NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title:	Biological Opinion on National Ocean Service National Centers for Coastal Ocean Science's proposed action to fund a project under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies (RESTORE) Act: "Linking habitat to recruitment: evaluating the importance of pelagic *Sargassum* to fisheries management in the Gulf of Mexico"
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1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with National Marine Fisheries Service (NMFS) for threatened or endangered species (ESA-listed), or designated critical habitat that may be affected by the action that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)).

The Federal action agency shall confer with the NMFS for species under NMFS jurisdiction on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat (50 C.F.R. §402.10). If requested by the Federal agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in §402.14.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

The action agency for this consultation is the National Centers for Coastal Ocean Science. The National Centers for Coastal Ocean Science proposes to fund a study in the Gulf of Mexico sampling the larval fish communities associated with *Sargassum* in the oceanic (greater than 200 meters deep) and neritic (less than 200 meters deep) environments.

This consultation, biological opinion, and incidental take statement, were completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§401-16), and agency policy and guidance and was conducted by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division (hereafter referred to as "we"). This biological opinion (opinion) and incidental take statement were prepared by NMFS Office of Protected Resources Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

This document represents the NMFS opinion on the effects of these actions on ESA-listed whales, sea turtles, fishes, and corals, and their designated critical habitats. A complete record of this consultation is on file at the NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

The National Ocean Service National Centers for Coastal Ocean Science's proposes to fund a project under the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies (RESTORE) Act: "Linking habitat to recruitment: evaluating the importance of pelagic *Sargassum* to fisheries management in the Gulf of Mexico". This project is designed to better understand the larval fish communities that congregate around pelagic *Sargassum* mats in the northern Gulf of Mexico. The project will be carried out by researchers at the University of Southern Mississippi on board the NOAA research vessel *Point Sur*.

1.2 Consultation History

This opinion is based on information provided in the National Centers for Coastal Ocean Science's request for informal consultation, correspondence, discussions with personnel at the National Centers for Coastal Ocean Science, and other sources of information. Our communication with the National Centers for Coastal Ocean Science is summarized as follows:

- **April 30, 2013:** NMFS issued a biological opinion on the NOAA National Ocean Service's Office of Coast Survey's proposal to conduct ongoing hydrographic surveys in coastal waters nationwide, carried out by NOAA ships and contractors. The formal programmatic consultation evaluated the effects of the suite of activities associated with the hydrographic surveys, including vessel transits, anchoring, hydrographic surveys, sound speed data collection, bottom sampling, tide gauge operations, testing of new survey products, and light detection and radar surveys. The consultation concluded that the National Ocean Service's Office of Coast Survey's action was not likely to jeopardize any ESA-listed species, or adversely modify or destroy designated critical habitat.
- **May 2, 2017**: The National Centers for Coastal Ocean Science submitted a memorandum requesting concurrence on their proposed action to fund a project under the RESTORE Act: "Linking habitat to recruitment: evaluating the importance of pelagic *Sargassum* to fisheries management in the Gulf of Mexico".
- **May 10, 2017**: Upon reviewing the request, NMFS Office of Protected Resources had discussions with personnel at the Southeast Regional Office, Protected Resources Division, and personnel in the Marine Mammal and Sea Turtle Conservation Division about the possibility of takes of juveniles and post-hatchling sea turtles in the *Sargassum* during the proposed activities. The Office of Protected Resources contacted the National Centers for Coastal Ocean the same day to inform them of the recommendation for formal consultation.
- **May 12, 2017**: The Office of Protected Resources met with the National Centers for Coastal Ocean Science to discuss formal consultation on the proposed action. The Office

of Protected Resources explained the rationale for recommending formal consultation, and pointed out several items that needed to be discussed in further detail. The National Centers for Coastal Ocean Science wanted to resubmit the request for concurrence with additional details and mitigation measures to avoid sea turtle take. Staff were concerned about the length of time it would take to complete a formal consultation with the research scheduled to start in July.

- **May 17, 2017**: The National Centers for Coastal Ocean Science submitted a revised letter of concurrence request for the proposed action.
- **May 23, 2017**: After review of the revised request for concurrence, and discussions with personnel at the Southeast Regional Office and Southeast Fisheries Science Center, the Office of Protected Resources informed the National Centers for Coastal Ocean Science of the recommendation for formal consultation. Information was sufficient to initiate consultation on this date.

2 The Assessment Framework

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species; or adversely modify or destroy their designated critical habitat.

"Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species." 50 C.F.R. §402.02.

"Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 C.F.R. §402.02).

An ESA section 7 assessment involves the following steps:

Description of the Proposed Action, Interrelated and Interdependent Actions, and *Action Area*. We describe the proposed action, identify any interrelated or interdependent actions, and describe the action area with the spatial extent of those stressors. *Interrelated* actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent use, apart from the action under consideration.

Status of Species and Designated Critical Habitat: We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time and evaluate the status of those species and habitat. In this Section, we also identify those *Species and Designated Critical Habitat Not Considered Further in the Opinion*, because these resources will either not be affected or are not likely to be adversely affected.

Environmental Baseline: We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, impacts of state or private actions that are contemporaneous with the consultation in process.

Effects of the Action: We identify the number, age, (or life stage), and sex of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. We also consider whether the action "may affect" designated critical habitat. This is our exposure analysis. We evaluate the available evidence to determine how individuals of those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analysis. We assess the consequences of these responses of individuals that are likely to be exposed to the populations those individuals represent, and the species those populations compromise. This is our risk analysis. The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.

Integration and Synthesis: In this section we integrate the analyses in the opinion to summarize the consequences to ESA-listed species and designated critical habitat under NMFS' jurisdiction.

Cumulative Effects: Cumulative effects are the effects to ESA-listed species and designated critical habitat of future state or private activities that are reasonably certain to occur within the action area. 50 C.F.R. §402.02. Effects from future Federal actions that are unrelated to the proposed action are not considered because they require separate ESA section 7 compliance.

Conclusion: With full consideration of the status of the species and the designated critical habitat, we consider the effects of the action within the action area on populations or subpopulations and on essential habitat features when added to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

- Reduce appreciably the likelihood of survival and recovery of ESA-listed species in the wild by reducing its numbers, reproduction, or distribution, and state our conclusion as to whether the action is likely to jeopardize the continued existence of such species; or
- Appreciably diminish the value of designated critical habitat for the conservation of an ESA-listed species, and state our conclusion as to whether the action is likely to destroy or adversely modify designated critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, then we must identify reasonable and prudent alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives. See 50 C.F.R. §402.14.

In addition, we include an *Incidental Take Statement* that specifies the impact of the take, reasonable and prudent measures to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures. ESA section 7 (b)(4); 50 C.F.R. §402.14(i). We also provide discretionary conservation recommendations that may be implemented by action agency. 50 C.F.R. §402.14(j). Finally, we identify the circumstances in which reinitiation of consultation is required. 50 C.F.R. §402.16.

NMFS does not have a regulatory definition for "harass", but has an interim definition in guidance: an act that "creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." (NMFSPD 02-110-19).

To comply with our obligation to use the best scientific and commercial data available, we collected information identified through searches of Google Scholar, Web of Science, literature cited sections of peer reviewed articles, species listing documentation, and reports published by government and private entities. This opinion is based on our review and analysis of various information sources, including:

- Information submitted by the Action Agency and the principal investigator on the project.
- Government reports (including NMFS biological opinions and stock assessment reports).
- NOAA technical memos.
- Peer-reviewed scientific literature.

These resources were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the proposed action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated critical habitat for the conservation of ESA-listed species.

3 Description of the Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The proposed action is the research conducted under the RESTORE Act science program project "Linking habitat to recruitment: Evaluating the importance of pelagic *Sargassum* to fisheries management in the Gulf of Mexico."

3.1 Proposed Activities

The National Centers for Coastal Ocean Science proposes to fund a study in the Gulf of Mexico sampling the larval fish communities associated with *Sargassum* in the oceanic (greater than 200 meters deep) and neritic (less than 200 meters deep) environments.

The purpose of the study is to quantify the abundance of *Sargassum* in the Gulf of Mexico, and to evaluate the nursery function and importance of *Sargassum* to fisheries. Researchers would:

- Quantify *Sargassum* variability in distribution and biomass at gulf-wide scales and understand the environmental controls of such variability.
- Quantify the nursery role function of *Sargassum* relative to temporal and spatial variability, habitat morphology, and open water habitats.
- Develop and test the efficacy of remote sensing and field-derived habitat indices for population assessments of managed species associated with *Sargassum*.

Researchers would conduct the sampling from the research vessel *Point Sur* transiting from its homeport of Gulfport, Mississippi. Four nine-day cruises would be conducted beginning in July 2017. Cruise 1 would take place in July 2017, Cruise 2 in May or June 2018, Cruise 3 in July or August 2018, and Cruise 4 in May or June 2019.

The action would involve two main activities: collecting *Sargassum* and juvenile fishes associated with *Sargassum* and non-*Sargassum* habitats in the field, and collecting remote sensing and environmental data.

To collect juvenile fishes associated with *Sargassum*, researchers would primarily use neuston nets. The neuston nets are one by two meters with 500 or 1,000 micron mesh. The neuston nets would be towed at the surface through *Sargassum* features and through open water. Tows would be less than one minute, as the net quickly fills up with *Sargassum*. The collected *Sargassum* would be directly brought on board.

Researchers would also use ten by three meter plankton purse seines in larger *Sargassum* habitats to capture mobile juveniles that associate below the *Sargassum* canopy. The purse seine would be deployed from a small vessel as it encircles a patch of *Sargassum*. The *Sargassum* may be lifted directly on board, or off-loaded into shrimp baskets, depending on how much *Sargassum* is collected and concerns about tearing the purse seine. Once on board, *Sargassum* would be rinsed of fishes and invertebrates in a 'sorting trough' designed for processing *Sargassum* and minimizing stress on organisms. Researchers would also deploy mid-water stereo camera rigs underneath the *Sargassum* canopy for 30 minute intervals during daylight hours to estimate abundances of larger, mobile juvenile fishes.

At dusk, researchers would use light traps to sample Sargassum habitats and open-water habitats at night. Light traps would capture juvenile stage fishes and help estimate abundance. Researchers would deploy multiple light traps for an hour, with soak time dependent on catch success.

Researchers would also opportunistically use hook and line Sabiki rigs to collect larger, mobile juvenile fishes associated with *Sargassum* and in open water habitats.

Sargassum collected in neuston net and purse seine samples would be rinsed, sorted for species type and associated organisms, and (wet) weighed. The rinsate from the *Sargassum* cleaning will be size-fractionated through a series of sieves. Samples of *Sargassum natans* and *S. fluitans* (less than 100 grams of each), sorted fishes and invertebrates, and the size-fractionated subsamples would be further processed on board for stable isotope analysis or preserved in ethanol for further diet, growth and condition analyses. The vast majority of the *Sargassum* would be returned to the water once these samples have been collected. Gear-specific fish abundances, richness and diversity would be calculated and compared between seasons, regions, and morphologies. Both Sargassum samples and epibiotic samples from Sargassum rinsate would be freeze-dried and ground into a fine powder for laboratory analyses. All collected and sorted fish and invertebrate samples would be identified to the lowest taxonomic level and frozen. Managed species (state, national, and international) that are encountered would be used for *Sargassum*-fish association and biomass data to formulate a *Sargassum* index for recruitment in the Gulf of Mexico. Researchers would identify the stomach contents of juvenile fishes preserved in ethanol. Blood and liver samples would be taken prior to freezing fish.

Remote sensing would be used in this project for spectral analysis of *Sargassum* and fine-tuning the multi-band algorithms and for data product validation. They would utilize the *Sargassum* Watch System (http://optics.marine.usf.edu/projects/saws.html), which uses satellite sensors to produce and distribute *Sargassum*-related products in near real-time. Environmental data would be collected from several sources to help understand the observed *Sargassum* distribution patterns. In addition, sea surface temperature anomaly data, photosynthetically available radiation data, Mississippi River discharge data, altimetry data, and surface current data will all be obtained.

3.2 Minimization Measures

The National Centers for Coastal Ocean Science proposed protective measures and best management practices to minimize or avoid exposure to ESA-listed resources. These measures are described in the 2013 biological opinion, and are summarized briefly below.

Protected species observers would be on watch for ESA-listed species and other protected resources, providing 100 percent coverage during the survey. The National Centers for Coastal Ocean Science would require any observations of marine mammals and sea turtles (the only ESA-listed species likely to be observed) to be recorded in their Observation Log, including the date, time, location, species, number of individuals, and response behavior (if any). They would also take a digital photograph. The information from the Observation Logs would be compiled, summarized, and provided to us at the end of each year.

The National Centers for Coastal Ocean Science will provide the list of protective measures to all vessel captains and crew, and explain that these measures are required to fulfill their ESA section 7 requirements (i.e., to ensure that the action does not jeopardize endangered or threatened species and does not adversely modify or destroy critical habitat.) They will ensure compliance with the minimization measures during surveys conducted aboard NOAA ships. They will strongly encourage compliance during transits aboard NOAA ships and record any instances of non-compliance.

In the event of incidental take above the amount identified in the Incidental Take Statement, the National Centers for Coastal Ocean Science would suspend all activities causing incidental take and immediately contact us. They would request reinitiation in the event of exceedance of the amount of take, systematic noncompliance with the minimization measures, unanticipated adverse effects, or modification of the action.

Additional measures, identified in an August 22, 2014, memo from Deputy Under Secretary for Operations Vice Admiral Michael Devany, the Office of Coast Survey have been incorporated to include habitat impact precautions and to mitigate concerns regarding entanglement.

- Minimize vessel disturbance and ship strike potential
  - Reduced speeds (less than 13 knots) when transiting through ranges of ESA-listed cetaceans (unless otherwise required, e.g., NOAA Sanctuaries).
  - Reduced speeds (less than 13 knots) while transiting through designated critical habitat (unless slower speeds are required, e.g., less than 10 knots in Right Whale critical habitat and management areas).
  - Trained observers aboard all vessels; 100 percent observer coverage.
  - Species identification keys (for marine mammals, reptiles, fishes, and invertebrates – as applicable) will be available on all vessels.
- Minimize noise
  - Reduced speed (see above).
- Minimize vessel discharges (including aquatic nuisance species)
  - Meet all Coast Guard requirements.
  - Clean hull regularly to remove aquatic nuisance species.
  - Avoid cleaning of hull in critical habitat.
  - Avoid cleaners with nonylphenols.
- Minimize anchor impact to corals, seagrass or other Essential Fish Habitat
  - Use designated anchorage area when available.
  - Use mapping data to anchor in mud or sand, to avoid anchoring on corals.
  - Minimize anchor drag.
- Sea Turtles, Manatees, and Dolphins
  - Avoid approaching within 50 yards.
- Sea Turtles and *Sargassum*
  - During transit, Protected Species observers will be on watch for patches of *Sargassum* and will also search for sea turtles.
  - Vessel speed upon approaching *Sargassum* will be reduced (1 knot or less).
  - Multiple observers, including protected species observers, will scan any proposed patch of *Sargassum* to be sampled for 10 minutes prior to deploying any net gear. If sea turtles are observed during the 10 minute observation period, that particular patch will not be sampled.
  - If a sea turtle is observed in the sampling path of a plankton net at any point during deployment, the net tow or plankton purse seine event will be halted.

- Cetaceans
  - Avoid approaching within 200 yards (182.9 meters), 500 yards for right whales.
  - Avoid critical habitat, when possible.
- Entanglement Protective Measures
  - Small nets (1 x 2 meter neuston and 10 x 3 meter plankton purse seine) utilized.
  - Net tow times should be minimized as much as possible.
  - No sample collection if sea turtles are observed.
- Habitat Protection
  - Avoid unnecessary contact of gear, towed or lowered, with the sensitive bottom habitat (*e.g.*, submerged aquatic vegetation and hard bottom.
- State Collecting Permits
  - No state collection permits are required for the planned activities.

4 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 C.F.R. §402.02).

The proposed action will take place in the northern Gulf of Mexico between 86°W and 92°W, and bordered to the south by 24°N. Sampling would take place in the neritic (less than 200 meters deep) and oceanic (greater than 200 meters deep) environments.

5 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent utility apart from the action under consideration.

NMFS determined that there are no interrelated or interdependent actions to the proposed action.

6 Species and Critical Habitat Not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed or critical habitat that are not likely to be adversely affected by the proposed action, as well as the effects of activities that are interrelated to or interdependent with the Federal agency's proposed action. The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the species ESA-listed in Table 1 and we summarize our results below.

An action warrants a "may affect, not likely to be adversely affected" finding when its effects are wholly *beneficial, insignificant* or *discountable*. *Beneficial* effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs and consultation is required because the species may be affected.

Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed species may be expected to be affected, but not harmed or harassed.

Discountable effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact a listed species),but it is very unlikely to occur.

6.1 Whales

ESA-listed whales such as fin, sei, sperm, blue, and proposed Gulf of Mexico Bryde's whales occur in the action area. These species may be exposed to stressors associated with the proposed action. These included vessel activity (strike, noise, visual disturbance, transit, discharges, and introduction of aquatic nuisance species), and the inwater research activities. When a vessel transits to and from the survey areas, potential effects on the ESA-listed species include vessel strike, noise generated by the vessel, and visual disturbance from the vessel itself. There will be no multi-beam echosounders or sub-bottom profilers in use for this proposed action, meaning that the only vessel noise generated will be from the operation of the vessel itself. Combined vessel noise and presence could cause slight response or behavioral interruptions, but they would be minor and temporary as the vessel moves away from any whales. The distance between the vessel and observed whales, per avoidance protocols, would also minimize the potential for acoustic disturbance from engine noise. Therefore, effects to ESA-listed or proposed whales from noise or presence associated with vessel transit would be insignificant.

Because the vessel would move at a very slow speed during the survey, a vessel striking an ESA-listed or proposed whale would be improbable and extremely unlikely. Further, adherence to reduced vessel speeds, use of protected species observers, and avoidance procedures are also expected to avoid vessel strikes. Therefore, effects from vessel strikes during the survey would be discountable.

The potential for fuel or oil leakages is extremely unlikely. An oil or fuel leak would likely pose a significant risk to the vessel and its crew and actions to correct a leak should occur immediately to the extent possible. In the event that a leak should occur, the amount of fuel and oil onboard the research vessel is unlikely to cause widespread, high dose contamination (excluding the remote possibility of severe damage to the vessel) that would impact listed species directly or pose hazards to their food sources. Because the potential for fuel or oil leakage is extremely unlikely to occur, we find that the risk from this potential stressor to any ESA-listed or proposed whale is discountable.

To minimize the risk of aquatic nuisance species introduction, personnel would: avoid discharge of ballast water in designated critical habitat; use anti-fouling coatings; clean the hull regularly to remove aquatic nuisance species (but avoid doing so in critical habitat), and rinse the anchor with a high-powered hose after retrieval. These protective measures go beyond the requirements of the Vessel and Small Vessel General Permits[1], as described in the mitigation measures above. Furthermore, the vessels would not transit outside of the United States; therefore, they would not introduce foreign aquatic nuisance species. Given the protective measures, it is highly unlikely that the vessels would transfer aquatic nuisance species to any ESA-listed or proposed whale during the proposed action.

Therefore, we conclude that the effects from vessel activity, pollution by oil or fuel leakage, and risk of aquatic nuisance species introduction are insignificant or discountable, and not likely to adversely affect ESA-listed or proposed whales.

The inwater research activites would include the use of plankton purse seines, neuston nets, Sabiki hook and line rigs, and light traps. This equipment is designed to capture larval fish and *Sargassum*. Due to the small size of the inwater research equipment, we conclude that there will be no effect to ESA-listed or proposed whales. Therefore, ESA-listed marine mammals, or those proposed for listing, will not be discussed further in this opinion.

6.2 Fishes

ESA-listed fishes such as Gulf sturgeon, Nassau grouper, smalltooth sawfish, and the proposed oceanic whitetip shark and giant manta ray could occur within the action area. Gulf sturgeon associate with the benthos, and can be found in the Gulf of Mexico and in rivers in Alabama, Mississippi, and the Florida panhandle. Gulf sturgeon spend most of the year in rivers, and are typically found in shallow Gulf waters (two to four meters) during winter (Fox et al. 2002). The proposed action would take place in the Gulf of Mexico, involving vessel activity and sampling at the waters' surface. Since the action will not involve sampling methods that could capture Gulf sturgeon, in an area where they typically do not occur, we expect there to be no effect from the proposed action to Gulf sturgeon, and will not consider it further. Critical habitat for gulf sturgeon has been designated in rivers in Louisiana, Mississippi, Alabama, and the Florida panhandle, outside of the action area of the neritic and oceanic Gulf of Mexico. Since the

[1] See Vessels General Permit and Small Vessels General Permit requirements at: https://www.epa.gov/npdes/vessels-vgp

proposed action will not occur in designated Gulf sturgeon critical habitat, we conclude that there will be no effect, and it will not be considered further.

The Nassau grouper occupies shallow water throughout the Caribbean, south Florida, Bermuda, and the Bahamas (NMFS 2013c). In the United States, smalltooth sawfish are found in shallow coastal waters around the peninsula of Florida (NMFS 2010b). Since these species are outside the action area, we have determined that there will be no effect to Nassau grouper or smalltooth sawfish as a result of the proposed action.

Giant manta rays, proposed for listing in January 2017, are commonly found offshore in oceanic waters, but are sometimes found feeding in shallow waters (less than 10 meters) (Miller 2016). The range of giant manta rays includes the Gulf of Mexico, and could coincide with the action area. Giant manta rays can grow to be as large as seven meters; fully developed pups are about 1.4 meters. The proposed action involves in-water sampling, but due to the size of the purse seines and neuston nets, the sampling methods are not likely to result in capture. The large size of the giant manta rays also makes it likely that the protected species observers would see it before sampling, and be able to avoid it. We conclude that there will be no effect from the proposed action to giant manta rays.

The oceanic whitetip shark, proposed for listing in December 2016, is distributed worldwide in tropical and subtropical waters, usually found in open ocean and near the outer continental shelf (Young 2016). Although oceanic whitetip sharks could occur in the deeper oceanic waters of the action area, the proposed in-water sampling activities are unlikely to result in capture due to the size of the equipment being used. Therefore, we expect there to be no effect from the proposed action to oceanic whitetip sharks, and will not consider it further.

6.3 Corals

The National Centers for Coastal Ocean Science identified seven ESA-listed coral species which may occur in the action area: lobed star coral, boulder star coral, mountainous star coral, pillar coral, rough cactus coral, elkhorn coral, and staghorn coral. Lobed star, boulder star, and mountainous star coral species are found in the Caribbean. Elkhorn and staghorn coral can be found in the Florida Keys; pillar coral and rough cactus coral can be found in southeastern Florida. The action funded by the National Centers for Coastal Ocean Science will take place in in the Gulf of Mexico, outside the range of where these species might occur. The research will involve vessel activity and inwater sampling that will not impact the substrate. The vessel operators will use mapping data to avoid anchoring on sensitive bottom types and coral reefs. Therefore, we conclude that the proposed action will have no effect on the seven coral species listed above.

6.4 Critical Habitat

Critical habitat for elkhorn and staghorn corals has been designated in Puerto Rico and the Florida Keys. Since these units of critical habitat occur outside the proposed action area, we conclude that there will be no effect from the proposed action to elkhorn or staghorn designated critical habitat.

Critical habitat has been designated for green, hawksbill and leatherback sea turtles. These units all are found outside the proposed action area, and will not be impacted by the proposed action.

7 Species and Critical Habitat Likely to be Adversely Affected

This section identifies the ESA-listed species that occur within the action area that may be affected by the proposed action (Section 3). All of the affected species potentially occurring within the action area are ESA-listed in Table 1 along with their regulatory status.

Table 1. Threatened and endangered species that may be affected by the National Ocean Service's proposed action of funding a research project in the northern Gulf of Mexico.

Species	ESA Status	Critical Habitat	Recovery Plan
	Sea Turtles		
Green turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	63 FR 46693[2]	63 FR 28359
Hawksbill Turtle (*Eretmochelys imbricata)*	E – 35 FR 8491	63 FR 46693	57 FR 38818
Kemp's Ridley turtle (*Lepidochelys kempii*)	E – 35 FR 18319	-- --	75 FR 12496
Leatherback turtle (*Dermochelys coriacea*)	E – 35 FR 8491	44 FR 17710 and 77 FR 4170	63 FR 28359
Loggerhead turtle, (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39856	63 FR 28359 74 FR 2995

8 Status of Species and Critical Habitat Likely to be Adversely Affected

This section examines the status of each species that would be affected by the proposed action. The status includes the existing level of risk that the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution," which is part of the jeopardy determination as described in 50 C.F.R. §402.02. More detailed information on the status and trends of these ESA-listed species, and

[2]As noted above, we do not consider further critical habitat designated for green, hawksbill or leatherback sea turtles are the habitat is outside of the action area.

their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on these NMFS Web sites: [http://www.nmfs.noaa.gov/pr/species/index.htm].

This section also examines the condition of critical habitat throughout the designated area (such as various watersheds and coastal and marine environments that make up the designated area), and discusses the condition and current function of designated critical habitat, including the essential physical and biological features that contribute to that conservation value of the critical habitat.

One factor affecting the rangewide status of sea turtles and aquatic habitat at large is climate change. Climate change will be discussed in the Environmental Baseline section.

8.1 Green Turtle North Atlantic Distinct Population Segment

The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The North Atlantic DPS green turtle is found in the north Atlantic Ocean and Gulf of Mexico (Figure 1).

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter) (Figure 2). The species was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed eleven DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057) (Table 2). The North Atlantic DPS is listed as threatened.

Table 2. North Atlantic distinct population segment green sea turtle summary information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Chelonia mydas	**Green Turtle**	**North Atlantic**	**Threatened**	2015	81 FR 20057	1991	63 FR 46693

We used information available in the 2007 Five Year Review (NMFS 2007) and 2015 Status Review (Seminoff et al. 2015) to summarize the life history, population dynamics and status of the species, as follows.

Life history

Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey.

Population dynamics

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the North Atlantic DPS green sea turtle.

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at seventy-three nesting sites, and available data indicate an increasing trend in nesting. The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts seventy-nine percent of nesting females for the DPS (Seminoff et al. 2015). Occasional nesting has also been documented along the Gulf Coast of Florida (Meylan et al. 1995).

For the North Atlantic DPS, the available data indicate an increasing trend in nesting. There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets of twenty-five years or more show 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.

The North Atlantic DPS has a distinct haplotype from other green turtles around the world, which was a factor in defining the discreteness of the population for the DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico and Costa Rica (Seminoff et al. 2015)(Shamblin et al. 2016).

Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and 19°N to the western coasts of Europe and Africa. Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba.

In U.S. Atlantic and Gulf of Mexico waters, green sea turtles are distributed throughout inshore and nearshore waters from Texas to Massachusetts. 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), 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 (Guseman and Ehrhart 1992; Wershoven and Wershoven 1992). The summer developmental habitat for green sea turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997a). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatán Peninsula.

Status

Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principal cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to fifty years. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

Recovery Goals

See the 1998 and 1991 recovery plans for the Pacific, East Pacific and Atlantic populations of green turtles for complete down-listing/delisting criteria for recovery goals for the species. Broadly, recovery plan goals emphasize the need to protect and manage nesting and marine habitat, protect and manage populations on nesting beaches and in the marine environment, increase public education, and promote international cooperation on sea turtle conservation topics.

8.2 Hawksbill Turtle

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans (Figure 3).

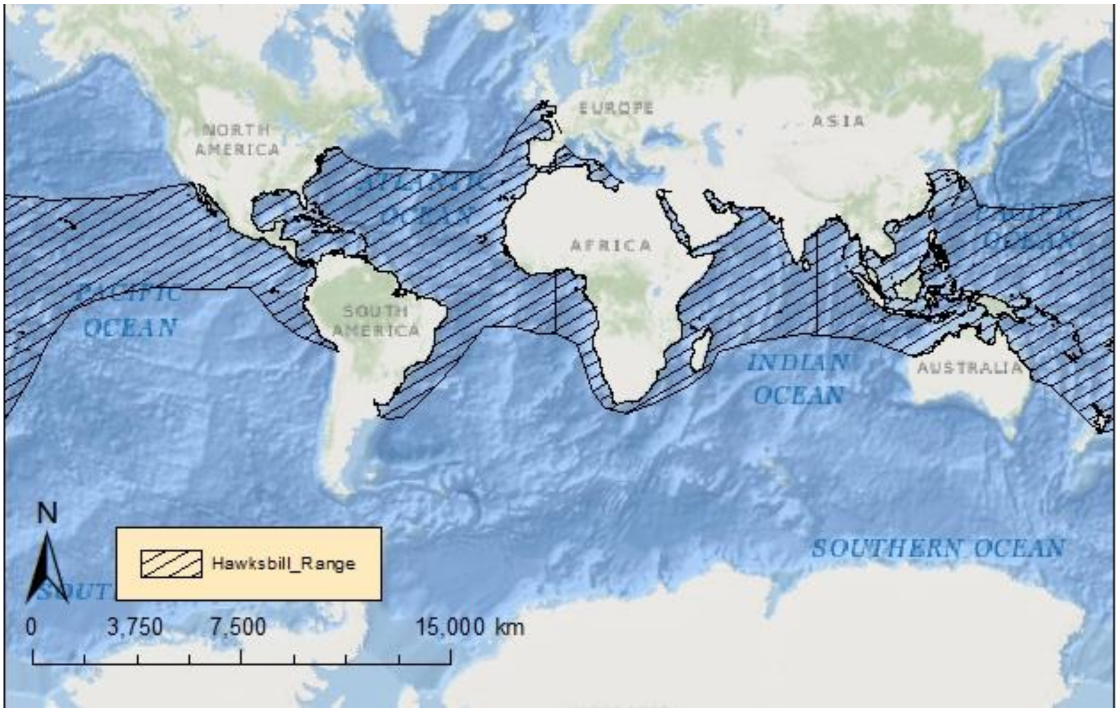

Figure 3. Map identifying the range of the hawksbill turtle.

The hawksbill sea turtle has a sharp, curved, beak-like mouth and a "tortoiseshell" pattern on its carapace, with radiating streaks of brown, black, and amber (Figure 4). The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (Table 3).

Table 3. Hawksbill turtle summary information

Species		Distinct		Recent			
Eretmochelys imbricata	**Hawksbill turtle**	**None**	**Endangered** range wide	2013	35 FR 8491	57 FR 38818 Atlantic	63 FR 46693 Atlantic

We used information available in the five year reviews (NMFS 2013a; NMFS and USFWS 2007a) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Hawksbill sea turtles reach sexual maturity at twenty to forty years of age. Hawksbill sea turtles nest on sandy beaches throughout the tropics and subtropics. Females return to their natal beaches every two to five years and nest an average of three to five times per season. Clutch sizes are large (up to 250 eggs). Sex determination is temperature dependent, with warmer incubation producing more females. Hatchlings migrate to and remain in pelagic habitats until they reach approximately twenty two to twenty five centimeters in straight carapace length. As juveniles, they take up residency in coastal waters to forage and grow. As adults, hawksbills use their sharp beak-like mouths to feed on sponges and corals. Hawksbill sea turtles are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997b; Plotkin 2003). Satellite tagged turtles have shown significant variation in movement and migration patterns. Distance traveled between nesting and foraging locations ranges from a few hundred to a few thousand kilometers (Horrocks et al. 2001; Miller et al. 1998).

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the hawksbill sea turtle.

Surveys at eighty eight nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS 2013a). In general, hawksbills are doing better in the Atlantic and Indian Ocean than in the Pacific Ocean, where despite greater overall abundance, a greater proportion of the nesting sites are declining. In the United States, hawksbills typically laid about 500 to 1,000 nests on Mona Island, Puerto Rico in the past (Diez and Van Dam 2007), but the numbers appear to be increasing, as the Puerto Rico Department of Natural and Environmental Resources counted nearly 1,600 nests in 2010 (PRDNER nesting data). Another 56 to 150 nests are typically laid on Buck Island off St. Croix (Meylan 1999; Mortimer and Donnelly 2008). Nesting also occurs to a lesser extent on beaches on Culebra Island and Vieques Island in Puerto Rico, the mainland of Puerto Rico, and additional beaches on St. Croix, St. John, and St. Thomas, U.S. Virgin Islands.

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos, Mexico) increased fifteen percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2013a). Nesting populations in nine out of ten nesting sites in the Caribbean have shown a recent increase, attributed to the implementation of conservation measures.

Populations are distinguished generally by ocean basin and more specifically by nesting location. Our understanding of population structure is relatively poor. Genetic analysis of hawksbill sea turtles foraging off the Cape Verde Islands identified three closely-related haplotypes in a large majority of individuals sampled that did not match those of any known nesting population in the western Atlantic, where the vast majority of nesting has been documented (McClellan et al. 2010; Monzon-Arguello et al. 2010). Hawksbills in the Caribbean seem to have dispersed into separate populations (rookeries) after a bottleneck roughly 100,000 to 300,000 years ago (Leroux et al. 2012).

The hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbills can be found in *Sargassum* mats; post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Bjorndal and Bolten 2010; Musick and Limpus 1997b).

Status

Long-term data on the hawksbill sea turtle indicate that sixty-three sites have declined over the past twenty to one hundred years (historic trends are unknown for the remaining twenty-five sites). Recently, twenty-eight sites (sixty-eight percent) have experienced nesting declines, ten have experienced increases, three have remained stable, and forty-seven have unknown trends. The greatest threats to hawksbill sea turtles are overharvesting of turtles and eggs, degradation of nesting habitat, and fisheries interactions. Adult hawksbills are harvested for their meat and carapace, which is sold as tortoiseshell. Eggs are taken at high levels, especially in southeast Asia where collection approaches one hundred percent in some areas. In addition, lights on or adjacent to nesting beaches are often fatal to emerging hatchlings and alters the behavior of nesting adults. The species' resilience to additional perturbation is low.

Recovery Goals

See the 1992 and 1998 Recovery Plans for the U.S. Caribbean, Atlantic and Gulf of Mexico and U.S. Pacific populations of hawksbill sea turtles, respectively, for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top recovery actions identified to support in the Recovery Plans:

1. Identify important nesting beaches.
2. Ensure long-term protection and management of important nesting beaches.
3. Protect and manage nesting habitat; prevent the degradation of nesting habitat caused by seawalls, revetments, sand bags, other erosion-control measures, jetties and breakwaters.
4. Identify important marine habitats; protect and manage populations in marine habitat.
5. Protect and manage marine habitat; prevent the degradation or destruction of important [marine] habitats caused by upland and coastal erosion.
6. Prevent the degradation of reef habitat caused by sewage and other pollutants.
7. Monitor nesting activity on important nesting beaches with standardized index surveys.
8. Evaluate nest success and implement appropriate nest-protection on important nesting beaches.
9. Ensure that law-enforcement activities prevent the illegal exploitation and harassment of sea turtles and increase law-enforcement efforts to reduce illegal exploitation.

10. Determine nesting beach origins for juveniles and subadult populations.

8.3 Kemp's Ridley Turtle

The Kemp's ridley turtle is considered to be the most endangered sea turtle, internationally (Groombridge 1982; Zwinenberg 1977). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas (Figure 5).

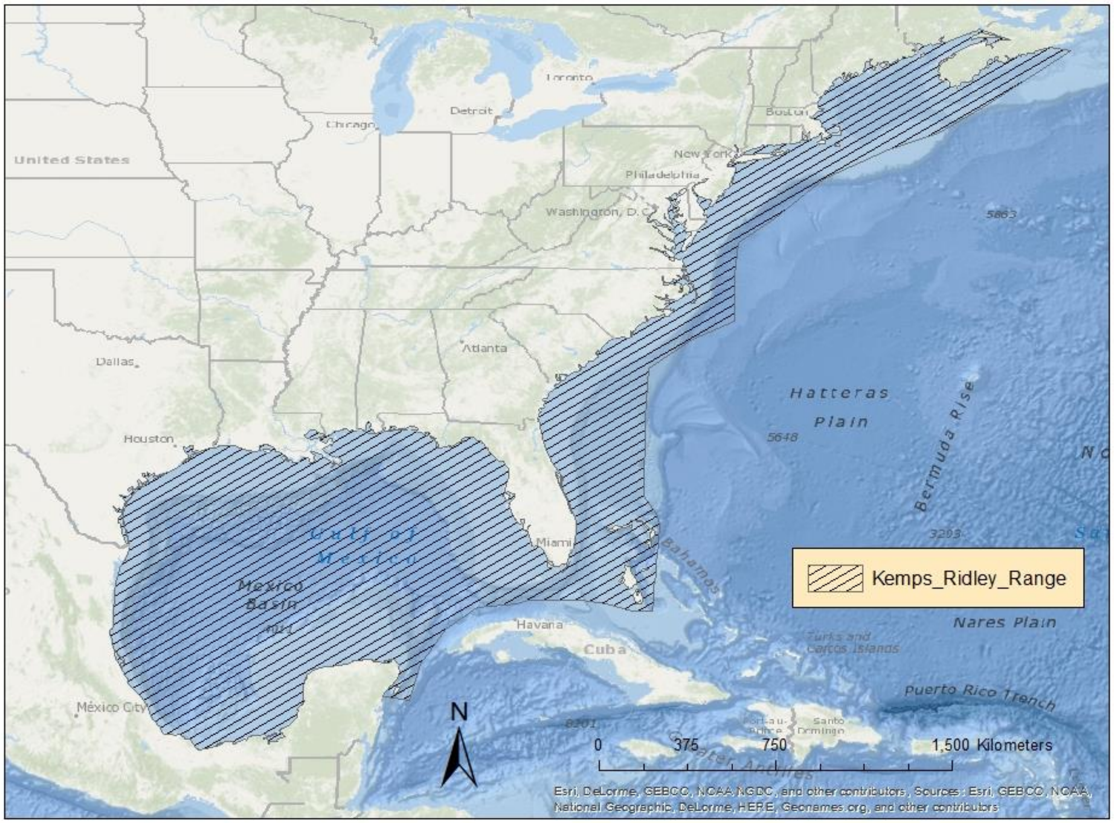

Figure 5. Map identifying the range of the Kemp's ridley sea turtle.

Kemp's ridley sea turtles are the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell (Figure 6). The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (Table 4).

Table 4. Kemp's ridley turtle summary information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	
Lepidochelys kempii	**Kemp's ridley turtle**	**None**	**Endangered** range wide	2015	35 FR 18319	75 FR 12496 U.S. Caribbean, Atlantic, and Gulf of Mexico (draft) U.S. Caribbean, Atlantic, and Gulf of Mexico	None Designated

We used information available in the revised recovery plan (NMFS 2011) and the Five-Year Review (NMFS 2015) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Females mature at twelve years of age. The average remigration is two years. Nesting occurs from April to July in large arribadas, primarily at Rancho Nuevo, Mexico. Females lay an average of 2.5 clutches per season. The annual average clutch size is ninety-seven to one hundred eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats. Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep, although they can also be found in deeper offshore waters. As adults, Kemp's ridleys forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS 2011).

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Kemp's ridley sea turtle.

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS 2015). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, fifty in 2005, 197 in 2009, and 119 in 2014 (NMFS 2015).

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased fifteen percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2015).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS 2011). Additional analysis of the mitochondrial DNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

The Kemp's ridley occurs from the Gulf of Mexico and along the Atlantic coast of the U.S. (TEWG 2000). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2010).

Status

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. A successful head-start program has resulted in the reestablishment of nesting at Texan beaches. While fisheries bycatch remains a threat, the use of turtle excluder devices mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. It is clear that the species is steadily increasing; however, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

Critical Habitat

No critical habitat has been designated for Kemp's ridley turtles.

Recovery Goals

See the 2011 Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were identified as priorities to recover Kemp's ridely sea turtles:

1. Protect and manage nesting and marine habitats.
2. Protect and manage populations on the nesting beaches and in the marine environment.
3. Maintain a stranding network.
4. Manage captive stocks.
5. Sustain education and partnership programs.
6. Maintain, promote awareness of and expand U.S. and Mexican laws.
7. Implement international agreements.
8. Enforce laws.

8.4 Leatherback Turtle

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 7).

Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their belly (Figure 8).

Figure 8. Leatherback turtle. Photo: R.Tapilatu.

The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973 (

Table 5).

Table 5. Leatherback turtle summary information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Dermochelys coriacea	**Leatherback sea turtle**	**None**	**Endangered** range wide	2013	E – 35 FR 8491	U.S. Caribbean, Atlantic and Gulf of Mexico	44 FR 17710 and 77 FR 4170

We used information available in the five year review (NMFS 2013b) and the critical habitat designation (77 FR 61573) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Age at maturity has been difficult to ascertain, with estimates ranging from five to twenty-nine years (Avens et al. 2009; Spotila et al. 1996). Females lay up to seven clutches per season, with more than sixty-five eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately fifty percent worldwide (Eckert et al. 2012). Females nest every one to seven years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about thirty-three percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the leatherback sea turtle.

Leatherbacks are globally distributed, with nesting beaches in the Pacific, Atlantic, and Indian oceans. Detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007a). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS 2013b).

Population growth rates for leatherback sea turtles vary by ocean basin. Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation has been declining at a rate of almost six percent per year since 1984 (Tapilatu et al. 2013). Leatherback subpopulations in the Atlantic Ocean, however, are showing signs of improvement. Nesting females in South Africa are increasing at an annual rate of four to 5.6 percent, and from nine to thirteen percent in Florida and the U.S. Virgin Islands (TEWG 2007a), believed to be a result of conservation efforts.

Analyses of mitochondrial DNA from leatherback sea turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS 2013b). Genetic analyses using microsatellite markers along with mitochondrial DNA and tagging data indicate there are seven groups or breeding populations in the Atlantic Ocean: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007b).

Leatherback sea turtles are distributed in oceans throughout the world. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, because of sea-level rise. The species' resilience to additional perturbation is low.

Recovery Goals

See the 1998 and 1991 Recovery Plans for the U.S. Pacific and U.S Caribbean, Gulf of Mexico and Atlantic leatherback sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan:

1. Reduce fisheries interactions.
2. Improve nesting beach protection and increase reproductive output.
3. International cooperation.
4. Monitoring and research.
5. Public engagement.

8.5 Loggerhead Turtle Northwest Atlantic Ocean Distinct Population Segment

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans. Northwest Atlantic Ocean DPS loggerheads are found along eastern North America, Central America, and northern South America (Figure 9).

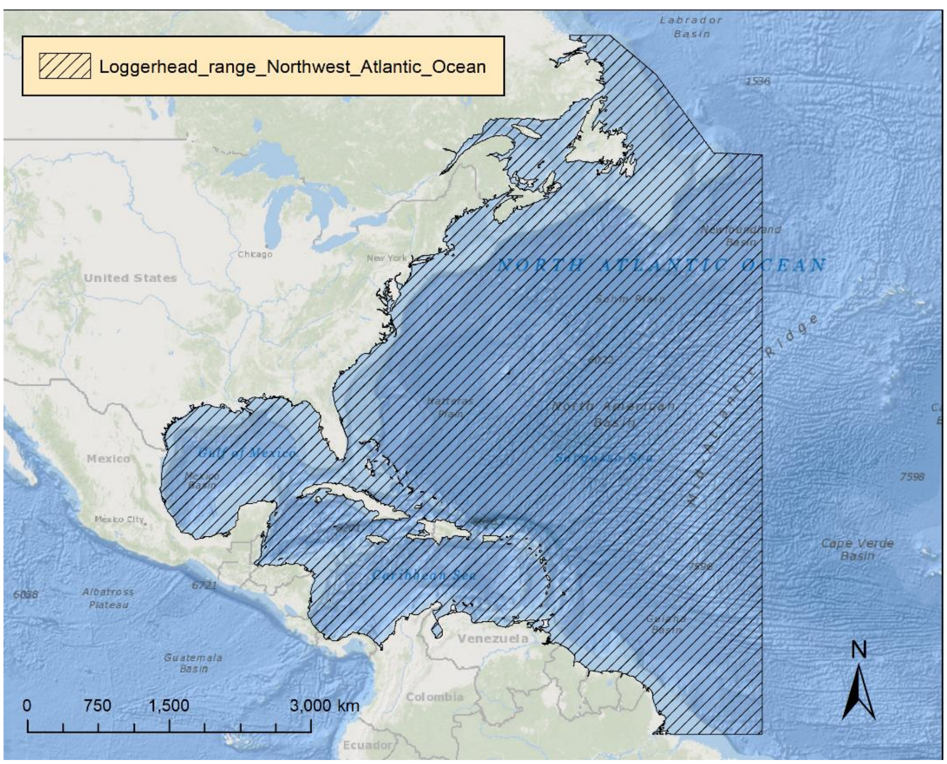

Figure 9. Map identifying the range of the Northwest Atlantic Ocean distinct population segment loggerhead sea turtle.

The loggerhead sea turtle is distinguished from other turtles by its reddish-brown carapace, large head and powerful jaws (Figure 10). The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800). On September 22, 2011, the NMFS designated nine distinct population segments of loggerhead sea turtles, with the Northwest Atlantic Ocean DPS listed as threatened (75 FR 12598) (Table 6).

Table 6. Northwest Atlantic Ocean distinct population segment summary information.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Caretta caretta	**Loggerhead turtle**	**Northwest Atlantic Ocean**	**Threatened**	2009	76 FR 58868	2009	79 FR 39855

We used information available in the 2009 Status Review (Conant et al. 2009a) and the final listing rule (76 FR 58868) to summarize the life history, population dynamics, and status of the species, as follows.

Life History

Mean age at first reproduction for female loggerhead sea turtles is thirty years. Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. As post-hatchlings, loggerheads enter the "oceanic juvenile" life stage, migrating offshore and becoming associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986; Conant et al. 2009b; Witherington 2002). Oceanic juveniles grow at rates of one to two inches (2.9 to 5.4 cm) per year (Bjorndal et al. 2003; Snover 2002) over a period as long as seven to 12 years (Bolten et al. 1998) before moving to more coastal habitats. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (i.e., coastal waters). Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads.

Population Dynamics

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Northwest Atlantic Ocean DPS loggerhead sea turtle.

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size. Adult nesting females often account for less than one percent of total population numbers (Bjorndal et al. 2005).

Using a stage/age demographic model, the adult female population size of the DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS-SEFSC 2009). Based on genetic information, the Northwest Atlantic Ocean DPS is further categorized into five recovery units corresponding to nesting beaches. These are Northern Recovery Unit, Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, Northern Gulf of Mexico Recovery Unit, and the Greater Caribbean Recovery Unit.

The Northern Recovery Unit, from North Carolina to northeastern Florida, and is the second largest nesting aggregation in the DPS, with an average of 5,215 nests from 1989 to 2008, and approximately 1,272 nesting females (NMFS and USFWS 2008).

The Peninsular Florida Recovery Unit hosts more than 10,000 females nesting annually, which constitutes eighty-seven percent of all nesting effort in the DPS (Ehrhart et al. 2003).

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003). Other significant nesting sites are found throughout the Caribbean, and including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over one hundred nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008).

The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. The only available data for the nesting subpopulation on Key West comes from a census conducted from 1995 to 2004 (excluding 2002), which provided a mean of 246 nests per year, or about sixty nesting females (NMFS and USFWS 2007b).

The Gulf of Mexico Recovery Unit has between one hundred to 999 nesting females annually, and a mean of 910 nests per year.

Nest counts taken at index beaches in Peninsular Florida show a significant decline in loggerhead nesting from 1989 to 2006, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Loggerhead nesting on the Archie Carr National Wildlife Refuge (representing individuals of the Peninsular Florida subpopulation) has fluctuated over the past few decades. There was an average of 9,300 nests throughout the 1980s, with the number of nests increasing into the 1990s until it reached an all-time high in 1998, with 17,629 nests. From that point, the number of loggerhead nests at the Refuge have declined steeply to a low of 6,405 in 2007, increasing again to 15,539, still a lower number of nests than in 1998 (Bagley et al. 2013).

For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina and Georgia declined at 1.9 percent annually from 1983 to 2005 (NMFS and USFWS 2007b).

The nesting subpopulation in the Florida panhandle has exhibited a significant declining trend from 1995 to 2005 (Conant et al. 2009a; NMFS and USFWS 2007b). Recent model estimates predict an overall population decline of seventeen percent for the St. Joseph Peninsula, Florida subpopulation of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014).

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71 to 88 percent) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madiera, Canary Islands and Adalusia, Gulf of Mexico and Brazil (Masuda 2010).

Status

Due to declines in nest counts at index beaches in the United States and Mexico, and continued mortality of juveniles and adults from fishery bycatch, the Northwest Atlantic Ocean DPS is at risk and likely to decline in the foreseeable future (Conant et al. 2009a).

Critical Habitat

NMFS has designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles. On July 10, 2014, NMFS and the U.S. Fish and Wildlife Service designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi (79 FR 39856) (Figure 11). These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors. The critical habitat is categorized into thirty-eight occupied marine areas and 685 miles of nesting beaches. The physical or biological features and primary constituent elements identified for the different habitat types include waters adjacent to high density nesting beaches, waters with minimal obstructions and manmade structures, high densities of reproductive males and females, appropriate passage conditions for migration, conditions that support sargassum habitat, available prey, and sufficient water depth and proximity to currents to ensure offshore transport of post-hatchlings. Loggerhead designated critical habitat occurs within the action area and the potential effects to it will be discussed later in this document.

Recovery Goals

See the 2009 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads for complete down listing/delisting criteria for each of the following recovery objectives.

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, Federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

9 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 C.F.R. §402.02).

9.1 Habitat Degradation

A number of factors may be directly or indirectly affecting listed species in the action area by degrading habitat. In-water construction activities (e.g., pile driving associated with shoreline projects) in both inland waters as well as coastal waters in the action area can produce sound levels sufficient to disturb sea turtles under some conditions. Pressure levels from 190 to 220 decibels re 1 micropascal were reported for piles of different sizes in a number of studies (NMFS 2006b). The majority of the sound energy associated with pile driving is in the low frequency range (less than 1,000 Hertz; Illingworth and Rodkin Inc. 2001; Illingworth and Rodkin Inc. 2004; Reyff 2003), which is the frequency range at which sea turtles hear best. Dredging operations also have the potential to emit sounds at levels that could disturb sea turtles. Depending on the type of dredge, peak sound pressure levels from 100 to 140 decibels re 1 micropascal were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, less than 1,000 Hertz (Clarke et al. 2003).

Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of sea turtles to sound. For example, a six-inch block of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 decibels (NMFS 2008). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 decibels lower than those generated by impact hammers (Nedwell and Edwards 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when sea turtles may be present; monitoring for sea turtles during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when sea turtles enter the zone (NMFS 2008).

Marine debris is a significant concern for listed species and their habitats. Marine debris accumulates in gyres throughout the oceans. The input of plastics into the marine environment also constitutes a significant degradation to the marine environment. In 2010, an estimated 4.8 to 12.7 million metric tons of plastic entered the ocean globally (Baulch and Simmonds 2015). Law et al. (2010) presented a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986 to 2008. More than 60 percent of 6,136 surface plankton net tows collected small, buoyant plastic pieces. The data identified an accumulation zone east of Bermuda that is similar in size to the accumulation zone in the Pacific Ocean and is a major accumulation center for anthropogenic debris (Schuyler et al. 2015).

For sea turtles, marine debris is a problem due primarily to individuals ingesting debris and blocking the digestive tract, causing death or serious injury (Laist et al. 1999; Lutcavage et al. 1997). Schuyler et al. (2015) estimated that, globally, 52 percent of individual sea turtles have ingested marine debris. Of Pacific green sea turtles, 91percent had marine debris (mostly plastics) in their guts (Wedemeyer-Strombel et al. 2015). Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives; this figure is supported by data from Lazar and Gracan (2010), who found 35 percent of loggerheads had plastic in their gut. Over 50 percent of loggerheads had marine debris in their guts (greater than 96 percent of which was plastic) in the Indian Ocean (Hoarau et al. 2014). One study found 37 precent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al. 2009). A Brazilian study found that 60 percent of stranded green sea turtles had ingested marine debris (primarily plastic and oil; Bugoni et al. 2001). Loggerhead sea turtles had a lesser frequency of marine debris ingestion. Plastic is possibly ingested out of curiosity or due to confusion with prey items; for example, plastic bags can resemble jellyfish (Milton and Lutz 2003). Marine debris consumption has been shown to depress growth rates in post-hatchling loggerhead sea turtles, elongating the time required to reach sexual maturity and increasing predation risk (McCauley and Bjorndal 1999). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997; NRC 1990; O'Hara et al. 1988). Studies of shore cleanups have found that marine debris washing up along the northern Gulf of Mexico shoreline amounts to about 100 kilogram/km (ACC 2010; LADEQ 2010; MASGC 2010; TGLO 2010). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997; NRC 1990; O'Hara et al. 1988).

9.2 Entrapment and Entanglement in Fishing Gear

Globally, 6.4 million tons of fishing gear is lost in the oceans every year (Wilcox et al. 2015). Fishery interaction remains a major limit on sea turtle recovery. NMFS (2002a) estimated that 62,000 loggerhead sea turtles have been killed as a result of incidental capture and drowning in shrimp trawl gear. Although turtle excluder devices and other bycatch reduction devices have significantly reduced the level of bycatch to sea turtles and other marine species in US waters, mortality still occurs in Gulf of Mexico waters.

In addition to commercial bycatch, recreational hook-and-line interaction also occurs. Cannon and Flanagan (1996) reported that from 1993 to 1995, at least 170 Kemp's ridley sea turtles were hooked or tangled by recreational hook-and-line gear in the northern Gulf of Mexico. Of these, 18 were dead stranded turtles, 51 were rehabilitated turtles, five died during rehabilitation, and 96 were reported as released by fishermen.

9.3 Dredging

Marine dredging vessels are common within US coastal waters. Construction and maintenance of federal navigation channels and dredging in sand mining sites have been identified as sources of sea turtle mortality and are currently being undertaken along the US East Coast, such as in Port Everglades, Florida. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge catch up to resting or swimming turtles. Entrained sea turtles rarely survive. Relocation trawling frequently occurs in association with dredging projects to reduce the potential for dredging to injure or kill sea turtles (Dickerson et al. 2007). Dredging has been documented to capture or kill 168 sea turtles from 1995 to 2009 in the Gulf of Mexico, including 97 loggerheads, 35 Kemp's ridleys, 32 greens, and three unidentified sea turtles (USACOE 2010).

9.4 US Navy Training and Testing Activities

Naval activities conducted during training exercises in designated naval operating areas and training ranges have the potential to adversely harm sea turtles. Species occurring in the action area could experience stressors from several naval training ranges or facilities listed below. Listed individuals travel widely in the North Atlantic and could be exposed to naval activities in several ranges.

- The Virginia Capes, Cherry Point, and Jacksonville-Charleston Operating Areas, which are situated consecutively along the migratory corridor for sea turtles, and
- The Key West, Gulf of Mexico, Bermuda, and Puerto Rican Complexes have the

potential to overlap the range of ESA-listed sea turtles.

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munition detonations, and sonar use.

Anticipated impacts from harassment include changes from foraging, resting, and other behavioral states that require lower energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures and, therefore, would represent significant disruptions of the normal behavioral patterns of the animals that have been exposed. Behavioral responses that result from stressors associated with these training activities are expected to be temporary and would not affect the reproduction, survival, or recovery of these species.

From 2009 to 2012, NMFS issued a series of biological opinions to the U.S. Navy for training activities occurring within their Virginia Capes, Cherry Point, and Jacksonville Range Complexes that anticipated annual levels of take of listed species incidental to those training activities through 2014. During the proposed activities 344 hardshell sea turtles (any combination of green, hawksbill, Kemp's ridley, or northwest Atlantic loggerhead sea turtles) per year were expected to be harassed as a result of their behavioral responses to mid- and high-frequency active sonar transmissions.

In 2014, NMFS issued a biological opinion to the U.S. Navy on all testing and training activities in the Atlantic basin. These actions would include the same behavioral and hearing loss effects as described above, but would also include other sub-lethal injuries that lead to fitness consequences and mortality that can lead to the loss of individuals from their populations.

9.5 Pollutants

The Gulf of Mexico is a sink for massive levels of pollution from a variety of marine and terrestrial sources, which ultimately can interfere with ecosystem health and particularly that of sea turtles. Sources include the petrochemical industry in and along the Gulf of Mexico, wastewater treatment plants, septic systems, industrial facilities, agriculture, animal feeding operations, and improper refuse disposal. The Mississippi River drains 80 percent of United States cropland (including the fertilizers, pesticides, herbicides, and other contaminants that are applied to it) and discharges into the Gulf of Mexico (MMS 1998). Agricultural discharges and discharges from large urban centers (e.g., Tampa) contribute contaminants as well as coliform bacteria to Gulf of Mexico habitats (Garbarino et al. 1995). These contaminants can be carried long distances from terrestrial or nearshore sources and ultimately accumulate in offshore pelagic environments (USCOP 2004). The ultimate impacts of this pollution are poorly understood.

Significant attention has been paid to nutrient enrichment of Gulf of Mexico waters, which leads to algal blooms (including harmful algal blooms), oxygen depletion, loss of seagrass and coral reef habitat, and the formation of a hypoxic "dead zone" (USCOP 2004). This hypoxic event occurs annually from as early as February to as late as October, spanning roughly 12,700 square kilometers (although in 2005 the "dead zone" grew to a record size of 22,000 square kilometers) from the Mississippi River Delta to Galveston, Texas (LUMCON 2005; MMS 1998; Rabalais et al. 2002; USGS 2010). Although sea turtles do not extract oxygen from sea water, numerous staple prey items of sea turtles, such as fish, shrimp, and crabs, do and are killed by the hypoxic conditions (Craig et al. 2001). More generally, the "dead zone" decreases biodiversity, alters marine food webs, and destroys habitat (Craig et al. 2001; Rabalais et al. 2002). High nitrogen loads entering the Gulf of Mexico from the Mississippi River is the likely culprit; nitrogen concentrations entering the Gulf of Mexico have increased three fold over within 60 years (Rabalais et al. 2002).

9.6 Oil Spills and Releases

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability.

Oil pollution has been a significant concern in the Gulf of Mexico for several decades due to the large amount of extraction and refining activity in the region. Routine discharges into the northern Gulf of Mexico (not including oil spills) include roughly 88,200 barrels of petroleum per year from municipal and industrial wastewater treatment plants and roughly 19,250 barrels from produced water discharged overboard during oil and gas operations (MMS 2007b; USN 2008). These sources amount to over 100,000 barrels of petroleum discharged into the northern Gulf of Mexico annually. Although this is only 10 percent of the amount discharged in a major oil spill, such as the Exxon *Valdez* spill (roughly one million barrels), this represents a significant and "unseen" threat to Gulf of Mexico wildlife and habitats. Generally, accidental oil spills may amount to less than 24,000 barrels of oil discharged annually in the northern Gulf of Mexico, making non-spilled oil normally one of the leading sources of oil discharge into the Gulf of Mexico, although incidents such as the 2010 *Deepwater Horizon* incident are exceptional (MMS 2007a). The other major source from year to year is oil naturally seeping into the northern Gulf of Mexico. Although exact figures are unknown, natural seepage is estimated at between 120,000 and 980,000 barrels of oil annually (MacDonald et al. 1993; MMS 2007b).

Although non-spilled oil is the primary contributor to oil introduced into the Gulf of Mexico, concern over accidental oil spills is well-founded (Campagna et al. 2011). Over five million barrels of oil and one million barrels of refined petroleum products are transported in the northern Gulf of Mexico daily (MMS 2007b); worldwide, it is estimated that 900,000 barrels of oil are released into the environment as a result of oil and gas activities (Epstein and (Eds.). 2002). Even if a small fraction of the annual oil and gas extraction is released into the marine environment, major, concentrated releases can result in significant environmental impacts. Because of the density of oil extraction, transport, and refining facilities in the Houston/Galveston and Mississippi Delta areas (and the extensive activities taking place at these facilities), these locations have the greatest probability of experiencing oil spills. Oil released into the marine environment contains aromatic organic chemicals known to be toxic to a variety of marine life; these chemicals tend to dissolve into the air to a greater or lesser extent, depending on oil type and composition (Yender et al. 2002). Solubility of toxic components is generally low, but does vary and can be relatively high (0.5 to 167 parts per billion) (Yender et al. 2002).

Several oil spills have affected the northern Gulf of Mexico over the past few years, largely due to hurricanes. The impacts of Hurricane Ivan in 2004 on the Gulf Coast included pipeline damage causing 16,000 barrels of oil to be released and roughly 4,500 barrels of petroleum products from other sources (BOEMRE 2010; USN 2008). The next year, Hurricane Katrina caused widespread damage to onshore oil storage facilities, releasing 191,000 barrels of oil (LHR 2010). Another 4,530 barrels of oil were released from 70 other smaller spills associated with hurricane damage. Shortly thereafter, Hurricane Rita damaged offshore facilities resulting in 8,429 barrels of oil released (USN 2008).

Major oil spills have impacted the Gulf of Mexico for decades (NMFS 2010a). Until 2010, the largest oil spill in North America (Ixtoc oil spill) occurred in the Bay of Campeche (1979), when a well "blew out," allowing oil to flow into the marine environment for nine months, releasing 2.8 to 7.5 million barrels of oil. Oil from this release eventually reached the Texas coast, including the Kemp's ridley sea turtle nesting beach at Rancho Nuevo, where 9,000 hatchlings were airlifted and released offshore (NOAA 2003). Over 7,600 cubic meters of oiled sand was eventually removed from Texas beaches, and 200 gallons of oil were removed from the area around Rancho Nuevo (NOAA 2003). Eight dead and five live sea turtles were recovered during the oil spill event; although cause of deaths were not determined, oiling was suspected to play a part (NOAA 2003). Also in 1979, the oil tanker *Burmah Agate* collided with another vessel near Galveston, Texas, causing an oil spill and fire that ultimately released 65,000 barrels of oil into estuaries, beachfronts, and marshland along the northern and central Texas coastline (NMFS 2010a). Clean up of these areas was not attempted due to the environmental damage such efforts would have caused. Another 195,000 barrels of oil are estimated to have been burned in a multi-month-long fire aboard the *Burmah Agate* (NMFS 2010a). The tanker *Alvenus* grounded in 1984 near Cameron, Louisiana, spilling 65,500 barrels of oil, which spread west along the shoreline to Galveston (NMFS 2010a). One oiled sea turtle was recovered and released (NOAA 2003). In 1990, the oil tanker *Megaborg* experienced an accident near Galveston during the lightering process and released 127,500 barrels of oil, most of which burned off in the ensuing fire (NMFS 2010a).

On April 20 2010, a fire and explosion occurred aboard the semisubmersible drilling platform *Deepwater Horizon* roughly 80 kilometers southeast of the Mississippi Delta (NOAA 2010a). The platform had 17,500 barrels of fuel aboard, which likely burned, escaped, or sank with the platform (NOAA 2010a). However, once the platform sank, the riser pipe connecting the platform to the wellhead on the seafloor broke in multiple locations, initiating an uncontrolled release of oil from the exploratory well. Over the next three months, oil was released into the Gulf of Mexico, resulting in oiled regions of Texas, Louisiana, Mississippi, Alabama, and

Florida and widespread oil slicks throughout the northern Gulf of Mexico that closed more than one-third of the US Gulf of Mexico Exclusive Economic Zone to fishing due to contamination concerns. Apart from the widespread surface slick, massive undersea oil plumes formed, possibly through the widespread use of dispersants and reports of tarballs washing ashore throughout the region were common. Although estimates vary, roughly 4.1 million barrels of oil were released directly into the Gulf of Mexico (USDOI 2012). During surveys in offshore oiled areas, 1,050 sea turtles were seen and half of these were captured (Witherington et al. 2012b). Of the 520 sea turtles captured, 394 showed signs of being oiled (Witherington et al. 2012b). A large majority of these were juveniles, mostly green (311) and Kemp's ridley sea turtles (451) (Witherington et al. 2012b). An additional 78 adult or subadult loggerheads were observed (Witherington et al. 2012b). Captures of sea turtles along the Louisiana's Chandeleur Islands in association with emergency sand berm construction resulted in 185 loggerheads, eight Kemp's ridley, and a single green sea turtle being captured and relocated (Dickerson and Bargo 2012). In addition, 274 nests along the Florida panhandle were relocated that ultimately produced 14,700 hatchlings, but also had roughly two percent mortality associated with the translocation (MacPherson et al. 2012). Females that laid these nests continued to forage in the area, which was exposed to the footprint of the oil spill (Hart et al. 2014). Large areas of *Sargassum* were affected, with some heavily oiled or dispersant-coated *Sargassum* sinking and other areas accumulating oil where sea turtles could inhale, ingest, or contact it (Powers et al. 2013; USDOI 2012). Of 574 sea turtles observed in these *Sargassum* areas, 464 were oiled (USDOI 2012).

Specific causes of injury or death have not yet been established for many of these individuals as investigations into the role of oil in these animals' health status continue. Above average fisheries bycatch may also have played a role in the large numbers of strandings observed in the central northern Gulf of Mexico. Large numbers of sea turtles also stranded in the region in 2011. Investigations, including necropsies, were undertaken by NMFS to attempt to determine the cause of those strandings. Based on the findings, the two primary considerations for the cause of death of the turtles that were necropsied are forced submergence or acute toxicosis. With regard to acute toxicosis, sea turtle tissue samples were tested for biotoxins of concern in the northern Gulf of Mexico. Environmental information did not indicate a harmful algal bloom of threat to marine animal health was present in the area. With regard to forced submergence, the only known plausible cause of forced submergence that could explain this event is incidental capture in fishing gear.

Use of dispersants can increase oil dispersion, raising the levels of toxic constituents in the water column, but speeding chemical degradation overall (Yender et al. 2002). Although the effects of dispersant chemicals on sea turtles is unknown, testing on other organisms have found currently used dispersants to be less toxic than those used in the past (NOAA 2003). It is possible that dispersants can interfere with surfactants in the lungs (surfactants prevent the small spaces in the lungs from adhering together due to surface tension, facilitating large surface areas for gas exchange), as well as interfere with digestion, excretion, and salt gland function (NOAA 2003).

After dispersion, the remaining oil becomes tar, which forms floating balls that can be transported thousands of kilometers into the North Atlantic. The most toxic chemicals associated with oil can enter marine food chains and bioaccumulate in invertebrates such as crabs and shrimp to a small degree (prey of some sea turtles; Law and Hellou 1999; Marsh et al. 1992), but generally do not bioaccumulate or biomagnify in finfish (Baussant et al. 2001; Meador et al. 1995; Varanasi et al. 1989; Yender et al. 2002). Sea turtles are known to ingest and attempt to ingest tar balls, which can block their digestive systems, impairing foraging or digestion and potentially causing death (NOAA 2003), ultimately reducing growth, reproductive success, as well as increasing mortality and predation risk (Fraser 2014). Tarballs were found in the digestive tracts of 63 percent of post hatchling loggerheads in 1993 following an oil spill and 20 percent of the same species and age class in 1997 (Fraser 2014). Oil exposure can also cause acute damage on direct exposure to oil, including skin, eye, and respiratory irritation, reduced respiration, burns to mucous membranes such as the mouth and eyes, diarrhea, gastrointestinal ulcers and bleeding, poor digestion, anemia, reduced immune response, damage to kidneys or liver, cessation of salt gland function, reproductive failure, and death (NOAA 2003; NOAA 2010b; Vargo et al. 1986c; Vargo et al. 1986a; Vargo et al. 1986b). Nearshore spills or large offshore spills can oil beaches on which sea turtles lay their eggs, causing birth defects or mortality in the nests (NOAA 2003; NOAA 2010b).

Oil can also cause indirect effects to sea turtles through impacts to habitat and prey organisms. Seagrass beds may be particularly susceptible to oiling as oil contacts grass blades and sticks to them, hampering photosynthesis and gas exchange (Wolfe et al. 1988). If spill cleanup is attempted, mechanical damage to seagrass can result in further injury and long-term scarring. Loss of seagrass due to oiling would be important to green sea turtles, as this is a significant component of their diets (NOAA 2003). The loss of invertebrate communities due to oiling or oil toxicity would also decrease prey availability for hawksbill, Kemp's ridley, and loggerhead sea turtles (NOAA 2003). Furthermore, Kemp's ridley and loggerhead sea turtles, which commonly forage on crustaceans and mollusks, may ingest large amounts of oil due oil adhering to the shells of these prey and the tendency for these organisms to bioaccumulate the toxins found in oil (NOAA 2003). It is suspected that oil adversely affected the symbiotic bacteria in the gut of herbivorous marine iguanas when the Galapagos Islands experienced an oil spill, contributing to a more than 60 percent decline in local populations the following year. The potential exists for green sea turtles to experience similar impacts, as they also harbor symbiotic bacteria to aid in their digestion of plant material (NOAA 2003). Dispersants are believed to be as toxic to marine organisms as oil itself.

9.7 Entrainment, Entrapment, and Impingement in Power Plants

Power plants withdraw millions of gallons of water per day from rivers, bays, or other water bodies to cool the nuclear reactor. The cooling water intake structure can impinge, entrap, or entrain aquatic organisms that get caught in the intake as the water is drawn into the cooling water intake structure. Aquatic organisms can be killed or injured as a result. There are numerous power plants in coastal areas of the action area, from Florida to Texas (Muyskens et al. 2015).

Sea turtles have been affected by entrainment, entrapment, and impingement in the cooling-water systems of electrical generating plants. We do not have data for many of these, but have reason to believe that impacts top particularly loggerhead and green sea turtles may be important. Over 40 years of operation at the St. Lucie Nuclear Power Plant in Florida, 16,600 sea turtles have been captured to avoid being drawn into cooling structures (which likely would kill sea turtles that enter), and 297 have died (NMFS 2016). These included: 9552 loggerheads (including 180 mortalities), 6886 green (including 112 mortalities), 42 leatherback (no mortalities), 67 Kemp's ridley (including four mortalities), and 65 hawksbill sea turtles (including one mortality) (NMFS 2016). Only since 2001 have the mortalities been classified as causally (or non-causally) related to operation of St. Lucie Nuclear Power Plant, and not all mortalities were causal to St. Lucie Nuclear Power Plant operations: 59 percent of dead loggerheads were causal to St. Lucie Nuclear Power Plant operation, 46 percent of greens, and none of hawksbills (no leatherback or Kemp's ridley mortalities occurred since 2001) (NMFS 2016).

A comprehensive biological opinion that covers all power plant cooling water intakes was issued by the USFWS and NMFS in May 2014. Effects would generally involve stress, injury, and mortality from being captured, entrained, or impinged by cooling water intake systems. Cooling water discharge (which is warmer than the surrounding water temperature) can alter habitat around the outflow pipe. This can present advantages (such as shelter from cold water temperatures that may stun sea turtles and allow for unseasonal growth of marine plants that green sea turtles may forage upon) and disadvantages (such as altering normal ecology sea turtles rely upon and result in individuals depending on unnatural conditions that can be problematic if a plant is decommissioned or goes offline) for ESA-listed species.

9.8 Seismic Surveys and Oil and Gas Development

Seismic surveys using towed airguns occur within the action area and are the primary exploration technique to locate oil and gas deposits, fault structure, and other geological hazards. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of 10 to 20 seconds for extended periods (NRC 2003). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235 to 240 decibels at dominant frequencies of 5 to 300 hertz (NRC 2003). Most of the sound energy is at frequencies below 500 hertz.

The northern Gulf of Mexico is the location of massive industrial activity associated with oil and gas extraction and processing. Over 4,000 oil and gas structures are located outside of state waters in the northern Gulf of Mexico; 90 percent of these occur off Louisiana and Texas (USN 2009). This is both detrimental and beneficial for sea turtles. These structures appreciably increase the amount of hard substrate in the marine environment and provide shelter and foraging opportunities for species like loggerhead sea turtles (Parker et al. 1983; Stanley and Wilson 2003). However, the Bureau of Ocean Energy Management requires that structures must be removed within one year of lease termination. Many of these structures are removed by explosively severing the underwater supportive elements, which produces a shock wave that kills, injures, or disrupts marine life in the blast radius (Gitschlag et al. 1997). For sea turtles, this means death or serious injury for individuals within a few hundred meters of the structure and overt behavioral (potentially physiological) impacts for individuals further away from the structure (Duronslet et al. 1986; Klima et al. 1988). Although observers and procedures are in place to mitigate impacts to sea turtles (i.e., not blasting when sea turtles are present), not all sea turtles are observed all the time, and low-level sea turtle injury and mortality still occurs (Gitschlag and Herczeg 1994; Gitschlag et al. 1997). Two loggerheads were killed in August 2010, and one Kemp's ridley was killed in July 2013, along with several additional stunning or sub-lethal injuries reported over the past five years (Gitschlag 2015). In an August 28, 2006 opinion, NMFS issued incidental take for Bureau of Ocean Energy Management-permitted explosive structure removals (NMFS 2006c). These levels were far surpassed by the *Deepwater Horizon* incident.

9.9 Cold Stunning

Cold-stunning is a natural threat to sea turtles. Although it is not considered a major source of mortality in most cases, as temperatures fall below 46.4 to 50 degrees Farhenheit (8 to 10 degrees Celcius) 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, and hundreds found dead or dying. A large cold-stunning event occurred in the western Gulf of Mexico in February 2011, resulting in approximately 1,650 green sea turtles found cold-stunned in Texas. Of these, approximately 620 were found dead or died after stranding, while approximately 1,030 turtles were rehabilitated and released. During this same time frame, approximately 340 green sea turtles were found cold-stunned in Mexico, though approximately 300 of those were subsequently rehabilitated and released.

9.10 Vessel Strikes

The impacts of vessel strikes to sea turtles are a poorly-studied threat, but have the potential to be an important source of mortality to sea turtle populations (Work et al. 2010). All sea turtles must surface to breathe, and several species are known to bask at the surface for long periods. Although sea turtles can move rapidly, sea turtles apparently are not able to avoid vessels moving at more than four kilometers per hour; most vessels move faster than this in open water (Hazel et al. 2007; Work et al. 2010). Given the high level of vessel traffic in the Gulf of

Mexico, frequent injury and mortality could affect sea turtles in the region (MMS 2007b). Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. Each state along the Gulf of Mexico has several hundred thousand recreational vessels registered, including Florida with nearly one million—the highest number of registered boats in the United States—and Texas with over 600,000 (ranked sixth nationally; NMMA 2007; USCG 2003; USCG 2005). Commercial vessel operations are also extensive. Vessels servicing the offshore oil and gas industry are estimated to make 115,675 to 147,175 trips annually, and many commercial vessels travel to and from some of the largest ports in the United States (such as New Orleans and Houston; MMS 2007a; USN 2008).

9.11 Fibropapillomatosis

Green sea turtles are susceptible to natural mortality from fibropapillomatosis disease. Fibropapillomatosis results in the growth of tumors on soft external tissues (flippers, neck, tail, etc.), the carapace, the eyes, the mouth, and internal organs (gastrointestinal tract, heart, lungs, etc.) of turtles (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). These tumors range in size from 0.04 inches (0.1 centimeters) to greater than 11.81 inches (30 centimeters) in diameter and may affect swimming, vision, feeding, and organ function (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). Presently, scientists are unsure of the exact mechanism causing this disease, though it is believed to be related to both an infectious agent, such as a virus (Herbst et al. 1995), and environmental conditions (e.g., habitat degradation, pollution, low wave energy, and shallow water (Foley et al. 2005). Fibropapillomatosis is cosmopolitan, but it has been found to affect large numbers of animals in specific areas, including Hawaii and Florida (Herbst 1994; Jacobson 1990; Jacobson et al. 1991).

9.12 Climate Change

We primarily discuss climate change as a threat common to all species addressed in this opinion, rather than in each of the species-specific narratives.

The 2014 Assessment Synthesis Report from the Working Groups on the Intergovernmental Panel on Climate Change concluded climate change is unequivocal (IPCC 2014). The report concludes oceans have warmed, with ocean warming the greatest near the surface (e.g., the upper 75 meters (246 feet) have warmed by 0.11° Celsius per decade over the period 1971 to 2010) (IPCC 2014). Global mean sea level rose by 0.19 meters (0.62 feet) between 1901 and 2010, and the rate of sea-level rise since the mid-19th century has been greater than the mean rate during the previous two millennia (IPCC 2014). Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014) and this rise has been linked to climate change. Climate change is also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, heat waves, and droughts (IPCC

2014). Climate change has the potential to impact species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. Though predicting the precise consequences of climate change on highly mobile marine species, such as many of those considered in this opinion, is difficult (Simmonds and Isaac 2007), recent research has indicated a range of consequences already occurring.

Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. He predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback sea turtles were predicted to gain core habitat area, whereas loggerhead sea turtles are predicted to experience losses in available core habitat. McMahon and Hays (2006) predicted increased ocean temperatures would expand the distribution of leatherback sea turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. MacLeod (2009) estimated, based upon expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, with 47 percent likely to be negatively affected. Willis-Norton et al. (2015) acknowledge there would be both habitat loss and gain, but overall climate change could result in a 15 percent loss of core pelagic habitat for leatherback sea turtles in the eastern south Pacific Ocean.

Similarly, climate-mediated changes in important prey species populations are likely to affect predator populations. For ESA-listed sea turtles that undergo long migrations (e.g., leatherbacks), if either prey availability or habitat suitability is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009).

Changes in global climatic patterns are expected to have profound effects on coastlines worldwide, potentially having significant consequences for the ESA-listed species considered in this opinion that are partially dependent on terrestrial habitat areas (i.e., sea turtles). For example, rising sea levels are projected to inundate some sea turtle nesting beaches (Caut et al. 2009; Wilkinson and Souter 2008), change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and increase the number of sea turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). The loss of nesting beaches may have catastrophic effects on global sea turtle populations if they are unable to colonize new beaches, or if new beaches do not provide the habitat attributes (e.g., sand depth, temperature regimes, refuge) necessary for egg survival. Additionally, increasing temperatures in sea turtle nests, as is expected with climate change, alters sex ratios, reduces incubation times (producing smaller hatchlings), and reduces nesting success due to exceeded thermal tolerances (Fuentes et al. 2009a; Fuentes et al. 2010; Fuentes et al. 2009b; Glen et al. 2003). All of these temperature related impacts have the potential to significantly impact sea turtle reproductive success and ultimately, long-term species viability. Poloczanska et al. (2009) noted that extant sea turtle species have survived past climatic shifts, including glacial periods and warm events, and therefore may have the ability to adapt to ongoing climate change (e.g., by finding new nesting beaches). However, the authors also suggested since the current rate of warming is very rapid, expected change may outpace sea turtles' ability to adapt.

Previous warming events (e.g., El Niño, the 1977 through 1998 warm phase of the Pacific Decadal Oscillation) may illustrate the potential consequences of climate change. Off the U.S. west coast, past warming events have reduced nutrient input and primary productivity in the California Current, which also reduced productivity of zooplankton through upper-trophic level consumers (Doney et al. 2012; Sydeman et al. 2009; Veit et al. 1996).

This is not an exhaustive review of all available literature regarding the potential impacts of climate change to the species considered in this opinion. However, this review provides some examples of impacts that may occur. While it is difficult to accurately predict the consequences of climate change to the species considered in this opinion, a range of consequences are expected, ranging from beneficial to catastrophic.

9.13 Scientific Research and Permits

Scientific research permits issued by the NMFS currently authorize studies of ESA-listed species in the North Atlantic Ocean and the Gulf of Mexico, some of which extend into portions of the action area for the proposed project. The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. Authorized research on ESA-listed sea turtles includes capture, handling, and restraint; satellite, sonic, and PIT tagging; blood and tissue collection; lavage; ultrasound; captive experiments; laparoscopy; and imaging.

Research activities involve "takes" by harassment, harm, pursuit, wound, entrapment, capture, and some mortality. There are numerous permits issued since 2009 under the provisions of the ESA authorizing scientific research on sea turtles. The consultations, which took place on the issuance of these ESA scientific research permits, each found that the authorized activities would not result in jeopardy to the species or adverse modification of designated critical habitat.

9.14 Impact of Environmental Baseline on ESA-listed Species

Listed resources are exposed to a wide variety of past and present state, Federal or private actions and other human activities that have already occurred or continue to occur in the action area. Any foreign projects in the action area that have already undergone formal or early section 7 consultation, and state or private actions that are contemporaneous with this consultation also impact listed resources. However, the impact of those activities on the status, trend, or the demographic processes of threatened and endangered species remains largely unknown. To the best of our ability, we summarize the effects we can determine based upon the information available to us in this section.

9.14.1 Sea turtles

Several of the activities described in this *Environmental Baseline* have significant and adverse consequences for nesting sea turtle aggregations whose individuals occur in the action area. In particular, the commercial fisheries annually capture substantial numbers of leatherback sea turtles.

Climate change has and will continue to impact sea turtles throughout the action area as well as throughout the range of the populations. Sex ratios of several species are showing a bias, sometimes very strongly, towards females due to higher incubation temperatures in nests. We expect this trend will continue and possibly may be exacerbated to the point that nests may become entirely feminized, resulting in severe demographic issues for affected populations in the future. Hurricanes may become more intense and/or frequent, impacting the nesting beaches of sea turtles and resulting in increased loss of nests over wide areas. Disease and prey distributions may well shift in response to changing ocean temperatures or current patterns, altering the morbidity and mortality regime faced by sea turtles and the availability of prey.

Although only small percentages of these sea turtles are estimated to have died as a result of their capture during research or incidental to fisheries, the actual number could be substantial if considered over the past five to 10 years. When we add the percentage of sea turtles that have suffered injuries or handling stress sufficient to have caused them to delay the age at which they reach maturity or the frequency at which they return to nesting beaches, the consequences of these fisheries on nesting aggregations of sea turtles would be greater than we have estimated.

Even with turtle excluder device measures in place, in 2002, NMFS (2002) expected these fisheries to capture about 323,600 sea turtles each year and kill about 5,600 (~1.7 percent) of the turtles captured. Leatherback sea turtle interactions were estimated at 3,090 captures with 80 (~2.6 percent) deaths as a result (NMFS 2002b). Since 2002, however, effort in the Atlantic shrimp fisheries has declined from a high of 25,320 trips in 2002 to approximately 13,464 trips in 2009, roughly 47 percent less effort. Since sea turtle takes are directly linked to fishery effort, these takes are expected to decrease proportionately. However, hundreds to a possible few thousand sea turtle interactions are expected annually, with hundreds of deaths (NMFS 2012). Additional mortalities each year along with other impacts remain a threat to the survival and recovery of this species and could slow recovery for leatherback sea turtles.

10 Effects of the Action

Section 7 regulations define "effects of the action" as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 C.F.R. §402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. This effects analyses section is organized following the stressor, exposure, response, risk assessment framework.

The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The destruction and adverse modification analysis considers whether the action produces "a direct or indirect alteration that appreciably diminished the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." 50 C.F.R. 402.02.

10.1 Mitigation to Minimize or Avoid Exposure

The National Centers for Coastal Ocean Science's proposed action includes the use of protected species observers and measures to minimize effects from vessel activity and the inwater research activities. These measures are described in the description of the action, and are considered throughout the exposure and response analysis.

10.2 Stressors Associated with the Proposed Action

The potential stressors we expect to result from the proposed action are:

- Vessel activity.
  - Vessel strike.
  - Noise.
  - Visual disturbance (e.g., presence).
  - Vessel transit.
  - Discharge of fuel or oil leakages.
  - Introduction of aquatic nuisance species.
- In-water research activities
  - Plankton purse seine.
  - Neuston net.
  - Sabiki rigs.
  - Light traps.

Based on a review of available information, we determined which of these possible stressors would be likely to occur and which would be discountable or insignificant.

10.2.1 Vessel Activity

The 2013 biological opinion identified several stressors associated with the Office of Coast Survey's hydrographic surveys in coastal waters. These included vessel activity (strike, noise, visual disturbance, transit, discharges, and introduction of aquatic nuisance species). These stressors pose risks to ESA-listed sea turtles.

When a vessel transits to and from the survey areas, potential effects on the ESA-listed sea turtles include vessel strike, noise generated by the vessel, and visual disturbance from the vessel itself. There will be no multi-beam echosounders or sub-bottom profilers in use for this proposed action, meaning that the only vessel noise generated will be from the operation of the vessel itself. Combined vessel noise and presence could cause slight sea turtle response or behavioral interruptions, but they would be minor and temporary as the vessel moves away from any marine mammals or sea turtles. The distance between the vessel and observed sea turtles, per avoidance protocols, would also minimize the potential for acoustic disturbance from engine noise. Therefore, effects from noise or presence associated with vessel transit would be insignificant.

Because the vessel would move at a very slow speed during the survey, a vessel striking a sea turtles would be improbable and extremely unlikely. Further, adherence to reduced vessel speeds, use of protected species observers, and avoidance procedures are also expected to avoid vessel strikes. Therefore, effects from vessel strikes during the survey would be discountable.

The potential for fuel or oil leakages is extremely unlikely. An oil or fuel leak would likely pose a significant risk to the vessel and its crew and actions to correct a leak should occur immediately to the extent possible. In the event that a leak should occur, the amount of fuel and oil onboard the research vessel is unlikely to cause widespread, high dose contamination (excluding the remote possibility of severe damage to the vessel) that would impact listed species directly or pose hazards to their food sources. Because the potential for fuel or oil leakage is extremely unlikely to occur, we find that the risk from this potential stressor to ESA-listed sea turtles is discountable.

To minimize the risk of aquatic nuisance species introduction, personnel would: avoid discharge of ballast water in designated critical habitat; use anti-fouling coatings; clean the hull regularly to remove aquatic nuisance species (but avoid doing so in critical habitat), and rinse the anchor with a high-powered hose after retrieval. These protective measures go beyond the requirements of the Vessel and Small Vessel General Permits[3], as described in the mitigation measures above. Furthermore, the vessels would not transit outside of the United States; therefore, they would not introduce foreign aquatic nuisance species. Given the protective measures, it is highly unlikely that the vessels would transfer aquatic nuisance species to ESA-listed sea turtles during the proposed action.

[3]See requirements for Vessel and Small Vessel General Permits at: https://www.epa.gov/npdes/vessels-vgp

Therefore, we conclude that the effects from vessel activity, pollution by oil or fuel leakage, and risk of aquatic nuisance species introduction are insignificant or discountable, and not likely to adversely affect ESA-listed sea turtles.

10.2.2 Inwater Research Activities

The proposed action includes research activities conducted to sample *Sargassum* and larval fish communities.This would involve the use of sampling equipment such as neuston nets, plankton purse seine, light-traps, and opportunistic hook-and-line sampling with Sabiki rigs.

The sampling equipment used for the inwater research activities is designed to capture larval fish and to collect *Sargassum*. The neuston net is one by two meters. The plankton purse seine is ten by three meters. Multiple light traps would be deployed for one hour. The dimensions of a light trap may vary, but they are typically between 30 centimeters and one meter in length, with entrance slots or openings to capture larval fishes (McLeod and Costello 2017). The Sabiki rigs consist of a weighted line with several branching lines with small fish hooks on each end.

The effects of the proposed action are reasonably likely to include those associated with the collection of *Sargassum* and in-water sampling, including capture and harassment. ESA-listed sea turtles are likely to be potentially exposed to those stressors. Since post-hatchling sea turtles associate with *Sargassum* mats in their pelagic, oceanic life phase, there is the possibility of take occurring for post-hatchling (39 to 78 millimeters) and juvenile (130 to 280 millimeters) sea turtles, especially loggerhead, green, Kemp's Ridley, and possibly hawksbill turtles, in pelagic *Sargassum* (Witherington et al. 2012a). Accordingly, this consultation focused on the following stressors likely to occur from the proposed research activities that may adversely affect ESA-listed sea turtles: the inwater research activities.

10.3 Exposure Analysis

The proposed action would take place in two broad areas—the neritic and oceanic environments. The applicant defines the neritic environment as waters less than 200 meters, and the oceanic as waters greater than 200 meters. The likelihood of exposure varies with sea turtle life stage and environment, because different life stages of sea turtles occupy different environments. We will also include a discussion of the likelihood of exposure to each of the gear types proposed for use.

10.3.1 Exposure by gear type

Four types of sampling gear would be used in the proposed action. Due to the differences in the gear types, how they will be used, and the relative frequency each will be used, we expect that each gear type carries with it a different likelihood of interacting with sea turtles.

Neuston nets would be the primary gear type used in the proposed action. Researchers would used very short tow times (30 seconds or less), and the net would fill up with *Sargassum* very quickly. The short tow times would limit the amount of *Sargassum* sampled, and reduce the likelihood of capture of sea turtles. Plankton purse seines (ten by three meters) would encircle a *Sargassum* mat, and its contents would be brought on board for sorting and sampling. This gear would collect a greater amount of *Sargassum* over a larger area than the neuston nets, creating a increased likelihood of capturing a sea turtle.

In the proposed action, light traps would be used at dusk or at night, for one-hour soak times. Artificial light can pose problems for sea turtle hatchlings, which can be disoriented by artificial light on beaches after hatching, preventing them from reaching the ocean. Light traps are used to capture larval fishes and marine crustaceans. The openings are sized to capture these species. In a broad review of the literature on the use of light traps in the marine environment, McLeod and Costello (2017) reported that light traps collected 12 phyla of benthic and planktonic animals, and 13 orders of crustaceans. Because of the size of the openings designed to capture larval fishes, and no reported capture of sea turtles, we determine that the effects to sea turtles from light traps are discountable, and sea turtles are not likely to be adversely affected.

Sabiki rigs will be used opportunistically to capture larger mobile juvenile fishes. The fact that this gear type will be used infrequently (relative to other gear) reduces the likelihood that it will interact with sea turtles. Incidental capture in commercial longline fisheries poses a significant threat to sea turtle populations world-wide, and efforts to reduce bycatch have included requiring the use of circle hooks. However, the Sabiki rigs used in the proposed action are much smaller, and will be used infrequently leading us to conclude that effects to sea turtles from Sabiki rigs are extremely unlikely to occur. The effects are discountable, and sea turtles are not likely to be adversely affected.

10.3.2 Sea turtle species exposed to inwater research activities

As discussed in the *Status of the Species* section, green, loggerhead, Kemp's ridley, and hawksbill sea turtles are found in the Gulf of Mexico. Leatherback sea turtles may also be present in the Gulf of Mexico. However, there is only very minimal leatherback nesting in the Gulf of Mexico, with major nesting sites occurring in the Caribbean, in the U.S. Virgin Islands, Puerto Rico, Trinidad and Tobago, and the east coast of Florida. Leatherbacks are known for their long oceanic migrations, with tagged individuals ranging from nesting sites in the Caribbean to feeding areas in the north Atlantic, off the coast of New Foundland (Stewart et al. 2013). Additionally, leatherback sea turtles are very rarely captured in Gulf of Mexico shrimp fisheries (Epperly et al. 2002). Since there is minimal nesting in the Gulf of Mexico, and no known feeding areas in the Gulf of Mexico, we do not expect leatherback sea turtles of any life stage to be exposed to the proposed action. The exposure analysis will focus on the sea turtle species we do expect to be present in the Gulf of Mexico: green, loggerhead, Kemp's ridley and hawksbill sea turtles.

10.3.3 Exposure in the neritic environment

In very general terms, the sea turtle's life history is as follows: sea turtles hatch and emerge from their nests, enter the ocean where they remain for several years until they grow large enough as juveniles to return to the nearshore environment. The size at which juvenile sea turtles move to neritic environments varies by species. Green and hawksbill sea turtles are between 20 and 35 centimeters (Bolten 2003), and Kemp's ridely sea turtles between 20 and 25 centimeters (about two years old) when they shift from the oceanic to neritic environment. Loggerheads are typically older (seven to twelve years old) and larger than other species (between 46 and 64 centimeters) when they move to the neritic environment (Bolten 2003).

Juvenile sea turtles in the neritic environment are potentially small enough to be caputured in the gear used in the proposed action. However, juvenile sea turtles in the neritic environment are larger than those in oceanic environment, and thus more likely to be sighted by protected species observers. The proposed action's mitigation measures, including the use of protected species observers and the pre-observation period before sampling increase the likelihood that juvenile sea turtles would be seen and avoided. Only two sea turtles have been incidentally captured using plankton trawl nets as part of the Southeast Area Monitoring and Assessment Program over the past thirty years. We do not believe that juveniles in the neritic environment are likely to be exposed to the inwater research activities associated with the proposed action.

Adult sea turtles also occupy the nearshore environment, and could be present in the action area and exposed to the inwater research activities. Loggerhead females that were tagged after nesting occupied waters 33 kilometers from shore averaging 31.6 meters deep (Hart et al. 2013). Kemp's ridley juveniles and sub-adults are mostly found in waters up to 50 meters deep (Coleman et al. 2017), and inter-nesting females occupied waters 14 to 19 meters deep, six to 11 kilometers from shore (Shaver et al. 2017). The size of adult sea turtle varies by species. Adult loggerhead and green turtles can be up to one meter long, while hawksbills and Kemp's ridley sea turtles are generally smaller (65 to 90 centimeters, and 60 to 70 centimeters, respectively). However, adult sea turtles in the neritic environment are large enough that we expect the protected species observers to be able to see them prior to using the sampling gear. Furthermore, the proposed action will take place in July, when we expect adult female sea turtles to be nesting. In addition, the researchers do not anticipate sampling in waters less than 40 meters deep. We do not expect adult sea turtles in the neritic environment to be exposed to the inwater research activities associated with the proposed action.

10.3.4 Exposure in the oceanic environment

Adult sea turtle distribution in the oceanic environment varies by species, thus influencing the likelihood that adults may be exposed to the proposed action. Kemp's ridley sea turtles are primarily found in nearshore waters less than 50 meters deep (Byles and Swimmer 1994). Adult loggerheads will forage and migrate through the oceaninc environment in the continental shelf waters of the United States, Bahamas, Cuba, and the Yucatan Peninsula. In the Caribbean, adult hawksbills eat a few types of sponges and are mostly associated with coral reefs. They are capable of undertaking long oceanic migrations (e.g., from the U.S. Virgin Islands to Nicaragua) (Spotila 2004). Adult green turtles are almost exclusively herbivores, eating sea grasses in the nearshore environment. Because of their relative scarcity in the oceanic environment, we do not think it is likely that adult sea turtles will be exposed to the inwater research activities associated with the proposed action. In the event that an adult sea turtle is encountered during the proposed action, we expect that the protected species observers will be able to sight the individual and avoid it.

The proposed action will take place in the neritic and oceanic environments, and will target *Sargassum* mats and openwater areas for sampling. Pelagic *Sargassum* mats are recognized as important habitat for post-hatchling and juvenile sea turtles. NMFS designated *Sargassum* as part of loggerhead critical habitat to support the species' recovery, and numerous studies have focused on *Sargassum* mats to research post-hatchling and juvenile sea turtles (Carr and Meylan 1980; Carr 1986; Witherington et al. 2012a; Witherington 2002). Since the proposed action would be targeting a habitat that sea turtles are known to inhabit with gear that is such a size that can capture them, we expect that sea turtle post-hatchlings and juveniles in the oceanic environment may be exposed to the proposed action. The likelihood of exposure of each individual sea turtle species varies by species, as nesting for certain species is greater than for others.

To estimate what species of post-hatchling and juvenile sea turtles might be exposed in the oceanic environment, we can examine the number and approximate size of known nesting sites in the Gulf of Mexico. We used NMFS sea turtle status reviews and data obtained through the Sea Turtles of the World Ocean Biographical Information System Spatial Ecological Analysis of Megavertebrate Populations (http://seamap.env.duke.edu/swot), an online mapping platform which summarizes nesting and distribution data for sea turtles worldwide. By examining the relative amount of nesting in the Gulf of Mexico by species, we can use this information to generalize the proportion of post-hatchling and juvenile sea turtles by species that we expect to be exposed to the inwater research activities in the oceanic environment. That is, we expect that a species that nests in greater numbers in the Gulf of Mexico would be more likely to be exposed to the proposed action than a species that has fewer nests in the region.

In the Atlantic, the majority of hawksbill nesting occurs in Cuba and Mexico, with major nesting sites in Campeche, Yucatan, and Quintana Roo, with about 2,800 nesting females annually (Spotila 2004). Significant nesting also occurs in U.S. waters in Puerto Rico and the U.S. Virgin Islands (Diez and Van Dam 2002). There is only one site in the Gulf of Mexico—in the Florida Keys—that hosts occasional hawksbill nesting.

The majority (80 percent) of loggerhead nesting for the Northwest Atlantic DPS occurs in six counties on the east coast of Florida. Limited nesting has been reported in Louisiana (one site), Mississippi (one site), Alabama (three sites), and in Texas (six sites). The Gulf coast of Florida hosts 17 sites for loggerhead nesting, ranging from nests with as few as 12 clutches to those with 4,884 clutches in Sarasota County[4].

In the Gulf of Mexico, there are two locations in Texas where green turtles nest (one to 25 clutches each). No green turtle nests have been reported in Louisiana, Mississippi, or Alabama. Some green turtle nesting occurs on the Gulf Coast of Florida, with eight sites total. Six of these sites reported fewer than 15 clutches each, and the remaining two reported 35 and 120 clutches apiece. Green turtle nesting occurs in greater amounts elsewhere in the Gulf of Mexico. Significant nesting sites for green turtles include Quintana Roo (18,257 nesting females), Campeche (2,207 nesting females), Veracruz (1,040 nesting females), and Tamaulipas (715 nesting females) (Seminoff 2015).

There are two reported Kemp's ridley nesting sites on the Florida Gulf Coast (one clutch and three clutches), and none in Mississippi, Alabama, or Louisiana. In Texas, there are 16 sites with between one and 25 clutches each, and one site with 26 to 100 clutches. However, like green turtles, major nesting for the species occurs in Mexico. About 95 percent of nesting for the species occurs at three nesting beaches in Tamaulipas, Mexico, with thousands of clutches annually. Nesting also occurs in Veracruz, Mexico on a smaller scale (NMFS 2015). Simulations of the oceanic distribution of Kemp's ridley sea turtles less than two years old indicate that they are likely to be found throughout the Gulf of Mexico, with the highest abundance predicted to be in the western Gulf (Putman et al. 2013).

Based on this information, we expect that Kemp's ridley and green turtle post-hatchlings and juveniles would be most likely to be exposed to the proposed action, because they nest in the Gulf of Mexico in larger numbers relative to other species. Loggerhead and hawksbill post-hatchlings and juveniles are also likely to be exposed, but to a lesser degree, based on the amount of relative nesting for these species in the Gulf of Mexico. Witherington et al. (2012a) sampled post-hatchling and juvenile sea turtles in Sargassum mats off the Atlantic coast of Florida and in the Gulf of Mexico. Loggerheads were the predominant species encountered. The authors pointed to the fact that large numbers of loggerheads nest on Atlantic coast Florida beaches, meaning that species would be well-represented in the sampling. In the Gulf of Mexico surveys, Witherington et al. (2012a) found mostly green (51.9 percent) and Kemp's ridley (44.2 percent) juveniles (130 to 280 millimeters), with loggerhead and hawksbills comprising the remainder of juveniles encountered. All of the post-hatchlings (39 to 78 millimeters) encountered in the Gulf of Mexico surveys were loggerheads.

[4] See map for Sea Turtles of the World website at: http://seamap.env.duke.edu/swot

10.3.5 Exposure Summary

To summarize, we expect that neuston nets and plankton purse seines to potentially capture sea turtles. Due to where we expect juveniles and adults to be during these life stages, we do not expect that juveniles and adult sea turtles in the neritic environment will be exposed to the proposed action. Because of their size, the size of the sampling gear, and the use of protected species oberservers, we do not expect adult sea turtles in the oceanic environment to be exposed to the proposed action. However, because they are smaller and inhabit the *Sargassum* mats which are targeted for sampling in the proposed action, we do expect juvenile and post hatchling sea turtles to be exposed in the oceanic environment.

There are a few factors that make it difficult to predict the sea turtle species that will be exposed to the proposed action. Due to their small size, it is difficult to sight and accurately identify post-hatchling sea turtles in traditional aerial and shipboard surveys. It is also difficult to track individual hatchlings with telemetry tags after leaving nesting beaches, again because of their size. There has been some sampling of oceanic-stage sea turtles in Sargassum mats in the Gulf of Mexico and the Atlantic Ocean, but these studies were conducted near Florida (Richardson 2001) (Witherington et al. 2012a). Sea turtle species are also not expected to be evenly distributed throughout the Gulf (Putman and Mansfield 2015; Putman et al. 2013). As a result, it is difficult to apply sea turtles species density for the entirety of the Gulf of Mexico, as there will likely be differences in species composition across the region.

Threre are some recent sources from the Gulf of Mexico that provide insight into the proportions of sea turtle species we expect to be exposed during the proposed action. During the Deepwater Horizon response effort, 574 sea turtles were documented by directed capture operation within the Deepwater Horizon oil spill zone, off of Louisiana, Alabama and Florida. Of these, 317 were Kemp's ridley (55.2 percent), 270 were green turtles (47 percent), 18 were loggerheads (3.14 percent), and 19 were hawksbills (3.3 percent) (DWHTrustees 2016). Transect searches in convergence zones focusing on pelagic juvenile sea turtles were also conducted as part of Deepwater Horizon response efforts. Kemp's ridley sea turtles comprised the majority of the sightings (51 percent), followed by green turtles (37 percent), loggerheads (seven percent), and hawksbill sea turtles (two percent) (McDonald et al. 2017). These proportions of juveniles are somewhat similar those that Witherington et al. (2012a) found in the Gulf of Mexico off the coast of Florida during the *Sargassum* surveys: 51.9 percent green turtles, 44.2 percent Kemp's ridley, 2.3 percent loggerhead, and 1.55 percent hawksbills.

To calculate the amount of sea turtles we expect to be exposed to the proposed action, we can use the available density information and the amount of effort expected to be put forth by the researchers. The proposed action will consist of four nine-day surveys, with a projected six purse seines and six neuston samples each cruise. Based on the dimensions of the gear, and the amount of effort per cruise, we estimate that approximately 0.483 square kilometers will be sampled each cruise. The survey will target open-water sites and *Sargassum* sites. We expect post-hatchling and juvenile sea turtles in the oceanic environment to be primarily associated with Sargassum mats, and less likely to be in open water.

Table 7. Total density (turtles per square kilometer) of pelagic juvenile sea turtles used to estimate exposure (McDonald et al. 2017).

Species	
Kemp's ridley	1.698
Green turtle	1.222
Loggerhead	0.246
Hawksbill	0.071

We used total density (turtles per square kilometer) from McDonald et al. (2017) to estimate pelagic juveniles exposed during the proposed action (Table 7). Post-hatchlings are not represented in these density estimates; Witherington et al. (2012) emcountered 31 post-hatchlings, all loggerheads, during those surveys. By multiplying the turtle density by the amount of effort expected for each cruise, we got exposure estimates of less than one for each species. Rounding the estimates, we expect that one sea turtle of each species will be exposed during each cruise. For the entire action (four cruises), we predict that four sea turtles of each species will be exposed.

10.4 Response Analysis

In this section we describe the range of responses among ESA-listed sea turtles that may result from the stressors associated with the inwater research activities that would occur as part of the proposed action. These include stressors associated with the inwater research activities including: incidental capture in neuston nets and plankton purse seines, and harassment from the inwater research activities (e.g., use of sampling gear, vessels approaching the *Sargassum* mats). Our response analysis considers and weighs evidence of adverse consequences, as well as evidence suggesting absence of such consequences.

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford

1993), reduced reproductive success (Giese 1996; Müllner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976).

Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The stress response of fish and reptiles involves the hypothalamic-pituitary-adrenal axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Atkinson et al. 2015; Barton 2002; Bayunova et al. 2002; Busch and Hayward 2009; Lankford et al. 2005; McConnachie et al. 2012; Wagner et al. 2002). These hormones subsequently can cause short-term weight loss, the release of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, fatigue, cardiovascular damage, and alertness, and other responses (Aguilera and Rabadan-Diehl 2000; Busch and Hayward 2009; Dierauf and Gulland 2001; Guyton and Hall 2000; NMFS 2006a; Omsjoe et al. 2009; Queisser and Schupp 2012; Romero 2004; Wagner et al. 2002), particularly over long periods of continued stress (Desantis et al. 2013; Sapolsky et al. 2000).

In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 2008; Cowan and Curry 2002; Curry and Edwards 1998; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the hypothalamic-pituitary-adrenal axis may persist for weeks.

Several studies have suggested that stress can adversely impact female reproduction through alterations in the estrus cycle (Herrenkohl and Politch 1979; Moberg 1991; Mourlon et al. 2011; Rivier and Rivest 1991). This is likely due to changes in sex steroids and growth hormone levels associated with the stress response (Sapolsky et al. 2000). Komesaroff et al. (1998) found that estrus may inhibit the stress response to some extent, although several studies suggest estrus and the follicular stage may be susceptible to stress-induced disruption (see Rivier (1991) and Moberg (1991) for reviews). Most of these studies were conducted with single or multiple invasive methodologies or chronic stress; we do not expect stressors associated with the proposed research to be nearly as stressful. Overall, we do not expect reproduction to be impaired primarily because of the lack extreme stressors used by studies to induce adverse reproductive impacts and the acute nature of the stressors involved.

In sum, the common underling stressor of a human disturbance as could be caused by the research activities that would be conducted as part of the proposed action may lead to a variety of different stress related responses. However, given the short duration of the activities and listed procedures, we do not anticipate these responses to result in negative fitness consequences. In addition to possibly causing a stress related response, each activity is likely to produce unique responses as detailed further below.

10.4.1 Incidental Capture and Handling

Capture can cause stress responses in sea turtles (Gregory 1994; Gregory and Schmid 2001; Hoopes et al. 1998; Jessop et al. 2003; Jessop et al. 2004; Thomson and Heithaus 2014). We also expect behavioral responses (attempts to break away via rapid swimming and biting) as well as physiological responses such as the release of stress hormones (Gregory et al. 1996; Gregory and Schmid 2001; Harms et al. 2003; Hoopes et al. 2000; Stabenau et al. 1991).

If incidental capture does occur, we would expect it to be very brief. The turtles would be located and released quickly to minimize the stress to them. If done correctly, the effects of incidental capture would be expected to be minimal. NMFS expects that individual turtles would experience no more than short-term stresses during these types of capture activities and that these stresses would dissipate within a short period of time. NMFS expects no mortalities or serious injuries from these capture activities.

Handling and restraint activities may markedly affect metabolic rate (St. Aubin and Geraci 1988), reproduction (Mahmoud and Licht 1997), and hormone levels (Gregory et al. 1996). Handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Gregory and Schmid 2001; Hoopes et al. 2000). The additional on-board holding time imposes an additional stressor on these already acidotic turtles (Hoopes et al. 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler et al. 1984). Thus, an increase in breathing effort in negatively buoyant animals may have heightened lactate production. Understanding the physiological effects of capture and handling methodology is essential to conducting research on endangered sea turtles, since safe return to their natural habitat is required. However, literature pertaining to the physiological effects of capture and handling on sea turtles is scarce. No mortalities or injuries are expected as a result of this research.

10.5 Risk Analysis

In this section, we assess the consequences of the responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. For designated critical habitat, we assess the consequences of these responses on the value of the critical habitat for the conservation of the species for which the habitat had been designated.

We measure risks to invidiuals of endangered or threatened species using changes in the individual's fitness, which may be indicated by changes to the individual's growth, survival, annual reproductive fitness, and lifetime reproductive success. When we do not expect ESA-listed animals exposed to an action's effects to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise.

Any time a turtle is removed from its natural habitat and handled, it undoubtedly experiences stress. However, based on observations over decades of research permits, capture of juvenile and post-hatchling sea turtles have had minor, if any, adverse effects on the captured turtles. Other projects have authorized take for scientific research permits to target post-hatchling and juvenile sea turtles in *Sargassum* mats, and these research projects have had their effects analyzed through formal consultation. In this proposed action, the researchers would not be targeting sea turtles for study, but the method by which sea turtles might be captured in this action (i.e., nets) we feel is similar enough for comparasion of effects. The neuston nets would be the primary gear used, and would have very short tow times (less than 30 seconds). Any captured sea turles would only be in the net for a few moments at most. Plankton purse seines would be used less frequently than neuston nets. All collected material from the purse seine would be brought on board and sorted, where a captured sea turtle could be located and released quickly. Captured sea turtles would be handled very minimally, photographed for later identification, and released immediately.

We expect up to one Kemp's ridely, one North Atlantic DPS green, one Northwest Atlantic Ocean DPS loggerhead, and one hawksbill sea turtle to be captured and subsequently released during each research cruise. Because of the short tow times, minimal handling, and mitigation measures, we do not expect any mortality to occur from the harassment or incidental capture that may occur as a result of the proposed action. The proposed action will result in temporary stress to the exposed sea turtles that is not expected to have more than short-term effects on individual North Atlantic green, hawksbill, Kemp's ridley, and Northwest Atlantic loggerhead sea turtles.

10.6 Loggerhead Turtle Designated Critical Habitat

Critical habitat for the Northwest Atlantic Ocean distinct population segment of loggerhead sea turtles is designated in several units off the southeastern coast of the United States, within the proposed action area, specifically, the *Sargassum* habitat. Other units of designated critical habitat for loggerhead sea turtles, such as nearshore reproductive, foraging, breeding, migratory, or winter units, are outside the action area. The essential biological features for *Sargassum* habitat include:

1. Convergence zones, surface-water downwelling areas, margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Saragassum* community in water temperatures suitable for optimal growth of *Sargassum* and inhabitance of loggerheads.
2. *Sargassum* in concentrations that support adequate prey abundance and cover.
3. Available prey and other material associated with *Sargassum* habitat including plants and cyanobacteria and animals native to the *Sargassum* community.
4. Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., greater than ten meters depth.

The proposed action will involve vessel activity, and the collection of *Sargassum* for sampling. *Sargassum* will be brought on board, rinsed and sorted for organisms. A small amount (less than one quart) will be retained for later analysis. The rest will be returned to the ocean. The action will involve an estimated 14,256 kilograms of sampled *Sargassum*, nearly all of which will be returned. There is an estimated one million tons of *Sargassum* in the Gulf of Mexico. Given the relatively tiny amount of *Sargassum* sampled in this action and the fact that it will be returned to the water after collection, we do not expect the proposed action to appreciably reduce the conservation value of loggerhead critical habitat. These activities will not affect the oceanic features, prey abundance, cover, water depth, or other essential biological features for loggerhead *Sargassum* critical habitat.

11 Integration and Synthesis

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the *Effects of the Action* (Section 9.1) to the *Environmental Baseline* (Section 9) and the *Cumulative Effects* (Section 12) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the *Status of the Species and Critical Habitat* (Section 8).

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered species and critical habitat that are likely to be exposed. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this opinion.

We expect exposed sea turtles to experience some degree of stress response to handling and restraint following capture. We also expect many of these individuals to respond behaviorally by attempting to fight when initially captured, startle when handled, and strongly swim away when released. We do not expect more than temporary displacement or removal of individuals for a period of hours from small areas as a result of the proposed actions. Individuals responding in such ways may temporarily cease feeding, breeding, resting, or otherwise disrupt vital activities. However, we do not expect that these disruptions will cause a measureable impact to any individual's growth or reproduction. Overall, we do not expect any population to experience a fitness consequence as a result of the proposed actions and, by extension, do not expect species-level effects.

As discussed previously, the proposed activities will not affect the oceanic features, prey abundance, cover, water depth, or other essential biological features for loggerhead *Sargassum* designated critical habitat.

12 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 C.F.R. §402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the Environmental Baseline (Section 9), which we expect will continue in the future. Anthropogenic effects include climate change, ship strikes, sound, military activities, fisheries, pollution, and scientific research, although some of these activities would involve a federal nexus and thus, but subject to future ESA section 7 consultation. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on sea turtle populations.

13 Conclusion

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of North Atlantic green, Northwest Atlantic Ocean loggerhead, hawksbill, or Kemp's ridley sea turtles or to destroy or adversely modify Northwest Atlantic Ocean loggerhead designated critical habitat.

14 Incidental Take Statement

Section 7(b)(4) of the ESA and implementing regulations require NMFS to specify the impact, i.e. identify the amount or extent, of any incidental take of endangered or threatened species, to include reasonable and prudent measures to minimize the impact of the take, and to provide terms and conditions to implement those reasonable and prudent measures. Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

ESA section 7(o)(2) provides that any take that is incidental to an otherwise lawful agency action is not considered to be prohibited under the ESA, if the agency action is performed in compliance with the terms and conditions identified below of this incidental take statement.

14.1 Amount or Extent of Take

Based on the calculated exposure estimates, we expect that up to one Northwest Atlantic DPS loggerhead, one North Atlantic DPS green, one hawksbill, and one Kemp's ridley sea turtle may be captured during each cruise in the proposed action. We anticipate that all sea turtles expected to be incidentally captured over the life of the permit will undergo short term harassment and/or minimal injury from being released from nets.

14.2 Effects of the Take

In this opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

14.3 Reasonable and Prudent Measures

NMFS believes the reasonable and prudent measures described below are necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

1. The National Centers for Coastal Ocean Science will, at the conclusion of each research cruise, assess the actual level of incidental take in comparison with the anticipated incidental take specified in this biological opinion.
2. The National Centers for Coastal Ocean Science will detect and report on when the level of anticipated incidental take is exceeded.
3. In addition to the reporting requirements that are part of the proposed action, the National Centers for Coastal Ocean Science will instruct the researchers to provide photographs of any incidentally captured sea turtles, if feasible. These photographs are to be included in the reports.

14.4 Terms and Conditions

To be exempt from the prohibitions of sections 9 and 4(d) of the ESA, the National Centers for Coastal Ocean Science must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures described above.

1. The National Centers for Coastal Ocean Science will require that the researcher observe the nets for sea turtles, and return to the water, to the maximum extent practicable and with vigilant consideration of safety, any live sea turtles that are found in nets during research.
2. The National Centers for Coastal Ocean Science will require the researcher to report any sea turtle interactions to NMFS within 14 days of the incident. This report must contain

the description of the take, species of sea turtle, a description of the sea turtle (e.g., size, markings), a photograph of the sea turtle, and release condition.

3. These reports must be forwarded to the ESA Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service 1315 East-West Highway, Silver Spring, Maryland, 20910.

15 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 C.F.R. §402.02).

No additional conservation recommendations are included for this action.

16 Reinitiation Notice

This concludes formal consultation for the National Centers for Coastal Ocean Science's proposal to fund a study in the Gulf of Mexico sampling the larval fish communities associated with *Sargassum* in the oceanic and neritic environments.. As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

(1) The amount or extent of taking specified in the incidental take statement is exceeded.
(2) New information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not previously considered.
(3) The identified action is subsequently modified in a manner that causes an effect to ESA-listed species or designated critical habitat that was not considered in this opinion.
(4) A new species is listed or critical habitat designated under the ESA that may be affected by the action.

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