NOAA's National Marine Fisheries Service
Endangered Species Act Section 7 Consultation

Biological Opinion

Agency: Permits and Conservation Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service

Activity Considered: Biological Opinion on the proposal to issue permit 16598 to Inwater Research Group to authorize research on green, hawksbill, Kemp's ridley, and loggerhead sea turtles in the coastal waters off of Florida, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973

Consultation Conducted by: Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service

Approved by: ______________________

Date: JUL - 3 2012

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1536(a)(2)) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat designated for them, that agency is required to consult with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service, depending upon the listed resources that may be affected. For the action described in this document, the action agency is the NMFS' Office of Protected Resources – Permits and Conservation Division. The consulting agency is the NMFS' Office of Protected Resources – Endangered Species Act Interagency Cooperation Division.

This document represents the NMFS' biological opinion (Opinion) of the effects of the proposed research on the threatened loggerhead sea turtle and the endangered green[1], hawksbill, and Kemp's ridley sea turtles, and these species' designated critical habitat, and has been prepared in accordance with Section 7 of the ESA. This Opinion is based on our review of the Permits and Conservation Division's draft Environmental Assessment, draft permit 16598, the application from Inwater Research Group, annual reports of past

[1] Green sea turtles in U.S. waters are listed as threatened except for Mexico's Pacific coast breeding population and the Florida breeding population, which are listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

research completed by the applicant, recovery plans for listed species, status and 5-year reviews, scientific and technical reports from government agencies, peer-reviewed literature, biological opinions on similar research, and other sources of information.

Consultation history

The NMFS' Permits and Conservation Division (Permits Division) requested consultation with the NMFS' Endangered Species Act Interagency Coordination Division (ESA IC Division) on the proposal to issue a scientific research permit authorizing studies on green, hawksbill, Kemp's ridley, and loggerhead sea turtles. Issuance of the permit constitutes a federal action, which may affect marine species listed under the ESA.

On April 19, 2012, the Permits Division requested initiation of Section 7 consultation to issue a permit to Inwater Research Group. The ESA IC Division formally initiated consultation on the same day.

Description of the proposed action

NMFS' Office of Protected Resources – Permits and Conservation Division proposes to amend a scientific research permit pursuant to Section 10(a)(1)(A) of the ESA. Issuance of permit 16598 to Inwater Research Group would authorize research on green, hawksbill, Kemp's ridley, and loggerhead sea turtles in the coastal waters off of Florida.

Proposed permit 16598

The Permits Division proposes to authorize the Inwater Research Group to capture and handle 160 green, 160 loggerhead, 75 hawksbill, and 66 Kemp's ridley sea turtles. The actions that would be included in handling are: measure, weigh, photograph, carapace mark, flipper and PIT tag, blood and tissue sample, and gastric lavage (green and hawksbill only). A portion of sea turtles would also receive satellite tags. Additionally, researchers would be authorized to count and survey (not capture and handle) up to 3600 green, 1200 loggerhead, 125 hawksbill, and 215 Kemp's ridley sea turtles; see Table 1 for details.

Survey

Vessel based visual sightings of sea turtles would be conducted throughout the study areas using haphazard unmarked non-linear transects (H.U.N.T.). These transects employ two experienced observers in an elevated tower of a 24' Carolina Skiff. The vessel moves at 8-10 km/hr over potential sea turtle habitat. Sea turtles sighted on transect are identified to species and life stage and locations are marked on the GPS unit. Habitat type for each sighting would also be recorded.

Capture

Most sea turtles would be captured using the rodeo method described by Ehrhart and Ogren (1999). This method entails pursuing and capturing turtles from a moving boat and would be used in conjunction with the H.U.N.T. method described above. A diver with mask and fins would be stationed on the bow of the boat. When a turtle is targeted for capture the boat would be positioned alongside the turtle in a manner that allows the diver to jump from the bow of the boat and engage the turtle. Once in the water the diver would attempt to control the turtle by the nuchal notch and posterior marginals of the carapace and guide it to the surface. When the diver has control of the turtle, it is brought on board for measurements and data collection.

Researchers would also use dip nets to capture sea turtles at each study site. This entails the same methods as the rodeo method, but when the turtle is alongside the boat a long handled dip net would be used to capture the turtle.

In certain situations, researchers would use free divers to capture turtles. This is very effective on reef tracts that are too deep to employ the rodeo or dip net capture methods. A pair of snorkelers swim a transect over a reef area and when a turtle is spotted the diver submerges and attempts to grab the turtle by the nuchal notch and the pigal scutes and surfaces with the turtle. Personnel on the boat would mark the start and end of each transect and mark the capture or sighting location on a GPS.

Measurements

Researchers would collect morphometric data using calipers and a flexible tape as described by Pritchard et al. (1983). Turtles would also be weighed and photographed before release. Tumors associated with fibropapilloma would be measured and recorded on a standardized tumor score sheet.

Tagging

Turtles would be tagged with a National Band and Tag inconel # 681 tag applied to the proximal trailing edge of each front flipper. The tag location is normally the first proximal scale. Prior to application, the tag site would be treated with Provodine and the point of the tag covered in a triple-antibiotic to prevent infection. The area would then be cleaned with isopropyl alcohol.

Researchers would also use passive integrated transponder (PIT) tags manufactured by Destron-Fearing. These would be inserted into the right front flipper at a point above the second proximal trailing scale and anterior to the first digit. All flippers would be scanned prior to insertion to ensure there are no PIT tags already present. The same antiseptic cleaning methods used for inconel tags would also be employed for PIT tags. After insertion, a cotton swab would be held over the tag site for several minutes to deter any bleeding. Researchers would scan the flipper to be sure of the functionality and identity of the tag.

Blood sampling

Blood samples would be collected within the first five minutes of capture so as not to bias the samples. Researchers would draw blood from the cervical sinus using a sterile vacutainer with no additive (Owens and Ruiz 1980). If no blood is obtained during the first attempt, a maximum of two other attempts would be performed. A 22 gauge 1" needle would be used on small juveniles, while a 1 ½" would be used on subadults and adult animals. Researchers would collect approximately 4 ml from each turtle.

In the event blood is unable to be attained, a small biopsy would be taken from the distal edge of one rear flipper. The area would be swabbed with provodine before and after inserting a 4 mm biopsy punch.

Table 1. Proposed annual "takes'" of sea turtles under Permit No. 16598.

Annual take number	Species	Collection Method	Take Activity
The following "takes" would occur in the Key West National Wildlife Refuge			
90	Green	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage
10	Green	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage, satellite tag
90	Loggerhead	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample
10	Loggerhead	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, satellite tag
50	Hawksbill	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage
10	Hawksbill	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage, satellite tag
6	Kemp's ridley	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample
3000	Green	Vessel Survey	Count/Survey
1000	Loggerhead	Vessel Survey	Count/Survey
100	Hawksbill	Vessel Survey	Count/Survey
15	Kemp's ridley	Vessel Survey	Count/Survey
The following "takes" would occur in the Big Bend Sea Grasses Aquatic Preserve			
50	Green	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage
10	Green	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage, satellite tag
50	Loggerhead	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample
10	Loggerhead	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, satellite tag
15	Hawksbill	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, gastric lavage
50	Kemp's ridley	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample
10	Kemp's ridley	Hand/Dip Net	Measure, weigh, photograph, carapace mark, PIT tag, flipper tag, tissue sample, blood sample, satellite tag
600	Green	Vessel Survey	Count/Survey
200	Loggerhead	Vessel Survey	Count/Survey
25	Hawksbill	Vessel Survey	Count/Survey
200	Kemp's ridley	Vessel Survey	Count/Survey

Tissue sampling

To obtain samples for stable isotope analysis researchers would use two methods: epidermis biopsy and scute biopsy.

For epidermis biopsy, sterile 2 or 4 mm biopsy punches (depending on turtle body size) would be used to remove epidermis samples from the dorsal surface of the right shoulder. Researchers would rinse the area with 10% betadine solution prior to sampling and apply triple antibiotic on the wound.

For scute biopsy, sterile 6 mm biopsy punches would be used to remove scute samples at a posterior (oldest) and anterior (youngest) site on the second costal scute. Six mm biopsy punches would be used to sample sea turtles captured in the neritic developmental habitats; researchers would use a # 21 scalpel blade to peel a 6 mm area of scute tissue from turtles caught in the offshore habitat, due to their smaller body size. The collection site would be rinsed with distilled water and cleaned gently with a plastic scrubbing pad.

Satellite tagging

For tracking sea turtles captured at each study site, researchers would use small satellite transmitters. Two possible units are Telonics ST-20, modelA-1010 (6.0 x 12.3 x 2.8 cm, 276 g) and the smaller and lighter Wildlife Computer Spot 5 tag.

Researchers would attach the transmitter to the turtle's carapace, centered, behind the nuchal scale in the area of second vertebral. In preparation for transmitter attachment, the turtle's carapace is cleaned with a small, soft brush and a 3M scrubby and then sanded lightly with fine sandpaper, to provide a roughened surface for the resin to adhere. The carapace is lightly cleaned with alcohol applied to a clean dry cloth. A layer of elastomer or epoxy is put on the bottom of the transmitter before it is inverted and set in place on the turtle's carapace. Strips of fiberglass cloth are laid over the transmitter and secured in place on the carapace with a polyester resin.

The transmitter should fall off the turtle harmlessly as the turtle sheds its scutes. The transmitters are capable of sending data for up to two years. Transmitter attachment would be accomplished on board the boat and generally take 1-2 hours. Turtles would be held in a secure area of the boat, away from other activities and in the shade during transmitter attachment. Turtles would be released as soon as the last application of resin has dried.

Gastric lavage

Researchers would sample food items caught in the esophagus of green and hawksbill turtles using the lavage technique (Balazs 1980). A clear flexible PVC tube would be lubricated with vegetable oil and inserted down the length of the esophagus to the middle of the gular scute. The diameter of the tube would be either ¼-inch or ⅜-inch depending on the size of the turtle. Seawater would be pumped into the tube using a veterinarian's double action stomach pump and the tube would be moved gently back and forth along the esophagus. Food items would be collected from the backwash into a five gallon bucket. Separate tubes would be used for turtles with fibropapilloma.

Marking and release

Prior to release, numeric markings would be painted on the turtle's carapace with two-part Gelcoat epoxy paint. These markings allow for clear visual identification so that turtles are not subjected to hand capture twice in a given sampling period. The paint is allowed to dry until set (5-10 minutes) and the turtles are lowered over the gunnel of the boat and released in the area of capture. This short term marking typically last for less than a month before the epoxy paint wears off.

Permit conditions

The proposed permit lists general and special conditions that are followed as part of the proposed research activities. These conditions are intended to minimize the potential adverse effects of the research activities on targeted endangered species and include the following that are relevant to the proposed permit:

- In the event of serious injury or mortality or if the permitted "take" is exceeded, researchers must suspend permitted activities and contact the Permits Division by phone within two business days, and submit a written incident report. The Permits Division may grant authorization to resume permitted activities.
- The Permit Holder may conduct the authorized activities on compromised or injured sea turtles, but only if the activities will not further compromise the animal. Care must be taken to minimize handling time and reduce further stress to the animal.
- **Equipment.** All equipment that comes in contact with sea turtles must be cleaned and disinfected between the processing of each turtle, and special care must be taken for animals displaying fibropapilloma tumors or legions. All turtles must be examined for existing tags before attaching or inserting new ones. If existing tags are found, the tag identification numbers must be recorded and included in the annual report.
- **Flipper tagging.** All tags must be cleaned and disinfected before being used. Applicators must be cleaned between animals. The application site must be cleaned and then scrubbed with disinfectant (e.g. Betadine) before the tag pierces the animal's skin.
- **PIT Tagging.** New, sterile tag applicators (needles) must be used. The application site must be cleaned and then scrubbed with a disinfectant (e.g. Betadine) before the applicator pierces the animal's skin. The injector handle shall be disinfected if it has been exposed to fluids from other animals.
- **Handling.** Researchers must use care when handling live animals to minimize any possible injury, and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. Whenever possible, injured animals should be transferred to rehabilitation facilities and allowed an appropriate period of recovery before return to the wild. An experienced veterinarian, veterinary technician, or rehabilitation facility must be named for emergencies. If an animal becomes highly stressed, injured, or comatose during the course of the research activities the researchers must contact a veterinarian immediately. Based on the instructions of the veterinarian, if necessary, the animal must be immediately transferred to the veterinarian or to a rehabilitation facility to receive veterinary care.

- Turtles are to be protected from temperature extremes of heat and cold, provided adequate air flow, and kept moist (if appropriate) during sampling. Turtles must be placed on pads for cushioning and this surface must be cleaned and disinfected between turtles. The area surrounding the turtle must not contain any materials that could be accidentally ingested.
- During release, turtles must be lowered as close to the water's surface as possible to prevent potential injuries. Newly released turtles must be monitored for abnormal behavior.
- **Blood sampling.** If an animal cannot be adequately immobilized for blood sampling, efforts to collect blood must be discontinued. Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side. No blood sample will be taken should conditions on the boat preclude the safety and health of the turtle. The permit includes limits on the amount of blood that can be drawn based on the turtle's body weight (3 ml per kg), and the cumulative blood volume taken from an individual over a 45-day period. Researchers must, to the best of their ability, attempt to determine if any of the turtles they blood sample may have been sampled within the past 3 months or will be sampled within the next 3 months by other researchers.
- **Biopsy (tissue-skin) sampling.** A new biopsy punch must be used on each turtle. Sterile techniques must be used at all times. The tissue surface must be thoroughly swabbed once with both betadine and alcohol, sampled, and then thoroughly swabbed again with just betadine. If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured and has been already sampled by this permit, no additional biopsy samples may be collected from the animal over the permit year.
- **Gastric lavage.** The actual lavage must not exceed three minutes. Equipment (e.g., lavage tubes) that comes in contact with sea turtles must be cleaned and disinfected before use on another animal.
- **Instrument tagging and marking.** Total weight of transmitter attachments must not exceed 5% of the body mass of the animal. The transmitter attachment must either contain a weak link (where appropriate) or have no gap between the transmitter and the turtle that could result in entanglement. The lanyard length (if used) must be less than 1/2 of the carapace length of the turtle. It must include a corrodible, breakaway link that will corrode and release the tag-transmitter after the tag-transmitter life is finished. Researchers must make attachments as hydrodynamic as possible.
- Adequate ventilation around the head of the turtle must be provided during the attachment of satellite tags or attachment of radio/sonic tags if attachment materials produce fumes. To prevent skin or eye contact with harmful chemicals used to apply tags, turtles must not be held in water during the application process.
- Researchers must use non-toxic paints that do not generate heat or contain xylene or toluene when painting the carapace.
- **Non-target species.** Researchers must take all practicable steps to identify SAV, coral communities, and live/hard bottom habitats and avoid setting gear in such areas.

If gear is lost, diligent efforts would be made to recover the lost gear to avoid further damage to benthic habitat and impacts related to "ghost fishing." No gear may be set, anchored on, or pulled across coral or hard/live bottom habitats.

- Researchers must avoid conducting research over, on, or immediately adjacent to sea grass species. If these species cannot be avoided, then the avoidance/minimization measures must be followed.

Approach to the assessment

The NMFS approaches its Section 7 analyses of agency actions through a series of steps. The first step identifies those aspects of proposed actions that are likely to have direct and indirect physical, chemical, and biotic effects on listed species or on the physical, chemical, and biotic environment of an action area. As part of this step, we identify the spatial extent of these direct and indirect effects, including changes in that spatial extent over time. The result of this step includes defining the *Action area* for the consultation. The second step of our analyses identifies the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence (these represent our *Exposure analyses*). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent. Once we identify which listed resources are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these represent our *Response analyses*).

The final steps of our analyses – establishing the risks those responses pose to listed resources – are different for listed species and designated critical habitat (these represent our *Risk analyses*). Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. The continued existence of these "species" depends on the fate of the populations that comprise them. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them – populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

Our risk analyses reflect these relationships between listed species, the populations that comprise that species, and the individuals that comprise those populations. Our risk analyses begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individual risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the individual's "fitness," or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable lethal, sub-lethal, or behavioral responses to an action's effect on the environment (which we identify during our *Response analyses*) are likely to have consequences for the individual's fitness.

When individual listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the populations those individuals represent (see Stearns 1992). Reductions in at least one of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population's viability, which is itself a necessary condition for reductions in a species' viability. As a result, when listed plants or animals exposed to an action's effects are not expected 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 (e.g., Brandon 1978; Anderson 2000; Mills and Beatty 1979; Stearns 1992). As a result, if we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

Although reductions in fitness of individuals is a necessary condition for reductions in a population's viability, reducing the fitness of individuals in a population is not always sufficient to reduce the viability of the population(s) those individuals represent. Therefore, if we conclude that listed plants or animals are likely to experience reductions in their fitness, we determine whether those fitness reductions are likely to reduce the viability of the populations the individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analysis, we use the population's base condition (established in the *Environmental baseline* and *Status of listed resources* sections of this Opinion) as our point of reference. If we conclude that reductions in individual fitness are not likely to reduce the viability of the populations those individuals represent, we would conclude our assessment.

Reducing the viability of a population is not always sufficient to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of listed resources* section of this Opinion) as our point of reference. Our final determinations are based on whether threatened or endangered species are likely to experience reductions in their viability and whether such reductions are likely to be appreciable.

To conduct these analyses, we rely on all of the evidence available to us. This evidence consists of

- monitoring reports submitted by past and present permit holders
- reports from the NMFS Science Centers
- reports prepared by natural resource agencies in States and other countries
- reports from non-governmental organizations involved in marine conservation issues

- the information provided by the NMFS Permits Division when it initiates formal consultation
- the general scientific literature

We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies.

During the consultation, we conducted electronic searches of the general scientific literature. We supplemented these searches with electronic searches of doctoral dissertations and master's theses. These searches specifically tried to identify data or other information that supports a particular conclusion as well as data that do not support that conclusion. When data were equivocal or when faced with substantial uncertainty, our decisions are designed to avoid the risks of incorrectly concluding that an action would not have an adverse effect on listed species when, in fact, such adverse effects are likely (i.e., Type II error).

Action Area

Activities would occur year-round, in the coastal waters off of Florida, specifically the Key West National Wildlife Refuge and the Big Bend Sea Grasses Aquatic Preserve (see Figures 1 and 2).

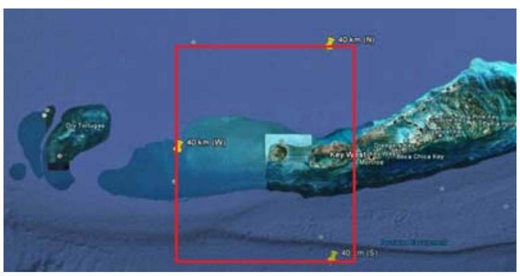

Figure 1: Key West study

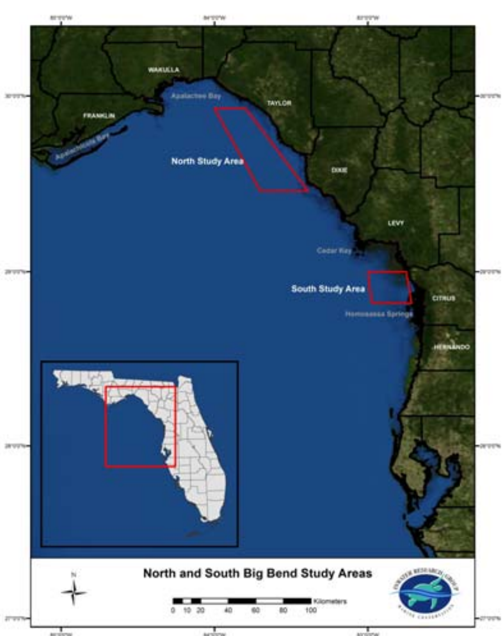

Figure 2: Big Bend study areas.

Status of listed resources

NMFS has determined that the actions considered in this Opinion may affect the following listed resources provided protection under the ESA of 1973, as amended (16 U.S.C. 1531 *et seq*.):

Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtles		
Green sea turtle – most areas	*Chelonia mydas*	Threatened
Florida and Mexico's Pacific coast breeding colonies		Endangered
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelyts coriacea*	Endangered
Loggerhead sea turtle Northwest Atlantic Ocean DPS	*Caretta caretta*	Threatened
Fish		
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Largetooth sawfish	*Pristis perotteti*	Endangered
Smalltooth sawfish	*Pristis pectinata*	Endangered
Invertebrates and Plants		
Elkhorn coral*	*Acropora palmata*	Threatened
Staghorn coral*	*Acropora cervicornis*	Threatened

* Critical habitat exists for these species within the action area.

Species not considered further in this opinion

To refine the scope of this Opinion, NMFS used two criteria (risk factors) to determine whether any endangered or threatened species or critical habitat are not likely to be adversely affected by vessel traffic, aircraft traffic, or human disturbance associated with the proposed actions. The first criterion was *exposure*: if we conclude that particular endangered or threatened species or designated critical habitat are not likely to be exposed to vessel traffic, aircraft traffic, or human disturbance, we must also conclude that those listed species or designated critical habitat are not likely to be adversely affected by the proposed action. The second criterion is *susceptibility* upon exposure: species or critical habitat may be exposed to vessel traffic, aircraft traffic, or human disturbance, but may not be unaffected by those activities – either because of the circumstances associated with the exposure or the intensity of the exposure – are also not likely to be adversely affected by the vessel traffic, aircraft traffic, or human disturbance. This section summarizes the results of our evaluations.

Blue, fin, humpback, North Atlantic right whale, sei, and sperm whales, leatherback sea turtles, gulf sturgeon, and largetooth and smalltooth sawfish may occur in the action area. However, research would be specifically directed at hard shell sea turtles. Vessels would be traveling at a speed low enough to locate turtles, reducing the risk of ship strikes for whales. Any whales in the area of the research vessel would likely be spotted and standard marine mammal viewing guidelines would be followed. No gear would be set or towed through the water column, reducing the likelihood of entangling or capturing whales, non-target sea turtles, or fish (sturgeon and sawfish). Leatherback sea turtles are not part of the proposed researcher permit, and due to their distinct appearance compared to hard-shelled sea turtles, it is unlikely that the researchers would mistakenly attempt to capture a leatherback sea turtle.

Elkhorn and staghorn corals could also occur in the action area, but we do not expect them to be adversely affected by the proposed action. Researchers would take all practicable steps to identify coral communities and live/hard bottom habitats and would not set gear or anchor in those areas.

Both coral species have designated critical habitat within the action area. The designation for both corals indicated natural consolidated hard substrate or dead coral skeleton that are free from fleshy or turf macroalgae cover and sediment cover as the primary constituent element for the corals' critical habitat. The proposed action would not affect this element, and therefore we do not expect it to adversely modify or destroy elkhorn and staghorn critical habitat.

Although these listed resources may occur in the action area, we believe they are either not likely to be exposed to the proposed research or are not likely to be adversely affected. Therefore, they will not be considered further in this Opinion.

Status of species considered in this opinion

The species narratives that follow focus on attributes of life history and distribution that influence the manner and likelihood that these species may be exposed to the proposed action, as well as the potential response and risk when exposure occurs. Consequently, the species' narrative is a summary of a larger body of information on localized movements, population structure, feeding, diving, and social behaviors. Summaries of the status and trends of the listed sea turtles are presented to provide a foundation for the analysis of the species as a whole. We also provide a brief summary of the species' status and trends as a point of reference for the jeopardy determination, made later in this Opinion. That is, we rely on a species' status and trend to determine whether an action's direct or indirect effects are likely to increase the species' probability of becoming extinct. Similarly, each species narrative is followed by a description of its critical habitat with particular emphasis on any essential features of the habitat that may be exposed to the proposed action and may warrant special attention.

Green sea turtle

Distribution

Green sea turtles have a circumglobal distribution, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. Green turtles appear to prefer waters that usually remain around 20º C in the coldest month, but may be found considerably north of these regions during warm-water events, such as El Niño. Stinson (1984) found green turtles to appear most frequently in U.S. coastal waters with temperatures exceeding 18º C. Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating Sargassum spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998a). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000).

Populations are distinguished generally by ocean basin and more specifically by nesting location. Based upon genetic differences, two distinct regional clades are thought to exist in the Pacific: western Pacific and South Pacific islands, and eastern Pacific and central Pacific, including the rookery at French Frigate Shoals, Hawaii. In the eastern Pacific, green sea turtles forage from San Diego Bay, California to Mejillones, Chile. Individuals along the southern foraging area originate from Galapagos Islands nesting beaches, while those in the Gulf of California originate primarily from Michoacán. Green turtles foraging in San Diego Bay and along the Pacific coast of Baja California originate primarily from rookeries of the Islas Revillagigedos (Dutton 2003).

Reproduction

Estimates of reproductive longevity range from 17 to 23 years (Fitzsimmons *et al.* 1995; Carr *et al.* 1978; Chaloupka *et al.* 2004). Considering that mean duration between females returning to nest ranges from 2 to 5 years (Hirth 1997), these reproductive longevity estimates suggest that a female may nest 3 to 11 seasons over the course of her life. Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit 9 to 33 clutches during her lifetime.

Once hatched, sea turtles emerge and orient towards a light source, such as light shining off the ocean. They enter the sea in a "frenzy" of swimming activity, which decreases rapidly in the first few hours and gradually over the first several weeks (Okuyama *et al.* 2009; Ischer *et al.* 2009). Factors in the ocean environment have a major influence on reproduction (Chaloupka 2001; Solow *et al.* 2002; Limpus and Nicholls 1988). It is also apparent that during years of heavy nesting activity, density dependent factors (beach crowding and digging up of eggs by nesting females) may affect hatchling production (Tiwari *et al.* 2005; Tiwari *et al.* 2006). Precipitation, proximity to the high tide line, and nest depth can also significantly affect nesting success (Cheng et al. 2009). Precipitation can also be significant in sex determination, with greater nest moisture resulting in a higher proportion of males (Leblanc and Wibbels 2009). Green sea turtles often return to the same foraging areas following nesting migrations (Broderick *et al.* 2006; Godley *et al.* 2002). Once there, they move within specific areas, or home ranges, where they routinely visit specific localities to forage and rest (Seminoff *et al.* 2002; Seminoff and Jones 2006; Godley *et al.* 2003; Makowski *et al.* 2006; Taquet *et al.* 2006). However, it is also apparent that some green sea turtles remain in pelagic habitats for extended periods, perhaps never recruiting to coastal foraging sites (Pelletier et al. 2003).

In general, survivorship tends to be lower for juveniles and subadults than for adults. Adult survivorship has been calculated to range from 0.82-0.97 versus 0.58-0.89 for juveniles (Seminoff *et al.* 2003; Chaloupka and Limpus 2005; Troëng and Chaloupka 2007), with lower values coinciding with areas of human impact on green sea turtles and their habitats (Bjorndal *et al.* 2003; Campbell and Lagueux 2005).

Movement and migration

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Plotkin 2003; Musick and Limpus 1997). The periodic migration between nesting sites and foraging areas by adults is a prominent feature of their life history. After departing as hatchlings and residing in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), green sea turtles make their way back to the same beach from which they hatched (Meylan *et al.* 1990; Carr *et al.* 1978). However, green sea turtles spend the majority of their lives in coastal foraging grounds. These areas include both open coastline and protected bays and lagoons. While in these areas, green sea turtles rely on marine algae and seagrass as their primary dietary constituents, although some populations also forage heavily on invertebrates. There is some evidence that individuals move from shallow seagrass beds during the day to deeper areas at night (Hazel 2009).

Feeding

While offshore and sometimes in coastal habitats, green sea turtles are not obligate plant-eaters as widely believed, and instead consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Seminoff *et al.* 2002; Hatase *et al.* 2006; Heithaus *et al.* 2002; Godley *et al.* 1998; Parker and Balazs 2008). However, a shift to a more herbivorous diet occurs when individuals move into neritic habitats, as vegetable mater replaces an omnivorous diet at around 59 cm in carapace length off Mauritania (Cardona et al. 2009). Localized movement in foraging areas can be strongly influenced by tidal movement (Brooks et al. 2009).

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and USFWS 1998a; Hazel *et al.* 2009). The maximum recorded dive depth for an adult green turtle was just over 106 m (Berkson 1967).

Status and trends

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered (43 FR 32800). The International Union for Conservation of Nature (IUCN) has classified the green turtle as “endangered.”

No trend data are available for almost half of the important nesting sites, where numbers are based on recent trends and do not span a full green sea turtle generation, and impacts occurring over four decades ago that caused a change in juvenile recruitment rates may have yet to be manifested as a change in nesting abundance. Additionally, these numbers are not compared to larger historical numbers. The numbers also only reflect one segment of the population (nesting females), who are the only segment of the population for which reasonably good data are available and are cautiously used as one measure of the possible trend of populations.

Current nesting abundance is known for 46 nesting sites worldwide (Tables 10). These include both large and small rookeries and are believed to be representative of the overall trends for their respective regions. Based on the mean annual reproductive effort, 108,761-150,521 females nest each year among the 46 sites. Overall, of the 26 sites for which data enable an assessment of current trends, 12 nesting populations are increasing, 10 are stable, and four are decreasing. Long-term continuous datasets of 20 years are available for 11 sites, all of which are either increasing or stable. Despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004).

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, from a combination of overexploitation and habitat loss (Seminoff *et al.* 2002; Eckert 1993). In the western Pacific, the only major (>2,000 nesting females) populations of green turtles occur in Australia and Malaysia, with smaller colonies throughout the area. Indonesian nesting is widely distributed, but has experienced large declines over the past 50 years. Hawaii green turtles are genetically distinct and geographically isolated, and the population appears to be increasing in size despite the prevalence of fibropapillomatosis and spirochidiasis (Aguirre et al. 1998).

There are no reliable estimates of the overall number of green turtles inhabiting foraging areas within the southeast United States, and it is likely that green turtles foraging in the region come from multiple genetic stocks. However, information from some sites is available. A long-term in-water monitoring study in the Indian River Lagoon of Florida has tracked the populations of juvenile green turtles in a foraging environment and noted significant increases in catch-per-unit effort (more than doubling) between the years 1983-85 and 1988-90. An extreme, short-term increase in catch per unit effort of ~300% was seen between 1995 and 1996 (Ehrhart *et al.* 1996). Catches of benthic immature turtles at the St. Lucie Nuclear Power Plant intake canal, which acts as a passive turtle collector on Florida's east coast, have also been increasing since 1992 (Martin and Ernst 2000).

Critical habitat

On September 2, 1998, critical habitat for green sea turtles was designated in coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693). Aspects of these areas that are important for green sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for green sea turtle prey. The proposed research would not take place in designated green sea turtle critical habitat.

Hawksbill sea turtle

Distribution

The hawksbill sea turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific oceans. Populations are distinguished generally by ocean basin and more specifically by nesting location. Satellite tagged turtles have shown significant variation in movement and migration patterns. In the Caribbean, distance traveled between nesting and foraging locations ranges from a few kilometers to a few hundred kilometers (Byles and Swimmer 1994; Miller *et al.* 1998; Horrocks *et al.* 2001; Hillis-Starr *et al.* 2000; Prieto *et al.* 2001; Lagueux *et al.* 2003). Hawksbill turtles are considered common in French Polynesian waters, but are not known to nest on the islands. Confirmed sightings have also been made near the proposed study area off Tonga, Fiji, and Niue (SPREP 2007).

Hawksbill sea turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Small juvenile hawksbills (5-21 cm straight carapace length) have been found in association with *Sargassum* spp. in both the Atlantic and Pacific oceans (Musick and Limpus 1997) and observations of newly hatched hawksbills attracted to floating weed have been made (Hornell 1927; Mellgren and Mann 1996; Mellgren *et al.* 1994). 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 (Musick and Limpus 1997), and mud flats (R. von Brandis, unpublished data in NMFS and USFWS 2007). Individuals of multiple breeding locations can occupy the same foraging habitat (Bass 1999; Bowen *et al.* 1996; Bowen *et al.* 2007; Diaz-Fernandez *et al.* 1999; Velez-Zuazo *et al.* 2008). As larger juveniles, some individuals may associate with the same feeding locality for more than a decade, while others apparently migrate from one site to another (Musick and Limpus 1997; Mortimer *et al.* 2003; Blumenthal *et al.* 2009). Larger individuals may prefer deeper habitats than their smaller counterparts (Blumenthal et al. 2009).

Reproduction

Hawksbill sea turtles breed while in the water, but eggs are laid on beaches worldwide. Females typically lay 3-5 clutches at 2-week intervals during a single nesting season (Witzell 1983; Mortimer and Bresson 1999; Richardson *et al.* 1999; Beggs *et al.* 2007). Nesting for each female occurs between 1.8-7 year intervals, depending upon nesting site (Mortimer and Bresson 1999; Richardson *et al.* 1999; Limpus 2004; Pita and Broderick 2005; Beggs *et al.* 2007; Chan and Liew 1999; Pilcher and Ali 1999; Garduño-Andrade 1999). Following incubation, hatchlings emerge from sand-covered pits in which their eggs were laid and enter the sea.

Hawksbill sea turtles reach sexual maturity at >20 years in Atlantic waters (León and Diez 1999; Diez and Dam 2002; Boulon 1983; Boulon 1994). Ages of 30-38 years have been estimated for individuals from Indo-Pacific waters, with males reaching maturity later than females (Limpus and Miller 2000). Duration of reproductive potential in the Caribbean is 14-22 years (Parrish and Goodman 2006). Based on the reasonable means of 3-5 nests per season (Mortimer and Bresson 1999; Richardson *et al.* 1999) and 130 eggs per nest (Witzell 1983), a female may lay 9 to 55 egg clutches, or about 1,170-7,190 eggs during her lifetime. However, up to 276 eggs have been recorded in a single nest (Kamel and Delcroix 2009). In the Cayman Islands, juvenile growth has been estimated at 3.0 cm/year (Blumenthal et al. 2009).

Movement and migration

Upon first entering the sea, neonatal hawksbills in the Caribbean are believed to enter an oceanic phase that may involve long distance travel and eventual recruitment to nearshore foraging habitat (Boulon 1994). In the marine environment, the oceanic phase of juveniles (i.e., the "lost years") remains one of the most poorly understood aspects of hawksbill life history, both in terms of where turtles occur and how long they remain oceanic.

Feeding

Dietary data from oceanic stage hawksbills are limited, but indicate a combination of plant and animal material (Bjorndal 1997). Studies have shown post-oceanic hawksbills to feed on sponges throughout their range (reviewed by Bjorndal 1997), but appear to be especially spongivorous in the Caribbean (Van Dam and Diez 1997; León and Bjorndal 2002; Meylan 1988). Jellyfish are also ingested on occasion (Blumenthal et al. 2009).

Status and trends

Hawksbill sea turtles were protected on June 2, 1970 (35 FR 8495) under the Endangered Species Conservation Act and since 1973 have been listed as endangered under the ESA. This species is currently listed as endangered throughout its range.

Only five regional nesting populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly 1999). Most populations are declining, depleted, or remnants of larger aggregations.

The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Each year, about 500-1000 hawksbill nests are laid on Mona Island, Puerto Rico (Diez and van Dam 2006) and another 100-150 nests on Buck Island Reef National Monument off St. Croix in the U.S. Virgin Islands (Meylan 1999).

Critical habitat

On September 2, 1998, critical habitat was declared for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey. The proposed research would not take place in designated hawksbill sea turtle critical habitat.

Kemp’s ridley sea turtle

Distribution

Adult Kemp’s ridley turtles are restricted to the Gulf of Mexico in shallow near shore waters, although adult-sized individuals sometimes are found on the eastern seaboard of the United States. Females rarely leave the Gulf of Mexico and adult males do not migrate. Juveniles feed along the east coast of the United States up to the waters off Cape Cod, Massachusetts (Spotila 2004). A small number of individuals reach European waters (Spotila 2004; Brongersma 1972) and the Mediterranean (Pritchard and Mtirquez 1973).

Juvenile Kemp's ridley sea turtles are the second most abundant sea turtle in the mid-Atlantic region from New England, New York, and the Chesapeake Bay, south to coastal areas off North Carolina. Juvenile Kemp's ridley sea turtles migrate into the region during May and June and forage for crabs in submerged aquatic vegetation (Keinath *et al.* 1987; Musick and Limpus 1997). In the fall, they migrate south along the coast, forming one of the densest concentrations of Kemp's ridley sea turtles outside of the Gulf of Mexico (Musick and Limpus 1997).

Reproduction

Mating is believed to occur about three to four weeks prior to the first nesting (Rostal 2007), or late March through early to mid April. It is presumed that most mating takes place near the nesting beach (Morreale *et al.* 2007; Rostal 2007). Females initially ovulate within a few days after successful mating and lay the first clutch approximately two to four weeks later; if a turtle nests more than once per season, subsequent ovulations occur within approximately 48 hours after each nesting (Rostal 2007).

Approximately 60% of Kemp's ridley nesting occurs along an approximate 25-mile stretch of beach near Rancho Nuevo, Tamaulipas, Mexico from April to July, with limited nesting to the north (100 nests along Texas in 2006) and south (several hundred nests near Tampico, Mexico in 2006; USFWS 2006). Nesting at this location may be particularly important because hatchlings can more easily migrate to foraging grounds (Putman *et al.* 2010). The Kemp's ridley sea turtle tends to nest in large aggregations or arribadas (Bernardo and Plotkin 2007). The period between Kemp's ridley arribadas averages approximately 25 days, but the precise timing of the arribadas is unpredictable (Rostal *et al.* 1997; Bernardo and Plotkin 2007). Like all sea turtles, Kemp's ridley sea turtles nest multiple times in a single nesting season. The most recent analysis suggests approximately 3.075 nests per nesting season per female (Rostal 2007). The annual average number of eggs per nest (clutch size) is 94 to 100 and eggs typically take 45 to 58 days to hatch, depending on temperatures (Marquez-M. 1994; USFWS 2000; USFWS 2001; USFWS 2002; USFWS 2003; USFWS 2004; USFWS 2005; USFWS 2006; Rostal 2007). The period between nesting seasons for each female is approximately 1.8 to 2.0 years (Marquez *et al.* 1989; Rostal 2007; TEWG 2000). The nesting beach at Rancho Nuevo may produce a "natural" hatchling sex ratio that is female-biased, which can potentially increase egg production as those turtles reach sexual maturity (Wibbels 2007; Coyne and Landry Jr. 2007).

Kemp's ridleys require approximately 1.5 to two years to grow from a hatchling to a size of approximately 7.9 inches long, at which size they are capable of making a transition to a benthic coastal immature stage, but can range from one to four years or more (Ogren 1989; Caillouet *et al.* 1995; Zug *et al.* 1997; Schmid 1998; Schmid and Witzell 1997; TEWG 2000; Snover *et al.* 2007). Based on the size of nesting females, it is assumed that turtles must attain a size of approximately 23.6 inches long prior to maturing (Marquez-M. 1994). Growth models based on mark-recapture data suggest that a time period of seven to nine years would be required for this growth from benthic immature to mature size (Schmid and Witzell 1997; Snover *et al.* 2007). Currently, age to sexual maturity is believed to range from approximately 10 to 17 years for Kemp's ridleys (Snover *et al.* 2007). However, estimates of 10 to 13 years predominate in previous studies (Caillouet *et al.* 1995; Schmid and Witzell 1997; TEWG 2000).

Movement and migration

These migratory corridors appear to extend throughout the coastal areas of the Gulf of Mexico and most turtles appear to travel in waters less than roughly 164 feet in depth. Turtles that headed north and east traveled as far as southwest Florida, whereas those that headed south and east traveled as far as the Yucatan Peninsula, Mexico (Morreale *et al.* 2007).

Following migration, Kemp's ridley sea turtles settle into resident feeding areas for several months (Byles and Plotkin 1994; Morreale *et al.* 2007). Females may begin returning along relatively shallow migratory corridors toward the nesting beach in the winter in order to arrive at the nesting beach by early spring.

Stranding data indicate that immature turtles in their benthic stage are found in coastal habitats of the entire Gulf of Mexico and U.S. Atlantic coast (TEWG 2000; Morreale *et al.* 2007). Developmental habitats for juveniles occur throughout the entire coastal Gulf of Mexico and U.S. Atlantic coast northward to New England (Schmid 1998; Wibbels *et al.* 2005; Morreale *et al.* 2007). Key foraging areas in the Gulf of Mexico include Sabine Pass, Texas; Caillou Bay and Calcasieu Pass, Louisiana; Big Gulley, Alabama; Cedar Keys, Florida; and Ten Thousand Islands, Florida (Carr and Caldwell 1956; Ogren 1989; Coyne *et al.* 1995; Schmid 1998; Schmid *et al.* 2002; Witzell *et al.* 2005). Foraging areas studied along the Atlantic coast include Pamlico Sound, Chesapeake Bay, Long Island Sound, Charleston Harbor, and Delaware Bay. Near-shore waters of 120 feet or less provide the primary marine habitat for adults, although it is not uncommon for adults to venture into deeper waters (Byles 1989a; Mysing and Vanselous 1989; Renaud *et al.* 1996; Shaver *et al.* 2005; Shaver and Wibbels 2007).

Benthic coastal waters of Louisiana and Texas seem to be preferred foraging areas for Kemp's ridley sea turtles (particularly passes and beachfronts), although individuals may travel along the entire coastal margin of the Gulf of Mexico (Landry and Costa 1999; Landry *et al.* 1996; Renaud 1995). Sightings are less frequent during winter and spring, but this is likely due to lesser sighting effort during these times (Shoop and Kenney 1992; Keinath *et al.* 1996).

Feeding

Kemp's ridley diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks. Kemp's ridley sea turtles can dive from a few seconds in duration to well over two and a half hours, although most dives are from 16 to 34 minutes (Mendonca and Pritchard 1986; Renaud 1995). Individuals spend the vast majority of their time underwater; over 12-hour periods, 89% to 96% of their time is spent below the surface (Byles 1989b; Gitschlag 1996).

Status and trends

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18319). Internationally, the Kemp's ridley is considered the most endangered sea turtle (USFWS 1999; National Research Council 1990).

In 1947, 40,000 female Kemp's ridley sea turtles were observed nesting on the beaches at Rancho Nuevo on a single day (Carr 1963; Hildebrand 1963). By the early 1970s, the estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. Between the years of 1978 and 1991 only 200 Kemp's ridleys nested annually. Today the Kemp's ridley population appears to be in the early stages of recovery. Nesting has increased steadily over the past decade. During the 2000 nesting season, an estimated 2,000 females nested at Rancho Nuevo, a single arribada of 1,000 turtles was reported in 2001, and an estimated 3,600 turtles produced over 8,000 nests in 2003. In 2006, a record number of nests were recorded since monitoring began in 1978; 12,143 nests were documented in Mexico, with 7,866 of those at Rancho Nuevo. By 2004, the number of adult females in the Gulf of Mexico is estimate to have increased to about 5,000 individuals (Spotila 2004).

The Turtle Expert Working Group (2000) estimated that the population size of Kemp's ridley sea turtles grew at an average rate of l1.3 percent per year (95% C.I. slope = 0.096-0.130) between 1985 and 1998. Over the same time interval, hatchling production increased at a slightly slower rate (9.5% per year).

Critical habitat

NMFS has not designated critical habitat for Kemp's ridley sea turtle.

Loggerhead sea turtle – Northwest Atlantic Ocean DPS

Distribution

Loggerheads are circumglobal occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans. Loggerheads are the most abundant species of sea turtle found in U.S. coastal waters.

On September 22, 2011, the NMFS designate nine distinct population segments (DPSs) of loggerhead sea turtles. Four were listed as threatened: Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean; and five were listed as endangered: Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, North Pacific Ocean, and South Pacific Ocean (76 FR 58868). The DPS that could be exposed to the proposed action is the Northwest Atlantic Ocean DPS.

In the Northwest Atlantic, the majority of loggerhead nesting is concentrated along the coasts of the United States from southern Virginia through Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatan Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison 1997; Addison and Morford 1996), on the southwestern coast of Cuba (F. Moncada-Gavilan, personal communication, cited in Ehrhart *et al.* 2003), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

Reproduction

Loggerhead nesting is confined to lower latitudes temperate and subtropic zones but absent from tropical areas (NMFS and USFWS 1991; Witherington *et al.* 2006; National Research Council 1990). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small juveniles, large juveniles, subadults, novice breeders, first year emigrants, and mature breeders (Crouse *et al.* 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near-ultraviolet light; Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as 7-12 years. At 15-38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (NMFS 2001; Witherington *et al.* 2006; Frazer and Ehrhart 1985; Casale *et al.* 2009).

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as in offshore from nesting beaches several weeks prior to the onset of nesting (NMFS and USFWS 1998b; Dodd 1988). Females usually breed every 2-3 years, but can vary from 1-7 years (Dodd 1988; Richardson *et al.* 1978). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984).

Movement and migration

As post-hatchlings, Northwest Atlantic loggerheads use the North Atlantic Gyre and enter Northeast Atlantic waters (Carr 1987). They are also found in the Mediterranean Sea. In these areas, they overlap with animals originating from the Northeast Atlantic and the Mediterranean Sea (Carreras *et al.* 2006; Eckert *et al.* 2008).

After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, The Bahamas, Cuba, and the Gulf of Mexico (Musick and Limpus 1997; Spotila *et al.* 1997; Hopkins-Murphy *et al.* 2003). As adults, loggerheads shift to a benthic habitat, where immature individuals forage in the open ocean and coastal areas along continental shelves, bays, lagoons, and estuaries (NMFS 2001; Bowen *et al.* 2004).

Feeding

Loggerheads are omnivorous and opportunistic feeders (Parker et al. 2005). Hatchling loggerheads feed on macroplankton associated with *Sargassum* spp. communities (NMFS and USFWS 1991). Pelagic and benthic juveniles forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; Wallace *et al.* 2009). Sub-adult and adult loggerheads prey on benthic invertebrates such as gastropods, mollusks, and decapod crustaceans in hard-bottom habitats, although fish and plants are also occasionally eaten (NMFS and USFWS 1998b).

Status and trends

Loggerhead sea turtles were listed as threatened under the ESA of 1973 on July 28, 1978 (43 FR 32800). On September 22, 2011, the NMFS designate nine distinct population segments (DPSs) of loggerhead sea turtles. Four were listed as threatened: Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean; and five were listed as endangered: Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, North Pacific Ocean, and South Pacific Ocean

(76 FR 58868). The DPS that could be exposed to the proposed action is the Northwest Atlantic Ocean DPS.

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 (Bjorndal et al. 2005). An important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates well. Adult nesting females often account for less than 1% of total population numbers.

Collectively, the Northwest Atlantic Ocean hosts the most significant nesting assemblage of loggerheads in the western hemisphere and is one of the two largest loggerhead nesting assemblages in the world. Analyses by NMFS and USFWS (2008), Witherington *et al.* (2009), and TEWG (2009) indicate that there had been a significant, overall nesting decline within this DPS. However, nesting in 2008 showed a substantial increase compared to the low of 2007, and nesting in 2010 reached the highest level seen since 2000. The most current nesting trend for the Northwest Atlantic Ocean DPS, from 1989–2010, is very slightly negative, but the rate of decline is not statistically different from zero (76 FR 58868).

Critical habitat

NMFS has not designated critical habitat for loggerhead sea turtles.

Environmental baseline

By regulation, environmental baselines for Opinions include the past and present impacts of all state, federal, 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 that are contemporaneous with the consultation in process (50 CFR §402.02). The *Environmental baseline* for this Opinion includes the effects of several activities affecting the survival and recovery of ESA-listed green, Kemp's ridley, hawksbill, and loggerhead sea turtles in the action area. The *Environmental baseline* focuses primarily on past and present impacts to these species.

The following discussion summarizes the natural and human phenomena in the action area that may affect the likelihood these species will survive and recover in the wild. These include predation, cold stunning, beach erosion, disease and parasites, fisheries interactions, habitat degradation and climate change, marine debris, poaching, contaminants, vessel strikes, scientific research, lack of international protection, and conservation and management efforts.

Natural sources of stress and mortality

Predation

While in the water, sea turtles face predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004). Tiger sharks (*Galeocerdo cuvieri*) and bull sharks (*Carcharhinus leucas*) are the species most often reported to contain sea turtle remains (Compagno 1984; Simpfendorfer *et al.* 2001; Witzell 1987). Predation by white sharks (*Carcharodon carcharias*) has also been reported (Fergusson *et al.* 2000). Hatchlings are preyed upon by herons, gulls, dogfish, and sharks.

Land predators (primarily of eggs and hatchlings) include dogs, pigs, rats, crabs, sea birds, reef fishes, groupers, feral cats, and foxes (Bell *et al.* 1994; Ficetola 2008). In some areas, nesting beaches can be almost completely destroyed and all nests can sustain some level of depredation (Ficetola 2008).

Natural beach erosion

Natural beach erosion events may influence the quality of nesting habitat in the action area. Nesting females may deposit eggs at the base of an escarpment formed during an erosion event where they are more susceptible to repeated tidal inundation. Erosion, frequent or prolonged tidal inundation, and accretion can negatively affect incubating egg clutches. Short-term erosion events (e.g., atmospheric fronts, northeasters, tropical storms, and hurricanes) are common phenomena throughout sea turtles' nesting range and may vary considerably from year to year. Sea turtles have evolved a strategy to offset these natural events by laying large numbers of eggs and by distributing their nests both spatially and temporally. Thus, the total annual hatchling production is never fully affected by storm-generated beach erosion and inundation, although local effects may be high.

Disease and parasites

Diseases caused by bacteria, fungus, and viruses affect sea turtles in the action area. Sea turtles are also found to have endo- and ectoparasites. Fibropapilloma (possibly viral in origin) is a major threat to listed turtles in many areas of the world. The disease is characterized by tumorous growths, which can range in size from very small to extremely large, and are found both internally and externally. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley *et al.* 2005). For unknown reasons, the frequency of fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations.

At least two bacterial diseases have been described in wild loggerhead populations, including bacterial encephalitis and ulcerative stomatitis/obstructive rhinitis/pneumonia (George 1997), and *Bartonella* was recently reported in wild loggerheads from North Carolina (Valentine *et al.* 2007). There are few reports of fungal infections in wild loggerhead populations. Homer *et al*. (2000) documented systemic fungal infections in stranded loggerheads in Florida.

Parasites also affect sea turtles in the action area. For example, a variety of endoparasites, including trematodes, tapeworms, and nematodes have been described in loggerheads (Herbst and Jacobson 1995). Heavy infestations of endoparasites may cause or contribute to debilitation or mortality in sea turtles. Trematode eggs and adults were seen in a variety of tissues including the spinal cord and brain of debilitated loggerheads during an epizootic in South Florida during late 2000 and early 2001. These were implicated as a possible cause of the epizootic (Jacobson *et al.* 2006).

Ectoparasites, including leeches and barnacles, may have debilitating effects on loggerheads. Large marine leech infestations may result in anemia and act as vectors for other disease producing organisms (George 1997). Barnacles are generally considered innocuous although some burrowing species may penetrate the body cavity resulting in mortality (Herbst and Jacobson 1995). Green sea turtles with an abundance of barnacles have been found to have a much greater probability of having health issues (Flint *et al.* 2009). Heavy loads of barnacles are associated with unhealthy or dead stranded loggerheads (Deem *et al.* 2009).

Although many health problems have been described in wild populations through the necropsy of stranded turtles, the significance of diseases on the ecology of wild populations is not known (Herbst and Jacobson 1995). However, several researchers have initiated health assessments to study health problems in free-ranging turtle populations.

Cold stunning

All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can be lethal. Kemp's ridley sea turtles are particularly prone to this phenomenon along Cape Cod (Innis *et al.* 2009).

Anthropogenic sources of stress and mortality

Fisheries interactions

Fisheries interactions are the largest in-water threat to sea turtle recovery. Wallace *et al.* (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace *et al.* 2010).

Of all commercial and recreational fisheries in the U.S., shrimp trawling is the most detrimental to the recovery of sea turtle populations. In a 1990 study, the National Academy of Sciences estimated that between 5,000 and 50,000 loggerheads were killed annually by the offshore shrimping fleet in the southeast U.S. Atlantic and Gulf of Mexico (National Research Council 1990). Mortality associated with shrimp trawls was estimated to be 10 times greater than that of all other human-related factors combined (Smith 1990). Most of these turtles were neritic juveniles, the life stages most critical to the stability and recovery of sea turtle populations (Crouse *et al.* 1987; Crowder *et al.* 1994).

Habitat degradation and climate change

Coastal development can deter or interfere with nesting, affect nest success, and degrade foraging habitats for sea turtles. Many nesting beaches have already been significantly degraded or destroyed. Nesting habitat is threatened by rigid shoreline protection or "coastal armoring" such as sea walls, rock revetments, and sandbag installations. Many miles of once productive nesting beach have been permanently lost to this type of shoreline protection. Nesting habitat can be reduced by beach renourishment projects, which result in altered beach and sand characteristics, affecting nesting activity and nest success. Beach nourishment also hampers nesting success of loggerhead sea turtles, but only in the first year post-nourishment, after which hatching success increases (Brock et al. 2009). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009). Because hawksbills prefer to nest under vegetation (Horrocks and Scott 1991; Mortimer 1982), they are particularly affected by beachfront development and clearing of dune vegetation (Mortimer and Donnelly 2007).

The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the sea, with up to 50% of some olive ridley hatchlings disoriented upon emergence in some years (Witherington 1992; Witherington and Bjorndal 1991; Karnad *et al.* 2009).

Coasts can also be threatened by contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Waycott *et al.* 2005; Lee Long *et al.* 2000; Francour *et al.* 1999).

At sea, there are numerous potential threats to sea turtles including marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction caused by fishing gear and practices, agricultural runoff, and sewage discharge (Frazier *et al.* 2007; Lutcavage *et al.* 1997). Hawksbills are typically associated with coral reefs, which are among the world's most endangered marine ecosystems (Wilkinson 2000).

The Gulf of Mexico is an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the 2010 Deepwater Horizon oil spill, the Ixtoc I oil well blowout and fire in the Bay of Campeche in 1979, and the explosion and destruction of a loaded supertanker, the Mega Borg, near Galveston in 1990). As ESA listed species (e.g., loggerhead and Kemp's ridley sea turtles) are known to migrate through, forage, and/or nest along the coastal waters of the Gulf of Mexico, the Deepwater Horizon oil spill is likely to affect their populations; however, because all the information on sea turtle and other ESA-listed species' stranding, deaths, and recoveries has not yet been finalized, the long-term effects of the oil spill on the their populations has not been determined at this time.

Climate change

Although climate change may expand foraging habitats into higher latitude waters and increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability, climate change could reduce nesting habitat due to sea level rise, as well as affect egg development and nest success. Hawksbill turtles exhibit temperature-dependent sex determination (Wibbels 2003) suggesting that there may be a skewing of future hawksbill cohorts toward strong female bias. Loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just 1º-2º C can potentially change hatchling sex ratios to all or nearly all female in tropical and subtropical areas (Hawkes *et al.* 2007). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds has also been linked to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris *et al.* 2009; Schofield *et al.* 2009). Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). However, warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009).

Marine debris

Ingestion of marine debris can be a serious threat to sea turtles. When feeding, sea turtles can mistake debris (e.g., tar and plastic) for natural food items. Some types of marine debris may be directly or indirectly toxic, such as oil. Other types of marine debris, such as discarded or derelict fishing gear, may entangle and drown sea turtles.

Poaching

In the U.S., killing of nesting turtles is infrequent. However, on some beaches, human poaching of turtle nests and clandestine markets for eggs has been a problem (Ehrhart and Witherington. 1987). Egg poaching is a more serious problem in Puerto Rico (Matos 1987).

Contaminants

In sea turtles, heavy metals, including arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc, have been found in a variety of tissues in levels that increase with turtle size (Godley *et al.* 1999; Fujihara *et al.* 2003; Storelli *et al.* 2008; Anan *et al.* 2001; Saeki *et al.* 2000; Gardner *et al.* 2006; Garcia-Fernandez *et al.* 2009; Barbieri 2009). Newly emerged hatchlings have higher concentrations than are present when laid, suggesting that metals may be accumulated during incubation from surrounding sands (Sahoo et al. 1996). Arsenic has been found to be very high in green sea turtle eggs (van de Merwe et al. 2009).

Sea turtle tissues have been found to contain organochlorines, including chlorobiphenyl, chlordane, lindane, endrin, endosulfan, dieldrin, PFOS, PFOA, DDT, and PCB (Keller *et al.* 2004b; Keller *et al.* 2004a; Keller *et al.* 2005; Gardner *et al.* 2003; Storelli *et al.* 2007; McKenzie *et al.* 1999; Corsolini *et al.* 2000; Rybitski *et al.* 1995; Alava *et al.* 2006; Perugini *et al.* 2006; Monagas *et al.* 2008; Oros *et al.* 2009; Miao *et al.* 2001). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight; Oros *et al.* 2009; Davenport *et al.* 1990). Levels of PCBs found in green sea turtle eggs are considered far higher than what is fit for human consumption (van de Merwe et al. 2009).

It appears that levels of organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller *et al.* 2006; Keller *et al.* 2004c; Oros *et al.* 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007), and are known to depress immune function in loggerhead sea turtles (Keller et al. 2006). Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation.

Exposure to sewage effluent may also result in green sea turtle eggs harboring antibiotic-resistant strains of bacteria (Al-Bahry et al. 2009).

Vessel strikes

Propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9% of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. The incidence of propeller wounds has risen from approximately 10% in the late 1980s to a record high of 20.5% in 2004 (NMFS, unpublished data).

Military activities

Vessel operations and ordnance detonations adversely affect listed species of sea turtles. U.S. Navy aerial bombing training in the ocean off the southeast U.S. coast involving drops of live ordnance (500 and 1,000-lb bombs) have been estimated to have injured or killed 84 loggerhead, 12 leatherback, and 12 green or Kemp‘s ridley sea turtles, in combination (NMFS 1997). The Navy ship-shock trials for the USS Winston S. Churchill was conducted in the proposed Action Area, although the U.S. Navy employed a suite of measures that appeared to protect marine mammal and sea turtle from being exposed to shock waves produced by the underwater detonations associated with the trial (Clarke and Norman 2005).

In August and September 2008, the U.S. Navy conducted a ship shock trial on the Mesa Verde in waters east of Jacksonville, Florida, using High Blast Explosive (HBX-1) for the detonations (U.S. Navy 2008). NMFS' biological opinion on the ship shock trial expected up to 36 sea turtles to be injured as a result of the ship shock trial and up to 1,727 turtles to be harassed as a result of their behavioral responses to the underwater detonations. The after action report for the ship shock trial could neither refute nor confirm these estimated number of animals that might have been harassed by the trials; however, surveys associated with the trial did not detect any dead or injured sea turtles during the shock trial event or during post-mitigation monitoring. In addition, no sea turtle stranding events have been attributed to the shock trial.

Military training activities that occur on coastal bases in the southeast U.S. have the potential to increase non-nesting emergences of nesting females, run over nesting females and emerging hatchlings, and destroy nests.

Scientific research

Sea turtles in the action area have been the subject of numerous scientific research activities as authorized by NMFS permits. Research activities for sea turtles range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, instrument attachment, blood and fecal sampling, biopsy sampling, lavage, and performing laparoscopy on intentionally captured turtles. Four permits, including the proposed action, authorize takes for sea turtle mortality. There are currently 10 active permits directed towards sea turtles in the action area.

Table 2. Existing permits authorizing takes for the target sea turtle species in Florida. The Proposed Action would replace the permit in *italics*

File Number	Permit Holder	Expiration Date
1599	*Inwater Research Group*	*June 30, 2012*
13573	Mike Salmon	May 1, 2012
10022-02	Raymond Carthy	April 30, 2013
13306	Karen Holloway-Adkins	June 30, 2013
13307	Kristen Hart	June 30, 2013
1551-03*	NMFS SEFSC	July 1, 2013
13543	South Carolina Department of Natural Resources	April 30, 2014
13544	Jeffrey Schmid	April 30, 2014
14272	Lawrence Wood	June 30, 2014
14655	Jane Provancha	June 1, 2015
14508	Inwater Research Group	June 1, 2015
14506	Llewellyn Ehrhart	September 15, 2015
14726	Blair Witherington	September 15, 2015
14622	Allen Foley	February 28, 2016
15566	South Carolina Department of Natural Resources	April 30, 2016
15552*	NMFS SEFSC	July 25, 2016
16174	Mike Salmon	November 18, 2016
16194*	NMFS SEFSC	December 31, 2016
16253*	NMFS SEFSC	January 31, 2017

* Permits, except No. 1599, with action areas that overlap with the Proposed Action's study areas.

Table 3. Research activities authorized by active permits. Sex and age class of animals affected varies by permit, as does the time of year and frequency of activity. The Proposed Action appears in *italics* and would replace No. 1599.

File No.	Capture	Blood sampling	Fecal sampling or lavage	Laparo-scopy	Tissue sampling	Attach instruments	Tags or marks	Mortality
16598	√	√	√		√	√	√	
1599	√	√	√		√	√	√	
13573	√						√	
10022-02	√				√	√	√	
13306	√	√			√	√	√	
13307	√	√	√		√	√	√	
1551-03	√	√	√	√	√	√	√	
13543							√	
13544	√		√		√	√	√	
14272	√	√			√	√	√	
14655	√	√			√	√	√	
14508	√	√	√		√		√	
14506	√	√	√		√		√	
14726	√		√		√	√	√	
14622	√	√		√	√	√	√	
15566	√	√	√		√	√	√	√
15552					√		√	
16174	√		√			√	√	
16194					√		√	
16253	√				√		√	√

Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, issuance of the permit by the NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species. Authorized "takes" by harassment represent substantial research effort relative to species abundance in the action area with repeated disturbances of individuals likely to occur each year. However, all permits for sea turtles contain conditions requiring the permit holders to coordinate their activities with the NMFS regional offices and other permit holders and, to the extent possible, share data to avoid unnecessary duplication of research.

The fact that multiple permitted "takes" of listed sea turtles is already permitted and is expected to continue to be permitted in the future, means that short-term behavioral harassment expected to listed sea turtles from similar research activities has the ability to contribute to or even exacerbate the non-lethal stress responses generated from other threats occurring in the action area. The point at which this leads to a measurable cumulative impact on the survival and recovery of listed sea turtles, however, is uncertain. Our ability to detect long-term effects from research activities will depend on several factors including our ability to better detect sub-lethal effects from research actions as well as funding and prioritizing long-term studies investigating survival and reproductive abilities of listed species targeted by similar types of research in the past. This may lead to statistically significant trends showing whether or not repeated non-lethal disturbances by research activities are affecting the ability of listed sea turtles to survive and recover in the wild to an appreciable degree.

International protection

Sea turtles are migratory and therefore require participation between multiple countries to create an umbrella of protection and recovery techniques throughout their entire range. The Inter-American Convention for the Protection and Conservation of Sea Turtles provides the legal framework for countries in the Americas and the Caribbean to take actions for the benefit of sea turtles. Regional Fishery Management Organizations (RFMO's) such as the International Commission for the Conservation of Atlantic Tunas can create recommendations aimed at sea turtle bycatch under its managed fisheries; however, this is not an RFMO's main function. The Convention on Trade in Endangered Species (CITES) regulates the trade of sea turtles; most, but not all nations have signed on to CITES and some nations have been found in violation of their signatory duties under CITES. The lack of a major international agreement to conserve and protect sea turtles is a major obstacle to sea turtle protection and recovery.

Conservation and management

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for the Atlantic Highly Migratory Species Fishery, Gulf of Mexico reef fish, and South Atlantic snapper-grouper fishery, and TED requirements for Southeast shrimp trawl fishery. NMFS published a final rule on July 6, 2004, to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality. In the Hawaii-based longline swordfish fishery which required vessels to switch from using a J-shaped hook with squid bait to a wider circle-shaped hook with fish bait has reduced capture rates of leatherback and loggerhead turtles significantly by 83% and 90% respectively (Gilman *et al.* 2007). There was also a highly significant reduction in the proportion of turtles that swallowed hooks (versus being hooked in the mouth or body or entangled) and a highly significant increase in the proportion of caught turtles that were released after removal of all terminal tackle, which could lead to the likelihood of turtles surviving the interaction (Read 2007).

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. In particular, NMFS has required the use of TEDs in southeast United States shrimp trawls since 1989 and in summer flounder trawls in the Mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It has been estimated that TEDs exclude 97 percent of the sea turtles caught in such trawls (Cox *et al.* 2007). These regulations have been refined over the years to ensure that TEDs are properly installed and used where needed to minimize the impacts on sea turtles. On August 3, 2007, NMFS published a final rule required selected fishing vessels to carry observers on board to collect data on sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle takes, and to determine whether additional measures to address prohibited sea turtle takes may be necessary (72 FR 43176).

NMFS published a final rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Those participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear. There is also an extensive network of Sea Turtle Stranding and Salvage Network participants along the Atlantic and Gulf of Mexico coasts that not only collect data on sea turtle mortality, but also rescue and rehabilitate any live stranded sea turtles that are encountered.

Effects of the proposed actions

Pursuant to Section 7(a)(2) of the ESA, federal agencies are required to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. The proposed permit by the Permits Division would expose listed sea turtles to actions that constitute “take” from tagging activities. In this section, we describe the potential physical, chemical, or biotic stressors associated with the proposed actions, the probability of individuals of listed species being exposed to these stressors based on the best scientific and commercial evidence available, and the probable responses of those individuals (given probable exposures) based on the available evidence. As described in the *Approach to the assessment* section, for any responses that would be expected to reduce an individual’s fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population. The purpose of this assessment is to determine if it is reasonable to expect the proposed studies to have effects on listed sea turtles affected by this permit that could appreciably reduce the species' likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned about behavioral disruptions that may result in animals that fail to feed or breed successfully or fail to complete their life history because these responses are likely to have population-level, and therefore species level, consequences. The proposed permit would authorize non-lethal "takes" by harassment of listed species during research activities, as well as authorizing a limited number of unintentional mortalities of sea turtles.

Potential stressors

The Permits Division proposes to authorize Inwater Research Group to measure, weigh, photograph, carapace mark, flipper and PIT tag, blood and tissue sample, and gastric lavage (green and hawksbill only). A portion of sea turtles would also receive satellite tags. Additionally, researchers would be authorized to count and survey (not capture and handle) sea turtles.

Exposure analysis

Exposure analyses identify the co-occurrence of ESA-listed species with the action's effects in space and time, and identify the nature of that co-occurrence. The *Exposure analysis* identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the populations(s) or subpopulation(s) those individuals represent.

The Permits Division proposes to issue a permit for scientific research to Inwater Research Group. Activities would occur year round, sampling quarterly in coastal waters off of Florida, specifically the Key West National Wild Life Refuge and the Big Bend Sea Grasses Aquatic Preserve (see Figures 1 and 2). Table 1 identifies the numbers of sea turtles that the Inwater Research Group would be authorized to capture annually under the five-year permit and the procedures that would be authorized.

A total of 160 green, 160 loggerhead, 75 hawksbill, and 66 Kemp's ridley sea turtles could be captured and handled annually under the proposed permit. The actions that would be included in handling are: measure, weigh, photograph, carapace mark, flipper and PIT tag, blood and tissue sample, and gastric lavage (green and hawksbill only). A portion of sea turtles would also receive satellite tags. Additionally, researchers would be authorized to count and survey (not capture and handle) up to 3600 green, 1200 loggerhead, 125 hawksbill, and 215 Kemp's ridley sea turtles; see Table 1 for details. Both sexes and all age groups of green, loggerhead, hawksbill, and Kemp's ridley sea turtles would be target for research.

The previous permit held by Inwater Research Group did not include the Big Bend Sea Grasses Aquatic Preserve as part of the study area, and therefore the permits division proposes to authorize additional captures. Based on previous annual reports, we believe the proposed number of annual "takes" could occur.

Response analysis

As discussed in the *Approach to the assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action's effects on the environment or directly on listed species themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal (or physiological), or behavioral responses that might reduce the fitness of individuals. Ideally, response analyses would consider and weigh evidence of adverse consequences as well as evidence suggesting the absence of such consequences.

Evidence indicates that wild animals respond to human disturbance in the same way they respond to predators (Lima 1998; Beale and Monaghan 2004; Frid and Dill 2002; Frid 2003; Gill *et al.* 2001; Romero 2004). These responses may manifest themselves as stress responses, 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).

Response to capture

Capture by the rodeo method or by dip net can result in raised levels of stressor hormones. The harassment of individual turtles during capture and handling could disrupt their resting or foraging cycles. However, this capture method is simple and not invasive. The turtles would be held in a manner to minimize the stress to them. NMFS does not expect that individual turtles would experience more than short-term stresses during this type of capture activity. No injury or mortality would be expected.

Response to handling, measuring and weighing, and carapace marking

Handling, measuring, and weighing can result in raised levels of stress hormones in sea turtles. However, the procedures are simple and not invasive. NMFS expects that individual turtles would normally experience no more than short-term stresses as a result of these activities. No injury would be expected from these activities, and turtles would be measured and weighed as quickly as possible to minimize stresses resulting from their capture. The applicant would also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals. The proposed action would only allow the use of a non-toxic marker. This activity would not injure or compromise the animal and would not add appreciably to the stress the animal would experience during handling and other activities.

Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to handling, NMFS expects that the activities would have minimal and insignificant effects on the animals. Turtles would be handled with care, kept moist, protected from temperature extremes, and returned to the sea.

Response to flipper tagging and PIT tagging

Tagging activities are minimally invasive and all tag types have negatives associated with them, especially concerning tag retention. Plastic tags can become brittle, break and fall off underwater, and titanium tags can bend during implantation and thus not close properly, leading to tag loss. Tag malfunction can result from rusted or clogged applicators or applicators that are worn from heavy use (Balazs 1999). Turtles that have lost external tags would be re-tagged if captured again at a later date, which subjects them to additional effects of tagging.

Turtles would experience some discomfort during the tagging procedures and these procedures would produce some level of pain. The discomfort would usually be short and highly variable between individuals (Balazs 1999). Most barely seem to notice, while a few others exhibit a marked response. However, NMFS expects the stresses to be minimal and short-term and that the small wound-site resulting from a tag would heal completely in a short period of time. Similarly, turtles that must be re-tagged would also experience minimal short-term stress and heal completely in a short period of time. Re-tagging would not be expected to appreciably affect these turtles. The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999).

Given the precautions that would be taken by the researchers to ensure the safety of the turtles and the permit conditions relating to handling, NMFS expects that the activities would have minimal and insignificant effects on the animals. All animals would be handled with care, kept moist, protected from temperature extremes and later returned to the sea.

Response to blood sampling

Taking a blood sample from the sinuses in the dorsal side of the neck is now a routine procedure (Owens 1999). According to Owens (1999), with practice it is possible to obtain a blood sample 95% of the time and the sample collection time would be expected to be about 30 seconds in duration. Sample collection sites would be disinfected with alcohol or other antiseptic prior to sampling. Blood sampling volume would be conditioned to only allow a conservative amount of blood (conditioned in the permit) to be drawn. Blood hormones and heart rate have been measured in animals that have had this amount of blood drawn from them and no stress has been observed (E. Stabenau, pers. comm. to P. Opay, NMFS, 2005).

Response to tissue sampling

Epidermis and scute biopsies would be conducted on sea turtles using a sterile biopsy punch. This activity would allow researchers to collect tissue with little effect on the turtles. NMFS does not expect that the collection of a tissue sample would cause any significant additional stress or discomfort to the turtle beyond what was experienced during other research activities.

Researchers would only take tissue samples when they are unable to take a blood sample, which they estimate would happen approximately in 30% of the captures they propose.

Response to satellite tagging

Transmitters attached to the carapace of turtles have the potential to increase hydrodynamic drag and affect lift and pitch (Watson and Granger 1998). It is possible that transmitter attachments would negatively affect the swimming energetics of the turtle. During a study of sonic-tracked turtles by Seminoff et al. (2002), green turtles returned to areas of initial capture, suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns. In a study of video camera-equipped green turtles, telemetered turtles exhibit normal diving behavior, and sufficient swimming speeds (Seminoff et al. 2006). However, none of the instruments in the proposed research are as large as the video cameras, and so lesser potential impacts would be expected.

The short-term stresses resulting from transmitter attachment and tracking would be expected to be minimal and not add significantly to any stress that turtles have already experienced from capture or other the research activities. The permit would contain conditions to mitigate adverse impacts to turtles from the transmitters. Turtles would be satellite tagged as quickly as possible to minimize stresses resulting from the research. Total weight of any transmitter or tag attachment for any one turtle must not exceed 5% of the body mass of the animal. The attachment must be made so that there is minimal risk to the turtle of entanglement and the attachment is as hydrodynamic as possible.

Based on past experience with these techniques used by turtle researchers and the documented effects of transmitter attachments, we expect that the turtles would experience some small additional stress from attaching transmitters during this research, but would not experience significant increases in stress or discomfort beyond what was experienced during capture and other research activities, and that the transmitters would not result in any serious injury. We expect that the transmitters would not significantly interfere with the turtles' normal activities after they are released.

Response to gastric lavage

The feeding habits of wild turtles can be determined by a variety of methods, but the preferred technique is gastric lavage or stomach flushing. This comparatively simple and reliable technique has been used to successfully sample the gut contents of various vertebrate animals groups without harm to the animal (Forbes 1999). This technique has been successfully used on green, hawksbill, olive ridley and loggerhead turtles ranging in size from 25 to 115 curved carapace length. Forbes (1999) states that many individual turtles have been lavaged more than three times without any known detrimental effect. Individuals have been recaptured from the day after the procedure up to three years later and appear healthy and feeding normally. Laproscopic examination of the intestines following the procedure has not detected any swelling or damage to the intestines. While individual turtles are likely to experience discomfort during this procedure, NMFS does not expect individual turtles to experience more than short-term distress. Injuries are not anticipated.

Response to survey and count

We do not expect the surveys and counts, which would not include capture or handling, to cause any stress to the sea turtles.

Cumulative effects

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered by this Opinion. 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. Sources queried include state legislature websites and Nexis. We reviewed bills passed from 2011-2012 and pending bills under consideration were included as further evidence that actions "are reasonably certain to occur."

Legislation from Florida addresses oil spill prevention and response, off-shore oil drilling and alternative energy development, wastewater treatment, protection of fish and wildlife, and beach preservation and management.

After reviewing available information, NMFS is not aware of effects from any additional future non-federal activities in the action area that would not require federal authorization or funding and are reasonably certain to occur during the foreseeable future.

Integration and synthesis of the effects

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness" – i.e., the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the population(s) those individuals represent or the species those populations comprise (Anderson 2000; Brandon 1978; Mills and Beatty 1979; Stearns 1992). As a result, if the assessment indicates that listed plants or animals are not likely to experience reductions in their fitness, we conclude our assessment.

The *Status of listed resources* and *Environmental baseline* described the factors that have contributed to the reduction in population size for green, hawksbill, Kemp's ridley, and loggerhead sea turtles. Sea turtle populations have suffered drastic declines, likely due to overharvesting of eggs and mortality from fishing activities (bycatch). Other threats include predation, habitat degradation and climate change, contaminants, and marine debris. NMFS expects that the current natural anthropogenic threats described in the *Environmental baseline* will continue. The *Cumulative effects* section provided examples of state legislation that is likely to occur and could have an effect on the action area.

The NMFS Permits Division proposes to issue a permit to the Inwater Research Group to capture and handle 160 green, 160 loggerhead, 75 hawksbill, and 66 Kemp's ridley sea turtles. The actions that would be included in handling are: measure, weigh, photograph, carapace mark, flipper and PIT tag, blood and tissue sample, and gastric lavage (green and hawksbill only). A portion of sea turtles would also receive satellite tags. Additionally, researchers would be authorized to count and survey (not capture and handle) up to 3600 green, 1200 loggerhead, 125 hawksbill, and 215 Kemp's ridley sea turtles. We considered the effects of the proposed permit, and we expect there would be no more than short-term effects on individual animals from the proposed actions. We do not believe the proposed action would lead to reduced opportunities for foraging or reproduction for targeted individuals, and we do not expect any mortality to occur.

Conclusion

After reviewing the current *Status of listed resources*; the *Environmental baseline* for the *Action area*; the anticipated effects of the proposed activities; and the *Cumulative effects*, it is NMFS' Biological Opinion that the activities authorized by the issuance of scientific research permit 16598, as proposed, are not likely to jeopardize the continued existence of green, hawksbill, Kemp's ridley, and loggerhead sea turtles, and we do not anticipated the destruction or adverse modification of designated critical habitat of within the action area.

Incidental take statement

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit the "take" of endangered and threatened species, respectively, without 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 the NMFS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Sections 7(b)(4) and 7(o)(2), taking that is incidental and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

As discussed in the accompanying Opinion, only the species targeted by the proposed research activities would be harassed as part of the intended purpose of the proposed action. Therefore, the NMFS does not expect the proposed action would incidentally take threatened or endangered species.

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 endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The following conservation recommendations would provide information that would improve the level of protections afforded in future consultations involving proposals to issue permits for research on the listed sea turtle species:

1. *Cumulative impact analysis.* The Permits Division should work with sea turtle recovery teams and the research community to develop protocols that would have sufficient power to determine the cumulative impacts (that is, includes the cumulative lethal, sub-lethal, and behavioral consequences) of existing levels of research on individuals populations of sea turtles.

In order for the NMFS' Endangered Species Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, listed species or their habitats, the Permits Division should notify the Endangered Species Division of any conservation recommendations they implement in their final action.

Reinitiation notice

This concludes formal consultation on the proposal to amend scientific research permit No. 16598 to the Inwater Research Group for studies of green, hawksbill, Kemp's ridley, loggerhead sea turtles, in the coastal waters of Florida. As provided in 50 CFR §402.16, 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 incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of authorized take is exceeded, the NMFS Permits Division must immediately request reinitiation of Section 7 consultation.

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