent or greater to track improvements and collect new data.	Rejected Alternative
Reduce the number of federal shrimp licenses (through a buy-back program).	Outside of Scope
Reduce the allowable size of shrimp nets.	Rejected Alternative
Require vessel monitoring systems on all shrimp trawlers.	Outside of Scope
Require all states that allow shrimping to record which trawl gear type is being used.	Outside of Scope
Establish federal funding for the STSSN.	Outside of Scope
Require all states that permit commercial shrimp fishing to participate in and submit weekly reports to the STSSN.	Outside of Scope
It does not stand to reason that the (Mississippi) shrimp fishery, which had been reduced from a high of 1,650 shrimp vessels in 2001 to less than 600 vessels in 2011 resulted in the highest sea turtle strandings on record. It is obvious there are causes other than the shrimping industry that need to be investigated and addressed.	Analyzed
According to aerial surveys and marine patrol reports during January 15 through April 30, 2011, the most shrimp trawl vessels (all otter trawls) observed working in Mississippi waters was eight, and on many other occasions there were no vessels observed. It would be highly unlikely, if not impossible, for a maximum of eight shrimp trawl vessels to be responsible for the hundreds of sea turtles stranded. It is obvious there are causes other than the shrimping industry that need to be investigated and addressed.	Analyzed

When Mississippi opened up all waters to shrimping on May 25, 2011, 162 trawl vessels were working (which was the second lowest effort for a season opener in Mississippi history), yet strandings declined. It is obvious there are causes other than the shrimping industry that need to be investigated and addressed.	Analyzed
During the period 2005-2009, when sea turtle strandings averaged 16 turtles from March through June, Mississippi shrimp effort was at least double as that documented in 2010-2011. It is obvious there are causes other than the shrimping industry that need to be investigated and addressed.	Analyzed
For the past 10 years, Mississippi regulations have limited headrope and footrope dimensions to 25 and 32 feet, respectively, and the most effective use of skimmer trawls in Mississippi waters is limited to water depths no greater than 15-20 feet.	Duly Noted
Shrimpers are using the same gear today that they used prior to 2010. There is less shrimping effort in Mississippi today as compared to years prior to 2010.	Duly Noted
With increased sea turtle hook strandings, it is important to make all Northern Gulf of Mexico anglers and charter fishermen aware of sea turtle saving options through an aggressive outreach program.	Duly Noted
A necessary option would increase NOAA outreach to all Gulf of Mexico recreational and commercial fishermen and boaters, including non-fishery work boats. NOAA should step up outreach to all user groups that interact with sea turtles with specific Gulf of Mexico work or provide funding to states for this needed activity.	Outside of Scope
Closing shrimping grounds and/or requiring additional gear will affect far more than just commercial trawlers, as it will affect shrimp dealers, processors, restaurants, fuel and all other suppliers.	Analyzed
Require NOAA training and certification for all manufacturers of TEDs to insure accurate building specifications and proper installation.	Rejected Alternative
Require at least one commercial fisherman aboard a shrimp vessel be certified in proper TED installation and sea turtle stranding responses including turtle resuscitation procedures.	Rejected Alternative
Support for the no action alternative.	Proposed Alternative
Temporarily suspend present TED regulations.	Contrary to Purpose and Need
There is a disconnect between sea turtle strandings and shrimp fisheries effort, suggesting another cause for strandings in spring 2011.	Duly Noted
Drawing inferences from necropsies on sea turtles are circumstantial and highly subjective.	Analyzed
Elevated spring strandings may be an annual phenomenon not related to the shrimp fisheries.	Duly Noted
Defer any consideration of additional management measures until after the results of a new biological opinion are fully understood and considered.	Proposed Alternative
Sea turtle strandings in 2010 were an aberration.	Analyzed
New regulatory measures are unnecessary to address compliance issues observed within the otter trawl sector of the shrimp fisheries.	Proposed Alternative
There is insufficient data to support requiring TEDs for skimmer trawls.	Analyzed
There is insufficient data to support time/area closures.	Analyzed
Immediately retract and cease further unsubstantiated claims relative to the cause of sea turtle deaths.	Outside of Scope
Determine, through independent peer-reviewed scientific investigation the primary cause of sea turtle deaths, including the impacts of the DWH oil spill event, dispersants, and bacteria.	Analyzed
Take any other necessary action to protect sea turtles from exposure to oil spills, toxic dispersants, untested bacterial oil spill response, other pollution, and dredging activities.	Outside of Scope
Prepare an EIS to reduce mortality of sea turtles resulting from oil and gas activities in the Gulf of Mexico, and close waters in the Gulf of Mexico to oil drilling, spraying of dispersants, or use of biological response until this EIS is completed.	Outside of Scope
TEDs on shrimp boats are dangerous.	Duly Noted

Carefully review the December 2010 decision by Judge Oliver W. Wanger in the *Delta Smelt Consolidated Cases*, 09-00407 (Eastern District of California).	Duly Noted
Sea turtle nesting is steadily increasing and new regulations are not warranted.	Proposed Alternative
INFORMATION REQUESTS FOR INCLUSION IN THE DEIS	
Closely consider Senator David Vitter's analysis of various inappropriate assumptions and inadequate science regarding numerous issues regarding loggerhead turtle data and other issues relevant to these matters[1].	
Incorporate the concepts of Dr. Benny Gallaway's preliminary analysis on sea turtle strandings.	
There is a need for standardized strandings data to reflect rate of coverage pre- and post-DWH oil spill event.	
Evaluate habitat impacts of bottom trawling, including resuspension of sediments contaminated by the DWH oil spill event, on Gulf sturgeon and smalltooth sawfish.	
There is an immediate need for an assessment of sea turtle populations and distribution prior to any new regulations.	
Please provide evidence there has been a documented increase in non-compliance (in alternative tow time restrictions for skimmer trawls) that could theoretically explain the increased strandings, despite greatly reduced trawling effort.	
Significance of shrimping-related sea turtle injuries, deaths, and strandings on sea turtle populations in the context that populations of some species, Kemp's ridley and possibly loggerhead (Caretta caretta), in the southeastern U.S. are increasing despite all natural and anthropogenic causes of mortality.	
Trends, current levels, and temporal-spatial distributions of standardized shrimping effort, by type of fishing unit (vessel, boat, stationary platform) and gear type.	
All available data from the electronic log book program should also be evaluated and applied to assess the decline in annual shrimping effort and possible changes in its temporal-spatial distributions as they relate to sea turtle-shrimping interactions leading to sea turtle injuries, deaths, and strandings.	
Trends, current levels, and temporal-spatial distribution of shrimping-associated rates of sea turtle injuries, deaths and strandings, by shrimping unit (vessel, boat, and platform) and gear type, in federal and state waters.	

[1] **Senator Vitter has not made available the cited analysis.**

Category Key: *Analyzed* = comment is addressed in the DEIS; *Proposed Alternatives* = comment is an element in one or more of the proposed alternatives; *Rejected Alternatives* = comment relates to regulatory alternatives considered but rejected by NMFS; *Outside of Scope* = comment falls outside the scope of the current regulatory action; *Duly Noted* = NMFS acknowledges the comment, but responding is difficult because the commenter did not articulate specific concerns, did not suggest concrete alternatives, or did not substantiate the position advocated; *Contrary to Purpose and Need* = comment would impede the protection and recovery of listed sea turtle populations.

2 MANAGEMENT ALTERNATIVES

After consideration of the best scientific information available and comments received during the scoping process, NMFS identified seven alternatives including the no action alternative. These alternatives are within the scope of NMFS' authority under the ESA, are technically feasible, and meet the purpose and need of this action. The basis for each alternative considered is included under the summary of the alternative. NMFS utilized all available scientific data to develop a preferred alternative (Alternative 2c), described below. An additional five alternatives, also described below, were considered but rejected from further analysis.

2.1 Alternative 1: No Action

This alternative would allow the shrimp fisheries to be fished in the same manner as they are currently fished as described in Section 2.1.1. The current TED requirements would remain in place and no additional measures would be required to reduce potential sea turtle interactions.

2.2 Alternative 2: Tow Time Restriction

The following two sub-alternatives address the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*) regarding skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls).

2.2.1 Alternative 2a: Amend Alternative Tow Time Restriction, Which Would Require Vessels 30 Feet and Greater in Length Using Skimmer Trawls, Pusher-Head Trawls, and Wing Nets (Butterfly Trawls) To Use TEDs

This alternative would amend the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*) and only apply to vessels less than 30 feet in length, thereby requiring vessels 30 feet and greater in length employing skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets.

2.2.2 Alternative 2b: Amend Alternative Tow Time Restriction, Which Would Require Vessels 20 Feet and Greater in Length Using Skimmer Trawls, Pusher-Head Trawls, and Wing Nets (Butterfly Trawls) To Use TEDs

This alternative would amend the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*) and only apply to vessels less than 20 feet in length, thereby requiring vessels 20 feet and greater in length employing skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets.

2.2.3 Alternative 2c (Preferred Alternative): Amend Alternative Tow Time Restriction, Which Would Require All Vessels Using Skimmer Trawls, Pusher-Head Trawls, and Wing Nets (Butterfly Trawls) To Use TEDs

This alternative would withdraw the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*), and require all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets.

2.3 Alternative 3: Time/Area Closure

The following four sub-alternatives would implement time/area closures for the shrimp fisheries.

2.3.1 Alternative 3a

Close all shrimp fishing in state waters from the Texas-Louisiana state boundary, eastward to the Alabama-Florida state boundary from March 1 through May 31.

2.3.2 Alternative 3b

Close all shrimp fishing in state waters from the Louisiana-Mississippi state boundary, eastward to the Alabama-Florida state boundary from March 1 through May 31.

2.3.3 Alternative 3c

Close all shrimp fishing in state waters from the Texas-Louisiana state boundary, eastward to the Alabama-Florida state boundary from April 1 through May 15.

2.3.4 Alternative 3d

Close all shrimp fishing in state waters from the Louisiana-Mississippi state boundary, eastward to the Alabama-Florida state boundary from April 1 through May 15.

2.4 Alternatives Considered But Rejected

NMFS considered a number of other alternatives to minimize the injury or mortality of sea turtles in trawl fisheries. For the reasons described below, these alternatives were rejected from further analysis in this DEIS.

NMFS' Certification of TEDs, TED Manufacturers, or Vessel Crew

NMFS' certification of TEDs, either at the time of construction and/or an annual certification, or NMFS' certification of TED manufacturers, were offered as a potential management alternatives to address TED compliance issues. Specific suggestions included requiring a NMFS stamp on the TED grid to identify the gear as compliant with federal TED requirements.

This alternative has been explored by NMFS in the past, however, it was determined that it was not appropriate nor would it fully address TED compliance issues. Federal TED requirements include minimum dimensions for escape openings, an acceptable range of angle for the TED grid, as well as other important criteria (e.g., bar spacing, flotation, etc.). NMFS has made it clear that a TED is a piece of gear that requires maintenance to insure compliance. Fishery conditions may damage or alter TED function. Additionally, intentional or unintentional alterations of the TED may render it non-compliant. Therefore, any certification would only demonstrate the TED was compliant at the time of inspection. Furthermore, TED certification may instill a false sense of confidence of gear performance and fishermen may neglect to maintain their TEDs. In relatively short order, a “legal” TED could become “illegal” and present an entrapment risk to sea turtles. Therefore, NMFS has determined this alternative would not be effective at reducing incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries.

Similar to the NMFS' certification of TEDs, requiring the certification of at least one crew member in the installation and maintenance of TEDs was offered as a potential management alternative. While additional training would likely prove beneficial at improving TED compliance, NMFS determined this would not fully address issues observed within the fishery, and it would potentially introduce significant burden and conflicts to the fisheries. Requiring a crew member to possess certified training could prove problematic in regards to documentation, especially with turnover of crew within the fisheries. A potential solution to this issue would be to require vessel owner certification. Certification, however, would not absolve a vessel from complying with TED requirements, which have been static and not changed since 2004, are well documented, and information is readily available. Yet, NMFS is pursuing voluntary outreach efforts to supplement available information on TED requirements to bolster TED compliance within the fisheries.

Reduction of Alternative Tow Times

The current alternative tow time restrictions specify tow times are not to exceed 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 (50 CFR 223.206(d)(3)(i)(A) and (B)). Sasso and Epperly (2006) suggest that these current tow times may not be conservative enough, and could result in sea turtle mortality. They documented sea turtle mortalities occur after only 10 minutes of towing in winter months, although mortality rates did not exceed 1 percent until tows reached 50 minutes in summer months (Sasso and Epperly 2006). For both seasons, tows of greater than 50 minutes resulted in a rapid escalation of mortality rates (Sasso and Epperly 2006, Henwood and Stuntz 1987). Regardless, tow times restrictions are difficult to enforce. Documentation of a tow time violation would require enforcement personnel to be in close proximity of a skimmer trawl to monitor gear deployment and recovery, whereupon they would have to record the time when the codend enters the water until it is removed (50 CFR 223.206(d)(3)(i)). Therefore, NMFS has determined this alternative was not worth further consideration.

Dynamic Area Management

Comments submitted during the scoping period suggested implementing dynamic area management based on seasonal sea turtle abundance (i.e., “hotspots”), water temperature, etc. That is, closed areas/seasons would be based on real-world thresholds. While the concept may have merit, it unfortunately is not practical given the requirements needed to monitor sea turtle abundance and identifying habitat “hotspots,” determining criteria for opening and closing areas, not to mention the potential issues related to conveying this information in a timely fashion to fisheries that span several states and into federal waters. Therefore, to avoid confusion within the fishery due to potentially rapid openings and closings that could vary from one year to the next, NMFS has determined this alternative is not viable; however, static time/area closures are considered as reasonable alternatives in Section 2.2.3.

Reduce the Allowable Size of Shrimp Nets

The reduction in the allowable size of shrimp nets was offered as an alternative during the scoping period. While a reduction in the size (e.g., maximum allowable footrope length) of a shrimp trawl net may reduce sea turtle interactions, it would not prevent sea turtle mortality of those turtles that would still invariably be captured in nets that are not equipped with TEDs, such as skimmer trawls. Additionally, an increase in effort could negate any reduction in sea turtle interactions occurring due to a reduction in net size. Therefore, NMFS has determined this alternative would not be effective in protecting and recovering listed sea turtle populations.

Expansion of Observer Coverage

Several comments received during the scoping process recommended increasing observer coverage on shrimp trawl vessels to 50 percent or greater, in order to track improvements in TED compliance and collect new data. Specifics of the regionally managed observer programs can be found on the NMFS National Observer Program’s website (http://www.st.nmfs.gov/st4/nop/), which has links to each regional observer program and in the 2008 National Observer Program Annual Report (NMFS

2009a). The Southeast Regional Observer Program observes the shrimp fisheries; Atlantic, Gulf of Mexico, and Caribbean pelagic longline fisheries; Gulf of Mexico reef fish fishery; directed large coastal shark bottom longline fisheries; and the Southeast shark gillnet fishery. Fisheries that are not federally managed, such as those that occur exclusively in state waters, are currently unlikely to be monitored regularly by observers.

The Gulf of Mexico and South Atlantic shrimp fisheries currently have approximately 2 and 1 percent observer coverage, respectively. While additional observer coverage may provide beneficial information, given the size of the shrimp fisheries (i.e., >5,000 total vessels), the need for observer coverage in other fisheries in both the Gulf of Mexico and South Atlantic, and current budgets and budget projections, NMFS is not in a position to increase observer coverage in the shrimp fisheries at this time. Fishery observers typically collect data on species composition of the catch, weights of fish caught, and disposition of landed species, though they may also collect information on protected species interactions. It is unlikely, however, that the fishery observer program would be able to provide definitive information on sea turtle bycatch in the shrimp fisheries, in of itself, due to the nature of sea turtle interactions with TEDs. Specifically, observers would not typically see interactions between sea turtles and deployed TEDs, nor would they be able to quantify sea turtle bycatch as turtles may fall out of the net during recovery and before an observer could see or document the event. Therefore, this alternative was not deemed to be practicable.

Even without a dedicated observer program, sea turtle mortalities in state and nearshore waters may be detected as elevated sea turtle strandings. The STSSN has become an important sentinel of nearshore sea turtle mortalities. The detection of sea turtle mortalities by the STSSN provided the first indications of sea turtle-fishery interactions in the summer flounder, large-mesh gillnet, and pound net fisheries in inshore and nearshore waters of the Mid-Atlantic. Subsequently, the observations and data collected by the STSSN supported the sea turtle conservation measures implemented to reduce bycatch in many of these fisheries.

Complete Closure of the Shrimp Fisheries in the Northern Gulf of Mexico

A complete closure of the shrimp fisheries in the Northern Gulf of Mexico (e.g., Louisiana, Mississippi, and Alabama state waters) would have massive impacts on the shrimp industry, as well as countless supporting businesses and local economies. Given the uncertainty into the exact cause of the increased sea turtle strandings in the Northern Gulf of Mexico, as well as the continued positive trend in Kemp's ridley sea turtle nesting (which comprise 84-85 percent of stranded sea turtles), closing the shrimp fisheries on a large scale was not deemed to be a reasonable alternative.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

This section describes the baseline conditions of important components of the environment in which the proposed action and alternatives would take place. The physical and environmental components of the affected area are described, followed by an account of important biological components, particularly sea turtles, marine mammals, listed fish species, and essential fish habitat (EFH) that may be affected by the shrimp fisheries. Last, human communities are discussed.

3.1 PHYSICAL AND BIOLOGICAL ENVIRONMENT

3.1.1 Gulf of Mexico Physical and Biological Environment

The physical and biological environment for Gulf of Mexico shrimp, as well as other species potentially affected by the alternatives considered in this DEIS, has been described in detail in the EIS for the Generic Essential Fish Habitat Amendment, and is incorporated herein by reference (GMFMC 2004). The Gulf of Mexico has a total area of approximately 600,000 square miles (1.5 million km^2), including state waters (Gore 1992). It is a semi-enclosed, oceanic basin connected to the Atlantic Ocean by the Straits of Florida and to the Caribbean Sea by the Yucatan Channel. Oceanic conditions are primarily affected by the Loop Current, the discharge of freshwater into the Northern Gulf, and a semi-permanent, anticyclonic gyre in the western Gulf. Gulf water temperatures range from 12°C to 29°C (54°F to 84°F) depending on time of year and depth of water. In the Gulf, adult penaeid shrimp are found in nearshore and offshore silt, mud, and sand bottoms while juveniles are found inhabiting estuaries.

The 2005 hurricane season, particularly Hurricane Katrina in late August 2005, resulted in significant impacts to the physical environment in the Northern Gulf of Mexico. Hurricane Katrina's storm surge resulted in massive flooding throughout the region, which in turn led to significant oil spills (i.e., millions of gallons) and the release of toxic materials such as raw sewage, pesticides, heavy metals, and a variety of other harmful chemicals. Debris from coastal communities littered marshes, estuaries, and other nearshore waters, potentially impacting nursery habitat such as oyster reefs. While hurricanes have historically altered the physical environment in the Northern Gulf of Mexico, due to the widespread and intense impacts to heavily-industrialized areas, the impacts of Hurricane Katrina extend beyond natural storm effects and may have a longer-lasting influence on the regional environment.

On April, 20, 2010, while drilling approximately 50 miles east-southeast of the Mississippi River Delta, Louisiana and 100 miles south of Dauphin Island, Alabama, the DEEPWATER HORIZON semi-submersible drilling rig experienced a catastrophic explosion due to a blowout. The fire burned out of control until the rig sank on April 22, 2010, which allowed the compromised well to release oil directly into the Gulf of Mexico. The well was temporarily capped on July 15, 2010, which significantly reduced the amount of leaking oil, but the well was not ultimately sealed and declared "effectively dead" until September 19, 2010. Estimates on the amount of released oil varied widely and over time, but final official estimates indicated 53,000 - 62,000 barrels were released per day as a result of the event; the total amount of oil released into the Gulf of Mexico was estimated at 4.9 million barrels (780,000m^3) (McNutt et al. 2011).

In the wake of the explosion and spill, approximately 2.1 million gallons of chemical dispersant were applied to surface waters (1.4 million gallons) and directly at the wellhead (0.77 million gallons) between May 15 and July 12, 2010[6]. COREXIT is a product line of solvents primarily used as a dispersant for breaking up oil slicks, and it (i.e., COREXIT 9527 and COREXIT 9500) was the most-used dispersant in the DWH oil spill event. COREXIT 9527 was replaced by COREXIT 9500 after the former was deemed too toxic; Unified Command records indicate that the last date of use of the COREXIT 9527 was May 22, 2010. According to the manufacturer, "When

[6] www.whitehouse.gov/blog/issues/Deepwater-BP-oil-spill (accessed November 3, 2010); from Kujawinski et al. 2011.

the COREXIT dispersants are deployed on the spilled oil, the oil is broken up into tiny bio-degradable droplets that immediately sink below the surface where they continue to disperse and bio-degrade. This quickly removes the spilled oil from surface drift and reducing direct exposure to birds, fish, and sea animals in the spill environment."

COREXIT 9527, considered by the EPA to be an acute health hazard, is stated by its manufacturer to be potentially harmful to red blood cells, the kidneys and the liver, and may irritate eyes and skin. The chemical 2-butoxyethanol, found in COREXIT 9527, was identified as having caused lasting health problems in workers involved in the cleanup of the EXXON VALDEZ oil spill. In contrast, COREXIT 9500, a combination of propylene glycol, is deemed to have low human and environmental risk according to the Materials Safety Data Sheet for the chemical. Its ingredients are not considered carcinogens, although no long-term exposure studies have been conducted on the solution. Furthermore, there is no information currently available on the effects of the dispersant on sea turtles, either by direct exposure or other avenues, such as bioaccumulation through foraging on prey species.

3.1.1.1 Gulf of Mexico Shrimp (Including EFH)

In the southeastern United States, the shrimp industry is based mostly on three shallow-water species of the family Penaeidae: white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), and pink shrimp (*Farfantepenaeus duorarum*). Rock shrimp (*Sicyonia brevirostris*) and royal red shrimp (*Pleoticus robustus*) are also fished in this region, but occur in deeper water than the three penaeid species. These shrimp species are fished by vessels operating under numerous jurisdictions (e.g., fishing for shrimp in various state or federal waters) and using a variety of gear (e.g., otter trawl, skimmer trawl, etc.). Additionally, many states have active recreational shrimp fisheries that employ a variety of gear, including trawls.

The federal Gulf of Mexico shrimp fishery is managed under the Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters (1981). Brown, white, and pink shrimp use a variety of habitats as they grow from planktonic larvae to spawning adults (GMFMC 1981). Brown shrimp eggs are demersal and occur offshore. The larvae occur offshore and begin to migrate to estuaries as postlarvae. Postlarvae migrate through passes on flood tides at night mainly from February-April with a minor peak in the fall. Postlarvae and juveniles are common to highly abundant in all U.S. estuaries from Apalachicola Bay in the Florida panhandle to the Mexican border. In estuaries, brown shrimp postlarvae and juveniles are associated with shallow vegetated habitats but also are found over silty sand and non-vegetated mud bottoms. Adult brown shrimp occur in neritic Gulf waters (i.e., marine waters extending from mean low tide to the edge of the continental shelf) and are associated with silt, muddy sand, and sandy substrates. More detailed discussion on habitat associations of brown shrimp is provided in Nelson (1992) and Pattillo et al. (1997).

White shrimp are offshore and estuarine dwellers and are pelagic or demersal, depending on life stage. The eggs are demersal and larval stages are planktonic; both occur in nearshore marine waters. Postlarvae migrate through passes mainly from May-November with peaks in June and September. Juveniles are common to highly abundant in all Gulf estuaries from Texas to about the Suwannee River in Florida. Postlarvae and juveniles inhabit mostly mud or peat bottoms with large quantities of decaying organic matter or vegetative cover. Migration from estuaries occurs in late August and September and appears to be related to size and environmental conditions (e.g., sharp temperature drops in fall and winter). Adult white shrimp are demersal and generally inhabit nearshore Gulf waters to depths less than 30 m on bottoms of soft mud or silt. See Nelson (1992) and Pattillo et al. (1997) for more detailed information on habitat associations of white shrimp. Pink shrimp occupy a variety of habitats, depending on their life stage. Eggs and early planktonic larval stages occur in marine waters. Eggs are demersal, whereas larvae are planktonic until the postlarval stage when they become demersal. Juveniles inhabit almost every U.S. estuary in the Gulf but are most abundant in Florida. Juveniles are commonly found in estuarine areas with seagrass where they burrow into the substrate by day and emerge at night. Adults inhabit offshore marine waters with the highest concentrations in depths of 9 to 44 m.

The three principal species (penaeids) of shrimp harvested by the shrimp fisheries are short-lived and provide annual crops. The condition of each shrimp stock is monitored annually, and none has been classified as being overfished for over 40 years (Nance et al. 2006). Brown shrimp is the most important species in the U.S. Gulf fishery with principal catches made from June through October. Annual commercial landings in recent years range from approximately 61 to 103 million pounds of tails depending on environmental factors influencing natural mortality. The fishery extends offshore to about 73 m. White shrimp, second in value, are found in near shore waters to about 37 m from Texas through Alabama. There is a small spring and summer fishery for overwintering individuals, but the majority is taken from August through December. Recent annual commercial landings range from approximately 36 to 71 million pounds of tails. Pink shrimp are found off all Gulf States but are most abundant off Florida’s west coast and particularly in the Tortugas grounds off the Florida Keys. Most landings are made from October through May with annual commercial landings ranging from approximately 6 to 19 million pounds of tails. In the northern and western Gulf states, pink shrimp are landed mixed with brown shrimp and are usually counted as browns. Most catches are made within 55 m.

Royal red shrimp is a deep-water species most abundant on the continental shelf from about 140 to 275 fathoms east of the Mississippi River. Unlike penaeid shrimp, which are short-lived and provide annual crops, royal reds live longer and several year classes may occur on the grounds at one time. Landings in the royal red shrimp fishery have remained below the maximum sustainable yield level of 392,000 pounds throughout the history of this fishery.

EFH for shrimp consists of Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Fort Walton Beach, Florida from estuarine waters out to depths of 183 m; waters and substrates extending from Grand Isle, Louisiana to Pensacola Bay, Florida between depths of 183 and 595 m; waters and substrates extending from Pensacola Bay, Florida to the boundary between the areas covered by the GMFMC and the SAFMC out to depths of 64 m, with the exception of waters extending from Crystal River, Florida to Naples, Florida between depths of 18 and 46 m; and in Florida Bay between depths of 9 and 18 m (GMFMC 2004).

3.1.1.2 Shrimp Fisheries Effort in the Northern Gulf of Mexico in 2010-2011

An analysis of the shrimp fisheries during 2010-2011 indicates effort in the spring of both 2010 and 2011 was significantly less than what typically occurs during the main shrimp season in early to mid June. In Mississippi, the 2010 sea turtle strandings exhibited two major spikes, the first beginning in week 17 (April 25 - May 1) and the second towards the end of week 22 (May 30 - June 5). The first spike correlated right after the DWH explosion and oil spill event, though oil did not reportedly wash up in any volume in Mississippi Sound until late June 2010. All Mississippi waters were closed to shrimping on April 30, which was at the beginning of the first reported spike in strandings. Therefore, shrimp effort does not appear to be involved with this spike. The second spike in strandings, however, correlated fairly closely with the opening and closing of the Mississippi shrimp season. Strandings began to increase at week 22 (May 30 - June 5), and the fishery opening occurred on June 3, 2010. Likewise, strandings decreased substantially at week 26 (June 27 - July 3), at the closing of all Mississippi state waters to fishing on July 2, and stayed relatively low for the remainder of the year, even with DWH oil occurring throughout Mississippi Sound. While this spike does correlate with the opening and closing of the summer shrimp season, effort during this time was low due to the DWH oil spill event. Many Mississippi shrimpers worked on the containment and clean up efforts during the DWH oil spill event; this effort shift is reflected in the June 3 opening day participation, which was a historic low of only 67 active shrimp trawlers. Regardless, this amount of effort could still result in significant turtle strandings if shrimp trawlers operated with improperly installed or maintained TEDs, or violated alternative tow time restrictions.

Available information indicates relatively low shrimping effort in Mississippi waters, as well as in Breton and Chandeleur Sounds in Louisiana, during spring 2011. The spring 2011 sea turtle stranding spike occurred primarily between weeks 11 (March 13 - 19) and 17 (April 24 - 30). From January 15 through April 30, 2011, Mississippi waters south of the Intracoastal Waterway (ICW) were open to shrimping; 173 sea turtle strandings were reported from Mississippi waters during this time period. According to MDMR aerial surveys conducted in April 2011, there were few shrimp trawlers observed during this time period. Specifically, on April 5, five shrimp trawlers were observed, four of which were anchored and one was in transit; on April 6, five shrimp trawlers were observed, three of which were actively fishing, and two were in transit; on April 12, five shrimp trawlers were observed, three of which were in transit and two were anchored; on April 14, eight shrimp trawlers were observed, five of which were in transit and three were anchored; on April 21, two shrimp trawlers were observed, one of which was actively fishing and one was in transit; and on April 25, seven shrimp trawlers were observed, five of which were in transit and two were actively fishing. All of the observed vessels were otter trawlers. These surveys were conducted during daylight hours, whereas (otter trawl) shrimping effort typically occurs at night. Skimmer boats typically conduct “day trips,” returning to the dock after a trip rather than anchoring offshore and, thus, their effort would be captured by the daytime aerial surveys, to the extent it was occurring in the survey area. From March 28 through May 17, 2011, MDMR Marine Patrol observed a total of 27 different shrimp trawlers, as well as 3 live bait shrimp vessels, offshore in Mississippi waters; 6 of these trawlers reportedly had no net on board. Likewise, according to preliminary LADWF data, only 8 vessels worked in Breton and Chandeleur Sounds in March, landing 27,316 pounds of shrimp; 29 vessels worked the sounds in April, landing 123,949 pounds of shrimp; increased effort was observed in May, with 136 vessels landing 354,054 pounds of shrimp, but this increase in effort occurred at the end of the 2011 stranding spike in week 18 (May 1 - 7). This information, as well as anecdotal information and additional surveys conducted by the GMT, indicated there were relatively few shrimp vessels working in the Mississippi Sound area, as well as throughout Breton and Chandeleur Sounds in Louisiana, during spring 2011.

While shrimp trawl effort may have been low in Mississippi Sound, as well as throughout Breton and Chandeleur Sounds in Louisiana, an overlap of abundant sea turtles and non-compliant shrimp trawlers (i.e., otter trawlers with TED issues or skimmer trawlers exceeding alternative tow time restrictions) in the same area could result in elevated incidental sea turtle bycatch and mortality. Alternatively, in areas of intense fishing effort and high sea turtle abundance, repeated interactions with compliant shrimp trawlers could still lead to elevated bycatch mortality, as sea turtles may not have sufficient time to recover between each interaction. Subsequently, should this occur in an area fairly close to shore, these scenarios could be reflected in elevated sea turtle strandings.

3.1.1.3 Other Gulf of Mexico Marine Harvested Species (Including EFH)

Information on other species can be found in the six other GMFMC fishery management plans (FMPs) and their subsequent amendments, and are incorporated herein by reference: Fishery Management Plan for the Red Drum Fishery of the Gulf of Mexico (GMFMC 1986); Fishery Management Plan for the Reef Fish Fishery of the Gulf of Mexico (GMFMC 1982); Fishery Management Plan for Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic (GMFMC and SAFMC 1985); Fishery Management Plan for the Stone Crab Fishery of the Gulf of Mexico (GMFMC 1979); Fishery Management Plan for Spiny Lobster in the Gulf of Mexico and South Atlantic (GMFMC and SAFMC 1982a); and the Fishery Management Plan for Coral and Coral Reefs of the Gulf of Mexico and South Atlantic (GMFMC and SAFMC 1982b). Information on EFH for GMFMC-managed species is included in the EIS for the Generic Essential Fish Habitat Amendment, and is incorporated herein by reference (GMFMC 2004).

3.1.2 South Atlantic Physical and Biological Environment

The physical and biological environment for the South Atlantic region, including that of South Atlantic shrimp and other species potentially affected by the alternatives considered in this DEIS, has been described in detail in the Fishery Ecosystem Plan of the South Atlantic Region, and is incorporated herein by reference (SAFMC 2009).

3.1.2.1 South Atlantic Shrimp (Including EFH)

In the southeastern United States, the shrimp industry is based mostly on three shallow-water species of the family Penaeidae: white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), and pink shrimp (*Farfantepenaeus duorarum*). Rock shrimp (*Sicyonia brevirostris*) and royal red shrimp (*Pleoticus robustus*) are also fished in this region, but occur in deeper water than the three penaeid species. The federal South Atlantic shrimp fishery is managed under the Shrimp Fishery Management Plan for the South Atlantic Region (SAFMC 1993).

White shrimp range from Fire Island, New York, to St. Lucie Inlet on the Atlantic Coast of Florida, and from the Ochlockonee River on the Gulf Coast of Florida to Ciudad Campeche, Mexico. Along the Atlantic Coast of the U.S., the white shrimp is more common off South Carolina, Georgia, and northeast Florida. White shrimp are generally concentrated on the continental shelf where water depths are 89 feet (27 m) or less, although occasionally they are found much deeper (up to 270 feet) (SAFMC 1998).

Brown shrimp occur from Martha's Vineyard, Massachusetts to the Florida Keys and northward into the Gulf to the Sanibel grounds. The species reappears near Apalachicola Bay and occurs around the Gulf Coast to northwestern Yucatan. Although brown shrimp may occur seasonally along the Mid-Atlantic States, breeding populations apparently do not occur north of North Carolina. The species may occur in commercial quantities in areas where water depth is as great as 361 feet (110 m), but they are most abundant in areas where the water depth is less than 180 feet (55 m) (SAFMC 1998).

Pink shrimp occur from southern Chesapeake Bay to the Florida Keys and around the coast of the Gulf of Mexico to Yucatan south of Cabo Catoche. Maximum abundance is reached off southwestern Florida and the southeastern Gulf of Campeche. Along the Atlantic coast of the U.S. pink shrimp are of major commercial significance only in North Carolina and the Florida Keys. Pink shrimp are most abundant in areas where water depth is 36-121 feet (11-37 m) although in some areas they may be abundant where water depth is as much as 213 feet (65 m) (SAFMC 1998).

For penaeid shrimp, EFH includes inshore estuarine nursery areas, offshore marine habitats used for spawning and growth to maturity, and all interconnecting water bodies as described in the Comprehensive Amendment Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region (SAFMC 1998). Inshore nursery areas include tidal freshwater, estuarine, and marine emergent wetlands (e.g., intertidal marshes); tidal freshwater forested areas; mangroves; tidal freshwater, estuarine, and marine submerged aquatic vegetation (e.g., seagrass); and subtidal and intertidal non-vegetated flats. This habitat is found from North Carolina through the Florida Keys.

In North Carolina, HAPCs for penaeid shrimp include estuarine shoreline habitats where juvenile shrimp congregate. Seagrass beds, prevalent in the sounds and bays of North Carolina and Florida, are particularly critical areas. South Carolina and Georgia lack substantial amounts of seagrass beds. Here, the shrimp nursery habitat is the high marsh areas that offer shell hash and mud bottoms. In addition, juvenile shrimp move seasonally out of the marsh into deep holes and creek channels adjoining the marsh system during winter. Therefore, the area of particular concern for early growth and development encompasses the entire estuarine system from the lower salinity portions of the river systems through the inlet mouths.

3.1.2.2 Other South Atlantic Marine Harvested Species (Including EFH)

Information on other species can be found in the seven other FMPs (and their subsequent amendments) of the SAFMC, and are incorporated herein by reference: Fishery Management Plan for Coastal Migratory Pelagic Resources (Mackerels) in the Gulf of Mexico and South Atlantic (GMFMC and SAFMC 1985); Fishery Management Plan for Spiny Lobster in the Gulf of Mexico and South Atlantic (GMFMC and SAFMC 1982a); Fishery Management Plan for Coral and Coral Reefs of the Gulf of Mexico (GMFMC and SAFMC 1982b); Fishery Management Plan for the Dolphin and Wahoo Fishery of the Atlantic (SAFMC 2003); Fishery Management Plan for the Golden Crab Fishery of the South Atlantic Region (SAFMC 1995); Fishery Management Plan for Pelagic Sargassum Habitat in the South Atlantic Region (SAFMC 2002); and the Fishery Management Plan for the Snapper Grouper Fishery of the South Atlantic Region (SAFMC 1983). Information on EFH for SAFMC-managed species is included in the Comprehensive Amendment

Addressing Essential Fish Habitat in Fishery Management Plans of the South Atlantic Region, and is incorporated herein by reference (SAFMC 1998).

3.2 SEA TURTLES

All sea turtle species occurring in the Atlantic Ocean are listed as either endangered or threatened under the ESA. The alternatives discussed in this DEIS may potentially affect five sea turtle species: the leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*), which are listed as endangered, and the loggerhead (*Caretta caretta*) Northwest Atlantic DPS and green (*Chelonia mydas*), which are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific coast of Mexico, which are listed as endangered.

The species discussions in this section will focus primarily on the Atlantic Ocean populations of these species, since these are the populations that may be affected by the proposed action. The following subsections are synopses of the best available information on the life history, distribution, population trends, and current status of the four species of sea turtles that are likely to be adversely affected by one or more components of the proposed action. Additional background information on the status of sea turtle species can be found in a number of published documents, including: recovery plans for the Atlantic green sea turtle (NMFS and USFWS 1991a), hawksbill sea turtle (NMFS and USFWS 1993), leatherback sea turtle (NMFS and USFWS 1992), and loggerhead sea turtle (NMFS and USFWS 2008), and sea turtle status reviews and biological reports (Conant et al. 2009; NMFS and USFWS 1995; TEWG 1998, 2000, 2007, and 2009).

3.2.1 Status of U.S. Atlantic Sea Turtle Populations

Thorough life history and status assessments of populations of sea turtles found in U.S. Atlantic waters can be found in the sea turtle recovery plans (NMFS and USFWS 1991a, 1991b, 1992, 1993, 1998a, 1998b, 2008; USFWS and NMFS 1992), and five-year reviews (NMFS and USFWS 1995, 2007a, 2007b, 2007c, 2007d, 2007e) and the loggerhead status review (Conant et al. 2009), which are incorporated herein by reference. A brief summary of the status of the species within U.S. Atlantic waters is given below.

All species of sea turtles that occur in U.S. waters are listed as threatened or endangered under the ESA. Two types of data are generally available to assess population trends: nesting data and in-water surveys. Given the normal variability in nesting activity between years, a long time series and standardized sampling methods, such as those used in the Florida index nesting beach surveys, are required to identify trends in the adult female population. Additionally, nesting data provides information about current egg production by the survivors from production a generation ago. The success or failure of current management measures on other life stages and the resultant positive or negative effects on those life stages are not immediately apparent in nesting trends.

The loggerhead recovery plan identified five recovery units for the Northwest Atlantic population of loggerhead sea turtles: Northern; Peninsular Florida; Dry Tortugas; Northern Gulf of Mexico; and Greater Caribbean Recovery Units. As described elsewhere in the DEIS, the Loggerhead Biological Review Team, convened in 2008, identified nine DPSs distributed globally, which were listed by NMFS and USFWS on September 22, 2011 (76 FR 58868); the DPS potentially affected by this DEIS is the threatened Northwest Atlantic Ocean DPS.

Florida accounts for more than 90 percent of the loggerhead nesting in the United States. An analysis of Florida's long term nesting data indicates that after a period of increased nest counts following listing protections, loggerhead nest counts declined 25 percent from 1998 to 2009. In 2010, loggerhead sea turtle nest numbers in Florida were above the average of the preceding 10-year period. The trend over the entire post-listing period of 1989 to 2010 suggests nest numbers may be stabilizing. Review of data from in-water sea turtle surveys provide further ambiguous information on loggerhead population trends. Both NMFS and USFWS (2008) and TEWG (2009) stress that population trend results currently available from in-water studies must be viewed with caution given the limited number of sampling sites, size of sampling areas, biases in sampling, and caveats associated with the analyses.

Green and leatherback sea turtles in Florida show a clearly increasing nesting trend over the same period. In 2010, the number of green and leatherback turtle nests on index beaches was the second highest since the trend monitoring program began in 1989 (FWRI 2010). Green turtle nests in Florida increased by a factor of 10 from 1989 through 2010 (FWRI 2010). An evaluation of threatened green sea turtle nesting sites was conducted as part of the five-year review of the species (NMFS and USFWS 2007a). The nesting groups of the Western Atlantic were considered to be doing relatively well (the number of sites with increasing nesting was greater than the number of sites with decreasing nesting) as were nesting groups in the Pacific and Central Atlantic (NMFS and USFWS 2007a). In contrast, the report concluded that nesting groups in Southeast Asia, the Eastern Indian Ocean, and perhaps the Mediterranean are doing relatively poorly (NMFS and USFWS 2007a).

Leatherbacks that occur in U.S. Atlantic coastal waters likely come from many Atlantic and Caribbean nesting beaches. Nest counts in many areas of the Northwest Atlantic Ocean show increasing trends (NMFS and USFWS 2007d). An analysis of seven Atlantic leatherback nesting groups showed an increasing or stable trend for all but the Western Caribbean and West African (no long-term data available) groups (TEWG 2007). In the Pacific Ocean, the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 10 to 20 years (NMFS and USFWS 2007d), and no reliable long-term trend data for the Indian Ocean populations are currently available.

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (USFWS and NMFS 1992; NMFS and USFWS 2007c), making the population easy to monitor but also vulnerable to concentrated threats. Nesting aggregations at Rancho Nuevo were discovered in 1947, and the adult female population was estimated to be in excess of 40,000 individuals based on a film by Andres Herrera (Hildebrand 1963; Carr 1963). Within approximately three decades, the population had declined to 924 nests, and it reached the lowest recorded nest count of 702 nests in 1985. Females lay approximately 2.5 nests each season they nest, thus, 702 nests represents fewer than 300 females nesting in a season. Since the mid-1980s, the number of nests observed at Rancho Nuevo and nearby beaches has increased 14-16 percent per year (Heppell et al. 2005), allowing optimism that the population is on its way to recovery. The total annual number of nests recorded at Rancho Nuevo and adjacent camps has exceeded 10,000 in recent years. Over 20,000 nests were recorded in 2009 at Rancho Nuevo and adjacent camps (J. Pena, Gladys Porter Zoo, personal communication in NMFS et al. 2010). For Texas, from 2002-2009, a total of 771 Kemp's ridley nests have been documented. This is more than nine times greater than the 81 nests recorded over the previous 54 years from 1948-2001 (Shaver and Caillouet 1998; Shaver 2004), indicating an increasing nesting population in Texas. There were 140 Kemp's ridley nests documented in Texas in 2010, and preliminary information indicates 199 Kemp's ridley nests in Texas in 2011 (Shaver pers. comm.); fewer nests were found in Texas during 2010 than in 2008 and 2009 (195 and 197 nests, respectively), which may have stemmed from the previous cold winter. From 2005 through 2009, the number of nests from all monitored beaches indicate approximately 5,500 females are nesting each season in the Gulf of Mexico. Events such as the DWH oil spill event in the Gulf of Mexico during 2010 may have long-term effects on the Kemp's ridley population, possibly changing the population's trajectory. Over 800 Kemp's ridleys were collected in the DWH oil spill area, including 328 that were dead or died after collection. The actual number of Kemp's ridleys affected to date, and the long-term effects of the event on the Kemp's ridley population are unknown.

3.2.1.1 Green Sea Turtle

Green turtles are distributed circumglobally and can be found in the Pacific, Indian, and Atlantic Oceans, as well as the Mediterranean Sea (NMFS and USFWS 1991a; NMFS and USFWS 2007a). In 1978, the Atlantic population of the green sea turtle was listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered.

Life History and Distribution

The estimated age at sexual maturity for green sea turtles is between 20-50 years (Balazs 1982; Frazer and Ehrhart 1985). Green sea turtle mating occurs in the waters off the nesting beaches. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs 1982). After hatching, green sea turtles go through a post-hatchling, pelagic stage during which they are associated with drift lines of algae and other debris. At approximately 20- to 25-cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal 1997).

Green sea turtles are primarily herbivorous, feeding on algae and sea grasses, but also occasionally consume jellyfish and sponges. The post-hatchling, pelagic-stage individuals are assumed to be omnivorous, but little data are available.

Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or seagrasses. This includes areas near mainland coastlines, islands, reefs, or shelves, as well as open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth 1997; NMFS and USFWS 1991). Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre and the Gulf inlets of Texas (Doughty 1984; Hildebrand 1982; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon system in Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward Counties (Wershoven and Wershoven 1992; Guseman and Ehrhart 1992). Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs.

Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito Lagoon and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Caribbean coast of Panama, the Miskito Coast in Nicaragua, and scattered areas along Colombia and Brazil (Hirth 1997). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997).

Population Dynamics and Status

Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 5-year status review for the species identified eight geographic areas considered to be primary sites for green sea turtle nesting in the Atlantic/Caribbean and reviewed the trend in nest count data for each (NMFS and USFWS 2007a). These sites include: (1) Yucatán Peninsula, Mexico; (2) Tortuguero, Costa Rica; (3) Aves Island, Venezuela; (4) Galibi Reserve, Suriname; (5) Isla Trindade, Brazil; (6) Ascension Island, United Kingdom; (7) Bioko Island, Equatorial Guinea; and (8) Bijagos Achipelago, Guinea-Bissau (NMFS and USFWS 2007a). Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precluded a meaningful trend assessment for either site (NMFS and USFWS 2007a). Seminoff (2004) likewise reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic, including all of the above with the exception that nesting in Florida was reviewed in place of Isla Trindade, Brazil. Seminoff (2004) concluded that all sites in the central and western Atlantic showed increased nesting, with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007a).

By far, the most important nesting concentration for green turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007a). Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007a). The number of females nesting per year on beaches in the Yucatán, Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007a). The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Meylan et al. 1995; Johnson and Ehrhart 1994). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Certain Florida nesting beaches have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches.

Since establishment of the index beaches in 1989, the pattern of green turtle nesting shows biennial peaks in abundance with a generally positive trend since 1989. This is perhaps due to increased protective legislation throughout the Caribbean (Meylan et al. 1995). A total statewide average (all beaches, including index beaches) of 5,039 green turtle nests were laid annually in Florida between 2001 and 2006, with a low of 581 in 2001 and a high of 9,644 in 2005 (NMFS and USFWS 2007a). Data from the index nesting beaches program in Florida substantiate the dramatic increase in nesting. In 2007, there were 9,455 green turtle nests found just on index nesting beaches, the highest since index beach monitoring began in 1989. The number fell back to 6,385 in 2008, further dropping under 3,000 in 2009, but that consecutive drop was a temporary deviation from the normal biennial nesting cycle for green turtles, as 2010 saw an increase back to 8,426 nests on the index nesting beaches (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan et al. 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina; just east of the mouth of the Cape Fear River; on Onslow Island; and on Cape Hatteras National Seashore. In 2010, a total of 18 nests were found in North Carolina, 6 nests in South Carolina, and 6 nests in Georgia (nesting databases maintained on www.seaturtle.org). Increased nesting has also been observed along the Atlantic coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Recent modeling by Chaloupka et al. (2007) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9 percent, and the Tortuguero, Costa Rica, population growing at 4.9 percent annually.

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas of the southeastern United States, where they come to forage. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant in St. Lucie County, Florida, shows that the annual number of immature green sea turtles captured by their offshore cooling water intake structures has increased significantly over the years. Green sea turtle annual captures averaged 19 for 1977-1986, 178 for 1987-1996, and 262 for 1997-2001 (FPL 2002). In the five years from 2002-2006, green sea turtle captures averaged 333 per year, with a high of 427 and a low of 267 (FPL and Quantum Resources, Inc. 2006). More recent unpublished data shows 101 captures in 2007, 299 in 2008, 38 in 2009 (power output was cut – and cooling water intake concomitantly reduced – for part of that year) and 413 in 2010. Ehrhart et al. (2007) has also documented a significant increase in in-water abundance of green turtles in the Indian River Lagoon area. It is likely that immature green sea turtles foraging in the southeastern United States come from multiple genetic stocks; therefore, the status of immature green sea turtles in the southeastern United States might also be assessed from trends at all of the main regional nesting beaches, principally Florida, Yucatán, and Tortuguero.

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the overexploitation of green sea turtles for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. However, there are still significant and ongoing threats to green sea turtles from human-related causes in the United States. These threats include beach armoring, erosion control, artificial lighting, beach disturbance (e.g., driving on the beach), pollution, foraging habitat loss as a result of direct destruction by dredging, siltation, boat damage, other human activities, and interactions with fishing gear. In 2010, there was a massive oil well release in the Gulf of Mexico at British Petroleum's DWH well. Official estimates are that 4.9 million barrels of oil were released into the Gulf, with some experts estimating even higher volumes. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts to sea turtles as a result of habitat impacts, prey loss, and subsurface oil particles and oil components broken down through physical, chemical, and biological processes are not known. Sea sampling coverage in the pelagic driftnet, pelagic longline, Southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. There is also the increasing threat from green sea turtle fibropapillomatosis disease. Presently, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Herbst 1994; Jacobson 1990; Jacobson et al. 1991). Other sources of natural mortality include cold-stunning and biotoxin exposure. Cold-stunning is not considered a major source of mortality in most cases. As temperatures fall below 8-10°C, turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989). During January 2010, an unusually large cold-stunning event in the southeastern United States resulted in around 4,600 sea turtles, mostly greens, found cold-stunned, with hundreds found dead, or dying after they were gathered. Another cold-stunning event occurred in the western Gulf of Mexico in February 2011, resulting in approximately 1,500 green turtles found cold-stunned off Texas, and another 300 or so off Mexico, with an as yet undetermined number found dead or dying after they were found.

There is a large and growing body of literature on past, present, and future impacts of global climate change exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov). Impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of green turtles may result (NMFS and USFWS 2007a). In marine turtles, sex is determined by temperature in the middle third of incubation, with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007a). Green sea turtle hatchling size also appears to be influenced by incubation temperatures, with smaller hatchlings produced at higher temperatures (Glenn et al. 2003).

The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction has denuded vegetation. Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as increased frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, forage fish, etc., which could ultimately affect the primary foraging areas of green sea turtles.

Summary of Status for Atlantic Green Sea Turtles

Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and the Caribbean Sea, but are considered rare in benthic areas north of Cape Hatteras (Wynne and Schwartz 1999). Green turtles face many of the same anthropogenic threats for other sea turtles described herein. In addition, green turtles are also susceptible to fibropapillomatosis, which can result in death. In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Recent population estimates for the western Atlantic area are not available. The pattern of green turtle nesting shows biennial peaks in abundance, with a strong positive trend since the establishment of index beaches in Florida in 1989.

3.2.1.2 Hawksbill Sea Turtle

The hawksbill turtle was listed as endangered under the precursor of the ESA on June 2, 1970, and is considered critically endangered by the International Union for the Conservation of Nature (IUCN). The hawksbill is a medium-sized sea turtle, with adults in the Caribbean ranging in size from approximately 62.5 to 94.0 cm straight carapace length. The species occurs in all ocean basins, although it is relatively rare in the Eastern Atlantic and Eastern Pacific, and absent from the Mediterranean Sea. Hawksbills are the most tropical sea turtle species, ranging from approximately 30°N latitude to 30°S latitude. They are closely associated with coral reefs and other hardbottom habitats, but they are also found in other habitats including inlets, bays, and coastal lagoons (NMFS and USFWS 1993). There are only five remaining regional nesting populations with more than 1,000 females nesting annually. These populations are in the Seychelles, Mexico, Indonesia, and two in Australia (Meylan and Donnelly 1999). There has been a global population decline of over 80 percent during the last three generations (105 years) (Meylan and Donnelly 1999).

In the western Atlantic, the largest hawksbill nesting population occurs on the Yucatán Peninsula of Mexico (Garduño-Andrade et al. 1999). With respect to the United States, nesting occurs in Puerto Rico, the U.S. Virgin Islands, and along the southeast coast of Florida. Nesting also occurs outside of the United States and its territories, in Antigua, Barbados, Costa Rica, Cuba, and Jamaica (Meylan 1999). Outside of the nesting areas, hawksbills have been seen off the U.S. Gulf of Mexico states and along the Eastern Seaboard as far north as Massachusetts, although sightings north of Florida are rare (NMFS and USFWS 1993).

Life History and Distribution

The best estimate of age at sexual maturity for hawksbill sea turtles is about 20-40 years (Chaloupka and Limpus 1997; Crouse 1999). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to their nesting beach or to courtship stations along the migratory corridor (Meylan 1999). Females nest an average of 3-5 times per season (Meylan and Donnelly 1999; Richardson et al. 1999). Clutch size is larger on average (up to 250 eggs) than that of other sea turtles (Hirth 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites.

The life history of hawksbills consists of a pelagic stage that lasts from the time they leave the nesting beach as hatchlings until they are approximately 22-25 cm in straight carapace length (Meylan 1999; Meylan and Donnelly 1999), followed by residency in developmental habitats (foraging areas where juveniles reside and grow) in coastal waters. Adult foraging habitat, which may or may not overlap with developmental habitat, is typically coral reefs, although other hard-bottom communities and occasionally mangrove-fringed bays may be occupied. Hawksbills show fidelity to their foraging areas over several years (van Dam and Díez 1998).

The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan 1988). Other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (van Dam and Díez 1997; Mayor et al. 1998).

Population Dynamics and Status

Nesting within the southeastern United States and U.S. Caribbean is restricted to Puerto Rico (>650 nests/yr), the U.S. Virgin Islands (~400 nests/yr), and, rarely, Florida (0-4 nests/yr) (Eckert 1995; Meylan 1999; Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute's Statewide Nesting Beach Survey data 2002). At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (Meylan 1999).

Threats

As with other sea turtle species, hawksbill sea turtles are affected by habitat loss, habitat degradation, marine pollution, marine debris, fishery interactions, and poaching in some parts of their range. There continues to be a black market for hawksbill shell products ("tortoiseshell"), which likely contributes to the harvest of this species.

There is a large and growing body of literature on past, present, and future impacts of global climate change exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov). Impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of hawksbill turtles may result (NMFS and USFWS 2007b). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward a higher numbers of females (NMFS and USFWS 2007d).

The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction has denuded vegetation. Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as increased frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, coral reefs, forage fish, etc. Since hawksbills are typically associated with coral reef ecosystems, increases in global temperatures leading to coral death (Sheppard 2006) could adversely affect the foraging habitats of this species.

Summary of Status for Hawksbill Sea Turtles

Worldwide, hawksbill sea turtle populations are declining. They face many of the same threats affecting other sea turtle species. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under U.S. law and international conventions.

3.2.1.3 Kemp's Ridley Sea Turtle

The Kemp's ridley was listed as endangered on December 2, 1970. Internationally, the Kemp's ridley is considered the most endangered sea turtle (Zwinenberg 1977; Groombridge 1982; TEWG 2000). Kemp's ridleys nest primarily at Rancho Nuevo, a stretch of beach in Mexico's Tamaulipas State. This species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Occasional individuals reach European waters (Brongersma 1972). Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the United States.

Life History and Distribution

The TEWG (1998) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998). Nesting occurs from April into July and is essentially limited to the beaches of the western Gulf of Mexico, near Rancho Nuevo in southern Tamaulipas, Mexico. The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season.

Little is known of the movements of the post-hatchling stage (pelagic stage) within the Gulf of Mexico. Studies have shown the post-hatchling pelagic stage varies from 1-4 or more years, and the benthic immature stage lasts 7-9 years (Schmid and Witzell 1997). Benthic immature Kemp's ridleys have been found along the Eastern Seaboard of the United States and in the Gulf of Mexico. Atlantic benthic immature sea turtles travel northward as the water warms to feed in the productive, coastal waters off Georgia through New England, returning southward with the onset of winter (Lutcavage and Musick 1985; Henwood and Ogren 1987; Ogren 1989). Studies suggest that benthic immature Kemp's ridleys stay in shallow, warm, nearshore waters in the Northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud 1995).

Stomach contents of Kemp's ridleys along the lower Texas coast consisted of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fisheries discards (Shaver 1991). A 2005 dietary study of immature Kemp's ridleys off southwest Florida documented predation on benthic tunicates, a previously undocumented food source for this species (Witzell and Schmid 2005). These pelagic stage Kemp's ridleys presumably feed on the available Sargassum and associated infauna or other epipelagic species found in the Gulf of Mexico.

Population Dynamics and Status

Of the seven extant species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the Rancho Nuevo beaches (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s, nesting numbers were below 1,000 (with a low of 702 nests in 1985). However, observations of increased nesting demonstrate that the decline in the ridley population has stopped and the population is now increasing (USFWS 2000). The number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 percent per year from 1985 to 1999 (TEWG 2000). These trends are further supported by 2004-2007 nesting data from Mexico. The number of nests over that period has increased from 7,147 in 2004, to 10,099 in 2005, to 12,143 in 2006, and 15,032 during the 2007 nesting season (Gladys Porter Zoo nesting database 2007). In 2008, there were 17,882 nests in Mexico (Gladys Porter Zoo nesting database 2008), and nesting in 2009 reached 21,144 (Gladys Porter Zoo nesting database 2010). In 2010, nesting declined significantly, to 13,302 (Gladys Porter Zoo nesting database 2010) but preliminary information indicates nesting trended back upwards with approximately 20,000 nest reported for 2011 (J. Pena, pers. comm., Gladys Porter Zoo). It is unclear if the 2010 decline was a result of environmental conditions, the DWH oil spill event, or some other effect. A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 128 in 2007, 195 in 2008, 197 in 2009, and then similar to that seen in Mexico for 2010, with 140 nests (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm).

A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of TEDs in the United States' and Mexico's shrimping fleets. As demonstrated by nesting increases at the main nesting sites in Mexico, adult ridley numbers have increased over the last decade. The population model used by TEWG (2000) projected that Kemp's ridleys could reach the recovery plan's intermediate recovery goal of 10,000 nesters by the year 2015. Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath et al. 1987; Musick and Limpus 1997). The juvenile population of Kemp's ridley sea turtles in Chesapeake Bay is estimated to be 211 to 1,083 sea turtles (Musick and Limpus 1997). These juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes* spp., *Ovalipes* spp., *Libinia* spp., and *Cancer* spp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile Kemp's ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly et al. 1995a; Epperly et al. 1995b).

Threats

Kemp's ridleys face many of the same natural threats as other sea turtle species, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999-2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green sea turtles were found on Cape Cod beaches (R. Prescott, NMFS, pers. comm.). Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stun events may be associated with numbers of sea turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned sea turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality. A complete list of other indirect factors can be found in NMFS (2001).

Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed in previous sections. For example, in the spring of 2000, a total of 5 Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the sea turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The 5 Kemp's ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction because it is unlikely that all of the carcasses washed ashore.

There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities, i.e., global warming. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The EPA's climate change web page provides basic background information on these and other measured or anticipated effects (see www.epa.gov/climatechange/index.html).

However, the impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty.

The Intergovernmental Panel on Climate Change has stated that global climate change is unequivocal (IPCC 2007) and its impacts may be significant to the hatchling sex ratios of Kemp's ridley sea turtles (Wibbels 2003; NMFS and USFWS 2007c). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward a higher numbers of females (NMFS and USFWS 2007c).

The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction has denuded vegetation. Sea level rise from global climate change (IPCC 2007) is also a potential problem, particularly for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as increased frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, forage fish, etc., which could ultimately affect the primary foraging areas of Kemp's ridley sea turtles.

Summary of Kemp's Ridley Status

The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). The number of nests observed at Rancho Nuevo and nearby beaches increased from 1985 to 2008. Nesting has also exceeded 12,000 nests per year from 2004-2010 (Gladys Porter Zoo nesting database). Kemp's ridleys mature at an earlier age (7-15 years) than other chelonids; thus, "lag effects" as a result of unknown impacts to the non-breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (USFWS and NMFS 1992).

The largest contributors to the decline of Kemp's ridleys in the past were commercial and local exploitation, especially poaching of nests at the Rancho Nuevo site, as well as the Gulf of Mexico trawl fisheries. The advent of TED regulations for trawlers and protections for the nesting beaches has allowed the species to begin to recover. Many threats to the future of the species remain, including interactions with fishery gear, marine pollution, foraging habitat destruction, illegal poaching of nests and potential threats to the nesting beaches from such sources as global climate change, development, and tourism pressures.

3.2.1.4 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. Leatherbacks are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtle species. The large size of adult leatherbacks and their tolerance to relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS 1995). Adult leatherbacks forage in temperate and subpolar regions from 71°N to 47°S latitude in all oceans and undergo extensive migrations to and from their tropical nesting beaches. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982); that number, however, is probably an overestimation as it was based on a particularly good nesting year in 1980 (Pritchard 1996). By 1995, the global population of adult females had declined to 34,500 (Spotila et al. 1996). Pritchard (1996) also called into question the population estimates from Spotila et al. (1996) and felt they may be somewhat low because it ended the modeling on data from a particularly bad nesting year (1994) while excluding nesting data from 1995, which was a good nesting year. The most recent population estimate for leatherback sea turtles from just the North Atlantic breeding groups is a range of 34,000-90,000 adult individuals (20,000-56,000 adult females) (TEWG 2007).

In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS 2001). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (NMFS 2001). Previous genetic analyses of leatherbacks using only mitochondrial DNA (mtDNA) resulted in an earlier determination that within the Atlantic basin there are at least three genetically different nesting populations: the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1999). Further genetic analyses using microsatellite markers in nuclear DNA along with the mtDNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007). When the hatchlings leave the nesting beaches, they move offshore but eventually utilize both coastal and pelagic waters. Very little is known about the pelagic habits of the hatchlings and juveniles, and they have not been documented to be associated with the *Sargassum* areas as are other species. Leatherbacks are deep divers, with recorded dives to depths in excess of 1,000 m (Eckert et al. 1989; Hays et al. 2004).

Life History and Distribution

Leatherbacks are a long-lived species, living for well over 30 years. It has been thought that they reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin 1985) to 13-14 years (Zug and Parham 1996). However, some recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the Northwest Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe 2007). Continued research in this area is vitally important to understanding the life history of leatherbacks and has important implications in management of the species.

Female leatherbacks nest frequently (up to 10 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55-75 days before hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 ccl.

Although leatherbacks are the most pelagic of the sea turtles, they enter coastal waters on an irregular basis to feed in areas where jellyfish are concentrated. Leatherback sea turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates.

Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate, and tropical waters (NMFS and USFWS 1992). A 1979 aerial survey of the outer continental shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia, showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in waters where depths ranged from 1 to 4,151 m, but 84.4 percent of sightings were in areas where the water was less than 180 m deep (Shoop and Kenney 1992). Leatherbacks were sighted in waters of a similar sea surface temperature as loggerheads from 7°C to 27.2°C (Shoop and Kenney 1992). However, this species appears to have a greater tolerance for colder waters because more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). This aerial survey estimated the in-water leatherback population from near Nova Scotia, Canada, to Cape Hatteras, North Carolina, at approximately 300-600 animals.

General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages identified by the TEWG in 2007, but data is limited. Marked or satellite tracked turtles from the Florida and North Caribbean assemblages have been re-sighted off North America, in the Gulf of Mexico, and along the Atlantic coast, and a few have moved to western Africa, north of the equator. In contrast, Western Caribbean and Southern Caribbean/Guianas animals have been found more commonly in the eastern Atlantic, off Europe and northern Africa, as well as along the North American coast. There are no reports of marked animals from the Northwest Atlantic assemblages entering the Mediterranean Sea or the South Atlantic Ocean, though in the case of the Mediterranean this may be due more to a lack of data rather than failure of Northwest Atlantic turtles moving into the Sea. The tagging data coupled with the satellite telemetry data indicate that animals from the Northwest Atlantic nesting subpopulations use virtually the entire North Atlantic Ocean. In the South Atlantic Ocean, tracking and tag return data follow three primary patterns. Although telemetry data from the West African nesting assemblage showed that all but one remained on the shallow continental shelf, there clearly is movement to foraging areas of the south coast of Brazil and Argentina. There is also a small nesting aggregation of leatherbacks in Brazil, and while data are limited to a few satellite tracks, these turtles seem to remain in the southwest Atlantic foraging along the continental shelf margin as far south as Argentina. South African nesting turtles apparently forage primarily south, around the tip of the continent.

Population Dynamics and Status

The status of the Atlantic leatherback population has been less clear than the Pacific population. This uncertainty has been a result of inconsistent beach and aerial surveys, cycles of erosion and reformation of nesting beaches in the Guianas (representing the largest nesting area), a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species, and inconsistencies in the availability and analyses of data. However, recent coordinated efforts at data collection and analyses by the Leatherback Turtle Expert Working Group have helped to clarify the understanding of the Atlantic population status (TEWG 2007).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with the vast majority of the nesting occurring in the Guianas and Trinidad. Past analyses had shown that the nesting aggregation in French Guiana had been declining at about 15 percent per year since 1987 (NMFS 2001). However, from 1979-1986, the number of nests was increasing at about 15 percent annually, which could mean that the current decline could be part of a nesting cycle that coincides with the erosion cycle of Guiana beaches described by Schultz (1975). It is thought that the cycle of erosion and reformation of beaches has resulted in shifting nesting beaches throughout this region. This was supported by the increased nesting seen in Suriname, where leatherback nest numbers have shown large recent increases concurrent with declines elsewhere (with more than 10,000 nests per year since 1999 and a peak of 30,000 nests in 2001), and the long-term trend for the overall Suriname and French Guiana population was thought to possibly show an increase (Girondot et al. 2002). In the past, many sea turtle scientists have agreed that the Guianas (and some would include Trinidad) should be viewed as one population and that a synoptic evaluation of nesting at all beaches in the region is necessary to develop a true picture of population status (Reichart et al. 2001). Genetics studies have added support to this notion and have resulted in the designation of the Southern Caribbean/Guianas stock. Using both Bayesian modeling and regression analyses, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate (using nesting females as a proxy for population). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007).

The Western Caribbean stock includes nesting beaches from Honduras to Colombia. The most intense nesting in that area occurs in Costa Rica, Panama, and the Gulf of Uraba in Colombia (Duque et al. 2000). The Caribbean coast of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troëng et al. 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population likely was not growing over the 1995-2005 time series of available data (TEWG 2007). Other modeling of the nesting data for Tortuguero indicates a possible 67.8 percent decline between 1995 and 2006 (Troëng et al. 2007).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, the U.S. Virgin Islands (St. Croix), and the British Virgin Islands (Tortola). In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 percent (TEWG 2007). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1 percent from 1986-2004 (TEWG 2007). Nesting in Tortola is limited, but has been increasing from 0-6 nests per year in the late 1980s to 35-65 per year in the 2000s, with an annual growth rate of approximately 1.2 percent between 1994 and 2004 (TEWG 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the index nesting beach surveys, the TEWG (2007) estimated a significant annual nesting growth rate of 1.17 percent between 1989 and 2005. In 2007, a record 517 leatherback nests were observed on the index beaches in Florida, with 265 in 2008, and then an increase to a new record of 615 nests in 2009, and a slight decline in 2010 back to 552 nests (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting, but overall the trend shows rapid growth on Florida's east coast beaches.

The West African nesting stock of leatherbacks is a large, important, but mostly unstudied aggregation. Nesting occurs in various countries along Africa's Atlantic coast, but much of the nesting is undocumented and the data are inconsistent. However, it is known that Gabon has a very large amount of leatherback nesting, with at least 30,000 nests laid along its coast in one season (Fretey et al. 2007). Fretey et al. (2007) also provide detailed information about other known nesting beaches and survey efforts along the Atlantic African coast. Because of the lack of consistent effort and minimal available data, trend analyses were not possible for this stock (TEWG 2007).

Two other small but growing nesting stocks utilize the beaches of Brazil and South Africa. For the Brazilian stock, the TEWG (2007) analyzed the available data and determined that between 1988 and 2003 there was a positive annual average growth rate of 1.07 percent using regression analyses and 1.08 percent using Bayesian modeling. The South African stock has an annual average growth rate of 1.06 based on regression modeling and 1.04 percent using the Bayesian approach (TEWG 2007).

Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1996, the entire Western Atlantic population was characterized as stable at best (Spotila et al. 1996), with numbers of nesting females reported to be on the order of 18,800. A subsequent analysis by Spotila (pers. comm.) indicated that by 2000, the Western Atlantic nesting population had decreased to about 15,000 nesting females. Spotila et al. (1996) estimated that the leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. This is consistent with the estimate of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) determined by the TEWG (2007).

Threats

Zug and Parham (1996) pointed out that the main threat to leatherback populations in the Atlantic is the combination of fishery-related mortality (especially entanglement in gear and drowning in trawls) and the intense egg harvesting on the main nesting beaches. Other important ongoing threats to the population include pollution, loss of nesting habitat, and boat strikes.

Of sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, possibly their method of locomotion, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets and pot/trap lines (used in various fisheries) and capture in trawl gear (e.g., shrimp trawls).

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. Unlike loggerhead turtle interactions with longline gear, leatherback turtles do not usually ingest longline bait. Instead, leatherbacks are typically foul-hooked by longline gear (e.g., on the flipper or shoulder area) rather than getting mouth-hooked or swallowing the hook (NMFS 2001). A total of 24 nations, including the United States (accounting for 5-8 percent of the hooks fished), have fleets participating in pelagic longline fisheries in the area. Basin-wide, Lewison et al. (2004) estimated that 30,000-60,000 leatherback sea turtle captures occurred in Atlantic pelagic longline fisheries in the year 2000 alone (note that multiple captures of the same individual are known to occur, so the actual number of individuals captured may not be as high). Genetic studies performed within the Northeast Distant Fishery Experiment indicate that the leatherbacks captured in the Atlantic highly migratory species pelagic longline fishery were primarily from the French Guiana and Trinidad nesting stocks (over 95 percent); individuals from West African stocks were surprisingly absent (Roden et al. 2008).

Leatherbacks are also susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer et al. 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer et al. 2002). Fixed gear fisheries in the Mid-Atlantic have also contributed to leatherback entanglements. In North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (D. Fletcher, pers. comm., in NMFS 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico Sound near Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (D. Fletcher, pers. comm., in NMFS 2001). In the Southeast, leatherbacks are vulnerable to entanglement in Florida’s lobster pot and stone crab fisheries. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 was due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm., in NMFS 2001). Because many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher.

Leatherback interactions with the Southeast Atlantic shrimp fisheries, which operates predominately from North Carolina through southeast Florida (NMFS 2002), have also been a common occurrence. Leatherbacks, which migrate north annually, are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast from Cape Canaveral, Florida, to the Virginia/North Carolina border. Leatherbacks also interact with the Gulf of Mexico shrimp fisheries. For many years, TEDs required for use in these fisheries were less effective at excluding leatherbacks than the smaller, hard-shelled turtle species. To address this problem, on February 21, 2003, the NMFS issued a final rule to amend the TED regulations, which required modifications to the size and design of TEDs to exclude leatherbacks and large and sexually mature loggerhead and green turtles. Mortality of leatherbacks in the shrimp fisheries is now estimated at 54 turtles per year.

Other trawl fisheries are also known to interact with leatherback sea turtles. In October 2001, a Northeast Fisheries Science Center (NEFSC) observer documented the take of a leatherback in a bottom otter trawl fishing for *Loligo* squid off Delaware; TEDs are not required in this fishery. The winter trawl flounder fishery, which did not come under the revised TED regulations, may also interact with leatherback sea turtles.

Gill net fisheries operating in the nearshore waters of the Mid-Atlantic States are also suspected of capturing, injuring, and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92 percent.

Poaching is not known to be a problem for nesting populations in the continental United States. However, in 2001 the SEFSC noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands and the Guianas. In all, four of the five strandings in St. Croix were the result of poaching (Boulon 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is on eggs.

Pollution may also represent a significant problem for leatherback sea turtles. Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage et al. 1997; Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained plastic (Mrosovsky 1981). Along the coast of Peru, intestinal contents of 19 of 140 (13 percent) leatherback carcasses were found to contain plastic bags and film (Fritts 1982). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size, or even movement as it drifts about, and induce a feeding response in leatherbacks. In 2010, there was a massive oil well release in the Gulf of Mexico at British

Petroleum's DWH well. Official estimates are that 4.9 million barrels of oil were released into the Gulf, with some experts estimating even higher volumes. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts to sea turtles as a result of habitat impacts, prey loss, and subsurface oil particles and oil components broken down through physical, chemical, and biological processes are not known.

It is important to note that, like marine debris, fishing gear interactions and poaching are problems for leatherbacks throughout their range. Entanglements are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are reported taken by many other nations that participate in Atlantic pelagic longline fisheries, including Taipei, Brazil, Trinidad, Morocco, Cyprus, Venezuela, Korea, Mexico, Cuba, U.K., Bermuda, People's Republic of China, Grenada, Canada, Belize, France, and Ireland (see NMFS 2001 for a description of take records). Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo et al. 1994; Graff 1995). Gillnets are one of the suspected causes of the decline in the leatherback sea turtle population in French Guiana (Chevalier et al. 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lageux et al. 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio-M. 2000). A study by the Trinidad and Tobago's Institute for Marine Affairs in 2002 confirmed that bycatch of leatherbacks is high in Trinidad. The Institute for Marine Affairs estimated that more than 3,000 leatherbacks were captured incidental to gillnet fishing in the coastal waters of Trinidad in 2000. As much as one-half or more of the gravid turtles in Trinidad and Tobago waters may be killed (Lee Lum 2003), though many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS 2001).

There is a large and growing body of literature on past, present, and future impacts of global climate change exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov). Impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of leatherback turtles may result (NMFS and USFWS 2007d). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). However, unlike other sea turtles species, leatherbacks tend to select nest locations in the cooler tidal zone of beaches (Kamel and Mrosovsky 2004). This preference may help mitigate the effects from increased beach temperature (Kamel and Mrosovsky 2004).

Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Global climate change is likely to influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007d). Several studies have shown leatherback distribution is influenced by jellyfish abundance (e.g., Houghton et al. 2006; Witt et al. 2006; Witt et al. 2007). How these changes in jellyfish abundance and distribution will impact leatherback sea turtle foraging behavior and distribution is currently unclear (Witt et al. 2007).

Summary of Leatherback Status

In the Atlantic Ocean, our understanding of the status and trends of leatherback turtles is somewhat more confounded, although the overall trend appears to be stable to increasing. The data indicate increasing or stable nesting populations in all of the regions except West Africa (no long-term data are available) and the Western Caribbean (TEWG 2007). Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic (i.e., leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in state, federal, and international waters). Poaching is also a problem that affects leatherbacks occurring in U.S. waters. Leatherbacks are also more susceptible to death or injury from ingesting marine debris than other turtle species.

3.2.1.5 Loggerhead Sea Turtle (Northwest Atlantic DPS)

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. It was listed because of direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat. Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. The majority of loggerhead nesting occurs in the Western Atlantic Ocean (South Florida, United States), and the western Indian Ocean (Masirah, Oman); in both locations nesting assemblages have more than 10,000 females nesting each year (NMFS and USFWS 2008). Loggerhead sea turtles are the most abundant species of sea turtle in U.S. waters.

NMFS and USFWS published a final rule designating nine DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011; effective October 24, 2011). The DPSs established by this rule include: (1) Northwest Atlantic Ocean (threatened); (2) Northeast Atlantic Ocean (endangered); (3) South Atlantic Ocean (threatened); (4) Mediterranean Sea (endangered); (5) North Pacific Ocean (endangered); (6) South Pacific Ocean (endangered); (7) North Indian Ocean (endangered); (8) Southeast Indo-Pacific Ocean (endangered); and (9) Southwest Indian Ocean (threatened). The Northwest Atlantic DPS is the only DPS potentially affected by this DEIS.

Within the Northwest Atlantic DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. Previous Section 7 analyses have recognized at least five Western Atlantic subpopulations, divided geographically as follows: (1) a northern nesting subpopulation, occurring from North Carolina to Northeast Florida at about 29ºN; (2) a South Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the Eastern Yucatán Peninsula, Mexico (TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2002). The recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded, based on recent advances in genetic analyses, that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula and that specific boundaries for subpopulations could not be designated based on genetic differences alone. Thus, the plan uses a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to identify recovery units. The recovery units are: (1) the Northern Recovery Unit (Florida/Georgia border north through southern Virginia); (2) the Peninsular Florida Recovery Unit (Florida/Georgia border through Pinellas County, Florida); (3) the Dry Tortugas Recovery Unit (islands located west of Key West, Florida); (4) the Northern Gulf of Mexico Recovery Unit (Franklin County, Florida, through Texas); and (5) the Greater Caribbean Recovery Unit (Mexico through French Guiana, the Bahamas, Lesser Antilles, and Greater Antilles) (NMFS and USFWS 2008). The recovery plan concluded that all recovery units are essential to the recovery of the species. Although the recovery plan was written prior to the listing of the Northwest Atlantic DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the Northwest Atlantic DPS.

Life History and Distribution

Past literature gave an estimated age at maturity of 21-35 years (Frazer and Ehrhart 1985; Frazer et al. 1994) with the benthic immature stage lasting at least 10-25 years. However, based on new data from tag returns, strandings, and nesting surveys, NMFS (2001) estimated ages of maturity ranging from 20-38 years and benthic immature stage lasting from 14-32 years.

Mating takes place in late March through early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs in the southeastern United States. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests per individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd 1988). Generally, loggerhead sea turtles originating from the Western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years or more. Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length, they begin to live in coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico, although some loggerheads may move back and forth between the pelagic and benthic environment (Witzell 2002). Benthic immature loggerheads (sea turtles that have come back to inshore and nearshore waters) – the life stage following the pelagic immature stage – have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico.

Tagging studies have shown loggerheads that have entered the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures. Loggerhead sea turtles occur year-round in offshore waters off North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to immigrate to North Carolina inshore waters (e.g., Pamlico and Core Sounds) and also move up the coast (Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority of loggerheads leave the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late fall. By December, loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore of North Carolina, particularly off Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (≥ 11°C) (Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c). Loggerhead sea turtles are year-round residents of central and south Florida. Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in a variety of habitats.

More recent studies are revealing that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002; Blumenthal et al. 2006; Hawkes et al. 2007; McClellan and Read 2007). One of the studies tracked the movements of adult females post-nesting and found a difference in habitat use was related to body size, with larger turtles staying in coastal waters and smaller turtles traveling to oceanic waters (Hawkes et al. 2007). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse, with some remaining in neritic waters while others moved off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes et al. study (2007), there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007). In either case, the research not only supports the need to revise the life history model for loggerheads but also demonstrates that threats to loggerheads in both the neritic and oceanic environments are likely impacting multiple life stages of this species.

Population Dynamics and Status

A number of stock assessments and similar reviews (TEWG 1998, 2000, 2009; NMFS 2001; Heppell et al. 2003; NMFS and USFWS 2008; Conant et al. 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size.

Numbers of nests and nesting females can vary widely from year to year. However, nesting beach surveys can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of females turtles, as long as such studies are sufficiently long and effort and methods are standardized (e.g., Meylan 1982; NMFS and USFWS 2008). NMFS and USFWS (2008) concluded that the lack of change in two important demographic parameters of loggerheads, remigration interval and clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population. Recent analysis of available data for the Peninsular Florida Recovery Unit has led to the conclusion that the observed decline in nesting for that unit over the last several years can best be explained by an actual decline in the number of adult female loggerheads in the population (Witherington et al. 2009).

Annual nest totals from beaches within what NMFS and USFWS have defined as the Northern Recovery Unit (NRU) averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (GDNR unpublished data; NCWRC unpublished data; SCDNR unpublished data), and represent approximately 1,272 nesting females per year (4.1 nests per female, per Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3 percent annually. Nest totals from aerial surveys conducted by South Carolina Department of Natural Resources (SCDNR) showed a 1.9 percent annual decline in nesting in South Carolina since 1980. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline. Data in 2008 has shown improved nesting numbers, but future nesting years will need to be analyzed to determine if a change in trend is occurring. In 2008, 841 loggerhead nests were observed compared to the 10-year average of 715 nests in North Carolina. The number dropped to 276 in 2009, but rose again to 846 in 2010. In South Carolina, 2008 was the seventh highest nesting year on record since 1980, with 4,500 nests, but this did not change the long-term trend line indicating a decline on South Carolina beaches. Then in 2009 nesting dropped to 2183, with an increase to 3,141 in 2010. Georgia beach surveys located a total of 1,648 nests in 2008. This number surpassed the previous statewide record of 1,504 nests in 2003. In 2009, the number of nests declined to 998, and in 2010, a new statewide record was established with 1,760 loggerhead nests. According to analyses by Georgia Department of Natural Resources (GDNR), the 40-year time-series trend data show an overall decline in nesting, but the shorter comprehensive survey data (20 years) indicate a stable population (SCDNR 2008; GDNR, NCWRC, and SCDNR nesting data located at http://www.seaturtle.org).

Another consideration that may add to the importance and vulnerability of the NRU is the sex ratio of this subpopulation. NMFS scientists have estimated that the Northern subpopulation produces 65 percent males (NMFS 2001). However, research conducted over a limited time frame has found opposing sex ratios (Wyneken et al. 2004), so further information is needed to clarify the issue. Since nesting female loggerhead sea turtles exhibit nest fidelity, the continued existence of the Northern subpopulation is related to the number of female hatchlings that are produced. Producing fewer females will limit the number of subsequent offspring produced by the subpopulation.

The Peninsular Florida Recovery Unit (PFRU) is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (from NMFS and USFWS 2008). The statewide estimated total for 2010 was 73,702 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). An analysis of index nesting beach data shows a 26 percent decline in nesting by the PFRU between 1989 and 2008, and a mean annual rate of decline of 1.6 percent despite a large increase in nesting for 2008, to 38,643 nests (Witherington et al. 2009; NMFS and USFWS 2008; Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). In 2009, nesting levels, while still higher than the lows of 2004, 2006, and 2007, dropped below 2008 levels to approximately 32,717 nests, but in 2010 a large increase was seen, with 47,880 nests on the index nesting beaches (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). The 2010 index nesting number is the largest since 2000.

The remaining three recovery units – the Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (GCRU) – are much smaller nesting assemblages but still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida's statewide survey program. Survey effort has been relatively stable during the 9-year period from 1995-2004 (although the 2002 year was missed). Nest counts ranged from 168-270, with a mean of 246, but with no detectable trend during this period (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data; NMFS and USFWS 2008). Nest counts for the NGMRU are focused on index beaches rather than all beaches where nesting occurs. The 12-year dataset (1997-2008) of index nesting beaches in the area shows a significant declining trend of 4.7 percent annually (NMFS and USFWS 2008). Similarly, nesting survey effort has been inconsistent among the GCRU nesting beaches and no trend can be determined for this subpopulation. Zurita et al. (2003) found a statistically significant increase in the number of nests on seven of the beaches on Quintana Roo, Mexico, from 1987-2001, where survey effort was consistent during the period. However, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008).

Determining the meaning of the nesting decline data is confounded by various in-water research that suggests the abundance of neritic juvenile loggerheads is steady or increasing (Ehrhart et al. 2007; M. Bresette, pers. comm., regarding captures at the St. Lucie Power Plant; SCDNR unpublished SEAMAP-SA data; Epperly et al. 2007). Ehrhart et al. (2007) found no significant regression-line trend in the long-term dataset. However, notable increases in recent years and a statistically significant increase in catch per unit effort (CPUE) of 102.4 percent from the 4-year period of 1982-1985 to the 2002-2005 periods were found. Epperly et al. (2007) determined the trends of increasing loggerhead catch rates from all the aforementioned studies in combination provide evidence there has been an increase in neritic juvenile loggerhead abundance in the southeastern United States in the recent past. A study led by the SCDNR found that standardized trawl survey CPUEs for loggerheads from South Carolina to North Florida was 1.5 times higher in summer 2008 than summer 2000. However, even though there were persistent inter-annual increases from 2000-2008, the difference was not statistically significant, likely due to the relatively short time series. Comparison to other datasets from the 1950s through 1990s showed much higher CPUEs in recent years regionally and in the South Atlantic Bight, leading SCDNR to conclude that it is highly improbable that CPUE increases of such magnitude could occur without a real and substantial increase in actual abundance (Arendt et al. 2009). Whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence is not clear. NMFS and USFWS (2008), citing Bjorndal et al. (2005), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern U.S. may be due to increased abundance of the largest Stage III individuals (oceanic/neritic juveniles, historically referred to as small benthic juveniles), which could indicate a relatively large cohort that will recruit to maturity in the near future. However, such an increase in adults may be temporary, as in-water studies throughout the eastern U.S. also indicate a substantial decrease in the abundance of the smallest Stage III loggerheads, a pattern also corroborated by stranding data (TEWG 2009).

The SEFSC has developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS 2009b). This model does not incorporate existing trends in the data (such as nesting trends) but instead relies on utilizing the available information on the relevant life-history parameters for sea turtles and then predicts future population trajectories based upon model runs using those parameters. Therefore, the model results do not build upon, but instead are complementary to, the trend data obtained through nest counts and other observations. The model uses the range of published information for the various parameters including mortality by stage, stage duration (years in a stage), and fecundity parameters such as eggs per nest, nests per nesting female, hatchling emergence success, sex ratio, and remigration interval. Model runs were done for each individual recovery unit as well as the Northwest Atlantic population as a whole, and the resulting trajectories were found to be very similar. One of the most robust results from the model was an estimate of the adult female population size for the Northwest Atlantic in the 2004-2008 timeframe. The distribution resulting from the model runs suggest the adult female population size to be likely between approximately 20,000 to 40,000 individuals, with a low likelihood of being up to 70,000. A much less robust estimate for total benthic females in the Northwest Atlantic was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1 million.

The results of one set of model runs suggest that the Northwest Atlantic population is most likely declining, but this result was very sensitive to the choice of the position of the parameters within their range and hypothesized distributions. This example was run to predict the distribution of projected population trajectories for benthic females using a range of starting population numbers from the 30,000 estimated minimum to the greater than the 300,000 likely upper end of the range and declining trajectories were estimated for all of the population estimates. After 10,000 simulation runs of the models using the parameter ranges, 14 percent of the runs resulted in growing populations, while 86 percent resulted in declining populations. While this does not translate to an equivalent statement that there is an 86 percent chance of a declining population, it does illustrate that, given the life history parameter information currently thought to comprise the likely range of possibilities, it appears most likely that with no changes to those parameters the population is projected to decline. Additional model runs using the range of values for each life history parameter, the assumption of non-uniform distribution for those parameters, and a 5 percent natural (non-anthropogenic) mortality for the benthic stages resulted in a determination that a 60-70 percent reduction in anthropogenic mortality in the benthic stages would be needed to bring 50 percent of the model runs to a static (zero growth or decline) or increasing trajectory.

As a result of the large uncertainty in our knowledge of loggerhead life history, at this point predicting the future populations or population trajectories of loggerhead sea turtles with precision is very uncertain. The model results, however, are useful in guiding future research needs to better understand the life history parameters that have the most significant impact in the model. Additionally, the model results provide valuable insights into the likely overall declining status of the species and in the impacts of large-scale changes to various life history parameters (such as mortality rates for given stages) and how they may change the trajectories. The results of the model, in conjunction with analyses conducted on nest count trends (e.g., Witherington et al. 2009) which have suggested that the population decline is real, provides a strong basis for the conclusion that the Northwest Atlantic loggerhead population is in decline. NMFS also recently convened a new TEWG for loggerhead sea turtles that gathered available data and examined the potential causes of the nesting decline and what the decline means in terms of population status. The TEWG ultimately could not determine whether or not decreasing annual numbers of nests among the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of the adult females, decreasing numbers of adult females, or a combination of those factors. Past and present mortality factors that could impact current loggerhead nest numbers are many, and it is likely that several factors compound to create the current decline. Regardless of the source of the decline, it is clear that the reduced nesting will result in depressed recruitment to subsequent life stages over the coming decades (TEWG 2009).

Threats

The 5-year status review of loggerhead sea turtles recently completed by NMFS and the USFWS provides a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007e). The Loggerhead Recovery Team also undertook a comprehensive evaluation of threats to the species, and described them separately for the terrestrial, neritic, and oceanic zones (NMFS and USFWS 2008). The diversity of sea turtles' life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms, as well as wave action, can appreciably reduce hatchling success. For example, in 1992 all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton et al. 1994). Also, many nests were destroyed during the 2004 and 2005 hurricane seasons. Other sources of natural mortality include cold-stunning and biotoxin exposure. Cold-stunning is not considered a major source of mortality, but cold-stunning of loggerhead turtles has been reported at several locations in the northeast and southeast United States, including the Indian River Lagoon in Florida (Mendonca and Ehrhart 1982; Witherington and Ehrhart 1989) and Texas inshore waters (Hildebrand 1982; Shaver 1990). Cold-stunning is a phenomenon during which turtles become incapacitated as a result of rapidly dropping water temperatures (Witherington and Ehrhart 1989; Morreale et al. 1992). As temperatures fall below 8-10°C, turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989). In January 2010, an unusually large cold-stunning event occurred throughout the southeast United States, with well over 3,000 sea turtles (mostly greens but also hundreds of loggerheads) found cold-stunned. Most were able to be saved, but a few hundred were found dead or died after being discovered in a cold-stunned state.

Anthropogenic factors that impact hatchlings and adult female sea turtles on land or the success of nesting and hatching include: beach erosion, beach armoring and nourishment, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, beach driving, coastal construction and fishing piers, exotic dune and beach vegetation, and poaching. An increase in human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (e.g., raccoons, armadillos, and opossums), which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected East Florida nesting beaches from Indian River to Broward County, including some high density beaches, are affected by all of the above threats.

Loggerhead sea turtles are affected by a completely different set of anthropogenic threats in the marine environment. These threats include oil and gas exploration, coastal development, marine transportation, marine pollution (which may have a direct impact, or an indirect impact by causing harmful algal blooms), underwater explosions, hopper dredging, offshore artificial lighting, power plant entrainment and/or impingement, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, poaching, and fishery interactions. In 2010, there was a massive oil well release in the Gulf of Mexico at British Petroleum's DWH well. Official estimates are that 4.9 million barrels of oil were released into the Gulf, with some experts estimating even higher volumes. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts to sea turtles as a result of habitat impacts, prey loss, and subsurface oil particles and oil components broken down through physical, chemical, and biological processes are not known. Loggerheads in the pelagic environment are exposed to a series of longline fisheries, which include the highly migratory species' Atlantic pelagic longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various longline fleets in the Mediterranean Sea (Aguilar et al. 1995; Bolten et al. 1994). Loggerheads in the benthic environment in waters off the coastal United States are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gillnet, pound net, longline, and trap fisheries. The sizes and reproductive values of sea turtles taken by fisheries vary significantly, depending on the location and season of the fishery, and size-selectivity resulting from gear characteristics. Therefore, it is possible for fisheries that interact with fewer, more reproductively valuable turtles to have a greater detrimental effect on the population than one that takes greater numbers of less reproductively valuable turtles if the fishery removes a higher overall reproductive value from the population (Wallace et al. 2008). The Loggerhead Biological Review Team determined that the greatest threats to the Northwest Atlantic DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009). Attaining a more thorough understanding of the characteristics, as well as the quantity, of sea turtle bycatch across all fisheries is of great importance.

There is a large and growing body of literature on past, present, and future impacts of global climate change exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov). Impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of loggerhead turtles may result (NMFS and USFWS 2007c). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007e). Modeling suggests an increase of 2°C in air temperature would result in a sex ratio of over 80 percent female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100 percent female offspring. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most clutches, leading to death (Hawkes et al. 2007).

Warmer sea surface temperatures have been correlated with an earlier onset of loggerhead nesting in the spring (Weishampel et al. 2004; Hawkes et al. 2007), as well as short inter-nesting intervals (Hays et al. 2002) and shorter nesting season (Pike et al. 2006). The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990). Alternatively, nesting females may nest on the seaward side of the erosion control structures, potentially exposing them to repeated tidal overwash (NMFS and USFWS 2007e). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc., which could ultimately affect the primary foraging areas of loggerhead sea turtles.

Actions have been taken to reduce anthropogenic impacts to loggerhead sea turtles from various sources, particularly since the early 1990s. These include lighting ordinances, predation control, and nest relocations to help increase hatchling survival, as well as measures to reduce the mortality of pelagic immatures, benthic immatures, and sexually mature age classes in various fisheries and other marine activities. Recent actions have taken significant steps towards reducing the recurring sources of mortality of sea turtles in the environmental baseline and improving the status of all loggerhead subpopulations. For example, the TED regulations published on February 21, 2003 (68 FR 8456), represents a significant improvement in the baseline effects of trawl fisheries on loggerhead sea turtles, though shrimp trawling is still considered to be one of the largest source of anthropogenic mortality on loggerheads.

Summary of Status for Loggerhead Sea Turtles

In the Atlantic Ocean, absolute population size is not known, but based on extrapolation of nesting information, loggerheads are likely much more numerous than in the Pacific Ocean. NMFS recognizes five recovery units of loggerhead sea turtles in the Northwest Atlantic based on genetic studies and management regimes, which comprise the Northwest Atlantic DPS. There are long-term declining nesting trends for the two largest Northwest Atlantic recovery units: the PFRU and the NRU. Furthermore, no long-term data suggest any of the loggerhead subpopulations throughout the entire North Atlantic are increasing in annual numbers of nests (TEWG 2009). Additionally, using both computation of susceptibility to quasi-extinction and stage-based deterministic modeling to determine the effects of known threats to Northwest Atlantic loggerheads, the Loggerhead

Biological Review Team determined that this population is likely to decline in the foreseeable future, driven primarily by the mortality of juvenile and adult loggerheads from fishery bycatch throughout the North Atlantic Ocean. These computations were done for each of the recovery units, and all of them resulted in an expected decline (Conant et al. 2009). With a recent increase in nesting, however, data through 2010 changes the trend for the PFRU from negative to no trend (slightly negative but not statistically significant) (NMFS and USFWS 2010). Nesting at the index nesting beaches for the PFRU in 2011 declined from 2010, but was still the second highest since 2001, at 43,595 nests (FWRI nesting database). Because of its size, the PFRU may be critical to the survival of the species in the Atlantic Ocean. In the past, this nesting aggregation was considered second in size only to the nesting aggregation on islands in the Arabian Sea off Oman (Ross 1979; Ehrhart 1989). However, the status of the Oman colony has not been evaluated recently; and it is located in an area of the world where it is highly vulnerable to disruptive events such as political upheavals, wars, catastrophic oil spills, and lack of strong protections for sea turtles (Meylan et al. 1995). Given the lack of updated information on this population, the status of loggerheads in the Indian Ocean basin overall is essentially unknown.

All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects that negatively influence the status of the species. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (i.e., fisheries in international waters).

3.2.2 Sources of Sea Turtle Mortality

Threats to the recovery of listed sea turtles are reviewed and documented extensively in the sea turtle recovery plans (NMFS and USFWS 1991a, 1991b, 1992, 1993, 1998a, 1998b, 2008; USFWS and NMFS 1992), the five-year reviews (NMFS and USFWS 1995, 2007a, 2007b, 2007c, 2007d, 2007e), and the loggerhead status review (Conant et al. 2009) which are incorporated by reference. These documents are summarized here and discussed in more detail for specific species in Section 3.2.1 of this DEIS. Recovery of sea turtle populations to historical levels requires a reduction in anthropogenic mortality on all fronts and for all life phases – both on nesting beaches and in the marine environment.

Sea turtles face many sources of natural mortality, some of which are exacerbated by humans. Hurricanes and other severe weather events are known to be destructive to sea turtle nests and hatchlings. Sand accretion, rainfall, and wave action that result from these storms can appreciably reduce hatching success. Other sources of natural mortality include cold stunning, biotoxin exposure, and native species predation.

Anthropogenic factors that impact hatchlings and adult females on land, or the success of nesting and hatching include: beach armoring and nourishment; artificial lighting; beach cleaning; beach pollution; increased human presence; recreational beach equipment; vehicular and pedestrian traffic; coastal development/construction; exotic dune and beach vegetation; removal of native vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (e.g., raccoons, armadillos, and opossums) which raid nests and feed on turtle eggs (NMFS and USFWS 2007a, 2008). Although primary sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic Coast (e.g., Merritt

Island, Archie Carr, and Hobe Sound National Wildlife Refuges); Tortuguero, Costa Rica; Rancho Nuevo, Mexico; and other important beaches, many Northwest Atlantic sea turtle nesting beaches have limited or no protection. Sea turtle nesting and hatching success on unprotected high density beaches, such as those in East Florida from Indian River to Broward County, are particularly affected by all of the above threats.

Many threats to sea turtles on land are expected to be exacerbated by the effects of global climate change (NMFS and USFWS 2007a, 2007b, 2007c, 2007d, 2007e). Potential increases in sea level of approximately 4.2 mm (1.65 in) per year until 2080 might remove available nesting beaches, particularly on narrow low-lying coastal and inland beaches and on beaches where coastal development has occurred (Church et al. 2001; IPCC 2007; Nicholls 1998; Fish et al. 2005; Baker et al. 2006; Jones et al. 2007; Mazaris et al. 2009). Additionally, global climate change may affect the severity of extreme weather (e.g., hurricanes), potentially generating more intense storms and associated erosion or damage to sea turtle nests and/or nesting sites (IPCC 2007). The cyclical loss of nesting beaches resulting from extreme storm events may then result in a decrease in hatching success and hatchling emergence (Pike and Stiner 2007). However, there is evidence that, depending on the species, those species with lower nest site fidelity (e.g., leatherbacks) would be less vulnerable to storm related threats than those with higher site fidelity (e.g., loggerheads). In Guiana, leatherbacks have continued to nest despite the loss of beaches between nesting years (Pike and Stiner 2007; Girondot and Fretey 1996).

Changes in air and beach temperatures can affect sea turtles at the population level. The sex of hatchlings is determined by temperatures during the middle third of incubation, with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). Based on modeling, a 2°C increase in air temperature is expected to result in a loggerhead sea turtle sex ratio of over 80 percent female offspring for loggerhead nesting beaches in the vicinity of Southport, North Carolina. Farther to the south at Cape Canaveral, Florida, a 2°C increase in air temperature would likely result in production of 100 percent females, while a 3°C increase in air temperature would likely exceed the thermal threshold of turtle clutches (i.e., greater than 35°C) resulting in death (Hawkes et al. 2007). Glenn et al. (2003) also reported that, for green sea turtles, incubation temperatures also appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures; however, it is unknown whether this effect is species specific and what impact it has on the survival of the offspring. Changes in air temperature as a result of global climate change may alter sex ratios and may reduce hatchling production in the most southern nesting areas of the United States (Hawkes et al. 2007; Hamann et al. 2007). Given that the south Florida nesting group is the largest loggerhead nesting group in the Atlantic (in terms of numbers of nests laid), a decline in the success of nesting as a result of global climate change could have profound effects on the abundance and distribution of the loggerhead species in the Atlantic, including the action area. However; variation of sex ratios to incubation temperature between individuals and populations is not fully understood. Therefore, it is unclear whether sea turtles will (or can) adapt behaviorally to altered incubation conditions to counter potential feminization or death of clutches associated with incubation temperatures, such as choosing nest sites that are located in cooler areas, such as shaded areas of vegetation or higher latitudes or nesting earlier or later during cooler periods of the year (Hawkes et al. 2007).

Sea turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation; marine pollution; underwater explosions; hopper dredging; offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching; and fishery interactions.

On April, 20, 2010, while drilling approximately 50 miles east-southeast of the Mississippi River Delta, Louisiana and 100 miles south of Dauphin Island, Alabama, the DWH semi-submersible drilling rig experienced a catastrophic explosion due to a blowout. The fire burned out of control until the rig sank on April 22, 2010, which allowed the compromised well to release oil directly into the Gulf of Mexico. The well was temporarily capped on July 15, 2010, which significantly reduced the amount of leaking oil, but the well was not ultimately sealed and declared "effectively dead" until September 19, 2010. Estimates on the amount of released oil varied widely and over time, but final official projections indicated 53,000 - 62,000 barrels were released per day as a result of the event; the total amount of oil released into the Gulf of Mexico was estimated at 4.9 million barrels (780,000m^3) (McNutt et al. 2011). As of August 24, 2011, light oiling was still being reported for areas of Chandeleur Sound, Louisiana, as well as portions of Cat Island, East Ship Island, Horn Island, and Petit Bois Island, Mississippi (Gulf Coast Incident Management Team, Shoreline Cleanup Assessment Team data).

In the wake of the explosion and blowout, approximately 2.1 million gallons of chemical dispersant were applied to surface waters (1.4 million gallons) and directly at the wellhead (0.77 million gallons) between May 15 and July 12, 2010[7]. COREXIT is a product line of solvents primarily used as a dispersant for breaking up oil slicks, and it (i.e., COREXIT 9527 and COREXIT 9500) was the most-used dispersant in the DWH Blowout. COREXIT 9527 was replaced by COREXIT 9500 after the former was deemed too toxic; Unified Command records indicate that the last date of use of the COREXIT 9527 was May 22, 2010. According to the manufacturer, "When the COREXIT dispersants are deployed on the spilled oil, the oil is broken up into tiny bio-degradable droplets that immediately sink below the surface where they continue to disperse and bio-degrade. This quickly removes the spilled oil from surface drift and reducing direct exposure to birds, fish, and sea animals in the spill environment."

COREXIT 9527, considered by the Environmental Protection Agency (EPA) to be an acute health hazard, is stated by its manufacturer to be potentially harmful to red blood cells, the kidneys and the liver, and may irritate eyes and skin. The chemical 2-butoxyethanol, found in COREXIT 9527, was identified as having caused lasting health problems in workers involved in the cleanup of the EXXON VALDEZ oil spill. In contrast, COREXIT 9500, a combination of propylene glycol, is deemed to have low human and environmental risk according to the Materials Safety Data Sheet for the chemical. Its ingredients are not considered carcinogens, although no long-term exposure studies have been conducted on the solution. Furthermore, there is no information currently available on the effects of the dispersant on sea turtles, either by direct exposure of other avenues, such as bioaccumulation through foraging on prey species.

Global climate change effects in the marine environment are anticipated to affect sea turtles in the Northwest Atlantic. Changes in water circulation may occur. Changes in the Gulf Stream would

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[7] www.whitehouse.gov/blog/issues/Deepwater-BP-oil-spill (accessed November 3, 2010); from Kujawinski et al. 2011.

have profound effects on every aspect of Northwest Atlantic sea turtle life history from hatching success, oceanic migrations at all life stages, foraging, and nesting (Gagosian 2003; NMFS and USFWS 2007a, 2007b, 2007c, 2007d, 2007e). Thermocline circulation patterns are expected to change in intensity and direction with changes in temperature and freshwater input at the poles (Rahmstorf 1997; Stocker and Schmittner 1997). This will potentially affect not only hatchlings that rely on passive transport in surface currents for migration and dispersal but also pelagic adults (i.e., leatherbacks) and juveniles that depend on current patterns and major frontal zones in obtaining suitable prey, such as jellyfish (Hamann et al. 2007; Hawkes et al. 2007).

Prey availability may also be affected by changes in water temperatures and currents. Seagrasses could ultimately be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Short and Neckles 1999; Bjork et al. 2008), as well as increased runoff due to the expected increase in extreme storm events as a result of global climate change. These alterations of the marine environment due to global climate change could ultimately affect the distribution, physiology, and growth rates of seagrasses, potentially eliminating them from particular areas. However, the magnitude of these effects on seagrass beds, and on the herbivorous green sea turtles that forage on them, are difficult to predict. Some populations of green sea turtles appear to specialize in the consumption of algae (Bjorndal 1997) and mangroves (Limpus and Limpus 2000), suggesting green turtles may be able to substitute other available forage species. Changes to benthic communities as a result of changes to water temperature may affect omnivorous species such as Kemp's ridley and loggerhead sea turtles; however, these species are less likely to suffer shortages of prey than species with more specific diets such as green sea turtles (Hawkes et al. 2007).

Several studies have also investigated the effects of changes in sea surface temperature (SST) and air temperatures on turtle reproductive behavior. For loggerhead sea turtles, warmer SSTs in the spring have been correlated to an earlier onset of nesting (Weishampel et al. 2004; Hawkes et al. 2007), shorter internesting intervals (Hays et al. 2002), and a decrease in the length of the nesting season (Pike et al. 2006). Green sea turtles also exhibited shorter internesting intervals in response to warming water temperatures (Hays et al. 2002).

Ocean acidification related to global climate change would also reasonably be expected to negatively affect sea turtles. The term "ocean acidification" describes the process of ocean water becoming corrosive as a result of carbon dioxide (CO_2) absorption from the atmosphere. The absorption of atmospheric CO_2 into the ocean lowers the pH of the waters, decreasing the effects of global climate change, however, the resulting change in ocean chemistry could adversely affect marine life, particularly organisms with calcium carbonate shells such as corals, mussels, mollusks, small creatures in the lower levels of the food chain (Guinotte and Fabry 2008), affecting as well the higher organisms such as sea turtles that rely on these species as prey. Sea grasses may benefit from extra atmospheric CO_2, affording some benefit to green turtles (Guinotte and Fabry 2008). Fully monitoring ocean acidification in the Atlantic and understanding the effects of climate change on listed species of sea turtles will require expansion of existing monitoring programs and development of conceptual and predictive models. Continued acquisition and maintenance of long-term data sets on sea turtle life history and responses to environmental changes will be needed to apply and maintain these models. At this time, the type and extent of effects to sea turtles of ocean acidification and other results of global climate change on sea turtles cannot, for the most part, be accurately predicted. Therefore, the information necessary to determine the significance of these effects is incomplete and unavailable.

Directed harvest likely caused the original decline of sea turtle populations in the Northwest Atlantic. Currently, 33 of 46 countries/territories in the North Atlantic now legislate complete protection of sea turtles in their territorial waters (see Appendix 3 of NMFS and USFWS 2008, followed by the Bahamas ban of sea turtle harvest effective September 1, 2009). Twelve Caribbean countries still allow some harvest of sea turtles. Despite some continued directed harvest and all of these additional sources of sea turtle mortality, a NRC (1990) report concluded that for juveniles, subadults, and adult female loggerheads in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. Fishery interactions continue to be identified as an important anthropogenic mortality source in every U.S. sea turtle recovery plan.

Incidental capture in fishery operations remains one of the primary marine anthropogenic mortality sources to Atlantic sea turtle populations. Sea turtle takes incidental to U.S. fishery operations have been documented in bottom trawls targeting shrimp, summer flounder, Atlantic sea scallop, and other demersal species in inshore, nearshore, and offshore U.S. Atlantic waters. Dredge fisheries for Atlantic sea scallops have also incidentally injured and killed sea turtles. Sea turtle captures have been documented in the U.S. Mid-Atlantic and Southeast bottom longline shark fishery, as well as the Gulf of Mexico and South Atlantic bottom longline fisheries for reef fish and snapper-grouper. Pelagic longline fisheries, particularly for swordfish and tuna, are known to take sea turtles in the Gulf of Mexico and Atlantic Ocean. Commercial and recreational vertical hook and line gear have also been known to take sea turtles. Although sea turtles taken in vertical hook and line fisheries are often alive when released, ingested hooks and entanglement in gear have been documented as the cause of death in some turtles. Takes of sea turtles have also been documented in large- and small-mesh gillnet fisheries operating off the Atlantic and Gulf Coasts. Sea turtles have also been entangled, sometimes lethally, in Chesapeake Bay pound net leaders. Takes in fish weirs and sea turtles entangled in the vertical buoy lines of whelk, sea bass, lobster, and crab pots have also been documented.

3.2.3 Sea Turtle Strandings

Sea turtle strandings occur due to a variety of reasons, including disease, exposure to biotoxins or pollutants, ingestion of marine debris, vessel collisions, and fishery interactions. The STSSN was formally established in 1980 to collect information on and document strandings of marine turtles along the U.S. Gulf of Mexico and Atlantic coasts. The network, which includes federal, state and private partners, encompasses the coastal areas of the eighteen-state region from Maine to Texas, and includes portions of the U.S. Caribbean. Stranded animals are found: (1) dead on the beach/shore or floating; (2) alive on beach/shore, but unable to return to the water due to sickness, injury, or other obstacle; or (3) in the water but unable to return to their natural habitat without assistance. Network participants document sea turtle strandings in their respective areas and contribute those data to a centralized STSSN database. The occurrence, observation, and documentation of turtles in the STSSN data depends upon a complicated congruence of oceanography, geography, vagaries of voluntary reporting, and the nature of STSSN effort and data reporting.

It is important to note that STSSN coverage has not been consistent since the program's inception, and comparing strandings data from various years has potential artifacts. Coverage in Louisiana from 1995 through August 2008 consisted of systematic surveys (i.e., bi-weekly or monthly) of Western Louisiana funded by NMFS. Prior to 1995 and after September 2008 in Western Louisiana, as well as the entire period in Eastern Louisiana, STSSN only received opportunistic reports of sea turtle strandings. Additionally, there was no STSSN state coordinator for Louisiana prior to the DWH oil spill event. In Mississippi, there were systematic aerial surveys (weekly or bi-weekly, depending on season) funded by NMFS to document strandings on the generally inaccessible barrier islands in the late 1990s. On the mainland, sea turtle stranding reports were only received opportunistically. While there was a STSSN state coordinator for Mississippi prior to Hurricane Katrina in 2005, the position was vacant until the April 2010 DWH oil spill event. Sea turtle stranding reports submitted to the STSSN for Alabama relied primarily on opportunistic reporting and sporadic STSSN state coordinators prior to 2002. Since 2003, there has been a single, consistent Alabama STSSN coordinator in place, who has worked to establish a good network of volunteers to document reported sea turtle strandings. As a result, stranding coverage has been fairly consistent, and Alabama effort likely only increased slightly following the April 2010 DWH oil spill event.

STSSN coverage in the wake of the DWH oil spill event is significantly greater in Louisiana and Mississippi than in previous years due to several factors: (1) there are Natural Resources Damage Assessment (NRDA) contractors surveying virtually the entire coastline of each state on a periodic basis, and they submit a report when they find a stranded turtle; (2) the public is more aware that the STSSN and the marine mammal stranding network exist, and they now know who to contact; and (3) collaborative efforts with state agencies have improved, and there is better response to stranding reports, recovery of animals, and reporting of turtle captures that are encountered during their routine activities (W. Teas, SEFSC, pers. comm.).

Over the past two years NMFS (via the STSSN) has documented elevated sea turtle strandings in the Northern Gulf of Mexico, particularly throughout the Mississippi Sound area. In the first three weeks of June 2010, over 120 sea turtle strandings were reported from Mississippi and Alabama waters, none of which exhibited any signs of external oiling to indicate effects associated with the DWH oil spill event. A total of 644 sea turtle strandings were reported in 2010 from Louisiana, Mississippi, and Alabama waters, 561 (87 percent) of which were Kemp's ridley sea turtles. During the DWH oil spill event response, 281 sea turtle carcasses from Mississippi waters were examined by a veterinary pathologist. No visible external or internal oil was found in any of these sea turtles. Of those carcasses in which assessment was possible (i.e., state of decomposition), 69.3 percent (133 out of 192) were found with fish in the gastrointestinal tracts and 16.4 percent (31 out of 189) were found with shrimp in the mouth, esophagus, and stomach. These findings indicate that these turtles were actively foraging at the time of death, and for those turtles with prey items in their mouth or esophagus, death was rapid.

During March through May of 2011, 267 sea turtle strandings were reported from Mississippi and Alabama waters. A total of 525 sea turtle strandings were reported in 2011 from Louisiana, Mississippi, and Alabama waters, with the majority (455) occurring from March through July, 390 (86 percent) of which were Kemp's ridley sea turtles. These stranding numbers are significantly greater than reported in past years; Louisiana, Mississippi, and Alabama waters reported 42 and 73 sea turtle strandings for 2008 and 2009, respectively. NMFS has examined a total of 52 animals that have stranded since March 1, 2011: 39 from Mississippi, 10 from Louisiana, and 3 from Alabama. Thirty-five of 52 strandings were in fair or good nutritional condition without evidence of significant traumatic injuries or disease as a cause of mortality. As with the 2010 stranding necropsy results, NMFS has continued to document a high rate of fish ingestion in which assessment was possible (33 of 45 assessable cases). Furthermore, 10 of the necropsied turtles had food items, predominantly fish, present in the esophagus, which is consistent with a relatively sudden event resulting in death.

The fact that in both 2010 and 2011 approximately 85 percent of all Louisiana, Mississippi, and Alabama stranded turtles were Kemp's ridleys is notable; however, this could simply be a function of the species' preference for shallow, inshore waters coupled with increased population abundance as reflected in recent Kemp's ridley nesting increases. There was no obvious relationship or trend between the elevated sea turtle strandings and water temperature. Mississippi sea turtle strandings for 2010 and 2011 are presented in Figures 1 and 2 below.

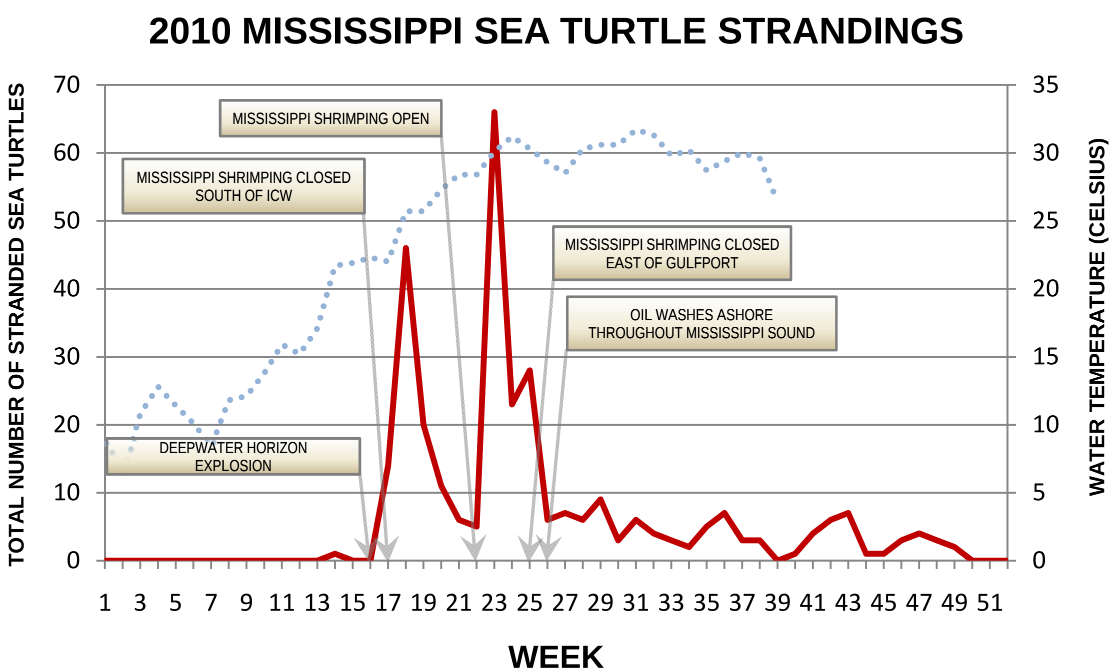

Figure 1. 2010 Mississippi sea turtle strandings (STSSN data), dark line. Water temperatures, dashed line, recorded by U.S. Geological Survey at the Merrill Shell Bank Light monitoring station in Mississippi Sound.

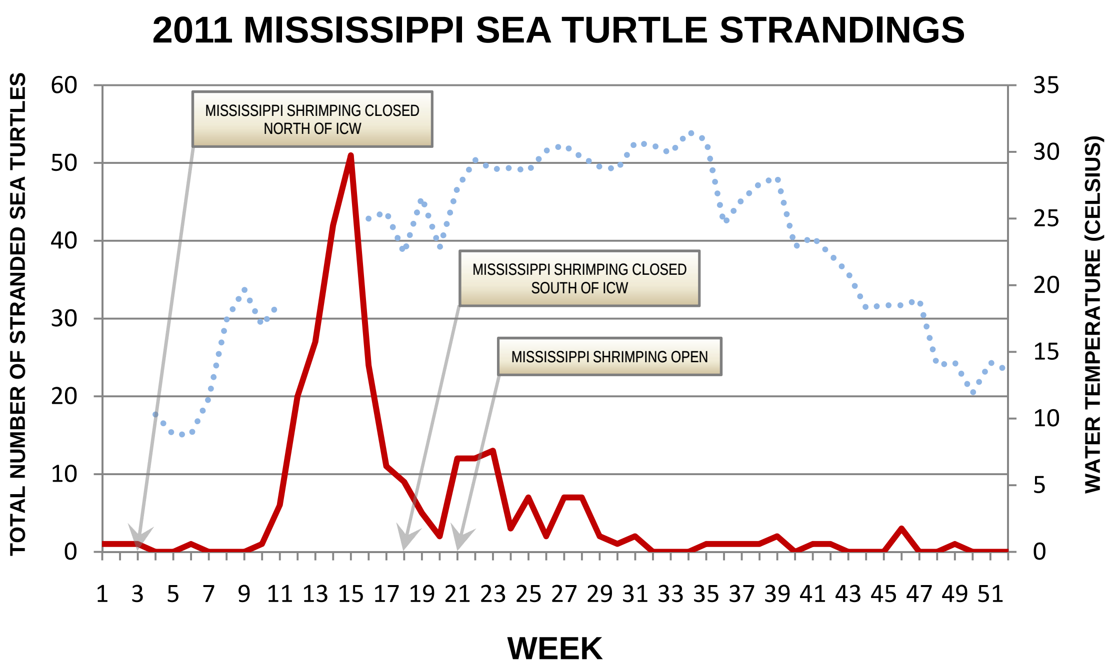

Figure 2. 2011 Mississippi sea turtle strandings (STSSN data), dark line. Water temperatures, dashed line, recorded by U.S. Geological Survey at the Merrill Shell Bank Light monitoring station in Mississippi Sound.

One of the 2011 turtle strandings occurred near Pass Christian, Mississippi, on March 19. This particular turtle was a Kemp's ridley previously released by the Institute of Marine Mammal Studies (IMMS) south of Ship Island, Mississippi, on November 23, 2010. Prior to the turtle's release, it was outfitted with a satellite tracking device, also known as a platform terminal transmitter (specifically PTT102741), that allowed for monitoring of the turtle's movements. The satellite data demonstrated that the turtle initially roamed south through Chandeleur Sound, Louisiana, before finally turning back north off East Bay, just south of Venice, Louisiana. The Kemp's ridley continued in a north-northeast direction before turning west offshore of Dauphin Island, Alabama. Entering Mississippi Sound, it headed west and roamed off Cat Island and Bay St. Louis before ultimately stranding near Pass Christian. The final movements (Figure 3) of this particular Kemp's ridley indicate it perished in fairly close proximity to its stranding location.

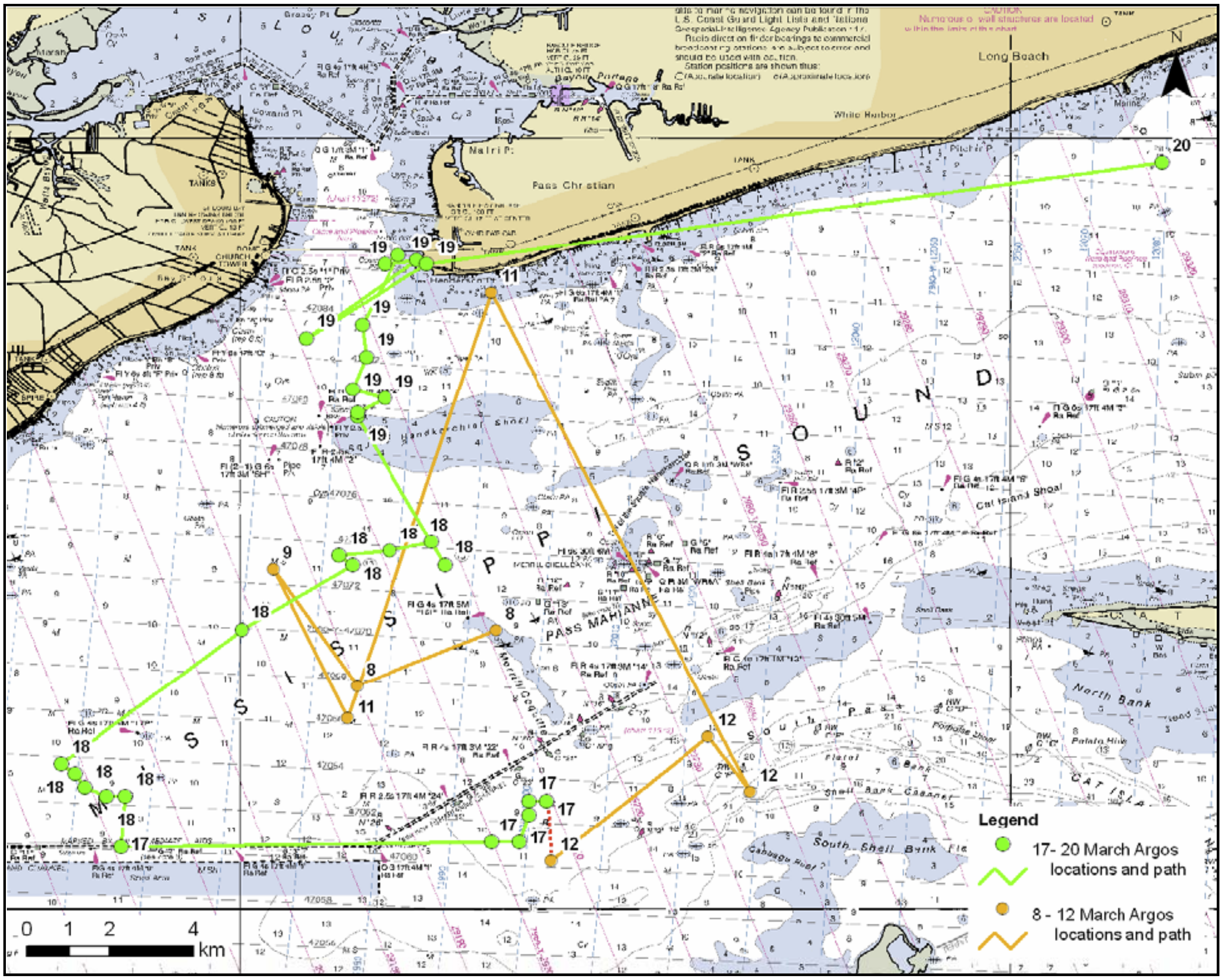

Figure 3. Map of positional data for a Kemp's ridley sea turtle (PTT102741) for the time period of March, 8-20, 2011. This sea turtle was released on November 23, 2010, south of Ship Island, Mississippi, and was found stranded on March 19, 2011. Locations are labeled according to the corresponding day of the month of March; orange points and path segments represent data collected from March 8-12; green points and path segments represent data collected from March, 17-20; the red (dashed) line represents the period of 4.8 days during which no positional data were obtained (from Hardy 2011).

Based on the satellite tag data, this Kemp's ridley likely perished on or just before March 12, 2011 (Hardy 2011). No data was recorded in the following 4.8 days, indicating the turtle was likely submerged. On March 17, 2011, the satellite tag transmitted locational data again, 1.4 km from the last reported position on March 12, which was approximately 14 km south of Pass Christian, Mississippi. It is assumed that at this time decompositional gasses resulted in the turtle carcass becoming buoyant, and it floated to the surface. The increase in logged positional information and the high quality of the locational data from March 17 onwards indicate the turtle was entirely on the surface during this time period. Furthermore, the low travel speeds (median: 1.05 km/hr) exhibited by the turtle support the turtle was likely dead and drifting with the prevailing wind and currents until ultimately stranding on the beach on March 19, 2011.

This case indicates this turtle, and likely the majority of other stranded turtles, perished in fairly close proximity to their stranding location. While few decompositional studies have been conducted on sea turtles, preliminary results documented in Higgins et al. (2007) support this conclusion. While wave action, sunlight exposure, and other factors affect the decompositional process, Higgins et al. (2007) demonstrated water temperature significantly affects sea turtle decomposition, and turtles decompose and transition from negatively buoyant to positively buoyant and back to negatively buoyant relatively quickly in warm water. In August 1995, in 33-34°C water, a juvenile Kemp's ridley carcass went from Code 1 (fresh dead) to Code 5 (clean bones) in only 96 hours (4 days); the carcass became positively buoyant within 24 hours of submergence and was negatively buoyant at 48 hours when gas could no longer be contained within the carcass. The process is slowed considerably in cooler water. In October of 1995 it took a total of 288 hrs (12 days) to reduce a Code 1 carcass to Code 5 in 14-21°C water. The carcass did not float until day 5, at which time it reached Code 3; the carcass did not become positively buoyant until day 5, and floated until day 10 when gas could no longer be contained within the carcass, and thus sank. According to U.S. Geological Survey data recorded at the Merrill Shell Bank Light monitoring station in Mississippi Sound, water temperatures averaged 18°C. Therefore, the findings of Higgins et al. (2007) are consistent with the satellite tag data of PTT102741.

The necropsy for this Kemp's ridley (PTT102741) was conducted on March 22, 2011. The postmortem examination was conducted to determine the cause of death (if possible), identify visible oil exposure due to the DWH oil spill event, and collect relevant biological samples for diagnostic or other analytical purposes. Samples of liver, lung, kidney, stomach, and intestine contents were analyzed by the NOAA National Ocean Service, Marine Biotoxins Program in Charleston, South Carolina, for domoic acid. Histopathology was limited to major organs due to postmortem state. According to the pathology consultation report (NMFS11-00020), "The carcass was well-muscled and adipose stores were abundant (i.e., good nutritional condition)." The report continued, stating the "liver was diffusely tan and moderately decomposed. The mouth, esophagus, and upper airway were clear. The stomach contained large fragments of crab. The colon contained a moderate amount of crab shell admixed with dark gray digesta, and small numbers of fish bones, included a segment of vertebrae, a fin, and a presumptive otolith. The airways contained a moderate amount of red-tinged fluid and the lungs are diffusely congested, wet, and heavy (assessment limited by decomposition). Assessment of visceral organs was limited by decomposition." The conclusion of the necropsy indicated that a cause of death could not be determined due to the postmortem condition of the carcass. The conclusion did state that, "Drowning is a consideration for immediate cause of death based exclusion of other findings and the character of the lungs; however, assessment was limited by decomposition. This turtle was in good nutritional condition and had abundant blue crab within the stomach at the time of death. No visible evidence of oil exposure was found. The presence of fish in the colon is suggestive of prior feeding upon dead fish, such as discarded bycatch or a fish kill. Biotoxin analyses performed on the Kemp's ridley of this report and other turtles that stranded during this time within the Mississippi and Louisiana have only detected very low concentrations of brevetoxin and domoic acid, which most likely reflect low level, background exposure. None of the results have indicated that mortality was associated with a harmful algal bloom/biotoxin."

Suspicion of drowning (i.e., involuntary or forced submergence) in a stranded sea turtle, such as that for PTT102741, is not based on any one finding alone (e.g., sediment in the lungs), but relies on exclusion (to the extent possible) of other potential causes of death/debilitation. It is not unusual to identify drowning as a potential cause of death for any air-breathing animal that lives in an aquatic environment. Furthermore, there is nothing diagnostic about a forced submergence scenario that would necessarily distinguish it from other causes of drowning. A conclusion of forced submergence is generally based on other findings, specifically the lack of any significant trauma, disease or indicators of poor general health; evidence of a sudden event (e.g., food in the mouth or esophagus); and/or absence of harmful algal bloom and other toxins.

Although other mortality factors, such as trauma due to probable watercraft collision and hook and line injuries, are represented in the necropsy results, a significant number of stranded sea turtles fit the profile of a forced submergence scenario. Another potential consideration for the cause of death is acute toxicosis. Testing for petrochemical exposure and dispersants on PTT102741 and other stranded sea turtles is being pursued under the NRDA program, but has not been completed yet (B. Stacy, NMFS, pers. comm.). However, evidence of organ toxicity (as detectable by standard clinical evaluation, gross examination, and histopathology) has not been observed in turtles that were visibly oiled and presumably exposed to dispersants during the DWH oil spill event (B. Stacy, NMFS, pers. comm.). The more apparent acute effects from oil resulted from heavy miring in oil and hyperthermia in hot surface oil, but these effects were under conditions of heavy oiling that have not been observed since offshore operations were concluded in the fall of 2010 (B. Stacy, NMFS, pers. comm.). Although potential long-term/chronic effects of oil and dispersant exposure are of concern and exposure in stranded turtles will be studied, acute mortality of the nature observed in the 2011 stranding event is not anticipated.

Concurrent to the necropsies, NMFS also investigated various potential sources of mortality, such as fishery activities or the U.S. Army Corps of Engineers' dredge operations at Gulfport, Mississippi. The U.S. Coast Guard, SEFSC Gear Monitoring Team (GMT), and various state agencies conducted patrols using aircraft and/or surface vessels to evaluate fishery effort in the area where sea turtles stranded in 2011, particularly throughout Mississippi Sound. While the necropsy results indicated a significant number of turtles likely perished due to forced submergence, the aforementioned efforts did not reveal any definitive findings. Significant portions of Mississippi Sound were closed to fishing during the 2011 stranding event and skimmer trawls in particular were not actively fishing in this area. Fishing effort in the open areas off Mississippi has been extremely low (i.e., 2-3 vessels) due to poor shrimp catch rates. The menhaden fishery was inactive during the stranding event. There were no takes reported by the hopper dredges, which have dedicated observers to monitor sea turtle interactions, working at Gulfport that may indicate those activities may at least be partially responsible for the elevated strandings.

Both the location of where the signal from the satellite tag (Kemp's ridley PTT102741) was lost on March 12, 2011, presumably in fairly close proximity to where the turtle perished, and where it was reacquired on March 17, when the carcass surfaced, is south of the ICW in an area that was open to shrimp fishing at that time. The water depth in this general area is approximately 10-12 feet, which is a depth that both skimmer and otter trawlers could work. This information, coupled with the necropsy findings indicating potential drowning (i.e., involuntary or forced submergence), as well as past experience and findings related to other historical stranding events, indicates interaction with a shrimp trawler is a highly probable scenario in this example. Furthermore, interaction with a shrimp trawler is also a probable scenario for other stranded sea turtles exhibiting similar necropsy findings. Due to a lack of available information, it is not possible to determine the exact mode of fishery interaction (i.e., otter trawlers with TED compliance issues or skimmer trawlers exceeding alternative tow time restrictions), though due to low fishery effort during the spring of 2010 or 2011, repeated interactions with compliant shrimp trawlers is unlikely.

3.2.4 Existing Measures to Reduce Sea Turtle Mortalities

Measures to Reduce Non-Fishery Threats

Nest and beach habitat protection efforts in the United States are focused on the most valuable nesting areas. Important sea turtle nesting beaches, encompassing 25 percent of all U.S. loggerhead sea turtle nesting, has been acquired and designated as the Archie Carr National Wildlife Refuge in Florida. Beach stabilization and nourishment projects are conducted with seasonal restrictions and other protective conditions developed through consultations with federal and state biologists. South Carolina, Georgia, and Florida have developed lighting ordinances and voluntary measures to reduce the disorienting effects of artificial lights on hatchlings. Most major nesting beaches within the continental United States employ predator control measures to protect sea turtle nests. Beach cleaning activities, which require state permits, are conditioned to minimize their effects on nesting sea turtles, nests, and hatchlings. Beach vehicular driving is prohibited on most U.S. nesting beaches. In Volusia County, Florida, where beach driving is still allowed, driving is restricted to daylight hours, in areas where nest densities are lowest and on the lower beach below sea turtle nests which must be well marked. Additionally, throughout the southern United States, efforts to eradicate exotic plants that contribute to beach erosion or that diminish nesting beach suitability are ongoing.

Federal actions that may affect sea turtles are assessed through ESA Section 7 consultations, as discussed above, and the actions are modified to monitor and reduce effects to sea turtles. Mitigation efforts include limits on incidental take, monitoring of power plant intake structures, observer requirements and seasonal restrictions on dredging and beach nourishment projects, observer requirements and seasonal restrictions on military operations, and restrictions on boat races. Additionally, the Marine Pollution Act enacted under the International Convention for the Prevention of Pollution from Ships, and subsequent U.S. Coast Guard regulations, restricts the disposal by all vessels and offshore platforms of all plastics, paper, rags, glass, metal, bottles, crockery, and similar refuse. To mitigate accidental oil releases, various federal, state, and local entities have oil release contingency plans and emergency response teams that could reduce potential impacts from these oil releases.

Natural mortality events in the nearshore marine environment, such as red tide outbreaks and cold weather impacts, are frequently first detected by the STSSN. When husbandry or healthcare is possible, these volunteers often help in the care and subsequent release of beached sea turtles. For example, during the winter of 2010, an unprecedented cold-stunning event occurred in the Southeast as a result of a sudden drop in temperature. Over 4,500 sea turtles stranded, including over 4,300 green turtles. Volunteer responders were able to save all but about 940, mostly green, sea turtles.

Internationally in the broader Northwest Atlantic, the USFWS and NMFS work with other countries in the Americas and the Caribbean thorough direct bilateral activities, capacity building related to gear research, participation in the Northwest Atlantic loggerhead and Kemp’s ridley Binational

Working Groups, and through compliance with and participation in multinational organizations working to promote the recovery of sea turtles, including the United Nation's Convention on International Trade in Endangered Species and the Inter-American Convention for the Protection and Conservation of Sea Turtles.

Measures to Reduce Fishery Threats

Incidental catch in commercial fisheries is identified as a threat in all sea turtle recovery plans. As early as 1975, upon proposing the listing of loggerheads as a threatened species, incidental capture in trawl fisheries was identified as a factor affecting the continued existence of sea turtles (40 FR 21975, May 20 1975). The listing determination identified fisheries bycatch as "most serious in the trawl fisheries of the South Atlantic and Gulf of Mexico regions" and discussed ongoing development of an excluder panel and plans for testing under commercial fishing conditions (43 FR 32800 July 28, 1978). These earliest efforts to mitigate the effects of fishing on sea turtles focused on the southeastern U.S. shrimp fisheries and the development of TEDs. These efforts, as well as a summary of TED regulations, are discussed in detail in Appendix II.

TEDs incorporate an escape opening, usually covered by a webbing flap, which allow sea turtles to escape from trawl nets. To be approved by NMFS, a TED design must be shown to be 97 percent effective in excluding sea turtles during testing based upon NMFS-approved scientific testing protocols (50 CFR 223.207(e)(1)). NMFS-approved testing protocols established to date include the "small turtle test" (55 FR 41092, October 9, 1990) and the "wild turtle test" (52 FR 24244, June 29, 1987). Additionally, NMFS has established a leatherback model testing protocol to evaluate a candidate TED's ability to exclude adult leatherback sea turtles (66 FR 24287, May 14, 2001). Because testing with live leatherbacks is impossible, NMFS obtained the carapace measurements of 15 nesting female leatherback turtles and used these data to construct an aluminum pipe-frame model of a leatherback turtle measuring 40 inches (101.6 cm) in width, 60 inches (152.4 cm) in length, and 21 inches (53.3 cm) in height. If the leatherback model and a diver with full scuba gear are able to pass through the escape opening of a candidate TED, that escape opening is judged to be capable of excluding adult leatherback sea turtles, as well as other large adult sea turtles.

A summary of regulatory measures that have been implemented to reduce incidental sea turtle bycatch and mortality in Atlantic fisheries (including the Gulf of Mexico) is provided in Table 2 below.

Table 2. Summary of regulatory measures to reduce sea turtle bycatch/mortality in Atlantic fisheries.

GEAR	AREA AND SEASON	REQUIREMENTS	DATE	CITATION
Shrimp Trawls	Inshore and offshore waters south of the Virginia border; Year-round.	TEDs	1987-1990	§223.206(d)(2), §223.207
Summer Flounder Trawls	Summer Flounder-Sea Turtle Protection Area (offshore waters from Cape Charles, Virginia, south to a line extending from the North Carolina/South Carolina border); Year-round south of Oregon Inlet, North Carolina; March 16 through January 14 from Cape Charles, Virginia south to Oregon Inlet, North Carolina.	TEDs	11/15/1992	§223.206(d)(2)(iii), §223.207
Inshore Gillnets (> 4.25 in (10.8cm) stretched)	Pamlico Sound, North Carolina and contiguous tidal waters; September 1 through December 15.	Closure	12/10/1999	§223.206(d)(7)
Large-Mesh Gillnets (> 7 in (17.8 cm) stretched)	Chincoteague, Virginia south to a line extending from the North Carolina/South Carolina border.	Expanding closure	05/18/2000	§223.206(d)(8)
Atlantic Pelagic Longline	Entire Atlantic; Year-round.	Gear modification, handling, and release protocols	10/10/2000	§223.206(d)(1)(ii), §635.21(c)-(d)
Gulf of Mexico Bottom Longline	Shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida; June through August.	Closure, gear and effort reduction	05/26/2010	§622.34(q)(1)-(3)
Pound Nets	Designated areas in Virginia mainstem of the Chesapeake Bay; May 6 through July 15.	Gear modification (modified leader)	06/19/2001	§223.206(d)(10)
Atlantic Sea Scallop Dredges	South of 41° 9' N; May 1 through November 30.	Gear modification (chain mats)	09/26/2006	§223.206(d)(11)

3.3 MARINE MAMMALS

This section provides information on marine mammals that occur in U.S. Atlantic waters and that may be affected by the alternatives considered within this DEIS. The Marine Mammal Protection Act (MMPA) of 1972 protects all marine mammals, regardless of whether or not they are listed under the ESA. The Secretary of Commerce is responsible for the protection of all cetaceans (whales, porpoises, and dolphins) and pinnipeds (seals and sea lions), except walruses, and has delegated authority for implementing the MMPA to NMFS. The Secretary of the Interior is responsible for the protection of walruses, polar bears, sea otters, manatees, and dugongs, and has delegated this responsibility to the USFWS. These responsibilities include providing oversight and advice to regulatory agencies on all federal actions that might affect these species. The MMPA prohibits the "take" of marine mammals, with certain exceptions, in waters under U.S. jurisdiction and by U.S. citizens on the high seas. Under the MMPA, take is defined as "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect."

Take causing serious injury and mortality of marine mammals incidental to commercial fishing operations is a primary threat to many marine mammal species. The MMPA of 1972 states that marine mammal species and stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part. In 1994, Congress amended the MMPA to address the incidental mortality and serious injury of marine mammals in U.S. commercial fisheries. Section 118 of the MMPA established a system for classifying commercial fisheries according to their levels of marine mammal bycatch and created the take reduction plan process to reduce that bycatch (45086 60 FR 45086, August 30, 1995).

Measures are in place to reduce the effects of fisheries on marine mammals, where necessary. None of the alternatives considered within this DEIS would overtly increase the likelihood of incidental capture of marine mammals in the shrimp fisheries. However, TED requirements in some of the fisheries may result in an increase in trawling time due to reduced target catch rates, and resultant increase in opportunity for incidental capture. The increase in tows to compensate target catch loss caused by TEDs, however, is not likely to significantly increase overall effort.

3.3.1 List of Fisheries

NMFS classifies commercial fisheries annually under one of three categories based on marine mammal take information contained in annual stock assessment reports (SARs) as well as other sources of new information (see 75 FR 68468, November 8, 2010). Category I fisheries are those with frequent incidental mortality and serious injury of marine mammals. Category II fisheries are those fisheries with occasional incidental mortality and serious injury of marine mammals. Category III fisheries are those with a remote likelihood of or no known incidental mortality and serious injury of marine mammals. Participants in Category I and II fisheries must register with the Marine Mammal Authorization Program; carry a Marine Mammal Authorization Program certificate aboard their vessel while fishing; report, within 48 hours of returning to port, all marine mammal accidental or incidental injuries or mortalities that occurred while fishing; accommodate an observer upon request; and comply with any applicable take reduction plans that may be developed for fisheries with high capture levels of certain "strategic" stocks (defined below). The southeastern U.S. shrimp fishery was elevated from a Category III fishery to a Category II fishery in 2011 (75 FR 68468, November 8, 2010).

The proposed 2011 List of Fisheries (75 FR 36318, June 25, 2010) based the elevated classification on interactions reported through observer reports, stranding data, and fisheries research data (2009 SAR), with multiple strategic marine mammal stocks (bottlenose dolphin, South Carolina coastal; bottlenose dolphin, Georgia coastal; bottlenose dolphin, Northern Gulf of Mexico coastal (Eastern, Northern, and Western); and bottlenose dolphin, Gulf of Mexico bay, sound and estuarine) and non-strategic marine mammal stocks (bottlenose dolphin, Northern Gulf of Mexico continental shelf; and spotted dolphin, Northern Gulf of Mexico). The potential biological removal (PBR) levels were known only for two of these stocks, the South Carolina and Georgia coastal stocks of bottlenose dolphins. The PBR levels were unknown or undetermined for the remaining stocks because of outdated population estimates (e.g., estimates are over 8 years old) and lack of abundance and mortality data necessary to calculate a PBR level. For this reason, the annual serious injury and mortality rate as it compares to each stock's PBR cannot be calculated for most of these stocks. The proposed 2012 List of Fisheries (76 FR 37716, June 28, 2011) listed the marine mammal species and stocks incidentally killed or injured in the southeastern U.S. shrimp fishery: Atlantic spotted dolphin, Gulf of Mexico continental and oceanic; bottlenose dolphin, South Carolina/Georgia coastal[8]; bottlenose dolphin, Eastern, Northern, and Western Gulf of

[8] The fishery was classified based on serious injuries and mortalities of this stock, which are greater than 1 percent and less than 50 percent of the stock's potential biological removal.

Mexico coastal[9]; bottlenose dolphin, Gulf of Mexico continental shelf; bottlenose dolphin, Gulf of Mexico bay, sound, and estuarine[10]; West Indian manatee, Florida.

NMFS determines whether a Category II classification is warranted for a given fishery (i.e., the fishery has occasional incidental mortality and serious injury of marine mammals) by other factors, such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, qualitative data from logbooks or fisher reports, stranding data, and the species or distribution of marine mammals in the area, or at the discretion of the Assistant Administrator (see 50 CFR 229.2). Due to the lack of PBR data and low observer coverage, NMFS conducted a qualitative analysis to determine the appropriate classification for the "southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl" fishery. NMFS reviewed the best scientific data available, including known and observed serious injuries and mortalities of bottlenose and other dolphin species obtained during extremely low observer coverage (less than 1 percent). NMFS considered the low level of observer coverage; number and type of documented interactions with trawl gear; levels of fishing effort; type of fishing gear used; lack of deterrence gear or methods; fishing process including soak time; and spatial and temporal co-occurrence of the shrimp trawl fishery and strategic marine mammal stocks. Based on this information, which is summarized below, NMFS proposed classifying this fishery in Category II.

This fishery was observed between 1992 and 2006 under a voluntary program, which became mandatory in 2007. Observer coverage has been less than 1 percent for all observed years. Even with low coverage, NMFS observed 12 dolphin takes (of which 11 animals were seriously injured or killed) in this fishery since 1993. Eleven of these takes occurred since 2002. Because observer data sheets often listed "dolphin" and did not specify the species, NMFS can only confirm that 4 of the 12 takes were bottlenose dolphins. Based on the location of the 8 observed takes that were not identified to species, the takes may be either bottlenose dolphins or Atlantic spotted dolphins. However, bottlenose dolphins are ubiquitous, and are the most commonly found cetacean throughout southeastern U.S. coastal waters, bays, sounds and estuaries.

In addition to observer reports of marine mammals seriously injured or killed in this fishery, the final 2009 SARs note that "occasional interactions with bottlenose dolphins have been observed [in the shrimp trawl fishery], and there is infrequent evidence of interactions from stranded animals." The lack of stranding evidence is not unusual. Some fisheries (e.g., gillnet and trap/pot) leave distinctive wounds on stranded animals, which are often found still entangled with tell-tale gear. However, it is thought that serious injuries or mortalities to marine mammals from trawl fisheries are less obvious on gross inspection: cause of death is more likely to be by blunt trauma from trawl doors, or drowning by enclosure in, rather than by entanglement with the net.

Marine Mammal Authorization Program records indicate one voluntarily-reported dolphin take in shrimp trawl gear in South Carolina in 2002. Thirteen additional dolphin takes, ten since 2002, have been documented by NMFS in Southeast U.S. research trawl operations, and/or relocation trawls conducted in conjunction with dredging and other marine construction activities. Twelve of the thirteen takes resulted in serious injury or mortality, and one out of the thirteen was an Atlantic spotted dolphin, the remaining animals were bottlenose dolphins. There are no substantive

[9] Ibid.
[10] Ibid.

differences between commercial fishing and relocation trawls, although relocation trawls are not equipped with TEDs, and soak time is considerably less (usually about 30 minutes) than commercial shrimp trawls.

3.3.2 Marine Mammals Listed under the ESA

Species of large whales protected by the ESA that occur throughout the Gulf of Mexico and Atlantic Ocean include the blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), North Atlantic right whale (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), and the sperm whale (*Physeter macrocephalus*). Additionally, the West Indian manatee (*Trichechus manatus*) also occurs both in the Gulf of Mexico and the Atlantic Ocean; the West Indian manatee is under the jurisdiction of the USFWS. These species are also considered depleted under the MMPA. Depleted and endangered designations afford special protections from captures, and further measures to restore populations to recovery or the optimum sustainable population are identified through required recovery (ESA species) or Conservation Plans (MMPA depleted species).

Blue, fin, sei, and sperm whales are predominantly found seaward of the continental shelf where shrimping does not take place. North Atlantic right whales and humpback whales are coastal animals and have been sighted in the nearshore environment in the Atlantic along the southeastern United States from November through March. North Atlantic right and humpback whales have been spotted in the Gulf of Mexico on rare occasions; however, these are thought to be inexperienced juveniles. There are no known endemic populations of these whales in the Gulf of Mexico. Sperm whales can be found along the continental shelf in the Gulf of Mexico, however, there is little or no shrimp fishing in this area in the Gulf. There have been no reported interactions between large whales and shrimp vessels in the Atlantic or Gulf of Mexico. Also shrimp trawlers move slowly (e.g., 2 knots while trawling) which would give a whale or the fishing vessel time to avoid a collision.

According to the final rule for the 2011 List of Fisheries (75 FR 68468, November 8, 2010), there has been at least one confirmed take of a West Indian manatee in the southeastern U.S. shrimp fishery since 1987; a manatee that was killed by a commercial shrimp trawler, with an observer aboard, in Georgia in 1997. Also, according to the USFWS' 2009 SAR, the bait shrimp fishery was suggested to cause three unconfirmed manatee mortalities in 1990. Furthermore, observer coverage for the shrimp trawl fishery has been less than 1 percent since 1992. Due to extremely low observer coverage, confirmed and unconfirmed takes by shrimp trawl gear, and the spatial and temporal co-occurrence of the shrimp trawl fishery and the Florida subspecies of the West Indian manatee, NMFS believes there is at least a remote likelihood of incidental mortality and serious injury for the Florida subspecies of the West Indian manatee.

Further information on the aforementioned ESA-listed whale species can be found in a number of published documents, including recovery plans (NMFS 1991, 1998a, 2005, 2010a), the Marine Mammal SARs (e.g., NMFS 2010b), status reviews, and other publications (e.g., Clapham et al. 1999; Perry et al. 1999; Best 2001), and are incorporated herein by reference. Detailed information on the West Indian manatee can be found in the Recovery Plan (USFWS 2001) and the five-year status review (USFWS 2007), which are also incorporated herein by reference.

3.3.3 Other Marine Mammal Species

Numerous species of marine mammals listed under the MMPA occur throughout the Atlantic Ocean and/or Gulf of Mexico, including the bottlenose dolphin (*Tursiops truncatus*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), short-beaked common dolphin (*Delphinus delphis*), harbor porpoise (*Phocoena phocoena*), Risso's dolphin (*Grampus griseus*), Atlantic spotted dolphin (*Stenella frontalis*), pantropical spotted dolphin (*Stenella attenuata*), striped dolphin (*Stenella coeruleoalba*), spinner dolphin (*Stenella longirostris*), rough-toothed dolphin (*Steno bredanensis*), Clymene dolphin (*Stenella clymene*), Fraser's dolphin (*Lagenodelphis hosei*), as well as the killer whale (*Orcinus orca*), Brydes's whale (*Balaenoptera edeni*), Cuvier's beaked whale (*Ziphius cavirostris*), Blainville's beaked whale (*Mesoplodon densirostris*), Gervais' beaked whale (*Mesoplodon europaeus*), false killer whale (*Pseudorca crassidens*), pygmy killer whale (*Feresa attenuata*), dwarf sperm whale (*Kogia sima*), pygmy sperm whale (*Kogia breviceps*), melon-headed whale (*Peponocephala electra*), and the short-finned pilot whale (*Globicephala macrorhynchus*).

Information on these species can be found in their respective SARs (NMFS 2010b) and are incorporated herein by reference. Aside from the interactions discussed for bottlenose and spotted dolphins in Section 3.3.1 and West Indian manatees in Section 3.3.2, there have been no reported interactions with other marine mammal species in the southeastern U.S. shrimp fisheries.

3.3.4 2010-2011 Unusual Mortality Event

An unusual mortality event (UME) is defined under the MMPA as, "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." The Marine Mammal UME Program was established in 1991. From 1991 to the present, there have been 52 formally recognized UMEs in the U.S., involving a variety of species and dozens to hundreds of individual marine mammals per event. The most common species involved in UMEs are bottlenose dolphins, California sea lions, and West Indian manatees. Causes have been determined for 25 of the 52 UMEs documented since 1991. Causes of UMEs include infections, biotoxins (e.g., domoic acid and brevetoxin), human interactions, and malnutrition.

A UME was declared for cetaceans in the Northern Gulf of Mexico (Texas/Louisiana border through Franklin County, Florida) from February 2010 through the present. As of August 7, 2011, the UME involved 512 Cetacean strandings in the Northern Gulf of Mexico (4 percent stranded alive and 96 percent stranded dead). Of these strandings, 113 cetaceans stranded prior to the DWH oil spill event response phase (February 1, 2010 - April 29, 2010); 115 cetaceans stranded or were reported dead offshore during the initial DWH oil spill event response phase (April 30, 2010 - November 2, 2010); and 277 cetaceans stranded after the initial DWH oil spill event response phase ended (November 3, 2010 - August 7, 2011). There have been 237 strandings reported in Louisiana, Mississippi, and Alabama waters from January 1, 2011, through August 7, 2011. Figure 4 below illustrates both cetacean and sea turtle strandings for Mississippi waters in 2011.

While there has been speculation that the DWH oil spill event is responsible for the 2010-2011 UME, as well as the sea turtle stranding events in the Northern Gulf of Mexico, the cause for the 2010-2011 UME is, as yet, undetermined. Similar to the seemingly coordinated dolphin and sea turtle strandings presented in Figure 5, NMFS has previously documented dolphin stranding events that occurred just prior to and during the initial period of elevated sea turtle strandings in the Gulf of Mexico. In early 1994, a number of stranded dolphins preceded elevated sea turtle strandings along the Texas coast. Ultimately, however, the cause of the dolphin strandings was determined to be a viral pathogen, morbillivirus, related to canine distemper and measles, while the turtle strandings were attributed to incorrect installation and improper use of TEDs (NMFS 1994).

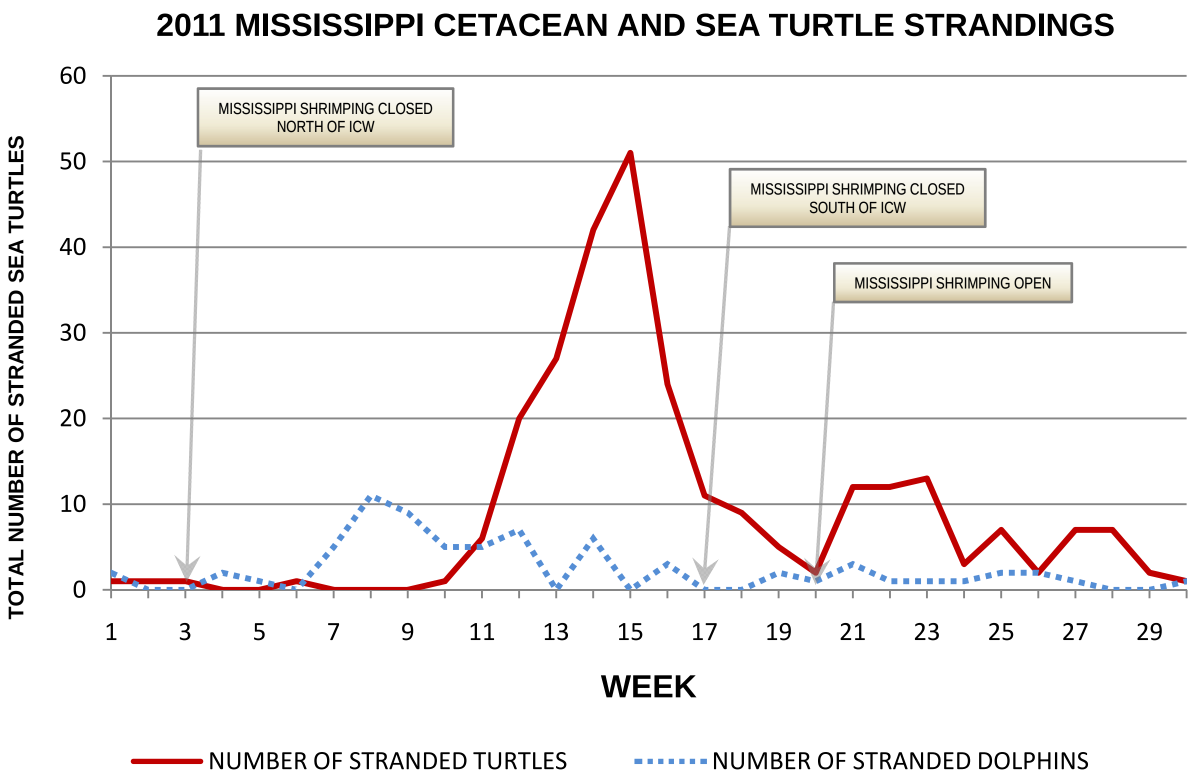

Figure 4. 2010 Mississippi cetacean and sea turtle strandings (MMUME and STSSN data).

3.4 FISH SPECIES LISTED UNDER THE ENDANGERED SPECIES ACT

Gulf sturgeon (*Acipenser oxyrinchus desotoi*), shortnose sturgeon (*Acipenser brevirostrum)*, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and smalltooth sawfish (*Pristis pectinata),* occur within the area encompassed by the alternatives analyzed within this DEIS. The 5-year review for Gulf sturgeon (USFWS and NMFS 2009) notes that bycatch in shrimp trawls has been documented but has likely been mitigated by TEDs and bycatch reduction devices (BRDs). However, informal conversations with shrimpers suggest that Gulf sturgeon are commonly encountered in Choctawhatchee Bay, Florida, during nocturnal commercial fishing (D. Fox., Delaware State University, pers. comm., in USFWS and NMFS 2009). The recovery plan for shortnose sturgeon (NMFS 1998b) states incidental take of shortnose sturgeon has been documented in shrimp trawls. As noted in the Status Review of Atlantic Sturgeon (NMFS 2007), Atlantic sturgeon have been reportedly captured in shrimp trawls, though TED and BRD requirements may reduce incidental take of Atlantic sturgeon in this fishery. The listing of the Carolina and South Atlantic DPS of Atlantic sturgeon on February 6, 2012 (77 FR 5914), however, noted data supplied by NCDMF documenting over 958 observed tows conducted by commercial shrimp trawlers working in North Carolina with no Atlantic sturgeon reported. Reports from the mandatory observer program in the South Atlantic shrimp fishery documented the capture of nine Atlantic sturgeon off South Carolina and Georgia between 2008 and 2011. TED testing was conducted by the NMFS SEFSC Harvesting Systems Branch in North Carolina from 2008 through 2009. Sturgeon were only captured during four test tows, but TED usage resulted in an 87 percent reduction in Atlantic sturgeon bycatch by number of individuals, and a 95 percent reduction by weight (B Ponwith, NMFS, March 2, 2012, memorandum to D. Bernhart, NMFS).

The shrimp fisheries may directly affect smalltooth sawfish that are foraging within or moving through an active trawling location via direct contact with the gear. The long, toothed rostrum of the smalltooth sawfish causes this species to be particularly vulnerable to entanglement in any type of netting gear, including the netting used in shrimp trawls. The saw penetrates easily through nets, causing the animal to become entangled when it attempts to escape. Mortality of entangled smalltooth sawfish is believed to occur as a result of the net being out of the water for a period of time with the smalltooth sawfish hanging from it before being disentangled (Simpfendorfer pers. comm. 2005). Despite increased effort placed on collecting smalltooth sawfish data since NMFS was petitioned to list the smalltooth sawfish in 1999 (e.g., Simpfendorfer and Wiley 2004; Poulakis and Seitz 2004), records of incidental capture in shrimp trawls are rare. The recovery plan for smalltooth sawfish (NMFS 2009c) documents that the species was documented as bycatch in the shrimp fisheries, with the greatest amount of data available from Louisiana (this does not mean the greatest catches were made in Louisiana, only that this is where the best records were kept). One data set from shrimp trawlers off Louisiana from the late 1940s through the 1970s (Simpfendorfer 2002) suggests a rapid decline in the species from the period 1950-1964. Anecdotal information collected by NMFS port agents indicates that smalltooth sawfish are now taken very rarely in the Louisiana shrimp trawl fishery.

While noting that there have been documented interactions between the above mentioned species and shrimp trawls, none of the actions considered in the proposed alternatives are likely to increase the likelihood of incidental take of these listed species. Detailed status information on the fish species listed under the ESA that may be affected by the proposed alternatives is included in Appendix III.

3.5 CRITICAL HABITAT

As this DEIS is focused on reducing incidental bycatch and mortality in the southeastern U.S. shrimp fisheries, specifically in the Northern Gulf of Mexico (and potentially in other areas where skimmer trawls operate), only Gulf sturgeon critical habitat would potentially be affected by the alternatives considered herein. Therefore, a discussion on Gulf sturgeon critical habitat follows.

Gulf sturgeon critical habitat was jointly designated by NMFS and USFWS on April 18, 2003 (50 CFR 226.214). Critical habitat is defined in Section 3(5)(A) of the ESA as: (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features: (a) essential to the conservation of the species, and (b) that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. The term “conservation” is defined in Section 3(3) of the ESA as the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which listing under the ESA is no longer necessary.

Gulf sturgeon critical habitat includes areas within the major river systems that support the seven currently reproducing subpopulations (USFWS et al. 1995), and associated estuarine and marine habitats. Gulf sturgeon use the rivers for spawning, larval and juvenile feeding, adult resting and staging, and to move between the areas that support these components. Gulf sturgeon use the lower riverine, estuarine, and marine environment during winter months primarily for feeding and, more rarely, for inter-river migrations. Estuaries and bays adjacent to the riverine units provide unobstructed passage of sturgeon from feeding areas to spawning grounds.

Fourteen areas (units) are designated as Gulf sturgeon critical habitat. Critical habitat units encompass a total of 2,783 river kilometers (km) and 6,042 km^2 of estuarine and marine habitats, and include portions of the following Gulf of Mexico rivers, tributaries, estuarine, and marine areas:

Unit 1	Pearl and Bogue Chitto Rivers in Louisiana and Mississippi;
Unit 2	Pascagoula, Leaf, Bowie, Big Black Creek, and Chickasawhay Rivers in Mississippi;
Unit 3	Escambia, Conecuh, and Sepulga Rivers in Alabama and Florida;
Unit 4	Yellow, Blackwater, and Shoal Rivers in Alabama and Florida;
Unit 5	Choctawhatchee and Pea Rivers in Florida and Alabama;
Unit 6	Apalachicola and Brothers Rivers in Florida;
Unit 7	Suwannee and Withlacoochee Rivers in Florida;
Unit 8	Lake Pontchartrain (east of causeway), Lake Catherine, Little Lake, the Rigolets, Lake Borgne, Pascagoula Bay, and Mississippi Sound systems in Louisiana and Mississippi, and sections of the state waters within the Gulf of Mexico;
Unit 9	Pensacola Bay system in Florida;
Unit 10	Santa Rosa Sound in Florida;
Unit 11	Nearshore Gulf of Mexico in Florida;
Unit 12	Choctawhatchee Bay system in Florida;
Unit 13	Apalachicola Bay system in Gulf and Franklin Counties, Florida; and
Unit 14	Suwannee Sound in Florida.

Critical habitat determinations focus on those physical and biological features that are essential to the conservation of the species (50 CFR 424.12). Federal agencies must ensure that their activities are not likely to result in the destruction or adverse modification of critical habitat through adverse effects to the essential features on which designations are based. Therefore, proposed actions that may impact designated critical habitat require an analysis of potential impacts to each essential feature.

Features identified as essential for the conservation of the Gulf sturgeon consist of: (1) abundant food items, such as detritus, aquatic insects, worms, and/or mollusks, within riverine habitats for larval and juvenile life stages; and abundant prey items, such as amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, mollusks and/or crustaceans, within estuarine and marine habitats and substrates for subadult and adult life stages; (2) riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay; (3) riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during fresh water residency and possibly for osmoregulatory functions; (4) a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of fresh water discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, staging, and for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larval staging; (5) water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; (6) sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and (7) safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., an unobstructed river or a dammed river that still allows for passage).

As stated in the final rule designating Gulf sturgeon critical habitat, the following activities, among others, when authorized, funded, or carried out by a federal agency, may destroy or adversely modify critical habitat: (1) actions that would appreciably reduce the abundance of riverine prey for larval and juvenile sturgeon, or of estuarine and marine prey for juvenile and adult Gulf sturgeon, within a designated critical habitat unit, such as dredging, dredged material disposal, channelization, in-stream mining, and land uses that cause excessive turbidity or sedimentation; (2) actions that would appreciably reduce the suitability of Gulf sturgeon spawning sites for egg deposition and development within a designated critical habitat unit, such as impoundment, hard-bottom removal for navigation channel deepening, dredged material disposal, in-stream mining, and land uses that cause excessive sedimentation; (3) actions that would appreciably reduce the suitability of Gulf sturgeon riverine aggregation areas, also referred to as resting, holding, and staging areas, used by adult, subadult, and/or juveniles, believed necessary for minimizing energy expenditures and possibly for osmoregulatory functions, such as dredged material disposal upstream or directly within such areas, and other land uses that cause excessive sedimentation; (4) actions that would alter the flow regime (the magnitude, frequency, duration, seasonality, and rate-of-change of fresh water discharge over time) of a riverine critical habitat unit such that it is appreciably impaired for the purposes of Gulf sturgeon migration, resting, staging, breeding site selection, courtship, egg fertilization, egg deposition, and egg development, such as impoundment; water diversion; and dam operations; (5) actions that would alter water quality within a designated critical habitat unit, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability, such as dredging, dredged material disposal, channelization, impoundment, in-stream mining, water diversion, dam operations, land uses that cause excessive turbidity, and release of chemicals, biological pollutants, or heated effluents into surface water or connected groundwater via point sources or dispersed non-point sources; (6) actions that would alter sediment quality within a designated critical habitat unit such that it is appreciably impaired for normal Gulf sturgeon behavior, reproduction, growth, or viability, such as dredged material disposal, channelization, impoundment, in-stream mining, land uses that cause excessive sedimentation, and release of chemical or biological pollutants that accumulate in sediments; and (7) actions that would obstruct migratory pathways within and between adjacent riverine, estuarine, and marine critical habitat units, such as dams, dredging, point-source-pollutant discharges, and other physical or chemical alterations of channels and passes that restrict Gulf sturgeon movement (68 FR 13399).

3.6 ESSENTIAL FISH HABITAT (EFH)

The 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) mandated that FMPs be amended to include the description and identification of EFH for all managed species. The MSFCMA defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." EFH for species managed by the Gulf of Mexico and South Atlantic Fishery Management Councils have been identified and described in their respective FMP amendments (GMFMC 1998, 2004, 2005; SAFMC 1998), and are incorporated herein by reference. Maps of EFH, and links to source documents can be found on the EFH mapping website, at http://sharpfin.nmfs.noaa.gov/website/EFH_Mapper/map.aspx.

EFH for a number of highly migratory species (HMS), including tuna, sharks, swordfish and billfish, also occur within the area considered within the scope of this DEIS. According to the 2006 Final Consolidated Atlantic HMS FMP, NMFS has not detected adverse effects from non-HMS fishing gears on HMS EFH. HMS EFHs occur primarily in the water column or are dependent on open-water conditions such as fronts and temperature gradients. Bottom trawling may affect nearshore and estuarine shark pupping areas, however these effects are currently undocumented and at this point are considered to be temporary and minimal (NMFS 2006).

Effects of Bottom Trawling on Benthic Habitat

All fishing has an effect on the marine environment, and therefore the associated habitat. Fishing has been identified as the most widespread human exploitative activity in the marine environment (Jennings and Kaiser 1998), as well as the major anthropogenic threat to demersal fisheries habitat on the continental shelf (Cappo et al. 1998). Fishing impacts range from the extraction of a species which skews community composition and diversity to reduction of habitat complexity through direct physical impacts of fishing gear. As the most extensively utilized towed bottom-fishing gear (Watling and Norse 1998), trawls have been identified as the most wide-spread form of disturbance to marine systems below depths affected by storms (Watling and Norse 1998; Friedlander et al. 1999). Jones (1992) broadly classified the way a trawl can affect the seabed as: scraping and ploughing; sediment resuspension; and physical habitat destruction, and removal or scattering of non-target benthos. The specific effects of otter and skimmer trawls were evaluated by Barnette (2001), and the discussion of those gear types is incorporated herein by reference.

3.7 ECONOMIC ENVIRONMENT

The alternatives analyzed within this DEIS could require a portion or all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets, or close various designated areas for specific amounts of time to all shrimp fishing to reduce incidental bycatch and mortality in the southeastern U.S. shrimp fisheries. This section identifies the number of vessels that would be affected by the range of alternatives considered, and summarizes available socioeconomic information. Sections 3.7.1 through 3.7.8 are largely focused on the Gulf of Mexico shrimp fisheries, and information specific to the North Carolina shrimp fisheries is also found in Section 3.7.9. There is considerably more information in the following sections dedicated to the Gulf of Mexico shrimp fisheries than the North Carolina shrimp fisheries. The Gulf of Mexico region, in particular the three Gulf states with skimmer trawl fisheries, hosts larger shrimp fisheries with more participants and that yields more shrimp landings as compared to the North Carolina shrimp fisheries. Furthermore, and as a result of these factors, the Gulf of Mexico region has been studied more in regards to the socio-economic aspects of the shrimp fisheries. Therefore, the following sections reflect these factors.

Gulf of Mexico Shrimp Fisheries

Most available information on the Gulf of Mexico shrimp fisheries focuses on the offshore, federally-permitted fishery. Little economic information is available on the inshore shrimp fishery, particularly in regards to the social environment. Shrimping vessels fishing in inshore waters are usually small vessels, often operated part-time, and generally less sophisticated from a business perspective. Further, licensing and the quality of contact information are not consistent across states. Some states issue licenses to vessels (e.g., Mississippi) while others issue licenses to gear or each net fished (e.g., Louisiana). Furthermore, there is some overlap of effort, as fishermen from one Gulf state can purchase a license in neighboring states to fish in their waters. Likewise, some vessels may fish in both offshore and inshore waters. As a result, collecting economic data from this segment is challenging. For example, information from Louisiana Department of Wildlife and Fisheries (LADWF) indicate there were a total of 12,806 shrimp gear licenses sold in 2010: 4,841 commercial trawl (presumably otter trawl) licenses, 2,846 recreational trawl (presumably otter trawl) licenses, 1,260 wing net licenses, and 6,705 skimmer net licenses. Louisiana issues a license for each net, so this approximates a universe of approximately 1,210 - 2,421 otter trawlers (range based on quad rigged vessels - double rigged vessels) and 3,300 skimmer boats in Louisiana (LADWF statistics). This is less than half the number of licenses sold in 2000, which totaled 27,799 licenses comprised of 12,262 commercial trawl (presumably otter trawl) licenses, 5,299 recreational trawl (presumably otter trawl) licenses, 2,576 wing net licenses, and 7,662 skimmer net licenses. However, it is important to point out that while there was a potential universe of approximately 1,210 - 2,421 otter trawlers (range based on quad rigged vessels - double rigged vessels) and 3,300 skimmer boats in Louisiana for 2010, only 700 otter trawl vessels, 148 butterfly trawlers, and 1,615 skimmer trawl vessels reported catch/sales in 2010 via Louisiana's required trip ticket system. This difference could be a result of several factors, including: vessels using both otter and skimmer trawl gear; latent effort in the fishery; under-reporting in the trip ticket system; and/or individuals holding commercial gear licenses but only fishing for personal consumption.

According to the Gulf Shrimp System[11] (GSS), which includes only vessels active in the Gulf of Mexico shrimp fisheries, there were 2,896 inshore vessels and 1,225 offshore vessels (i.e., federally-permitted vessels) from the west coast of Florida through Texas in 2008 (Table 3). This may underestimate the total true population due to problems with the GSS. Some dealers report minor landings from multiple boats consolidated into a single record. In these cases, the landings cannot be assigned to a specific boat. Gulf-wide, consolidated records account for a little over 2 percent of total shrimp landings and revenue. Further, reporting coverage is probably less than 100

[11] The GSS consolidates data from a variety of state and federal sources. More information can be found at: www.sefsc.noaa.gov/fisheries/gulfshrimp.htm.

percent, as a substantial number of inshore vessels sell product directly to consumers or restaurants, which also likely occurs in the offshore sector as well. With no federal permit requirement for dealers, these landings and trades are unlikely to be reflected in the GSS.

Table 3. Gulf of Mexico inshore and offshore shrimp fisheries in 2008 according to the GSS (Miller et al. 2011).

	INSHORE	OFFSHORE	TOTAL
NUMBER OF VESSELS	2,896	1,225	4,121
AVERAGE REVENUE PER VESSEL ($)	24,170	228,470	84,899
AVERAGE LANDINGS PER VESSEL (LBS.)	12,251	65,977	28,221
AVERAGE PRICE PER POUND ($)	1.97	3.46	3.01
TOTAL REVENUE ($ MILLION)	78	280	358
TOTAL LANDINGS (MILLION LBS.)	38	81	119
PERCENT OF TOTAL REVENUE	22	78	100

As is quickly apparent from Table 3, the federally-permitted offshore vessels differ substantially from the inshore vessels. At the vessel level, inshore vessels report average annual revenue from Gulf shrimp of just $24,170; this total is for all inshore vessels combined (skimmer trawl, otter trawl, etc.). This contrasts with an average of $228,470 for offshore vessels. The higher revenue is due not only to more landings – on average, offshore vessels landed more than five times as much as inshore vessels – but also to a higher price per pound of shrimp; in offshore waters the shrimp are usually larger and hence command a higher price per pound. Within the skimmer trawl fishery itself, there are significant differences between states. In Louisiana, which hosts the most skimmer boats in the southeastern U.S. shrimp fisheries, skimmer trawl is also the dominant gear type for shrimp landings within the state, whereas the otter trawl is more prevalent in other states' shrimp fisheries.

A report recently prepared for the Gulf States Marines Fisheries Commission (GSMFC) on the inshore shrimp fisheries, using information for calendar year 2008, focuses on addressing the aforementioned data deficiencies and needs. Miller et al. (2011) determined the total population of individuals who harvest commercial shrimp from inshore (i.e., state jurisdiction) waters by deleting all duplicate records and federal shrimp permit holders, which resulted in 3,765 unique Gulf of Mexico resident commercial shrimpers. Of this total, there were 2,288 Louisiana shrimpers, 333 Mississippi shrimpers, and 467 Alabama shrimpers. Because of the aforementioned issues when relying on state license information, this DEIS will largely rely on the information included in Miller et al. (2011) in determining economic effects on the Gulf of Mexico inshore shrimp fisheries.

While not specific to the skimmer trawl segment, Miller et al. (2011) conducted an economic survey on the Gulf of Mexico inshore shrimp fisheries, which is perhaps the best source of information to help evaluate impacts from potential management alternatives. Throughout the spring of 2009, 1,868 vessels were randomly selected, stratified by state, from a population of approximately 3,765 vessels holding a state shrimping license for the Gulf of Mexico. After two mailings and a reminder postcard, 591 surveys were ultimately returned. This represents a region-wide response rate of approximately 34 percent. The data was subsequently entered and cleaned in order to arrive at a total number of 313 observations used in the financial analysis. Data regarding vessel values, indebtedness, commercial shrimping activities, revenues, and expenses were combined to produce simple standardized financial statements, including a balance sheet, cash flow statement, and income statement for the average or typical vessel.

The economic survey's assessment of the inshore shrimp fisheries is rather bleak. Based on the balance sheet analysis, net worth or equity – the difference between the assets and liabilities of the businesses – of the average owner of an active vessel in the inshore fleet in 2008 was nearly $41,000. Average cash inflow – the sum of seafood revenues and government payments – was approximately $46,000. Cash outflow – the sum of all expenditures – averaged approximately $40,000. Net cash flow – the difference between cash inflow and outflow – was on average about $6,000 in 2008. Net revenue from operations – which evaluates the real profit or loss to the business by eliminating financing costs and extraordinary income and expenses – was negative $1,063 for the average inshore vessel.

Overall, the financial situation in 2008 was economically unsustainable for the average active inshore shrimping business. These results parallel similar research into the economic performance of the offshore fleet and documented reduction of vessels of shrimp harvesters throughout the Gulf of Mexico. Increasing fuel costs, increases in imported shrimp volume, which places downward pressure on domestic prices, as well as recent natural and manmade disasters, continue to erode the economic vitality of the Gulf of Mexico shrimp harvesting fleet.

North Carolina Shrimp Fisheries

It is estimated that over 30 million pounds of shrimp were consumed by North Carolina residents in 2002, over three times the number of pounds actually landed from North Carolina waters (Table 4). Even if all shrimp caught in North Carolina remained in the state in 2002, it would only supply one third of the state's consumption needs. There is a large reliance on shrimp imported into North Carolina from other states, and foreign countries. Thus, it appears imports represent a two-edged sword. On the one hand, they have increased the supply, and also demand because of the effect on price. On the other hand, the effect on price has greatly diminished the economic returns to domestic fishermen. One result is that some fishermen look for more land based work. In other cases, wives take full time jobs to supplement their husband's income so they can continue shrimping (Maiolo 2004).

Table 4. North Carolina commercial shrimp landings for 2004-2010. Shrimp landings consist of white, pink, brown, and rock shrimp (NCDMF 2006).

YEAR	POUNDS LANDED (HEAD ON)	VALUE
2004	4,880,817	$9,462,853
2005	2,357,516	$4,409,124
2006	5,736,649	$9,141,435
2007	9,552,155	$17,937,913
2008	9,423,815	$19,243,008
2009	5,407,691	$8,527,675
2010	5,955,457	$10,690,675

Table 5. Detailed values of pounds landed, total value, deflated value, and price per pound for shrimp landed in North Carolina, 1999-2003. CPI: Consumer Price Index inflation-adjusted figures; PPI: Producer Price Index (PPI) for unprocessed shrimp. Data from North Carolina Division of Marine Fisheries Trip Ticket Program (NCDMF 2006).

YEAR	POUNDS LANDED	INFLATED VALUE	CPI DEFLATED VALUE	INFLATED PRICE PER POUND	CPI PRICE PER POUND	PPI FOR SHRIMP
1999	9,004,430	$22,095,815	$,5,543,848	$2.45	$0.62	$2.33
2000	10,334,915	$25,400,172	$6,165,663	$2.46	$0.60	$2.70
2001	5,254,214	$11,906,335	$2,810,191	$2.27	$0.53	$2.12
2002	9,969,026	$18,364,776	$4,267,080	$1.84	$0.43	$1.44
2003	6,167,371	$10,945,676	$2,486,572	$1.77	$0.40	$1.62

Table 6 shows the economic impact of commercial fishing for shrimp in North Carolina to the state's overall economy. These impacts were calculated using the number of persons harvesting shrimp and the value of those landings (IMPLAN 2000). The numbers provided are to be considered an underestimate of the total impact because there are no North Carolina specific data available that accurately describe the business-to-business cash flow between commercial fishermen and those who provide services to them. However, the impacts do include the added value to the economy by commercial fishermen based on their spending just from the money they received for the annual catch of shrimp.

Table 6. Economic impact of the commercial shrimp fisheries in North Carolina, 1999-2003 (NCDMF 2006).

YEAR	EX-VESSEL VALUE	NORTH CAROLINA ECONOMIC IMPACT
1999	$22,095,815	$36,955,204
2000	$25,400,172	$42,481,502
2001	$11,906,335	$19,488,601
2002	$18,364,776	$30,059,482
2003	$10,945,676	$18,934,449

Table 7 below documents the number of North Carolina shrimp dealers for 2006-2010. Some North Carolina seafood dealers will go so far as to head shrimp for customers, but the majority of shrimp are sold heads on. Shrimp that cannot be sold fresh are frozen and sold that way. A few dealers sell shrimp to be processed into other consumable products such as frozen breaded shrimp, however, there are no shrimp processors currently operating in North Carolina (NCDMF 2006). Fish dealers sell shrimp to other dealers, restaurateurs, retail outlets and directly to the consumer. There is no specific information available as to how much North Carolina shrimp is sold through each of these venues (NCDMF 2006).

Table 7. Number of North Carolina shrimp dealer licenses 2006-2010 (NCDMF).

YEAR	SHRIMP LICENSES	TOTAL NUMBER OF LICENSES
2006	334	769
2007	344	756
2008	327	738
2009	340	788
2010	374	834

North Carolina commercial shrimping effort has steadily declined in recent years. In 2000, there were 976 active inshore shrimp trawlers and 223 active offshore trawlers, which dropped to 709 active inshore trawlers and 157 active offshore trawlers in 2002. Skimmer vessels in North

Carolina have also declined in recent years, from 99 vessels in 2006 to 64 active vessels in 2010 (NCDMF). Total commercial shrimp fishing trips declined from 922 trips in 1999 to just 594 trips in 2003 (Table 8). During this same period, an average of 12 percent of all participants only had one trip with shrimp landings. An average of 65 percent of all persons reporting shrimp landings had 20 or fewer trips in a given year. Only 17 percent of all fishermen reported taking 41 or more trips per year. Abundance of shrimp, prices received for the catch, and weather events such as hurricanes greatly affect the number of trips a fisherman might take.

According to the North Carolina Shrimp FMP (NCDMF 2006), nearly 96 percent of the fishermen owned their fishing operation as a sole proprietorship. The average boat was 28.47 feet long, was 10 years old and had a current market value of just under $26,000. The average shrimp fisherman (including full and part time) earned just under $11,720 profit from all of their fishing activities. They averaged $96.85 for routine fishing trip costs (fuel, ice, groceries, etc.). They averaged nearly $13,250 in annual fixed business costs (new equipment, repairs, business loan payments, etc.) (NCDMF 2006). In 2010, 45 percent of all commercial fishing vessel registrations were for vessels 18 feet in length or less, and approximately 94 percent of all commercial fishing vessel registrations were for vessels 38 feet in length or less (Table 9; NCDMF statistics).

Table 8. Number of fishermen and the number of trips taken in which shrimp was landed for 1999-2003 (NCDMF 2006).

	YEAR					
	1999	2000	2001	2002	2003	TOTAL
1 TRIP	121	117	94	80	57	469
% WITHIN YEAR	13%	13%	13%	10%	10%	12%
2 – 10 TRIPS	328	309	245	256	181	1,319
% WITHIN YEAR	36%	33%	34%	33%	30%	33%
11 – 20 TRIPS	173	180	158	163	123	797
% WITHIN YEAR	19%	19%	22%	21%	21%	20%
21 – 30 TRIPS	102	128	85	96	67	478
% WITHIN YEAR	11%	14%	12%	12%	11%	12%
31 – 40 TRIPS	47	59	35	51	43	235
% WITHIN YEAR	5%	6%	5%	6%	7%	6%
41 – 50 TRIPS	36	39	28	34	34	171
% WITHIN YEAR	4%	4%	4%	4%	6%	4%
51 – 60 TRIPS	32	22	21	24	27	126
% WITHIN YEAR	3%	2%	3%	3%	5%	3%
61 – 70 TRIPS	25	25	17	17	21	105
% WITHIN YEAR	3%	3%	2%	2%	4%	3%
71 – 80 TRIPS	18	13	8	23	16	78
% WITHIN YEAR	2%	1%	1%	3%	3%	2%
81 – 90 TRIPS	12	17	7	13	12	61
% WITHIN YEAR	1%	2%	1%	2%	2%	2%
91 – 100 TRIPS	7	7	11	9	6	40
% WITHIN YEAR	1%	1%	2%	1%	1%	1%
> 100 TRIPS	21	11	8	20	7	67
% WITHIN YEAR	2%	1%	1%	3%	1%	2%
TOTAL	922	927	717	786	594	3,946

Table 9. Total number of North Carolina commercial fishing vessel registrations issued by vessel length (NCDMF statistics).

YEAR	0-18 FOOT	>18-38 FOOT	>38 FOOT TO 50 FOOT	>50 FOOT	TOTAL
2006	3,967	4,241	304	289	8,801
2007	4,013	4,221	295	302	8,831
2008	4,003	4,249	286	308	8,846
2009	4,120	4,363	289	316	9,088
2010	4,030	4,311	282	293	8,916

Table 10 below shows the number of participants in the North Carolina commercial shrimp fisheries by year and the ex-vessel value of their landings. In 2003, the majority (59 percent) of commercial shrimp fishermen landed $10,000 or less of shrimp in North Carolina.

Table 10. Number of participants in the shrimp fisheries by value of landings and year in North Carolina (NCDMF 2006).

	YEAR					
	1999	2000	2001	2002	2003	TOTAL
$1 – $1,000	273	272	199	189	112	1,045
% WITHIN YEAR	30%	29%	28%	24%	19%	26%
$1,001 – $5,000	198	170	153	176	148	845
% WITHIN YEAR	21%	18%	21%	22%	25%	21%
$5,001 – $10,000	120	120	103	91	89	523
% WITHIN YEAR	13%	13%	14%	12%	15%	13%
$10,001 – $20,000	78	76	61	92	62	369
% WITHIN YEAR	8%	8%	9%	12%	10%	9%
$20,001 – $35,000	36	39	41	36	40	192
% WITHIN YEAR	4%	4%	6%	5%	7%	5%
$35,001 – $50,000	79	96	84	76	76	411
% WITHIN YEAR	9%	10%	12%	10%	13%	10%
$50,001 – $75,000	44	42	44	50	45	225
% WITHIN YEAR	5%	5%	6%	6%	8%	6%
>$75,000	94	112	32	76	22	336
% WITHIN YEAR	10%	12%	4%	10%	4%	9%
TOTAL PARTICIPANTS	922	927	717	786	594	
% CHANGE	-	1%	-23%	10%	-24%	

Studies in the 1970s and 1980s revealed that shrimp fishermen engage in a variety of both land and water based activities. Fishing activities required moving from one target species to another as opportunities prevailed, even though shrimping involved most of the effort throughout the year (Maiolo 2004). Cheuvront (2002, 2003) found that shrimp fishermen continue to engage in a variety of capture activities throughout the year. Like most of North Carolina's commercial fishermen, these fishermen tend to diversify the species they target, gears they use, and water bodies they fish. Clams (*Mercenaria mercenaria*), oysters (*Crassostrea virginica*), striped mullet (*Mugil cephalus*), spot (*Leiostomus xanthurus*), blue crabs (*Callinectes sapidus*), and flounder (*Paralichthys* spp.) were other important target species, with scallops (*Argopecten irradians*), Atlantic croaker (*Micropogonias undulatus*), and weakfish (*Cynoscion regalis*) pursued less often. Shrimp constituted an average of 59 percent of the fishing income earned by these fishermen.

North Carolina's shrimp fisheries are unusual in the southeastern United States because the majority of the effort is expended in inshore waters; inshore waters account for 76 percent and ocean waters account for 24 percent of the total harvest (NCDMF 2006). Total landings from 1994-2003 have averaged 7,539,730 lbs per year (range of 4.6-10.3 million lbs) caught on an average of 18,591 annual trips (range of 14,399-23,901 trips). The majority of the shrimp harvest (93 percent) is taken by otter trawls followed by skimmer trawls (4 percent) and channel nets (3 percent). About 73-80 percent of the shrimp trawl trips occur in estuarine waters, with the remainder in ocean waters. Most of these ocean trips are within state territorial seas (<3 mi offshore) and concentrated off the southern coast of North Carolina. Annual shrimp trawling effort has fluctuated with shrimp abundance, but has gradually declined since 1994, though some of this decline may be attributed to a shift in the fishery in 1999, when a recreational commercial gear license became available to fishermen. In 2000, there were 976 active inland shrimp trawlers and 223 active inshore trawlers, which dropped to 709 active inland trawlers and 157 active inshore trawlers in 2002. Skimmer vessels in North Carolina have also declined in recent years, from 99 vessels in 2006 to 64 active vessels in 2010 (NCDMF statistics). A comparison of the North Carolina otter and skimmer trawl fisheries is included in Table 11 below.

Table 11. Comparison of vessel, participant, and trip numbers in the North Carolina otter and skimmer trawl fisheries (NCDMF statistics).

YEAR	SHRIMP TRAWL			SKIMMER TRAWL		
	VESSELS	PARTICIPANTS	TRIPS	VESSELS	PARTICIPANTS	TRIPS
2005	344	324	4,553	82	75	1,137
2006	380	364	5,710	99	88	1,366
2007	410	386	6,735	100	87	1,557
2008	442	418	5,995	98	95	936
2009	410	381	5,749	65	60	807

The fishery is characterized by a large number of small to medium size boats that fish internal waters in the southern part of the state and in the tributaries of larger water bodies in the central and northern waters. Medium and larger size vessels fish Pamlico Sound, Core Sound, the Atlantic Ocean and the larger rivers (Neuse, Pamlico, Pungo, and Bay).

From 1994 to 2000, the average dockside value for the shrimp fisheries was $17.1 million and ranged from $10.9 million in 1998 to $25.4 million in 2000. The price per pound for the same period averaged just below $2.50 per pound. However, since 2000, the price per pound paid to fishermen dropped to a low of $1.77 in 2003. Imports of low cost shrimp have put North Carolina shrimp fishermen at an economic disadvantage and this coupled with increased fuel prices have put the industry in a crisis situation.

Regionally, shrimp trawl effort has generally been greatest in Core and Bogue sounds and associated estuaries (range of 5,115-9,964 trips/year). The southern estuaries account for the second largest number of inside trawl trips per year, ranging from 3,095-4,814 trips/year. The previous section includes data that is somewhat dated. While more recent information is incomplete or unavailable, the economic information included in this DEIS for the North Carolina shrimp fisheries was deemed adequate to determine significance for any management alternative.

3.7.1 Social Environment

When examining the shrimp fisheries' social as opposed to economic environment, the focus of the discussion shifts primarily from vessels and firms to people and places (i.e., communities), though obviously vessels and firms are a part of those communities. There is little data to adequately describe the affected environment for communities dependent on the shrimp fisheries, particularly for the inshore shrimp fisheries. In order to understand the impact that any new rules and regulations will have on participants in the fishery, in-depth community profiles need to be developed that will aid in the description of communities involved in this fishery, both present and historical. Such research is currently being conducted by NMFS for communities in the Gulf of Mexico. This research is being at least partly guided by research conducted under contract with Impact Assessment, Inc. (IAI) (IAI 2005a,b,c,d). The purpose of this initial phase of the research was to compile baseline information regarding communities in each Gulf state which were believed to have some level of association with marine fisheries. That is, based on a full range of descriptive information and analyses, IAI developed a basic typology of the study communities and their involvement with marine fisheries and related industries. This information can be used in determining which communities are "fishing communities." In general, "fishing communities" are communities that are "substantially dependent on or substantially engaged in" fishing or fishing related activities. However, until in-depth community profiles are developed for at least a representative sample of the potentially affected communities, it is not possible to fully describe the possible impacts of any change in federal fishing regulations on the shrimp fisheries.

Past hurricane seasons have fundamentally affected the shrimp fisheries, their supporting infrastructure, and communities. Although studies regarding the impacts of the hurricanes continue, a complete picture of how the fishing industry in the Gulf of Mexico has changed is still unavailable at this time, in part because the industry continues to change and adapt in response to constantly changing external conditions. Additionally, it is very difficult to disentangle the adverse effects of the hurricanes from those arising from the current economic conditions in the shrimp fisheries. Many people and businesses have likely left the industry and their communities as a result of the combination of past hurricane impacts and economic issues. It may never be known with a high degree of certainty how many shrimp boats were lost due to past hurricanes, and how many fishermen have left the fishery and may never return. Fishing infrastructure is being rebuilt, boats are being salvaged and repaired, fishermen are fishing again, and communities are picking up the pieces. Even though social and economic assessments of the nature and magnitude of these impacts are ongoing and not yet complete, limited information is available on fishermen, fishing-dependent businesses, or communities that depend on the Gulf shrimp fisheries.

Even before Hurricanes Katrina and Rita in 2005, fishermen in the shrimp industry were already having a difficult time making a living in the shrimp fisheries due to the high cost of fuel, the low price received for their product, and the overcapitalization of the shrimp fisheries. Many shrimp fishermen had dropped the insurance on their boats and reduced the number of crew on their boats to increase profits. Large shrimp boats were being repossessed at an increasing rate, and fishermen were exiting the shrimp fisheries.

The hurricanes of 2005 brought massive disruptions to the fishing industry across the Northern Gulf of Mexico. Docks, marinas, fuel sources, and icehouses were heavily damaged or destroyed. Some fishermen with operable boats have moved, at least temporarily, to other locations to fish, and may unload in an area that is different than where they unloaded before the hurricanes. A year after the 2005 storms, several communities were still struggling to get back on their feet and recover the shrimp fishing industry. In 2004, Louisiana, Mississippi, and Alabama accounted for almost half of the shrimp harvested in the nation. In Louisiana, 66 percent of the shrimp fishermen live in areas affected by Hurricane Katrina. Eighty-three percent of Louisiana's seafood processors and all eight seafood canning factories were also located in these areas. Two of the largest shrimp processors in Louisiana, Bumble Bee Cannery in Violet, Louisiana, and Piazza Seafoods in New Orleans, Louisiana, were left inoperable; Bumble Bee is not planning to reopen (IAI 2007).

Boats and fishing infrastructure were lost to the hurricanes and fishing dependent communities were totally disrupted. In the case of lower Plaquemines Parrish and St. Bernard Parrish in Louisiana, most of the fishing infrastructure was completely destroyed. The Empire/Venice area of Plaquemines Parish was one of the top areas for landings of shrimp in the Gulf of Mexico prior to the storms. In October 2005, two-thirds of the shrimp fleet was out of commission (IAI 2007). A shrimp dock in Buras, Louisiana, reopened in May 2006 and the owner said he had half of the number of shrimp boats landing shrimp in July 2006 as he had at the same time in 2005 (Ingles, pers. comm., 2006). Grand Isle, Louisiana, had two shrimp docks with icehouses and fuel before the storm. Both of these docks were left in ruins after the storm passed. One shrimp dock reopened in November 2005, the other opened in April 2006. In July 2006, the number of shrimpers unloading shrimp in Grand Isle was less than it was a year ago (Ingles, pers. comm., 2006).

In 2005, the LADWF estimated that at one year out, there would be an economic loss of over $538 million to the shrimp industry. Even as infrastructure is rebuilt and some shrimp fishermen go back to shrimping, there are still many challenges ahead. Currently, there are still not enough processors in business to process all of the shrimp that is coming in, causing bottle necks in the processing. Louisiana had a reported loss of 35 to 40 percent of the labor pool they had before the hurricane in jobs dependent on the fishing industry. Many workers relocated to other areas after the hurricane and have not returned. In Plaquemines Parish, the number of commercial fishing licenses was down 38 percent in 2006 from the number of licenses in 2004-2005. The number of commercial fishing licenses in St. Bernard Parish was down 43 percent for the same time frame (IAI 2007).

The shrimp industry in Mississippi also suffered great losses from Hurricane Katrina. Many boats were damaged or destroyed and most of the infrastructure for the shrimp industry in Gulfport and Biloxi was destroyed. At the start of the shrimp season in May 2006, 15 percent of the shrimp fleet that had been in place pre-Katrina went out to fish. Aerial surveys conducted on the opening day of the Mississippi shrimp season documented 306 boats in 2006, which was down from 633 in 2005. The declining trend has continued, with 230 boats in 2009 and only 162 in 2011 (MDMR statistics).

Sixty percent of the commercial shrimp boats in Bayou La Batre, Alabama, were destroyed in Hurricane Katrina (IAI 2007). Even before the storm, many of the boats in Bayou La Batre were tied up at the docks and had been repossessed.

The April 2010 DWH oil spill event also impacted the shrimp fisheries in the Northern Gulf of Mexico. Due to oil encroaching into the offshore and inshore fishing grounds, the 2010 shrimp season was significantly affected. Louisiana, Mississippi, and Alabama closed all or significant portions of their waters to all fishing activities, and large areas of federal waters were also closed for several months in the wake of the incident. Lost revenue was adjusted to some extent, however, as some shrimp fishermen worked as contractors during the immediate and extended cleanup phases of the oil spill event. Some fishermen elected not to fish for most of 2010, and only re-entered the fishery in mid-2011, while it is likely some fishermen opted not to leave the fishery after the DWH oil spill event. Public comment during the July scoping meetings indicated that some fishermen were affected by potential exposure to the oil and COREXIT dispersant, and were forced out of work due to subsequent health issues.

The Gulf of Mexico shrimp industry faces many challenges ahead. Some of the challenges are created due to the low prices paid at the docks for shrimp due to the competition from the price paid for imported shrimp and the high cost of fuel. Other challenges were created by Hurricane Katrina. Many fishermen are still displaced, and do not have homes to return to in their communities. There is still a need for funding to help rebuild the infrastructure that supported the shrimp industry prior to the storm. Shrimp boats are still in need of repair and salvaging. There are not enough processors, commercial marinas, icehouses, and fuel docks to service the shrimp fisheries in the Gulf of Mexico as they rebuild. Some of the land that was occupied by infrastructure that supported the shrimp industry before Hurricane Katrina is being bought up and converted to other uses such as space for condominiums and casinos. As the price of waterfront property continues to increase as a result of higher demand by other industries, it is becoming more common in many communities for fishermen and others working in fishing dependent businesses to live inland, away from the water. This compounds the problem of trying to identify fishing communities as a certain location where people dependent on marine resources live and work. In some areas, fishermen who used to live in one community may now be dispersed in several outlying communities with more affordable housing. Simply put, communities along the Gulf coast are changing rapidly, and a variety of natural, economic, and social forces are accelerating this rate of change.

With respect to secondary information, data on the distribution of Gulf shrimp landings and revenues, permitted and active shrimp vessels/permit holders, shrimp dealers/wholesalers, and shrimp processors across communities is available for 2005 and 2006. Such information should be useful in gauging the shrimp fisheries' importance to particular communities, and the importance of certain communities to the fishery. In turn, these data can be analyzed and used as a starting point to identify some of the communities that may be affected by changes in federal fishing regulations. Furthermore, analyzing changes in this information between 2005 and 2006 should provide some insights into how the industry is adapting in the post-hurricane environment, as well as how those adaptive behaviors are affecting particular communities and their relationship to the Gulf shrimp fisheries. Undoubtedly, some of those relationships have weakened while others have strengthened, at least in a relative sense.

There is not enough ethnographic research on individual communities involved with this fishery to know the status of race or income among people who rely on the shrimp industry. Therefore, it is not possible to definitively know if the actions in this proposed rule would have any disproportionately high and adverse effects on minority or low-income populations. By comparing basic demographic information of communities associated with the Gulf shrimp fisheries to national averages, however, it should be possible to discern whether any of these communities are socio-economically disadvantaged, and thus whether impacts on them should be given special consideration, as per Executive Order 12898. E.O. 12898 requires fisheries managers to address environmental justice in minority and low-income populations regarding the proposed actions. Data from the 1990 and 2000 U.S. Census were used for the descriptions in this document so that it is possible to see changes in the communities in those ten years.

Unfortunately, U.S. Census data offers its own set of problems when trying to identify the number of people who are dependent on fishing resources in a given community. First, the U.S. Census is only conducted every ten years. In the span of ten years, much can change in a coastal community due to the increasing pressure to develop waterfront property. Second, people who work seasonally in fishing dependent areas may or may not be counted in a particular community that is dependent on fishing, depending if they are residing in that community at the time of the census. A third problem is the U.S. Census fishing category is lumped together with farming and forestry occupations under the occupation category and with agriculture, forestry, and hunting under the industry category. Therefore, it is very difficult to discern how many people are actually dependent on fishing from the other occupations fishing is lumped with. Further, people who rely on other supplemental work outside of fishing related occupations may report their occupation under another category.

Thus, as illustrated above, more community research is needed if the dynamics of fishing dependency within individual communities are to be better understood, which in turn would create the ability to competently describe the social impacts of any changes in federal fishing regulations. As more community profiles are developed in the future, it may be possible to better describe specific social impacts of fishing regulations on some communities. Until that time, secondary data will be used as a starting point, but it will limit the utility of the assessment of the social impacts arising from new regulations.

3.7.2 Fishery Description

A complete description of the fishery can be found in the Gulf of Mexico Fishery Management Council's Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters (GMFMC 1981) and its subsequent plan amendments, as well as the South Atlantic Council's Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (SAFMC 1993) and its subsequent plan amendments. The following summarizes the gear used within the shrimp fisheries. Additional information on the shrimp fisheries can be found in Sections 3.7, 5.13, and 5.14.

The Northern Gulf of Mexico (and North Carolina) shrimp fisheries are based primarily on two species, brown shrimp (*Farfantepenaeus aztecus*) and white shrimp (*Litopenaeus setiferus*). Three other species are also harvested to a much lesser degree: pink shrimp (*Farfantepenaeus duorarum*), royal red shrimp (*Hymenopenaeus robustus*), and seabobs (*Xiphopenaeus kroyeri*). Louisiana is the center of abundance of white shrimp and seabobs.

Brown shrimp is the most important species in the U.S. Gulf fishery with principal catches made from June through October. Annual commercial landings in recent years range from approximately 61 to 103 million pounds of tails depending on environmental factors that influence natural mortality. The fishery extends offshore to about 40 fathoms. Brown shrimp is also the most abundant shrimp species in North Carolina, and accounts for 67 percent of North Carolina's shrimp landings. The brown shrimp fisheries occur primarily at night in offshore (i.e., EEZ) waters, but a significant portion of brown shrimp effort in inshore waters occurs in daylight hours.

White shrimp, second in value, are found in near shore waters to about 20 fathoms from Texas through Alabama. There is a small spring and summer fishery for overwintering individuals, but the majority is taken from August through December. Recent annual commercial landings range from approximately 36 to 71 million pounds of tails. In North Carolina white shrimp is harvested primarily in the fall, and accounts for 28 percent of North Carolina shrimp landings. A good portion of the white shrimp fisheries occur during daylight hours.

Pink shrimp are found off all Gulf of Mexico states but are most abundant off Florida's west coast and particularly in the Tortugas grounds off the Florida Keys. Most landings are made from October through May with annual commercial landings ranging from approximately 6 to 19 million pounds of tails. In the Northern and Western Gulf states, pink shrimp are landed mixed with brown shrimp and are usually counted as browns. Most catches are made within 30 fathoms. Pink shrimp are harvested in the spring and the fall in North Carolina, and account for 5 percent of North Carolina's shrimp landings.

The commercial fishery for royal red shrimp has expanded in recent years with the development of local markets. This deep-water species is most abundant on the continental shelf from about 140 to 275 fathoms east of the Mississippi River. Landings have varied from approximately 200,000 to 300,000 pounds, with a high of approximately 336,000 pounds in 1994.

The three principal species (penaeids) in the fishery are short-lived and provide annual crops; however, royal red shrimp live longer, and several year classes may occur on the grounds at one time. The condition of each shrimp stock is monitored annually, and none has been classified as being overfished for over 40 years.

Brown, white, and pink shrimp are subjected to fishing from inland waters and estuaries, through the state-regulated territorial seas, and into federal waters of the EEZ. Royal red shrimp occur only in the EEZ. Management measures implemented under the MSFCMA apply only to federal waters in the EEZ. Cooperative management occurs when state and federal regulations are consistent. Examples are the seasonal closure off Texas, the Tortugas Shrimp Sanctuary, and the shrimp/stone crab seasonally closed zones off Florida.

NMFS has classified commercial shrimp vessels comprising the near shore and offshore fleet into size categories from under 25 feet to over 85 feet. More than half fall into a size range from 56 to 75 feet. Federal permits for shrimp vessels are currently required, and state license requirements vary. A moratorium on federal shrimp permits was approved by the GMFMC in 2005. Many vessels maintain licenses in several states because of their migratory fishing strategy. The number of vessels in the fishery at any one time varies due to economic factors such as the price and availability of shrimp and cost of fuel. As of January 23, 2012, there were 1,457 federally-permitted (limited access) Gulf of Mexico shrimp vessels, which is a significant decline from the 2,385 vessels encompassed by a previously open-access Gulf of Mexico federal shrimp permit, which sunset on March 25, 2007 (NMFS statistics).

Various types of gear are used to capture shrimp, including but not limited to: cast nets, haul seines, otter trawls, stationary butterfly nets, wing nets (butterfly trawls), skimmer nets, traps, and beam trawls. The otter trawl, with various modifications, is the dominant gear used in offshore waters. A basic otter trawl consists of a heavy mesh bag with wings on each side designed to funnel the shrimp into the "cod end" or "tail bag." A pair of otter boards or trawl doors positioned at the end of each wing hold the mouth of the net open by exerting a downward and outward force at towing speed. A lead line or footrope extends from door to door on the bottom of the trawl, while a cork line or headrope is similarly attached at the top of the net. A "tickler chain" is also attached between the trawl doors that runs just ahead of the net, and is used to spook shrimp off the bottom and into the trawl net. The lead lines of larger nets are weighted with a 1/4-to 3/8-inch loop chain attached at about 1-foot intervals with a 14- to 16-inch drop. Many larger nets are also equipped with rollers on the lead line that keeps the lead line from digging into muddy bottom.

Shrimp trawl nets are usually constructed of nylon or polyethylene mesh webbing, with individual mesh sizes ranging from as small as 1-1/4 inch to 2 inch. The sections of webbing are assembled according to the size and design (usually flat, balloon, or semi-balloon) of trawl desired, which affects the width and height of the trawl's opening and its bottom-tending characteristics. The tongue or "mongoose" design incorporates a triangular tongue of additional webbing attached to the middle of the headrope pulled by a center towing cable, in addition to the two cables pulling the doors. This configuration allows the net to spread wider and higher than conventional nets and as a result has gained much popularity for white shrimp fishing.

Until the late 1950s, most shrimp vessels pulled single otter trawls, ranging from 80 to 100 feet in width, directly astern of the boat. Double-rig trawling was introduced into the shrimp fleet during the late 1950s. The single large trawl was replaced by two smaller trawls, each 40 to 50 feet in width, towed simultaneously from stoutly constructed outriggers located on the port and starboard sides of the vessels. The advantages of double-rig trawling include: (1) increased catch per unit of effort, (2) fewer handling problems with the smaller nets, (3) lower initial gear costs, (4) a reduction in costs associated with damage or loss of the nets, and (5) greater crew safety.

In 1972, the quad rig was introduced in the shrimp fisheries, and by 1976 it became widely used in the EEZ of the western Gulf. The quad rig consists of a twin trawl pulled from each outrigger. One twin trawl typically consists of two 40- or 50-foot trawls connected to a center sled and spread by two outside trawl doors. Thus, the quad rig with two twin trawls has a total spread of 160-200 feet versus the total spread of 110 feet in the old double rig of two 55-foot trawls. The quad rig has less drag and is more fuel efficient. The quad rig is the primary gear used in federal waters by larger vessels. Smaller boats and inshore trawlers often still use single- or double-rigged nets.
Try nets are small otter trawls about 12 to 16 feet in width that are used to test areas for shrimp concentrations. These nets are towed during regular trawling operations and lifted periodically to allow the fishermen to assess the amount of shrimp and other fish and shellfish being caught. These amounts in turn determine the length of time the large trawls will remain set or whether more favorable locations will be selected.

Butterfly nets (wing nets or "paupiers") were introduced in the 1950s and used on stationary platforms and on shrimp boats either under power or while anchored. A butterfly net consists of square metal frame which forms the mouth of the net. Webbing is attached to the frame and tapers back to a cod end. The net can be fished from a stationary platform or a pair of nets can be attached to either side of a vessel. The vessel is then anchored in tidal current or the nets are "pushed" through the water by the vessel.

Vietnamese fishermen began moving into Louisiana in the early 1980s and introduced a gear called the "xipe" or "chopstick" net around 1983. The chopstick was attached to a rigid or flexible frame similar to the butterfly net; however, the frame mounted on the bow of the boat was attached to a pair of skids and fished by pushing the net along the bottom. As with butterfly nets, the contents of the net could be picked up and dumped without raising the entire net out of the water as is necessary with an otter trawl.

The skimmer trawl was developed for use in some areas primarily to catch white shrimp, which has the ability to jump over the cork line of standard trawls while being towed in shallow water. The skimmer net frame allows the net to be elevated above the water while the net is fishing, thus preventing shrimp from escaping over the top. Owing to increased shrimp catch rates, less debris or bycatch, and lower fuel consumption than otter trawlers, the use of skimmer nets quickly spread throughout Louisiana, Mississippi, and Alabama.

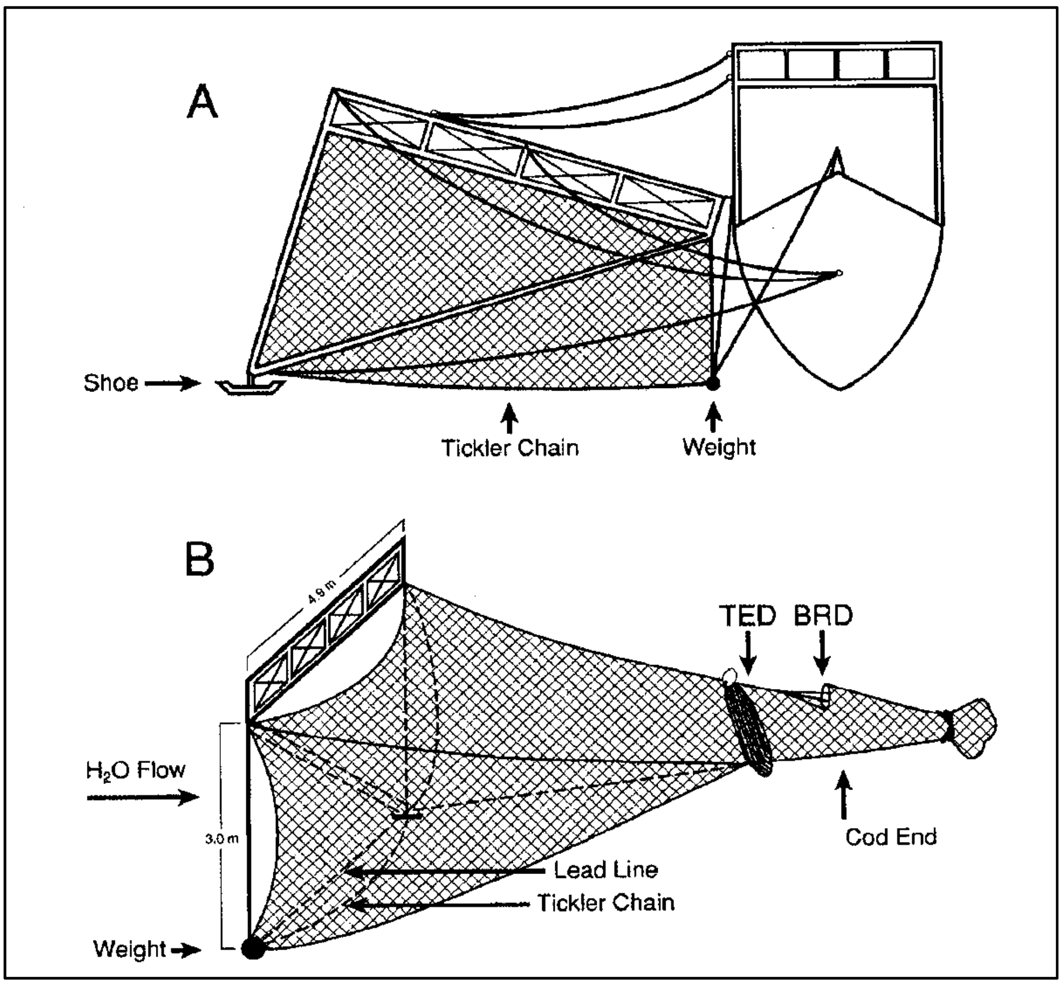

Figure 5. Skimmer trawl diagram showing (A) the skimmer trawl frame and (B) the components of the net, including an installed TED and BRD (from Warner et al. 2004).

The basic components of a skimmer trawl (Figure 5) include a frame, the net, heavy weights, skids or "shoes," and tickler chains. The net frame is usually constructed of schedule 80 steel or aluminum pipe or tubing and is either L-shaped (with an additional stiff leg) or a trapezoid design. When net frames are deployed, they are aligned perpendicularly to the vessel and cocked or tilted forward and slightly upward. This position allows the net to fish better and reduces the chance of the leading edge of the skid digging into the bottom and subsequently damaging the gear. The frames are maintained in this position by two or more stays or cables to the bow. The outer leg of the frame is held in position with a "stiff leg" to the horizontal pipe and determines the maximum depth at which each net is capable of working. To the bottom of the outer leg is attached the skid or "shoe," which allows the frame to ride along the bottom, rising and falling with the bottom contour. Tickler chains and lead lines comprise the bottom of this gear.

Within the Gulf of Mexico, Louisiana, Mississippi, Alabama, and Florida include skimmer trawls as an allowable gear. The Louisiana state shrimp seasons are flexible and are set each year by the LADWF based upon biological and technical data relative to shrimp populations in Louisiana waters. Generally, the spring inshore season will begin in early to mid-May and may extend into July. The fall inshore season usually begins in early to mid-August and extends into December. The shrimp season in Louisiana's territorial waters is generally open year-round except for a closed season in portions of state outside waters which may be set during late fall to early winter, usually beginning in mid to late December and extending into April or May. Regulations specific to Louisiana state waters specify that no person on a vessel shall use a double skimmer net having an individual net frame more than 16 feet measured horizontally or 12 feet measured vertically, or 20 feet measured diagonally, or with a lead line measuring more than 28 feet for each net in Louisiana waters. Additionally, reinforcement framing attached to the net frame shall not be considered in determining the dimensions of a double skimmer. A skimmer or butterfly net may be mounted no more than 24 inches from the side of the vessel and individual nets cannot be tied together in Louisiana waters. Lastly, Louisiana fishing regulations state that no person shall use sweeper devices, leads, extensions, wings or other attachments in conjunction with or attached to butterfly nets or skimmer nets.

The Mississippi shrimp fishery is managed by the MDMR, and the opening of the annual shrimp season is determined by the average size of shrimp documented in surveys conducted by the MDMR. Regulations specific to skimmer trawls in Mississippi specify that it shall be unlawful to use skimmer trawls or wing nets with a maximum size greater than 25 feet on the headrope and 32 feet on the footrope.

The Alabama Department of Conservation and Natural Resources (ALDCNR) manages the Alabama shrimp fishery, and the Alabama Administrative Code (Chapter 220-3-.01) states that, "It shall be illegal for any person, firm or corporation to take or attempt to take shrimp or other seafoods in or from the inside waters of the State of Alabama by trawl or trawls used together the total width of which exceeds fifty (50) feet as measured in a straight distance along the cork line, which is the main top line containing corks. The use of more than two trawls is prohibited in the inside waters; provided however, that one "try trawl" not to exceed ten (10) feet as measured across the cork line may be used for sampling in addition to the above. In addition, wings shall be cut and tied to the wing line only on points and it shall be illegal to use a trawl or trawls on which the length of the top leg line exceeds the length of the bottom leg line, the length of the leg line being defined as the distance from the rear of the trawl door to the beginning of the wing."

Managed by the Florida Fish and Wildlife Conservation Commission (FFWCC), the use of skimmer trawls is allowable in Florida state waters, and much of the effort occurs in the Florida Panhandle, specifically in Apalachicola Bay (Warner et al. 2004). While skimmer trawls are an authorized gear, Florida Administrative Code 68B-31.004 states that TEDs are required on all otter and skimmer trawls, except for a single try net or rectangular rigid roller frame trawl that has an opening shielded with a grid of vertical bars spaced no more than 3 inches apart.

In recent years, the skimmer trawl has become a major gear in the inshore shrimp fisheries in the Northern Gulf and also has some use in inshore North Carolina. Information from LADWF indicates there were 6,705 skimmer net licenses sold in 2010; Louisiana issues a license for each net, so this approximates a universe of approximately 3,300 skimmer vessels in Louisiana, although only 1,615 skimmer trawls reported catch/sales via a required trip ticket system in 2010 (LADWF statistics). The MDMR does not differentiate gear type within the shrimp fishery, but a 2008 survey of trip tickets indicated there were approximately 247 otter trawl, 56 skimmer trawl, 4 butterfly net, and 2 chopstick boats active in Mississippi (M. Brainard, MDMR, pers. comm.). Alabama also does not differentiate gear type within the fishery, but 60 Alabama skimmer boats reported landings in 2008 according to the GSS. Skimmer vessels in North Carolina have declined in recent years, from 99 vessels in 2006 to 64 active vessels in 2010 (NCDMF statistics).

As with any commercial fishery, the commercial shrimp fisheries have three primary sectors: the harvesting sector (i.e. vessels), dealers/wholesalers, and processors[12]. The harvesting sector is the focus of the following description and analysis given that it is the sector most directly affected by management measures. However, that sector has multiple components as well. While the shrimp fisheries are dominated overall by the use of otter trawls, butterfly and skimmer nets are also important. In particular, skimmer nets are the most significant gear type in Louisiana's inshore fishery, accounting for approximately 64 percent of all shrimp landings from state waters. Additionally, though most shrimp are harvested for consumptive purposes, a commercial bait shrimp fishery does exist, though vessel and trip level data on bait shrimp landings are not currently collected in some states (e.g., Texas) and, thus, it is not possible to ascertain or account for their importance to individual vessels in the shrimp fisheries

Gulf of Mexico Shrimp Harvesters

Total Gulf of Mexico shrimp landings (i.e., all species combined, inshore and offshore components combined) and revenues were 288.97 million pounds and $397.7 million in 2006, and 229.45 million pounds and $304.8 million in 2009. The 2006 landings are the highest achieved in the fishery since 1986 and thus represent a much higher than average level of production. Total landings and revenue for 2008, as well as average vessel landings and revenue, broken down by inshore and offshore components, can be found in Table 3 (Miller et al 2011).

Small vessels are more numerous than large vessels within the fishery as a whole and within the universe of non-federally-permitted vessels. As would be expected, large vessels dominate the

[12] Some companies operate as both dealer/wholesalers and processors.

universe of federally permitted vessels. Large vessels also account for a much higher percentage of landings and revenues than their smaller counterparts within the fishery as a whole, accounting for approximately 68 percent of the landings and 78 percent of revenues in 2008 (Miller et al. 2011). Conversely, because small vessels dominate within the non-permitted universe (e.g., they outnumbered large vessels nearly 25 to 1 in 2006), they account for a much higher percentage of landings and revenues (approximately 72 percent in 2005 and 85 percent in 2006) within that particular group.

A much wider range of Gulf of Mexico shrimp landings and revenue exists within the non-permitted vessel group than what would be expected, given the federal permit requirement in EEZ waters. Landings ranged from 3 to over 246,000 pounds and revenue from $3 to nearly $722,000 in 2006. Breaking down the gross revenues for these vessels into reasonable groupings, of the 3,410 non-permitted vessels, the vast majority (2,184) grossed less than $10,000 in Gulf of Mexico food shrimp revenues in 2006. Another 983 vessels had gross revenues between $10,000 and $50,000, and 321 vessels had gross revenues between $50,000 and $100,000. These revenue levels are to be expected for vessels that do not operate in EEZ waters and would thus not need to have a federal permit. However, 100 vessels currently without permits had revenues between $100,000 and $150,000, 31 vessels had revenues between $150,000 and $200,000, and another 28 vessels exceeded $200,000. It is doubtful that all of these 28 vessels could achieve such levels of revenue generation without venturing into federal waters, though some could have given the high level of abundance in 2006. In order to continue their present operations in the future, since the application deadline for moratorium permits ended as of October 26, 2007, many of these vessels would likely need to purchase/transfer a federal permit from another moratorium permit owner[13].

Several issues have emerged over the past decade that have impacted the economic condition of the Gulf of Mexico shrimp fisheries. The average cost of diesel fuel nationwide (highway retail sales) more than doubled between 2001 and 2011, increasing from an average of $1.52 per gallon in January 2001 to an average of $3.38 per gallon in January 2011 (U.S. Energy Information Administration). The average cost of diesel fuel along the Gulf Coast (highway retail sales) increased from $2.86 per gallon in 2007 to $3.78 in 2011 (U.S. Energy Information Administration). Probably a more appropriate proxy to use for fuel prices paid by commercial shrimpers (or commercial fishermen in general) is the diesel fuel price paid by farmers, statistics for which are generated by the U.S. Department of Agriculture. This price is more appropriate than the diesel fuel price "paid on the street," because it removes fuel excise taxes, which neither commercial fishermen nor farmers pay. The diesel fuel price per gallon paid by farmers changed as follows in each year from 2002 and 2006: $0.96, $1.24, $1.31, $1.97, and $2.28 (U.S. Department of Agriculture). This represents a price increase of nearly 138 percent between 2002 and 2006, with the largest increases occurring in 2003, 2005, and 2006. Costs for other expenditures such as ice and preservative (e.g., sodium metabisulfate) have also increased: the annual inflation rate has averaged 2.49 percent from 2000 through 2010 (Bureau of Labor Statistics). While costs have increased significantly, revenue has not. Depending on the size, Gulf of Mexico shrimp prices declined approximately 50 percent on average between 2000 and 2006, with most of the declines

[13] A further examination of these vessels' permit histories reveals that many did in fact have moratorium permits at one point in time, but had transferred their permits to other vessels prior to December 2007. Several others had applied for moratorium permits but their applications were denied. Still others originally possessed open access permits but never applied for a moratorium permit.

occurring between 2001 and 2003 and in 2006. The annual average price per pound of shrimp landed in Louisiana state waters decreased from $1.45 per pound in 2000 to $1.31 per pound in 2010 (all species combined; LADWF).

Past analyses indicated that rapidly declining prices were the primary source of the deterioration in the industry's economic condition. In the aggregate, the average nominal price of shrimp in the Gulf of Mexico decreased by approximately 28 percent between 2000 and 2002. Revenues decreased even more as a result of relatively lower shrimp abundance and, therefore, landings in 2001 and 2002, relative to 2000. The magnitude of the price decline varied by shrimp size category, with the under 15 count ("jumbo") and 68 and over count ("small") size categories seeing the smallest declines (approximately 23 percent) and the 31-40 and 41-50 count ("large" and "medium") size categories seeing the largest declines (approximately 35 percent). Due to inflation, these price declines were even larger in real terms.

According to Haby et al. (2003), increases in shrimp imports have been the primary cause of the recent decline in U.S. shrimp prices. A complete discussion of the factors contributing to the increase in imports can be found in Haby et al. (2003). In general, recent surges in imports have been caused by increases in the production of foreign, farm-raised shrimp. More specifically, increased competition from shrimp imports has been due to three primary factors: (1) changes in product form due to relatively lower wages in the exporting countries; (2) shifts in production to larger count sizes; and (3) tariff and exchange rate conditions which have been favorable to shrimp imports into the U.S. With respect to the first factor, lower wage rates have allowed major shrimp exporters (e.g., Thailand) to increase production of more convenient and higher value product forms, such as hand-peeled raw and cooked shrimp. With respect to the second factor, changes in farming technology and species have allowed production of foreign product to shift towards larger, more valuable sizes. As a result of these factors, imports are more directly competing with the product traditionally harvested by the domestic industry, thereby reducing the latter's historical comparative advantage with respect to these product forms and sizes. Finally, with respect to the third factor, the lack of duties on shrimp imports into the U.S., the presence of relatively significant duties on shrimp imports into the European Union and the recent strength of the U.S. dollar relative to foreign currencies have created favorable conditions for countries exporting products to the U.S.

As Haby et al. (2003) note, the increase in imports caused the domestic industry's share of the U.S. shrimp market to decrease from 44.6 percent to 14.8 percent between 1980 and 2001. While the growth in imports was relatively steady throughout most of this time period (e.g., 4 to 5 percent in the late 1990s), shrimp imports surged by 16 percent in 2001. Since 2001, which is the last year accounted for in their analysis, shrimp imports have continued to rise. Although the increase in 2002 was a modest 7.2 percent, relative to the increase in 2001, a significant increase of 19.1 percent occurred in 2003 according to the most recently available data[14]. These increases led to further erosion in the domestic industry's market share and additional price declines.

In order to further investigate changes to the industry's economic status, Travis and Griffin (2004) conducted an additional economic analysis. Their analysis revealed that, on average, vessels were not even able to cover their variable costs in 2002. Preliminary information at the time indicated that domestic shrimp prices had continued to decline in 2003, which would lead to the expectation

[14] Shrimp import data can be found at http://www.st.nmfs.gov/st1/trade/trade_prdct_cntry.html

that the vessels' inability to cover their variable costs would continue in 2003 and probably beyond[15]. If vessels cannot cover their variable costs, they will be forced to cease operations (i.e., exit the fishery), at least until conditions change.

Projections of fleet size, as measured by full-time equivalent vessels (FTEVs) and nominal effort were updated and extended farther into the future (20 years, or through 2021) to determine how long it would take for the fishery to reach an equilibrium state, assuming no changes in external factors (e.g., imports, regulations, etc.). In general, equilibrium occurs once economic losses are no longer being incurred (i.e., economic profits are zero) and fleet size is stable (i.e., fleet size has reached its minimum level).

According to the updated projections, the average rate of return in the fishery for 2002 was projected to have been approximately -33 percent, slightly better than initial projections, and the difference between the rates of return in the small vessel sector and large vessel sector also narrowed to a small degree (-27 and -36 percent, respectively). Economic losses were forecasted to continue throughout the fishery on average until 2012, all other things remaining constant. As would be expected, these losses cause vessels to continue exiting from the fishery during this time. The size of the large vessel sector and level of associated fishing activity decline continuously, in terms of FTEVs and nominal effort, through 2012 and were expected to have decreased by 39 percent and 34 percent, respectively, relative to 2002 levels. However, only the large vessel sector reached equilibrium by 2012. Although the number of FTEVs and nominal effort are expected to decrease in the small vessel sector by approximately 29 percent by 2012, the small vessel sector continued to decrease in size and effort throughout the entire twenty-year simulation. The logic behind this differential result between the large and small vessel sectors is fairly straightforward. Specifically, as large vessels, which predominately operate in offshore waters, exit the fishery, their departure leads to an improvement in the economic performance of the large vessels that remain in the fishery, primarily as a result of increases in CPUE in offshore waters. However, given the migration pattern of shrimp from inshore to offshore waters, the departure of large vessels does not generally increase CPUE in inshore waters where the smaller vessels tend to operate. Conversely, the departure of small vessels improves the economic performance of both small and large vessels by removing competition in inshore waters and by allowing more shrimp to escape into offshore waters (i.e., CPUE should increase in both inshore and offshore waters). Although the economic performance of large vessels was projected to improve more quickly than that of small vessels, all other things remaining constant, it must be emphasized that, under 2002 conditions, economic recovery even in the large vessel sector is not expected for several years.

Gulf of Mexico Shrimp Dealers/Wholesalers

In addition to the harvesting sector, dealers/wholesalers play an important role in the Gulf of Mexico shrimp industry. Unfortunately, no studies have been done to specifically examine their current economic performance. However, given the documented declines in the harvesting sector and the processing sector, and also given the fact that many dealers are also harvesters or

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[15]Available data at that time indicated that the decline in nominal prices from 2000 to 2003 was 36 percent across all size categories. Depending on the size category, the declines ranged from 27 to 40 percent.

processors, it is logical to conclude that this sector is also experiencing adverse economic conditions for the same reasons.

In 2005 and 2006, 706 dealers were identified in the Shrimp Landings File data. This figure compares to 626 dealers in 2002 and 745 dealers in 2004. Therefore, the number of dealers in 2005-2006 was more than the number of dealers in 2002, but less than the number of dealers in 2004, which is generally though not entirely consistent with the hypothesis that this sector, like the harvesting sector, experienced a significant economic decline in 2005-2006. All of these figures are considerably higher than in previous, recent years. For example, between 1999 and 2001, the number of dealers ranged 310 to 320. Such a dramatic increase is inconsistent with the hypothesis that this sector has also been experiencing adverse economic conditions. However, the answer to this apparent mystery lies primarily in certain harvesters' responses to the poor economic conditions[16]. Specifically, in their attempts to reduce costs and obtain higher prices for their product, it appears that many harvesters decided to remove one of the so-called "middlemen" by obtaining dealer licenses themselves in order to sell directly to the public. This phenomenon has been most prominent in Louisiana and Florida. An in-depth examination of the data appears to support this conclusion.

Statistics suggest that considerable heterogeneity exists within this sector with respect to individual dealers' volume and sales. For example, in 2006, the data indicate that, of the 706 dealers reporting sales figures, 77 percent (544) reported food shrimp sales of less than $100,000. Of these, over 66 percent (359) reported sales of less than $10,000. It is highly likely that the vast majority of these dealers are in fact harvesters who decided to obtain a dealer license in order to sell their own product rather than sell through a traditional dealer/wholesaler. If these "dealers" are factored out, these figures indicate that only 160 dealers sold more than $100,000 of food shrimp. These firms are likely the traditional dealers that have dockside businesses/facilities. Of these 160 dealers, 84 had food shrimp sales between $100,000 and $1.0 million, while the remaining 76 had sales exceeding $1.0 million. Many of these 76 dealers are also processing firms. Three firms had sales exceeding $10.0 million, all of which are processors as well. Given that the number of dealers with sales over $100,000 was 228 in 2002, this figure is closer to what would be expected given numbers from previous years and prevailing economic conditions.

With respect to the decrease in the number of dealers between 2004 and 2005, it appears that this decline is almost entirely attributable to the decline in the number of harvesters between those two years. Given that there were 193 and 190 dealers that sold more than $100,000 of food shrimp in 2004 and 2005 respectively, the number of "traditional" dealers decreased by only three firms in 2005, suggesting that, prior to the decline in 2006, the decline in this sector primarily occurred in 2003 and 2004. Conversely, the number of dealers with sales of less than $100,000 was 550 and the number with less than $10,000 was 396 in 2004. Compared to the 2005 figures, which were 515 and 374 dealers respectively, the decrease in "dealers" that occurred in 2005 was in the group with sales less than $100,000, which in turn likely represents harvesters with dealer licenses that exited the fishery. As in the harvesting sector, the marked decrease from 2005 to 2006 is likely due to a combination of economic conditions and impacts from the 2005 hurricanes.

[16] Improved identification of dealers also plays a role, though it appears not a significant one.

Gulf of Mexico Shrimp Processors

As with the dealer sector, there is considerable heterogeneity within the processing sector regarding employment, volume, and sales. In 2005, the data indicate that 18 processors had less than $1 million in food shrimp production, 14 had between $1 and $5 million, 10 had between $5 and $10 million, 9 had between $10 and $20 million, and the remaining 10 exceeded $20 million. In 2006, the number of processors in each group was 11, 14, 6, 13 and 13 respectively. Back in 2002, the data indicated that 21 processors had less than $1 million in food shrimp production, 22 had between $1 and $5 million, 9 had between $5 and $10 million, 11 had between $10 and $20 million, and the remaining 11 exceeded $20 million. This information indicates that the number of firms has decreased from 74 to 55 between 2002 and 2006, which in turn reflects additional consolidation in the Gulf of Mexico shrimp processing sector. The data also indicates that the surviving firms have expanded their production (i.e., average production per firm has increased, thereby causing an increase in the number of large processors), which has helped to maintain the value of their production in the face of generally declining prices (i.e., processed value per firm has remained relatively stable)[17]. Also, in general, the firms that have exited the industry in the last few years are the smaller processors (i.e., those with less than $5 million of processed shrimp value). In 2006, eight processors left the industry (five small and three medium/large). Rather interestingly though, three new processors entered the industry and, in effect, "picked up the slack." The entry of these new processing firms was timely given the significant increase in the volume of processed shrimp in 2006, which was driven by the significant increase in domestic landings and led to an increase in the processed value per firm.

The data also indicates that a majority of these firms are highly dependent on the processing of food shrimp. Unfortunately, it is not been historically possible to determine with certainty how much of the shrimp being processed is domestic as opposed to imported by using NMFS' processor data. However, by cross-referencing multiple data sources, Keithly et al. (2005) attempted to approximate this figure[18]. According to their findings, use of imports by domestic processors increased steadily through the 1980s and, for example, in 1986, accounted for about one-third of production. Between 1992 and 1994, which was apparently the peak period, domestic and imported product accounted for nearly equal proportions of total processed shrimp products in the Southeast U.S. As noted previously, even though imports have continued to increase since then, Southeast U.S. shrimp processing activities have not increased proportionately as a result.

Keithly et al. (2005) hypothesized that this outcome is a direct result of a significant and steady decrease in the deflated price of processed shrimp from over $7 per pound in the early 1980s to less than $4 per pound in recent years. This decline has also precipitated a decline in processors' marketing margins (i.e., per unit profitability). As a result of the declining margins, some processors have adjusted by increasing output in order to compensate; many have been unable to make such an adjustment, and thus have been forced to exit the industry. This is illustrated by the

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[17] Even though ex-vessel prices decreased significantly in 2006, prices at the processor level were surprisingly unchanged from 2005, a finding that deserves further investigation.

[18] The one weakness with their approach is the assumption that all domestic production is utilized by the processing sector. While this assumption would be plausible under stable economic conditions, it is less reasonable in dire economic times when harvesters shift from traditional sales channels and instead sell directly to the public.

fact that the number of Gulf of Mexico shrimp processors fell from 124 to 72 between 1980 and 2001. Thus, the situation illustrates the classic case of an industry in economic decline, wherein the number of firms falls, and those who remain become larger in size (as measured by output). That is, the industry has become more concentrated. Moreover, Keithly et al. (2005) concluded that if production of farm-raised shrimp continues to increase and a substantial portion of that production enters the U.S. market, the price of processed shrimp will continue to decline; margins will continue to narrow; and consolidation will continue to occur as additional firms exit and remaining firms attempt to compensate by increasing their output.

A more recent study by Keithly et al. (2006) supports many of the conclusions and hypotheses offered in Keithly et al. (2005), and also helps to explain the changes that have occurred in this sector between 2002 and 2004, as noted above. In the recent study, Keithly et al. (2006) conducted a survey of shrimp processors in order to better estimate their marketing margins and their dependency on domestic as opposed to imported product. The survey information was combined with data from NMFS' processor database for analysis. A critical finding of this study is that shrimp processors' marketing margins have continued to decrease in recent years because the price of processed shrimp has been declining at a faster rate than the price of raw product. The decrease in the price of processed shrimp has been caused by increased imports of value-added product that directly compete with the domestic processors' product. The price decline has caused marketing margins to decrease, which in turn has forced firms to either exit the industry or increase their production. In general, smaller processors have exited while medium to larger sized processors have expanded, probably due to differences in their respective access to financial capital (i.e., smaller firms likely have less access to financial capital than their larger counterparts).

Additionally, the study found that in recent years domestic processors have used a very limited amount of imported, raw product and instead are heavily dependent on domestically harvested product, contrary to popular belief. Therefore, the health of the processing sector is heavily dependent on domestic harvesting production. Keithly et al. (2006) note that the remaining firms' ability to maintain operations is dependent on their ability to expand, assuming processed shrimp prices continue to decline, which would be the case if imports of value-added product continue to increase. Therefore, if domestic harvesting production decreases, processors will be constrained in their ability to expand production, and additional consolidation of the industry will be likely. The decrease in Gulf of Mexico shrimp landings in 2005 may have exacerbated the decline in the economic health of the Gulf of Mexico shrimp processing sector. On the other hand, as previously noted, domestic landings rebounded significantly in 2006, which in turn likely helped to stabilize the processing sector and in fact encouraged three new firms to join the industry. Various reports also indicate that the processing sector was significantly impacted by Hurricane Katrina, either directly as a result of wind/storm surge damage or indirectly as a result of population shifts/displacement which in turn created labor shortages. Processors located in Biloxi, D'Iberville, and Ocean Springs, Mississippi as well as in New Orleans and Violet, Louisiana were particularly hard hit (IAI 2007). However, the data suggests that most of these processors were back in operation, at least to some level, in 2006.

Information on the number of participants and dealers in the North Carolina shrimp fisheries was included earlier in Section 3.7. Analyses similar to what were included above for the Gulf of Mexico sectors have not been conducted for the sectors in the North Carolina shrimp fisheries. While the information necessary to determine significance is incomplete and unavailable, it is expected that the North Carolina shrimp industry sectors are experiencing similar issues (e.g., increasing fuel costs) as those documented in the Gulf of Mexico shrimp industry sectors.

3.7.4 Distribution of Northern Gulf of Mexico Shrimp Dealers, Landings, and Sales by Community

The information presented in Table 12 regarding the distribution of food shrimp dealers, landings, and sales by community provides insight into the importance of the shrimp fisheries to particular communities, and their importance to the fisheries. The information in Table 12 pertains to all Northern Gulf of Mexico food shrimp landings, regardless of whether they came from federal or state waters. In 2005, all but one of the communities (Bayou La Batre, Alabama) with ten or more dealers were located in Louisiana. However, it should be kept in mind that this result is partly an artifact wherein many individual shrimpers have obtained dealer licenses so that they can sell directly to the public, and this phenomenon is most pronounced in Louisiana. Seven communities in the Northern Gulf of Mexico with at least $10 million in shrimp sales in 2005 or 2006 were in Louisiana (Dulac, Abbeville, Golden Meadow, Chauvin, Cut Off, Grand Isle, and Venice), while Biloxi, Mississippi and Bayou La Batre, Alabama also documented more than $10 million in sales. These findings illustrate that fishing vessel owners do not always live where their product is being bought and sold[19].

Table 12. Northern Gulf of Mexico Food Shrimp Landings, Sales, and Number of Dealers in 2006 and 2005 by Select Communities (based on dealer location), Ranked by Sales in 2006[20].

City	State	Number of Dealers (2006)	Shrimp Landings (2006)	Shrimp Sales (2006)	Number of Dealers (2005)	Shrimp Landings (2005)	Shrimp Sales (2005)
BAYOU LA BATRE	AL	10	11,601,477	$28,908,601	11	7,385,580	$22,382,010
ABBEVILLE	LA	18	10,356,449	$22,073,339	11	7,033,220	$18,797,377
GRAND ISLE	LA	10	10,044,483	$15,204,610	8	5,726,732	$10,217,558
DULAC	LA	9	7,132,447	$12,937,057	14	10,056,294	$22,633,341
BILOXI	MS	8	5,589,848	$12,285,548	6	4,216,572	$12,191,912
CUT OFF	LA	20	4,857,573	$11,306,790	13	2,514,991	$6,706,646
CHAUVIN	LA	28	7,810,742	$10,983,930	26	6,955,645	$12,141,876
VENICE	LA	4	7,128,228	$10,647,620	3	3,318,664	$6,146,924
LAFITTE	LA	14	5,786,199	$7,893,420	11	4,792,818	$9,539,489
LAKE CHARLES	LA	14	4,097,960	$7,847,550	4	11,560	$38,723
BOOTHVILLE	LA	6	4,095,957	$7,361,694	3	1,984,358	$4,242,576
GOLDEN MEADOW	LA	14	3,968,040	$6,924,667	14	5,769,319	$12,863,442
BON SECOUR	AL	7	1,805,611	$5,864,451	7	1,636,368	$6,161,778

[19] Note that the information in this table was compiled according to where the shrimp were bought and sold, which is oftentimes different from the port of landing (i.e. where the shrimp cross the dock) since product is often trucked from a port to a dealer that may be in a different community.
[20] For communities where the number of dealers is less than three, landings and sales are suppressed to protect firms' confidential data. Only communities with more than $300,000 in sales in at least on year were selected for presentation.

CROWN POINT	LA	3	3,186,035	$4,442,781	2	***	***
LOCKPORT	LA	5	1,743,015	$3,294,333	3	1,026,503	$2,143,891
BELLE CHASSE	LA	8	1,863,203	$2,988,106	5	920,442	$1,739,878
THERIOT	LA	9	2,293,090	$2,726,232	6	2,180,607	$3,212,594
EMPIRE	LA	3	1,442,313	$2,413,734	11	2,696,127	$4,597,449
MONTEGUT	LA	10	1,682,453	$2,250,590	8	1,716,148	$3,140,727
DELCAMBRE	LA	9	1,217,925	$2,013,075	10	1,830,430	$3,107,631
PORT SULPHUR	LA	2	***	***	2	***	***
IRVINGTON	AL	3	797,797	$1,926,612	3	401,675	$1,145,162
CODEN	AL	5	465,595	$1,505,458	6	249,916	$872,384
CAMERON	LA	31	948,441	$1,319,962	25	885,122	$1,351,238
YSCLOSKEY	LA	3	820,884	$1,186,310	3	319,695	$494,129
HOUMA	LA	12	887,627	$1,077,809	12	943,886	$1,451,230
HACKBERRY	LA	5	897,299	$917,494	5	674,106	$818,213
BATON ROUGE	LA	5	752,041	$904,550	0	-	-
ST BERNARD	LA	10	671,968	$895,833	6	183,714	$315,947
MORGAN CITY	LA	19	269,032	$615,557	13	929,366	$2,208,013
THEODORE	AL	4	146,106	$257,921	4	325,192	$698,473
NEW ORLEANS	LA	10	55,538	$138,092	8	217,014	$463,542
PASS CHRISTIAN	MS	1	***	***	2	***	***
GRAND BAY	AL	1	***	***	1	***	***
PASCAGOULA	MS	1	***	***	3	178,463	$418,792
GULFPORT	MS	0	-	-	2	***	***

Between 2005 and 2006, many communities experienced changes in the landings and sales of Gulf food shrimp, with most of those changes being for the better and mostly due to the overall increase in landings in 2006. However, the shift in landings to non-hurricane impacted communities also appears to have been a factor. In the Northern Gulf of Mexico, the communities of Bayou La Batre, Alabama, and Cut Off, Venice, Grand Isle, and Lake Charles, Louisiana saw the biggest increases, either absolutely or relatively, in landings and sales. Other communities that experienced significant increases were Abbeville, Boothville, and Crown Point, Louisiana. Somewhat surprising were the increases in Venice, Grand Isle, and Boothville, Louisiana, as these communities were significantly impacted by Hurricane Katrina according to numerous reports. However, some of these reports also indicate that at least some dealers/docks in these particular communities were able to resume their operations much sooner than their counterpart in other nearby communities. As such, with fewer nearby choices, those onshore businesses which were able to resume operations sooner than most clearly benefitted as a result, as did the communities in which they operate. Conversely, the communities in the Northern Gulf of Mexico that saw the smallest increases, either absolutely or relatively, in landings and sales were Golden Meadow and Dulac, Louisiana. With respect to these two communities, this result appears completely driven by the apparent relocation of one major dealer in each case to another community. This was particularly important in Dulac as the dealer in question operated at multiple dock locations previously.

The data also appear to suggest that many communities lost one and sometimes several dealers in 2006. Again, this apparent finding is largely an artifact of some harvesters obtaining dealer licenses and then either going out of business or leaving the fishery. Also, undoubtedly as a result of Hurricane Katrina, Empire, Louisiana lost four of its five dealers/docks. Luckily for that community, the lone remaining dealer was able to pick up some of the slack, though certainly not all as many of the nearby vessels apparently offloaded their product in Venice and Boothville, Louisiana.

3.7.5 Distribution of Supplying Northern Gulf of Mexico Shrimp Vessels by Community[21]

Though shrimp sales and landings volume are potentially important indicators of a community's ties to the fishery, also of interest is the number of vessels that supply shrimp to dealers in each community. More so than volume and sales, number of vessels is indicative of how many fishermen and fishing households have a relationship with a particular community. This information is presented in Table 13, which includes all known Northern Gulf shrimp vessels (inshore and offshore). In comparing this information to a similar table that includes only offshore vessels, it is fairly clear that many communities in Louisiana have strong ties to vessels that operate in state waters.

Table 13. Number of Vessels Supplying Shrimp to Selected Northern Gulf of Mexico Communities in 2005 and 2006.

City	State	Number of Vessels (2005)	Number of Vessels (2006)
LAFITTE	LA	528	542
GRAND ISLE	LA	543	487
CHAUVIN	LA	431	450
DULAC	LA	612	441
GOLDEN MEADOW	LA	517	402
VENICE	LA	274	349
BAYOU LA BATRE	AL	241	224
BOOTHVILLE	LA	184	218
MONTEGUT	LA	198	199
ABBEVILLE	LA	195	198
CROWN POINT	LA	140	171
BELLE CHASSE	LA	90	164
LAKE CHARLES	LA	11	162
PORT SULPHUR	LA	164	152
THERIOT	LA	136	142
CUT OFF	LA	123	139
LOCKPORT	LA	163	134
DELCAMBRE	LA	174	116
BILOXI	MS	155	105
BATON ROUGE	LA	0	101
ST BERNARD	LA	54	95
EMPIRE	LA	326	91
HACKBERRY	LA	57	82
HOUMA	LA	72	79
CAMERON	LA	105	78
YSCLOSKEY	LA	50	75
MORGAN CITY	LA	78	31
NEW ORLEANS	LA	99	18
BARATARIA	LA	64	12

[21] For this analysis, vessel counts were not presented according to port of landing since, within the Shrimp Landings File, the "port" code is oftentimes a county or parish, which does not allow the analyst to determine the specific community where the vessel is docked.

Between 2005 and 2006, some fairly significant changes took place both with respect to the total number of vessels and number of federally-permitted vessels supplying shrimp to particular communities. Some of these changes are directly related to either or both of the loss and relocation of dealers mentioned in the last section. Specifically, with respect to all supplying vessels, the biggest "winners" in 2006 were Lake Charles and Baton Rouge, with Venice, Belle Chasse, and St. Bernard also gaining a significant number of supplying vessels. With the exception of Venice, the other four communities benefitted from the fact that one or more dealers relocated there as a result of Hurricanes Katrina and Rita. Conversely, the biggest "losers" were Dulac, Golden Meadow, Empire, and New Orleans, though reductions were also seen in Grand Isle, Delcambre, Biloxi, and Barataria. These reductions appear to be primarily hurricane induced, though economic conditions probably played a role as well.

3.7.6 Distribution of Northern Gulf of Mexico Shrimp Processors by Community

Because of the decline in the number of shrimp processors and the resulting fact that most communities only have one or two shrimp processors, and NOAA Administrative Order 216-100, which requires NMFS to protect businesses' confidential information, very little detailed information regarding processing activities can be revealed at the community level. Nonetheless, the ranking should provide some insights into approximately how important shrimp processing activities are to the communities listed in Tables 14 and 15.

Table 14. Processed Pounds, Value, and Employment of Gulf Shrimp Processors by Northern Gulf of Mexico Community in 2005, Ranked by Processed Shrimp Value[22].

City	State	Number of Shrimp Processors	Total Processed Pounds	Total Processed Value	Processed Shrimp Pounds	Processed Shrimp Value	Employment	Shrimp as Percent of Processed Value
DELCAMBRE	LA	4	21,115,149	$66,330,738	21,115,149	$66,330,738	170	100.0
BAYOU LA BATRE	AL	8	21,336,661	$62,527,413	16,495,961	$55,227,198	231	88.3
BILOXI	MS	7	19,708,834	$42,225,235	19,482,121	$42,108,637	296	99.7
DULAC	LA	5	15,011,516	$38,837,889	15,004,076	$38,822,265	155	100.0
NEW ORLEANS	LA	1	***	***	***	***	***	100.0
BON SECOUR	AL	2	***	***	***	***	***	79.9
D'IBERVILLE	MS	1	***	***	***	***	***	100.0
MOBILE	AL	1	***	***	***	***	***	100.0
CHAUVIN	LA	5	1,398,309	$4,620,674	1,398,309	$4,620,674	65	100.0
VIOLET	LA	1	***	***	***	***	***	100.0
GOLDEN MEADOW	LA	2	***	***	***	***	***	100.0
HARAHAN	LA	1	***	***	***	***	***	100.0
OCEAN SPRINGS	MS	1	***	***	***	***	***	99.9
THERIOT	LA	1	***	***	***	***	***	100.0

[22] For communities where the number of processors is less than three, information regarding processed pounds, value, and employment are suppressed to protect firms' confidential data. However, dependency on the value of processed shrimp is reported for all communities with shrimp processors.

PASCAGOULA	MS	1	***	***	***	***	***	100.0
HOUMA	LA	1	***	***	***	***	***	0.3

Table 15. Processed Pounds, Value, and Employment of Gulf Shrimp Processors by Northern Gulf of Mexico Community in 2006, Ranked by Processed Shrimp Value[23].

City	State	Number of Shrimp Processors	Total Processed Pounds	Total Processed Value	Processed Shrimp Pounds	Processed Shrimp Value	Employment	Shrimp as Percent of Processed Value
DELCAMBRE	LA	4	29,996,992	$102,953,996	29,996,992	$102,953,996	184	100.0
BAYOU LA BATRE	AL	6	18,832,130	$63,412,905	18,647,030	$63,033,900	123	99.4
DULAC	LA	5	18,779,949	$44,282,421	18,770,979	$44,262,956	159	100.0
BILOXI	MS	6	17,494,430	$39,464,673	17,494,430	$39,464,673	207	100.0
BON SECOUR	AL	2	***	***	***	***	***	85.4
D'IBERVILLE	MS	1	***	***	***	***	***	100.0
MOBILE	AL	1	***	***	***	***	***	100.0
NEW ORLEANS	LA	1	***	***	***	***	***	100.0
CHAUVIN	LA	5	972,844	3,445,956	972,844	3,445,956	79	100.0
PASCAGOULA	MS	1	***	***	***	***	***	100.0
GOLDEN MEADOW	LA	1	***	***	***	***	***	100.0
HARAHAN	LA	1	***	***	***	***	***	100.0
THERIOT	LA	1	***	***	***	***	***	100.0

Many of these communities appear to have a very strong or at least some relationship with harvesters and dealer/wholesalers. Further, in 2005, with the exceptions of the processor in Houma and three additional processors in Bayou La Batre, the other processors and thus their communities rely heavily, if not entirely, on shrimp with respect to their processing activities. Again, how much of that shrimp comes from domestic production cannot be known with certainty, though analysis in Keithly et al. (2005) suggests a likely estimate of 60 percent. Communities that appear to have a much stronger relationship with the shrimp processing sector than the harvesting and wholesaling sectors would include Delcambre, Louisiana, D'Iberville, Mississippi, and Bon Secour, Alabama. Undoubtedly, many of the processors in these communities receive product from other nearby communities that have closer ties to harvesters and dealers. For example, recent field research suggests a strong relationship between dealer/wholesalers and vessel owners in Abbeville, who also have a strong relationship with vessels ported in Intracoastal City, and with processors in Delcambre, Louisiana.

Many significant changes occurred between 2005 and 2006 in the processing sector. The number of total shrimp processors in the Gulf of Mexico decreased from 60 to 55. This was caused by the departure of five small processors in Seadrift, Texas, Golden Meadow, Harahan, and Houma, Louisiana, and Ocean Springs, Mississippi, and three larger processors, two in Bayou La Batre, Alabama and one in Biloxi, Mississippi. The departure of these larger processors caused a

[23] For communities where the number of processors is less than three, information regarding processed pounds, value, and employment are suppressed to protect firms' confidential data. However, dependency on the value of processed shrimp is reported for all communities with shrimp processors.

significant decline in processing employment within these two communities. With the exception of one of the two processors in Bayou La Batre and the one in Biloxi, the other departing processors were only marginally involved in shrimp processing activities, and thus their departure likely did not affect total shrimp processing capacity in the Gulf to any great extent.

With respect to processing value and poundage, both increased significantly in 2006 relative to 2005 because of the increase in domestic landings. However, the benefits of this increased processing activity were not equally distributed across processors and communities. In fact, some communities saw their role in the shrimp processing sector decline. Overall, Delcambre continued to have the highest level of shrimp processing activity of all communities in the Gulf. In fact, the pounds and value of processed shrimp in Delcambre increased dramatically in 2006. Production and value also increased in Bayou La Batre, even with the loss of two processors, and in Pascagoula. In these cases, the processors and communities became much more dependent on shrimp processing activities in 2006 compared to 2005. Conversely, major decreases in shrimp processing activities were seen in New Orleans.

3.7.7 An Overall Assessment of Community Relationships with the Gulf of Mexico Shrimp Fisheries

Community involvement in fishing-related activities was evaluated in recent research completed by IAI (2005a,b,c,d), in collaboration with NMFS. In this evaluation, a wide set of attributes was used to characterize fishing communities throughout the Gulf of Mexico. Fishing communities are defined under MSFCMA's National Standard 8 as communities which are "substantially dependent on or substantially engaged in" fishing or fishing-related activities. Fishing-specific attributes considered in this recent research include commercial permits and licenses (federal and state), for-hire and other recreational permits, seafood landings and retail markets, processing facilities, recreational tournaments, commercial and recreational docking facilities, and other seafood/fishing-related parameters. A summary index derived from the presence or absence of these fishing-specific attributes was used to provide a preliminary characterization of "fishing-oriented" communities in the Gulf states. Communities are categorized as "primarily-involved," "secondarily-involved," or "tangentially-involved" based on their level of involvement in fishing-related activities. For each Gulf state, summary tables listing communities and their preliminary categorization are presented in the reports. As expected, most communities with the strongest ties to the shrimp industry are classified as communities "primarily-involved" in fishing and fishing related activities, e.g., Dulac, Cut Off, and Chauvin in Louisiana, Biloxi in Mississippi, and Bayou La Batre in Alabama. Grand Isle and Abbeville, Louisiana were characterized as "secondarily-involved" in fishing and fishing related activities.

3.7.8 Assessment of Community Resiliency

In addition to the place-based fishery data above, additional information can be gleaned by looking at the socio-demographic composition of these communities. As per E.O. 12898, of specific interest are communities that have relatively high percentages of minorities; communities which are lower than average with respect to important socioeconomic factors, such as level of education, average household income, and poverty rates; and communities which have a relatively strong economic dependence on the fishing industry in general. These factors would be evaluated relative to national averages. For example, nationally, slightly more than 29 percent of the population is composed of minorities: Blacks/African Americans (12.6 percent), American Indians/Native Alaskans (0.9 percent), Asians (4.8 percent), and Hispanics/Latinos (16.3 percent). Median household income is $50,221 and 14.3 percent of the population lives in poverty. Over 84.6 percent of the population have a high school education or better, while 27.5 percent have a bachelor's degree or higher. This information generally comes from the U.S. Census Bureau (2010).

Upon an analysis of the U.S. Census data for each community, many communities appear to be relatively vulnerable to social and economic impacts as a result of adverse management changes, or adverse changes due to other factors. That is, these communities would find it more difficult to adjust to or "absorb" adverse impacts because, relative to other communities, they lack the sufficient human, physical, and financial capital to do so. From a social justice perspective, the impacts of shrimp fisheries management changes on the communities should be given additional consideration. More specifically, the communities can be subjectively broken into two groups: (1) communities which reflect all five of the attributes noted above (percentage of minorities, education, household income, poverty rate, and level of economic dependence on fishing) or reflect at least four of the attributes above and additionally appear to have been significantly impacted by the 2005 hurricanes (Group 1), and (2) communities which indicate four of the attributes noted above or reflect at least three of the attributes above and additionally appear to have been significantly impacted by the 2005 hurricanes (Group 2). Within each of those groups, there are eight (Boothville, Cameron, Dulac, Empire, Grand Isle, and Venice, Louisiana, and Bayou La Batre and Coden, Alabama) and seven (Abbeville, Chauvin, Delcambre, Golden Meadow, Houma, Lafitte, and Montegut, Louisiana) communities, respectively. Communities in the first group would be the most vulnerable, i.e., least able to adapt, to adverse impacts from additional federal regulations. Within these two groups of communities, according to IAI (2005a,b,c,d), the following communities were determined to be primarily-involved with marine fisheries: Dulac, Empire, Golden Meadow, Venice, Chauvin, Cameron, Montegut, and Houma in Louisiana; and Bayou La Batre and Coden in Alabama. Abbeville and Delcambre, Louisiana, were determined to be secondarily-involved in fishing and fishing-related activities. Thus, the vast majority of these socio-economically vulnerable communities are also highly dependent on fishing.

3.7.9 Descriptions of Select Communities with Strong Relationships to the Shrimp Fisheries

As mentioned above, there is still much uncertainty in the shrimp fisheries as some communities that were heavily damaged by the hurricanes of 2005, such as Biloxi, Mississippi; Bayou La Batre, Alabama; and Venice, Louisiana, rebuild their fishing infrastructure. Some of the shrimpers unloaded in different ports than where they unloaded before the hurricanes, shifting the distribution of landings, vessels, and therefore revenue and income across communities. Reports generally indicate that the shifts were away from hurricane-impacted areas, primarily communities in Louisiana and Mississippi that were close to the water (and therefore subject to storm surge), westward to communities in Texas, eastward to communities in Alabama, and more inland communities in Louisiana (IAI 2007; NMFS 2007). For the purpose of further describing a couple communities that are most likely to be impacted by new regulations on the shrimp fisheries, additional basic information, including demographics, is provided for Dulac, Louisiana and Bayou La Batre, Alabama, given that these communities have the strongest ties to the Gulf shrimp industry and are classified as communities "primarily-involved" in fishing and fishing related activities.

These community descriptions are based on information found in IAI's community profiling reports (2005a,b,c,d).

Dulac, Louisiana

Dulac is one of the many small towns located on the "five fingers" south of Houma experiencing coastal erosion and saltwater intrusion. With easy access to Timbalier Bay and the Gulf of Mexico via the Houma Navigational Canal, many Dulac residents are deeply involved in commercial fishing, and many recreational fishers from Houma and even faraway Lafayette have camps in this area. The Houma Indian Center is here and numerous Houma Indians call Dulac home. The Houma Indians are not a federally-recognized tribe, but continue to seek tribal status.

Dulac had a year 2010 population of 1,463 persons, a decrease of 995 from 2000 (U.S. Census Bureau 2010). Many residents claim fishing as their primary occupation. One informant indicated that there was little else to do in Dulac but fish. Most residents are involved in some aspect of the shrimp industry that, in turn, supports many local businesses. Several stores sell fishing supplies, gas, and ice, and there are various boat ramps here. Shrimp, crab, and oyster are the primary species for the Dulac commercial fleet, with small quantities of pelagic species taken via three active federal permits. Dulac was ranked 12th in value ($48.9 million) and 23rd in quantity (35.6 million pounds) of landings for all U.S. ports in 2008. Local processors employed an average of 31 persons in 1980, 20 in 1990, and an undisclosed number in 2000.

Dulac's shrimp industry is reportedly in decline due to marketing challenges. Some local commercial shrimpers explain that they do not want to eliminate the foreign market, since the American market for shrimp exceeds the ability to supply it locally, but want legislation to prohibit the flooding of the market with foreign shrimp and significant loss of value to the domestic product. Informants also complain that new quality standards requiring more rigorous use of ice are driving up costs without due compensation. Boat builders in Dulac report a decline in sales, explaining that under current challenging conditions, fewer commercial fishermen are in the market for new boats. Informants suggest that the region's oil industry offers some possibilities for alternative employment, and that, for instance, more of Dulac's shipyard business now comes from the oil industry than the local commercial fishing fleet.

Bayou La Batre, Alabama

Bayou La Batre is located in southern Mobile County. It is adjacent to the body of water of the same name. The bayou empties into Mississippi Sound, providing easy access to several major ship channels and the Gulf of Mexico. Bayou La Batre is some 25 miles south of Mobile and approximately 22 miles east of the Pascagoula-Moss Point, Mississippi Metro area. The Gulf of Mexico is about 17 miles south, accessible via Portersville Bay and the Mississippi Sound.

Bayou La Batre was founded in the 1780s by a Frenchman named Joseph Bosarge. "La Batre" refers to a strategic battery built by the French during that period. Following the introduction of rail service in the late 1800s, the area developed as a resort town. Following a hurricane that devastated the area in 1906, commercial fishing became the only source of income. Residents subsequently established a lengthy history of involvement in the harvest, processing, and distribution of seafood.

Population in Bayou La Batre in 2010 documented 2,558 persons, an increase from the 2,313 count in 2000 (U.S. Census Bureau 2010). Most residents were employed in manufacturing industries or sales occupations in 2000.

The local fishing fleet here ranges from small bay boats that fish for shrimp and finfish to large Offshore vessels (called “steel slabs”) that make extended trips throughout the Gulf of Mexico and Southeast Atlantic. Shrimp, oysters, crabs, and finfish are primary products. Bayou La Batre was ranked 19th in value ($36 million) and 36th in quantity (19 million pounds) of landings for all U.S. ports in 2008. Fishery participants from Bayou La Batre also produce the majority of Alabama seafood landings; shrimp accounts for 90 percent of landed seafood value. Crews for hundreds of shrimp vessels work out of and deliver product to Bayou La Batre. Local processing activities include cleaning, heading, picking, shucking, grading, breading, packaging, frozen storage, and transportation. Much of the seafood processed in Bayou La Batre’s processing plants is trucked in from out of state. These plants employ approximately 1,500 year-round workers and 800 seasonal workers. An additional number of packing houses and wholesale seafood dealers employ many year-round and seasonal workers. There are also at least a dozen marine supply shops and marine electronics firms in Bayou La Batre.

Shipbuilding is Bayou La Batre’s other major industry. Oil supply boats, work boats, barges, shrimp trawlers, tugs, cruisers, and casino boats are among the vessels built in Bayou La Batre. There is a small downtown business district at the intersection of Shell Belt Road and State Road 188. Shell Belt Road is the address of many fishing-related industries, such as seafood processors, fish houses, and boat building yards. Numerous shrimp vessels are docked nearby. There are no bars, hotels, or non-fishing related businesses located on the bayou, but there are non-fishing related businesses in town. A NMFS port agent has an office in town.

The local Vietnamese American population is involved in all facets of the local seafood industry. Many settled in the community with the help of the Catholic Church after the end of the Vietnam Conflict.

According to one fishery specialist, the recent rise in fuel prices and the increase in imports and subsequent drop in price for domestic shrimp have forced Alabama shrimp fishermen to adjust their annual fishing pattern. In the past, fishing trips would be made during the off-season even though shrimp were not as abundant since the trips were still economically feasible. That is no longer the case, and many vessels remain tied to the dock during the off-season; returns can no longer cover operating costs.

North Carolina

North Carolina coastal communities rely significantly less on commercial fishing now than in the past (Maiolo 2004). This is the result of the development of the communities as multiple use zones, with retirement, light industry, recreation, and tourism becoming the dominant domains of the local economies. Fewer and fewer native born residents make a full time living as fishermen like those in previous generations. Cheuvront (2002, 2003) found that among Core Sound fishermen and south of that location, the average fisherman earned about 76 percent of his income from commercial fishing. More specifically, Cheuvront found that just under half (48 percent) were totally reliant on fishing for their incomes. This compares with data gathered in the late 1980s where nearly all full-time fishermen captains were committed to fishing for nearly all (95 percent) of their incomes (Maiolo 2004).

According to NCDMF statistics, the top five counties for commercial seafood landings in 2009 were Dare (approximately 25.4 million pounds valued at approximately $21.9 million), Hyde (approximately 7.0 million pounds valued at approximately $8.1 million), Cartaret (approximately 5.6 million pounds valued at approximately $9.5 million), Tyrrell (approximately 4.5 million pounds valued at approximately $3.7 million), and Camden (approximately 3.8 million pounds valued at approximately $4.1 million). In 2009, shrimp was documented as one of the top five ranking species (by pounds) in several North Carolina waterbodies (Table 16). Overall, shrimp landings were greatest by far in Pamlico Sound, ranking second and fourth for brown and white shrimp, respectively. But it is important to note that in several other waterbodies, shrimp ranked as high or higher (e.g., white shrimp ranking first in the North River/Back Sound area with approximately 1.3 percent of the Pamlico Sound brown shrimp landings) of all landed species, indicating its relative importance to those areas.

Table 16. North Carolina waterbodies where shrimp ranked in the top five landed commercial species in 2009 (NCDMF).

WATERBODY	SPECIES	POUNDS	RANK
PAMLICO SOUND	BROWN SHRIMP	2,999,794	2
PAMLICO SOUND	WHITE SHRIMP	556,062	4
OCEAN 0-3 MILES, SOUTH OF CAPE HATTERAS	WHITE SHRIMP	489,568	2
OCEAN 0-3 MILES, SOUTH OF CAPE HATTERAS	BROWN SHRIMP	352,412	4
NEUSE RIVER	BROWN SHRIMP	105,004	3
NEWPORT RIVER	WHITE SHRIMP	40,377	2
CAPE FEAR RIVER	WHITE SHRIMP	39,743	2
NORTH RIVER/BACK SOUND	WHITE SHRIMP	39,183	1
NEWPORT RIVER	BROWN SHRIMP	32,193	3
WHITE OAK RIVER	WHITE SHRIMP	32,013	2
INLAND WATERWAY (ONSLOW)	BROWN SHRIMP	28,743	2
INLAND WATERWAY (ONSLOW)	WHITE SHRIMP	22,936	4
TOPSAIL SOUND	BROWN SHRIMP	21,704	4
NORTH RIVER/BACK SOUND	BROWN SHRIMP	13,759	5
STUMP SOUND	BROWN SHRIMP	11,618	4
INLAND WATERWAY (BRUNSWICK)	BROWN SHRIMP	11,435	2
INLAND WATERWAY (BRUNSWICK)	WHITE SHRIMP	4,059	4

Out of a NCDMF survey yielding 182 individuals identifying themselves as shrimp fishermen, Table 17 shows the most frequently cited communities where shrimp fishermen live (Cheuvront 2002, 2003). The largest number of fishermen in the surveys who fished for shrimp came from Sneads Ferry, followed by Harkers Island, Atlantic, Beaufort, and Cedar Island, all communities known to have sizable shrimp fleets.

Table 17. Most frequently cited communities where shrimp fishermen live (Cheuvront 2002, 2003 in NCDMF 2006).

COMMUNITY	PERCENT OF RESPONDENTS
SNEADS FERRY	12.6
HARKERS ISLAND	9.9
ATLANTIC	6.6
BEAUFORT	4.9
CEDAR ISLAND	4.9
DAVIS	4.4
MOREHEAD CITY	4.4
HAMPSTEAD	3.8
OTWAY	3.8
SEA LEVEL	3.8
WILMINGTON	3.8

Table 18 shows a summary of the demographic characteristics of the 182 North Carolina shrimp fishermen interviewed by Cheuvront (2002, 2003). Nearly all of the shrimp fishermen were white males. They averaged 45 years old and had over 25 years fishing experience. The average shrimp fisherman was currently married and had a high school diploma or less education. Approximately 37 percent of the fishermen had incomes of $15,000 to $30,000. Another 29.7 percent had total household incomes of $30,001 to $50,000.

Table 18. Demographic characteristics of North Carolina shrimp fishermen (Cheuvront 2002, 2003 in NCDMF 2006).

N = 182	CATEGORY VALUES	AVERAGE OR PERCENT
YEARS FISHING		25.4
AGE		45.2
GENDER		
	MALE	98.4%
	FEMALE	1.6%
RACE		
	WHITE	98.9%
	HISPANIC	0.6%
	BLACK	0.6%
EDUCATION		
	LESS THAN HIGH SCHOOL	36.8%
	HIGH SCHOOL GRADUATE	46.2%
	SOME COLLEGE	11.0%
	COLLEGE GRADUATE	6.0%
MARITAL STATUS		
	MARRIED	78.0%
	DIVORCED	10.4%
	WIDOWED	1.1%
	NEVER MARRIED	0.5%
	SEPARATED	9.9%
TOTAL HOUSEHOLD INCOME		
	LESS THAN $15,000	12.1%
	$15,001 - $30,000	37.4%
	$30,001 - $50,000	29.7%
	$50,001 - $75,000	12.1%
	MORE THAN $75,000	13.2%
	REFUSED TO ANSWER	7.6%

Approximately 64 percent of the fishermen interviewed said they fished all year long. Of those who did not fish all year, fishing activity was lowest from January through March. The peak fishing participation months for these fishermen were May through November. Seventy-seven percent of the fishermen indicated that fishing was their sole source of income. Of those who had other sources of income, the most frequently cited sources of additional income included carpentry, machinery mechanic, government, and retirement pensions.

4 ENVIRONMENTAL CONSEQUENCES

This section provides an evaluation of the potential direct, indirect, and cumulative impacts to the affected environment described in Section 3, caused by the management alternatives proposed to reduce incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries. Expected impacts on sea turtles, marine mammals, listed fish and other marine species, EFH, and the shrimp fisheries are considered below.

4.1 CONSEQUENCES FOR SEA TURTLES

As discussed throughout this DEIS, the capture of sea turtles incidental to fishing operations has been identified as a primary threat to the recovery of sea turtle populations in the Atlantic. The capture and mortality of sea turtles in bottom fishing trawl gear is well documented (e.g., Henwood and Stuntz 1987; NMFS and USFWS 1991, 1992, 2008; NRC 1990). Although sea turtles can voluntarily remain submerged for relatively long periods of time, when forcibly submerged in fishing gear, they appear to rapidly consume oxygen stores, disturbing acid-base balance to potentially lethal levels (Lutcavage and Lutz 1997).

The ESA statutory and regulatory definitions of "take" encompass all types of interactions that may occur between fishing vessels and sea turtles. Sea turtles that encounter trawls that are equipped with functional TEDs are typically excluded without being observed, but are considered "taken" in the statutory sense. The term captured is used in the DEIS to refer to all observable sea turtle interactions, including those turtles brought on deck or observed falling from a net upon haulback. Mortalities or lethal takes are a further subset of captures. Observed captures include turtles reported as apparently uninjured, comatose, injured, or condition unknown.

To date, sea turtle bycatch estimates have not been available for skimmer trawl gear. Relying on otter trawl CPUE estimates, such as those used in Epperly et al. (2002), for skimmer trawl gear was deemed inappropriate due to potential gear selectivity issues between otter and skimmer trawls and a lack of observed effort in areas where skimmer trawl gear is primarily used; there was no observed otter trawl effort for inshore waters of the Western Gulf of Mexico and there was no observed otter trawl effort for any waters in the Eastern Gulf of Mexico (i.e., east of the Mississippi River) or North Carolina. Recent studies specific to skimmer trawls, however, have provided a small amount of data that now allow calculation of these estimates. The process for calculating sea turtle bycatch estimates for skimmer trawls is described below; estimates are provided separately for the North Carolina and Gulf of Mexico skimmer trawl fisheries. It should be noted that the generated estimates should not be considered explicit or definitive, but rather a reflection on anticipated scale of take.

As noted previously, skimmer trawls are used in Louisiana, Mississippi, Alabama, Florida, and North Carolina. Because Florida already requires TEDs to be used by skimmer trawls in state waters, they are excluded from this analysis. Additionally, for the purposes of this analysis, butterfly/wingnet, and chopstick vessels are included in the bycatch estimates for Gulf of Mexico skimmer trawl gear.

In 2010, Price and Gearheart (2011) observed six North Carolina skimmer boats to examine target shrimp catch retention, bycatch reduction, and TED feasibility in skimmer trawl gear. During testing, a TED was installed in one net, while the other was left naked (i.e., no TED installed), with the TED switched between nets daily to remove potential vessel side bias. Fishing locations and times were considered to be representative of the North Carolina skimmer trawl fishery (B. Price, NMFS, pers. comm.).

Price and Gearheart (2011) observed 341 tows during 40 trips, for a total of 243 effort hours. No sea turtle interactions were observed in TED-equipped nets, however, three Kemp's ridley sea turtles were captured in naked nets. To evaluate the status quo (i.e., no TEDs in skimmer trawls) the 243 hours of total effort was adjusted by 50 percent to reflect that observed effort was only for one naked net, versus two naked nets usually fished per vessel, resulting in 121.5 adjusted vessel effort hours. Therefore, CPUE for Kemp's ridley sea turtles based on observed take in Price and Gearheart (2011) was estimated to be 0.02469 turtles/hour (3 Kemp's ridley sea turtle captures / 121.5 effort hours = 0.02469).

Because Price and Gearheart (2011) only observed Kemp's ridley sea turtle captures, and in the absence of other appropriate data, an alternative approach was developed to estimate take for remaining sea turtle species. While this study did not observe captures of other sea turtle species, available sea turtle literature and sea turtle stranding data document that other sea turtle species do occur in the area utilized by the North Carolina skimmer trawl fleet and, therefore, are also susceptible to incidental capture during fishery operations. CPUE values for other species likely to interact with North Carolina skimmer trawl gear were calculated by utilizing inshore sea turtle stranding records for North Carolina as a reasonable representation of in-water species distribution. It should be noted that when reviewing strandings records for the past few years, several instances were noted where green sea turtle strandings exhibited significant spikes due to cold stunning events; green sea turtles are more prone to cold stunning events than other sea turtle species, and, therefore, could bias results. Data from 2011, however, did not exhibit any anomalous cold-stunning stranding events. Using the relative abundance of sea turtle species documented in North Carolina, inshore strandings records for 2011 (56, 52, and 72 Kemp's ridley, loggerhead, and green sea turtle strandings, respectively; STSSN database) resulted in relative abundance values of 31.11 percent for Kemp's ridley, 28.89 percent for loggerhead, and 40 percent for green sea turtles. These relative abundance values were then utilized to obtain CPUE values of 0.02293 and 0.03175 for loggerhead and green sea turtles, respectively (e.g., ([Kemp's ridley CPUE] 0.02469 / [Kemp's ridley relative abundance] 31.11)*([loggerhead relative abundance] 28.89) = ([loggerhead CPUE] 0.02293)), and can be seen below in Table 19. Based on the life history characteristics of leatherback sea turtles and the fact that leatherbacks do not appear in inshore strandings records for North Carolina leads us to believe they would be very rarely encountered, if at all, in the North Carolina skimmer trawl fishery. Therefore, they are excluded from further analysis.

Table 19. CPUE values and relative abundance of sea turtle species for North Carolina.

SEA TURTLE SPECIES	CPUE VALUES CALCLUATED FROM PRICE AND GEARHEART (2011)	RELATIVE ABUNDANCE FROM STSSN (2011 NC INSHORE STRANDINGS)	EXTRAPOLATED CPUE VALUES
Kemp's Ridley	0.02469	31.11	-
Loggerhead	x	28.89	0.02293
Green	x	40.00	0.03175
Leatherback	x	0	0

In 2010, the North Carolina skimmer trawl fishery documented 1,096 trips, which was up from 807 trips conducted in 2009 (S. McInerny, NCDMF, pers. comm.). Skimmer trawl trips are typically day trips, where the vessel departs and returns to the dock on the same day, which is reflective of the small average size of the vessels; approximately 55 percent of all 2010 trips were conducted by skimmer vessels less than 30 feet in overall length. The average effort per trip recorded by Price and Gearheart (2011) was 4.3 hours. Due to artifacts related to the study (e.g., documentation of catch composition), this is likely an under-estimate of average trip effort. For the purposes of this exercise, average trip effort was estimated to be 6 hours per trip, which takes into consideration transit time to and from the dock to the fishing grounds, as well as other fishery-related issues such as trip preparation, catch delivery, etc. As a result, total fishing effort for the North Carolina skimmer trawl fishery in 2010 was estimated to be 6,576 hours (1,096 trips x 6 hours = 6,576 hours). It should be noted that based on these estimates, Price and Gearheart (2011) observed approximately 3.6 percent of total trips and 1.85 percent of total estimated fishing effort conducted by the North Carolina skimmer trawl fishery in 2010, which is a considerably greater percentage of total effort than the observed fishing effort used to calculate CPUEs for otter trawl gear in Epperly et al. (2002), which was 0.05 percent for the Western Gulf of Mexico in 1997-1998.

Using the estimated CPUE for Kemp's ridley sea turtles and the total estimated effort hours, results in a total of 162 Kemp's ridley sea turtles captured by the North Carolina skimmer trawl fishery in 2010 (6,576 total effort hours x 0.02469 turtles/hour = 162.4 turtle takes). Likewise, we estimated 151 and 209 loggerhead and green sea turtles, respectively, also captured in 2010. The resulting take estimates for the North Carolina skimmer trawl fishery are presented below in Table 20a. Estimated mortalities were calculated based on seasonal mortality rates for both legal tow times and long (i.e., 102 minutes) tow times, using the model discussed in Sasso and Epperly (2006).

Table 20a. Estimated captures and mortalities of sea turtles by species in the North Carolina skimmer trawl fishery in 2010. Estimated mortalities are based on compliance with alternative tow times or long (i.e., 102 minutes) tow times, which results in a 4.9 and 18.4 percent mortality rate, respectively.

SEA TURTLE SPECIES	ESTIMATED CAPTURES	ESTIMATED MORTALITIES: LEGAL TOW TIMES	ESTIMATED MORTALITIES: LONG TOW TIMES
Kemp's Ridley	162	8	30
Loggerhead	151	7	28
Green	209	10	38
TOTAL	522	26	96

Based on the estimated number of captures and effort hours, on average, a sea turtle is captured every 12.6 hours across the North Carolina skimmer trawl fleet. Furthermore, with only 64 total vessels in the North Carolina skimmer trawl fleet in 2010, on average and everything else being treated as equal, every skimmer trawl vessel captured 8.2 turtles during the course of the fishing year.

In order to project sea turtle captures and mortality estimates in skimmer trawl fisheries operating with installed TEDs, we need to account for and consider the effect of TED violations on sea turtle capture rates and total mortalities. This was accomplished by calculating overall compliance and non-compliance rates in the Gulf of Mexico and the Atlantic otter trawl shrimp fisheries (i.e., to serve a proxy for the skimmer trawl fisheries, assuming TED compliance would be similar between the two fisheries) based on vessel boarding data from TED inspections. For the Gulf of Mexico compliance analysis we calculated monthly and average rates based on average May through September 2011 vessel boarding data provided by OLE. As there is no comparable data pool for the entire South Atlantic region, estimated annual compliance rates were calculated based on average rates during the period 2006-2011 as documented by boarding data provided by GDNR, which includes compliance checks done on their own, as well as those done in conjunction with OLE. Boarding records which had one or more violations and sufficient violation details were then sorted into impact categories based on the most egregious violation. The resulting average documented compliance rates were 65.88 percent in the Gulf of Mexico and 39.82 percent in the South Atlantic. SEFSC gear experts then separated the most egregious violation from each vessel by TED component (e.g., TED grid angle, escape opening dimension, escape flap configuration, etc.) and assigned a level of severity (probability of capture) relative to turtle size. For example, a TED angle of 65 degrees was scored as having a 90 percent probability of capturing a juvenile turtle and a 60 percent probability of capturing an adult (B. Ponwith, NMFS, December 16, 2011, memorandum to R. Crabtree, NMFS). Conversely, escape opening dimensions that were less than the required minimum or more than the required maximums were assigned lower probabilities of capturing juvenile turtles and higher probabilities for adults; for example, a double-cover escape opening with a 52- to 54-inch leading edge cut (56-inch minimum) was scored as having an 80 percent probability of capturing an adult turtle but only a 10 percent probability of capturing a juvenile (J. Mitchell, NMFS, pers. comm.). Probabilities were derived from the following: TED testing observations during which juvenile loggerheads were exposed to various configurations of non-compliant TEDs, TED testing (diver-assisted) assessments of a leatherback model passing through non-compliant TED configurations, and expert opinion of SEFSC gear technicians. For this analysis, probabilities of capture were applied to one of two size-groups of turtles which are encountered in the shrimp fisheries – either juveniles of loggerhead and green sea turtles, and all Kemp’s ridley sea turtles (i.e., small-size group), or adult loggerhead and green sea turtles, and all leatherback sea turtles (i.e., large-size group). The number of captures was estimated based on expected levels of future overall fleet compliance and non-compliance associated with each violation category by assuming: (1) a one-to-one relationship between expected vessel compliance rates and effort (e.g., if 85 percent of vessels were documented to be fully compliant, we assumed 85 percent of effort was from compliant vessels) and the extent of violations by each category and effort (e.g., if 10 percent of non-compliant vessels boarded had violations in a particular category, we assumed 10 percent of non-compliant effort had violations in that category) and, (2) that the compliance data were representative of overall levels of fleet compliance and violation categories. Last, we estimated the number of sea turtle mortalities by multiplying our estimated number of sea turtle captures in each stratum by the proportion of animals expected to drown, based on the mortality rate estimates in Epperly et al. (2002).

Based on average TED compliance results in the South Atlantic otter trawl fishery, Table 20b summarizes the anticipated number of sea turtle captures and mortalities across the North Carolina skimmer trawl fishery operating with required TEDs. As mentioned previously, TED compliance issues may have a differential effect between small/juvenile and adult sea turtles (e.g., TED grid angle is more critical to juvenile versus adult sea turtles; TED escape opening size is more critical to adult versus juvenile sea turtles); therefore, the analysis determined the sea turtle size differential likely to be encountered by the North Carolina skimmer trawl fleet. This fleet works in shallow, inshore waters, typically where juvenile and sub-adult sea turtles are more abundant than larger, adult sea turtles. Information reviewed from the STSSN database and fishery-independent surveys that encounter sea turtles (e.g., Southeast Area Monitoring and Assessment Program) support this conclusion, therefore, the analysis assumed a 90 percent juvenile/Kemp's ridley and 10 percent adult sea turtle size composition likely to be encountered by the North Carolina skimmer trawl fleet.

Table 20b. Estimated captures and mortalities of sea turtles by species in the North Carolina skimmer trawl fishery operating with TEDs. Estimated mortalities are based on summary TED compliance and long (i.e., 102 minutes) tow times during the summer.

SEA TURTLE SPECIES	ESTIMATED CAPTURES WITH TEDS	ESTIMATED MORTALITIES WITH TEDS
Kemp's Ridley	49	9
Loggerhead	52	10
Green	67	12
TOTAL	168	31

While there have been several skimmer trawl studies recently conducted in the Gulf of Mexico, their utility to develop sea turtle CPUE is compromised based on the lack of observed sea turtle bycatch. Scott-Denton et al. (2006) observed 307 tows during 96 trips for a total of 517 effort hours in Louisiana coastal waters from September 2004 through June 2005; no sea turtle captures were documented. Likewise, Price and Gearheart (2011) observed a total of 156 tows for 69.99 adjusted effort hours (i.e., paired trawling with TED installed in one net) in Mississippi and Alabama coastal waters in 2008 and 2009 (J. Gearheart, NMFS, pers. comm.); again, no sea turtle captures were documented. In November 2011, however, skimmer trawl work, similar to the protocol used in Price and Gearheart (2011) was initiated in Louisiana coastal waters. While the work is ongoing and results are preliminary, out of the first 43 tows (approximately 19.3 adjusted effort hours) completed there was one recorded green sea turtle capture just south of Devil Island in Timbalier Bay (E. Scott-Denton, NMFS, pers. comm.). Therefore, CPUE for green sea turtles based on observed effort in Scott-Denton et al. (2006), Price and Gearheart (2011), and NMFS (unpublished data) was estimated to be 0.00165 turtles/hour (1 green sea turtle captures / 606.3 effort hours = 0.00165).

While captures of other sea turtle species were not observed in the Northern Gulf of Mexico aside from the aforementioned green sea turtle, available sea turtle literature and sea turtle stranding data document that other sea turtle species do occur in the area utilized by the Northern Gulf of Mexico skimmer trawl fleet and, therefore, are also susceptible to incidental capture during fishery operations. Similar to the approach used for the North Carolina skimmer trawl fishery, sea turtle strandings for the Northern Gulf of Mexico (i.e., Louisiana through Alabama) in 2010-2011 were utilized to determine relative abundance, and were, in turn, used to extrapolate CPUE values for other sea turtle species. The resulting values are presented in Table 21 below. As noted in the North Carolina analysis, leatherback sea turtles have not appeared in inshore strandings records for the Northern Gulf of Mexico and are unlikely to be encountered by the skimmer trawl fisheries that operate in the shallow, inshore and nearshore waters of Louisiana, Mississippi, and Alabama; therefore, they are excluded from further analysis.

Table 21. CPUE values and relative abundance of sea turtle species for the Northern Gulf of Mexico.

SEA TURTLE SPECIES	CPUE VALUES CALCLUATED FROM SCOTT-DENTON ET AL. (2006); PRICE AND GEARHEART (2011); AND NMFS (UNPUBLISHED DATA)	RELATIVE ABUNDANCE FROM STSSN (2010-2011 LA-AL INSHORE STRANDINGS)	EXTRAPOLATED CPUE VALUES
Kemp's Ridley	x	92.5	0.04361
Loggerhead	x	3.5	0.00189
Green	0.00165	4.0	-
Leatherback	x	0	0

In 2009, the Northern Gulf of Mexico skimmer trawl fisheries documented 24,399 effort days (i.e., 24-hour effort days), which equates to 585,576 effort hours (J. Nance, NMFS, pers. comm.). Using the estimated CPUE for green sea turtles and the total estimated effort hours, results in a total of 966 green sea turtles captured by the Northern Gulf of Mexico skimmer trawl fisheries in 2009 (585,576 total effort hours x 0.00165 turtles/hour = 966.2 turtle takes). Likewise, we estimated a total of 25,535 and 1,104 Kemp's ridley and loggerhead sea turtles, respectively, also captured in 2009. The resulting take estimates for the Northern Gulf of Mexico skimmer trawl fisheries is presented in Table 22a. Estimated mortalities were calculated based on seasonal mortality rates for both legal tow times and long (i.e., 102 minutes) tow times, using the model discussed in Sasso and Epperly (2006).

Table 22a. Estimated captures and mortalities of sea turtles by species in the Gulf of Mexico skimmer trawl fisheries. Estimated mortalities are based on (a) compliance with alternative tow times, which results in a 4.9 (summer) or 21.8 (winter) percent mortality rate, depending on season or (b) long (i.e., 102 minutes) tow times, which results in a 18.4 (summer) or 49.7 (winter) percent mortality rate.

SEA TURTLE SPECIES	ESTIMATED CAPTURES	ESTIMATED MORTALITIES: LEGAL TOW TIMES	ESTIMATED MORTALITIES: LONG TOW TIMES
Kemp's Ridley	25,535	1,911	5,907
Loggerhead	1,104	82	256
Green	966	73	223
TOTAL	27,605	2,066	6,386

Based on the estimated number of captures and effort hours, on average, a sea turtle is captured every 21.2 hours across the Northern Gulf of Mexico skimmer trawl fleet. Furthermore, with an estimated 2,370 total active skimmer, butterfly/wingnet, and chopstick vessels (2008 data) in the Northern Gulf of Mexico fleet, on average and everything else being treated as equal, every vessel captured approximately 11.6 turtles during the course of the fishing year.

Based on summary TED compliance results in the Gulf of Mexico otter trawl fisheries, and using the methodology previously discussed in estimating sea turtle captures in North Carolina, Table 22b summarizes the anticipated number of sea turtle captures and mortalities across the Northern Gulf of Mexico skimmer trawl fisheries operating with required TEDs. As TED compliance issues may have a differential effect between small/juvenile and adult sea turtles (e.g., TED grid angle is more critical to juvenile versus adult sea turtles; TED escape opening size is more critical to adult versus juvenile sea turtles), the analysis determined the sea turtle size differential likely to be encountered by the Northern Gulf of Mexico skimmer trawl fleet. This fleet works in shallow, inshore waters, typically where juvenile and sub-adult sea turtles, as well as small adult Kemp's ridley sea turtles, are more abundant than larger, adult sea turtles (e.g., loggerhead). Information reviewed from the STSSN database and fishery-independent surveys that encounter sea turtles (e.g., Southeast Area

Monitoring and Assessment Program) support this conclusion, therefore, the analysis assumed a 90 percent juvenile/Kemp's ridley and 10 percent adult sea turtle size composition likely to be encountered by the Northern Gulf of Mexico skimmer trawl fleet.

Table 22b. Estimated captures and mortalities of sea turtles by species in the Northern Gulf of Mexico skimmer trawl fisheries operating with TEDs. Estimated mortalities are based on summary TED compliance and long (i.e., 102 minutes) tow times during the summer and winter.

SEA TURTLE SPECIES	ESTIMATED CAPTURES WITH TEDS	ESTIMATED MORTALITIES WITH TEDS
Kemp's Ridley	4,101	949
Loggerhead	178	41
Green	155	36
TOTAL	4,433	1,025

The above analysis anticipates a total estimate of 6,482 total sea turtle mortalities (96 mortalities in North Carolina + 6,385 mortalities in the Northern Gulf of Mexico) in the combined skimmer trawl fisheries that currently operate without TEDs. Based on compliance results observed in otter trawl vessels operating in the South Atlantic and Gulf of Mexico shrimp fisheries, which have required TEDs for over two decades, the analysis anticipates a total estimate of 1,056 sea turtle mortalities (31 mortalities in North Carolina + 1,025 mortalities in the Northern Gulf of Mexico) should TEDs be required in the combined skimmer trawl fisheries. This represents a potential reduction of 5,426 sea turtle mortalities annually.

4.1.1 Impacts of Alternative 1: No Action

The ongoing impacts to sea turtles as a result of the shrimp fisheries, as discussed in the preceding sections, would continue to affect sea turtle populations.

4.1.2 Impacts of Alternative 2a: Amend Alternative Tow Time Restriction

This alternative would amend the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*) and only apply to vessels less than 30 feet in length, thereby requiring vessels 30 feet and greater in length employing skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets. The alternative tow time restrictions specify tow times are not to exceed 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 (50 CFR 223.206(d)(3)(i)(A) and (B)).

This alternative would potentially result in direct beneficial effects for listed sea turtles. The rationale for this alternative is that past assumptions on skimmer trawl fisheries, specifically that skimmer boats retrieved their nets at intervals that would not be fatal to any sea turtles that were captured in the net, are no longer valid. This could be due to either: (1) current tow time requirements may be too long, and sea turtles, particularly small sea turtles, may be more sensitive to submergence than previously thought (Sasso and Epperly 2006); (2) increased sea turtle abundance (see Section 3.2.3) has resulted in repeated incidental bycatch exposure that is proving fatal for a significant number of turtles; (3) sea turtles may be getting trapped in pockets of netting in skimmer trawls that are not easily observed during fishing operations; or (4) skimmer trawlers may be working in areas that don't require regular dumping of their nets (e.g., clean bottom absent of debris) and, therefore, they exceed tow time requirements.

This alternative focuses on the portions of the skimmer trawl fisheries operating larger vessels that have the ability to more easily operate in deeper water (compared to smaller vessels). Information obtained during the scoping period for this DEIS indicate many small skimmer trawl vessels in Louisiana operate in shallow waters (e.g., 4-5 feet) of bays and lakes where sea turtles may not be expected to be abundant (versus openwater estuaries and in deeper channels). The average length of the three Louisiana skimmer vessels that participated in Scott-Denton et al. (2006) was 39.7 feet, and the average tow depth averaged 7.8 feet (+/- 1.2 feet s.d.). For the segment of the skimmer trawl fleet 30 feet and greater in length that is exceeding the tow time restrictions and potentially incidentally capturing sea turtles, an unknown percentage of which could result in mortalities, a TED requirement would allow those turtles to escape the net. Benefits to sea turtles would be more significant if tow time violations are occurring on a large scale on vessels 30 feet in length and larger within the skimmer trawl fisheries. At this time, the extent tow time restrictions are exceeded by the skimmer trawl fleet in the Northern Gulf of Mexico and in North Carolina is unclear. The information necessary to determine significance is incomplete and unavailable; the incomplete and unavailable information is directly relevant to evaluating the impacts on the human environment, as new regulations are based on the conclusion current regulations (i.e., tow time restrictions) are ineffective; existing credible scientific information is included throughout the document, and referenced accordingly; and the evaluation of impacts and the approaches used are discussed and detailed for each alternative. As a proxy for skimmer trawl tow times, the above bycatch analysis includes an estimate that assumes the fleet exceeds the required tow times and regularly employs long tow times (i.e., 102 minutes). Based on the results, on average and everything else being treated as equal, every vessel in the North Carolina fleet contributed 8.0 sea turtle captures and 1.5 sea turtle mortalities during the course of the year, and the Gulf of Mexico fleet contributed 11.6 sea turtle captures and 2.7 sea turtle mortalities during the course of the fishing year.

As stated previously, skimmer trawls are used in Louisiana, Mississippi, Alabama, Florida, and North Carolina. Louisiana hosts the vast majority of skimmer boats, with 2,248 skimmer and butterfly trawlers reporting landings in 2008 (GSS statistics), while Mississippi had approximately 62 active skimmer, butterfly, and chopstick boats (M. Brainard, MDMR, pers. comm.), and Alabama had 60 active skimmer boats (GSS statistics). In 2009, North Carolina had 65 active skimmer trawl vessels (NCDMF statistics). For the corresponding years, 41 percent of the Louisiana skimmer and butterfly fleet (2007; LADWF statistics), 19 percent of the Alabama skimmer fleet (ALDCNR and GSS statistics), and 29 percent of the North Carolina skimmer fleet (NCDMF statistics) was under 30 feet in length. Because Mississippi does not differentiate by gear type for their shrimp license, and due to the absence of shrimp landings reported by skimmer trawls in Mississippi via the GSS, it is not possible to determine the size distribution of the Mississippi skimmer fleet. As the size of the fleet is similar to Alabama's skimmer fleet, however, this analysis will use the same percentage of vessels under 30 feet in Alabama (i.e., 19 percent) for the Mississippi fleet. Therefore, this alternative would continue to allow approximately 964 skimmer and butterfly trawl vessels less than 30 feet in length (estimated as 922 in Louisiana, 12 in Mississippi, 11 in Alabama, and 19 in North Carolina), to operate with alternative tow time restrictions.

If skimmer trawl vessels are regularly exceeding the tow time restrictions and killing incidentally captured sea turtles, this alternative would benefit those turtles by allowing them to escape the net and avoid drowning. Specifically, based on the assumptions included in the bycatch analysis, this alternative would prevent approximately 3,326 sea turtle mortalities in the combined skimmer trawl fisheries (North Carolina: [46 vessels x 1.5 sea turtle mortalities per vessel without TEDs = 69 sea turtles] – [46 vessels x 0.5 sea turtle mortalities per vessel with TEDs = 23 sea turtles] = 46 sea turtles + Northern Gulf of Mexico: [1,425 vessels x 2.7 sea turtle mortalities per vessel without TEDs = 3,847.5 sea turtles] – [1,425 vessels x 0.4 sea turtle mortalities per vessel with TEDs = 570 sea turtles] = 3,277.5 sea turtles).

Conversely, if tow time violations are restricted to only a small percentage of vessels 30 feet and greater in length within the skimmer trawl fisheries, and tow times are in fact effective in avoiding or reducing sea turtle mortality, this alternative may potentially result in an increase in sea turtle mortality stemming from incidental bycatch. As discussed in Section 2.1.4, a perfectly installed and maintained TED will result in an approximate 95 to 98 percent turtle exclusion efficiency rate (J. Gearhart memo to S. Epperly, NMFS, March 29, 2011). However, TED effectiveness within the fisheries has not been demonstrated to be on par with these cited rates, which were calculated during monitored and regimented testing protocols. If TED compliance issues reduce sea turtle exclusion significantly below the ideal 95 to 98 percent rate, and the status quo compliance rate with alternative tow time restrictions, or rather the current effectiveness of tow time restrictions in reducing sea turtle bycatch mortality, amongst skimmer trawls 30 feet and greater in length is greater than the TED rate, this alternative could potentially be less effective in reducing sea turtle mortality as compared to current tow time restrictions.

Additionally, the required use of TEDs may result in an increase in trawling time and overall effort due to reduced catch rates of shrimp, potentially increasing the opportunity for interactions with sea turtles. The anticipated improvements in TED performance and TED design, such as was observed in shrimp otter trawls, should improve target catch retention and minimize the extent to which increased trawling time might occur. Yet, any increase in tow time and overall effort to compensate for target catch loss caused by the required use of TEDs is not likely to increase overall effort beyond the effort expended as recently as the 1990s through the early 2000s.

Adequate enforcement is needed to insure compliance with federal TED requirements. This issue is particularly important for this alternative, given that the majority of all skimmer trawl vessels in the southeastern U.S. shrimp fisheries operate in Louisiana waters, where state law prohibits the enforcement of TED regulations by state enforcement agencies. The Louisiana Revised Statutes (56:57.2) state that, "The department shall not enforce any federal law which requires the use of turtle exclusion devices by commercial fishermen in Louisiana waters until such devices have been thoroughly and scientifically tested; have been proven to work efficiently with an acceptable amount of loss of commercial catch; have been shown not to cause damage to the state's waterbottoms or other fishery structures or resources; and it has been demonstrated that the use of such devices will appreciably contribute to the attainment of a specific goal."

4.1.3 Impacts of Alternative 2b: Amend Alternative Tow Time Restriction

This alternative would amend the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*) and only apply to vessels less than 20 feet in length, thereby requiring vessels 20 feet and greater in length employing skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets. The alternative tow time restrictions specify tow times are not to exceed 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 (50 CFR 223.206(d)(3)(i)(A) and (B)).

This alternative would potentially result in direct beneficial effects for listed sea turtles, and the effects of this alternative would be similar to those described in Alternative 2a, albeit on a larger scale. Based on the information presented in Alternative 2a, 9.5 percent of the Louisiana skimmer and butterfly fleet (2007; LADWF statistics), 0 percent of the Alabama skimmer fleet (ALDCNR and GSS statistics), and 15 percent of the North Carolina skimmer fleet (2009; NCDMF statistics) was under 20 feet in length. Because Mississippi does not differentiate by gear type for their shrimp license, and due to the absence of shrimp landings reported by skimmer trawls in Mississippi via the GSS, it is not possible to determine the size distribution of the Mississippi skimmer fleet. As the size of the fleet is similar to Alabama's skimmer fleet, however, this analysis will take the liberty of using the same percentage of vessels under 20 feet in Alabama (i.e., 0 percent) for the Mississippi fleet. Therefore, this alternative would continue to allow approximately 224 skimmer and butterfly trawl vessels less than 20 feet in length (estimated as 214 in Louisiana and 10 in North Carolina), to operate with alternative tow time restrictions.

If skimmer trawl vessels are regularly exceeding the tow time restrictions and killing incidentally captured sea turtles, this alternative would benefit those turtles by allowing them to escape the net and avoid drowning. Specifically, based on the assumptions included in the bycatch analysis, this alternative would prevent 5,013 sea turtle mortalities in the combined skimmer trawl fisheries (North Carolina: [54 vessels x 1.5 sea turtle mortalities per vessel without TEDs = 81 sea turtles] – [54 vessels x 0.5 sea turtle mortalities per vessel with TEDs = 27 sea turtles] = 54 sea turtles + Northern Gulf of Mexico: [2,156 vessels x 2.7 sea turtle mortalities per vessel without TEDs = 5,821.2 sea turtles] – [2,156 vessels x 0.4 sea turtle mortalities per vessel with TEDs = 862 sea turtles] = 4,959.2 sea turtles).

Conversely, if tow time violations are restricted to only a small percentage of vessels within the skimmer trawl fisheries, and tow times are in fact effective in avoiding or reducing sea turtle mortality, this alternative may potentially result in an increase in sea turtle mortality stemming from incidental bycatch. Additional considerations discussed in Alternative 2a would also apply to this alternative.

4.1.4 Impacts of Alternative 2c (Preferred Alternative): Withdraw Alternative Tow Time Restriction

This alternative would withdraw the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(*3*), thereby requiring vessels employing skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets. The alternative tow time restrictions specify tow times are not to exceed 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 (50 CFR 223.206(d)(3)(i)(A) and (B)).

This alternative would potentially result in direct beneficial effects for listed sea turtles, and the effects of this alternative would be similar to those described in Alternative 2a, albeit on a larger scale. This alternative would require approximately 2,435 active skimmer and butterfly trawl vessels (estimated as 2,248 in Louisiana, 62 in Mississippi, 60 in Alabama, and 65 in North Carolina) to use TEDs in their nets.

If skimmer trawl vessels are regularly exceeding the tow time restrictions and killing incidentally captured sea turtles, this alternative would benefit those turtles by allowing them to escape the net and avoid drowning. Specifically, based on the assumptions included in the bycatch analysis, this alternative would prevent 5,515[24] sea turtle mortalities in the combined skimmer trawl fisheries (North Carolina: [64 vessels x 1.5 sea turtle mortalities per vessel without TEDs = 96 sea turtles] – [64 vessels x 0.5 sea turtle mortalities per vessel with TEDs = 32 sea turtles] = 64 sea turtles + Northern Gulf of Mexico: [2,370 vessels x 2.7 sea turtle mortalities per vessel without TEDs = 6,399 sea turtles] – [2,370 vessels x 0.4 sea turtle mortalities per vessel with TEDs = 948 sea turtles] = 5,451 sea turtles).

Conversely, if tow time violations are restricted to only a small percentage of vessels within the skimmer trawl fisheries, and tow times are in fact effective in avoiding or reducing sea turtle mortality, this alternative may potentially result in an increase in sea turtle mortality stemming from incidental bycatch. Additional considerations discussed in Alternative 2a would also apply to this alternative.

4.1.5 Impacts of Alternative 3a: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

Implementing a time/area closure would result in a reduction of incidental bycatch and mortality of sea turtles as a result of shrimp fisheries interactions. This alternative would introduce a three-month closure for state waters along the entire Northern Gulf of Mexico. While it is not possible to quantify the conservation benefits to sea turtle species, this would be the most conservative time/area closure alternative in terms of geographical scope and duration. This alternative would benefit juvenile and sub-adult Kemp's ridley sea turtles in particular, which depend on inshore and coastal waters for foraging. These same waters are important for the inshore shrimp fisheries as well, and there is active fishing effort in Louisiana, and, to a lesser extent, in Mississippi and Alabama.

Louisiana shrimp seasons are flexible and are fixed by LADWF based upon biological and technical data relative to shrimp populations in three zones: (1) Mississippi state line to the eastern shore of South Pass of the Mississippi River; (2) eastern shore of South Pass of the Mississippi River to the western shore of Vermilion Bay and Southwest Pass at Marsh Island; and (3) western shore of Vermilion Bay and Southwest Pass at Marsh Island to the Texas state line (Figure 6). In 2011, state waters in portions of Breton and Chandeleur Sounds, as described by the double-rig line (Louisiana Revised Statutes 56:495.1.(A)2), were open during the entire proposed three-month period; all shrimp zones were open in early to mid-May, and there was a special five-day season in mid-April for portions of Zone 2. In 2011, Mississippi state waters south of the ICW were open to shrimping between March 1 and April 30. Only Alabama state waters offshore of the barrier islands extending out to the EEZ were open in 2011 during the proposed three-month period.

[24] This estimate differs from the 5,426 estimate presented in Section 4.1 due to rounding effects.

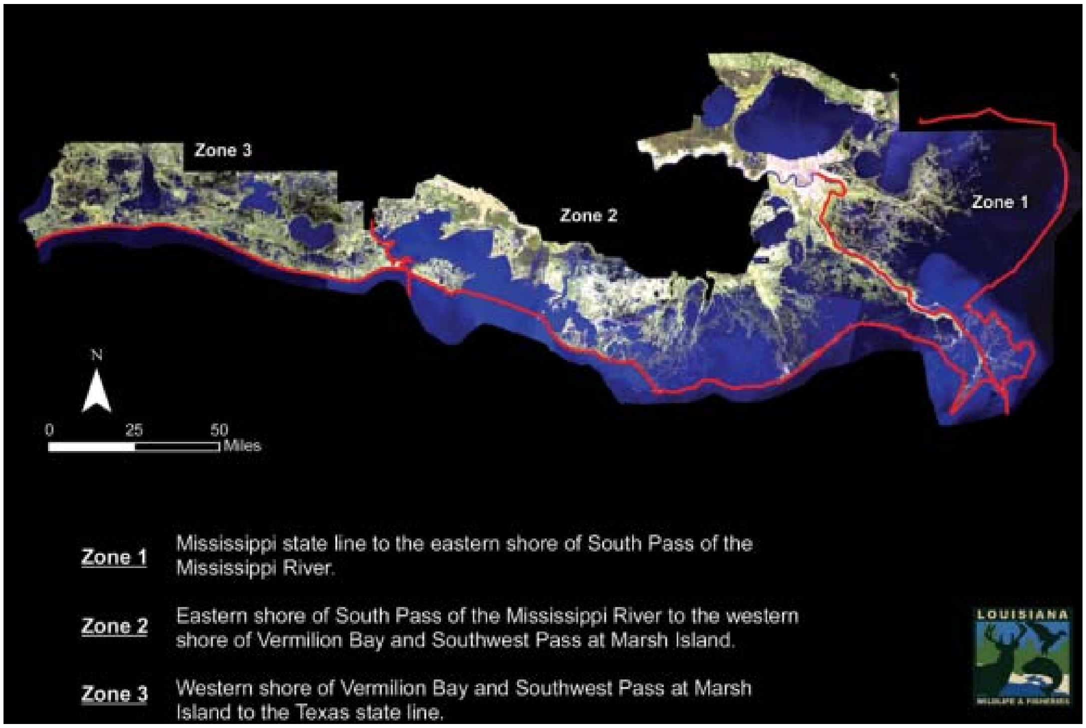

Figure 6. Louisiana inshore shrimp management zones (LADWF).

During the seasonal timeframe and within the geographical area encompassed by this alternative there were 220 sea turtle strandings (63 in Louisiana, 97 in Mississippi, and 60 in Alabama) in 2010, and 325 sea turtle strandings (63 in Louisiana, 210 in Mississippi, and 52 in Alabama) in 2011.

Sea turtle strandings occur due to a variety of reasons, including disease, exposure to biotoxins or pollutants, ingestion of marine debris, vessel collisions, extremely cold water temperatures, and fishery interactions. In the past, correlations have been observed between sea turtle strandings and effort in the shrimp fisheries. Based on available information (Section 2.1.3), however, fishery effort during these periods in both 2010 and 2011 for Mississippi and Alabama waters was limited. Even though effort was limited, it is not unreasonable to assume that a fishery closure will reduce interactions and incidental mortality of sea turtles to the extent that they are occurring, particularly if they are abundant in the specific area during the specified time.

Sea turtle abundance may be affected by numerous factors and may fluctuate seasonally. Prey abundance, chronic, large-scale hypoxia (Craig et al. 2001), and water temperature may alter when sea turtles utilize inshore and coastal waters in the Northern Gulf of Mexico, which could happen outside of the proposed timeframe of this alternative. Additionally, if shrimp fisheries effort is contributing to elevated sea turtle strandings, a time/area closure may result in enhanced effort just prior to and at the end of the closure. Subsequently, this may reduce the conservation benefit to sea turtles, particularly if sea turtles are particularly abundant before and/or after the closure. As Texas does not allow skimmer trawl gear in state waters and Florida already requires TEDs in skimmer trawls fished in state waters, a geographical effort shift is not likely as a result of this alternative as there is nowhere else for skimmer trawl vessels to fish during this closure. Effort could, however, increase slightly before and after the seasonal closure, though effort is generally dictated by fishery conditions (i.e., availability of marketable quantities of shrimp on the grounds).

4.1.6 Impacts of Alternative 3b: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

Implementing a time/area closure would result in a reduction of incidental bycatch and mortality in sea turtles as a result of shrimp fisheries interactions. This alternative would benefit juvenile and sub-adult Kemp's ridley sea turtles in particular, which depend on inshore and coastal waters for foraging. This alternative would introduce a three-month closure for Mississippi and Alabama state waters. There is not a significant amount of fishing effort in this area during the proposed three-month period, particularly by skimmer trawls, as a result of existing state closures and low shrimp abundance. In 2011, Mississippi state waters south of the ICW were open to shrimping between March 1 and April 30. Only Alabama state waters offshore of the barrier islands extending out to the EEZ were open in 2011 during the proposed three-month period. Therefore, benefits to sea turtles would likely be limited.

During the seasonal timeframe and within the geographical area encompassed by this alternative there were 157 sea turtle strandings (97 in Mississippi and 60 in Alabama) in 2010, and 262 sea turtle strandings (210 in Mississippi and 52 in Alabama) in 2011. Due to the geographical range of this alternative, there would be no benefit to sea turtles affected by the shrimp fisheries during this period off Louisiana. Additional considerations discussed in Alternative 3a would also apply to this alternative. Unlike Alternative 3a, however, an effort shift could occur by Mississippi and Alabama skimmer trawl vessels moving to Louisiana waters. These vessels could obtain Louisiana shrimp licenses and fish in open Louisiana waters during this proposed closure, and this effort shift could negatively impact the beneficial effect of this alternative. Conversely, if Mississippi and Alabama waters hosted significantly more sea turtles during this period than Louisiana waters (i.e., sea turtle "hot spot"), then an effort shift would likely have a less significant impact. Effort could also increase slightly before and after the seasonal closure, though effort is generally dictated by fishery conditions (i.e., availability of marketable quantities of shrimp on the grounds), and current effort is generally low during this period as a result of low yields of marketable shrimp in affected waters.

4.1.7 Impacts of Alternative 3c: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

Implementing a time/area closure would result in a reduction of incidental bycatch and mortality in sea turtles as a result of shrimp fisheries interactions. This alternative would benefit juvenile and sub-adult Kemp's ridley sea turtles in particular, which depend on inshore and coastal waters for foraging. These same waters are important for the inshore shrimp fisheries as well, and there is active fishing effort in Louisiana, and, to a lesser extent, in Mississippi and Alabama as well. This alternative would introduce a 45-day closure for state waters along the entire Northern Gulf of Mexico. While this alternative includes the broadest geographical area under consideration, it is unclear how significant the benefit would be to sea turtles due to the limited duration.

Louisiana shrimp seasons are flexible and are fixed by LADWF based upon biological and technical data relative to shrimp populations in three zones: (1) Mississippi state line to the eastern shore of South Pass of the Mississippi River; (2) eastern shore of South Pass of the Mississippi River to the western shore of Vermilion Bay and Southwest Pass at Marsh Island; and (3) western shore of Vermilion Bay and Southwest Pass at Marsh Island to the Texas state line. In 2011, state waters in portions of Breton and Chandeleur Sounds as described by the double-rig line (Louisiana Revised Statutes 56:495.1.(A)2) were open during the entire proposed three-month period and there was a special five-day season in mid-April for portions of Zone 2; the majority of area in the three zones did not open until early to mid-May. In 2011, Mississippi state waters south of the ICW were open to shrimping in April. Only Alabama state waters offshore of the barrier islands extending out to the EEZ were open in 2011 during the proposed 45-day period.

During the seasonal timeframe and within the geographical area encompassed by this alternative there were 148 sea turtle strandings (37 in Louisiana, 80 in Mississippi, and 31 in Alabama) in 2010, and 82 sea turtle strandings (11 in Louisiana, 49 in Mississippi, and 22 in Alabama) in 2011. Additional considerations discussed in Alternative 3a would also apply to this alternative. As noted in Alternative 3a, a geographical effort shift is not likely as a result of this alternative as there is nowhere else for skimmer trawl vessels to fish during this closure. Likewise, a seasonal effort shift could occur, but is generally not expected to be significant due to low fishing effort during this period as a result of low yields of marketable shrimp in affected waters.

4.1.8 Impacts of Alternative 3d: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

Implementing a time/area closure would result in a reduction of incidental bycatch and mortality in sea turtles as a result of shrimp fisheries interactions. This alternative would introduce a 45-day closure for Mississippi and Alabama state waters. There is not a significant amount of fishing effort in this area during the proposed 45-day period, particularly by skimmer trawls, as a result of existing state closures and low shrimp abundance. In 2011, Mississippi state waters south of the ICW were open to shrimping in April. Only Alabama state waters offshore of the barrier islands extending out to the EEZ were open in 2011 during the proposed 45-day period. Therefore, amongst the proposed time/area closures, this alternative would likely yield the least benefit to sea turtles. Additional considerations discussed in Alternative 3a would also apply to this alternative.

During the seasonal timeframe and within the geographical area encompassed by this alternative there were 111 sea turtle strandings (80 in Mississippi and 31 in Alabama) in 2010, and 71 sea turtle strandings (49 in Mississippi and 22 in Alabama) in 2011. Considerations of a potential effort shift as noted in Alternative 3b would also apply to this alternative as well.

4.2 CONSEQUENCES FOR MARINE MAMMALS

As discussed in Section 3.3, the MMPA protects all marine mammals, regardless of whether or not they are listed under the ESA. The MMPA prohibits the “take” of marine mammals, with certain exceptions, in waters under U.S. jurisdiction and by U.S. citizens on the high seas. The capture of marine mammals causing serious injury and mortality, incidental to commercial fishing operations, is a primary threat to many marine mammal species. The effects of the southeastern U.S. shrimp fisheries on marine mammals are estimated and considered annually in SARs, and voluntary strategies have been developed to reduce serious injury or mortality of marine mammals in bottom trawl gear where necessary. The southeastern U.S. shrimp fishery is designated a Category II fishery under the MMPA List of Fisheries.

U.S. Atlantic and Gulf of Mexico Marine Mammal SARs have been published annually since 1995 to meet the requirements of the 1994 amendments to the MMPA. The SARs review marine mammal fishery interactions from data sources including the Marine Mammal Stranding Network database. Although all historical data are reviewed in the SARs, mortality estimates are derived from the most recent five-years for which data are available. Therefore the SARs are most comprehensive in reviewing data collected since 1989, the earliest year included within the first SARs.

Historically, there have been very low numbers of incidental mortality or injury in the bottlenose dolphin stocks associated with shrimp trawls (NMFS 2010b). A voluntary observer program for the Gulf of Mexico shrimp trawl fishery began in 1992 and became mandatory in 2007. Three bottlenose dolphin mortalities were observed in the Gulf of Mexico shrimp trawl fishery: one mortality occurred in 2008 off the coast of Texas in the vicinity of Laguna Madre; one mortality occurred in 2007 off the coast of Louisiana in the vicinity of Atchafalaya Bay; and one mortality occurred in 2003 off the coast of Alabama near Mobile Bay (NMFS 2010b). During 1992-2008 the observer program recorded an additional six unidentified dolphins caught in a lazy line or TED, and one or more of these animals may have belonged to the Eastern or Northern Coastal stocks, and it is likely that three or four of the animals belonged to the continental shelf stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In two of the six cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. In 2008, an additional dolphin carcass was caught on the tickler of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. Only one bottlenose dolphin take has been reported for the South Atlantic portion of the southeastern U.S. shrimp fishery: in August 2002, a Beaufort County, South Carolina fisherman self-reported a dolphin entanglement in a commercial shrimp trawl.

It is worth noting that dolphin interactions with shrimp trawls primarily occur due to the feeding behavior of dolphins. Video documentation demonstrates that dolphins will actively swim alongside the trawl and voluntarily enter the TED escape opening to feed on bycatch. In some instances, these animals may become trapped or entangled, potentially resulting in mortality.

No interactions between ESA-listed whales and shrimp trawlers have been documented within the data sources summarized in the SARs. The southeastern U.S. shrimp fishery is not identified in Recovery Plans and Status Reviews as threats to endangered marine mammals. None of the endangered marine mammals that occur in U.S. Atlantic waters are likely to interact with shrimp trawls as currently fished or as potentially operated under the alternatives considered within this DEIS.

Manatees are managed under the jurisdiction of the USFWS. USFWS has only prepared two SARs, one in 1995 and one in 2009 (74 FR 69136, December 30, 2009). From 2003 to 2007, no manatee deaths or injuries attributable to the shrimp fisheries have been reported from the Atlantic and Gulf coasts in the southeastern United States. Furthermore, this commercial fishery is not known to have taken any manatees since 1987, when the last confirmed report of a manatee captured and drowned in fishery shrimp trawl was recorded. However, three unconfirmed deaths were documented in 1990. Necropsy findings and/or circumstances associated with these cases suggested that an inshore bait shrimp trawl may have been responsible for the deaths but definitive information was lacking. A manatee that died in a shrimp trawl in 1997 was captured by a research trawler investigating excluder devices; the researchers used a shrimp trawl without installed TEDs (S. Branstetter, NMFS, pers. comm.), but they were not engaged in commercial fishing operations (USFWS 2009).

In addition to incidental capture by fishing vessels, vessels can harm marine mammals through harassment or more directly by collision. Low frequency vessel noise may interfere with baleen whales' ability to communicate, navigate, detect prey, or conduct other vital functions (Croll et al. 2001; Wright et al. 2007). Aside from the possibility that fishing vessels may contribute to noise in the ocean environment that can affect baleen whales' sound production and reception capabilities and disrupt the associated functions, other more acute effects of vessels have been posited. Terhune and Verboom (1999) suggested that confusion caused by sounds produced over an area by multiple vessels may make it difficult for whales to detect and avoid approaching vessels. Additionally, baleen whales may not be able to hear high frequency propeller noises (Terhune and Verboom 1999), possibly contributing to their vulnerability to vessel strikes. Manatees, to the contrary, may be unable to hear low frequencies well (Gerstein et al. 1999), which some researchers suggest make them ineffective at detecting and avoiding vessels (USFWS 2001). Laist et al. (2001) summarize data from 58 large whale ship strike incidences and determined that although vessels of any size can injure whales, most severe injuries are caused by vessels 80 m or greater in length and traveling at speeds of 14 knots or faster. Manatee mortalities are considered to be caused primarily by small recreational vessels, and studies indicate vessel strikes at speeds of 13-15 mph (15-17.3 knots) can cause fractures to manatee bones (Clifton 2005). Most shrimp trawlers operate below these speed thresholds, although smaller and slower vessels can still cause injuries. Measures are in place to protect manatees and right whales from ship strikes in their most vulnerable locations; specifically, speed zones and protective areas have been established and shown to be protective for manatees in Florida (USFWS 2001); and since 2008, vessels 65 feet (19.8 m) and larger must travel at 10 knots (11.5 mph) or slower in certain locations along the U.S. Atlantic coast in certain times of year to reduce the threat of collisions with right whales (50 CFR 224.105). Although fishing vessels may affect marine mammals through noise production or vessels strikes, currently they are considered a very low threat, particularly when compared to larger and faster vessels that share the same waters (NMFS 2008c; Hatch et al. 2007).

4.2.1 Impacts of Alternative 1: No Action

Impacts to marine mammals as a result of the shrimp fisheries as discussed in preceding sections would continue to affect those populations.

4.2.2 Impacts of Alternatives 2a, 2b, and 2c (Preferred Alternative): Amend or Withdraw Alternative Tow Time Restriction

Requiring vessels to use TEDs is not expected to result in operational changes such as time, location, or fishing practices that may affect marine mammal interaction rates. It may result in an increase in trawling time due to reduced catch rates of shrimp, potentially increasing the opportunity for incidental capture of marine mammals to occur. The anticipated improvements in TED performance and TED design, such as was observed in shrimp otter trawls, should improve target catch retention and minimize the extent to which increased trawling time might occur. Additionally, there has been a significant reduction in the level of participation in the offshore shrimp fisheries since approximately 2001 due to low shrimp prices from competition with foreign imports and high fuel costs (GMFMC 2005). Furthermore, Hurricanes Katrina and Rita in 2005 damaged or destroyed a large number of shrimping vessels and their associated infrastructure such that landings, and probably effort, were reduced in 2005 to approximately one third of the average during the 1990s (GMFMC 2006). Any increase in tows to compensate for target catch loss caused by a TED requirement is not likely to increase overall effort beyond the effort expended as recently as the 1990s through the early 2000s.

4.2.3 Impacts of Alternative 3a: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

While interactions between marine mammals and shrimp trawlers are infrequent events, it is expected that any closed area alternative may have beneficial effects on marine mammals by eliminating the threat of incidental take by the fishery during the proposed time and area. Shrimp effort during this time period is generally limited in the Northern Gulf of Mexico. The month of May is an important time for the Louisiana shrimp fisheries, however, and on average (i.e., 2000-2009) contributes over 20 percent of Louisiana shrimp landings for the entire year. This alternative would be the more extensive both in geographical scope and duration, and, therefore, would likely offer the most beneficial effects to marine mammal species. Effects of potential geographic or temporal effort shifts from this alternative would be the same as those discussed in Section 4.1.5.

4.2.4 Impacts of Alternative 3b: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

While interactions between marine mammals and shrimp trawlers are infrequent events, it is expected that any closed area alternative may have beneficial effects on marine mammals by eliminating the threat of incidental take by the fishery during the proposed time and area. Like Alternative 3a, this alternative is the most extensive in regards to duration, however, the geographical scope is limited in comparison to Alternatives 3a and 3c. Therefore, benefits to marine mammals would likely not be as extensive as offered by those alternatives. Effects of potential geographic or temporal effort shifts from this alternative would be the same as those discussed in Section 4.1.6.

4.2.5 Impacts of Alternative 3c: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

While interactions between marine mammals and shrimp trawlers are infrequent events, it is expected that any closed area alternative may have beneficial effects on marine mammals by eliminating the threat of incidental take by the fishery during the proposed time and area. Like

Alternative 3a, this alternative is the most extensive in regards to geographical scope, however, the duration is limited in comparison to Alternatives 3a and 3b. Benefits to marine mammals are likely intermediate between those alternatives. Effects of potential geographic or temporal effort shifts from this alternative would be the same as those discussed in Section 4.1.7.

4.2.6 Impacts of Alternative 3d: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

While interactions between marine mammals and shrimp trawlers are infrequent events, it is expected that any closed area alternative may have beneficial effects on marine mammals by eliminating the threat of incidental take by the fishery during the proposed time and area. This alternative is the least extensive in terms of geographical scope and is also the shortest in duration. Therefore, it would offer the least benefit to marine mammal species. Effects of potential geographic or temporal effort shifts from this alternative would be the same as those discussed in Section 4.1.8.

4.3 CONSEQUENCES FOR LISTED FISH AND OTHER MARINE SPECIES

4.3.1 Impacts on Listed Fish Species

Gulf sturgeon (*Acipenser oxyrinchus desotoi*), shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and smalltooth sawfish (*Pristis pectinata*), which are listed under the ESA, occur within the area encompassed by the alternatives analyzed within this DEIS. As discussed in Section 3.4, captures of these species are rare or undocumented in shrimp trawl fisheries. None of the actions considered in the alternatives analyzed within this DEIS are likely to increase the likelihood of incidental capture of these listed species or otherwise increase the likelihood of adverse effects. As discussed below, beneficial effects may occur to listed fish species as a result of the various management alternatives.

4.3.2 Impacts on Other Marine Species

In general, the discarded bycatch of fish and invertebrates in shrimp fisheries is highly variable according to season and area. Marine species frequently encountered as bycatch in shrimp fisheries include Atlantic menhaden (*Brevoortia tyrannus*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), striped mullet (*Mugil cephalus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), black drum (*Pogonias cromis*), red drum (*Sciaenops ocellatus*), red snapper (*Lutjanus campechanus*), sheepshead (*Archosargus probatocephalus*), whiting (*Menticirrhus littoralis*), flounder (*Paralicthys* sp.), red goatfish (*Mullus auratus*), inshore lizardfish (*Synodus foetens*), gafftopsail catfish (*Bagre marinus*), Spanish mackerel (*Scomberomorus maculatus*), king mackerel (*Scomberomorus cavalla*), weakfish (*Cynoscion regalis*), sand seatrout (*Cynoscion arenarius*), cannonball jellyfish (*Stomolophus meleagris*), blue crab (*Callinectes sapidus*), lesser blue crab (*C. similis*), and other various invertebrate species.

Research during the 1990s in the Gulf of Mexico and South Atlantic shrimp trawl fisheries examined the proportions of catch and bycatch by weight between 1990 and 1996. The data indicated that catches (by weight) in the Gulf consisted of about 67 percent finfish, 16 percent commercial shrimp, 13 percent non-commercial shrimp, and 4 percent other invertebrates, while in the South Atlantic the catch averaged 51 percent finfish, 18 percent commercial shrimp, 13 percent non-commercial shrimp and crustaceans, and 18 percent non-crustacean invertebrates. During 1997 and 1998, shrimp trawlers in federal waters of the Gulf of Mexico and South Atlantic regions were required to use a BRD in their nets. Use of BRDs resulted in significant reductions for weakfish, croaker and spot in the South Atlantic region, and for Atlantic croaker and red snapper in the Gulf of Mexico.

4.3.3 Impacts of Alternative 1: No Action

Impacts to fish and other marine species as a result of the shrimp fisheries as discussed in the preceding sections would continue to those populations.

4.3.4 Impacts of Alternatives 2a, 2b, and 2c (Preferred Alternative): Amend or Withdraw Alternative Tow Time Restriction.

Alternatives 2a and 2b would require the use of TEDs on skimmer boats 30 and 20 feet in length and greater, respectively, while Alternative 2c (preferred alternative) would require the use of TEDs on all skimmer boats. As a result of these alternatives, finfish bycatch may be reduced on those vessels required to use TEDs, particularly of larger species such as sharks and rays. It is expected TEDs could reduce the incidental bycatch of Gulf sturgeon in the Northern Gulf of Mexico, as well as shortnose and Atlantic sturgeon in North Carolina. It is unclear how significant this benefit may actually be, as skimmer trawls currently have to comply with alternative tow time restrictions, and, therefore, it is anticipated captured Gulf sturgeon could be released alive in most instances. Regardless, the use of a TED would reduce a sturgeon’s exposure in a net and avoid the need for fishermen to handle a large fish on the deck of their boat, potentially subjecting the fish to injury. As a result, the use of TEDs would likely be beneficial to sturgeons. In contrast, TED use would likely have an insignificant effect on smalltooth sawfish, as most interactions and injuries in shrimp trawls occur when the sawfish entangles its toothed rostrum in netting. Further, smalltooth sawfish are rarely documented outside of Florida, where TED use is already required in state waters.

As previously mentioned, bycatch in the shrimp fisheries is highly variable, not only in season and area, but also depending on gear used by individual vessels; bycatch reduction is likely affected not only by when and where a vessel fishes, but what kind of a TED is employed and how it is rigged. Holland (1989) documented a 15 percent total finfish catch reduction in North Carolina waters with the use of a Georgia TED with four-inch bar spacing. In contrast, Renaud et al. (1990) noted the use of an accelerator funnel in front of a TED significantly decreased finfish bycatch, from 12 lb/hr finfish bycatch without a funnel to 3.9 lb/hr with a funnel.

Because the number of vessels vary depending on the specific alternative, it is expected Alternative 2c (preferred alternative) would offer the most benefit to listed fish and other marine species as it requires the most vessels to use TEDs, followed by Alternative 2b and, finally, Alternative 2a.

4.3.5 Impacts of Alternative 3a: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

This time/area alternative would only be expected to have beneficial effects for fish and other marine species otherwise potentially impacted by the shrimp fisheries during the three-month period. In particular, Gulf sturgeon, which typically overwinter in coastal and nearshore waters of the Northern Gulf of Mexico, would likely benefit as potential incidental bycatch and mortality would be absent during this period. Likewise, numerous other finfish species may benefit as well. Conversely, some predatory species that thrive on shrimp bycatch may be adversely affected by this alternative. As this time/area alternative is the largest in terms of geographical scope and duration, it would likely result in the greatest benefits to listed fish and other marine species. Effects of potential geographic or temporal effort shifts from this alternative would be the same as those discussed in Section 4.1.5.

4.3.6 Impacts of Alternative 3b: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

The effects of this alternative on listed fish and other marine species would be beneficial, albeit on a smaller scale compared to Alternative 3a as the geographical scope is confined to just Mississippi and Alabama waters. Additionally, potential beneficial effects could be negatively affected by a geographic or temporal effort shift, as discussed in Section 4.1.6.

4.3.7 Impacts of Alternative 3c: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

The effects of this alternative on listed fish and other marine species would be beneficial, albeit on a smaller scale compared to Alternative 3a as the duration of this alternative is roughly half of Alternative 3a. Effects of potential geographic or temporal effort shifts from this alternative would be the same as those discussed in Section 4.1.7.

4.3.8 Impacts of Alternative 3d: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

The effects of this alternative on listed fish and other marine species would be beneficial, albeit on a smaller scale compared to all other alternatives, as both the geographical scope and the duration of this alternative is significantly less than that proposed in Alternative 3a, the duration is less than that proposed in Alternative 3b, and the geographical scope of this alternative is less than that proposed in Alternative 3c. Additionally, potential beneficial effects could be negatively affected by a geographic or temporal effort shift, as discussed in Section 4.1.8.

4.4 CONSEQUENCES FOR EFH

Federal action agencies are required to consult with NMFS on activities that may adversely affect EFH. Information within this DEIS represents the assessment of the effects of the analyzed alternatives on EFH. As discussed in Section 3.6, EFH for species and life stages that rely on the seafloor for shelter (e.g., from predators), reproduction, or food is vulnerable to disturbance by trawls. Additionally, the MSFCMA requires FMPs to include measures to reduce the effects of fishing on EFH. Adverse EFH impacts of all fishing activities managed under FMPs have been minimized to the extent practicable within the management actions implemented in recent years. Generally, this is done through a variety of measures concurrent with rebuilding overfished stocks or preventing overfishing. In some cases, gear restricted areas or closures to bottom trawls are implemented to protect EFH or HAPC. One example of this is the Oculina Bank HAPC.

Two general conclusions, originally derived from studies that focused on the effects of trawling in the North Sea (Lindeboom and de Groot 1998), were that low-energy environments populated by organisms unused to disturbance are more affected by bottom trawling, and that bottom trawling affects the potential for habitat recovery (i.e., after trawling ceases, benthic communities and habitats may not always return to their original pre-impacted state). Therefore, factors such as the type of habitat, its vulnerability to disturbance, the degree of natural disturbance, and the degree to which the habitat is already being impacted by bottom-tending mobile gear used in other fisheries, are also relevant to an evaluation of the seriousness of the impacts that proposed changes to bottom trawling effort and distribution may have on EFH and HAPC. Although effort may be redistributed under the alternatives considered within this DEIS, it is likely to occur in areas in which bottom trawling already occurs and has occurred for decades; rather than over more valuable undisturbed habitats.

4.4.1 Impacts of Alternative 1: No Action

Impacts to EFH as a result of shrimp trawling as discussed in the preceding sections would continue to occur.

4.4.2 Impacts of Alternatives 2a, 2b, and 2c (Preferred Alternative): Amend or Withdraw Alternative Tow Time Restriction

The use of a TED does not typically result in a significant interaction with the seabed, in and of itself. The main components of a trawl that interact with the benthos include the doors and footrope (and tickler chain), and also the codend of the net when burdened with a large catch. Depending on the net rigging and habitat type, a TED frame could interact with the bottom. For example, it is possible for a TED frame to rub the seafloor, and in muddy habitat, it could grab and gouge the sediment. However, this could be mitigated by the use of mud roller gear. Furthermore, a heavy bag following the TED frame could potentially overshadow any impact made by the TED itself. While this alternative is not expected to have any significant positive or negative impacts to EFH, it should be pointed out that the skimmer trawl fisheries currently operate in areas that have been subjected to trawling – and numerous other anthropogenic impacts such as dredging and other fishing activities – for several decades, as well as been frequently impacted by numerous high-intensity storms, including hurricanes. Therefore, the required use of a TED would likely have indistinguishable impacts on EFH (e.g., sediment resuspension) compared to the status quo.

And while Alternative 2c (preferred alternative) would require more vessels to use TEDs than 2a and 2b (and likewise when comparing Alternative 2b with 2a), because TED use is not expected to result in any significant positive or negative impacts to EFH, Alternatives 2a, 2b, and 2c would likely have indistinguishable impacts on EFH.

4.4.3 Impacts of Alternative 3a: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

This time/area alternative would be expected to have beneficial effects for EFH potentially impacted by shrimp trawling during the three-month period. In particular, foraging habitat for Gulf sturgeon, which typically overwinter in coastal and nearshore waters of the Northern Gulf of Mexico, would likely benefit as potential habitat disturbance would be absent during this period. Benthic and infaunal species would not be impacted from trawling activity, to the extent that it occurs during this period.

As noted previously, outside of May, there is little shrimp trawling activity in the Northern Gulf of Mexico. Additionally, during this time the Gulf of Mexico can be subjected to strong winter storms that may impact coastal waters, obfuscating any trawl-related impacts. Regardless, as this time/area alternative is the largest in terms of geographical scope and duration, it would likely result in the greatest benefits to EFH. Potential beneficial effects could be negatively affected by a geographic or temporal effort shift, as discussed in Section 4.1.5.

4.4.4 Impacts of Alternative 3b: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

The effects of this alternative would have beneficial effects on EFH, albeit on a smaller scale compared to Alternative 3a as the geographical scope is confined to just Mississippi and Alabama waters. Potential beneficial effects could be negatively affected by a geographic or temporal effort shift, as discussed in Section 4.1.6.

4.4.5 Impacts of Alternative 3c and 3d: Close All Shrimp Fishing in State Waters From Either the Texas-Louisiana State Boundary or the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

Due to the limited duration of this alternative, any beneficial impacts on EFH would be expected to be negligible. The short duration offered in both Alternatives 3c and 3d would not likely allow infaunal communities to recover completely, in spite of the fact that shallow, nearshore and coastal Gulf of Mexico habitat is likely used to periodic disturbances (e.g., storms). The smaller geographical scope of Alternative 3d would further limit any benefit to EFH from the proposed closure, and potential beneficial effects could also be negatively affected by a geographic or temporal effort shift, as discussed in Sections 4.1.7 and 4.1.8.

Due to the limited duration and geographical scope of this alternative, any beneficial impacts on EFH would be expected to be negligible.

4.5 CONSEQUENCES FOR THE SOCIO-ECONOMIC ENVIRONMENT

The proposed alternatives considered within this DEIS would require TED use or close fishing areas during specific times to reduce the incidental bycatch and mortality of sea turtles in shrimp trawls. The socio-economic effects of the regulations portray the primary effects these actions would have on the human environment.

There is no commercial value associated with sea turtles; however, a reduction in the impact of fishery interactions on turtle populations would result in non-market benefits to the nation, to the extent the public values sea turtles. Social benefits may be realized if the sea turtle conservation measures effectively reduce the injury and mortality of sea turtles and contribute to the recovery of their populations. Society members that value biodiversity will benefit from the recovery of these populations. People who do not value biodiversity will not experience a social benefit from sea turtle recovery. Further social benefits can be achieved from the application of management practices that demonstrate that fishing practices and sea turtles can co-exist. Continued collaboration between scientists, industry, and NMFS managers on research projects can result in social benefits as industry, scientists, and managers better understand each other's perspectives and goals.

While enforcement is also necessary to insure compliance with alternative tow time restrictions (i.e., Alternative 1), which is compounded by the logistical difficulties in monitoring and enforcing these restrictions, it is possible that many skimmer boats operate within these parameters simply due to fishery conditions. This premise was the original basis for giving those vessels the alternative of using limited tow times, rather than requiring the use of TEDs. That is, fishing in shallow inshore waters may result in significant debris accumulation in trawl nets, and dragging for long periods of times may not be practical, particularly for small boats. Sorting shrimp amidst large quantities of debris (which may also degrade catch quality) on vessels with limited deck space may not be feasible. Therefore, an unknown percent of skimmer boats may operate under de facto tow time restrictions. Public comment during the DEIS scoping period indicated that TEDs (i.e., Alternatives 2a and 2b) would not remedy this situation, in that some skimmers would not necessarily tow for longer periods of time with TEDs and may still be compelled to regularly check their nets.

4.5.1 Effects of Alternative 1: No Action

Effects to the shrimp fisheries (e.g., increasing fuel prices and other costs, competition from foreign imports) and associated interests as discussed in the preceding sections would continue to affect the socio-economic environment. While there would be no additional economic effects in the short term as a result of this alternative, the delay of management action may potentially result in additional (i.e., beyond the other alternatives included in the DEIS) negative economic effects in the long term should the status of threatened and endangered sea turtles worsen, and, thus, potentially require more significant management action in the future.

4.5.2 Effects of Alternative 2a: Amend Alternative Tow Time Restriction

Louisiana hosts the vast majority of skimmer boats, with 2,248 skimmer and butterfly trawlers reporting landings in 2008 (GSS statistics), while Mississippi had approximately 62 active skimmer, butterfly, and chopstick boats (M. Brainard, MDMR, pers. comm.), and Alabama had 60 active skimmer boats (GSS statistics). In 2010, North Carolina had 64 active skimmer trawl vessels (NCDMF statistics). For the corresponding years, 41 percent of the Louisiana skimmer and butterfly fleet (2007; LADWF statistics), 19 percent of the Alabama skimmer fleet (ALDCNR and GSS statistics), and 36 percent of the North Carolina skimmer fleet (NCDMF statistics) was under 30 feet in length. Because Mississippi does not differentiate by gear type for their shrimp license, and due to the absence of shrimp landings reported by skimmer trawls in Mississippi via the GSS, it is not possible to determine the size distribution of the Mississippi skimmer fleet. As the size of the fleet is similar to Alabama's skimmer fleet, this analysis will use the same percentage of vessels under 30 feet in Alabama (i.e., 19 percent) for the Mississippi fleet. Therefore, this alternative would require approximately 1,471 skimmer and butterfly trawl vessels 30 feet in length and greater (estimated as 1,326 in Louisiana, 50 in Mississippi, 49 in Alabama, and 46 in North Carolina) to install TEDs in their nets. This alternative would continue to allow approximately 964 skimmer and butterfly trawl vessels less than 30 feet in length (estimated as 922 in Louisiana, 12 in Mississippi, 11 in Alabama, and 19 in North Carolina) to operate with alternative tow time restrictions.

TED Costs

Immediate effects to skimmer trawl vessels encompassed by this alternative would be the required acquisition or purchase of TEDs to continue participation in the fishery. A single TED would cost between $300 and $400, and with two nets the total cost would be $600 to $800 per vessel. Therefore, using an average of $700 per vessel, this alternative would have an estimated direct economic cost to the skimmer, chopsticks, and butterfly trawl shrimp fisheries of approximately $1,029,700 for active vessels 30 feet in length or greater (1,471 vessels x $700 = $1,029,700), in the Northern Gulf of Mexico and North Carolina.

The National Fish and Wildlife Foundation (NFWF) allocated funds, received from oil recovery income during the DWH oil spill event, to Gulf of Mexico restoration efforts. In 2010, funding was made available to purchase and disperse TEDs for skimmer trawl vessels. According to MDMR, 360 TEDs have been distributed to 180 Mississippi resident shrimp vessels. Therefore, it is expected the majority of skimmer trawl vessels operating in Mississippi already possess TEDs and the economic impact (direct costs) of this alternative to Mississippi fishermen will be mitigated as a result. It is possible additional available NFWF funding might be made available to other skimmer fishermen in the near future, thus mitigating the direct impact of this alternative.

As a result of fishing conditions, we anticipate that fishermen will spend approximately $300 per vessel on TED maintenance costs annually. This includes time and materials to mend webbing on torn nets and weld repairs to damaged TED grids. Therefore, this results in an estimated cost to the skimmer, chopsticks, and butterfly trawl shrimp fisheries of approximately $441,300 for active vessels 30 feet in length or greater (1,471 vessels x $300 = $441,300), in the Northern Gulf of Mexico and North Carolina. Additionally, we expect fishermen will have to replace their TEDs approximately every three years on average due to attrition; therefore, this will result in a recurring cost related to TED purchase, though not on an annual basis.

Reductions in Gross Revenue Due to Shrimp Loss

Aside from the immediate costs of a TED requirement, specifically the purchase and installation of TEDs in skimmer trawl nets, there may also be indirect costs related to this alternative. As documented with TEDs in the otter trawl fleet, TEDs in skimmer trawls may lead to target catch loss, which would impact revenue. While fishers may adjust their fishing practices to mitigate catch loss, such as towing for longer periods of time, this would also result in economic effects, such as increased fuel and crew costs, which may impact overall revenue negatively. Therefore, while fisher behavior may mitigate losses to some extent, the following does not forecast changes in fisher behavior and simply looks at potential catch loss to document the threshold of economic effects of this alternative.

Price and Gearhart (2011) evaluated North Carolina, Alabama, and Mississippi skimmer trawlers and compared catch between TED-equipped and naked nets; an evaluation of catch loss in the Louisiana skimmer trawl fishery is underway for late 2011 and early 2012. On average, Price and Gearhart (2011) documented a 4.97 percent (95 percent CI: 2.89 to 7.05 percent) catch loss across all vessels and areas.

Based on average landings from all skimmer and butterfly vessels that reported shrimp landings in the GSS and their corresponding revenue in 2008 (i.e., Alabama: 7,192 pounds and $21,357; Louisiana: 12,313 pounds and $22,536), TED use may result in a loss of $1,061 - $1,120 per vessel (i.e., Alabama: $21,357 x 0.0497 = $1,061; Louisiana: $22,536 x 0.0497 = $1,120) due to catch loss. It is important to note that no shrimp landings were reported for Mississippi in the GSS in 2008, or for any recent years before or after this time. This could be a result of either landings reported in Louisiana or Alabama versus Mississippi; skimmer trawlers selling direct and not reporting landings; or some other factor. Therefore, it is not possible to estimate catch loss or revenue for Mississippi skimmer trawlers with any confidence. North Carolina average vessel landings and revenue are much lower, with only 2,792 pounds and $2,675 yielded per skimmer vessel, resulting in an estimated catch loss of $133 per vessel. In total, catch loss as a result of this alternative may lead to an estimated $1,543,299 negative annual economic effect across the Northern Gulf of Mexico and North Carolina shrimp fisheries ($1,120 x 1,326 Louisiana vessels = $1,485,172; $1,061 x 49 Alabama vessels = $52,011; $133 x 46 North Carolina vessels = $6,116; $1,485,172 + $52,011 + $6,116 = $1,543,299).

The total potential cost (i.e., TED purchase and catch loss) of this alternative over the first year of TED requirement/use is estimated to be approximately $2,572,999 ($1,029,700 total TED costs + $1,543,299 total catch loss = $2,572,999). As Louisiana has the most skimmer and butterfly trawl vessels, the cost to the Louisiana shrimp fisheries is by far the most significant, estimated at $2,413,372 alone. On an average vessel basis, this alternative would result in an estimated cost of $1,820 for each of the 1,326 skimmer and butterfly trawl vessels, $1,761 for each of the 49 Alabama skimmer vessels, and $833 for each of the 46 North Carolina skimmer vessels affected by this alternative. This represents an approximate 8 percent loss in revenue to Louisiana and Alabama fishermen, and a 31 percent loss in revenue to North Carolina fishermen. Following the initial TED purchase, economic effects of this alternative would be less in subsequent years.

The above economic effects (i.e., percentage loss in revenue) are based on gross revenue of participants in the shrimp fisheries. Miller et al. (2011) includes information on net revenue, which more accurately reflects overall income following operating expenses such as fuel, labor, repairs, and other overhead costs. As mentioned in Section 3.7, Miller et al. (2011) calculated net revenue of operations in the inshore Gulf of Mexico shrimp fisheries as negative $1,063, which includes revenue from commercial fishing pursuits other than shrimp. That is, on average, the inshore fisheries are operating at a loss. Similar to the differences in catch and revenue noted in the various states, the same is true for differences in net revenue. Miller et al. (2011) estimated 2008 net revenue for the inshore shrimp fisheries in Louisiana as negative $643, in Mississippi as negative $7,459, and in Alabama as negative $9,876. Therefore, while it's not possible to quantify the adjusted net revenue following the implementation of this alternative, it is possible to state that the economic effects of this alternative will compound those losses occurring within the inshore shrimp fisheries.

While enforcement is also necessary to insure compliance with alternative tow time restrictions (i.e., Alternative 1), which is compounded by the logistical difficulties in monitoring and enforcing these restrictions, it is possible that many skimmer boats operate within these parameters simply due to fishery conditions. That is, fishing in shallow inshore waters may result in significant debris accumulation in trawl nets, and dragging for long periods of times may not be practical, particularly for small boats. Sorting shrimp amidst large quantities of debris (which may also degrade catch quality) on vessels with limited deck space may not be feasible. Therefore, an unknown percent of skimmer boats may operate under de facto tow time restrictions. Public comment during the DEIS scoping period indicated that TEDs would not change this situation, in that some skimmers would not necessarily tow for longer periods of time with TEDs and may still be compelled to regularly check their nets.

4.5.3 Effects of Alternative 2b: Amend Alternative Tow Time Restriction

Louisiana hosts the vast majority of skimmer boats, with 2,248 skimmer and butterfly trawlers reporting landings in 2008 (GSS statistics), while Mississippi had approximately 62 active skimmer, butterfly, and chopstick boats (M. Brainard, MDMR, pers. comm.), and Alabama had 60 active skimmer boats (GSS statistics). In 2009, North Carolina had 65 active skimmer trawl vessels (NCDMF statistics). For the corresponding years, 9.5 percent of the Louisiana skimmer and butterfly fleet (2007; LADWF statistics), 0 percent of the Alabama skimmer fleet (ALDCNR and GSS statistics), and 15 percent of the North Carolina skimmer fleet (2009; NCDMF statistics) was under 20 feet in length. Because Mississippi does not differentiate by gear type for their shrimp license, and due to the absence of shrimp landings reported by skimmer trawls in Mississippi via the GSS, it is not possible to determine the size distribution of the Mississippi skimmer fleet. As the size of the fleet is similar to Alabama's skimmer fleet, however, this analysis will use the same percentage of vessels under 20 feet in Alabama (i.e., 0 percent) for the Mississippi fleet. Therefore, this alternative would require approximately 2,211 skimmer and butterfly trawl vessels 20 feet in length and greater (estimated as 2,034 in Louisiana, 62 in Mississippi, 60 in Alabama, and 55 in North Carolina) to install TEDs in their nets. This alternative would continue to allow approximately 224 Louisiana and North Carolina skimmer and butterfly trawl vessels less than 20 feet in length to operate with alternative tow time restrictions.

TED Costs

Immediate effects to skimmer trawl vessels encompassed by this alternative would be the required acquisition or purchase of TEDs to continue participation in the fishery. A single TED would cost between $300 and $400, and with two nets the total cost would be $600 to $800 per vessel. Therefore, using an average of $700 per vessel, this alternative would have an estimated direct economic cost to the skimmer and butterfly trawl shrimp fisheries of approximately $1,547,700 for active vessels 20 feet in length or greater (2,211 vessels x $700 = $1,547,700), in the Northern Gulf of Mexico and North Carolina.

NFWF allocated funds, received from oil recovery income during the DWH oil spill event, to Gulf of Mexico restoration efforts. In 2010, funding was made available to purchase and disperse TEDs for skimmer trawl vessels. According to MDMR, 360 TEDs have been distributed to 180 Mississippi resident shrimp vessels. Therefore, it is expected the majority of skimmer trawl vessels operating in Mississippi already possess TEDs and the economic impact (direct costs) of this alternative to Mississippi fishermen will be mitigated as a result. It is possible additional available NFWF funding might be made available to other skimmer fishermen in the near future, thus mitigating the direct impact of this alternative.

As a result of fishing conditions, we anticipate that fishermen will spend approximately $300 per vessel on TED maintenance costs annually. This includes time and materials to mend webbing on torn nets and weld repairs to damaged TED grids. Therefore, this results in an estimated cost to the skimmer, chopsticks, and butterfly trawl shrimp fisheries of approximately $663,300 for active vessels 20 feet in length or greater (2,211 vessels x $300 = $663,300), in the Northern Gulf of Mexico and North Carolina. Additionally, we expect fishermen will have to replace their TEDs approximately every three years on average due to attrition; therefore, this will result in a recurring cost related to TED purchase, though not on an annual basis.

Reductions in Gross Revenue Due to Shrimp Loss

Aside from the immediate costs of a TED requirement, specifically the purchase and installation of TEDs in skimmer trawl nets, there may also be indirect costs related to this alternative. As documented with TEDs in the otter trawl fleet, TEDs in skimmer trawls may lead to target catch loss, which would impact revenue. While fishers may adjust their fishing practices to mitigate catch loss, such as towing for longer periods of time, this would also result in economic effects, such as increased fuel and crew costs, which may impact overall revenue negatively. Therefore, while fisher behavior may mitigate losses to some extent, the following does not forecast changes in fisher behavior and simply looks at potential catch loss to document the threshold of economic effects of this alternative.

Price and Gearhart (2011) evaluated North Carolina, Alabama, and Mississippi skimmer trawlers and compared catch between TED-equipped and naked nets; an evaluation of catch loss in the Louisiana skimmer trawl fishery is underway for late 2011 and early 2012. On average, Price and Gearhart (2011) documented a 4.97 percent (95 percent CI: 2.89 to 7.05 percent) catch loss across all vessels and areas.

Based on average landings from all skimmer and butterfly vessels that reported shrimp landings in the GSS and their corresponding revenue in 2008 (i.e., Alabama: 7,192 pounds and $21,357; Louisiana: 12,313 pounds and $22,536), TED use may result in a loss of $1,061 - $1,120 per vessel (i.e., Alabama: $21,357 x 0.0497 = $1,061; Louisiana: $22,536 x 0.0497 = $1,120) due to catch loss. It is important to note that no shrimp landings were reported for Mississippi in the GSS in 2008, or for any recent years before or after this time. This could be a result of either landings reported in Louisiana or Alabama versus Mississippi; skimmer trawlers selling direct and not reporting landings; or some other factor. Therefore, it is not possible to estimate catch loss or revenue for Mississippi skimmer trawlers with any confidence. North Carolina average vessel landings and revenue are much lower, with only 2,792 pounds and $2,675 yielded per skimmer vessel, resulting in an estimated catch loss of $133 per vessel. In total, catch loss as a result of this alternative may lead to an estimated $2,349,082 negative annual economic effect across the Northern Gulf of Mexico and North Carolina shrimp fisheries ($1,120 x 2,034 Louisiana vessels = $2,278,080; $1,061 x 62 Alabama vessels = $63,687; $133 x 55 North Carolina vessels = $7,315; $2,278,080 + $63,687 + $7,315 = $2,349,082).

The total potential cost (i.e., TED purchase and catch loss) of this alternative over the first year of TED requirement/use is estimated to be approximately $3,896,782 ($1,547,700 total TED costs + $2,349,082 total catch loss = $3,896,782). As Louisiana has the most skimmer and butterfly trawl vessels, the cost to the Louisiana shrimp fisheries is by far the most significant, estimated at $3,701,880 alone. On an average vessel basis, this alternative would result in an estimated cost of $1,820 for each of the 2,034 Louisiana skimmer and butterfly trawl vessels, $1,761 for each of the 60 Alabama skimmer vessels, and $833 for each of the 55 North Carolina skimmer vessels affected by this alternative. This represents an approximate 8 percent loss in revenue to Louisiana and Alabama fishermen, and a 31 percent loss in revenue to North Carolina fishermen. Following the initial TED purchase, economic effects of this alternative would be less in subsequent years.

The above economic effects (i.e., percentage loss in revenue) are based on gross revenue of participants in the various shrimp fisheries. Miller et al. (2011) includes information on net revenue, which more accurately reflects overall income following operating expenses such as fuel, labor, repairs, and other overhead costs. As mentioned in Section 3.7, Miller et al. (2011) calculated net revenue of operations in the inshore Gulf of Mexico shrimp fisheries as negative $1,063, which includes revenue from commercial fishing pursuits other than shrimp. That is, on average, the inshore fisheries are operating at a loss. Similar to the differences in catch and revenue noted in the various states, the same is true for differences in net revenue. Miller et al. (2011) estimated 2008 net revenue for the inshore shrimp fisheries in Louisiana as negative $643, in Mississippi as negative $7,459, and in Alabama as negative $9,876. Therefore, while it's not possible to quantify the adjusted net revenue following the implementation of this alternative, it is possible to state that the economic effects of this alternative will compound those losses occurring within the inshore shrimp fisheries.

While enforcement is also necessary to insure compliance with alternative tow time restrictions (i.e., Alternative 1), which is compounded by the logistical difficulties in monitoring and enforcing these restrictions, it is possible that many skimmer boats operate within these parameters simply due to fishery conditions. That is, fishing in shallow inshore waters may result in significant debris accumulation in trawl nets, and dragging for long periods of times may not be practical, particularly for small boats. Sorting shrimp amidst large quantities of debris (which may also degrade catch quality) on vessels with limited deck space may not be feasible. Therefore, an unknown percent of skimmer boats may operate under de facto tow time restrictions. Public comment during the DEIS scoping period indicated that TEDs would not change this situation, in that some skimmers would not necessarily tow for longer periods of time with TEDs and may still be compelled to regularly check their nets.

4.5.4 Effects of Alternative 2c (Preferred Alternative): Withdraw Alternative Tow Time Restriction

This alternative would have similar effects to that discussed above in Sections 4.52 and 4.5.3, though on a larger scale. Specifically, this alternative would require approximately 2,435 active skimmer and butterfly trawl vessels (estimated as 2,248 in Louisiana, 62 in Mississippi, 60 in Alabama, and 65 in North Carolina) to use TEDs in their nets. Due to the larger universe of affected vessels, this alternative would have a larger economic impact on the various shrimp fisheries in the Northern Gulf of Mexico and North Carolina as compared to Alternative 2a.

TED Costs

Immediate effects to skimmer trawl vessels encompassed by this alternative would be the required acquisition or purchase of TEDs to continue participation in a fishery. A single TED would cost between $300 and $400, and with two nets the total cost would be $600 to $800 per vessel. Therefore, using an average of $700 per vessel, this alternative would have an estimated direct economic cost to the skimmer and butterfly trawl shrimp fisheries of approximately $1,704,500 for all skimmer and butterfly trawlers (2,435 vessels x $700 = $1,704,500) in the Northern Gulf of Mexico and North Carolina.

NFWF allocated funds, received from oil recovery income during the DWH oil spill event, to Gulf of Mexico restoration efforts. In 2010, funding was made available to purchase and disperse TEDs for skimmer trawl vessels. According to MDMR, 360 TEDs have been distributed to 180 Mississippi resident shrimp vessels. Therefore, it is expected the majority of skimmer trawl vessels operating in Mississippi already possess TEDs and the economic impact (direct costs) of this alternative to Mississippi fishermen will be mitigated as a result. It is possible additional available NFWF funding might be made available to other skimmer fishermen in the near future, thus mitigating the direct impact of this alternative.

As a result of fishing conditions, we anticipate that fishermen will spend approximately $300 per vessel on TED maintenance costs annually. This includes time and materials to mend webbing on torn nets and weld repairs to damaged TED grids. Therefore, this results in an estimated cost to the skimmer, chopsticks, and butterfly trawl shrimp fisheries of approximately $730,500 for all skimmer and butterfly trawlers (2,435 vessels x $300 = $730,500) in the Northern Gulf of Mexico and North Carolina. Additionally, we expect fishermen will have to replace their TEDs approximately every three years on average due to attrition; therefore, this will result in a recurring cost related to TED purchase, though not on an annual basis.

Reductions in Gross Revenue Due to Shrimp Loss

Per the discussion on average catch and potential catch loss in Sections 4.5.2 and 4.5.3 and based on average landings from all skimmer and butterfly vessels that reported shrimp landings in the GSS and their corresponding revenue in 2008 (i.e., Alabama: 7,192 pounds and $21,357; Louisiana: 12,313 pounds and $22,536), TED use may result in a loss of $1,061 - $1,120 per vessel (i.e., Alabama: $21,357 x 0.0497 = $1,061; Louisiana: $22,536 x 0.0497 = $1,120) due to catch loss. It is important to note that no shrimp landings were reported for Mississippi in the GSS in 2008, or for any recent years before or after this time. This could be a result of either landings reported in Louisiana or Alabama versus Mississippi; skimmer trawlers selling direct and not reporting landings; or some other factor. Therefore, it is not possible to estimate catch loss or revenue for Mississippi skimmer trawlers with any confidence. North Carolina average vessel landings and revenue are much lower, with only 2,792 pounds and $2,675 yielded per skimmer vessel, resulting in an estimated catch loss of $133 per vessel. In total, catch loss as a result of this alternative may lead to an estimated $2,590,177 negative annual economic effect across the Northern Gulf of Mexico and North Carolina shrimp fisheries ($1,120 x 2,248 Louisiana vessels = $2,517,845; $1,061 x 62 Alabama vessels = $63,687; $133 x 65 North Carolina vessels = $8,645; $2,517,845 + $63,687 + $8,645 = $2,590,177).

The total potential cost (i.e., TED purchase and catch loss) of this alternative over the first year of TED requirement/use is estimated to be approximately $4,294,677 ($1,704,500 total TED costs + $2,590,177 total catch loss = $4,294,677). As Louisiana has the most skimmer and butterfly trawl vessels, the cost to the Louisiana shrimp fisheries is by far the most significant, estimated at $4,091,445 alone. On an average vessel basis, this alternative would result in an estimated cost of $1,820 for each of the 2,248 skimmer and butterfly trawl vessels, $1,761 for each of the 60 Alabama skimmer vessels, and $833 for each of the 65 North Carolina skimmer vessels affected by this alternative. This represents an approximate 8 percent loss in revenue to Louisiana and Alabama fishermen, and a 31 percent loss in revenue to North Carolina fishermen. Following the initial TED purchase, economic effects of this alternative would be less in subsequent years.

The above economic effects (i.e., percentage loss in revenue) are based on gross revenue of participants in the shrimp fisheries. Miller et al. (2011) includes information on net revenue, which more accurately reflects overall income following operating expenses such as fuel, labor, repairs, and other overhead costs. As mentioned in Section 3.7, Miller et al. (2011) calculated net revenue of operations in the inshore Gulf of Mexico shrimp fisheries as negative $1,063, which includes revenue from commercial fishing pursuits other than shrimp. That is, on average, the inshore fisheries are operating at a loss. Similar to the differences in catch and revenue noted in the various states, the same is true for differences in net revenue. Miller et al. (2011) estimated 2008 net revenue for the inshore shrimp fisheries in Louisiana as negative $643, in Mississippi as negative $7,459, and in Alabama as negative $9,876. Therefore, while it's not possible to quantify the adjusted net revenue following the implementation of this alternative, it is possible to state that the economic effects of this alternative will compound those losses occurring within the inshore shrimp fisheries.

While enforcement is also necessary to insure compliance with alternative tow time restrictions (i.e., Alternative 1), which is compounded by the logistical difficulties in monitoring and enforcing these restrictions, it is possible that many skimmer boats operate within these parameters simply due to fishery conditions. That is, fishing in shallow inshore waters may result in significant debris accumulation in trawl nets, and dragging for long periods of times may not be practical, particularly for small boats. Sorting shrimp amidst large quantities of debris (which may also degrade catch quality) on vessels with limited deck space may not be feasible. Therefore, an unknown percent of skimmer boats may operate under de facto tow time restrictions. Public comment during the DEIS scoping period indicated that TEDs (i.e., Alternatives 2a, 2b, and 2c) would not remedy this situation, in that some skimmers would not necessarily tow for longer periods of time with TEDs and may still be compelled to regularly check their nets.

An additional consequence of this alternative may be an increased safety risk when using TEDs on small (e.g., less than 20-30 feet in length) vessels with limited deck space, particularly in rough conditions. Public comment during the DEIS scoping period indicated there would be increased likelihood of fishermen potentially being injured by swinging TEDs during deployment and recovery.

4.5.5 Impacts of Alternative 3a: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

In 2009, shrimp effort in the Gulf of Mexico for the inshore and 0-10 fathom components, which would roughly correspond to state waters, totaled 96,131 days. Most of this effort was focused in the Northern Gulf of Mexico between the Texas-Louisiana state boundary and the Alabama-Florida state boundary (statistical zones 10-17; Figure 7), with 84,404 days (88 percent) for the inshore and 0-10 fathom components. This alternative would close all shrimp fishing in this area between March 1 and May 31. In 2009, 15,958 fishing days were recorded during this time in this area, which is 18.9 percent of the total annual effort recorded in this area and 16.6 percent of the total annual effort for the inshore and 0-10 fathom components in the entire Gulf of Mexico basin.

The months of March and April historically have not significantly contributed to overall shrimp landings in Louisiana, indicating effort may be relatively low during this time of the year. Specifically, landings in March through April comprised only 1.98 percent of the total landings for the year on average for the period 2000-2009 (LADWF statistics). May, however, is an important month and, in and of itself, averaging 24.5 million pounds of shrimp (all species combined, heads-on weight) for the period 2000-2009, which represents 20.46 percent of average annual landings for the same period.

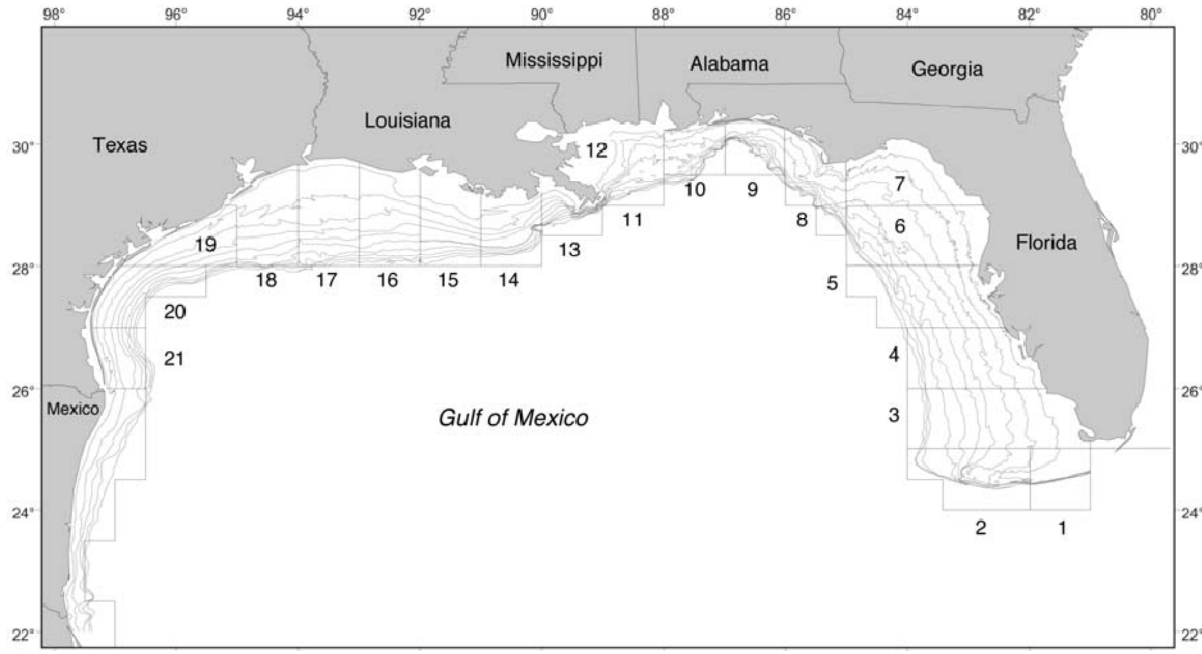

Figure 7. Gulf of Mexico statistical zones.

According to statistics compiled from trip tickets (J. Primrose, NMFS SEFSC, pers. comm.), a total of 8,227,647 pounds of shrimp were harvested (i.e., by skimmer, butterfly, and otter trawler combined) during the time and from the area encompassed by this alternative in 2008; this data does not include catch by commercial fishermen sold through non-dealer channels. The value of this shrimp to each state was $13,769,882 for Louisiana, $80,886 for Mississippi, and $148,736 for Alabama. As a result, this alternative would potentially represent a loss of approximately $13,999,504 to the Gulf of Mexico shrimp fisheries. When averaged across all inshore vessels, economic losses range from $243 per Mississippi vessel to $6,018 per Louisiana vessel ($13,769,882 Louisiana shrimp value / 2,288 Louisiana inshore shrimp vessels = $6,018 loss per vessel; $80,886 Mississippi shrimp value / 333 Mississippi inshore shrimp vessels = $243 loss per vessel; $148,736 Alabama shrimp value / 467 Alabama inshore shrimp vessels = $318 loss per vessel).

Additional consequences from this alternative would be potential effects to allied industries and support businesses, such as dealers, packing houses, restaurants, etc. Due to a lack of product during this time period, hypothetically speaking, it is possible that these businesses may rely on foreign imported product more, which could impact the shrimp fisheries long after the period of the proposed closure. Compared to the other time/area closure alternatives, the consequences of this alternative would be the most severe due to the largest geographical scope and longest duration.

4.5.6 Impacts of Alternative 3b: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From March 1 Through May 31

In 2009, shrimp effort in the Gulf of Mexico for the inshore and 0-10 fathom components totaled 96,131 days. Within the area affected by this alternative, 18,090 days were fished in the inshore and 0-10 fathom components. This effort total is for shrimp statistical zones 10-12, which includes Breton and Chandeleur Sounds in Louisiana and a portion of West Florida, and may also include EEZ waters since it roughly bounded by the 10-fathom depth contour rather than state jurisdictional boundaries; therefore, due to these factors the following analysis may slightly overestimate impacts for this alternative. This alternative would close all shrimp fishing in this area between March 1 and May 31. In 2009, 1,696 fishing days were recorded during this time in this area, which is 9.37 percent of the total annual effort recorded in this area and 1.76 percent of the total annual effort for the inshore and 0-10 fathom components in the entire Gulf of Mexico basin.

According to statistics compiled from trip tickets (J. Primrose, NMFS SEFSC, pers. comm.), a total of 59,716 pounds of shrimp were harvested (i.e., by skimmer, butterfly, and otter trawler combined) during the time and from the area encompassed by this alternative in 2008; this data does not include catch by commercial fishermen sold through non-dealer channels. The value of this shrimp to each state was $14,775 for Mississippi and $123,122 for Alabama. As a result, this alternative would potentially represent a loss of approximately $137,897 to the Gulf of Mexico shrimp fisheries. When averaged across all inshore vessels, economic losses range from $44 per Mississippi vessel to $264 per Alabama vessel ($14,775 Mississippi shrimp value / 333 Mississippi inshore shrimp vessels = $44 loss per vessel; $123,122 Alabama shrimp value / 467 Alabama inshore shrimp vessels = $264 loss per vessel).

Additional consequences from this alternative would be similar to those discussed in Alternative 3a (e.g., potential effects to allied industries and support businesses). Compared to the other time/area closure alternatives, the consequences of this alternative would be the second least severe due to the geographical scope that limits effects to the Mississippi and Alabama shrimp fisheries.

4.5.7 Impacts of Alternative 3c: Close All Shrimp Fishing in State Waters From the Texas-Louisiana State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

In 2009, shrimp effort in the Gulf of Mexico for the inshore and 0-10 fathom components totaled 96,131 days. Most of this effort was focused in the Northern Gulf of Mexico between the Texas-Louisiana state boundary and the Alabama-Florida state boundary, with 84,404 days (88 percent) for the inshore and 0-10 fathom components. This alternative would close all shrimp fishing in this area between April 1 and May 15; for the purposes of this analysis, total effort in May was divided evenly to obtain an effort estimate for the first half of May. In 2009, 8,313 fishing days were recorded during this time in this area, which is 9.85 percent of the total annual effort recorded in this area and 8.65 percent of the total annual effort for the inshore and 0-10 fathom components in the entire Gulf of Mexico basin.

The month of April historically has not significantly contributed to overall shrimp landings in Louisiana, indicating effort may be relatively low during this time of the year. Specifically, landings in April comprised only 1.39 percent of the total landings for the year on average for the period 2000-2009 (LADWF statistics). May, however, is an important month and, in and of itself, averaging 24.5 million pounds of shrimp (all species combined, heads-on weight) for the period 2000-2009, which represents 20.46 percent of average annual landings for the same period.

According to statistics compiled from trip tickets (J. Primrose, NMFS SEFSC, pers. comm.), a total of 2,941,086 pounds of shrimp were harvested (i.e., by skimmer, butterfly, and otter trawler combined) during the time and from the area encompassed by this alternative in 2008; this data does not include catch by commercial fishermen sold through non-dealer channels. The value of this shrimp to each state was $4,942,672 for Louisiana, $12,860 for Mississippi, and $58,470 for Alabama. As a result, this alternative would potentially represent a loss of approximately $5,014,002 to the Gulf of Mexico shrimp fisheries. When averaged across all inshore vessels, economic losses range from $39 per Mississippi vessel to $2,160 per Louisiana vessel ($4,942,672 Louisiana shrimp value / 2,288 Louisiana inshore shrimp vessels = $2,160 loss per vessel; $12,860 Mississippi shrimp value / 333 Mississippi inshore shrimp vessels = $39 loss per vessel; $58,470 Alabama shrimp value / 467 Alabama inshore shrimp vessels = $125 loss per vessel).

Additional consequences from this alternative would be similar to those discussed in Alternative 3a (e.g., potential effects to allied industries and support businesses). Compared to the other time/area closure alternatives, the consequences of this alternative would be the second most severe due to the geographical scope; however, the shorter time frame mitigates much of the impact that would be experienced in Alternative 3a.

4.5.8 Impacts of Alternative 3d: Close All Shrimp Fishing in State Waters From the Louisiana-Mississippi State Boundary, Eastward to the Alabama-Florida State Boundary From April 1 Through May 15

In 2009, shrimp effort in the Gulf of Mexico for the inshore and 0-10 fathom components totaled 96,131 days. Within the area affected by this alternative, 18,090 days were fished in the inshore and 0-10 fathom components. This effort total is for shrimp statistical zones 10-12, which includes Breton and Chandeleur Sounds in Louisiana and a portion of West Florida, and may also include EEZ waters since it roughly bounded by the 10-fathom depth contour rather than state jurisdictional boundaries; therefore, due to these factors the following analysis may slightly overestimate impacts for this alternative. This alternative would close all shrimp fishing in this area between April 1 and May 15; for the purposes of this analysis, total effort in May was divided evenly to obtain an effort estimate for the first half of May. In 2009, 899 fishing days were recorded during this time in this area, which is 4.97 percent of the total annual effort recorded in this area and 0.94 percent of the total annual effort for the inshore and 0-10 fathom components in the entire Gulf of Mexico basin.

According to statistics compiled from trip tickets (J. Primrose, NMFS SEFSC, pers. comm.), a total of 14,329 pounds of shrimp were harvested (i.e., by skimmer, butterfly, and otter trawler combined) during the time and from the area encompassed by this alternative in 2008; this data does not include catch by commercial fishermen sold through non-dealer channels. The value of this shrimp to each state was $12,860 for Mississippi and $32,856 for Alabama. As a result, this alternative would potentially represent a loss of approximately $45,716 to the Gulf of Mexico shrimp fisheries. When averaged across all inshore vessels, economic losses range from $39 per Mississippi vessel to $70 per Alabama vessel ($12,860 Mississippi shrimp value / 333 Mississippi inshore shrimp vessels = $39 loss per vessel; $32,856 Alabama shrimp value / 467 Alabama inshore shrimp vessels = $70 loss per vessel).

Additional consequences from this alternative would be similar to those discussed in Alternative 3a (e.g., potential effects to allied industries and support businesses). Compared to the other time/area closure alternatives, the consequences of this alternative would be the least severe due to the limited geographical scope and duration.

4.5.9 Summary of Socio-Economic Consequences

Table 23 below summarizes the potential economic effects of the various alternatives across state skimmer and butterfly trawl fisheries.

Table 23. Summary of economic effects of the various alternatives. Data for all inshore shrimp vessels in 2008 is derived from Miller et al. (2011); data for skimmer/butterfly vessels in 2008 originates from the GSS; and North Carolina data for skimmer trawl vessels in 2009 is from NCDMF statistics.

	LOUISIANA	MISSISSIPPI	ALABAMA	NORTH CAROLINA
ALTERNATIVE 2A				
ANTICIPATED NUMBER OF AFFECTED VESSELS	1,326	50	49	46
COST PER VESSEL FOR TED PURCHASE (2 @ $350)	$700	$700	$700	$700
COST TO FISHERY FOR TED PURCHASE (2 @ $350)	$928,200	$35,000	$34,300	$32,200
ANNUAL COST PER VESSEL FOR TED MAINTENANCE	$300	$300	$300	$300
ANNUAL COST TO FISHERY FOR TED MAINTENANCE	$397,800	$15,000	$14,700	$13,800
COST PER VESSEL FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$1,120	-	$1,061	$133
COST TO FISHERY FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$1,485,172	-	$52,011	$6,116
TOTAL COST PER VESSEL	$2,120	$1,000	$2,061	$1,133
TOTAL COST TO FISHERY	$2,811,120	$50,000	$100,989	$52,118
GRAND TOTAL COST TO FISHERY		$3,014,227		
ALTERNATIVE 2B				
ANTICIPATED NUMBER OF AFFECTED VESSELS	2,034	62	60	55
COST PER VESSEL FOR TED PURCHASE (2 @ $350)	$700	$700	$700	$700
COST TO FISHERY FOR TED PURCHASE (2 @ $350)	$1,423,800	$43,400	$42,000	$38,500
ANNUAL COST PER VESSEL FOR TED MAINTENANCE	$300	$300	$300	$300
ANNUAL COST TO FISHERY FOR TED MAINTENANCE	$610,200	$18,600	$18,000	$16,500
COST PER VESSEL FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$1,120	-	$1,061	$133
COST TO FISHERY FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$2,278,080	-	$63,687	$7,315
TOTAL COST PER VESSEL	$2,120	$1,000	$2,061	$1,133
TOTAL COST TO FISHERY	$4,312,080	$62,000	$123,660	$62,315
GRAND TOTAL COST TO FISHERY		$4,560,055		

ALTERNATIVE 2C				
ANTICIPATED NUMBER OF AFFECTED VESSELS	2,248	62	60	65
COST PER VESSEL FOR TED PURCHASE (2 @ $350)	$700	$700	$700	$700
COST TO FISHERY FOR TED PURCHASE (2 @ $350)	$1,573,600	$43,400	$42,000	$45,500
ANNUAL COST PER VESSEL FOR TED MAINTENANCE	$300	$300	$300	$300
ANNUAL COST TO FISHERY FOR TED MAINTENANCE	$674,400	$18,600	$18,000	$19,500
COST PER VESSEL FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$1,120	-	$1,061	$133
COST TO FISHERY FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$2,517,845	-	$63,687	$8,645
TOTAL COST PER VESSEL	$2,120	$1,000	$2,061	$1,133
TOTAL COST TO FISHERY	$4,765,845	$62,000	$123,687	$73,645
GRAND TOTAL COST TO FISHERY		$5,025,177		
ALTERNATIVE 3A				
COST PER VESSEL	$6,018	$243	$318	-
COST TO FISHERY	$13,769,882	$80,886	$148,736	-
GRAND TOTAL COST TO FISHERY		$13,999,504		
ALTERNATIVE 3B				
COST PER VESSEL	-	$44	$264	-
COST TO FISHERY	-	$14,775	$123,122	-
GRAND TOTAL COST TO FISHERY		$137,897		
ALTERNATIVE 3C				
COST PER VESSEL	$2,160	$39	$125	-
COST TO FISHERY	$4,942,672	$12,860	$58,470	-
GRAND TOTAL COST TO FISHERY		$5,014,002		
ALTERNATIVE 3D				
COST PER VESSEL	-	$39	$70	-
COST TO FISHERY	-	$12,860	$32,856	-
GRAND TOTAL COST TO FISHERY		$45,716		

4.6 SUMMARY COMPARISON OF ENVIRONMENTAL CONSEQUENCES

The proposed alternatives considered within this DEIS would require TED use or close fishing area during specific times to reduce the incidental bycatch and mortality of sea turtles in the shrimp fisheries. Relative to Alternative 1 (No-Action), Alternatives 3a-d have positive impacts on sea turtles, listed fish species and other marine life, and EFH, and Alternatives 2a-c would likely have positive impacts on sea turtles, though there is the possibility of negative impacts as discussed in Section 4.1.2, at least in the near term. All of the alternatives would have negative impacts on the economics of the shrimp fisheries. A summary comparison of the proposed alternatives is included in Table 24 below. Alternatives are qualitatively compared and ranked, with the lowest rank being the most beneficial; socio-economic impacts are ranked with the lowest rank having the least amount of impact on either the fishery as a whole or on an individual vessel.

Table 24. Summary comparison of environmental consequences of the proposed alternatives. A low score would result in the most beneficial effects to sea turtles and other species, and would result in the least amount of negative ecomonimc effects to the socio-economic environment.

	SEA TURTLES	MARINE MAMMALS	LISTED FISH	EFH	SOCIO-ECONOMICS
NO-ACTION	-	-	-	-	-
ALTERNATIVE 2A	3	-	3	-	FISHERY: 3 VESSEL: 3[1]
ALTERNATIVE 2B	2	-	2	-	FISHERY: 4 VESSEL: 3[1]
ALTERNATIVE 2C	1	-	1	-	FISHERY: 5 VESSEL: 3[1]
ALTERNATIVE 3A	4	1	4	1	FISHERY: 7 VESSEL: 7
ALTERNATIVE 3B	6	3	6	3	FISHERY: 2 VESSEL: 2
ALTERNATIVE 3C	5	2	5	2	FISHERY: 6 VESSEL: 6
ALTERNATIVE 3D	7	4	7	4	FISHERY: 1 VESSEL: 1

[1] Effects on individual vessels would be the same in Alternatives 2a - 2c.

4.7 CUMULATIVE EFFECTS ANALYSIS (CEA)

As directed by NEPA, federal agencies are mandated to assess not only the indirect and direct impacts, but cumulative impacts of actions as well. NEPA defines a cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 C.F.R. 1508.7). Cumulative effects can either be additive or synergistic. A synergistic effect is when the combined effects are greater than the sum of the individual effects.

This section uses an approach for assessing cumulative effects that is based upon guidance offered in CEQ (1997). The report outlines 11 items for consideration in drafting a CEA for a proposed action:

1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals.
2. Establish the geographic scope of the analysis.
3. Establish the timeframe for the analysis.
4. Identify the other actions affecting the resources, ecosystems, and human communities of concern.
5. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stress.

6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds.
7. Define a baseline condition for the resources, ecosystems, and human communities.
8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.
9. Determine the magnitude and significance of cumulative effects.
10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.
11. Monitor the cumulative effects of the selected alternative and adapt management.

Cumulative effects on the biophysical environment, socio-economic environment, and administrative environments are analyzed below.

4.7.1 Significant Cumulative Effects Issues Associated With the Proposed Action and Assessment Goals

The CEQ cumulative effects guidance states this step is accomplished through three activities as follows:

A. The direct and indirect effects of the proposed actions (Section 4);
B. Which resources, ecosystems, and human communities are affected (Section 3); and
C. Which effects are important from a cumulative effects perspective (information revealed in this CEA)

Valued environmental components (VECs) are "any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern" (CEAA 1999). Specifically, the important VECs for this analysis include: (1) sea turtles; (2) other ESA- and MMPA-listed species; (3) EFH; and (4) socio-economic environment relative to the shrimp fisheries. These are discussed in the sections that follow.

4.7.1.1 Cumulative Effects on Sea Turtles

Section 1.2.3 presents the numerous actions that cause injuries or mortalities to sea turtles, establishing the baseline. Below are past and present actions that are likely to continue to affect sea turtles in the foreseeable future.

4.7.1.1.1 Vessel Operations

There is the potential for adverse effects from vessels operating in the geographic area of the southeastern U.S. shrimp fisheries from the shoreline to the outer boundary of the EEZ. These include federal, private, and commercial vessels. Federal vessels include the U.S. Navy and U.S. Coast Guard, who maintain the largest federal fleet, as well as the EPA, NOAA, and the U.S. Army Corps of Engineers. Formal consultations pursuant to Section 7 of the ESA have been conducted with the U.S. Coast Guard and the U.S. Navy, and NMFS is currently in the early phases of consultation with other federal agencies on their vessel operations. These consultations have evaluated the impacts of vessel operations on listed species throughout the Atlantic. The operation of federal vessels in the area may result in collisions with sea turtles resulting in subsequent injury or mortality.

Private and commercial vessels also have the potential to interact with sea turtles. These activities may result in the lethal (e.g., boat strike) and non-lethal (e.g., harassment) takes of listed species that could prevent or slow a species' recovery. The magnitude of these interactions is not currently known. The STSSN's reports include evidence of vessel interactions (e.g., carapace damage from propeller and skeg impact injuries) with sea turtles. It is not known how many of these injuries occur pre- or post-mortem. It is likely that the interactions with commercial and recreational vessels result in a higher level of sea turtle mortality than what is documented, since some carcasses would not reach the beach. Minor vessel collisions may cause injuries that weaken or otherwise affect sea turtles that can then become vulnerable to predation, disease, and other natural or anthropogenic hazards.

Collisions between commercial fishing vessels and sea turtles, or adverse effects resulting from disturbance, have been documented. However, fishing vessels represents only a portion of marine vessel activity. Due to reduction in vessel speed during fishing operations, collisions are more likely when vessels are in transit. As fishing vessels are smaller than large commercial tankers and container ships, and less fast and agile than recreational speed boats, collisions are less likely to result in mortality.

Commercial fishing vessel activity is not likely to increase in the foreseeable future within the Gulf of Mexico or along the Atlantic coast. While allowable catch levels may increase as fish stocks are rebuilt, associated increases in catch rates may preclude the need to increase effort to obtain allowable catch. Conversely, recreational vessel activity may increase as populations on the coast continue to grow and access to the ocean increases. Vessels (federal and private, commercial and recreational) will continue to operate in the area for the foreseeable future, and the impacts described above will likely persist.

Sea turtles may also be affected directly or indirectly by fuel oil spills. Fuel spills involving fishing vessels are common events. However, these spills are typically small amounts that are unlikely to affect listed species unless they occur adjacent to nesting beaches or in foraging habitats. Larger spills may result from accidents, although these events are rare and generally involve small areas. Fuel spills may impact nesting beaches, bottom habitat and benthic resources, but it is unknown to what extent oil releases from recreational and commercial vessels or shoreline activities such as fueling facilities may affect sea turtles in migratory or foraging areas. Immediately after an oil release, direct contact with petroleum compounds or dispersants used to respond to spills may cause skin irritation, chemical burns, and infections (Lutcavage et al. 1995). Inhalation of volatile petroleum vapors can irritate lungs and dispersants have a surfactant effect that may further irritate or injure the respiratory tract, which may lead to inflammation or pneumonia (Shigenaka et al. 2010). Ingestion of petroleum compounds may remain in the turtle's digestive system for days (Van Vleet and Pauly 1987), which may affect the animals' ability to absorb or digest foods. Absorption of petroleum compounds or dispersants may damage liver, kidney, and brain function as well as causing anemia and immune suppression as seen in seabirds that have ingested and absorbed petroleum compounds (Shigenaka et al. 2010). Exposure to an oil release can cause long-term chronic effects such as decreased survival and lowered reproductive success may occur.

Persistent petrochemical products in the marine environment are frequently encountered by sea turtles. Tarballs are frequently observed sealing the mouths and nostrils of small sea turtles. Witherington (1994) found evidence of tar in the gastro-intestinal tracts of over one-third of the post-hatchling sea turtles examined offshore of Florida in 1993 and evidence of tar ingestion was documented in 20 percent of neonate loggerhead sea turtles examined along the Gulf Stream (Witherington 2002). Van Vleet and Pauly (1987) concluded that the source of tar observed on stranded sea turtles the Gulf of Mexico originated from crude oil tanker discharges and have a significant impact on marine turtles in the eastern Gulf of Mexico.

Threats of oil releases and discharges from vessels are greatest in port areas, shipping lanes, and areas of heavy recreational vessel use. Oil releases caused by oil and gas development and transportation activities, as well as oil releases from vessels or shoreline activities such as fueling facilities adjacent to nesting beaches, may directly affect sea turtles and nesting beaches. During the decade between 1992 and 2001, sea turtles were identified as resources at risk in 73 oil releases. Nine of these releases occurred along Florida's Atlantic coast (Milton et al. 2003). The continued exposure of sea turtles and other living marine resources due to vessel and land based oil releases is likely to continue into the future. There is no basis to conclude that the level of interaction represented by the various vessel activities that would occur under the preferred alternative would be detrimental to the existence of biological resources considered with the proposed action.

4.7.1.1.2 Fishery Operations

Several commercial fisheries in the broader geographical area use gear that is known to capture, injure, and/or kill sea turtles. Many of these fisheries have been considered in Section 7 consultations and in some cases have been regulated (Table 2) to reduce their effects on sea turtles and other listed species. These are discussed in Section 3.2.4. In general, fisheries that use gillnet, hook and line, longline, trawl, seine, dredge, and trap gear have been documented as unintentionally capturing or entangling sea turtles.

Specific to the Gulf of Mexico, several commercial fisheries use gear that are known to interact with sea turtles. For all fisheries for which there is an FMP or for which any federal action has been taken to manage the fishery, impacts have been evaluated through the ESA Section 7 process. Formal opinions conducted on Gulf of Mexico fisheries include: Southeast shrimp trawl; Atlantic HMS pelagic longline; HMS directed shark; Gulf of Mexico reef fish; and coastal migratory pelagic resources fisheries. Anticipated take levels associated with these actions are presented in Table 25; the take levels reflect the impact on sea turtles and other listed species of each activity anticipated from the date of the ITS forward in time. However, there are other fisheries in the area not subject to Section 7 consultations as they operate solely in state waters or have not been subject to a federal management action. Various fishing methods used in state fisheries are known to incidentally take listed species, including trawls, pot and trap, flynets, and gillnets (NMFS 2001). At this time, the past and current effects of these fisheries on sea turtles cannot be quantified.

Table 25. Summary of sea turtle incidental take levels authorized under ITS associated with NMFS' opinions for current federal fisheries occurring in the Gulf of Mexico EEZ.

FISHERY	OPINION	ITS PERIOD	SEA TURTLE TAKE (LETHAL) BY SPECIES				
			LOGGERHEAD	LEATHERBACK	KEMP'S RIDLEY	GREEN	HAWKSBILL
Southeastern U.S. Shrimp[1]	2002	Annual	163,160 (3,948)[2]	3,090 (80)[2]	155,503 (4,208)[2]	18,757 (514)[2]	640 (640)[2]
Atlantic Pelagic Longline[3]	2004	3-Year	1,905 (339)	1,764 (252)	105 combined (18)		
Atlantic HMS Shark Fisheries[3]	2008	3-Year	679 (346)	74 (47)	2 (1)	2 (1)	2 (1)
Gulf Reef Fish	2005	3-Year	203 (78)	20 (9)	3 (1)	51 (21)	44 (13)
Coastal Migratory Pelagic[4]	2007	Annual	33 (33)	2 (2)	4 (4)	14 (14)	2 (2)
South Atlantic/Gulf Spiny Lobster[5]	2009	3-Year	3 (3)	1 (1)	1 (1)	3 (3)	1 (1)

[1] The southeastern U.S. shrimp fisheries analyzed for its effects on sea turtles occurs in state and federal (i.e. EEZ) waters in both the Atlantic and Gulf of Mexico.
[2] The incidental take authorized in this opinion is based on 1997-2001 effort; current effort in the Gulf is at least 50 percent less; estimates do not include skimmer trawl captures or effects of poor compliance.
[3] The Atlantic pelagic longline fishery and Atlantic shark fisheries action areas both include the Atlantic, Gulf, and Caribbean EEZ.
[4] The coastal migratory pelagic fishery action area includes Atlantic and Gulf of Mexico EEZ waters.
[5] The federal spiny lobster fishery, managed jointly by the GMFMC and SAFMC under the SLFMP, occurs throughout the South Atlantic and Gulf of Mexico regions.

Sea turtles have also been caught on recreational hook and line gear. While most interactions are likely not reported, from January 1 through August 31, 2011, 28 incidental hook and line captured Kemp's ridley sea turtles were reported in Louisiana, Mississippi, and Alabama (STSSN database); it is believed most, if not all of these were incidentally caught by recreational fishermen. These animals were typically reported alive, and while the hooks should be removed whenever possible if it would not further injure the turtle, NMFS suspects that the turtles are probably often released with fishing tackle still hooked in the animal. Entanglement in monofilament left behind by recreational fishermen is commonly reported for sea turtles stranded in Florida (STSSN database). In a Section 7 consultation on the recreational component of SAFMC's Snapper Grouper FMP, analysis of private angler and charter boat (non-headboat) snapper-grouper fishing effort (MRFSS and Headboat Survey 2001-2003 data) resulted in an estimate that the fishery could take (by entanglement or ingested hook) up to 185 hardshell sea turtles in three years of effort (NMFS 2006). While most turtles are released alive, post release mortality, particularly when hooks have been ingested, is possible.

Summary of Fishery Interactions

A wide range of fisheries in the region employ gear that is known to capture, injure, and/or kill sea turtles. Due to the complex life history of sea turtles, these fisheries impact different life stages of sea turtles depending on the temporal and spatial extent of the fishery. The Loggerhead Biological

Review Team determined that the greatest threat to the Northwest Atlantic loggerhead DPS was cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009). Cumulative impacts from fisheries operations have had a negative impact on sea turtle populations in the past and present, and are likely to continue to impact sea turtles in the reasonably foreseeable future.

4.7.1.1.3 Dredging Operations and Beach Nourishment

The construction and maintenance of federal navigation channels have caused sea turtle mortalities. Hopper dredges can entrain and kill sea turtles. Dredging may also alter foraging habitat and relocation trawling associated with the project may injure or kill sea turtles and displace the turtles out of their preferred habitat. Whole sea turtles and sea turtle parts have been taken in hopper dredging operations from New York through Florida. Between 1980 and 2003, the last time a comprehensive report was prepared by the COE, 475 documented incidents of sea turtle interactions during dredging activities in 34 channels from New York to Texas were documented. Most sea turtle encounters with hopper dredges result in serious injuries or mortalities. Through the Section 7 consultation process, seasonal restrictions have been implemented on dredging have been required, observers monitor hopper dredge activities to ensure projects stay within incidental take estimates, and hopper dredge deflectors and relocation trawling are conducted to reduce sea turtle captures, injuries and mortalities

The shorelines from North Carolina through Texas provide important nesting habitat for sea turtles; particularly for loggerheads. Due to beach erosion in some winters, dredged materials are commonly borrowed from offshore shoals to deposit onto beaches, generally for recreational purposes. Sea turtles can be impinged by the dredges at the borrow sites, nesting success can be reduced by inappropriate quality sand deposited onto nesting beaches, or nests can be directly injured by sand deposited over nests. Georgia, South Carolina, Florida and the USFWS have implemented seasonal restrictions and other protective conditions to reduce the effects of dredging, beach stabilization, and nourishment projects on sea turtles. Dredging and beach nourishment impacts to sea turtles are likely to continue into the foreseeable future.

4.7.1.1.4 Power Plants

Power plants can pose a danger of injury and mortality to sea turtles. In Florida, thousands of sea turtles have been entrained with cooling water pulled in from the Atlantic Ocean in the St. Lucie Nuclear Power Plant's intake canal over the past couple of decades (Bresette et al. 2003). Most of the entrained turtles are net captured and released, and mortality rates have remained below 1 percent since 1990 (Bresette et al. 2003). Based on past levels of impingement, the distribution of the species, and the operation of the facility, NMFS anticipates that hundreds of sea turtles will continue to be entrained at the St. Lucie Plant annually, but with few mortalities.

4.7.1.1.5 Marine Pollution and Water Quality Issues, Including the DWH Oil Spill Event

Sources of pollutants within the geographic scope of the proposed action include atmospheric loading of pollutants such as polychlorinated biphenyls (PCBs), storm water runoff, groundwater discharges, sewage treatment effluent, and oil spills. Chemical contaminants may have an effect on marine species' reproduction and survival. It has been well established that organochlorine (OC) compounds, including PCBs and OC pesticides, bioaccumulate in animal tissues. A study of 48 loggerhead sea turtles collected in Core Sound, North Carolina, provided the first evidence that OC contaminants may be affecting sea turtle health. Significant correlations between OC levels and health parameters for a wide range of biological functions were found. This relationship is strictly correlative and further studies are required to determine precise causal relationships between the contaminants and health effects in sea turtles (Keller et al. 2004). While the effects of contaminants on sea turtles are relatively unclear at this time, pollution may also make sea turtles more susceptible to disease by weakening their immune system.

Marine debris (discarded fishing line, lines from boats, plastics) can entangle sea turtles and drown them. Turtles commonly ingest plastic or mistake debris as food, as observed with the leatherback sea turtle. The leatherback's preferred diet includes jellyfish, but similar looking plastic bags are often found in the turtle's stomach content.

Excessive turbidity due to coastal development and/or construction could influence marine resources, including the sea turtle foraging ability. Turtles are not very easily directly affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, they might eventually tend to leave or avoid these less desirable areas (Ruben and Morreale 1999).

The Gulf of Mexico is a particularly active area for oil and gas exploration and extraction. As a result, oil and chemical spills have occurred over the years that have impacted the environment. Numerous small-scale releases have occurred within the region over the past, and are likely to continue into the future. Significant, large-scale events also occur on occasion. The April 2010 DWH oil spill event is one of the most significant events to occur in recent years. Official estimates are that 4.9 million barrels of oil were released into the Gulf of Mexico during this event, with some experts estimating even higher volumes. Additionally, approximately 1.84 million gallons of chemical dispersant was applied both subsurface and on the surface to attempt to break down the oil. There is no question that the unprecedented DWH oil spill event and associated response activities (e.g., skimming, burning, and application of dispersants) have resulted in adverse effects on listed sea turtles. Gulf sturgeon and smalltooth sawfish may also be adversely affected by oil, but at this time there is no evidence documenting effects on these species from this particular oil spill.

The overall effects of the DWH oil spill event on species found throughout the Gulf of Mexico, including ESA-listed sea turtles, are not currently known. Presently, there is an ongoing investigation and analysis being conducted under the National Resource Damage Assessment (NRDA) program, but the final outcome of that investigation may not be known for many months to years from the time of this DEIS. Additionally, the NRDA evaluation focuses primarily on attempting to quantify injuries, in order to determine how those injuries can be compensated, and does not necessarily result in an understanding of the population-level impacts to a species. Ultimately, restoration efforts that occur as part of the legal requirement stemming from the spill will help to offset at least some of the losses experienced by the species, but just as the impacts from the spill are not yet known, the success of any future restoration efforts is also unknowable at this time.

As of February 15, 2011, a total of 1,146 sea turtles have been documented as stranded or collected during response efforts in the spill area. Up through October 20, 2010, all stranded or distressed turtles found in the area were included on the list, regardless of evidence of oil exposure. Subsequent to that, only confirmed visibly-oiled animals were added to the list. The available data on sea turtle strandings and response collections during the time of the spill are expected to represent an unknown fraction of the actual losses to the species, as most individuals likely were never recovered. It also does not provide insights into potential sub-lethal impacts that could reduce long-term survival or fecundity of individuals affected. However, it does provide some insight into the potential relative scope of the impact among the sea turtle species in the area. It appears that Kemp's ridley sea turtles may have been the hardest hit species, as they accounted for almost 71 percent of all stranded/collected turtles, and 79 percent of all dead turtles. Green sea turtles represented the second highest number of total individuals found, at 17.5 percent, but only 4.8 percent of the dead individuals. Loggerheads comprised only 7.7 percent of the total individuals, and 11 percent of the total dead. The remaining turtles were hawksbills and dead unidentified turtles; no leatherbacks were counted among the stranded/collected turtles in the spill area. Table 26 summaries the sea turtles documented during the DWH oil spill event.

Table 26. Sea turtles documented in the DWH oil spill area.

SEA TURTLE SPECIES	ALIVE	DEAD	TOTAL
Green sea turtle (*Chelonia mydas*)	172	29	201
Hawksbill sea turtle (*Eretmochelys imbricata*)	16	0	16
Kemp's ridley sea turtle (*Lepidochelys kempii*)	328	481	809
Loggerhead sea turtle (*Caretta caretta*)	21	67	88
Unidentified turtle species	0	32	32
TOTAL	537	609	1146

(http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm)

In addition to the direct effects on subadult and adult sea turtles, the May through September sea turtle nesting season in the Northern Gulf of Mexico may also have been adversely affected by the DWH oil spill event. Setting booms to protect beaches may have had unintended effects, such as preventing females from reaching nesting beaches and thereby reducing nesting. However, there is almost no sea turtle nesting in Louisiana, and limited nesting in Mississippi, which is where most of the booming of the coastline in response to the oils spill occurred, thus such effects were likely very minimal.

The oil spill may also have adversely affected hatchling success. In the Northern Gulf of Mexico, approximately 700 nests are laid annually in the Florida Panhandle and up to 80 nests are laid annually in Alabama. Most nests are made by loggerhead sea turtles; however, a few Kemp's ridley and green sea turtle nests have also been documented in 2010. Hatchlings begin emerging from nests in early to mid-July, with approximately 50,000 hatchlings anticipated to be produced from Northern Gulf of Mexico nests in 2010. To avoid the loss of most, if not all, of this year's Northern Gulf of Mexico hatchling cohort, all sea turtle nests laid along the Northern Gulf of

Mexico coast were visibly marked to ensure that nests were not harmed during oil spill cleanup operations that are undertaken on beaches. Additionally, a late-term nest collection and hatchling release plan was implemented to provide the best possible protection for sea turtle hatchlings emerging from nests in Alabama and the Florida Panhandle. Starting in June, these nests were relocated to the Atlantic to provide the highest probability of reducing the anticipated risks to hatchlings as a result of the DWH oil spill event. A total of 274 nests, all loggerheads except for 4 green and 5 Kemp's ridley sea turtle nests, were translocated from the Northern Gulf of Mexico to the east coast of Florida so that the hatchlings could be released in areas not affected by the oil spill. In mid-August, it was determined that the risks to hatchlings emerging from beaches and entering waters off the coast of Franklin and Gulf Counties (Florida) had diminished significantly. Nest excavations continued west of the St. Joseph Peninsula for several more weeks. Table 27 summarizes the number of translocated nets and released hatchlings.

Table 27. Number of turtle nests translocated from the Northern Gulf of Mexico coast and hatchlings released in the Atlantic Ocean. The sea turtle nest translocation effort ceased on August 19, 2010.

TURTLE SPECIES	TRANSLOCATED NESTS	HATCHLINGS RELEASES
Green sea turtle (*Chelonia mydas*)	4	455
Kemp's ridley sea turtle (*Lepidochelys kempii*)	5	125
Loggerhead sea turtle (*Caretta caretta*)	265*	14,216

*Does not include one nest that included a single hatchling and no eggs (http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm).

The survivorship and future nesting success of individuals from one nesting beach being transported to and released at another nesting beach is unknown. Although the loggerheads nesting and emerging from nests in the Florida Panhandle and Alabama are part of the Northern Gulf of Mexico Recovery Unit and differ genetically from loggerheads produced along the Atlantic Coast of Florida, they are part of the same currently proposed Northwest Atlantic DPS. Evidence suggests that some portion of loggerheads produced on Northern Gulf of Mexico beaches are transported naturally into the Atlantic by currents and spend portions of their life cycle away from the Gulf of Mexico. This is based on the presence of some loggerheads with a Northern Gulf of Mexico genetic signature in the Atlantic. These turtles are assumed to make their way back to the Gulf of Mexico as subadults and adults. Therefore it was determined that transporting them would provide at least some possibility of success, versus a likely complete loss of the nests on the natal beaches due to oil impacts.

Gulf of Mexico loggerhead nesting represents a small proportion of overall Florida loggerhead nesting and an even smaller proportion of the proposed Northwest Atlantic DPS. For comparison, the 5-year average (2006-2010) for the statewide number of loggerhead nests in the state of Florida is 56,483 nests annually (FFWCC nesting database). As previously stated, we do not know what the impact of relocating 265 nests will be on this year's nesting cohort compared to the total of approximately 700 nests laid on Northern Gulf of Mexico beaches. Although some additional mortality beyond natural levels must be expected, translocating these nests has given the greatest number of hatchlings the best opportunity to survive and contribute to the ongoing recovery of their species. While there may be a risk of possible increased gene flow across loggerhead recovery units, it is not outside the proposed Northwest Atlantic DPS and would likely not be on a scale of conservation concern.

Kemp's Ridley Sea Turtles

As noted earlier, the vast majority of sea turtles collected in relation to the DWH oil spill event were Kemp's ridleys, including 328 live and 481 dead individuals. We expect that additional mortalities occurred that were undetected and, therefore, currently unquantifiable. It is likely that the Kemp's ridley sea turtle was also the species most impacted by the DWH oil spill event on a population level. Relative to the other species, Kemp's ridley populations are much smaller, yet observed strandings and collections related to DWH oil spill event were higher. The location and timing of the DWH oil spill event were also an important factor. Although significant seasonal juvenile populations occur in some areas of the U.S. Atlantic coast, Kemp's ridley sea turtles utilize the Gulf of Mexico as their primary habitat for most life stages, including all of the nesting and mating. As a result, all mating and nesting adults in the population necessarily spend significant time in the Gulf of Mexico, as do all hatchlings as they leave the beach and enter the currents. However, not all of those individuals will necessarily have encountered oil and/or dispersants, depending on the timing and location of their movements relative to the location of the subsurface and surface oil. In addition to mortalities, the effects of the spill may have included disruptions to foraging and resource availability, migrations, and other unknown effects as the spill began in late April just before peak mating/nesting season (May-July). These impacts may have played a part in the steep drop in nesting during the 2010 season after decades of significant increases, as described in Section 3.2.3. Nesting rebounded in 2011, but there may yet be long-term population impacts resulting from the reduced nesting year. Preliminary simple population impact modeling has suggested that the DWH oil spill event will likely slow the population recovery that we have been seeing, but that there is reason for cautious optimism for the resilience of the species if high survival rates can be quickly restored (Crowder and Heppell 2011). How quickly the species returns to the previous fast pace of recovery may also depend in part on how much of an impact the DWH oil spill event has had on Kemp's ridleys' food resources (Crowder and Heppell 2011).

Loggerhead Sea Turtles

As presented earlier, as of February 15, 2011, 88 loggerhead sea turtles have been documented within the designated spill area; 67 were dead and 21 were alive. There were likely additional mortalities that were undetected and, therefore, currently unquantifiable. Although it is expected that the effects of the DWH oil spill event on loggerheads was significant, it likely was not as severe on a population level as it was for Kemp's ridleys. In comparison to Kemp's ridleys, the population size is many times larger, the observed strandings and mortalities linked to the DWH oil spill event are much smaller in absolute numbers, and the relative proportion of the population exposed to the effects of the event was much smaller. Additionally, unlike Kemp's ridleys, the majority of nesting for the Northwest Atlantic loggerhead DPS occurs on the Atlantic coast. It is possible that impacts to the Northern Gulf of Mexico Recovery Unit of the Northwest Atlantic loggerhead DPS would be proportionally much greater than the impacts occurring to other recovery units because of impacts to nesting (as described above) and a larger proportion of that recovery unit, especially mating and nesting adults, being exposed to the spill. However, the impacts to that recovery unit, and the possible effect of such a disproportionate impact on that small recovery unit to the Northwest Atlantic DPS and the species, remain unknown.

Green Sea Turtles

Green sea turtles comprised the second-most common species collected as part of the DWH oil spill response, with 201 individuals. However, only 29 of those were found dead or later died during attempts at rehabilitation. The mortality number is lower than that for loggerheads despite loggerheads having far fewer total strandings. While green turtles regularly utilize the Northern Gulf of Mexico, they have a wide spread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic. As described in Section 3.2.1, nesting is also relatively rare along the Northern Gulf of Mexico beaches. Therefore, similar to loggerhead sea turtles, while it is expected that impacts were significant, the relative proportion of the population that is expected to have been exposed to and impacted by the DWH oil spill event, and thus the population-level impact, is much smaller than for Kemp's ridleys.

Hawksbill and Leatherback Sea Turtles

Presently available information indicates hawksbill and leatherback sea turtles appear to be least affected by the DWH oil spill event. No leatherbacks and only 16 hawksbills (all alive) were counted among the stranded and response-collected sea turtles. Hawksbills do not typically utilize the Northern Gulf of Mexico in large numbers, and thus population-level effects from the spill are expected to be negligible. Leatherbacks rarely nest along the Gulf of Mexico coast, but do utilize the offshore waters. Potential DWH oil spill event related impacts to leatherback sea turtles could include ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources. There is no information available to determine the extent of those impacts, if they occurred. However, leatherback prey species are typically jellyfish and other cnidarians, salps, and tunicates, which occur in great abundance throughout much of the Gulf of Mexico and tend to be fast-reproducing species.

4.7.1.1.6 Climate Change

Many threats to sea turtles on land are expected to be exacerbated by the effects of global climate change (NMFS and USFWS 2007a, 2007b, 2007c, 2007d). Potential increases in sea level of approximately 4.2 mm (1.65 in) per year until 2080 might remove available nesting beaches, particularly on narrow low-lying coastal and inland beaches and on beaches where coastal development has occurred (Church et al. 2001; IPCC 2007; Nicholls 1998; Fish et al. 2005; Baker et al. 2006; Jones et al. 2007; Mazaris et al. 2009). Additionally, global climate change may affect the severity of extreme weather (e.g., hurricanes), potentially generating more intense storms and associated erosion or damage to sea turtle nests and/or nesting sites (Goldenburg et al. 2001; Webster et al. 2005; IPCC 2007). The cyclical loss of nesting beaches resulting from extreme storm events may then result in a decrease in hatching success and hatchling emergence (Martin 1996; Ross 2005; Pike and Stiner 2007; Prusty et al. 2007; Van Houton and Bass 2007). However, there is evidence that, depending on the species, those species with lower nest site fidelity (e.g., leatherbacks) would be less vulnerable to storm related threats than those with a higher site fidelity (e.g., loggerheads). In Guiana, leatherbacks have continued to nest despite the loss of beaches between nesting years (Pike and Stiner 2007; Witt et al. 2008; Plaziat arid Augustinius 2004; Girondot and Fretey 1996; Rivalan et al. 2005; Kelle et al. 2007).

Changes in air and beach temperatures can affect sea turtles at the population level. The sex of hatchlings is determined by temperatures during the middle third of incubation, with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35°C (Ackerman 1997). Based on modeling, a 2°C increase in air temperature is expected to result in a loggerhead sea turtle sex ratio of over 80 percent female offspring for loggerhead nesting beaches in the vicinity of Southport, North Carolina. Farther to the south at Cape Canaveral, Florida, a 2°C increase in air temperature would likely result in production of 100 percent females while a 3°C increase in air temperature would likely exceed the thermal threshold of turtle clutches (i.e., greater than 35°C) resulting in death (Hawkes et al. 2007). Glen et al. (2003) also reported that, for green sea turtles, incubation temperatures also appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures; however, it is unknown whether this effect is species specific and what impact it has on the survival of the offspring. Changes in air temperature as a result of global climate change may alter sex ratios and may reduce hatchling production in the most southern nesting areas of the United States (Hawkes et al. 2007; Hamann et al. 2007). Given that the south Florida nesting group is the largest loggerhead nesting group in the Atlantic (in terms of nests laid), a decline in the success of nesting as a result of global climate change could have profound effects on the abundance and distribution of the loggerhead species in the Atlantic, including the action area. However; variations of sex ratios to incubation temperature between individuals and populations is not fully understood. As such, it is unclear whether sea turtles will (or can) adapt behaviorally to altered incubation conditions to counter potential feminization or death of clutches associated with incubation temperatures such as choosing nest sites that are located in cooler areas (e.g., shaded areas of vegetation or higher latitudes) or nesting earlier or later during cooler periods of the year (Hawkes et al. 2009).

Global climate change effects in the marine environment are anticipated to affect sea turtles in the Northwest Atlantic. Changes in water circulation may occur. Changes in the Gulf Stream would have profound effects on every aspect of Northwest Atlantic sea turtle life history from hatching success, oceanic migrations at all life stages, foraging, and nesting (Gagosian 2003; NMFS and USFWS 2007a, 2007b, 2007c, 2007d; Rahmstorf 1997, 1999; Stocker and Schmittner 1997). Thermocline circulation patterns are expected to change in intensity and direction with changes in temperature and freshwater input at the poles (Rahmstorf 1997; Stocker and Schmittner 1997). This will potentially affect not only hatchlings that rely on passive transport in surface currents for migration and dispersal but also pelagic adults (e.g., leatherbacks) and juveniles that depend on current patterns and major frontal zones in obtaining suitable prey, such as jellyfish (Hamann et al. 2007; Hawkes et al. 2009).

Prey availability may also be affected by changes in water temperatures and currents. Seagrasses could ultimately be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Short and Neckles 1999; Bjork 2008), as well as increased runoff due to the expected increase in extreme storm events as a result of global climate change. These alterations of the marine environment due to global climate change could ultimately affect the distribution, physiology, and growth rates of seagrasses, potentially eliminating them from particular areas. However, the magnitude of these effects on seagrass beds, and on the herbivorous green sea turtles that forage on them are difficult to predict. Some populations of green sea turtles appear to specialize in the consumption of algae (Bjorndal 1997) and mangroves (Limpus and Limpus 2000), suggesting green turtles may be able to substitute other available forage species. Changes to benthic communities as a result of changes to water temperature may affect omnivorous species such as Kemp's ridley and loggerhead sea turtles; however, these species are less likely to suffer shortages of prey than species like green sea turtles with more specific diets (Hawkes et al. 2009).

Several studies have also investigated the effects of changes in SST and air temperatures on turtle reproductive behavior. For loggerhead sea turtles, warmer SSTs in the spring have been correlated to an earlier onset of nesting (Weishampel et al. 2004; Hawkes et al. 2007), shorter internesting intervals (Hays et al. 2002), and a decrease in the length of the nesting season (Pike et al. 2006). Green sea turtles also exhibited shorter internesting intervals in response to warming water temperatures (Hays et al. 2002).

Ocean acidification related to global climate change would also reasonably be expected to negatively affect sea turtles. The term "ocean acidification" describes the process of ocean water becoming corrosive as a result of carbon dioxide (CO_2) being absorbed from the atmosphere. The absorption of atmospheric CO_2 into the ocean lowers the pH of the waters, decreasing the effects of global climate change; however the resulting change in ocean chemistry could adversely affect marine life, particularly organisms with calcium carbonate shells such as corals, mussels, mollusks, small creatures in the lower levels of the food chain, (reviewed in Guinotte and Fabry 2008), affecting as well the higher organisms such as sea turtles that rely on these species as prey. Sea grasses may benefit from extra atmospheric CO_2, affording some benefit to green turtles (Guinotte and Fabry 2008). Fully monitoring ocean acidification in the Atlantic and understanding the effects of climate change on listed species of sea turtles will require expansion of existing monitoring programs and development of conceptual and predictive models. Continued acquisition and maintenance of long-term data sets on sea turtle life history and responses to environmental changes will be needed to apply and maintain these models. At this time, the type and extent of effects to sea turtles of ocean acidification and other results of global climate change on sea turtles cannot, for the most part, be accurately predicted.

4.7.1.1.7 Conservation and Recovery Actions Impacting Sea Turtles

In addition to the sea turtle conservation measures listed in Table 2 (Section 3.2.4), a number of activities are in progress that ameliorate some of the negative impacts on marine resources, sea turtles in particular, posed by the activities summarized above. Education and outreach are considered one of the primary tools to reduce the risk of collision represented by the operation of federal, private, and commercial vessels.

NMFS' regulations require fishermen to handle sea turtles in such a manner as to prevent injury. Any sea turtle taken incidentally during fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to a series of procedures (50 CFR 223.206(d)(1)). NMFS has been active in public outreach efforts to educate fishermen regarding sea turtle handling and resuscitation techniques. NMFS has also developed a recreational fishing brochure that outlines what to do should a sea turtle be hooked and includes recommended sea turtle conservation measures. These outreach efforts will continue in an attempt to increase the survival of protected species through education on proper release guidelines.

There is an extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts. This network not only collects data on dead sea turtles but also rescues and rehabilitates live stranded turtles. Data collected are used to monitor stranding levels and identify areas where unusual or elevated mortality is occurring. The data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All states that participate in the STSSN are collecting tissue for genetic studies to better understand the population dynamics of the northern subpopulation of nesting loggerheads. These states also tag live turtles when encountered through the stranding network or in-water studies. Tagging studies help provide an understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

There is an organized formal program for at-sea disentanglement of sea turtles. Entangled sea turtles found at sea in recent years have been disentangled by STSSN members, the whale disentanglement team, the USCG, and fishermen. NMFS has developed a wheelhouse card to educate fishermen and recreational boaters on the sea turtle disentanglement network and disentanglement guidelines. A final rule published on July 25, 2005 (70 FR 42508), allows any agent or employee of NMFS, the USFWS, the U.S. Coast Guard, or any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead entangled sea turtle, or salvage a dead endangered sea turtle for scientific or education purposes. NMFS affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

Sea turtle nest and beach habitat protection efforts in the United States occur from North Carolina through Texas, particularly on the most valuable nesting areas. Important sea turtle nesting beaches, encompassing 25 percent of all U.S. loggerhead sea turtle nesting, has been acquired and designated as the Archie Carr National Wildlife Refuge in Florida. South Carolina, Georgia, and Florida have developed lighting ordinances and voluntary measures to reduce the disorienting effects of artificial lights on hatchlings. Most major nesting beaches within the continental United States employ predator control measures to protect sea turtle nests. Additionally, throughout the southern United States, efforts to eradicate exotic plants that contribute to beach erosion or that diminish nesting beach suitability are ongoing. Beach cleaning activities, which require state permits, are conditioned to minimize their effects on nesting sea turtles, nests, and hatchlings. Beach vehicular driving is prohibited on most U.S. nesting beaches. In Volusia County, Florida, where beach driving is still allowed, driving is restricted to daylight hours, in areas where nest densities are lowest and on the lower beach below sea turtle nests which must be well marked.

4.7.1.2 Cumulative Effects on Marine Mammals

As discussed in Section 3.3, marine mammal interactions in the shrimp fisheries are infrequent events. While effort may decrease or be redistributed under the alternatives considered within this DEIS, none of the alternatives are expected to result in additional impacts to marine mammals. The time/area alternatives may result in an absence of shrimp fisheries effort in specific areas during specific times, however, overall effort during the course of a year is not expected to change significantly.

There are many other fisheries aside from the southeastern U.S. shrimp fisheries that may impact marine mammal species within the Gulf of Mexico and Atlantic Ocean. While some marine mammal species, such as the North Atlantic right whale, may be especially vulnerable to incremental effects due to low stock size, because they generally do not occur in areas and times where the shrimp fisheries are prosecuted this does not appear to be a significant concern, either singularly (i.e., shrimp fisheries as a whole) or when combined with other anthropogenic effects.

4.7.1.3 Cumulative Effects on Listed Fish and Other Marine Species

There have been documented take of Atlantic, Gulf, and shortnose sturgeon, as well as smalltooth sawfish, in the shrimp fisheries. The preferred alternative, as well as the time/area closures, may have beneficial effects on these listed (or proposed for listing) species, as well as other marine species. While effort may decrease or be redistributed under the alternatives considered within this DEIS, none of the alternatives are expected to result in additional impacts to listed fish species. The time/area alternatives may result in an absence of shrimp fisheries effort in specific areas during specific times, however, overall effort during the course of a year is not expected to change significantly.

There are many other fisheries aside from the southeastern U.S. shrimp fisheries that may impact listed fish and other marine species within the Gulf of Mexico and Atlantic Ocean. While some listed fish species, such as the Gulf sturgeon, may be especially vulnerable to incremental effects due to constricting habitat availability, it is expected that the alternatives considered in this DEIS would be beneficial in light of cumulative effects and mitigate other actions in the region impacting these species. The shrimp fisheries have historically impacted sturgeons and smalltooth sawfish, as well as other species such as red snapper, effort reduction due to the economic environment and other management actions (e.g., TEDs and BRDs) have reduced some of these effects.

4.7.1.4 Cumulative Effects on EFH

While effort may decrease or be redistributed under the preferred and other alternatives considered within this DEIS, shrimp trawling will continue to occur in areas that have been trawled for decades, rather than over undisturbed, and potentially more ecologically sensitive, habitats. Overall effort is expected to stay within levels fished within the past several years. None of the areas that have been closed to bottom trawling to protect EFH will be opened by the preferred alternative.

Although fishing continues to negatively affect habitat, the cumulative effect of implementation of EFH closed and regulated areas, as well as effort reduction that has occurred for the purposes of rebuilding stocks to sustainable levels, have likely had a generally positive effect on habitat. Other actions in the Gulf of Mexico and Atlantic Ocean, such as dredging projects, estuarine habitat modification, and natural storm impacts, also impact EFH and, in some cases, could be considered to have similar effects. Since any direct or indirect impacts to EFH under the preferred alternative are expected to be minimal and temporary, significant negative cumulative effects on habitat are unlikely.

4.7.1.5 Cumulative Effects on the Shrimp Fishery

Under the preferred alternative and relative to 2008 landings and revenues, revenues for affected vessels in the southeastern U.S. shrimp fisheries would be reduced by at least approximately 8 percent for Louisiana and Alabama, to as much as 31 percent to North Carolina. These projections do not capture measures that may mitigate the impact, such as NFWF funding that could acquire and distribute TEDs to affected fishermen. Regardless, when considering other actions affecting the southeastern U.S. shrimp fisheries, as well as the current economic condition of the inshore shrimp fisheries, any of the proposed alternatives may result in significant immediate and cumulative effects.

Some of the reduced revenues are caused by the cost of purchasing, installing, and maintaining/repairing TEDs, which would only be immediate or periodic costs, and additional reductions are caused by target catch loss caused by TEDs, which would be expected to be a long-term, sustained impact. The cumulative impacts on economies and communities caused by past, present, and reasonably foreseeable future actions are likely to have adverse short-term effects due to the immediate costs of TED use. Adverse effects may be reduced over time as the cost of TED purchase is absorbed over subsequent years, and catch loss is reduced due to user familiarity with fishing with TEDs. In addition to the short- and long-term effects of the preferred alternative, other impacts to the shrimp fisheries are expected to continue, notably increasing fuel costs and increasing foreign imports to satisfy consumer demand, which may continue to impact overall revenue.

According to Miller et al. (2011), the majority of inshore shrimp harvesters had a net cash flow in 2008 of less than $1,000. The authors of this report noted that their estimates may overstate the returns to commercial shrimping as they do not account for the opportunity cost of the owner-operators' time and effort. When that factor is considered, average net revenues were negative.

The average cost of diesel fuel nationwide (highway retail sales) more than doubled between 2001 and 2011, increasing from an average of $1.52 per gallon in January 2001 to an average of $3.38 per gallon in January 2011 (U.S. Energy Information Administration). The average cost of diesel fuel along the Gulf Coast (highway retail sales) increased from $2.86 per gallon in 2007 to $3.78 in 2011 (U.S. Energy Information Administration). Costs for other expenditures such as ice and preservative (e.g., sodium metabisulfate) have also increased: the annual inflation rate has averaged 2.49 percent from 2000 through 2010 (Bureau of Labor Statistics). While costs have increased significantly, revenue has not. The annual average price per pound of shrimp landed in Louisiana state waters decreased from $1.45 per pound in 2000 to $1.31 per pound in 2010 (all species combined; LADWF statistics).

The shrimp fisheries have also been impacted by numerous other adverse effects, including hurricane impacts and the DWH oil spill event. Hurricanes in particular have resulted in significant impacts to the shrimp fisheries through direct impacts from storm-related damage to vessels, as well as indirect impacts such as compromised infrastructure (e.g., loss of processing and support facilities). Additionally, the passing of a storm also directly impacts the fishery, as inclement weather precludes fishing operations (i.e., revenue-making opportunities).

4.7.1.6 Summary

Sea turtles, marine mammals, listed fish and other marine species, EFH, and the human environment have been impacted by past and present actions in the region and are likely to continue to be impacted by these actions in the future. The measures implemented under the preferred alternative are not expected to result in substantial direct or indirect impacts to marine mammals or EFH, and are not, consequently, expected to contribute to cumulative effects on these ecosystem components. Therefore, there is no net beneficial or adverse effect on these ecosystem components.

Sea turtles have been, are, and will continue to be negatively impacted by a variety of past, present, and future activities. These cumulative impacts impact the recovery of the species, although the extent cannot be quantified. Vessel and fishing operations, dredging activities, and marine pollution have had a net negative impact to sea turtles found in the area and are likely to continue to impact these ecosystem components in the future. Sea turtle conservation measures under the preferred alternative will reduce the effects of the shrimp fisheries on Kemp's ridley and other sea turtle populations, benefiting these species. These positive impacts are expected to mitigate to a certain extent the negative cumulative impacts to sea turtle populations.

The other activities that are negatively impacting sea turtles should continue to be addressed to ensure sea turtles are protected. NMFS also intends to continue outreach efforts to educate fishermen regarding sea turtles to help conserve and recover sea turtles. Future anticipated research will likely further our knowledge on the details of the interactions between sea turtles and fisheries, will likely improve target catch retention in trawls equipped with TEDs, and may result in new technologies that will reduce the capture of sea turtles in fisheries. The continued implementation of outreach efforts and anticipated research address activities that negatively impact sea turtles and are expected to have a beneficial impact on sea turtles.

For listed fish and other marine species (e.g., bycatch species), the escapement that occur in trawls equipped with TEDs could contribute to the rebuilding of listed or overfished stocks. Additionally, the loss of unwanted bycatch species through TEDs may improve the quality of landed fish, and reduce the time needed to sort and process target species. Potential beneficial impacts to Gulf sturgeon, and to a lesser extent, Atlantic and shortnose sturgeon may also occur as a result of TED use in the skimmer trawl fisheries (i.e., anticipated differential due to a greater number of skimmer trawl vessels in the Northern Gulf of Mexico versus North Carolina).

The human community will experience negative economic impacts from the implementation of the preferred alternative. It is possible these adverse effects will cause some participants already struggling in the fishery to leave the fishery entirely. Therefore, it is expected that the additive effects of this action will contribute to or result in adverse cumulative impacts on the human community.

In conclusion, while the preferred alternative is expected to benefit sea turtles by reducing the capture of sea turtles in the southeastern U.S. shrimp fisheries, the cumulative effects of this action are not likely to have a substantial impact on any of the ecosystem components associated with the fisheries, with the notable exception of the human community.

4.7.2 Geographic Scope of the Analysis

The geographic scope affected by this action includes areas of tidally influenced waters and substrates of the Gulf of Mexico and its estuaries in Louisiana, Mississippi, and Alabama, as well as tidally-influenced waters and substrates of the South Atlantic and its estuaries in North Carolina, and extending out to the limit of the U.S. EEZ. This area is described in detail in Section 3.1.

4.7.3 Timeframe for the Analysis

In the Gulf of Mexico, the shrimp fisheries originated as an inshore fishery using cast nets, haul seines, and bar nets. In 1902, fishermen first began going into deeper water, pulling a haul seine from a power-driven boat. In 1913, the first otter trawl was used to catch shrimp. As the shrimp trawl fishery developed, so too did its impact on incidental bycatch and mortality of sea turtles.

While it would be advantageous to go back to a time when sea turtle populations, the shrimp fisheries, and the overall marine environment were natural and unmodified, information on many of these attributes were not available until after many significant changes had occurred (e.g., anthropogenic impacts on sea turtles, initial prosecution and expansion of the shrimp fisheries, etc.). Landings data employed in annual Gulf of Mexico shrimp assessments uses data from 1960 to present. In determining how far into the future to analyze cumulative effects, the length of the effects would depend on the species, fishery, etc. The preferred alternative would require all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets. This requirement would be expected to take place upon the final rule becoming effective. The effectiveness of this action regarding sea turtle conservation should continue to be monitored indefinitely to ensure that management measures are adequate to protect the subject species.

4.7.4 Other Actions Affecting the Resources, Ecosystems, and Human Communities of Concern

Past and present actions affecting the sea turtle populations are discussed throughout Section 3.2, and Appendix II specifically details the history of TED requirements within the shrimp fisheries. Additional actions that can affect sea turtle populations in the reasonably foreseeable future include development of rulemaking through the Atlantic Sea Turtle Strategy process, which would implement additional conservation requirements in various fisheries to reduce incidental bycatch and mortality of sea turtles. Conversely, continued development in coastal areas around the globe could negatively affect sea turtle populations, particularly nesting populations.

Past and present actions affecting the shrimp fisheries are discussed throughout Section 3.7. Additional actions that can affect the shrimp fisheries in the reasonably foreseeable future include the implementation of annual catch limits for the non-annual crop species, annual catch targets, and accountability measures.

4.7.5 Characterization of the Resources, Ecosystems, and Human Communities Identified in Scoping in Terms of Their Response to Change and Capacity to Withstand Stress

This step should identify the trends, existing conditions, and the ability to withstand stresses of the environmental components. As previously described, the shrimp trawl fisheries have been in a long-term decline due to economic conditions and competition from inexpensive foreign imports, as well as by the hurricanes that struck in the Gulf of Mexico during 2004 and 2005. Therefore, it is likely that the human communities associated with the shrimp fisheries have little capacity to withstand additional stress. As a result of this decline, however, reductions in effort have, and are, occurring that have resulted in reductions of incidental sea turtle bycatch and mortality, likely benefiting sea turtle populations and the associated ecosystems.

4.7.6 Characterization of the Stresses Affecting These Resources, Ecosystems, and Human Communities and Their Relation to Regulatory Thresholds

This section examines whether resources, ecosystems, and human communities are approaching conditions where additional stresses could have an important cumulative effect beyond any current plan, regulatory, or sustainability threshold (CEQ 1997). Sustainability thresholds can be identified for some resources, which are levels of impact beyond which the resources cannot be sustained in a stable state. Other thresholds are established through numerical standards, qualitative standards, or management goals. The CEA should address whether thresholds could be exceeded because of the contribution of the proposed action to other cumulative activities affecting resources.

While this DEIS primarily deals with the inshore shrimp fisheries, quantitative definitions of overfishing and overfished for managed shrimp species are included in the respective GMFMC and SAFMC shrimp FMPs, which are incorporated by reference. Generally, sea turtle species are listed as either threatened or endangered. A threatened species, the less severe threshold category, is any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. An endangered species means any species which is in danger of extinction throughout all or a significant portion of its range. Information on listed sea turtle species, including threats affecting these species, is included in Section 3.2 as well as cited status reviews, recovery plans, and biological reports, and are incorporated herein by reference.

4.7.7 Baseline Condition for the Resources, Ecosystems, and Human Communities

Gulf of Mexico shrimp stocks are assessed each year and current assessment methods are based on Nichols (1984). The assessments show trends in catch, effort, CPUE, and recruitment. For these assessments, reliable data are available back to 1960. A discussion on the condition and current status of sea turtle populations, including current status, is included in Section 3.2, while information on additional marine resources and associated ecosystems are included in Sections 3.3 through 3.6. Information on the condition of the human communities and economic environment is included in Section 3.7.

4.7.8 Important Cause-and-Effect Relationships Between Human Activities and Resources, Ecosystems, and Human Communities

The relationship between human activities and resources, ecosystems, and human communities within the context of this DEIS is solely related to the southeastern U.S. shrimp fisheries and the implementation of sea turtle conservation requirements. Appendix II details the history of TED requirements within the shrimp fisheries. Various biological opinions conducted on the fisheries have concluded that the regulations would have a positive impact on sea turtles by substantially reducing mortalities.

4.7.9 Magnitude and Significance of Cumulative Effects

Past, present, and reasonably foreseeable future actions probably have not and would not have a significant, adverse effect on the shrimp resource. The preferred alternative in this DEIS would be expected to yield beneficial cumulative effects on the biological environment, specifically on sea turtle populations. There may be an increase of fishing effort or fishing pressure on target species as a result of the preferred alternative to offset catch loss. Conversely, overall fishing effort may decrease if participants exit a fishery due to cumulative impacts.

4.7.10 Alternatives to Avoid, Minimize, or Mitigate Significant Cumulative Effects

Various management measures other than the preferred alternative were considered in this DEIS that could avoid, minimize, or mitigate significant cumulative effects. Specifically, alternatives requiring TEDs for a smaller universe of individuals and time/area closures in effect for a shorter duration or impacting a smaller geographical area were considered.

4.7.11 Monitoring of the Cumulative Effects of the Preferred Alternative and Modification of Management as Necessary

The effects of the proposed action are, and will continue to be, monitored through collection of data by NMFS, states, stock assessments, stock assessment updates, life history studies, and other scientific observations.

4.8 UNAVOIDABLE ADVERSE EFFECTS

The preferred alternative would require all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use TEDs in their nets. This would result in an initial annual negative economic effect of $5,025,177 to the shrimp fisheries following alternative implementation. It is expected that the economic effect in subsequent years would be less, as the cost of the TED would not be repeating past initial purchase, aside from occasional repair and replacement costs. This action would have beneficial impacts on sea turtle populations and the general public, however, due to a reduction of incidental bycatch and mortality in the shrimp fisheries.

4.9 SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

NMFS weighed the short-term impacts upon the shrimp fisheries against the long-term productivity and stability of sea turtle populations and concluded that the proposed action would result in net benefits to society. While this action would have negative impacts on inshore shrimp fishermen due to the cost of TED purchase and target catch loss, it is not expected to reduce overall effort or landings. Therefore, no impact to the long-term stability of the shrimp fisheries is expected as a result of implementation of the preferred alternative. The required use of TEDs in skimmer, pusher-head, and butterfly trawls is expected to reduce incidental bycatch and mortality of sea turtles, benefiting sea turtle conservation. These benefits are expected to aid in recovery goals for sea turtle species, potentially expediting their delisting from the ESA.

4.10 MITIGATION AND MONITORING

The preferred alternative in this DEIS would not result in any specific mitigation or monitoring requirements. As previously mentioned, the NFWF allocated funds, received from oil recovery income during the DWH oil spill event, to Gulf of Mexico restoration efforts. In 2010, funding was made available to purchase and disperse TEDs for skimmer trawl vessels. According to MDMR, 360 TEDs have been distributed to 180 Mississippi resident shrimp vessels. Therefore, it is expected the majority of skimmer trawl vessels operating in Mississippi already possess TEDs and the economic impact (direct costs) of this alternative to Mississippi fishermen will be mitigated as a result. It is possible additional available NFWF funding might be made available to other skimmer fishermen in the near future, thus mitigating the direct impact of this alternative. Monitoring of the implemented TED requirements in the skimmer, pusher-head, and butterfly trawl fisheries would occur through regular, ongoing law enforcement activities, as well as supplementary outreach efforts (e.g., TED workshops, GMT voluntary inspections, etc.).

4.11 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Irreversible commitments are defined as commitments which cannot be reversed, except perhaps in the extreme long-term, whereas irretrievable commitments are lost for a period of time. The preferred alternative in this DEIS would not result in irreversible or irretrievable commitment of resources.

5 REGULATORY IMPACT REVIEW (RIR)

5.1 INTRODUCTION

NMFS conducts a Regulatory Impact Review (RIR) pursuant to E.O. 12866, as amended. The RIR: (1) provides a comprehensive review of the incidence and level of impacts associated with a proposed or final regulatory action; (2) provides a review of the problems and the policy objectives prompting the regulatory proposals and an evaluation of alternatives that could be used to solve the problem; and (3) ensures that the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost-effective way. The RIR provides the information needed to determine if the proposed regulations constitute a significant regulatory action under E.O. 12866.

5.2 PROBLEMS AND ISSUES

Problems and issues that prompted the development of this DEIS and the various management alternatives considered herein are discussed in Section 1.

5.3 OBJECTIVES

The need for the proposed action and alternatives is to aid in the protection and recovery of listed sea turtle populations. Under the ESA (16 USC. 1531 et seq.), NMFS has the responsibility to implement programs to conserve marine life listed as endangered or threatened. Section 9 of the ESA prohibits the take (including harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting or attempting to engage in any such conduct), including incidental take, of endangered sea turtles. Pursuant to section 4(d) of the ESA, NMFS has issued regulations extending the prohibition of take, with exceptions, to threatened sea turtles (50 CFR 223.205 and 223.206). Section 11(f) of the ESA authorizes the issuance of regulations to enforce the take prohibitions. The purpose of the proposed action is to aid in the protection and recovery of listed sea turtle populations by reducing incidental bycatch and mortality of sea turtles in the southeastern U.S. shrimp fisheries.

5.4 DESCRIPTION OF THE FISHERY

A description of the shrimp fisheries, including a detailed description of the socio-economics of the shrimp fisheries, in particular the skimmer trawl fisheries of the Northern Gulf of Mexico and North Carolina, can be found in Section 3.7 of this DEIS. A complete description of the federal fisheries can be found in the Gulf of Mexico Fishery Management Council's Fishery Management Plan for the Shrimp Fishery of the Gulf of Mexico, U.S. Waters (GMFMC 1981) and its subsequent plan amendments, as well as the South Atlantic Council's Fishery Management Plan for the Shrimp Fishery of the South Atlantic Region (SAFMC 1993) and its subsequent plan amendments, which are incorporated herein by reference.

5.5 ANALYSIS OF ALTERNATIVE MANAGEMENT MEASURES

A discussion of the expected economic effects of all alternatives considered in this proposed action is provided in Section 4.5. The expected economic effects of the proposed action, Preferred Alternative 2c, are provided in Table 28. The total expected first year cost to participants in the shrimp fishery in Louisiana, Mississippi, Alabama, and North Carolina of the proposed withdrawal of alternative tow time restrictions would be approximately $5 million, based on the estimated cost of TED purchases and reduced shrimp revenues. Approximately 34 percent of these costs would be associated with the purchase of new TEDs. The cost of new TEDs would not be expected to be an annually occurring expense. Reduced shrimp revenues may be an annually-occurring cost, however, fishing behavioral changes may allow some mitigation of these losses.

Table 28. Estimated economic impact of Alternative 2c.

	LOUISIANA	MISSISSIPPI	ALABAMA	NORTH CAROLINA
ANTICIPATED NUMBER OF AFFECTED VESSELS	2,248	62	60	65
COST PER VESSEL FOR TED PURCHASE (2 @ $350)	$700	$700	$700	$700
COST TO FISHERY FOR TED PURCHASE (2 @ $350)	$1,573,600	$43,400	$42,000	$45,500
ANNUAL COST PER VESSEL FOR TED MAINTENANCE	$300	$300	$300	$300
ANNUAL COST TO FISHERY FOR TED MAINTENANCE	$674,400	$18,600	$18,000	$19,500
COST PER VESSEL FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$1,120	-	$1,061	$133
COST TO FISHERY FOR ESTIMATED 4.97 PERCENT CATCH LOSS	$2,517,845	-	$63,687	$8,645
TOTAL COST PER VESSEL	$2,120	$1,000	$2,061	$1,133
TOTAL COST TO FISHERY	$4,765,845	$62,000	$123,687	$73,645
GRAND TOTAL COST TO FISHERY		$5,025,177		

5.6 PRIVATE AND PUBLIC COSTS

The preparation, implementation, enforcement, and monitoring of this or any federal action involves the expenditure of public and private resources that can be expressed as costs associated with the regulations. Costs associated with this specific action will include:

NMFS administrative costs of DEIS preparation, meetings, and review	$50,000
Law enforcement costs	$1,667,000
Outreach costs	$410,000
TOTAL	**$2,127,000**

Federal costs of DEIS preparation are based on staff time, travel, printing, and any other relevant items where funds were expended directly for this specific action. There are no permit requirements in this proposed action. Based on past experience with requiring TEDs in shrimp trawls, it is expected that additional enforcement activity by OLE and outreach efforts by the agency (e.g., TED workshops, GMT activity) will be required, at least in the first year or two following implementation, to insure the effectiveness of the preferred alternative.

5.7 DETERMINATION OF A SIGNIFICANT REGULATORY ACTION

Pursuant to E.O. 12866, a regulation is considered a "significant regulatory action" if it is likely to result in: (1) an annual effect of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities; (2) create a serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights or obligations of recipients thereof; or (4) raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this executive order. Based on the information provided above, this action would not be expected to be economically significant for purposes of E.O. 12866.

6 REGULATORY FLEXIBILITY ACT (RFA)

6.1 INTRODUCTION

The purpose of the RFA is to establish a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals, and to explain the rationale for their actions to assure such proposals are given serious consideration. The RFA does not contain any decision criteria; instead the purpose of the RFA is to inform the agency, as well as the public, of the expected economic impacts of various alternatives contained in the FMP or amendment (including framework management measures and other regulatory actions) and to ensure the agency considers alternatives that minimize the expected impacts while meeting the goals and objectives of the FMP and applicable statutes.

With certain exceptions, the RFA requires agencies to conduct an initial regulatory flexibility analysis (IRFA) for each proposed rule. The IRFA is designed to assess the impacts various regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those impacts. An IRFA is conducted to primarily determine whether the proposed action would have a "significant economic impact on a substantial number of small entities." In addition to analyses conducted for the RIR, the IRFA provides: (1) a description of the reasons why action by the agency is being considered; (2) a succinct statement of the objectives of, and legal basis for, the proposed rule; (3) a description and, where feasible, an estimate of the number of small entities to which the proposed rule will apply; (4) a description of the projected reporting, record-keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities which will be subject to the requirements of the report or record; and, (5) an identification, to the extent practicable, of all relevant federal rules, which may duplicate, overlap, or conflict with the proposed rule.

6.2 STATEMENT OF THE NEED FOR, OBJECTIVES OF, AND LEGAL BASIS FOR THE ACTION

A discussion of the need for and objectives of this action is provided in Section 1 of this document. In summary, the purpose of this proposed rule is to reduce the incidental bycatch and mortality of sea turtles in the Southeastern U.S. shrimp fisheries. The ESA provides the statutory basis for this action.

6.3 DESCRIPTION AND ESTIMATE OF THE NUMBER OF SMALL ENTITIES TO WHICH THE PROPOSED ACTION WOULD APPLY

This proposed rule would be expected to directly affect fishermen who use skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls). This gear is only used in Louisiana, Mississippi, Alabama, Florida, and North Carolina. However, Florida already requires TED use by vessels using this gear. Among the remaining states, approximately 2,435 active vessels have been identified that use this gear (2,248 in Louisiana, 62 in Mississippi, 60 in Alabama, and 65 in North Carolina). All of these vessels would be expected to be affected by this proposed rule.

The average annual revenue (2008 dollars) for vessels that harvest shrimp using skimmer trawls, pusher-head trawls, or wing nets (butterfly trawls) is estimated to be approximately $22,500 for Louisiana vessels, $21,400 for Alabama vessels, and $2,700 for North Carolina vessels. Fishermen commonly participate in multiple fisheries and these results may not include revenue from non-shrimp species. Comparable information for Mississippi vessels is not available because no shrimp landings from Mississippi vessels using this gear were recorded in the comparable time period (2006-2010). Although some Mississippi vessels are expected to be actively using this gear, it is not known whether these vessels are landing their shrimp harvests in other states, selling directly to the public and not through dealers, or engaging in some other practice that has resulted in the absence of recorded landings.

The Small Business Administration has established size criteria for all major industry sectors in the U.S. including fish harvesters. A business involved in fish harvesting is classified as a small business if it is independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $4 million (NAICS code 114112, shellfish fishing) for all its affiliated operations worldwide. Based on the average revenue estimates provided above, all commercial fishing vessels expected to be directly affected by this proposed rule are determined for the purpose of this analysis to be small business entities.

6.4 DESCRIPTION OF THE PROJECTED REPORTING, RECORD-KEEPING AND OTHER COMPLIANCE REQUIREMENTS OF THE PROPOSED ACTION, INCLUDING AN ESTIMATE OF THE CLASSES OF SMALL ENTITIES WHICH WILL BE SUBJECT TO THE REQUIREMENT AND THE TYPE OF PROFESSIONAL SKILLS NECESSARY FOR THE PREPARATION OF THE REPORT OR RECORDS

This proposed action would not establish any new reporting, record-keeping, or other compliance requirements beyond the requirement to use a TED when using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls). TEDs are typically installed by the net manufacturer, so no special skills would be expected to be required of fishermen for TED installation. Some learning may be required for the maintenance and routine use of the TED. However, the use of TEDs is common in the general shrimp fishery and the skills required for TED use is consistent with the skillset and capabilities of commercial shrimp fishermen in general. As a result, special professional skills would not be expected to be necessary.

6.5 IDENTIFICATION OF ALL RELEVANT FEDERAL RULES, WHICH MAY DUPLICATE, OVERLAP OR CONFLICT WITH THE PROPOSED ACTION

No duplicative, overlapping, or conflicting federal rules have been identified.

6.6 SIGNIFICANCE OF ECONOMIC IMPACTS ON SMALL ENTITIES

Substantial Number Criterion

This proposed action, if implemented, would be expected to directly affect all commercial fishing entities using skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls), in Louisiana, Mississippi, Alabama, and North Carolina, or an estimated 2,435 entities. As previously discussed, all of these affected entities have been determined, for the purpose of this analysis, to be small entities. Therefore, it is determined that this proposed action, if implemented, would affect a substantial number of small entities.

Significant Economic Impacts

The outcome of "significant economic impact" can be ascertained by examining two factors: disproportionality and profitability.

<u>Disproportionality</u>: Do the regulations place a substantial number of small entities at a significant competitive disadvantage to large entities?

All entities expected to be directly affected by the measures in this proposed action are determined for the purpose of this analysis to be small business entities, so the issue of disproportionality does not arise in the present case.

<u>Profitability</u>: Do the regulations significantly reduce profits for a substantial number of small entities?

If the affected entities are required to pay for their TEDs, the proposed action would be expected to result in an estimated average first-year cost of $2,120 for fishermen in Louisiana, $1,000 for fishermen in Mississippi, $2,061 for fishermen in Alabama, and $1,133 for fishermen in North Carolina. These results are based on an estimated cost of $350 per TED, the use of two TEDs per vessel, an annual maintenance cost of $300 per vessel, and an estimated 4.97 percent reduction in shrimp harvest. Based on the average annual revenue estimates provided above, these costs are equivalent to approximately 9.4 percent of average annual shrimp revenue for affected entities in Louisiana, 9.6 percent in Alabama, and 42.4 percent in North Carolina. The total average effect per entity would be reduced if these fishermen also operate in other fisheries, which is expected to be the case for most entities. Total revenues from all species for the affected fishermen are not known. However, the estimated average annual net revenue, including revenue from all species, for operations in the inshore shrimp sector, which includes the entities described here, across all Gulf states, is negative, indicating the average vessel is operating at a loss. As a result, any increased costs or reduced revenues would be expected to compound these losses. Similar information is not available for North Carolina fishermen but this analysis assumes the average net revenue for North Carolina fishermen is comparable to that of inshore shrimp fishermen in the Gulf.

As previously discussed, a comparable analysis for entities in Mississippi cannot be completed because of the absence of appropriate revenue information. As a result, the estimated effect for entities in Mississippi simply reflects the cost of the TEDs. The cost associated with TED purchase, however, may be overstated, particularly for Mississippi vessels. The NFWF allocated funds received from oil recovery income as a result of the DWH oil spill event for Gulf of Mexico restoration efforts. In 2010, funding was made available to purchase and disperse TEDs for skimmer trawl vessels and, to date, an estimated 360 TEDs have been distributed to 180 Mississippi resident shrimp vessels. Therefore, it is expected the majority of skimmer trawl vessels operating in Mississippi already possess TEDs. It is not known whether vessel in other states have similarly received TEDs.

Because a TED is a durable device, the cost of a new TED would not be an annual expense. The estimated replacement cycle for a TED is at least three years, barring net damage and TED loss. In a year in which a new TED is not purchased, the effect of this proposed action would be limited to TED maintenance costs and reduced shrimp harvest associated with TED use. These costs would be expected to be approximately $1,420 for Louisiana vessels, $1,361 for Alabama vessels, and $433 for North Carolina vessels. It may also be possible to reduce shrimp losses over time through changes in fishing practices or increased experience with TED use.

The cost of initial TED purchase would be reduced if special funding is available, similar to the NFWF funding in 2010 or a comparable project. This analysis does not assume that TEDs will be provided. If TEDs are provided, the initial and recurring expected effects of this proposed rule would be reduced to the costs of TED maintenance, replacement TEDs, and shrimp loss.

6.7 DESCRIPTION OF SIGNIFICANT ALTERNATIVES TO THE PROPOSED ACTION AND DISCUSSION OF HOW THE ALTERNATIVES ATTEMPT TO MINIMIZE ECONOMIC IMPACTS ON SMALL ENTITIES

Eight alternatives, including the proposed action and the no-action alternative, were considered to reduce incidental bycatch and mortality of sea turtles in the Southeastern U.S. shrimp fisheries. The no-action alternative would not have changed any current management measures and was not selected because it would not be expected to result in any reduction in the incidental bycatch and mortality of sea turtles.

Two other management alternatives also considered TED use instead of the current tow time authorization for varying portions of the skimmer trawl fleets. The remaining four alternatives considered different time/area closures for the shrimp fisheries. The two alternatives that considered alternative tow time restrictions would have, alternatively, required TED use in lieu of tow time restrictions based on vessel length, limiting TED use to either vessels 30 feet or longer, or 20 feet or longer. Both alternatives would have affected fewer vessels (1,471 and 2,211 vessels, respectively) and resulted in lower adverse economic effects (by 40 percent and 9 percent, respectively) than the proposed action. These alternatives were not selected because they would be expected to result in insufficient reduction in the incidental bycatch and mortality of sea turtles in general, as well as provide an incentive for effort to shift to smaller vessels, thereby reducing the benefits of TED use by larger vessels.

The four alternatives that considered alternative closures varied by geographic coverage, either the Texas-Louisiana or Louisiana-Mississippi state borders through the Alabama-Florida state border, or duration, either March 1 through May 31 or April 1 through May 15. The expected economic effects of these alternatives would be expected to result from reduced shrimp harvest and range from a loss of approximately $50,000 to a loss of approximately $14 million. While three of these alternatives would be expected to result in lower adverse economic effects on affected entities than the proposed action, none of these alternatives was selected because of the low fishing effort during the time periods considered. As a result, the total reduction in the incidental bycatch and mortality would be insufficient to afford these species the necessary protection.

7 APPLICABLE LAWS

7.1 ADMINISTRATIVE PROCEDURE ACT (APA)

The federal Administrative Procedure Act (APA) establishes procedural requirements applicable to informal rulemaking by federal agencies. The purpose of the APA is to ensure public access to the federal rulemaking process and to give the public notice and an opportunity to comment before the agency promulgates new regulations. Specifically, the APA requires NMFS to solicit, review, and respond to public comments on actions. Development of the alternatives considered for the sea turtle conservation measures in the Southeastern U.S. shrimp fisheries provided several opportunities for public review, input, and access to the rulemaking process. For example, during the public scoping process, NMFS requested suggestions and information from the public on the range of issues that should be addressed and alternatives that should be considered in the DEIS. A summary of the scoping comments is included in Section 1.3 and Table 1. Public comments will also be accepted on the DEIS and the proposed rule. These comments, along with those received to date, will be considered in developing the final action.

7.2 COASTAL ZONE MANAGEMENT ACT (CZMA)

The Coastal Zone Management Act (CZMA) is designed to encourage and assist states in developing coastal management programs, to coordinate state activities, and to safeguard regional and national interests in the coastal zone. Section 307(c) of the CZMA requires that any federal activity affecting the land or water uses or natural resources of a state's coastal zone be consistent with the state's approved coastal management program, to the maximum extent practicable. NMFS has determined that the implementation of the preferred alternative would be consistent to the maximum extent practicable with the approved coastal management programs of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. This determination will be submitted, along with a copy of this document, for review and concurrence by the responsible state agencies under Section 307 of the CZMA. A list of the specific state contacts and a copy of the letters are available upon request.

7.3 ENDANGERED SPECIES ACT (ESA)

Section 7 of the ESA requires federal agencies conducting, authorizing, or funding activities that may affect threatened or endangered species to ensure that those impacts do not jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat determined to be critical. This document analyzes the potential impacts of the preferred alternative on ESA-listed species in Section 4. NMFS has reinitiated section 7 consultation on the effects of the shrimp fisheries in both the Atlantic and Gulf areas; this consultation also addresses the effects of sea turtle conservation regulations, including TED use.

7.4 INFORMATION QUALITY ACT (SECTION 15)

The Information Quality Act directed the Office of Management and Budget to issue government wide guidelines that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies." Under the NOAA guidelines, the conservation measures included in the DEIS are considered a Natural Resource Plan. It is a composite of several types of information, including scientific, management, and stakeholder input, from a variety of sources. Compliance of this document with NOAA guidelines is evaluated below.

7.4.1 Utility

The information disseminated is intended to describe proposed management actions and the impacts of those actions. The information is intended to be useful to: (1) industry participants, conservation groups, and other interested parties so they can understand the management action, its effects, and its justification, and can provide informed comments on the alternatives considered; and (2) managers and policy makers so they can choose an alternative for implementation.

7.4.2 Integrity

Information and data, including statistics, that may be considered confidential, were used in the analysis of impacts associated with this document. This information was necessary to assess the biological, social, and economic impacts of the alternatives considered. NMFS complied with all relevant statutory and regulatory requirements as well as NOAA policy regarding confidentiality of data. For example, confidential data were only accessible to authorized federal employees and contractors for the performance of required analyses. Additionally, confidential data are safeguarded to prevent improper disclosure or unauthorized use. Finally, the information to be made available to the public was done so in aggregate, summary, or other such form, that does not disclose the identity or business of any person.

7.4.3 Objectivity

The NOAA Information Quality Guidelines for Natural Resource Plans state that plans must be presented in an accurate, clear, complete, and unbiased manner. NMFS strives to draft and present proposed management measures in a clear and easily understandable manner with detailed descriptions that explain the decision making process and the implications of management measures on marine resources and the public. Although the alternatives considered in this document rely upon scientific information, analyses, and conclusions, clear distinctions are drawn between policy choices and the supporting science. Additionally, the scientific information relied upon in the development, drafting, and publication of this DEIS is properly cited. Finally, this document was reviewed by a variety of biologists, economists, and policy analysts from NMFS' Southeast Region, Southeast Fisheries Science Center, and Headquarters offices.

7.5 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (MSFCMA)

The EFH provisions of the MSFCMA require NMFS to provide recommendations to federal and state agencies for conserving and enhancing EFH if a determination is made that an action may adversely impact EFH. NMFS policy regarding the preparation of NEPA documents recommends incorporating EFH assessments into environmental impact statements; therefore, this DEIS will also serve as an EFH assessment. Pursuant to these requirements, Section 2 of this document provides a description of the alternatives considered for sea turtle conservation measures in the Southeastern U.S. shrimp fisheries. Sections 3 and 4.4 provide a description of the affected environment, including the identification of areas designated as EFH, HAPC, and an analysis of the impacts of fishing gear on that environment.

7.6 MARINE MAMMAL PROTECTION ACT (MMPA)

Under the MMPA, federal responsibility for protecting and conserving marine mammals is vested with the Departments of Commerce (NMFS) and Interior (USFWS). The primary management objective of the MMPA is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in cooperation with the applicable provisions of the ESA. The species of marine mammals that occur in the proposed action area are discussed in Section 3 of the DEIS. The potential impact of the alternatives on marine mammals is provided in Section 4. The alternatives considered would not adversely affect marine mammals.

7.7 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

This analysis was prepared in full compliance with the requirements of NEPA. All established procedures to ensure that federal agency decision makers take environmental factors into account, including the use of the public process were followed. This DEIS contains all the components required by NEPA, including a brief discussion of the purpose and need for the proposal (Section 1), the alternatives considered (Section 2), description of the affected environment (Section 3), the environmental impacts of the proposed action and the alternatives (Section 4), regulatory impact review (Section 5), a list of document preparers and reviewers (Sections 7 and 9), and other relevant information.

7.8 NATIONAL MARINE SANCTUARIES ACT (NMSA)

Under the National Marine Sanctuaries Act (NMSA) (also known as Title III of the Marine Protection, Research, and Sanctuaries Act of 1972), as amended, the U.S. Secretary of Commerce is authorized to designate National Marine Sanctuaries to protect distinctive natural and cultural resources whose protection and beneficial use requires comprehensive planning and management. The Office of National Marine Sanctuaries of NOAA administers the National Marine Sanctuary Program. The Act provides authority for comprehensive and coordinated conservation and management of these marine areas. The National Marine Sanctuary Program currently comprises 13 sanctuaries around the country. There are no marine sanctuaries in the geographic area that would be affected by the preferred alternative.

7.9 PAPERWORK REDUCTION ACT (PRA)

The collection of information for or by the federal government is subject to the requirements of the PRA) of 1995. PRA establishes a process for the review and approval of information collections by the Office of Management and Budget (OMB), in an effort to minimize the paperwork burden resulting from federal information collection efforts. This action includes no new collection of information and further analysis is not required. The proposed action would require no additional reporting burdens by permit holders, dealers, or other entities in the southeastern U.S. shrimp fishing industry.

7.10 REPORTING, RECORDKEEPING, AND OTHER COMPLIANCE REQUIREMENTS

This action does not introduce any new reporting, recordkeeping, or other compliance requirements.

7.11 DUPLICATION, OVERLAP, OR CONFLICT WITH OTHER FEDERAL RULES

The proposed action does not duplicate, overlap, or conflict with other federal rules.

7.12 SOCIAL IMPACT ASSESSMENT

Under NEPA, NMFS is required to analyze the social impacts of fishing regulations on fishing communities. A fishing community, as defined under National Standard 8 of the MSFCMA, is "...a community that is substantially dependent upon or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, crew, and fish processors that are based in such communities."

Often, it is the economic impacts (described in Section 4.5 of this DEIS) which drive the changes in fishing communities, however, social impacts can occur without any associated economic impacts. While NMFS collects fishing and economic data through observers and reporting requirements, this only provides information on when, where, and how vessels fish and the productivity of their fishing trips. These data do not provide information on the social aspects of the shrimp fisheries. Furthermore, because most past actions have related to the federal shrimp fisheries, most socio-economic studies completed to date focus on the offshore component of the fishery. Additionally, because some shrimp vessels and their crew are "migratory," following the shrimp throughout the Gulf of Mexico, and other vessels and their crew generally stay in one location (particularly smaller vessels), it is difficult to estimate the impacts of some of these measures on fishing communities. For these reasons, the social impacts of the alternatives on fishing communities are discussed qualitatively, not quantitatively. This section analyzes the social impacts of the proposed actions in this document on fishing communities. Background and information on potentially affected communities is discussed in detail throughout Section 3.7.

Direct and Indirect Effects on the Social Environment

Contrary to the economic analysis, which focused on quantifiable impacts to individual participants, the analysis of impacts on the social environment focus on community level impacts as well as less quantifiable impacts that are reflected by how potentially impacted individuals feel about the proposed action and its impacts on them (i.e., attitudes and perceptions). As noted previously, direct and indirect impacts to the social environment are expected to affect skimmer trawl, pusher-head trawl, and wing net (butterfly trawl) vessels in Louisiana, Mississippi, Alabama, and North Carolina. While adverse impacts may be more widespread (in terms of participants) in Louisiana due to the significance of the skimmer trawl fishery in that area, they may be more significant (in terms of reduction of revenue) in North Carolina due to lower overall average revenue earned from the fishery compared to other states. As a result, the communities associated with these inshore fisheries would be likewise significantly impacted. Because of data limitations and the inability to accurately predict behavioral changes, it cannot be known with certainty which communities would face the greatest impacts[25].

In addition to these types of impacts, less quantifiable impacts must also be considered. Specifically, from the perspective of industry participants, the proposed action would be yet another regulatory change and burden in a relatively long list of regulatory changes imposed on this industry at both the federal and state levels. In past years, the shrimp industry as a whole has had to accept changes in the TED requirements, a federal permit requirement, additional closures in Texas' state waters, mandatory electronic logbooks, mandatory observers, additional data reporting requirements, and new state trip ticket programs. Since the industry has been beset by adverse economic conditions for the past 5-10 years as a result of, among other factors, higher fuel prices and greater competition from imports, the proposed action would only add to the difficult economic and regulatory environment faced by this industry. Many individuals and businesses that have been involved in the industry for years, and probably decades, have already been forced to leave the industry as a result of these forces. Additionally, some participants were also significantly affected by hurricanes Katrina and Rita in 2005 and the 2010 DWH oil spill event. Because of the collective impacts of these past factors and the proposed regulatory action, it's likely that the action would be highly resented by affected industry participants.

In this case, industry perceives there is a lack of a necessary rationale for the proposed action. Specifically, industry participants indicated during scoping they believe that increased sea turtle strandings are not the result of the shrimp industry, but due to other factors such as the DWH oil spill event and increased abundance of sea turtles in nearshore waters. From the perspective of Gulf and North Carolina shrimp industry participants, they believe they have already contributed more than their fair share in aiding the recovery of sea turtles via the use of TEDs and mandatory tow time restrictions, as well as indirectly due to significant reductions in the size of the Gulf and North

[25] Even if behavioral changes could be predicted, accurately predicting such impacts at the community level would require an input-output model applicable to the particular communities that would account for multiplier effects. Such a model is not currently available.

Carolina shrimp fleets and the concomitant significant reduction in shrimp trawl effort that has occurred in recent years.

An additional social issue is the perceived regulatory inequity within the shrimp fisheries in regard to required TED use. Otter trawl vessels are required to use TEDs and operate in similar physical and economic circumstances as skimmer trawl vessels, which currently may use alternative tow time restrictions in lieu of TEDs. Some fishermen operating otter trawl vessels have noted that skimmer trawl vessels should also be required to use TEDs in their nets, which would removed a perceived unfair advantage and insure that all sectors of the shrimp fisheries are doing “their fare share” to protect threatened and endangered sea turtles.

7.13 EXECUTIVE ORDER 13158 (MARINE PROTECTED AREAS)

E.O. 13158 requires each federal agency whose actions affect the natural or cultural resources that are protected by a Marine Protected Area (MPA) to identify such actions, and, to the extent permitted by law and to the extent practicable, avoid harm to the natural and cultural resources that are protected by an MPA. E.O. 13158 promotes the development of MPAs by enhancing or expanding the protection of existing MPAs and establishing or recommending new MPAs. The E.O. defines an MPA as “any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” All national marine sanctuaries are listed under the National Registry. There are no marine sanctuaries in the geographic area that would be affected by the preferred alternative.

7.14 NATIONAL HISTORIC PRESERVATION ACT

There is one submerged cultural resource listed in the *National Register of Historic Places* in the action area that could be affected by the alternatives described in this EIS: the wreck of the U.S.S. TECUMSEH, which rests in Mobile Bay, Alabama. The U.S.S. TECUMSEH is a charted wreck and, therefore, would likely be avoided by any trawling activities in Mobile Bay, to the extent that they currently occur in the area.

Implementation of any of the alternatives will not change the shrimp fisheries’ effects on cultural resources in the area. The use of a TED (Alternatives 2a, 2b, or Preferred Alternative 2c) would not significantly add or modify any impacts that may occur from gear interaction with submerged cultural resources; the trawl doors or skids and footrope are the significant interactive agents. NMFS has determined that the proposed action and alternatives have no potential to cause effects on historic properties. Therefore, coordination with the State Historic Preservation Officer under the National Historic Preservation Act is not required.

7.15 EXECUTIVE ORDER 12898 (ENVIRONMENTAL JUSTICE)

The EPA defines environmental justice as, “the fair treatment for all people of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies.” E.O. 12898 was implemented in response to the growing need to address the impacts of environmental pollution on particular segments of our society. This order requires each federal agency to achieve environmental justice by addressing "disproportionately high and adverse human health and environmental effects on minority and low-income populations." In furtherance of this objective, the EPA developed an Environmental Justice Strategy that focuses the action agency's efforts in addressing these concerns. For example, to determine whether environmental justice concerns exist, the demographics of the affected area should be examined to ascertain whether minority populations and low-income populations are present, and, if so, a determination must be made as to whether implementation of the alternatives may cause disproportionately high and adverse human health or environmental effects on these populations. Environmental justice concerns typically relate to pollution and other environmental health issues, but the EPA has stated that addressing environmental justice concerns is consistent with NEPA; therefore, all federal agencies are required to identify and address these issues.

Information on the race and income status for groups at the different participation levels (vessel owners, crew, dealers, processors, employees, employees of associated support industries, etc.) in the shrimp fisheries is not available. The shrimp fisheries and its supporting industries are not disproportionately identified with a given ethnic or economic minority. Nonetheless, many of the participants may come from lower income and/or ethnic minority populations. For example, in many port groups, crew includes ethnic minorities (e.g., Hispanic, Vietnamese, etc.), and many regions in which bottom trawl fishing is an important livelihood are economically impoverished. These populations may be more vulnerable to the associated costs of regulatory implementation. Additional discussion on environmental justice issues within the shrimp fisheries can be found in Section 3.7.

Although economic impacts are likely to occur to persons employed in the shrimp fisheries, as well as associated businesses and communities, it is not expected nor can it be shown at this time that there would be a disproportionately high and adverse effect on the health or environment of minority and low-income populations. The proposed alternatives evaluated in this DEIS were determined to be viable measures to reduce incidental bycatch and mortality of sea turtles in the shrimp fisheries. The measures do not specifically target any one community, although due to the preferred alternatives focus on skimmer trawl vessels and the fact these vessels dominate Louisiana's inshore shrimp fisheries, communities in that state may be more likely to be affected than others. Regardless, adverse economic impacts are expected under all but the no action alternative. These impacts are not expected to be localized and limited to or focused on specific minority or poor neighborhoods. Rather, they would be distributed throughout the entire Northern Gulf of Mexico region and North Carolina, and the respective local economies. Therefore, within each community, the economic impacts of the proposed action would not likely disproportionately affect minority or low-income populations.

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11 INDEX

APPENDIX I: RECOVERY PLANS, STATUS REVIEWS, AND INTERAGENCY COORDINATION

NMFS and the USFWS share responsibility for implementing the ESA. Generally, USFWS manages land and freshwater species, while NMFS manages marine and anadromous species. Because sea turtles depend upon both the beach and the ocean for their survival, and because of programs and expertise that existed within the agencies when the ESA was implemented, NMFS and USFWS signed a Memorandum of Understanding (MOU) in 1977 to jointly administer the ESA for sea turtles. NMFS has responsibility for the conservation and recovery of sea turtles in the marine environment and USFWS has responsibility for the conservation and recovery of sea turtles on nesting beaches. The agencies work together to develop overarching programs and policies, consult on major activities, and are co-authors on listing decisions, sea turtle recovery plans, five-year and status reviews, and critical habitat decisions.

Sea Turtle Recovery Plans

Section 4(f) of the ESA directs NMFS and the USFWS to develop and implement recovery plans "for the conservation and survival of endangered species and threatened species," unless "…such a plan will not promote the conservation of the species." The ESA defines "conservation" as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." Each plan must include a description of management actions necessary to ensure the conservation and survival of the species; recovery criteria that must be met to delist the species; an estimate of the time and costs required to achieve the recovery plan goal; and intermediate steps towards the goal.

The ESA does not explicitly require any agency or entity to implement recovery plans; they are guidance documents rather than regulatory tools. However, by synthesizing the best available information to determine the relative effects of existing threats, and by prioritizing recovery actions needed to reduce those threats, recovery plans assist federal agencies in fulfilling their obligations under section 7(a)(1) of the ESA, which requires all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species...." Additionally, recovery plans provide the context from which NMFS and the USFWS can assess the effects of federal agency actions and can conditionally authorize incidental takes of listed species that occur during these federal activities, following the requirements of Section 7(a)(2) of the ESA. Recovery plans provide state and local agencies and private entities with guidance to help them minimize takes of listed species in programs they conduct or authorize, and to develop ESA Section 10 Conservation Plans with NMFS and the USFWS. Recovery plans also guide NMFS and USFWS in determining research, management, and regulatory priorities, and provide a framework from which to authorize takes under ESA Section 10 research and enhancement permits.

Recovery plans have been developed for all sea turtle species that occur in U.S. waters, and can be found in their entirety on the NMFS Office of Protected Resources (OPR) website, at: http://www.nmfs.noaa.gov/pr/recovery/plans.htm#turtles. Most of the recovery plans for sea turtles in the Atlantic published in the early 1990s. However, the "Recovery Plan for the Northwest Atlantic Loggerhead Sea Turtle" was revised in 2008 (NMFS and USFWS 2008), and the

"Recovery Plan for the Kemp's Ridley Sea Turtle" was revised in 2011 (NMFS, USFWS, and SEMARNAT 2011). Incidental catch in commercial fisheries is identified as a threat in all sea turtle recovery plans, and takes in demersal trawl fisheries beyond the southeastern U.S. shrimp fisheries is specifically identified as a threat in the Kemp's ridley and loggerhead recovery plans. Recovery actions included in the Northwest Atlantic loggerhead plan include expanding the TED requirements in other U.S. trawl fisheries. Similarly, the draft Kemp's ridley plan includes recovery actions related to expanding the TED requirements, or implementing other equally effective bycatch reduction measures as appropriate.

Although some of the plans may appear dated, new information regarding biology, status, and threats to each species, is evaluated as part of the five-year reviews required by Section 4(c)(2) of the ESA. In addition to considering whether recovery criteria have been met, for species with recovery plans that are not up to date, these reviews analyze new information to determine whether the status and threats have changed since the last review and whether a change in classification is warranted.

Five-Year Reviews

Once a species is listed, a review of the species status must be conducted every five years, under Section 4(c)(2) of the ESA to determine whether a change in listing classification is warranted. As described in the guidance document developed by USFWS and NMFS (2006), a five-year review summarizes new information and evaluates how the species status and threats have changed in comparison to the last status review. Regardless of the recommendations resulting from the status review, the review does not involve rulemaking. A species classification is not changed until the rulemaking process is completed.

The five-year review tracks the progress of a species towards recovery and may identify the next steps required for the species conservation. Like recovery plans, the reviews assist NMFS, USFWS, federal action agencies, and others, in prioritizing conservation actions. Five-year reviews on the status of all of the species of sea turtles discussed in this EIS were completed in 2007 and can be found at: http://www.nmfs.noaa.gov/pr/listing/reviews.htm#species. Of particular note, incidental capture in fisheries, including trawl fisheries, is identified in the status reviews as an important factor affecting the conservation and recovery of all the sea turtle species, and as the most important anthropogenic factor affecting loggerhead sea turtles.

Section 7 Consultations

Section 7 of the ESA (16 USC. 1536) requires federal agencies to protect listed species and designated critical habitat. Section 7(a)(2) of the ESA (16 USC. 1536(a)(2)) directs federal agencies, in consultation with and with the assistance of the Secretaries of the Interior and Commerce (delegated to the respective Services), to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of habitat of such species that has been designated as critical (i.e., "critical habitat"). In keeping with the 1977 MOU between the Services, action agencies consult with USFWS on actions that affect sea turtles on land and with NMFS for those activities that affect sea turtles in the marine environment.

The regulations implementing Section 7, found at 50 CFR part 402 (subparts A and B), require action agencies to consult with the Services on any federal action that "may affect" a listed species or critical habitat. A Consultation Handbook elaborating the procedures followed by the Services when conducting section 7 consultations can be found at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esa_section7_handbook.pdf. Briefly, a consultation may be concluded "informally" if the action agency determines that the federal action under consideration is "not likely to adversely affect" a listed species or critical habitat and the Service gives written concurrence. Formal consultation is required if the action is likely to adversely affect a listed species or critical habitat. During formal consultation, the action agency and the Service examine the effects of the proposed action and the Service determines whether the proposed federal action is likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat and whether incidental take of listed species is anticipated.

A formal consultation concludes with a biological opinion issued by the Service detailing the effects of the action on the listed species or critical habitat. If the Service finds a federal agency action is likely to jeopardize a species or cause adverse modification of critical habitat, the biological opinion must also include reasonable and prudent alternatives to the proposed action, if any are available, to avoid jeopardy. Where jeopardy or adverse modification of critical habitat is not likely to occur, but incidental take of listed species is expected, the Service issues an incidental take statement (ITS) that specifies the amount of take anticipated. Incidental take is defined as take that is incidental to, and not the purpose of, the execution of an otherwise lawful activity. Incidental take statements include reasonable and prudent measures and terms and conditions necessary to minimize the effects of the action. According to ESA Sections 7(b)(4) and 7(o)(2), when the terms and conditions of the ITS are followed and takes do not exceed the level identified within the ITS, the incidental takings that occur are not subject to any prohibition against take that may otherwise apply. That is, incidental takes of listed species during an otherwise lawful activity that would be prohibited under ESA Section 9 and Section 4(d) rules are allowed if the takes do not exceed the level anticipated in the consultation and if the terms and conditions of the ITS are followed. Following the consultation, the action agency is responsible implementing the requirements of the ITS which may include monitoring takes. Failure to implement the terms and conditions through enforceable measures may result in a lapse of the protective coverage of Section 7(o)(2).

NMFS has conducted Section 7 consultations on the effects of federal actions, and has identified the associated anticipated take levels of sea turtles. Consultations have been conducted on federally managed fisheries and research activities; with the U.S. Army Corps of Engineers on channel dredging and beach deposition projects; with the U.S. Navy on vessel, aircraft, and training activities; with the Nuclear Regulatory Commission on the effects of cooling water intake and discharges; and with Bureau of Ocean Energy Management, Regulation, and Enforcement, formerly known as Mineral Management Services, on oil and gas development activities. Approximately 90 biological opinions have been issued for current (through 2009) federally conducted, funded, or authorized activities in the Northeast and Southeast Region that may result in sea turtle takes in the marine environment (NMFS unpublished data). The resulting ITSs are as varied as the activities themselves. Some ITSs identify take levels anticipated for multiple years (up to 30) or for the life of the project, rather than identifying an annual estimate of take. Some identify the anticipated number of sea turtle takes based on observed takes, while other consultations identify the anticipated number of sea turtle takes based on estimates extrapolated from observer data.

Reasonable and prudent measures are required with all ITSs and may include, among others, monitoring requirements, seasonal restrictions, handling and resuscitation measures, measures to analyze characteristics of observed sea turtles takes, and research to develop measures to reduce takes.

The most commonly requested biological opinions issued by the Southeast Region can be found at: http://sero.nmfs.noaa.gov/pr/Section7FisheryBiologicalOpinions.htm.
Recent biological opinions issued by NMFS Office of Protected Resources are found at: http://www.nmfs.noaa.gov/pr/consultation/opinions.htm.

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APPENDIX II: DEVELOPMENT OF TURTLE EXCLUDER DEVICES

Trawling is a method of fishing that involves actively pushing or towing a net through the water. Trawls can be unselective and have the capability to incidentally capture sea turtles and other species that are not the intended target of the fishery. Sea turtles captured in commercial trawl fisheries may drown due to forced submergence over long periods. Even when drowning does not occur, the stress of forced submergence has been shown to result in various negative physiological consequences (Henwood and Stuntz 1987; Lutcavage and Lutz 1997) that can make the turtles susceptible to delayed mortality, predation, boat strike or other sources of injury and mortality.

NMFS began developing physical barriers in trawl nets to deflect sea turtles from trawl codends in the 1970s. Briefly, according to Watson et al. (1986), soft panel separator gear for trawls, designed originally for cold-water shrimp fisheries in the 1960s, were the first turtle excluder gear evaluated for the shrimp fisheries. Testing and development in commercial fishing conditions in the Gulf of Mexico indicated a rigid grid was needed due to the diversity in the sizes and types of fish bycatch that clogged or ripped soft panels (Watson and McVea 1977). Oravetz and Grant (1986) describe the adaptation of the “jellyball” shooter, a hooped grid with a slit at the top inserted by Georgia shrimp fishermen ahead of the codend of the trawl to exclude jellyfish. By 1980, a rigid grid TED was developed and shown to be effective at eliminating sea turtles, as well as finfish, jellyfish, sharks, rays, sponge and other large bycatch (Watson et al. 1986).

Turtle Excluder Device Regulation History

1970: Hawksbill, Kemp’s ridley, and leatherback sea turtles are listed by the U.S. Fish and Wildlife Service (USFWS) as endangered species under the Endangered Species Conservation Act of 1969.

December 28, 1973: Enactment of the Endangered Species Act of 1973 (ESA).

May 20, 1975: NMFS and USFWS publish a proposal to list green, loggerhead, and (Pacific) olive ridley sea turtles as threatened species under the ESA (40 FR 21982, 40 FR 21974). The proposal includes an exception to the ESA takings prohibitions for incidental catch of threatened sea turtles in fishing gear if: (a) the fishing is not in an area of substantial sea turtle breeding or feeding, and (b) the turtles are immediately returned to the water.

July 28, 1978: NMFS and USFWS publish final regulations (43 FR 32800) listing loggerhead, green, and olive ridley sea turtles as threatened species, except for Florida green turtle breeding colony populations and Pacific coast of Mexico olive ridley and green turtle breeding colony populations, which were listed as endangered. Many commenters on the proposal had objected to the “areas of substantial breeding and feeding” language, fearing that a strict interpretation could put many shrimpers out of business. In the final rule, incidental capture of threatened turtles with fishing gear is exempted from the ESA takings prohibitions in all areas, if turtles are returned to the water following resuscitation attempts for unconscious animals. The rule also states that NMFS has developed and is testing a turtle excluder panel installed across the mouth of a shrimp trawl to prevent or substantially reduce the capture of sea turtles, with the objective of completing the development and testing of the panel by the end of the 1978 shrimp season. NMFS states its “goal is to promulgate regulations requiring the use of the panel to prevent, or substantially reduce, incidental catch of sea turtles without significantly reducing shrimp production."

1978: Testing of the turtle excluder panels resulted in preventing 75 percent of encountered turtles from entering the trawls, but shrimp losses (15 to 30 percent) were unacceptable. Research was then directed towards releasing turtles once they entered the trawl versus preventing them from entering the trawl (NMFS 1987).

1978-1981: NMFS attention is turned toward testing and development of a rigid turtle excluder device (TED) that can be inserted farther back in the net. Turtle exclusion and shrimp retention results for the TED are positive. By 1981, the NMFS TED – a large, cage-like device with a metal-framed trap door – has been developed and found to release 97 percent of the turtles caught in shrimp trawls with no loss of shrimp (52 FR 24244, June 29, 1987).

1981-1983: NMFS encourages voluntary use of TEDs in the shrimp fisheries.

1983-1986: NMFS operates a formal program which builds and delivers TEDs to shrimp fishermen who agree to use them voluntarily in commercial shrimping operations. The program proves ineffective. As of late 1986, less than three percent of the shrimp fleet had used TEDs (Oravetz 1986).

October-December 1986: NMFS sponsors mediated sessions involving environmental and shrimp industry groups. The negotiations attempt to develop a mutually acceptable implementation of TED requirements and avert threatened litigation from environmental groups. One party to the mediation sessions, the Concerned Shrimpers of Louisiana, refuses to sign the developed agreement and negotiations break down.

1987: A report (Henwood and Stuntz 1987) analyzing observer data from the southeastern U.S. shrimp fisheries from 1973-1984 conservatively estimates that the shrimp fisheries in offshore waters kills 9,874 loggerhead, 767 Kemp's ridley, and 229 green turtles annually.

March 2, 1987: NMFS develops and publishes proposed regulations to require the use of TEDs in most offshore shrimp trawlers (52 FR 6179).

June 29, 1987: NMFS publishes final regulations implementing TED requirements (52 FR 24244). The regulations are codified at 50 CFR parts 217, 222, and 217. Many of the provisions of the rule phase in over a 20-month period. Ultimately, TEDs are required seasonally aboard all shrimp trawlers over 25 feet in length in offshore waters of the Gulf and South Atlantic, except for southwest Florida and the Canaveral area, where they are required year-round. Shrimp trawlers less than 25 feet in length and all trawlers in inshore waters are required to limit their tow-times to a maximum of 90 minutes seasonally, except in southwest Florida and the Canaveral area, where tow-times are required year-round. Exemptions to the TED requirement are included for trawlers fishing for royal red shrimp and rock shrimp. Try nets up to 20 feet in headrope length are also exempted. Four specific designs of hard TEDs – the NMFS TED, the Cameron TED, the Matagorda TED, and the Georgia TED – are included in the regulations as qualified TEDs. The minimum size of the TED escape openings is specified as 32 inches in the Gulf and 35 inches in the

Atlantic, but how this opening is measured is not specified. The regulations make provisions for testing and approving additional TED designs that may be developed by NMFS or the shrimping industry. An appendix published with the regulations specifies a scientific protocol for evaluating new TEDs in the Cape Canaveral shipping channel. Candidate TEDs must demonstrate a reduction in the catch of wild turtles, compared to a net with no TED, of greater than 96 percent.

September 30, 1987: NMFS completes a biological opinion on the implementation of the 1987 regulations. The 1987 opinion addresses the potential adverse effects to listed species of implementation of the rule, and concludes that the regulations would have a positive impact on sea turtles by substantially reducing mortalities. At that time, NMFS' policy on ESA section 7 consultation is to address the potential impacts to listed species of management actions and not to address potential adverse effects of the fishery itself. The policy is ultimately changed on October 18, 1990, when the Assistant Administrator for Fisheries advises all NMFS Regional Directors that future ESA consultations on fishery management actions would address both the fishery and the proposed management action.

October 5, 1987: NMFS issues a final rule/technical amendment (52 FR 37152) to authorize an additional type of TED, the Morrison TED, which is the first soft TED. It uses an upward-sloping panel of flexible webbing instead of the rigid grid used in hard TEDs.

October 1987 - May 1990: A chaotic array of lawsuits, injunctions, suspensions of law enforcement, legislative actions by several states, legislation by Congress, and temporary rules issued by NMFS and the Department of Commerce follows the initial effective date of the 1987 regulations. The result is a patchwork of times and areas where TEDs are and are not required/enforced.

October 7, 1988: President Reagan signs a bill that requires a study by the National Academy of Sciences to review the question of sea turtle conservation status and the significance of mortality from commercial trawling.

September 1, 1988: NMFS issues a final rule/technical amendment (53 FR 33820) to authorize an additional soft TED, the Parrish TED. It uses a downward-sloping webbing panel leading to a rigid frame.

November 21, 1989: President G. Bush signs Public Law 101-162. Section 609 requires the Department of State, in consultation with the Department of Commerce, to initiate negotiations with foreign countries to develop agreements for sea turtle conservation, with emphasis on countries that have commercial fishing fleets that adversely affect sea turtles. It further requires the United States to ban the importation of commercially harvested shrimp unless the exporting country has been certified by the Department of State as having a regulatory program for sea turtle incidental capture in shrimp trawls that is comparable to the United States' requirements. The certification is due on May 1, 1991, and annually thereafter.

May 1990: The report, "Decline of the Sea Turtles: Causes and Prevention," is released (National Research Council 1990). The report concludes that: (1) combined annual counts of nests and nesting females indicate that nesting sea turtles continue to experience population declines in most of the United States. Declines of Kemp's ridleys on the nesting beach in Mexico and of loggerheads on South Carolina and Georgia nesting beaches are especially clear; (2) natural mortality factors – such as predation, parasitism, diseases and environmental changes – are largely unquantified, so their respective impacts on sea turtle populations remain unclear; (3) sea turtles can be killed by several human activities, including the effects of beach manipulations on eggs and hatchlings and several phenomena that affect juveniles and adults at sea, collisions with boats, entrapment in fishing nets and other gear, dredging, oil-rig removal, power plant entrainment, ingestion of plastics and toxic substances, and incidental capture in shrimp trawls; (4) shrimp trawling kills more sea turtles than all other human activities combined, and the annual mortality estimate from Henwood and Stuntz (1987) may be low by as much as a factor of four; (5) shrimp trawling can be compatible with the conservation of sea turtles if adequate controls are placed on trawling activities, especially the mandatory use of TEDs in most places at most times of the year; and (6) the increased use of conservation measures on a worldwide basis would help to conserve sea turtles.

October 9, 1990: NMFS issues a final rule/technical amendment (55 FR 41088) to authorize an additional soft TED, the Andrews TED. It uses a net-within-the-net design.

October 9, 1990: NMFS publishes an alternative scientific protocol (55 FR 41092) to the Canaveral test for approving new TED designs. In 1989, there were not enough turtles in the Canaveral Channel to conduct TED testing, necessitating the development of a new protocol. The new small turtle test protocol overcomes some of the other concerns over the Canaveral test. In particular, it uses turtles that are similar in size to wild Kemp's ridleys, the species of greatest conservation concern at the time, and it allows divers to videotape every turtle's encounter with the candidate TED, greatly increasing the understanding of the factors in a TED's design that affect sea turtle exclusion. The small turtle test's limitation, however, is that, since captive animals are used under experimental conditions, the metric used for decisions is a candidate TED's performance relative to a control TED, rather than its straight reduction in sea turtle captures.

April 1992: The South Atlantic Fishery Management Council (SAFMC) requests consultation on the Shrimp Fishery Management Plan for the South Atlantic, and the Gulf of Mexico Fishery Management Council (GMFMC) requests consultation on Amendment 6 to the Gulf of Mexico Shrimp Fishery Management Plan.

April 30, 1992: NMFS proposes to amend the sea turtle conservation regulations to strengthen their effectiveness and enforceability (57 FR 18446). The proposal would require essentially all shrimp trawlers in the southeast U.S. to use TEDs year-round, even in inshore waters, with only limited exemptions.

August 19, 1992: NMFS completes section 7 consultation and issues a biological opinion that considers the two Council's FMPs, the shrimp fisheries in the Gulf and South Atlantic, and the implementation of the 1992 revised sea turtle conservation regulations. The opinion concludes that shrimp trawling, as managed by the Councils and in compliance with the proposed sea turtle conservation regulations, is not likely to jeopardize the continued existence of listed species under NMFS' jurisdiction. With respect to leatherback turtles, however, the opinion states, "leatherback mortalities remain a problem that must be addressed to avoid jeopardizing the recovery of this species." The opinion's incidental take statement includes six reasonable and prudent measures (RPMs). Three have to do with items that are implemented through the regulations (required use of TEDs, limitations on the use of tow-times, and resuscitation of comatose turtles). A fourth is the requirement to implement an observer program to monitor turtle take whenever tow-times are authorized as an alternative to TEDs. NMFS never implements such an observer program. Instead, on the future occasions when NMFS does subsequently issue tow-time authorizations because of hurricane debris or algae blooms, NMFS consults with the state fisheries directors who agree to provide elevated enforcement to ensure compliance with tow-times. A fifth reasonable and prudent measure states that NMFS should develop a program so that all turtle mortalities are reported to the Southeast Regional Office of NMFS in person, by phone, or by letter, within 10 days of return from the fishing trip during which the incidental take occurred. This reporting program is never implemented. The final requirement is to develop and implement a contingency plan to eliminate the episodic take of leatherback turtles by shrimp trawlers. A contingency plan addressing some months along the Atlantic coast is ultimately developed.

September 8, 1992: NMFS publishes an interim final rule implementing some of the provisions of the April 1992 proposed rule.

December 4, 1992: NMFS publishes a final rule (57 FR 57348) implementing the April proposal. The rule includes a phase-in period for inshore vessels with small nets until December 1, 1994. The rule requires all shrimp trawlers in inshore and offshore waters from North Carolina to Texas to have TEDs installed in all nets that are rigged for fishing. Exempted from the TED requirements are: (1) royal red shrimp trawlers; (2) beam and roller trawls, if vertical bars on 4-inch spacings are attached across the mouth of the trawl; and (3) a single try net, up to 20 feet in headrope length, per boat. Also exempted from the TED requirements, if fishermen follow tow-time limits of 55 minutes from April-October and 75 minutes from November-March, are: (1) trawls that are entirely hand-hauled; (2) bait shrimpers, if all shrimp are kept in a live-well with no more than 32 pounds of dead shrimp aboard; (3) pusher-head trawls (i.e., chopsticks rigs), skimmer trawls, and wing nets (i.e., butterfly nets); (4) trawlers in an area and at a time where the Assistant Administrator determines that special environmental conditions make TED use impracticable; and (5) if the Assistant Administrator determines that TEDs are ineffective. Resuscitation measures that fishermen must follow for incidentally caught turtles that come aboard in a comatose condition are modified, and fishermen are allowed to hold turtles on board under certain conditions, while they are being resuscitated. The technical specifications for hard TEDs are rewritten to create more explicit and more flexible descriptions of the required construction characteristics of hard TEDs, rather than require shrimpers to use one of the four named styles of hard TEDs from the 1987 regulation. The specifications for the TED opening dimensions are clarified for single-grid hard TEDs: 35 inches horizontal and, simultaneously, 12 inches vertical in the Atlantic, and 32 inches horizontal and, simultaneously, 10 inches vertical in the Gulf of Mexico. Descriptions of accelerator funnels and webbing flaps – optional modifications to increase shrimp retention – are added. A framework and procedures are established whereby the Assistant Administrator may impose additional restrictions on shrimping, or any other fishing activity, if the incidental taking of sea turtles in the fishery would violate an incidental take statement, biological opinion, or incidental take permit or may be likely to jeopardize the continued existence of a listed species.

May 17, 1993: NMFS issues a final rule/technical amendment (58 FR 28795) to authorize an additional soft TED, the Taylor TED. It is similar to the Morrison TED, but uses a smaller panel of smaller-mesh webbing and a flap over the escape opening. A modification of the Morrison TED to use a larger escape opening covered with a flap is also approved. The Taylor TED and modified Morrison TED have escape openings that are large enough to release leatherback turtles.

October 20, 1993: NMFS issues a final rule/technical amendment (58 FR 54066) to create a new category of hard TEDs – special hard TEDs – and to authorize a new special hard TED for the shrimp fisheries, the Jones TED. The Jones TED features bars that are set diagonally, rather than vertically, in the face of the grid, and whose bar ends are not attached to other bars or to the TED frame.

May 18, 1994: NMFS issues a final rule/technical amendment (59 FR 25827) to specify a modification that can be made to the escape opening of single grid hard TEDs that will allow the TEDs to exclude leatherback turtles.

June 29, 1994: NMFS issues an interim final rule (59 FR 33447) to require bottom-opening hard TEDs to be modified by attaching floats to the TEDs to keep them from riding hard on the sea floor. Major increases in sea turtle strandings were observed in early 1994 in Texas, and the absence of floats on bottom-opening TEDs was determined to be one contributing factor.

November 14, 1994: NMFS completes section 7 consultation and issues a biological opinion on the impacts of shrimp trawling in the southeastern United States (NMFS 1994). Consultation on the shrimp fisheries had been reinitiated as the result of extraordinarily high strandings of sea turtles, particularly the critically endangered Kemp's ridley turtle, in Texas and Louisiana corresponding to periods of heavy nearshore shrimping effort. The opinion concludes that "continued long-term operation of the shrimp fishery in the southeastern U.S., resulting in mortalities of Kemp's ridley turtles at levels observed in the Gulf of Mexico in 1994, is likely to jeopardize the continued existence of the Kemp's ridley population." The jeopardy opinion included a reasonable and prudent alternative (RPA) that would allow the shrimp fisheries to continue and avoid the likelihood of jeopardizing Kemp's ridley sea turtles. The RPA specified the following measures that NMFS must take to improve TED regulation compliance: (1) develop an emergency response plan (ERP) to address increases in sea turtle strandings or TEDs noncompliance; (2) deploy a specially trained law enforcement team to respond to high strandings, TEDs noncompliance, or intensive shrimping effort in areas of expected sea turtle abundance; (3) develop and implement a TED enforcement training program for U.S. Coast Guard boarding parties; (4) amplify domestic TED technology programs; and (5) develop a permitting or registration system for offshore shrimpers that would allow sanctioning the permit for TED violations and failing to pay assessed fines. NMFS also was required to re-examine the effectiveness of bottom-shooting hard TEDs and soft TEDs, and mitigate the impacts of intensive nearshore shrimping effort through the identification of areas requiring special turtle management. NMFS ultimately implemented all the elements of the RPA, with the exception of the shrimp fisheries permitting/registration system. The opinion's incidental take statement, in addition to establishing incidental take levels based on observer coverage, sets indicated take levels, based on historical stranding levels. The ITS incorporates all of the RPMs from the 1992 opinion and also adds a number of new RPMs, such as improving the overall observer coverage in the shrimp fisheries and stranding network coverage in poorly covered states. NMFS must use this observer and stranding information to implement the actions of the ERP. NMFS must also convene a team of population biologists, sea turtle scientists, and life history specialists to compile and examine information on the status of sea turtle species. The team should attempt to determine the maximum number of individual sea turtles of each species that can be taken incidentally to commercial fishing activities without jeopardizing the continued existence of the species and what the corresponding level of strandings would be. Lastly, NMFS is required to evaluate other human-caused sources of sea turtle mortality and identify measure to reduce those sources of mortality.

March 14, 1995: NMFS issues the details of the ERP, required under the RPA of the 1994 opinion. The ERP is issued to identify monitoring, reporting and enforcement actions, as well as associated management measures that NMFS would consider implementing by emergency rulemaking if strandings become elevated. Briefly, the ERP identifies interim sea turtle management areas (ISMAs) within which enforcement would be elevated from April through November. Two ISMAs were identified: Atlantic Interim Special Management Area, including shrimp fishery statistical Zones 30 and 31 (i.e., northeast Florida and Georgia) and the Northern Gulf Interim Special Management Area, including statistical Zones 13 through 20 (i.e., Louisiana and Texas from the Mississippi River to North Padre Island). NMFS would implement gear restrictions on shrimp trawling through existing rulemaking authority (codified at 50 CFR 227.72(e)(6)) in response to two weeks of elevated strandings at levels approaching (within 75 percent of) the indicated take levels or higher in the ISMAs when no other likely causes of mortality were evident. Outside of the ISMA, implementation of similar restrictions would be considered after four weeks of elevated strandings. Areas monitored were delineated as the NMFS shrimp fishery statistical areas, and restrictions would be implemented within zones of elevated strandings out to 10 nautical miles (nm) offshore.

March 24, 1995: NMFS issues a final rule/technical amendment (60 FR 15512) to finalize the float requirement and implement a variety of other minor changes to TED technical specifications. One of these specifies that the width of the cut for a hard TED's escape opening must extend at least from the outermost bar of the grid to the opposite outermost bar of the grid.

May-August 1995: NMFS implements gear restrictions based on the ERP through temporary rulemaking four times during 1995: twice in the Gulf of Mexico and twice in the Atlantic (60 FR 21741, May 3, 1995; 60 FR 26691, May 18, 1995; 60 FR 31696, June 16, 1995; 60 FR 32121, June 20, 1995; 60 FR 42809, August 17, 1995; 60 FR 43106, August 18, 1995; 60 FR 44780, August 29, 1995).

May 12, 1995: NMFS issues an interim rule (60 FR 25620) to establish all inshore and offshore waters from Cape Canaveral, Florida (28° 24.6'N) to the North Carolina-Virginia border (36° 30.5'N) as the leatherback conservation zone and to provide for short-term closures of areas in that zone when high abundance levels of leatherback turtles are documented (i.e., "the leatherback contingency plan"). Upon such documentation, NMFS would prohibit, in the closed areas, fishing by any shrimp trawler required to have a TED installed in each net that is rigged for fishing, unless the TED installed is specified in the regulations as having an escape opening large enough to exclude leatherback turtles. NMFS also proposes (60 FR 25663) to adopt as final this interim rule establishing the leatherback conservation zone.

June 2, 1995: NMFS temporarily amends the regulations (60 FR 28741) protecting sea turtles to allow compliance with tow-time limits as an alternative to the use of TEDs in a 30-square mile (48.3-square km) area off the coast of North Carolina to allow shrimp fishermen to fish under conditions of high concentrations of red and brown algae that make trawling with TEDs impracticable while maintaining adequate protection for sea turtles in this area.

September 14, 1995: NMFS issues a final rule (60 FR 47713) establishing the leatherback conservation zone and leatherback contingency plan in the Atlantic.

April 24, 1996: NMFS proposes (61 FR 18102) prohibiting the use of all previously approved soft TEDs; requiring the use of approved hard TEDs in try nets with a headrope length greater than 12 feet (3.6 m) or a footrope length greater than 15 feet (4.6 m); establishing Shrimp Fishery Sea Turtle Conservation Areas (SFSTCAs) in the northwestern Gulf of Mexico and in the Atlantic along the coasts of Georgia and South Carolina; and, within the SFSTCAs, prohibiting soft TEDs, imposing the new try net restrictions, and prohibiting the use of bottom-opening hard TEDs.

June 11, 1996: NMFS completes section 7 consultation and issues a biological opinion on the impacts of shrimp trawling in the southeastern United States (NMFS 1996). Consultation on the shrimp fisheries had been reinitiated to evaluate the effects of the April 24, 1996 proposed rule, a plan to implement a shrimp vessel registration system, and to consider the effects of strandings-based incidental take levels that had been exceeded. The opinion concludes that continued operation of the shrimp fisheries is not likely to jeopardize listed sea turtles, with implementation of the proposed TED rule changes and of a shrimp vessel registration system, which the opinion requires to be proposed formally by the end of 1996. The opinion also eliminates the strandings-based incidental take levels that had been in place since the introduction of the ERP in March 1995. The ERP is replaced instead with a more flexible requirement for NMFS to consult with state stranding coordinators to identify significant local stranding events and to implement 30-day restrictions on shrimping in response, as appropriate.

June 27, 1996: NMFS, in response to elevated strandings, issues temporary additional restrictions (61 FR 33377) on shrimp trawlers fishing in the Atlantic Area in inshore waters and offshore waters out to 10 nautical miles (18.5 km) from the COLREGS line between the Georgia-Florida border and the Georgia-South Carolina border. The restrictions include prohibitions on the use of soft TEDs and try nets with a headrope length greater than 12 feet (3.6 m) or a footrope length greater than 15 feet (4.5 m), unless the try nets are equipped with approved TEDs other than soft TEDs. The restrictions are in response to elevated sea turtle mortality.

November 13, 1996: NMFS completes section 7 consultation and issues a biological opinion on the impacts of shrimp trawling in the southeastern United States (NMFS 1996). Consultation on the shrimp fisheries had been reinitiated to evaluate the effects of the final rule implementing the April 24, 1996 proposed rule and of elevated loggerhead strandings that occurred during 1996. The opinion concludes that continued operation of the shrimp fisheries is not likely to jeopardize listed sea turtles, with the publication of the final rule, which implements the RPA component of the 1994 opinion requiring NMFS to address mortalities resulting from incorrect installation of TEDs and the certification of TEDs which do not effectively exclude sea turtles. The opinion extends the deadline for finalizing the shrimp vessel registration requirement through February 1997.

December 19, 1996: NMFS issues a final rule (61 FR 66933) requiring that TEDs be installed in try nets with a headrope length greater than 12 feet (3.6 m) and a footrope length greater than 15 feet (4.6 m); removing the approval of the Morrison, Parrish, Andrews, and Taylor soft TEDs; establishing SFSTCAs, and within the SFSTCAs, imposing the new TED requirement for try nets, removing the approval of soft TEDs, and modifying the requirements for bottom-opening hard TEDs.

March 24, 1998: NMFS completes section 7 consultation and issues a biological opinion on the impacts of shrimp trawling in the southeastern United States (NMFS 1998). Consultation on the shrimp fisheries had been reinitiated to evaluate the effects of approving the use of a new soft TED, to discuss the decision not to implement a mandatory shrimp vessel registration system (part of the 1994 biological opinion's RPA), and to evaluate recent data on sea turtle populations and strandings. The opinion concludes that continued operation of the shrimp fisheries is not likely to jeopardize listed sea turtles, with continued improved enforcement of the sea turtle conservation regulations and expanded education and outreach programs.

April 13, 1998: NMFS issues an interim final rule (63 FR 17948) authorizing the use of a new soft TED – the Parker TED – in certain trawl net styles for an 18-month trial period, during which its performance will be evaluated to ensure that it remains effective at excluding sea turtles during extended commercial use.

October 14, 1998: NMFS issues a temporary rule (63 FR 55053) effective through November 6, 1998, to allow the temporary use of limited tow times by shrimp trawlers in Alabama inshore waters as an alternative to the requirement to use TEDs in order to address difficulty with TED performance due to large amounts of debris in Alabama's bays in the aftermath of a hurricane.

May-June 1999: NMFS issues four temporary rules (64 FR 25460, May 12, 1999; 64 FR 27206, May 19, 1999; 64 FR 28761, May 27, 1999; 64 FR 29805, June 3, 1999) to protect leatherback sea turtles within the leatherback conservation zone.

October 13, 1999: NMFS issues an interim final rule (64 FR 55434) extending the authorized use of the Parker TED for an additional 12 months, as the results of the Parker TED's evaluation have been inconclusive.

December 13, 1999: NMFS issues a 30-day rule (64 FR 69416) imposing an additional restriction on shrimp trawlers required to have a TED installed in each net that is rigged for fishing, operating in Atlantic offshore waters out to 10 nautical miles from the coast of Florida between 28°N latitude and the Georgia-Florida border. Shrimp vessels operating in this area must use the leatherback modification for hard TEDs or the leatherback modification for the Parker soft TED. The restrictions are in response to greatly elevated leatherback sea turtle strandings in the area. The strandings occur during a time when the leatherback contingency plan does not apply, necessitating the use of the 30-day rule.

October 25, 1999: NMFS issues a temporary rule (64 FR 57397) to allow the use of limited tow times by shrimp trawlers as an alternative to the use of TEDs in the Matagorda Bay area of Texas. This action is required due to extraordinarily high concentrations of a bryozoan lodging in TEDs, rendering them ineffective in expelling sea turtles as well as negatively impacting fishermen's catches.

April 5, 2000: NMFS issues an advance notice of proposed rulemaking to announce that it is considering technical changes to the requirements for TEDs. NMFS proposes to modify the size of the TED escape opening, modify or decertify hooped hard TEDs and weedless TEDs, and change the requirements for the types of flotation devices allowed. NMFS also proposes to consider modifications to the leatherback conservation zone regulations to provide better protection to leatherback turtles.

April 25, 2000: NMFS issues a 30-day rule (65 FR 24132) imposing an additional restriction on shrimp trawlers required to have a TED installed in each net that is rigged for fishing, operating in Gulf of Mexico offshore waters out to 10 nautical miles between Port Mansfield Channel and Aransas Pass, Texas. Shrimp vessels operating in this area must use the leatherback modification for hard TEDs or the leatherback modification for the Parker soft TED. The restrictions are in response to leatherback sea turtle strandings in the area. The strandings occur in an area where the leatherback contingency plan does not apply, necessitating the use of the 30-day rule.

May 2000: NMFS issues two temporary rules (65 FR 25670, May 3, 2000; 65 FR 33779, May 25, 2000) to protect leatherback sea turtles within the leatherback conservation zone.

August 29, 2000: NMFS issues a temporary rule (65 FR 52348) to allow the use of limited tow times by shrimp trawlers as an alternative to the use of TEDs in inshore waters of Galveston Bay, Texas. Dense concentrations of marine organisms documented in this area were clogging TEDs, rendering them ineffective in expelling sea turtles from shrimp nests as well as negatively impacting fishermen's catches.

January 9, 2001: NMFS issues a final rule (66 FR 1601) permanently approving the use of the Parker soft TED. Although industry use of the Parker TED is extremely low, NMFS' evaluation of its effectiveness does not find significant problems with compliance with the TED's specifications or with sea turtle captures.

May 14, 2001: NMFS issues an interim final rule (66 FR 24287) approving the use of an additional style of single-grid hard TED – the double cover flap TED.

October 2, 2001: NMFS issues a proposed rule (66 FR 50148) to amend the sea turtle conservation regulations to enhance their effectiveness in reducing sea turtle mortality resulting from shrimp trawling in the Atlantic and Gulf Areas of the southeastern United States. NMFS determines that modifications to the design of TEDs need to be made to exclude leatherbacks and large loggerhead and green turtles; several approved TED designs are structurally weak and do not function properly under normal fishing conditions; and modifications to the trynet and bait shrimp exemptions to the TED requirements are necessary to decrease lethal takes of sea turtles.

December 20, 2001: NMFS issues a 30-day rule (66 FR 65658) imposing an additional restriction on shrimp trawlers required to have a TED installed in each net that is rigged for fishing, operating in Atlantic offshore waters out to 10 nautical miles from the coast of Florida between 28°N latitude and the Georgia-Florida border. Shrimp vessels operating in this area must use the leatherback modification for hard TEDs or the leatherback modification for the Parker soft TED. The restrictions are in response to greatly elevated leatherback sea turtle strandings in the area. The strandings occur during a time when the leatherback contingency plan does not apply, necessitating the use of the 30-day rule.

December 31, 2001: NMFS issues a final rule (66 FR 67495) amending the sea turtle handling and resuscitation regulation.

April-May 2002: NMFS issues three temporary rules (67 FR 20054, April 24, 2002; 67 FR 21585, May 1, 2002; 67 FR 34622, May 15, 2002) to protect leatherback sea turtles within the leatherback conservation zone.

May 30, 2002: NMFS issues a 30-day rule (67 FR 37723) imposing additional restrictions on shrimp trawlers in offshore Atlantic waters west of approximately Cape Fear, North Carolina and north of approximately St. Augustine, Florida. Shrimp fishermen operating in this area are required to use TEDs with escape openings modified to exclude leatherback turtles and are prohibited from fishing at night between one hour after sunset and one hour before sunrise. These restrictions are implemented in response to greatly elevated strandings of loggerhead turtles and an apparent change in effort and behavior of the local fishery.

November 7, 2002: NMFS issues a temporary rule (67 FR 67793) effective through December 2, 2002, to allow the temporary use of limited tow times by shrimp trawlers in Louisiana state waters east of 92° 20'W (approximately at Fresh Water Bayou in Vermilion Parish, Louisiana) and inshore Alabama waters of Bon Secour Bay, Mobile Bay, and Mississippi Sound, south of the ICW, due to large amounts of debris in the wake of Tropical Storm Isidore and Hurricane Lili.

February 21, 2003: NMFS publishes a final rule amending sea turtle conservation measures to reduce sea turtle mortality in the shrimp trawl fisheries (68 FR 8456). Specifically, it requires the use of larger TEDs to allow the escapement of leatherback and large loggerhead and green sea turtles. The effective date is April 15, 2003, for the South Atlantic, and August 21, 2003, in the Gulf of Mexico.

September 28, 2005: NMFS issues a temporary rule (70 FR 56593) effective through October 24, 2005, to allow the temporary use of limited tow times by shrimp trawlers in state and federal waters from the Florida/Alabama border, westward to the boundary of Cameron Parish, Louisiana (approximately 92°37'W), and extending offshore 50 nautical miles. This action is necessary because environmental conditions resulting from Hurricane Katrina are preventing some fishermen from using TEDs effectively.

October 14, 2005: NMFS issues a temporary rule (70 FR 60013) effective through November 10, 2005, to allow the temporary use of limited tow times by shrimp trawlers in state and federal waters off Cameron Parish, Louisiana (approximately 92°37'W), westward to the boundary shared by Matagorda and Brazoria Counties, Texas, and extending offshore 50 nautical miles. This action is necessary because environmental conditions resulting from Hurricane Rita are preventing some fishermen from using TEDs effectively.

October 27, 2005: NMFS issues a temporary rule (70 FR 61911) effective through November 23, 2005, to allow the temporary use of limited tow times by shrimp trawlers in inshore and offshore waters from the Florida/Alabama border, westward to the boundary shared by Matagorda and Brazoria Counties, Texas, and extending offshore 50 nautical miles. This action is necessary because environmental conditions resulting from Hurricanes Katrina and Rita are preventing some fishermen from using TEDs effectively.

November 24, 2005: NMFS issues a temporary rule (70 FR 71406) effective through December 23, 2005, to allow the temporary use of limited tow times by shrimp trawlers in inshore and offshore waters from the Florida/Alabama border, westward to the boundary shared by Matagorda and Brazoria Counties, Texas, and extending offshore 20 nautical miles. This action is necessary because environmental conditions resulting from Hurricanes Katrina and Rita are preventing some fishermen from using TEDs effectively.

December 29, 2005: NMFS issues a temporary rule (70 FR 77054) effective through January 23, 2006, to allow the temporary use of limited tow times by shrimp trawlers in inshore and offshore waters from the Florida/Alabama border, westward to the Louisiana/Texas border, and extending offshore 20 nautical miles. This action is necessary because environmental conditions resulting from Hurricanes Katrina and Rita are preventing some fishermen from using TEDs effectively.

February 22, 2006: NMFS issues a temporary rule (71 FR 8990) effective through March 20, 2006, to allow the temporary use of limited tow times by shrimp trawlers in inshore and offshore waters from the Florida/Alabama border, westward to the Louisiana/Texas border, and extending offshore 10 nautical miles. This action is necessary because environmental conditions resulting from Hurricanes Katrina and Rita are preventing some fishermen from using TEDs effectively.

October 1, 2008: NMFS issues a temporary rule (73 FR 57010) effective through October 27, 2008, to allow the temporary use of limited tow times by shrimp trawlers in state and federal waters offshore of Louisiana (from the Mississippi/Louisiana boundary to the Texas/Louisiana boundary) extending offshore 20 nautical miles. This action is necessary because environmental conditions resulting from Hurricanes Gustav and Ike are preventing some fishermen from using TEDs effectively.

October 14, 2008: NMFS issues a temporary rule (73 FR 60038) effective through November 7, 2008, to allow the temporary use of limited tow times by shrimp trawlers in state and federal waters offshore of Texas (from the Texas/Louisiana boundary southward to the boundary shared by Matagorda and Brazoria Counties; approximately 95° 32'W) extending offshore 20 nautical miles. This action is necessary because environmental conditions resulting from Hurricane Ike are preventing some fishermen from using TEDs effectively.

November 3, 2008: NMFS issues a temporary rule (73 FR 65277) effective through November 28, 2008, to allow the temporary use of limited tow times by shrimp trawlers in state and federal waters off Louisiana from the western end of Timbalier Island (approximately 90° 33'W) eastward to the Plaquemines/Jefferson Parish line (approximately 89° 54'W), and extending offshore 15 nautical miles. This action is necessary because environmental conditions resulting from Hurricanes Gustav and Ike are preventing some fishermen from using TEDs effectively.

November 12, 2008: NMFS issues a temporary rule (73 FR 66803) effective through December 7, 2008, to allow the temporary use of limited tow times by shrimp trawlers in state and federal waters offshore of Texas (from the Texas/Louisiana boundary southward to the boundary shared by Matagorda and Brazoria Counties; approximately 95° 32'W) extending offshore 9 nautical miles. This action is necessary because environmental conditions resulting from Hurricane Ike are preventing some fishermen from using TEDs effectively.

September 2, 2010: NMFS issues a proposed rule (75 FR 53925) to revise TED requirements to allow the use of new materials and modifications to existing approved TED designs. Specifically, proposed allowable modifications include the use of flat bar, rectangular pipe, and oval pipe as construction materials in currently-approved TED grids; an increase in maximum mesh size on escape flaps from 15⁄8 to 2 inches (4.1 to 5.1 cm); the inclusion of the Boone Big Boy TED for use in the shrimp fisheries; the use of three large TED and Boone Wedge Cut escape openings; and the use of the Chauvin shrimp deflector to improve shrimp retention. NMFS also proposes to allow a new TED for use in the summer flounder fishery. Additionally, there are proposed corrections to the TED regulations to rectify an oversight regarding the maximum size chain that can be used on the Parker TED escape opening flap, and the proposed addition of a brace bar as an allowable modification to hard TEDs.

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APPENDIX III: FISH SPECIES LISTED UNDER THE ENDANGERED SPECIES ACT

Gulf sturgeon (*Acipenser oxyrinchus desotoi*), shortnose sturgeon (*Acipenser brevirostrum)*, Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), and smalltooth sawfish (*Pristis pectinata),* occur within the area encompassed by the alternatives analyzed within this DEIS. The 5-year review for Gulf sturgeon (USFWS and NMFS 2009) note that bycatch in shrimp trawls has been documented but has likely been mitigated by TEDs and BRDs. However, informal conversations with shrimpers suggest that Gulf sturgeon are commonly encountered in Choctawhatchee Bay, Florida, during nocturnal commercial fishing (USFWS and NMFS 2009). The recovery plan for shortnose sturgeon (NMFS 1998) states incidental take of shortnose sturgeon has been documented in shrimp trawls. As noted in the Status Review of Atlantic Sturgeon (NMFS 2007), Atlantic sturgeon have been reportedly captured in shrimp trawls, though TED and BRD requirements may reduce incidental take of Atlantic sturgeon in this fishery.

The shrimp fisheries may directly affect smalltooth sawfish that are foraging within or moving through an active trawling location via direct contact with the gear. The long, toothed rostrum of the smalltooth sawfish causes this species to be particularly vulnerable to entanglement in any type of netting gear, including the netting used in shrimp trawls. The saw penetrates easily through nets, causing the animal to become entangled when it attempts to escape. Mortality of entangled smalltooth sawfish is believed to occur as a result of the net being out of the water for a period of time with the smalltooth sawfish hanging from it before being disentangled (Simpfendorfer pers. comm. 2005). Despite increased effort placed on collecting smalltooth sawfish data since NMFS was petitioned to list the smalltooth sawfish in 1999 (e.g., Simpfendorfer and Wiley 2004; Poulakis and Seitz 2004), records of incidental capture in shrimp trawls are rare. The recovery plan for smalltooth sawfish (NMFS 2009) documents that the species was documented as bycatch in the shrimp fisheries, with the greatest amount of data available from Louisiana (this does not mean the greatest catches were made in Louisiana, only that this is where the best records were kept). One data set from shrimp trawlers off Louisiana from the late 1940s through the 1970s (Simpfendorfer 2002) suggests a rapid decline in the species from the period 1950-1964. Anecdotal information collected by NMFS port agents indicates that smalltooth sawfish are now taken very rarely in the Louisiana shrimp trawl fishery.

While noting that there have been documented interactions between the above mentioned species and shrimp trawls, none of the actions considered in the proposed alternatives are likely to increase the likelihood of incidental take of these listed species.

1 Gulf sturgeon

NMFS and the USFWS jointly listed the Gulf sturgeon as a threatened species throughout its range on September 30, 1991 (56 CFR 49653). The 1991 listing rule cited the following impacts and threats: (1) habitat curtailment and alteration from dams that prevent use of upstream areas for spawning; dredging, desnagging, and spoil deposition carried out in connection with channel improvement and maintenance; poor water quality from heavy pesticides, and contamination from heavy metals and industrial contaminants; (2) overutilization in commercial fisheries from large commercial harvests in the late 1800s through the early 1900s; and (3) the potential threat of hybridization with the white sturgeon should they be introduced for aquaculture.

The Gulf sturgeon Recovery Plan (USFWS et al. 1995) identified reasonable actions believed to be required to recover and/or protect the species. Five recovery tasks were identified. The short-term recovery objective was to prevent further reduction of existing wild populations. The long-term recovery objective was to establish population levels that would allow delisting of the Gulf sturgeon in discrete management units. Most recently, NMFS and USFWS prepared a 5-year review for the Gulf sturgeon in 2009 (USFWS and NMFS 2009) wherein no changes to the ESA listing was identified. The 5-year review also summarized recent research, identified new threats, and suggested updating the recovery plan to include new recovery criteria. New threats to Gulf sturgeon included: climate change, point and non-point discharges, hurricanes, collisions with boats, red tide, and aquaculture (USFWS and NMFS 2009).

The Gulf sturgeon (*Acipenser oxyrinchus desotoi*), also known as the Gulf of Mexico sturgeon, is a primitive fish inhabiting coastal rivers from Louisiana to Florida during the warmer months and over-wintering in estuaries, bays, and the Gulf of Mexico. The Gulf sturgeon is an anadromous fish – adults migrate between fresh and estuarine/marine habitats during their life cycle. Spawning occurs in freshwater in the spring, adults move downstream and spend summers in the lower rivers before moving into estuarine/marine waters in the fall to feed and grow. Gulf sturgeon are long-lived, with some individuals reaching at least 42 years in age (Huff 1975). Sturgeon are characterized by a heterocercal tail (upper lobe is longer than the lower lobe) a ventral protrusible tubular mouth, a row of 4-long unfringed barbels present anterior to mouth, and a mostly cartilaginous skeleton. The head is covered with bony plates, and the body is brown dorsally and pale ventrally with five rows of bony keeled scutes, and small bony scales between the scute rows. While sturgeon possess a primitive body plan (heterocercal tail, spiral-valve intestine, pelvic fin insertion ventroanterior to dorsal fin, and nearly immobile pectoral fins), they are perhaps the earliest group of fishes to evolve protrusile jaws, which is a distinguishing hallmark of advanced teleosts. Adults usually range between 1.2 to 2.4 m in length with females growing larger than males. The Gulf sturgeon is distinguished from the geographically disjunct Atlantic sturgeon (*A. o. oxyrinchus*) by its longer head, pectoral fins, and spleen (Vladykov 1955; Wooley and Crateau 1985). Microsatellite DNA analyses has indicated substantial genetic divergence between Atlantic and Gulf sturgeon (King et al. 2001).

Historically, Gulf sturgeon occurred from the Mississippi River east to Tampa Bay. Sporadic occurrences were recorded as far west as the Rio Grande River in Texas and Mexico, and as far east and south as Florida Bay (Wooley and Creteau 1985; Reynolds 1993). The present range of the Gulf sturgeon extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi east to the Suwannee River in Florida.

Foraging and Diet

The Gulf sturgeon is a benthic suction feeder. This suction feeding requires an expandable mouth that extends downward and a relatively narrow mouth through which to funnel water and food items (Westneat 2001). Success of suction feeding relies on the ability of the predator's mouth to protrude into the proximity of prey (Westneat 2001) and vacuum up sediments containing their prey (infaunal macro invertebrates). Findeis (1997) described sturgeon (*Acipenseridae*) as exhibiting evolutionary traits adapted for benthic cruising. As benthic cruisers, sturgeon forage by feeding focally from the substrate while their mouth maintains contact with the benthos. The sturgeon's heterocercal tail produces both lift and thrust; the beating of the tail tends to pitch the head downward (Vecsei and Peterson 2004) and hypochordal lobe is often reduced to allow sweeping of the tail while close to the substrate (Findeis 1997).

As benthic cruisers, sturgeon forage extensively in an area, presumably until preferred prey is depleted/reduced, relocate, and resume foraging. Tracking observations by Sulak and Clugston (1999), Fox et al. (2002), and Edwards et al. (2003) support that individual Gulf sturgeon move over an area until they encounter suitable prey type and density, at which time they forage for extended periods of time. Individual Gulf sturgeon often remain in localized areas (less than 1 square kilometer) for extended periods of time (greater than two weeks) and then move rapidly to another area where localized movements occurred again (Fox et al. 2002). While the exact amount of benthic area required to sustain Gulf sturgeon health and growth is unknown (and likely dependent on prey density, fish size, and reproductive status), Gulf sturgeon have been known to travel long distances (greater than 161 kilometers) during their winter feeding period.

Few data have been collected on the food habits of Gulf sturgeon; their threatened status limits sampling efforts and gastric lavage techniques have only recently become successful. Gulf sturgeon have been described as opportunistic and indiscriminate benthivores; their guts generally contain benthic marine invertebrates including amphipods, lancelets, polychaetes, gastropods, shrimp, isopods, mollusks, and crustaceans (Huff 1975; Mason and Clugston 1993; Carr et al. 1996; Fox et al. 2000; Fox et al. 2002). Generally, Gulf sturgeon prey are burrowing species (e.g., polychaetes and oligochaetes, amphipods, isopods, and lancelets) that feed on detritus and/or suspended particles, and inhabit sandy substrate.

Adult Gulf sturgeon are known to forage sparingly in freshwater and depend almost entirely on estuarine and marine prey for their growth (Gu et al. 2001). Adults and subadults can lose up to 30 percent of their total body weight while in freshwater, and subsequently compensate for the loss during winter feeding in marine areas (Wooley and Crateau 1985; Clugston et al. 1995; Sulak and Clugston 1999). Gu et al. (2001) compared stable carbon isotope ratios of tissue samples from subadult and adult Suwannee River Gulf sturgeon with their potential freshwater and marine food sources and found a large difference in isotope ratios between freshwater food sources and fish muscle tissue. Results indicate that subadult and adult Gulf sturgeon do not feed significantly in freshwater and the isotope similarity between Gulf sturgeon and marine food resources strongly indicates that this species relies almost entirely on the marine food web for its growth (Gu et al. 2001).

During the early fall and winter, immediately following downstream migration, Gulf sturgeon are most often located in nearshore (depth less than 6.1m), sandy areas that support burrowing macro invertebrates, where the fish are presumably foraging (Fox et al. 2002). Based on distribution and density of infaunal macro invertebrates, Gulf sturgeon have been found to forage in the shallow (2 to 4 meters) shoreline areas of the bays and sounds rather than the deeper portions where low dissolved oxygen levels and the high percentage of silt in the sediments are the probable causes for the observed low abundance of infaunal macroinvertebrates (Livingston 1986). Tracking data indicate Gulf sturgeon typically forage in depths greater than 1 meter perhaps to avoid the higher wave energy of the swash zone from the downward cycloidal movement of waves (wave energy is exponentially dissipated with depth).

Young-of-the-year (YOY) Gulf sturgeon remain in freshwater feeding on aquatic invertebrates, mostly insect larvae, and detritus for about a year after spawning occurs (Mason and Clugston 1993; Sulak and Clugston 1999). Juveniles (i.e., age 1 to 6 years and less than 5 kg) are believed to forage extensively and exploit scarce food resources throughout the river, including aquatic insects (e.g., mayflies and caddis flies), oligochaetes, and bivalve mollusks (Huff 1975; Mason and Clugston 1993). Juvenile sturgeon collected in the Suwannee River are trophically active (foraging) near the river mouth at the estuary, but trophically dormant (not foraging) in summer holding areas upriver; however, a portion of the juvenile population reside and feed year round near the river mouth (K. Sulak, USGS, pers. comm.). In the Choctawhatchee River, juvenile Gulf sturgeon do not remain at the river mouth for the entire year; instead they are located during winter months throughout Choctawhatchee Bay and moved to riverine aggregation areas in the spring (Fox et al. 2002). Subadults (age six to sexual maturity) and adult (sexually mature) Gulf sturgeon do not feed in freshwater (Wooley and Crateau 1985; Mason and Clugston 1993).

After fasting for at least six months in the riverine habitat, adult Gulf sturgeon are presumed to begin feeding immediately in the adjacent estuarine habitat when they exit the river. Adult and subadult Gulf sturgeon forage opportunistically (Huff 1975), primarily on benthic invertebrates. Gut content analyses have indicated that the Gulf sturgeon's diet is predominantly amphipods, lancelets, polychaetes, gastropod mollusks, shrimp, isopods, bivalve mollusks, and crustaceans (Huff 1975; Mason and Clugston 1993; Carr et al. 1996; Fox et al. 2000; Fox et al. 2002). Ghost shrimp (*Lepidophthalmus louisianensis*) and haustoriid amphipods (e.g., *Lepidactylus* spp.) are strongly suspected to be important prey for adult Gulf sturgeon over 1 m (Heard et al. 2000; Fox et al. 2002). Harris et al. (2005) reported that the Gulf sturgeon's major prey resources in the Suwannee River consisted of brachiopods, amphipods, and brittle stars. Distribution of Gulf sturgeon in the spring and fall appear to be associated with sandy areas on which brachiopods settle (Harris et al. 2005). It is unknown how much benthic area is needed to sustain Gulf sturgeon health and growth, but Gulf sturgeon are known to travel long distances (greater than 161 km) during the winter, which suggests that significant resources must be necessary.

Reproduction and Habitat

Currently Gulf sturgeon are known to spawn in seven rivers: Pearl, Pascagoula, Escambia, Yellow, Choctawhatchee, Apalachicola, and Suwannee. Adult Gulf sturgeon spawn in the upper reaches of rivers, at least 100 km upstream of the river mouth during the spring when water temperature rises to between 17° and 25°C (Sulak et al. 2004). Similar to shortnose sturgeon, Randall and Sulak (2007) found some evidence to suggest an additional fall spawning event for Gulf sturgeon in the Suwannee River. Age at sexual maturity ranges from 8 to 17 years for females and 7 to 21 years for males (Huff 1975). Spawning periodicity is thought to be similar to Atlantic sturgeon with a long inter-spawning period for females at every 3 to 5 years, and males every 1 to 5 years (Smith 1985). Both Huff (1975) and Fox et al. (2000) indicate Gulf sturgeon males are capable of annual spawning, but females require more than one year between spawning events.

Gulf sturgeon eggs are demersal, adhesive, and vary in color from gray to brown to black (Vladykov and Greeley 1963; Huff 1975). Chapman et al. (1993) estimated that mature female Gulf sturgeon weighing between 29 and 51 kg produce an average of 400,000 eggs. Eggs hatch after 2 to 4 days as artificially spawned Gulf sturgeon eggs hatched between 86 hours at 18.4°C to about 54 hours at about 23.0°C (Parauka et al. 1991). Chapman et al. (1993) reported that artificially spawned Gulf sturgeon eggs incubated at 20°C hatched in 3.5 days.

Habitat at egg collection sites consists of one or more of the following: limestone bluffs and outcroppings, cobble, limestone bedrock covered with gravel and small cobble, gravel, and sand (Marchant and Shutters 1996; Sulak and Clugston 1999; Heise et al. 1999; Fox et al. 2000; Craft et al. 2001; Pine et al. 2006). A dense matrix of gravel or cobble is likely essential for Gulf sturgeon egg adhesion in the Suwannee River and the sheltering of the yolk sac larvae, and is a habitat spawning adults apparently select (Sulak and Clugston 1999). Other substrates identified as possible spawning habitat include marl (clay with substantial calcium carbonate), soapstone, or hard clay (T. Slack, ERDC, pers. comm.; F. Parauka, USFWS, pers. comm.). Water depths at egg collection sites range between 1.4 to 7.9 m, and temperatures range between 18.2° and 25.3°C (Fox et al. 2000; Ross et al. 2000; Craft et al. 2001; Pine et al. 2006).

Laboratory experiments indicated optimal water temperature for survival of Gulf sturgeon larvae is between 15°C and 20°C, with low tolerance to temperatures above 25°C (Chapman and Carr 1995). While Sulak and Clugston (1999) suggested that sturgeon spawning activity in the Suwannee River is related to the phase of the moon after the water temperature has risen to 17°C, other researchers (Slack et al. 1999; Fox et al. 2000) have found little evidence of lunar influence. Ion conductivity and calcium ion concentrations associated with the spring high water may influence egg development and adhesion in the Suwannee River (Sulak and Clugston 1999). Fox et al. (2002) found no clear pattern between timing of Gulf sturgeon entering the river and flow patterns on the Choctawhatchee River. Ross et al. (2001) surmised that high flows in early March were a cue for sturgeon to begin their upstream movement in the Pascagoula River.

Similar to other sturgeons, larvae initiate downstream drift about 9-12 days after hatching and are extremely sensitive to saline habitat. Laboratory experiments on shortnose sturgeon indicate larvae are nocturnal and preferred deep water, grey color, and a silt substrate (Richmond and Kynard 1995). When small, sturgeons are especially sensitive to saline habitat and oxygen levels. This sensitivity is likely a result of the sturgeon's limited behavioral and physiological capacity to respond to hypoxia (Secor and Niklitschek 2001). Jenkins et al. (1993) examined environmental tolerance of dissolved oxygen on shortnose sturgeon and found that younger fish were differentially susceptible to low oxygen levels in comparison to older juveniles. Shortnose sturgeon older than 77 days experienced minimal mortality at nominal levels >2.5 mg/L; mortality at 2.0 mg/L increased to 24-38 percent. Dissolved oxygen at 3.0 mg/L resulted in 18-38 percent mortality of fish less than 78 days old; increasing to 80 percent at 2.5mg/L.

During early life history stages, sturgeon require bedrock and clean gravel or cobble as a substrate for egg adhesion and a shelter for developing larvae (Sulak and Clugston 1999). In the Suwannee river, YOY disperse widely downstream of spawning sites, using extensive portions of the river as nursery habitat. These YOY are typically found in open sand-bottom habitat away from the shoreline and vegetated habitat. The wide dispersal of YOY fish in the river may be an adaptation to exploit scarce food resources in these sandy habitat types (Randall and Sulak 1999). Clugston et al. (1995) reported that young Gulf sturgeon in the Suwannee River, weighing between 0.3 and 2.4 kg, remained in the vicinity of the river mouth and estuary during the winter and spring. Sulak et al. (2004) noted that the apparent preference of juvenile sturgeon for sandy main channel habitats enable sturgeon to exploit a unique niche with little competition.

In the Pascagoula and the Apalachicola Rivers, some adult and subadult Gulf sturgeon remain near the spawning grounds throughout the summer months (Wooley and Crateau 1985; Ross et al. 2001), but the majority move downstream to areas referred to as summer resting or holding areas. Notably upstream migration in both the Pascagoula and Apalachicola is limited due to impediments and therefore spawning occurs lower in the river compared to the Suwannee and Choctawhatchee. A few Gulf sturgeon have been documented remaining at or near their spawning grounds throughout the winter (Wooley and Crateau 1985; Slack et al. 1999; Heise et al. 1999). Within the river adults and subadults are not distributed uniformly, instead telemetry data indicate a preference for discrete areas usually located in lower and middle river reaches (Hightower et al. 2002). Often, these areas are located near natural springs throughout the warmest months of the year, but are not located within a spring or thermal plume emanating from a spring (Clugston et al. 1995; Foster and Clugston 1997; Hightower et al. 2002) and often include holes along straight-aways ranging from 2 to 19 m in depth (Wooley and Crateau 1985; Ross et al. 2001; Craft et al. 2001; Hightower et al. 2002). Substrate in these resting holes include limestone and sand (Clugston et al. 1995), sand and gravel (Wooley and Crateau 1985), or sand (Hightower et al. 2002).

Upstream migration and spawning are both likely cued by river flow (Chapman and Carr 1995; Ross et al. 2001), however strong flow can exceed sturgeon's swimming ability. In the Suwannee River, data strongly indicates that Gulf sturgeon cannot continuously swim against prevailing currents of greater than 1 to 2 m per second (K. Sulak, USGS, pers. comm., cited in Wakeford 2001). If flow is too strong at the spawning location, eggs might not be able to settle on and adhere to suitable substrate (Wooley and Crateau 1985). Low flows at the spawning site can cause clumping of eggs that leads to increased mortality from asphyxiation and fungal infection (Wooley and Crateau 1985). Flow velocity requirements for YOY sturgeon may vary depending on substrate type. Chan et al. (1997) found that YOY Gulf sturgeon under laboratory conditions exposed to water velocities over 12 cm/s sought cobble substrate, but when velocity was less than 12 cm/s, a variety of substrates including sand, gravel, and cobble were used.

Gulf sturgeon require large areas of diverse habitat that have natural variations in water flow, velocity, temperature, and turbidity (USFWS et al. 1995; Wakeford 2001). Laboratory experiments indicate that Gulf sturgeon eggs, embryos, and larvae have the highest survival rates when temperatures are between 15° and 20°C. Mortality rates of Gulf sturgeon gametes and embryos are highest when temperatures are 25°C and above (Chapman and Carr 1995). Researchers have documented temperature ranges at Gulf sturgeon resting areas between 15.3° and 33.7°C with dissolved oxygen levels between 5.6 - 9.1 mg/l (Hightower et al. 2002).

Most subadult and adult Gulf sturgeon spend the cooler winter months in estuarine areas, bays, or in the Gulf of Mexico (Clugston et al. 1995; Fox et al. 2002). Most (i.e., 78 percent) subadult Gulf sturgeon in Choctawhatchee Bay remained in the bay the entire winter, some (13 percent) moved into the connecting bay, and the others (9 percent) possibly overwintered in the Gulf of Mexico. On the other hand, adult Gulf sturgeon are more likely to overwinter in the Gulf of Mexico, as 45 percent of those tagged left Choctawhatchee Bay and spent extended periods of time in the Gulf of Mexico (Fox et al. 2002). There has been one report of adult sturgeon overwintering in freshwater in the Apalachicola River (Wooley and Crateau 1985); however, it is likely the result of a shed tag and not actual overwintering in freshwater as no movement occurred (F. Parauka, USFWS, pers. comm.).

Gulf sturgeon winter movements are a pattern of directed slow, steady travel over several kilometers followed by periods of randomly directed travel (Edwards et al. 2003). This pattern is consistent with the benthic cruising foraging strategy that is adapted to a patchy distribution of food resources by an animal that lacks advance knowledge of the location of the patches or an ability to detect the patches from afar. Both Edwards et al. (2007) and Ross et al. (2009) describe broad mixing of Gulf sturgeon from different riverine populations at winter foraging areas.

Migration

In the spring (March to May), most adult and subadult Gulf sturgeon return to their natal river, where sexually mature sturgeon spawn and reside until October or November in freshwater although some individuals enter later during the summer (Clugston et al. 1995; Fox et al. 2000). Migratory behavior of the Gulf sturgeon seems influenced by sex, reproductive status, water temperature, and possibly river flow. Carr et al. (1996) reported that male Gulf sturgeon initiate migration to the river earlier in spring than females. Fox et al. (2000) found no significant difference in the timing of river entry due to sex, but reported that males migrate further upstream than females and that ripe (in reproductive condition) males and females enter the river earlier than non reproductive fish. Change in temperature is thought to be an important factor in initiating sturgeon migration (Wooley and Crateau 1985; Chapman and Carr 1995; Foster and Clugston 1997). Most adults and subadults begin moving from estuarine and marine waters into the coastal rivers in early spring when river water temperatures range from 16.0° to 23.0°C (Sulak and Clugston 1999), while others may enter the rivers during summer months (Fox et al. 2000). Some research supports the theory that spring migration coincides with the general period of spring high water (Chapman and Carr 1995; Sulak and Clugston 1999; Ross et al. 2001), however, other observations have not found a clear relationship between the timing of river entrance and flow patterns (Fox et al. 2002).

Downstream migration from fresh to saltwater begins in September (at about 23°C) and continues through November (Huff 1975; Wooley and Crateau 1985; Foster and Clugston 1997) and may be related to discharge. Parauka et al. (2001) reported that tagged sub adult Gulf sturgeon departed the Choctawhatchee River in early October 1998 as river discharge increased and water temperature was 24.5°C. These fish migrated from the river to the marine system 2-4 weeks earlier than sub adults monitored in 1996 and 1997. Heise et al. (1999) found that the greatest seaward movement of Gulf sturgeon in the Pascagoula River in 1998 corresponded with elevated river flows associated with Hurricane Georges.

During the fall migration from fresh to saltwater, Gulf sturgeon may require a period of physiological acclimation to changing salinity levels, referred to as osmoregulation or staging (Wooley and Crateau 1985). This period may be short (Fox et al. 2002) as sturgeon develop an active mechanism for osmoregulation and ionic balance by age 1 (Altinok et al. 1998). On some river systems, timing of the fall migration appears to be associated with pulses of higher river discharge (Heise et al. 1999; Ross et al. 2000, 2001; Parauka et al. 2001).

Juvenile sturgeon have been found to remain in the mouth of the Suwannee River over winter and YOY migrate downstream in late January to early February (Sulak and Clugston 1999). Huff (1975) noted that juvenile Gulf sturgeon in the Suwannee River most likely participated in pre- and post-spawning migrations, along with the adults. Parauka et al. (2001) relocated sub adult Gulf sturgeon overwintering in Choctawhatchee Bay in lower (6.3 ppt) saline areas found in the eastern portion of the bay. Fox et al. (2002) reported that most male Gulf sturgeons (60%) overwintered exclusively in Choctawhatchee Bay while most females (60%) were found in adjacent bays, the Gulf of Mexico, or were not located.

Findeis (1997) described sturgeon (*Acipenseridae*) as exhibiting evolutionary traits adapted for benthic cruising. Tracking observations indicate individuals travel until they encounter suitable prey type and density, at which time they forage in that area for extended periods of time (Sulak and Clugston 1999; Fox et al. 2002; Edwards et al. 2007). Individual fish often remained in localized areas (less than 1 km^2) for extended periods of time (greater than 2 weeks), and then moved rapidly to another area where localized movements occurred again (Fox et al. 2002). When temperatures drop in the fall, often associated with major cold fronts, Gulf sturgeon from the Escambia, Yellow, and Suwannee Rivers are no longer relocated within estuarine bays (Craft et al. 2001; Edwards et al. 2003). It is suggested the sudden drop in water temperature disperses sturgeon from the bays to the nearshore coastal foraging grounds. It is uncertain if Gulf sturgeon undertake extensive offshore migrations into the Gulf of Mexico; further study is needed to determine whether Gulf sturgeon utilize offshore winter-feeding habitat.

Population Structure and Riverine Fidelity

Stabile et al. (1996) analyzed tissue from Gulf sturgeon in eight drainages along the Gulf of Mexico for genetic diversity. They noted significant differences among Gulf sturgeon stocks and suggested that they displayed region-specific affinities and may exhibit river-specific fidelity. Stabile et al. (1996) identified five regional or river-specific stocks: (1) Lake Pontchartrain and Pearl River; (2) Pascagoula River; (3) Escambia and Yellow Rivers; (4) Choctawhatchee River; and (5) Apalachicola, Ochlockonee, and Suwannee Rivers. Mark-recapture studies have confirmed the general fidelity of individual Gulf sturgeon returning to particular rivers (NMFS and USFWS 2003), presumably their natal rivers. Preliminary results from microsatellite analysis indicate there are likely two (west and east) or three (Pearl/Pascagoula; Pensacola/Choctawhatchee; and Apalachicola/Ochlockonee/Suwannee) distinct groups of Gulf sturgeon; while the greatest differences are between the west and the east; the three group scenario is also strongly supported (B. Krieser, USM, pers. comm.).

Both genetic and tagging data supports Gulf sturgeon river fidelity. Ongoing standardized field studies should provide important movement data to inform inter-basin transfers. DNA indicates high river fidelity (ranging from 75 to 98 percent in the spawning rivers) and coupled with the strong levels of differentiation, at least at the regional scale, suggests that most movement is not effective as genetic material is not being exchanged. On smaller spatial scales, some gene flow might be taking place and this is producing a smaller level of differentiation between any two particular drainages. The gene flow is low in Gulf sturgeon stocks, with each stock exchanging less than one mature female per generation (Waldman and Wirgin 1998).

Abundance and Population Trends

Currently, seven rivers are known to support reproducing populations of Gulf sturgeon. Although variable, most populations appear relatively stable with a few exceptions (Table 1). The status of Gulf sturgeon is considered to be stable (USFWS and NMFS 2009). The number of Gulf sturgeon in the Escambia River system may have recently declined due to hurricane impacts, and the Suwannee River population appears to be slowly increasing. Due to lack of research since Hurricanes Ivan and Katrina, no data are available to determine the current size of the Gulf sturgeon populations within the Pearl and Pascagoula Rivers; however a recent release from a paper mill on the Pearl River killed at least 22 Gulf sturgeon. A complete summary of Gulf sturgeon population estimates was presented in the 5-year review (USFWS and NMFS 2009).

Table 1. Gulf sturgeon abundance estimates with confidence intervals (CI) for the seven know reproducing populations. Notably all estimates listed apply to only a portion of the population exceeding a minimum size, which varies between researchers according to sampling method used.

River	States	Abundance Estimate (CI)	Source
Pearl	LA, MS	430 (323 - 605)	Rogillio et al. 2002
Pascagoula	MS	216 (124 - 429)	Ross et al. 2001
Escambia	AL, FL	451 (338 - 656)	USFWS 2007
Yellow	AL, FL	911 (550 - 1,550)	Berg et al. 2007
Choctawhatchee	AL, FL	3314 (n/a)	USFWS 2000
Apalachicola	FL	144 (83 - 205)	Zehfuss et al. 1999
Suwannee	FL	9,728 (6,487 - 14,664)	Randall 2008

Population modeling by Pine and Martell (2009) found a general trend of gradually increasing abundance is apparent in the Apalachicola River. Similarly, for the Suwannee River data, estimated abundance in the early 1980s of about 3,000 age 1+ sturgeon, increasing to about 10,000 in 2004. Pine et al. (2001) found a positive population growth of about 5 percent annually for adults within the Suwannee River Gulf sturgeon population, and therefore in number to about 10,000 individuals in 2004.

Few data are available to assess Gulf sturgeon age structure and recruitment. The age structure evident from mark/recapture studies of the Apalachicola River sturgeon population suggests variable recruitment over time (Pine and Allen 2005), but the factors influencing this variability have not yet been investigated. Randall and Sulak (2007) examined variable recruitment in the Suwannee River and suggested that it may be due to flow in fall and amount of estuarine habitat of moderate salinity. Flowers (2008) describes the rapid decline in Gulf sturgeon landings as likely reflective of rapid erosion of the population age-structure of the large, older, highly fecund individuals being removed which led to a rapid change in the age-structure of the population and thereby reducing annual reproductive output and population recovery.

Threats

The 1991 listing rule cited the following impacts and threats: (1) dams on the Pearl, Alabama, and Apalachicola rivers; also on the North Bay arm of St. Andrews Bay; (2) channel improvement and maintenance activities: dredging and de-snagging; (3) water quality degradation; and (4) contaminants. Additional information on Gulf sturgeon threats included in the 5-year status review (USFWS and NMFS 2009) is discussed below.

All of the dams noted in the listing rule continue to block passage of Gulf sturgeon to historical spawning habitats and thus either reduce the amount of available spawning habitat or entirely impede access to it. Since Gulf sturgeon were listed, several new dams have been proposed on rivers that support Gulf sturgeon, including the Pearl, Escambia/Conecuh, Choctawhatchee, Yellow, and Apalachicola River drainages (USFWS and NMFS 2009). Maintenance dredging occurs regularly in numerous navigation channels that traverse the bays, passes, and river mouths of all seven river drainages that are used by Gulf sturgeon. Most of this dredging occurs within designated Gulf sturgeon critical habitat and may modify foraging habitat as well as causing injury or killing Gulf sturgeon.

Berg (2006) found that loss of habitat associated with pollution and contamination has been documented for sturgeon species. Several characteristics of the Gulf sturgeon (i.e., long lifespan, extended residence in riverine and estuarine habitats, benthic predator) predispose the species to long-term and repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants. Chemicals and metals such as chlordane, DDE, DDT, dieldrin, PCBs, cadmium, mercury, and selenium settle to the river bottom and are later incorporated into the food web as they are consumed by benthic feeders, such as sturgeon or macroinvertebrates. Some of these compounds may affect physiological processes and impede the ability of a fish to withstand stress, while simultaneously increasing the stress of the surrounding environment by reducing dissolved oxygen, altering pH, and altering other water quality properties.

Climate change has potential implications for the status of the Gulf sturgeon through alteration of its habitat. The Intergovernmental Panel on Climate Change (IPCC 2007) concluded that it is very likely that heat waves, heat extremes, and heavy precipitation events over land will increase during this century. Warmer water, sea level rise and higher salinity levels could lead to accelerated changes in habitats utilized by Gulf sturgeon.

While overutilization due to directed harvest is no longer a threat, some Gulf sturgeon researchers offer that possibly significant Gulf sturgeon mortality occurs as bycatch in fisheries directed at other species. In particular, fisheries that employ trawl and entanglement gear in areas that sturgeon regularly occupy pose a risk of incidental bycatch.

2 Shortnose sturgeon

The shortnose sturgeon was originally listed as an endangered species by the USFWS on March 11, 1967 under the Endangered Species Preservation Act (32 FR 4001). Shortnose sturgeon continued to meet the listing criteria as “endangered” under subsequent definitions specified in the 1969 Endangered Species Conservation Act. NMFS assumed jurisdiction for shortnose sturgeon from the USFWS under a 1970 government reorganization plan. The ESA was enacted in 1973 and all species that were listed as endangered species threatened with extinction in the 1969 Endangered Species Conservation Act were deemed endangered species under the ESA (39 FR 41370).

Shortnose sturgeon currently remains listed as an endangered species throughout all of its range along the U.S. East Coast.

Life History and Distribution

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America: they attain a maximum length of about 120 cm, and a weight of 24 kg (Dadswell et al. 1984). Adults resemble similar-sized juvenile Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) that historically co-occurred in the lower mainstem rivers of major basins along the Atlantic coast. The shortnose sturgeon is distinguished from other North American sturgeons by a wide mouth, absence of a fontanelle, nearly complete absence of postdorsal scutes, and preanal scutes often arranged in a single row (Scott and Crossman 1973; Dadswell et al. 1984). Morphological differences between shortnose and Atlantic sturgeon have been discussed (Vecsei and Peterson 2004); most researchers in the field use mouth width versus interorbital width to separate species. Coloration varies but adult shortnose sturgeons are generally dark dorsally and are lighter ventrally, usually white to yellow in color beginning at the row of lateral scutes. All of the fins are pigmented, and the paired fins are outlined in white. There is no external sexual dimorphism in morphology.

Shortnose sturgeon migrate seasonally between upstream freshwater spawning habitat and downstream foraging mesohaline areas within the river based on water temperature, flow and salinity cues. Shortnose sturgeon have generally been described as being anadromous but freshwater amphidromous may be a better description for the fish occurring in the southern rivers because they rarely leave their natal rivers or associated estuaries (Kieffer and Kynard 1993).

Shortnose sturgeon inhabit large coastal rivers of eastern North America. Although it is considered an anadromous species, shortnose sturgeon distributed in the southern areas of the United States are more properly characterized as “freshwater amphidromous” meaning that they move between fresh and salt water during some part of their life cycle, but not necessarily for spawning. Historically, shortnose sturgeon were found in the coastal rivers along the east coast of North America from the Saint John River in Canada, to perhaps as far south as the Indian River in Florida (Gilbert 1989). Currently, the distribution of shortnose sturgeon across their range is disjunct, with northern populations separated from southern populations by a distance of about 400 km near their geographic center in Virginia. In the southern portion of its range, they are currently found in the Altamaha, Ogeechee, and Savannah Rivers in Georgia. They are thought to be extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002-2003. Shortnose sturgeon prefer nearshore marine, estuarine, and riverine habitat of these large river systems. The species is significantly more abundant in some rivers in northern portions of its range than it is in the south. Bycatch in commercial fisheries and increased industrial uses of the nation’s large coastal rivers during the 20th century (e.g., hydropower, nuclear power, port dredging) have contributed to the further decline and slow recovery of shortnose sturgeon.

While adult shortnose sturgeon may occasionally be found in marine waters during the summer, they typically are found in more estuarine waters, and in rivers near the saltwater-freshwater interface. There are spawning populations in the Savannah River, and Hall et al. (1991) and Collins and Smith (1993), using telemetry techniques, identified two distinct spawning locations. However, the status of stocks is poorly understood and survival of juveniles and recruitment to the adult population has been identified as a potential limiting factor in population growth (Smith et al. 1992). According to historical distribution records much of the spawning and nursery habitat formerly available to sturgeon in the Savannah River is inaccessible (USFWS et al. 2001).

Spawning migration and cues

Initiation of the upstream movement of shortnose sturgeon to spawn is likely triggered partially by water temperatures above 8°C (Dadswell 1979; Kynard 1997) during late winter/early spring (southern rivers) to mid-to-late spring (northern rivers); specifically occurring in the southern range (North Carolina and south) between late December and March. Southern populations of shortnose sturgeon usually spawn at least 200 km upriver (Kynard 1997) or throughout the fall zone, if they are able to reach it. Spawning areas are usually associated with areas where the substrate is composed of gravel, rubble, cobble, or large rocks (Dadswell 1979; Kynard 1997), or timber, scoured clay, and gravel (Hall et al. 1991). Water depth and flow are also important parameters for spawning site (Kieffer and Kynard 1996). Spawning sites are characterized by moderate river flows with average bottom velocities between 0.4 and 0.8 m/s (Hall et al. 1991; Kieffer and Kynard 1996; NMFS 1998). Spawning in the southern rivers has been reported at water temperatures of 10.5°C in the Altamaha River (Heidt and Gilbert 1978) and 9-12°C in the Savannah River (Hall et al. 1991). In the southern portion of the range, adults typically spawn well upriver in the late winter to early spring and spend the rest of the year in the vicinity of the fresh/brackish water interface (Collins and Smith 1993).

Shortnose sturgeon vary in pre-spawning migration patterns that may reflect energetic adaptations to migration distance, river discharge and temperature, and physiological condition of fish (Kieffer and Kynard 1993). The three patterns of migrations are: (1) a rapid, 1-step migration in spring only a few weeks before spawning; (2) a longer, 1-step migration many weeks in late winter and spring before spawning; and (3) a 2-step migration composed of a long fall migration, which places fish near the spawning site for overwintering, then a short migration in spring to spawn. Following the spring spawning period, adult shortnose sturgeon move rapidly and directly downstream to freshwater reaches of rivers or river reaches that are influenced by tides; as a result, they often inhabit only a few short reaches of a river's entire length (Buckley and Kynard 1985). Adult shortnose sturgeon are usually located in deeper downstream areas with soft substrate and vegetated bottom areas where their prey are present. Juvenile (non-spawning, sexually immature) shortnose sturgeon generally move lesser distances upstream for the spring and summer seasons and downstream for fall and winter; however, these movements usually occur above the salt/freshwater interface of the rivers they inhabit (Dadswell et al. 1984; Hall et al. 1991).

Age and Growth

Dadswell et al. (1984) reviewed shortnose sturgeon growth throughout the latitudinal range. Growth of all juveniles is rapid, attaining lengths of 14-30 cm during the first year. Fish in the southern portion of the range grow the fastest, but do not reach the larger size of fish in the northern part of the range that continue to grow throughout life. This phenomenon may be related to different bioenergetic styles of southern and northern shortnose sturgeon, but sufficient data are not available for conclusions. The land-locked shortnose sturgeon population located upstream of

Holyoke Dam at river km 140 of the Connecticut River has the slowest growth rate of any surveyed (Taubert 1980); growth rates of the other land-locked population in Lakes Marion and Moultrie are not available for comparison. The slower growth rate of this land-locked population suggests bioenergetic consequences to foraging in freshwater habitat and advantages associated with foraging in the lower river or fresh/saltwater interface.

Length at maturity (45-55 cm FL) is similar throughout the latitudinal range of shortnose sturgeon, but growth rate, maximum age, and maximum size vary with latitude. Fish in the southern areas grow more rapidly and mature at younger ages but attain smaller maximum sizes than those in the north (Dadswell et al. 1984). Maximum age of shortnose sturgeon in the northern portion of the species' range is greater than the southern portion of the species' range (Gilbert 1989). The maximum age reported for a shortnose sturgeon in the Saint John River in New Brunswick is 67 years (for a female), 40 years for the Kennebec River, 37 years for the Hudson River, 34 years in the Connecticut River, 20 years in the Pee Dee River, and 10 years in the Altamaha River (Gilbert 1989 using data presented in Dadswell et al. 1984).

Shortnose sturgeon also exhibit sexually dimorphic growth patterns across latitude: males mature at 2-3 years in Georgia, 3-5 years in South Carolina, and 10-11 years in the Saint John River, Canada; females mature at 4-5 years in Georgia, 7-10 years in the Hudson River, and 12-18 years in the Saint John River. Males begin to spawn 1-2 years after reaching sexual maturity and spawn every other year and perhaps annually in some rivers (Dadswell 1979; Kieffer and Kynard 1996; NMFS 1998). Age at first spawning for females is about approximately 5 years post-maturation (Dadswell 1979) with spawning occurring about every three years although spawning intervals may be as infrequent as every 5 years for some females (Dadswell 1979). Female shortnose sturgeon apparently grow larger than and outlive males (Dadswell et al. 1984; Gilbert 1989). Fecundity of shortnose sturgeon ranges between approximately 30,000-200,000 eggs per female (Gilbert 1989). Substrates commonly used by spawning shortnose sturgeon include gravel, rubble, large rock, sand, logs, and cobble (Dadswell 1979; Taubert 1980; Kieffer and Kynard 1996; Kynard 1997).

Research indicates that yearlings are the primary migratory stage (Kynard 1997), while juveniles (3-10 year olds) reside near the saltwater/freshwater interface in most rivers (Dadswell 1979; Hall et al. 1991). Juveniles regularly move throughout the saline portions (0-16 ppt) of the salt wedge during summer (Pottle and Dadswell 1979) and are more active when water temperatures are cooler (<16°C) (Weber 1996). Juveniles have been found congregating in deeper sand/mud substrate in depths of 10-14 m (Hall et al. 1991). Due to their low tolerance for high temperatures, warm summer temperatures (above 28°C) may severely limit available juvenile rearing habitat in some rivers in the southeastern United States. Juveniles in the Altamaha and Ogeechee Rivers have been found in a single area with cool and deep water (Flournoy et al. 1992; Weber 1996). In the Southeast, juveniles age one and older make seasonal migrations like adults, moving upriver during warmer months where they shelter in deep holes, before returning to the fresh/salt water interface when temperatures cool (Flournoy et al. 1992). Telemetry studies have identified nursery habitats for juveniles, a primary example being just inside the mouth of the Middle River branch of the lower Savannah River, and near the Kings Island Turning Basin.

Little is known about YOY behavior and movements in the wild but shortnose sturgeon at this age are believed to remain in channel areas within freshwater habitats upstream of the salt wedge for about one year (Dadswell et al. 1984; Kynard 1997). Residence of YOY in freshwater is supported by several studies on cultured shortnose sturgeon. Jenkins et al. (1993) found that salinity tolerances of young shortnose sturgeon improve with age; individuals 76 days old suffered 100 percent mortality in a 96-hour test at salinities ≥15 ppt while those 330 days old tolerated salinities as high as 20 ppt for 18 hours but experienced 100 percent mortality at 30 ppt. Jarvis et al. (2001) demonstrated that 16-month old juveniles grew best at 0 percent salinity and poorest at 20 percent salinity. Lastly, Ziegeweid et al. (2008) demonstrated that salinity and temperature interact, affecting survival of YOY shortnose sturgeon. As salinity and temperature increased, survival decreased; however, as body size increased, individuals were better able to tolerate higher temperatures and salinities (Ziegeweid et al. 2008).

Foraging

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning and move rapidly to downstream feeding areas in the spring (Dadswell et al. 1984; Kieffer and Kynard 1993; Collins and Smith 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Shortnose sturgeon are benthic carnivores throughout their life who locate prey by using their barbels as tactile receptors and vacuuming either the substrate or plant surfaces with their protuberant mouth (Dadswell et al. 1984; Gilbert 1989). Shortnose sturgeon feed opportunistically on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al. 1984). Studies of gut contents show that the diet of adult shortnose sturgeon typically consists of small bivalves, gastropods, polychaetes, and even small benthic fish (Dadswell 1979; Dadswell et al. 1984; Gilbert 1989; Collins et al. 2002), and they have also been observed feeding off plant surfaces and may take fish bait (Collins et al. 2002). Some reports indicate that female adult shortnose sturgeon have been found to feed throughout the year; however, Dadswell (1979) found that females ceased feeding nearly eight months before spawning. Conversely, males continue to feed throughout the fall and winter as long as they are located in saline waters (Dadswell et al. 1984). Dadswell (1979) documented individuals of both sexes actively feeding immediately after spawning. Limited observations indicate that feeding occurs primarily at night (Dadswell et al. 1984; Gilbert 1989). Juveniles feed indiscriminately, often ingesting large amounts of mud, stone, and plant material along with prey items (Dadswell 1979). Because substrate type strongly affects composition of benthic prey, both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Kynard 1997).

In the southern part of their range, shortnose sturgeon are known to forage widely throughout the estuary during the winter, fall, and spring (Collins and Smith 1993). During the hotter months of summer, foraging may taper off or cease as shortnose sturgeon take refuge from high water temperatures by congregating in cool, deep areas of rivers (Flournoy et al. 1992; Weber 1996). During winter months, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith 1993). Older juveniles likely inhabit the same areas as adults, but younger juveniles primarily remain in freshwater habitats perhaps due to low salinity tolerances (Jenkins et al. 1993; Jarvis et al. 2001).

Threats

As noted in the shortnose sturgeon recovery plan (NMFS 1998), habitat degradation or loss resulting from dams, bridge construction, channel dredging, and pollutant discharges, and mortality from impingement on cooling water intake screens, dredging, and incidental capture in fisheries are principal threats to the species' survival.

Summary of Status of Shortnose Sturgeon

The shortnose sturgeon is a freshwater amphidromous fish inhabiting large coastal rivers along the eastern seaboard of North America from the Saint John River in New Brunswick, Canada, south to the St. Johns River in Florida. Clinal differences in growth and behavior are obvious for shortnose sturgeon: fish in the north grow slower but reach larger size, timing of spawning migration is earlier in the south, etc. Genetic analysis has indicated that at least two or perhaps three metapopulations of shortnose sturgeon exist across the range of shortnose sturgeon. Within a metapopulation, individual populations interact at some level via movement, but not effectively (i.e., reproduction). Shortnose sturgeon from North Carolina south through Florida are part of a single metapopulation, the Southern (also "Carolinian Province") metapopulation. There are markedly fewer shortnose sturgeon in the southern United States compared to the north. No recent population trend data exist.

3 Atlantic Sturgeon

On October 6, 2010, NMFS published two *Federal Register* notices (75 FR 61872 and 61904) proposing their determination that the anadromous Atlantic sturgeon is made up of five DPSs that qualify as species under the ESA, and proposing to list one DPS as threatened and four as endangered. The comment period on these listing determinations was extended to February 30, 2011. On February 6, 2012, NMFS published a *Federal Register* notice (77 FR 5914) listing the Carolina and South Atlantic DPS of Atlantic sturgeon as endangered. Information summarized below is taken from the *Federal Register* notices and the Atlantic Sturgeon Status Review (NMFS 2007), which provide extensive reviews of the literature and data on Atlantic sturgeon.

Historically, Atlantic sturgeon were present in approximately 38 rivers in the United States from the St. Croix in Maine to the Saint Johns River in Florida. Thirty-five of these rivers have been confirmed to have had historical spawning populations. Atlantic sturgeon are currently present in approximately 36 U.S. rivers, including 18 in which spawning is believed to occur (NMFS 2007). Atlantic sturgeon show a high degree of reproductive isolation, spawning exclusively in ecologically unique natal rivers (NMFS 2007). NMFS evaluated the life history and genetics of Atlantic sturgeon and proposes five discrete Atlantic sturgeon population segments in the U.S; three in the Northeast Region (Gulf of Maine population segment that originates from the Kennebec River; the New York Bight population segment that originates from the Hudson and Delaware Rivers; and the Chesapeake Bay population that originates from the James and York Rivers), and two in the Southeast Region (the Carolina population segment originating from the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, Pee Dee, and Santee-Cooper Rivers; and the South Atlantic population segment originating from the Ashepoo, Combahee, and Edisto River Basin and the Savannah, Ogeechee, Altamaha, and Saltilla Rivers). The Gulf of Maine population segment of

Atlantic sturgeon has been proposed for threatened species status. The other four proposed DPSs have been proposed for endangered listing status.

Atlantic sturgeon are omnivorous benthic feeders that forage on mollusks, gastropods, amphipods, isopods, and fish. Juvenile sturgeon feed on aquatic insects and other invertebrates (NMFS 2007). They may live up to 60 years, maturing late in life, reaching a length of up to 14 ft (4.26 m) and over 800 lbs (<364 kg). Female Atlantic sturgeon can produce (depending on age and size) from 400,000 to 4 million eggs every 2 to 5 years (75 FR 61872, October 6, 2010). Atlantic sturgeon are dependent on estuaries; with spawning believed to occur in flowing waters of 18° to 20°C between the salt front of estuaries and the fall line of large rivers. Sturgeon eggs are highly adhesive, requiring a hard bottom substrate. Hatching occurs after 4 to 7 days, followed by a brief demersal stage before the larvae move downstream, using rough bottom for protection. Juvenile sturgeon move into brackish waters, where they may reside in estuaries for months or years before moving to open ocean as subadults (NMFS 2007). The timing of spawning migration, and growth rates of sturgeon are specific to the different river systems, with spawning occurring generally earlier in the year and faster growth rates in the southern rivers.

Tracking and tagging studies have shown that subadult and adult Atlantic sturgeon that originate from different rivers mix within the marine environment, utilizing ocean and estuarine waters for life functions such as foraging and overwintering (NMFS 2007). Fishery-dependent data, as well as fishery-independent data, demonstrate that Atlantic sturgeon use relatively shallow inshore areas of the continental shelf, primarily waters less than 50 m in depth (Stein et al. 2004b; ASMFC 2007; Dunton et al. 2010). The data also suggests regional differences in Atlantic sturgeon depth distribution, with sturgeon observed in waters primarily less than 20 m in the Mid-Atlantic Bight and in deeper waters of the Gulf of Maine (Stein et al. 2004b; ASMFC 2007; Dunton et al. 2010). Information on population sizes for each Atlantic sturgeon DPS is very limited. Based on the best available information, NMFS has concluded that bycatch, vessel strikes, water quality and availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon.

Although landing Atlantic Sturgeon has been prohibited since 1998, continued incidental capture in Atlantic bottom trawl fisheries is well documented (Stein et al. 2004a; ASMFC 2007). Stein et al. (2004b) reviewed Northeast Fisheries Observer Program (NEFOP) data on Atlantic Sturgeon bycatch in commercial fisheries between 1989 and 2000 to identify bycatch and mortality rates by different fishing gear. Significant takes were documented in sink gillnet, drift gillnet, and otter trawl gear (Stein et al. 2004b; ASMFC 2007). It was also noted that bycatch rates in all gear increased from north to south, with the highest rates offshore of Maryland, Virginia, and North Carolina. However, because fishing effort was higher farther north, the highest cumulative sturgeon catches were offshore of New Jersey and Massachusetts. Seasonally, bycatch rates were lowest during summer months, highest during the winter and spring. Sink and drift gillnet gears showed higher bycatch rates, but because bottom trawling effort is much higher, actual captures in bottom trawl gear was also higher. Additionally, the mean size of Atlantic sturgeon captured by bottom trawls was much larger than the size captured on sink and drift gillnets (Stein 2004b). None of the Atlantic sturgeon captured between 1989 and 2000 were reported as dead upon landing, however, some post-release mortalities due to stress and injury is likely (Stein 2004b). Coast wide, Stein (2004b) estimated a total capture of Atlantic sturgeon in otter trawls between 1989 and 2000, declining from 200,000 lb (90,718 kg) per year to 150,000 lbs (68,039 kg) per year.

A subsequent review of NEFOP data for the years 2001-2006 indicated sturgeon bycatch occurred in statistical areas abutting the coast from Massachusetts (statistical area 514) to North Carolina (statistical area 635) (ASMFC 2007). Based on the available data, participants in an a bycatch workshop (ASMFC 2007) concluded that there were some seasonal patterns to sturgeon encounters, which tended to occur in waters less than 50 m (164 ft) throughout the year, with 84 percent found at depths of less than 20 m (66 ft). Otter trawl captures of Atlantic sturgeon ranged from 2,167 fish in 2005 to 7,210 fish in 2002, with a mean for these years of about 3,800 sturgeon, which were about one third of the captures estimated by Stein (2004b) for the earlier period (ASMFC 2007).

Declines in Atlantic sturgeon populations were likely caused primarily by the directed fisheries that ceased in 1999. Continued threats to Atlantic sturgeon include barriers in rivers such as dams or turbines, and the impacts of climate change. Additionally, for all proposed DPS, bycatch in commercial fisheries has been identified as a major threat. Recovery of Atlantic sturgeon populations likely depends on reductions in bycatch mortality. Steps to reduce mortalities will likely be required if final listing rules are published. The ASMFC Technical Committee calculated an annual average bycatch of approximately 3,800 sturgeon in otter trawl gear between 2001 and 2006 (ASMFC 2007); the rate of release mortality from the gear is unknown (Stein et al. 2004b).

4 Smalltooth Sawfish

The U.S. DPS of smalltooth sawfish was listed as endangered under the ESA on April 1, 2003 (68 FR 15674). The smalltooth sawfish is the first elasmobranch to be listed in the United States. Critical habitat for the species was designated on September 2, 2009 (74 FR 45353). The two units are located along the southwestern coast of Florida between Charlotte Harbor and Florida Bay and will be discussed in more detail in Section 3.3. Historically, smalltooth sawfish occurred commonly in the inshore waters of the Gulf of Mexico and the U.S. Eastern Seaboard up to North Carolina, and more rarely as far north as New York. Today, smalltooth sawfish remain in the United States typically in protected or sparsely populated areas off the southern and southwestern coasts of Florida; the only known exception is the nursery area in the Caloosahatchee River in an area of waterfront residences and seawalls (NMFS 2010).

Life History and Distribution

Smalltooth sawfish are approximately 31 in (80 cm) in total length at birth and may grow to a length of 18 feet (540 cm) or greater. A recent study by Simpfendorfer suggests rapid juvenile growth occurs during the first two years after birth (Simpfendorfer et al. 2008). First year growth is 26-33 in (65-85 cm) and second year growth is 19-27 in (48-68 cm). Growth rates beyond two years are uncertain; however, the average growth rate of captive smalltooth sawfish has been reported between 5.8 in (13.9 cm) and 7.7 in (19.6 cm) per year. Apart from captive animals, little is known of the species' age parameters (i.e., age-specific growth rates, age at maturity, and maximum age). Simpfendorfer (2000) estimated age at maturity between 10 and 20 years, and a maximum age of 30 to 60 years. Simpfendorfer et al. (2008) reported that males appear to mature between 100-150 in (253-381 cm) total length, and unpublished data from Mote Marine Laboratory

(MML) and NMFS indicates male smalltooth sawfish do not reach maturity until they reach 133 in (340 cm) total length.

No directed research on smalltooth sawfish feeding habits exists. Reports of sawfish feeding habits suggest they subsist chiefly on small schooling fish, such as mullets and clupeids. They are also reported to feed on crustaceans and other bottom-dwelling organisms. Observations of sawfish feeding behavior indicate that they attack fish by slashing sideways through schools, and often impale the fish on their rostral (saw) teeth (Breder 1952). The fish are subsequently scraped off the teeth by rubbing them on the bottom and then ingested whole. The oral teeth of sawfish are ray-like, having flattened cusps that are better suited to crushing or gripping.

Very little is known about the specific reproductive biology of the smalltooth sawfish. No confirmed breeding sites have been identified to date since directed research began in 1998. As with all elasmobranchs, fertilization occurs internally. Development in sawfish is believed to be ovoviparous. The embryos of smalltooth sawfish, while still bearing the large yolk sac, resemble adults relative to the position of their fins and absence of the lower caudal lobe. During embryonic development, the rostral blade is soft and flexible. The rostral teeth are also encapsulated or enclosed in a sheath until birth. Shortly after birth, the teeth become exposed and attain their full size, proportionate to the size of the saw. (Bigelow and Schroeder 1953) reported gravid females have been documented carrying between 15-20 embryos; however, the source of their data is unclear and may represent an over-estimate of litter size. Studies of largetooth sawfish in Lake Nicaragua (Thorson 1976) report brood sizes of 1-13 individuals, with a mean of 7 individuals. The gestation period for largetooth sawfish is approximately 5 months, and females likely produce litters every second year. Although there are no such studies on smalltooth sawfish, their similarity to the largetooth sawfish implies that their reproductive biology may be similar. Genetic research currently underway may assist in determining reproductive characteristics (i.e., litter size and breeding periodicity). Research is also underway to investigate areas where adult smalltooth sawfish have been reported to congregate along the Everglades coast to determine if breeding is occurring in the area.

Life history information on the smalltooth sawfish has been evaluated using a demographic approach and life history data on largetooth sawfish and similar species from the literature. Simpfendorfer estimates intrinsic rates of natural population increase as 0.08 to 0.13 per year and population doubling times from 5.4 to 8.5 years (Simpfendorfer 2000). These low intrinsic rates of population increase are associated with the life history strategy known as "k-selection." K-selected animals are usually successful at maintaining relatively small, persistent population sizes in relatively constant environments. Consequently, they are not able to respond effectively (rapidly) to additional and new sources of mortality resulting from changes in their environment. Musick (1999) noted that intrinsic rates of increase less than ten percent were low, and such species are particularly vulnerable to excessive mortalities and rapid population declines, after which recovery may take decades. Thus, smalltooth sawfish populations are expected to recover slowly from depletion. Simpfendorfer concluded that recovery was likely to take decades or longer, depending on how effectively sawfish could be protected (Simpfendorfer 2000). However, if ages at maturity for both sexes prove to be lower than those previously used in demographic assessments, then population growth rates are likely to be greater and recovery times shorter (Simpfendorfer et al. 2008).

Smalltooth sawfish are tropical marine and estuarine elasmobranch (e.g., sharks, skates, and rays) fish that are reported to have a circumtropical distribution. The historic range of the smalltooth sawfish in the United States extends from Texas to New York (NMFS 2009). The U.S. region has historically harbored the largest number of smalltooth sawfish is south and southwest Florida from Charlotte Harbor to the Dry Tortugas. Most capture records along the Atlantic coast north of Florida are from spring and summer months and warmer water temperatures. Most specimens captured along the Atlantic coast north of Florida have also been large (greater than 10 feet or 3 m) adults and are thought to represent seasonal migrants, wanderers, or colonizers from a core or resident population(s) to the south rather than being resident members of a continuous, even-density population (Bigelow and Schroeder 1953). Historic records from Texas to the Florida Panhandle suggest a similar spring and summer pattern of occurrence. While less common, winter records from the Northern Gulf of Mexico suggest a resident population, including juveniles, may have once existed in this region. The Status Review Team (NMFS 2000) compiled information from all known literature accounts, museum collection specimens, and other records of the species. The species suffered significant population decline and range constriction in the early to mid 1900s. Encounters with the species outside of Florida have been rare since that time.

Since the 1990s, the distribution of smalltooth sawfish in the United States has been restricted to peninsular Florida (Seitz and Poulakis 2002; Simpfendorfer and Wiley 2005; National Sawfish Encounter Database). The Florida Museum of Natural History manages the National Sawfish Encounter Database and is currently under contract with NMFS for smalltooth sawfish research. Encounter data indicates smalltooth sawfish encounters can be found with some regularity only in south Florida from Charlotte Harbor to Florida Bay. A limited number of reported encounters (one in Georgia, one in Alabama, one in Louisiana, and one in Texas) have occurred outside of Florida since 1998.

Peninsular Florida is the main U.S. region that historically and currently hosts the species year-round because the region provides the appropriate climate (subtropical to tropical) and contains the habitat types (lagoons, bays, mangroves, and nearshore reefs) suitable for the species. Encounter data and research efforts indicate a resident, reproducing population of smalltooth sawfish exists only in southwest Florida (Simpfendorfer and Wiley 2005).

General habitat use observations

Encounter databases have provided some general insight into the habitat use patterns of smalltooth sawfish. Poulakis and Seitz (2004) reported that where the substrate type of encounters was known 61 percent were mud, 11 percent sand, 10 percent seagrass, 7 percent limestone, 4 percent rock, 4 percent coral reef, and 2 percent sponge. Simpfendorfer and Wiley (2005) reported closer associations between encounters and mangroves, seagrasses, and the shoreline than expected at random. Encounter data have also demonstrated that smaller smalltooth sawfish occur in shallower water, and larger sawfish occur regularly at depths greater than 32 feet (10 m). Poulakis and Seitz (2004) reported that almost all of the sawfish <10 feet (3 m) in length were found in water less than 32 feet (10 m) deep and 46 percent of encounters with sawfish >10 feet (3 m) in Florida Bay and the Florida Keys were reported to occur at depths between 200 to 400 feet (70 to 122 m). Simpfendorfer and Wiley (2005) also reported a substantial number of larger sawfish in depths greater than 32 feet (10 m). Simpfendorfer and Wiley (2005) demonstrated a statistically significant relationship between the estimated size of sawfish and depth, with smaller sawfish on average occurring in shallower waters than large sawfish. There are few verified depth encounters for adult smalltooth sawfish and more information is needed to verify the depth distribution for this size class of animals.

Encounter data has also identified river mouths as areas where many people observe sawfish. Seitz and Poulakis (2002) noted that many of the encounters occurred at or near river mouths in southwest Florida. Simpfendorfer and Wiley (2005) reported a similar pattern of distribution along the entire west coast of Florida. Information on juvenile smalltooth sawfish indicates that they prefer shallow euryhaline habitats adjacent to red mangroves (NMFS 2009).

Very small juveniles (< 39 in (100 cm) in length) habitat use

Very small sawfish are those that are less than 39 in (100 cm), and are young-of-the-year. Like all elasmobranchs of this age, they are likely to experience relatively high levels of mortality due to factors such as predation (Heupel and Simpfendorfer 2002) and starvation (Lowe 2002). Many elasmobranchs utilize specific nursery areas that have lower numbers of predators and abundant food resources (Simpfendorfer and Milward 1993). Acoustic tracking results for very small smalltooth sawfish indicate that shallow depths and red mangrove root systems are likely important in helping them avoid predators (Simpfendorfer 2003). At this size smalltooth sawfish spend the vast majority of their time on shallow mud or sand banks that are less than 1 foot (30 cm) deep. Since water depth on these banks varies with the tide, the movement of the very small sawfish appears to be directed towards remaining in shallow water. It is hypothesized that by staying in these very shallow areas the sawfish are inaccessible to predators (mostly sharks) and increase their chances of survival. The dorso-ventrally compressed body shape helps them in inhabiting these shallow areas, and they can often be observed swimming in only a few inches of water.

The use of red mangrove prop root habitat is also likely to aid very small sawfish in avoiding predators. Simpfendorfer (2003) observed very small sawfish moving into prop root habitats when shallow habitats were less available (especially at high tide). One small animal tracked over three days moved into a small mangrove creek on high tides when the mud bank on which it spent low tide periods was inundated at depths greater than 1 foot (30 cm). While in this creek it moved into areas with high prop root density. The complexity of the prop root habitat likely restricts the access of predators and so protects the sawfish.

Very small sawfish show high levels of site fidelity, at least over periods of days and potentially for much longer. Acoustic tracking studies have shown that at this size sawfish will remain associated with the same mud bank over periods of several days. These banks are often very small and daily home range sizes can be of the magnitude of 100-1,000 m^2 (Simpfendorfer 2003). Acoustic monitoring studies have shown that juveniles have high levels of site fidelity for specific nursery areas for periods up to almost 3 months (Wiley and Simpfendorfer 2007). The combination of tracking and monitoring techniques used expanded the range of information gathered by generating both short- and long-term data (Wiley and Simpfendorfer 2007) and further analysis of these data is currently underway.

Small juveniles (39-79 in (100–200 cm) in length) habitat use

Small juveniles have many of the same habitat use characteristics seen in the very small sawfish. Their association with very shallow water (< 1 foot deep) is weaker, possibly because they are better suited to predator avoidance due to their larger size and greater experience. They do still have a preference for shallow water, remaining in depths mostly less than 3 feet (90 cm). They will, however, move into deeper areas at times. One small sawfish acoustically tracked in the Caloosahatchee River spent the majority of its time in the shallow waters near the riverbank, but for a period of a few hours it moved into water 4-6 feet deep (Simpfendorfer 2003). During this time, it was constantly swimming, a stark contrast to active periods in shallow water that lasted only a few minutes before resting on the bottom for long periods.

Site fidelity has been studied in more detail in small sawfish. Several sawfish approximately 59 in (150 cm) in length fitted with acoustic tags have been relocated in the same general areas over periods of several months, suggesting a high level of site fidelity (Simpfendorfer 2003). The daily home ranges of these animals are considerably larger (1-5 km^2) than for the very small sawfish and there is less overlap in home ranges between days. The recent implementation of acoustic monitoring systems to study the longer-term site fidelity of sawfish has confirmed these observations, and also identified that changes in environmental conditions (especially salinity) may be important in driving changes in local distribution and, therefore, habitat use patterns (Simpfendorfer et al. 2011). Salinity electivity analysis results from Simpfendorfer et al. (2011) indicate an affinity for salinities between 18 and at least 24 psu, suggesting movements are likely made in part, to remain within this range.

Juveniles (≤ 79 in (200 cm) in length) habitat use

Using the Heupel et al. (2007) framework for defining nursery areas for sharks and related species such as sawfish, and juvenile smalltooth sawfish encounter data, NMFS identified two nursery areas (Charlotte Harbor Estuary and Ten Thousand Islands/Everglades Units) for juvenile smalltooth sawfish in south Florida. Heupel et al. (2007) argue that nursery areas are areas of increased productivity, which can be evidenced by natal homing or philopatry (use of habitats year after year), and that juveniles in such areas should show a high level of site fidelity (remain in the area for extended periods of time). Heupel et al. (2007) proposed that shark nursery areas can be defined based on three primary criteria: (1) juveniles are more common in the area than other areas (i.e., density in the area is greater than the mean density over all areas); (2) juveniles have a tendency to remain or return for extended periods, such as weeks or months (i.e., site fidelity is greater than the mean site fidelity for all areas); and (3) the area or habitat is repeatedly used across years whereas other areas are not. NMFS analyzed juvenile smalltooth sawfish encounter data and mapped the location of the areas that met the Heupel et al. (2007) criteria for defining a nursery area. Two nursery areas were identified as meeting these criteria and were included in a critical habitat designation in 2009 (74 FR 45353). The northern nursery area is located within the Charlotte Harbor Estuary and the southern nursery area is located in the Ten Thousand Islands area south into the ENP. The habitats within the nursery areas are characterized as having red mangroves and shallow euryhaline habitats with water depths less than 3 feet in depth.

Large juveniles (>79 in (200 cm) in length) habitat use

There are few data on the habitat use patterns of large juvenile sawfish. No acoustic telemetry or acoustic monitoring studies have examined this size group. Thus there is no detailed tracking data to identify habitat use and preference. However, some data are available from the deployment of pop-up archival transmitting (PAT) tags. These tags record depth, temperature, and light data, which is stored on the tag until it detaches from the animal, floats to the surface, and sends data summaries back via the ARGOS satellite system. More detailed data can be obtained if the tag is recovered. A PAT tag deployed on a 79 in (200 cm) sawfish in the Marquesas Keys collected 120 days of data. The light data indicated that the animal had remained in the general vicinity of the outer Keys for this entire period. Depth data from the tag indicated that this animal remained in depths less than 17 feet (5 m) for the majority of this period, making only two excursions to water down to 50 feet (15 m) in depth. There is no information on site fidelity in this size class of sawfish. More data is needed from large juveniles before conclusions about their habitat use and preferences can be made.

Adult habitat use

Information on the habitat use of adult smalltooth sawfish comes from encounter data, observers aboard fishing vessels, and from PAT tags. The encounter data suggest that adult sawfish occur from shallow coastal waters to deeper shelf waters. Poulakis and Seitz (2004) observed that nearly half of the encounters with adult-sized sawfish in Florida Bay and the Florida Keys occurred in depths from 200 to 400 feet (70 to 122 m). Simpfendorfer and Wiley (2005) also reported encounters in deeper water off the Florida Keys, noting that these were mostly reported during winter. Observations on commercial longline fishing vessels and fishery independent sampling in the Florida Straits report large sawfish in depths up to 130 feet (~40 m) (National Sawfish Encounter Database). Little information is available on the habitat use patterns of the adults from the encounter data.

PAT tags have been successfully deployed on several sawfish and have provided some data on movements and habitat use. One large mature female was fitted with a tag near East Cape Sable in November 2001. The tag detached from this animal 60 days later near the Marquesas Keys, a straight-line distance of 80 nautical miles (148 km). The data from this tag indicated that the fish most likely traveled across Florida Bay to the Florida Keys and then along the island chain until it reached the outer Keys. The depth data indicated that it spent most of its time at depths less than 30 feet (10 m), but that once it arrived in the outer Keys it made excursions (1-2 days) into water as deep as 180 feet (60 m).

Limited data are available on the site fidelity of adult sawfish. Seitz and Poulakis (2002) reported that one adult-sized animal with a broken rostrum was captured in the same location over a period of a month near Big Carlos Pass suggesting that they may have some level of site fidelity for relatively short periods. However, historic occurrence of seasonal migrations along the U.S. east coast also suggests that adults may be more nomadic than the juveniles with their distribution controlled, at least in part, by water temperatures.

Population Dynamics and Status

Despite being widely recognized as common throughout their historic range (Texas to North Carolina) up until the middle of the 20th century, the smalltooth sawfish population declined dramatically during the middle and later parts of the century. The decline in the population of smalltooth sawfish is attributed to fishing (both commercial and recreational), habitat modification, and sawfish life history. Large numbers of smalltooth sawfish were caught as bycatch in the early part of this century. Smalltooth sawfish were historically caught as bycatch in various fishing gears throughout their historic range, including gillnet, otter trawl, trammel net, seine, and to a lesser degree, handline. Frequent accounts in earlier literature document smalltooth sawfish being entangled in fishing nets from areas where smalltooth sawfish were once common but are now rare (Evermann and Bean 1898). There are few long-term abundance data sets that include smalltooth sawfish. One dataset from shrimp trawlers off Louisiana from the late 1940s through the 1970s suggests a rapid decline in the species from the period 1950-1964 (NMFS 2009). However, this dataset has not been validated nor subjected to statistical analysis to correct for factors unrelated to abundance.

The Everglades National Park has established a fisheries monitoring program based on sport fisher dock-side interviews since 1972. An analysis of these data using a log-normal generalized linear model to correct for factors unrelated to abundance (e.g., change in fishing practices) indicate that the population in the ENP is stable and may be increasing (Carlson et al. 2007). From 1989-2004, smalltooth sawfish relative abundance has increased by about 5 percent per year.
There is currently no estimate of smalltooth sawfish abundance throughout its range. Although smalltooth sawfish encounter databases may provide a useful future means of measuring changes in the population and its distribution over time, including the current range, areas where recovery may be expected to occur, and the habitat needs of various size classes. Conclusions about the current abundance of smalltooth sawfish cannot be made because outreach efforts and observation effort have not expanded evenly across each study period. However, based on genetic sampling, the estimates of current effective population size are 269.6-504.9 individuals (95 percent confidence interval 139.3-1515; e-mail communication between D. Chapman and T. Wiley, April 11, 2010). Chapman also states that this number is usually 1/2 - 1/4 census population size (breeding adults, male and female) in elasmobranchs, so it appears high hundreds to low thousands is probably the estimated range expected for the extant breeders

Threats

Smalltooth sawfish are threatened today by the loss of southeastern coastal habitat through such activities as agricultural and urban development, commercial activities, dredge-and-fill operations, boating, erosion, and diversions of freshwater runoff. Dredging, canal development, seawall construction, and mangrove clearing have degraded a significant proportion of the coastline. Smalltooth sawfish have been found near warm water discharge areas near power plants. Power plant discharges may provide a warm water refuge for the species during cold weather conditions. Smalltooth sawfish, especially small juveniles, are vulnerable to coastal habitat degradation due to their use of shallow, red mangrove, estuarine habitats for foraging and to avoid predation from sharks.

Recreational and commercial fisheries also still pose a threat to smalltooth sawfish. Although changes over the past decade to U.S. fishing regulations such as Florida's "Net Ban," which includes both a prohibition on the use of gill and entangling nets in all state waters and a size limit on other nets such as seines, have reduced these threats to the species over parts of its range; however, smalltooth sawfish are still incidentally caught in commercial shrimp trawls, bottom longlines, and by recreational rod-and-reel fisheries.

The current and future abundance of the smalltooth sawfish is limited by its life history characteristics (NMFS 2000). Slow-growing, late-maturing, and long-lived, these combined characteristics result in a very low intrinsic rate of population increase and are associated with the life history strategy known as "K-selection." As noted earlier in this section, K-selected animals are usually successful at maintaining relatively small, persistent population sizes in relatively constant environments. Consequently, they are not able to respond effectively (rapidly) to additional and new sources of mortality resulting from changes in their environment (Musick 1999). Simpfendorfer demonstrated that the life history of this species makes it impossible to sustain any significant level of fishing and makes it slow to recover from any population decline (Simpfendorfer 2000). Thus, the species is susceptible to population decline, even with relatively small increases in mortality.

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