National Marine Fisheries Service
Endangered Species Act Section 7 Consultation
Biological Opinion

Action Agency: **Permits and Conservation Division of the Office of Protected Resources, National Marine Fisheries Service**

Proposed Action: **Proposal to issue permit No. 16134 to the Virginia Aquarium, which would conduct scientific research on sea turtles in U.S. Mid-Atlantic coastal waters, pursuant to Section 10(a)(1)(A) of the Endangered Species Act of 1973**

Consulting Agency: **Endangered Species Act Interagency Cooperation Division of the Office of Protected Resources, National Marine Fisheries Service**

Approved by: _____

Date: 8/27/12

Section 7(a)(2) of the Endangered Species Act (ESA; 16 U.S.C. 1536(a)(2)) requires each Federal agency to insure 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 a Federal agency's action "may affect" a listed species or designated critical habitat, that agency is required to consult with the National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service, depending on the species that may be affected.

In this instance, the action agency is the Permits and Conservation Division of NMFS (Permits Division). The Permits Division proposes to issue scientific research permit No. 16134 (the action), which would authorize the Virginia Aquarium (VA, the applicant or researchers) to conduct scientific researchers on sea turtles in U.S. Mid-Atlantic coastal waters (the action area).

This document represents NMFS' final Biological Opinion (Opinion) on the effects of this action on endangered and threatened species and critical habitat that has been designated for those species. We, the Endangered Species Act Interagency Cooperation Division, prepared this Opinion in accordance with the requirements of Section 7 of the ESA and its implementing regulations (50 CFR Part 402). We based our opinion on information provided in the permit application, the draft permit, and the environmental assessment. We also identified, gathered, and examined data from peer-reviewed scientific literature, NMFS internal reports, recovery plans, and unpublished datasets.

CONSULTATION HISTORY

In a memorandum dated March 8, 2012, the Permits Division requested ESA Section 7 consultation on its proposal to issue scientific research permit No. 16134. We initiated consultation on March 9, 2012.

DESCRIPTION OF THE PROPOSED ACTION

The Permits Division proposes to issue a 5-year, scientific research permit pursuant to Section 10(a)(1)(A) of the ESA. Permit No. 16134 would authorize researchers at the Virginia Aquarium (responsible party, Mark Swingle) to annually take 200 sea turtles in Mid-Atlantic coastal waters (Tables 1 and 2) . The purpose of the research is to monitor the status of sea turtles by collecting data on abundance, distribution, and health.

Table 1. Maximum annual takes under Permit No. 16134 for research conducted in Chesapeake Bay and waters off of Virginia and Maryland.

Species	No. Turtles	Life Stage	Activities
Loggerhead	10	Subadult, adult	Capture in tangle net; handle; measure; weigh; photograph/video; mark carapace; tag (flipper and PIT); sample (blood, fecal, oral, scute, tissue); remove epibiota.
Loggerhead	20	Subadult, adult	Capture in tangle net; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue; muscle biopsy); photograph/video; remove epibiota; collect tumors; ultrasound; attach instrument.
Loggerhead	10	Subadult, adult	Recover from pound net or dredge/trawl; transport; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota.
Loggerhead	20	Subadult, adult	Recover from pound net or dredge/trawl; transport; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; collect tumors; ultrasound; attach instrument.
Kemps	6	Juvenile, subadult, adult	Capture in tangle net; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota.
Kemps	7	Juvenile, subadult, adult	Capture in tangle net; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Kemps	6	Juvenile, subadult, adult	Recover from pound net or dredge/trawl; transport; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota.
Kemps	7	Juvenile, subadult, adult	Recover from pound net or dredge/trawl; transport; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Green	5	Juvenile, subadult, adult	Capture in tangle net; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Green	5	Juvenile, subadult, adult	Recover from pound net or dredge/trawl; transport; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; collect tumors; ultrasound; attach instrument.
Hawksbill	1	Juvenile, subadult	Capture in tangle net; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Hawksbill	1	Juvenile, subadult	Recover from pound net or dredge/trawl; transport; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; collect tumors; ultrasound; attach instrument.
Leatherback	2	Juvenile, subadult	Capture in tangle net; mark carapace; tag (flipper and PIT); measure; photograph/video.

Survey

The researchers propose to conduct in water visual surveys for sea turtles in a 45 ft research vessel. They would conduct surveys at 10 km per hour and record the GPS location of all turtles sighted. They would identify turtles to be captured. In preparation for trawling, they would also collect data on bottom topography, sample the substate, and chart potential hangs to be avoided.

Close Approach

The researchers propose to use one of two boats to approach sea turtles for capture. They would use their 45 ft research vessel to approach turtles for capture in a hoop net. They would use a small, inflatable vessel to approach turtles for capture in a hand or dip net.

Table 2. Maximum annual takes under Permit No. 16134 for research conducted along the coast of the Mid-Atlantic, from Cape Hatteras, NC to Atlantic City, NJ, including waters inside the Delaware Bay.

Species	No. Turtles	Life Stage	Activities
Loggerhead	30	Subadult, adult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota.
Loggerhead	20	Subadult, adult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue; muscle biopsy); photograph/video; remove epibiota; collect tumors; ultrasound; attach instrument.
Kemps	22	Juvenile, subadult, adult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota.
Kemps	8	Juvenile, subadult, adult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Green	12	Juvenile, subadult, adult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota.
Green	8	Juvenile, subadult, adult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Hawksbill	2	Juvenile, subadult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; handle; mark carapace; tag (flipper and PIT); measure; weigh; sample (blood, fecal, oral, scute, tissue); photograph/video; remove epibiota; attach instrument.
Leatherback	2	Juvenile, subadult	Capture in tangle net or hand net or dip net or hoop net or removal from dredge/trawl; mark carapace; tag (flipper and PIT); measure; photograph/video.
Unidentified sea turtle	2	Juvenile, subadult, adult	Salvage carcass, tissue, parts.

Capture

The researchers propose to capture sea turtles in hand/dip nets, hoop nets, and tangle nets. If unable to capture turtles using these relatively safe methods, the researchers would trawl for turtles. They would also receive turtles caught as bycatch in pound nets and dredge mitigating trawls (as permitted under other authorities)

Hand/dip net

The researchers propose to capture turtles in a hand-held dip net. They would place a dip net under the turtle. They would bring the netted turtle aboard the inflatable vessel and transfer it (still in the net) to the larger research vessel.

Hoop net

The researchers propose to capture turtles in a custom-made breakaway hoop net. Sitting on the bow of the 45 ft research vessel, one researcher would guide the hoop net (fitted to a long pole) over the turtle. They would purse the net to secure the turtle and bring it alongside the vessel. They would lift the netted turtle onto the deck.

Tangle net

The researchers propose to set entanglement nets to capture turtles. The nets measure up to 150 x 5 m^2 with 40 cm stretch mesh made of braided nylon twine. The researchers would set the nets from their research vessel. They would use the inflatable vessel and another boat to continually search for and extract turtles and bycatch, including listed sturgeon. Bycatch would be immediately released. The researchers would use a dip net to remove turtles and transfer them to the research vessel. They would observe the float lines at all times and check the nets at regular intervals of 30 minutes or less (20 minutes or less in cold and warm water). They would deploy the nets for up to 10 daylight hours.

Pound nets
The researchers propose to study turtles captured in pound nets. Virginia pound net fishermen would contact the researchers when turtles are captured incidentally in the live trap portion. The researchers or fishermen would remove turtles from the pound nets. Turtles may be held, unmonitored, in the nets or for up to 48 hours. They may also be removed from the pound net and held in a shaded area on a boat or dock. The researchers would place turtles in separate containers and transport them to the VA Marine Animal Care Center.

Dredge/trawl
The researchers propose to study turtles captured in dredges mitigating trawls. Observers on dredging vessels would contact the researchers when turtles are caught in the dredge mitigating trawls as bycatch. The researchers would meet the dredging vessel either at sea or at a dock to take custody of the turtle. They would place turtles in separate containers and transport them to the VA Marine Animal Care Center.

Handle
The researchers propose to bring turtles aboard their 45 ft research vessel. The researchers would not bring leatherbacks aboard their ship; they would tag, measure, and photograph leatherback in the water. They would examine the turtles for general physical condition. They would contact their veterinarian or NMFS if a turtle appears to be in need of medical attention or treatment. They would handle turtles for a maximum of 90 minutes performing the activities described below.

Measure
The researchers propose to collect standard morphometric measurements using a measuring tape and calipers.

Weigh
The researchers propose to weigh the turtles on a platform scale or in a hanging scale (with the turtles suspended in a harness).

Photograph/Video
The researchers propose to photograph and/or videotape the turtles for subsequent identification.

Mark Carapace
The researchers propose to temporarily mark the carapaces of turtles with non-toxic paint, avoiding the suture lines separating scutes.

Tag
For future identification purposes, the researchers propose to tag turtles with flipper and Passive Integrated Transponder (PIT) tags.

Flipper
The researchers would attach Inconel tags (National Band & Tag Co.) to the trailing edge of the rear flippers. Inconel is a metal alloy that was designed to resist marine degradation. Prior to attachment, the researchers would disinfect the tags and applicators with 10 percent povidone-iodine solution.

PIT
Passive Integrated Transponder (PIT) tags are glass-enclosed, electromagnetic tags that are injected subcutaneously and read by a radio frequency scanner. The researchers would clean the injection area and end of the injector with 10 percent povidone-iodine solution. They would inject the PIT tag into the turtle's triceps superficialis muscle.

Sample collection
The researchers propose to collect specimens from turtles to assess genetic stock structure (DNA analyses), foraging ecology (stable isotope analysis), and sex determination.

Blood
The researchers would draw blood from the external jugular vein using a new needle with a disposal syringe or vacuum tube. The total amount of blood drawn would not exceed 2.5 percent of the body weight of the turtle.

Tissue
The researchers would use a new, sterile biopsy punch to remove a small amount of tissue from the posterior edge of the rear flipper.

Scute
The researchers would use a new, sterile biopsy punch to remove a portion from the dorsal, cranial region of the second costal scute, preferably on the right side. They would photograph the wound and pack it with silver sulfadiazine topical cream.

Fecal, Oral, and Nasal Swabs
The researchers would swab the nasal, oral, and anal orifices of turtles. They would also opportunistically collect fecal samples.

Muscle Biopsy
The researchers propose to perform a muscle biopsy on a subset of loggerhead turtles. Dr. Amanda Southwood would perform a muscle biopsy as described in her 2003 paper (Southwood 2003). She would clean the flexor tibialis muscle of the rear flipper with 95 percent ethanol and Betadine topical antiseptic and inject two percent Lidocaine anesthetic. Using surgical scissors, she would remove 100-200 mg of muscle tissue. She would use dissolvable sutures to fuse the muscle tissue and to close the wound. She would treat the area with a topical antibiotic cream and inject the turtle with antibiotics (e.g., 5 mg/kg of Amiglyde).

Ultrasound
The researchers propose to use ultrasonography to examine gonad development of turtles.

Remove Epibiota
The researchers propose to use a plastic scraper to remove epibiota from turtles.

Collect Tumors
The researchers propose to remove and collect tumors from turtles.

Instrument Attachment
The researchers propose to attach satellite tags directly onto the carapace of hardshell turtles (i.e., not leatherbacks). They would prepare the carapace by removing epibionts, scrubbing, cleaning with 10 precent povidone-iodine, sanding, and wiping with alcohol or acetone. They would use a two-part cool setting epoxy to mount the transmitter between the first and second vertebral scutes.

Release
The researchers propose to release the turtles at the site of capture.

Transport to the VA Marine Animal Care Center
The researchers propose to transport turtles caught in the pound nets or dredge mitigating trawls to the VA Marine Animal Care Center (MACC). They would sample and tag the turtles as described above. They would place the turtles in 600 – 10,000 gallon indoor tanks for observation up to 48 hours before being released at the site of capture.

PERMIT CONDITIONS

The Permits Division requires permitted researchers to minimize the potential for any adverse impacts to the target species as well as any additional ESA-listed species in the action area. Only experienced personnel may handle, biopsy, and tag the turtles. Biopsy and tag attachment areas must be cleaned before each procedure. Sampling equipment and tags must be cleaned and disinfected before each use; any invasive tools must be either new or sterilized between uses. In addition, the Permits Division would place following conditions and requirements on research permit No. 16134:

1. For hoop netting, the researchers must minimize in-water chase activities and safely remove sea turtles as quickly as possible.
2. For entanglement netting, the researchers must use nets with large enough mesh size to diminish bycatch. They must attach highly visible buoys to the float line of each net, spaced at least every 10 yards. They must check nets at intervals of less than 30 minutes, and more frequently whenever turtles or other organisms are observed in the net. If water temperatures are $\leq 10^{o}$C or $\geq 30^{o}$C, they must check nets at less than 20 minute intervals. "Net checking" is defined as a complete and thorough visual check of the net either by snorkeling the net in clear water or by pulling up on the top line such that the full depth of the net is viewed along the entire length. They must observe the float lines at all times and immediately check the nets if they observe any movement. They must refrain from setting the nets when marine mammals are in the vicinity and must raise and drop the lead line if marine mammals enter the area after a net has been set.
3. For pound nets and dredge mitigating trawls, the researchers must only transport turtles that have been captured legally and appear to be in good health. They must recover turtles within 24 hours, when possible, and never longer than 48 hours.
4. The researchers must handle turtles according to procedures specified in 50 CFR 223.206(d)(1)(i) (see Attachment 2). They must use care when handling live animals to minimize any possible injury and use appropriate resuscitation techniques on any comatose turtle prior to returning it to the water. When possible, they should transfer injured animals to rehabilitation facilities and allow them an appropriate period of recovery before return to the wild. They must have an experienced veterinarian, veterinary technician, or rehabilitation facility on call for emergencies. If a sea turtle becomes highly stressed, injured, or comatose, the researchers must immediately contact a veterinarian and, if directed, transfer the sea turtle to the veterinarian or to a rehabilitation facility to receive veterinary care.
5. The researchers must protect turtles from temperature extremes of heat and cold, provide adequate air flow, and keep the turtles moist (if appropriate) during sampling. They must place turtles on pads for cushioning and cleanse these surfaces between turtles. The area surrounding the turtle must not contain any materials that could be accidentally ingested.
6. During release, the researchers must lower turtles as close to the water's surface as possible to prevent potential injuries.
7. The researchers must carefully observe newly released turtles and record observations on their apparent ability to swim and dive in a normal manner. If a turtle is not behaving normally within one hour of release, they must recapture the turtle and take it to a rehabilitation facility.
8. The researchers must not board leatherbacks.
9. The researchers must limit blood samples to 3 ml per 1 kg of animal within a 45 day period.
10. The researchers must not take additional specimens from a turtle that has been already sampled.
11. The researchers must not take digital fecal specimens form turtles less than 50 cm SCL.

12. For transmitter attachments, the researchers must eliminate the risk of entanglement. They must include 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 and must include a corrodible, breakaway link. The researchers must make attachments as hydrodynamic as possible. They must ensure that there is adequate ventilation around the head of the turtle during the attachment of tags. To prevent skin or eye contact with harmful chemicals, the researchers must not apply tags while the turtle is submerged in water.
13. For carapace marking, the researchers must use non-toxic paints that do not generate heat or contain xylene or toluene.

INTERRELATED AND INTERDEPENDENT ACTIONS

There are no interrelated and interdependent actions associated with the proposed action.

APPROACH TO THE ASSESSMENT

The National Marine Fisheries Service approaches its Section 7 analyses through a series of steps. In the first step, we identify the location and spatial extent of the action (i.e., the *Action Area*). We then identify the ESA listed species that occur in the *Action Area*. Our jeopardy determinations must be based on an action's impact on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, as well as distinct populations segments (DPSs), and evolutionarily significant units (ESUs) of vertebrate species. For species that are likely to be adversely affected by the action, we describe their *Status* and *Environmental Baseline*. We then perform our analyses of the *Effects of the Proposed Action*. We first try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to the activities and the populations or subpopulations those individuals represent. We then identify the stressors of an activity; i.e., those aspects of proposed action 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. We examine available scientific and commercial data to determine whether and how listed individuals are likely to respond to each stressor. Animal responses to human disturbance are similar to their responses to potential predators (Beale & Monaghan 2004; Frid & Dill 2002; Gill & Sutherland 2001; Lima 1998; Romero 2004). These responses include interruptions of essential behavior and physiological processes such as feeding, mating, resting, digestion, etc. Each of these can result in stress, injury, and increased susceptibility to disease and predation (Frid & Dill 2002; Romero 2004). We are particularly concerned about behavioral disruptions that might reduce the fitness of individuals, which are further considered in a later section.

The final steps of our analyses include assessing the risks those responses pose to listed species and the impacts to their designated critical habitat. These analyses reflect the relationships between listed species, the populations (or in this case, subpopulations) that comprise them, and the individuals within the subpopulations. The continued existence of species depends on the fate of the subpopulations, and the viability of the subpopulations depends on the fate of the individuals. Subpopulations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so). We conduct our analyses by assessing the risks that actions pose to listed individuals. We then integrate those individual risks to identify consequences to relevant subpopulations. Our analyses conclude by determining the consequences of those subpopulation level risks to the species.

We measure risks to listed individuals in terms of "fitness," i.e., their 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 are likely to have consequences for its fitness. If listed individuals 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. As a result, we would conclude our assessment. Alternatively, when listed individuals 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 subpopulations those individuals represent (Stearns 1992; Mills & Beatty 1979; Anderson 2000).

If we conclude that listed individuals are likely to experience reductions in their fitness, we must next consider whether those fitness reductions are likely to reduce the viability of the subpopulation(s) the individuals represent (measured using changes in the subpopulations' abundance, reproduction, spatial structure and connectivity, growth rates, variance in these measures, or measures of extinction risk). In this step of our analyses, we use the subpopulation's base condition (established in the *Environmental Baseline* and *Status of the Species* 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 subpopulations those individuals represent, we would conclude our assessment.

In the final step of our analyses, we determine if reductions in a subpopulation's viability are likely to reduce the viability of the species 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 the Species* 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.

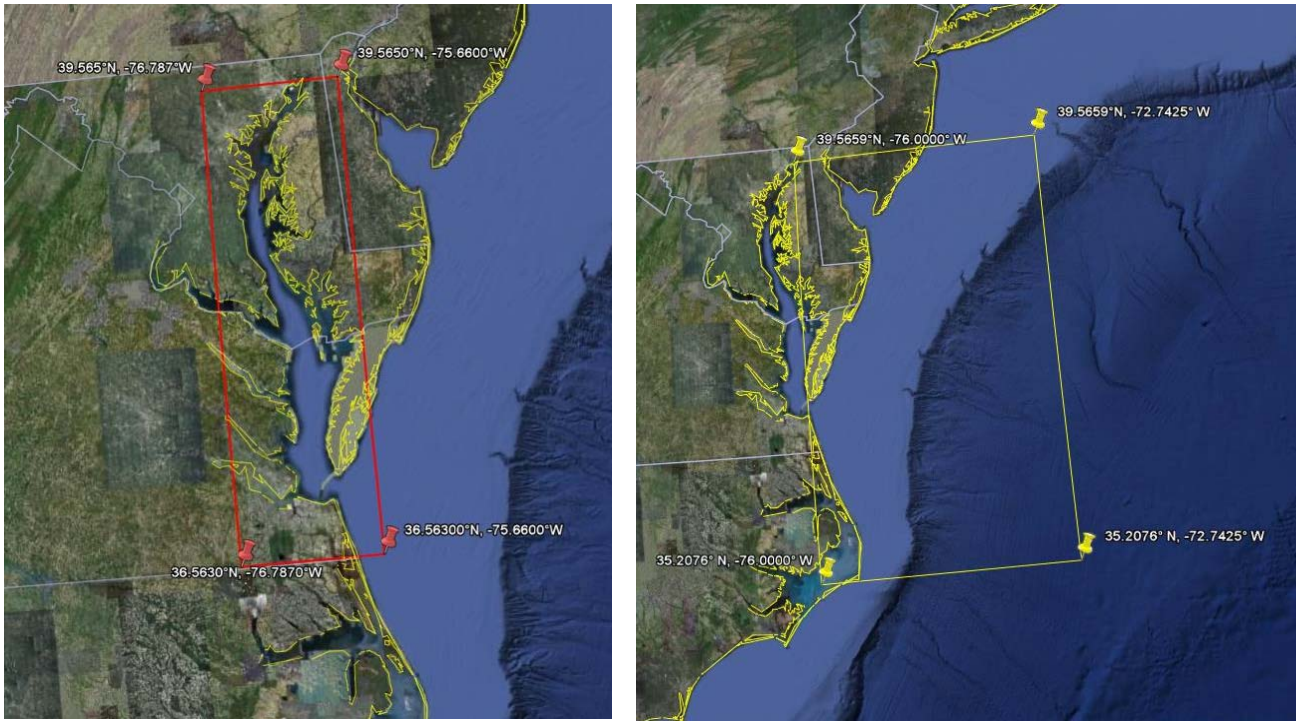
To conduct these analyses, we rely on all of the evidence available to us. This evidence might consist of: monitoring reports submitted by past and present permit holders; reports from NMFS Science Centers; reports prepared by natural resource agencies in states and other countries; reports from domestic and foreign non-governmental organizations involved in marine conservation issues; the information provided by the Permits Division when it initiates formal consultation; and published scientific literature. To find this information, we conduct searches of peer reviewed scientific literature, master's theses, doctoral dissertations, government reports, and commercial studies. These searches include the use of literature search engines such as *Science Direct, BioOne*, *JSTOR*, and *Google Scholar* as well as the use of NOAA and university libraries. We focus on identifying recent information on the biology, ecology, distribution, status, and trends of the threatened and endangered species considered in this opinion.

We evaluate all evidence based on the quality of the study design, sample sizes, and study results. When data are equivocal, or in the face of 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. The U.S. Congress directs us to provide the "benefit of the doubt" to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)]. Therefore, we generally make determinations, which provide the most conservative outcome for listed species.

ACTION AREA

The action area is defined in 50 CFR 402.2 as "all areas to be affected directly or indirectly by the Federal Action and not merely the immediate area involved in the action." The action area under these proposed activities would be as follows for the next five years: U.S. mid-Atlantic coastal waters from North Carolina to southern New Jersey (Fig. 1).

Figure 1. The action area in U.S. mid-Atlantic coastal waters from North Carolina to southern New Jersey: the red lines define the action area for research conducted in Chesapeake Bay and waters off of Virginia and Maryland.; the yellow lines define the action area for research conducted along the coast of the Mid-Atlantic, from Cape Hatteras, NC to Atlantic City, NJ, including waters inside the Delaware Bay.



STATUS OF THE SPECIES

Several endangered and threatened species may occur in the action area (Table 3).

Table 3. Endangered and threatened species occurring in the action area.

Common Name	Scientific Name	Listing Status
Marine Mammals		
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Sea Turtles		
Green sea turtle	*Chelonia mydas*	
Most areas		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	*Caretta caretta*	
Northwest Atlantic DPS		Threatened
Fish		
Atlantic sturgeon	*Acipenser oxyrinchus*	
New York Bight DPS		Endangered
Chesapeake Bay DPS		Endangered
Carolina DPS		Endangered
South Atlantic DPS		Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered

Species Not Considered Further in the Biological Opinion
The purpose of this action is to perform research on sea turtles, discussed in a later section. There is potential for non-target species to be affected by: survey, close approach, and capture in tangle nets or trawls.

The researchers propose to conduct surveys in their research vessel and approach turtles in their small inflatable vessel. They would not intentionally approach non-target species in either vessel. They would avoid all marine mammals and fish. They would operate their vessels at slow speeds and abide by safe boating guidelines. In addition to the captain or boat driver, there would be observers aboard to watch out for non-target marine animals. We conclude that the likelihood of vessel disturbance or collision is discountable, i.e., extremely unlikely to occur. Therefore, survey activities and close-vessel approach are not likely to adversely affect the above listed marine mammals and fish.

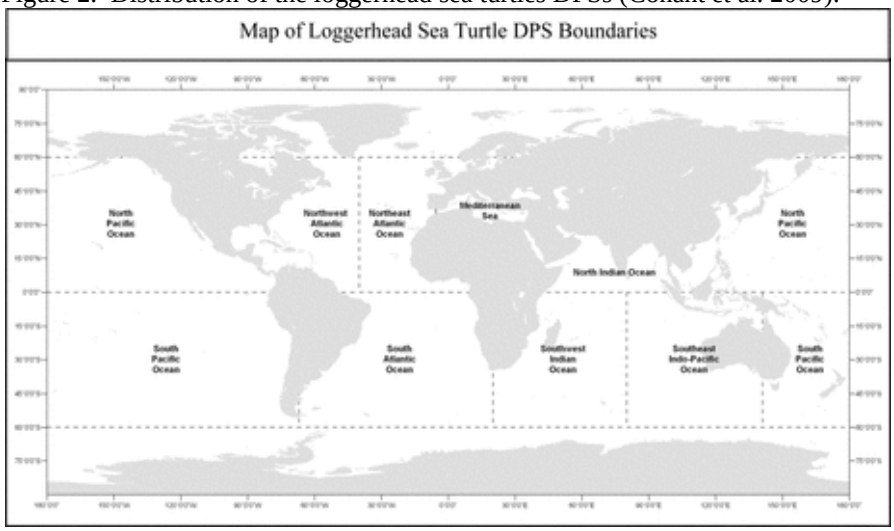
The researchers propose to capture turtles in entanglement nets. This methods often result in bycatch, including the above listed fish species. To minimize bycatch, the researchers would only use entanglement nets in shallower, coastal waters. They would watch out for non-target species and refrain from setting nets when marine mammals are in the vicinity. They would employ only small-meshed tangle nets. We conclude that the likelihood of capture or entanglement of large cetaceans is discountable, i.e., extremely unlikely to occur. Therefore, capture activities are not likely to adversely affect the above listed marine mammals.

The following species are not considered further in this Opinion: humpback whale, North Atlantic right whale, blue whale, fin whale, sei whale, and sperm whale.

Species Considered Further in the Biological Opinion

Loggerhead sea turtle, Northwest Atlantic Ocean DPS
Species Description and Distribution
The loggerhead sea turtle has a large head and powerful jaws, which enables it to feed on hard-shelled prey, such as whelks and conch. It is the most abundant sea turtle in U.S. coastal waters. The Northwest Atlantic Ocean DPS is defined as turtles occurring from 0 – 60°N and 40ºW to the coastal Americas (Fig. 2).

Figure 2. Distribution of the loggerhead sea turtles DPSs (Conant et al. 2009).



Listing Status
In 1978, the loggerhead sea turtle was listed as threatened under the ESA (43 FR 32800). In 2011, the listing was modified to include nine distinct population segments (76 FR 58868). The Northwest Atlantic Ocean DPS has a large population size (>60,000 adults). Though the nesting trend (between 1989 and 2010) is slightly negative, it is not significantly different from zero (76 FR 58868). Therefore, the Northwest Atlantic Ocean DPS was listed as threatened. Critical habitat for this DPS has yet to be designated.

Population Designations, Abundance, and Trends
Peninsular Florida (Florida/Georgia border through Pinellas County, FL. The Peninsular Florida nesting subpopulation is the largest in the Western Atlantic, with over 65,000 nests per year. From 1989 to 2007, loggerhead nesting declined by 28-31 percent (1.4-2.6 percent annually), as determined by the Index Nesting Beach Survey Program, which surveys 28 areas (covering 70 percent of the total number of loggerhead nests) in Florida (Witherington et al. 2009).

Northern U.S. (Florida/Georgia border through southern Virginia)
The Northern U.S. nesting subpopulation is the second largest in the Western North Atlantic, with an average of 5,151 nests per year (TEWG 2009). The subpopulation declined an average of 1.6 percent annually between 1983 and 2006 , as determined at 11 survey beaches, which host 30 percent of the subpopulation's nests (TEWG 2009).

Northern Gulf of Mexico (Franklin County, Florida through Texas)
There are an estimated 1,000 nests annually in the Northern Gulf of Mexico subpopulation, where nesting is concentrated in the Florida Panhandle. There, the number of nests declined from 1,212 nests in 1999 to 587 nests in 2006 (Florida Fish and Wildlife Conservation Commission, unpublished data); this decline is corroborated by data from three survey beaches (TEWG 2009).

Dry Tortugas (islands located west of Key West, Florida and Cay Sal Bank, Bahamas)
The Dry Tortugas subpopulation is the smallest in the Western North Atlantic, with an average of 700 nests per year. It has declined since 1995.

Greater Caribbean (all other nesting assemblages within the Greater Caribbean, Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles)
The majority of loggerhead nesting in the Greater Caribbean occurs in Quintana Roo, Mexico, which host an average of 1,674 nests annually (TEWG 2009). The subpopulation declined 3.8 percent annually between 1989 and 2006, according to surveys at eight beaches, which contain almost 65 percent of loggerhead nests in this area (TEWG 2009).

Threats
Incidental take in commercial fisheries has been the greatest source of mortality for loggerhead sea turtles over the last half century (TEWG 2009). Shrimp trawls were the major source of mortality until 2003 when turtle excluder devices were mandated. Pelagic longline, finfish trawl, gill net, drift net, and pound net fisheries are additional sources of mortality. Estimated mean annual bycatch in the Atlantic is 26,500 loggerheads, of which an estimated 1,400 die (Finkbeiner et al. 2011b). The TEWG (2009) concludes that incidental capture of loggerheads in these commercial fisheries "may certainly be playing a role in the recent apparent decrease in the numbers of adult female loggerheads in the Western North Atlantic." Commercial harvest of turtles and eggs also plays a role. Threats to nesting habitat include: coastal development and construction, placement of erosion control structures, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis et al. 2003; Mazaris et al. 2009b; USFWS 1998). Loggerhead sea turtles face numerous threats in the marine environment as well, including oil and gas exploration, marine pollution, trawl, purse seine, hook and line, gill net, pound net,

longline, and trap fisheries, underwater explosions, dredging, offshore artificial lighting, power plant entrapment, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, and poaching. Climate change may also have significant implications on loggerhead populations worldwide. In addition to potential loss of nesting habitat due to sea level rise, 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. 2007a). Increasing ocean temperatures may also lead to reduced primary productivity and food availability. Natural threats include predation by sharks, seabirds, raccoons, and crabs (Barton & Roth 2008).

Life History

Loggerhead females mature at 15 – 38 years of age (Casale et al. 2009; Frazer & Ehrhart 1985; NMFS 2001; Witherington et al. 2006). They breed approximately every 2-3 years (Dodd 1988; Richardson et al. 1978), and lay 4 – 5 nests per season, which generally lasts from March until August (Murphy & Hopkins 1984; Tucker 2010). The average clutch size is 100-130 eggs (Dodd 1988). There are five life stages for the loggerhead: year one (terrestrial to oceanic hatchlings); juvenile one (exclusively oceanic), juvenile two (oceanic or neritic, 41 – 82 cm standard carapace length), juvenile three (oceanic or neritic, 63 – 100 cm standard carapace length), and adult (TEWG 2009).

Migration and movement

As oceanic juveniles, Northwestern Atlantic loggerheads use the North Atlantic gyre and often are associated with *Sargassum* communities (Carr 1987); they also are found in the Mediterranean Sea. In these areas, they overlap with animals originating from the Northeast Atlantic and the Mediterranean Sea (Laurent *et al*. 1993, 1998; Bolten *et al*. 1998; Bowen *et al*.2005; LaCasella *et al*. 2005; Carreras *et al*. 2006, Monzón-Argüello *et al*. 2006; Revelles *et al*. 2007). As larger, neritic juveniles, they show more genetic structure and tend to inhabit areas closer to their natal origins (Bowen *et al*. 2004), but some move to and from oceanic foraging grounds throughout this life stage (Mansfield 2006, McClellan and Read 2007), and others continue to use the Mediterranean Sea (Casale *et al*. 2008b, Eckert *et al*. 2008). Adult populations are highly structured with no overlap in distribution among adult loggerheads from the Northwest Atlantic, Northeast Atlantic, South Atlantic, and Mediterranean (Conant et al. 2009).

Diet

Loggerhead sea turtles are omnivorous and opportunistic feeders through their lifetimes (Parker et al. 2005). Hatchling loggerheads feed on macroplankton associated with *Sargassum* spp. communities (NMFS and USFWS 1991b). Pelagic and benthic juveniles forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; Wallace et al. 2009). Loggerheads in the deep, offshore waters of the western North Pacific feed on jellyfish, salps, and other gelatinous animals (Dodd Jr. 1988; Hatase et al. 2002). 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 1998d). Stable isotope analysis and study of organisms on turtle shells has recently shown that although a loggerhead population may feed on a variety of prey, individuals have specialized diets (Reich et al. 2010; Vander Zanden et al. 2010).

Diving

Loggerhead diving behavior varies based upon habitat, with longer surface stays in deeper habitats than in coastal ones. Routine dives can last 4–172 min (Byles 1988; Renaud & Carpenter 1994; Sakamoto et al. 1990). The maximum-recorded dive depth for a post-nesting female was over 230 m, although most dives are far shallower (9-21 m (Sakamoto et al. 1990).

Habitat

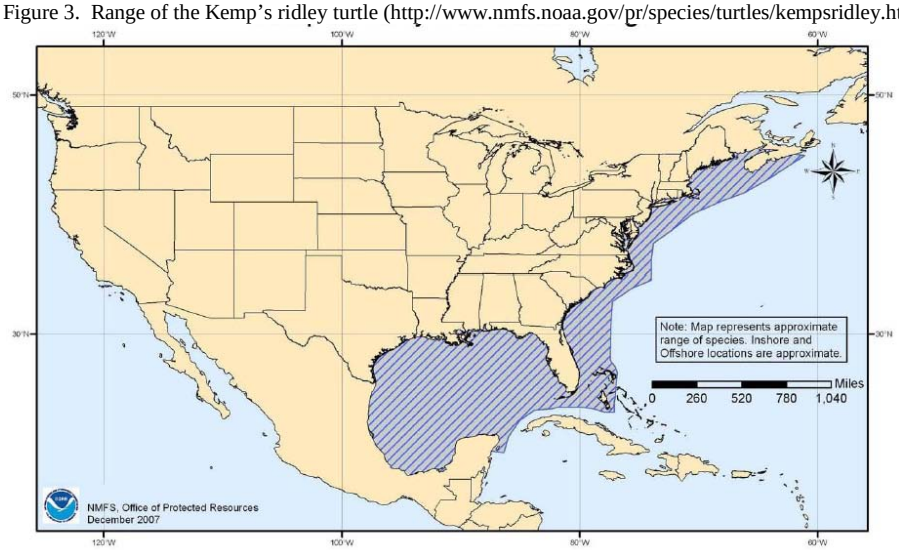
Loggerhead nesting is confined to lower latitude temperate and subtropic zones but does not occur in tropical areas (NMFS and USFWS 1991b; NRC 1990b; Witherington et al. 2006b).

Kemp's ridley turtle (*Lepidochelys kempii*)

Species description and distribution.

The Kemp's ridley turtle is the smallest of all sea turtles. It was formerly known only from the Gulf of Mexico and along the Atlantic coast of the U.S. as shown in Figure 3 (TEWG 2000); however, there have been recent records of Kemp's ridley turtles in the Mediterranean Sea (Tomas & Raga 2008).

Figure 3. Range of the Kemp's ridley turtle (http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm)



Status

In 1970, the Kemp's ridley turtle was listed as endangered under the ESA (35 FR 18319). The International Union for Conservation of Nature (IUCN) has classified the species as critically endangered. It was once considered the most endangered sea turtle (NRC 1990a; USFWS 1999). NMFS has not designated critical habitat for Kemp's ridley sea turtle.

Population designations, abundance, and trends

Kemp's ridley females lay their eggs in synchronized nesting events called aribadas. The species was once abundant in the Gulf of Mexico, with arribadas of 40,000 turtles at Rancho Nuevo, Mexico (Hildebrand 1963). By 1978, arribadas had declined to ~200 turtles (TEWG 2000; USFWS & NMFS 1992). Protection led to increases in abundance in the early 1990s. By 2006, there were approximately 7,866 nests at Rancho Nuevo and ~12,000 nests throughout Mexico which translates to an estimated 4,000 females nesting annually (Rostal 2007; Rostal et al. 1997; USFWS 2006) and a total population size of 7,000 – 8,000 adult females (Marquez et al. 1989; Rostal 2007; TEWG 2000). In Mexico, there were 17,882 nests in 2008 (Gladys Porter Zoo 2008) and 21,144 nests in 2009 (Gladys Porter Zoo 2010). In 2010, nesting declined to 13,302 nests (Gladys Porter Zoo 2010) but recovered to 20,570 nests in 2011 (http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/kemps-ridley-sea-turtle.htm). A successful head-start program has resulted in the reestablishment of nesting at South Padre Island: in 2011, 199 turtles nested on Texan beaches (http://www.nps.gov/pais/naturescience/current-season.htm).

Threats

The primary cause for the mid-century decline in Kemp's ridley turtles was overharvesting of turtles and eggs. This threat has subsided in recent years. Habitat destruction remains a concern in the form of bottom trawling and shoreline development. Finkbeiner et al. (2011a) estimated that at least 98,300 individuals are caught annually in U.S. Atlantic fisheries (resulting in at least 2,700 mortalities). Kemp's ridley turtles have among the highest levels of PCB and DDT (Pugh & Becker 2001). Oil can also be hazardous to Kemp's ridley turtles, causing significant mortality and morphological changes in hatchlings (Fritts & McGehee 1981). Natural threats include predation by

sharks and "cold stunning," mortality induced by cold water temperatures (Innis et al. 2009).

Life History

Kemp's ridley females mature at 10 – 17 years of age (Snover et al. 2007). They nest multiple times in a single nesting season, producing an average of 3.075 nests per female per season (Rostal 2007). The annual average clutch size is 94 – 100 eggs per nest (Marquez-M. 1994; Rostal 2007; USFWS 2000; 2001; 2002; 2003; 2004; 2005; 2006). The inter-nesting interval is approximately 1.8 to 2.0 years (Marquez et al. 1989; Rostal 2007; TEWG 2000). Nesting occurs in large arribadas, primarily at Rancho Nuevo, Mexico (NMFS et al. 2011). Nesting at this location may be particularly important because hatchlings can more easily migrate to foraging grounds (Putman et al. 2010). Kemp's ridleys require approximately 1.5 – 2 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 (Caillouet et al. 1995; Ogren 1989; Schmid 1998; Schmid & Witzell 1997; Snover et al. 2007; TEWG 2000; Zug et al. 1997). 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 & Witzell 1997; Snover et al. 2007).

Migration and movement

Tracking of post-nesting females from Rancho Nuevo and Texas beaches indicates that turtles move along coastal migratory corridors either to the north or south from the nesting beach (Byles 1989b; Byles & Plotkin 1994; Renaud 1995; Renaud et al. 1996; Shaver 1999; 2002). 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 & 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.

Habitat

Juvenile turtles occur in coastal habitats throughout the Gulf of Mexico and U.S. Atlantic coast (Morreale et al. 2007; TEWG 2000). 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 & Vanselous 1989; Renaud et al. 1996; Shaver et al. 2005; Shaver & Wibbels 2007). The majority of nesting occurs on beaches at Rancho Nuevo; nesting is increasing throughout all of Mexico and Texas.

Diet

The diet of the Kemp's ridley turtle consists mainly of swimming crabs, but may also include fish, jellyfish, mollusks, and tunicates (Witzell and Schmid 2005).

Diving

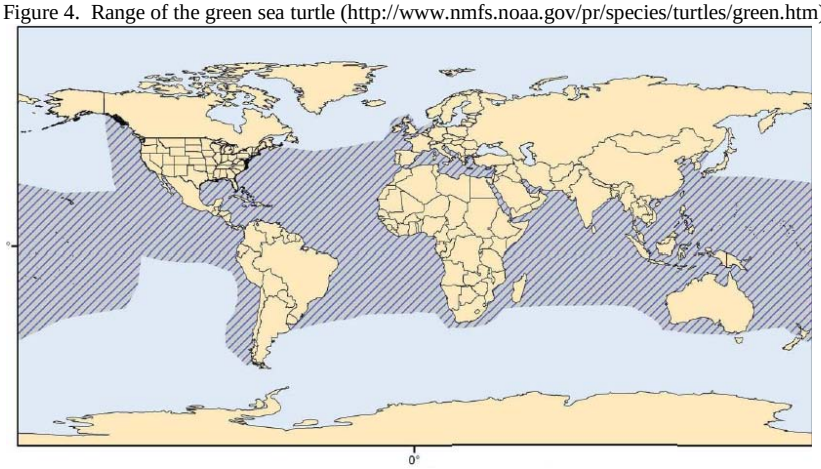
Kemp's ridley sea turtles can dive from a few seconds in duration to well over two and a half hours, although most dives range from 16 to 34 minutes (Mendonca & Pritchard 1986; Renaud 1995). Individuals spend the vast majority of their time underwater; over 12-hour periods, 89% to 96% of their time is spent below the surface (Byles 1989b; Gitschlag 1996).

Green sea turtle (*Chelonia mydas*)

Species description and distribution

The green sea turtle is a large, herbivorous, hard-shelled turtle. It has a circumglobal distribution, occurring throughout tropical, subtropical, and, to a lesser extent, temperate waters (Fig. 4).

Figure 4. Range of the green sea turtle (http://www.nmfs.noaa.gov/pr/species/turtles/green.htm)



Status

In 1978, the green sea turtle was listed as threatened for all populations with the exception of the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered (43 FR 32800). The International Union for Conservation of Nature (IUCN) has classified the species as endangered.

Population designations, abundance and trends

The species can be divided into two distinct populations: Atlantic and Indo-Pacific. Nesting beaches within each population are connected genetically via male mediated gene flow (Karl et al. 1992; Roberts et al. 2004), but females generally return to their natal beaches to nest, resulting in maternally isolated subpopulations (Bowen et al. 1992). An estimated 100,000 – 150,000 females nest each year at 46 locations (Table 4). Based historical trends at some of these locations, there appears to an increase in the global population size, but trend data are available for just over half of all sites examined and very few datasets span a full generation (Seminoff 2004). Nesting is stable or increasing at most sites throughout the Atlantic (NMFS & USFWS 1991). Nesting has declined throughout the Pacific, with the exception of Hawaii, where the nesting population has steadily increased in abundance over the past 30 years (Balazs & Chaloupka 2004).

Table 4. Locations and abundance estimates of threatened green sea turtles as annual nesting females (AF), annual nests (AN), annual egg production (EP), and annual egg harvest (EH).

Location	Abundance	Reference
Atlantic Ocean		
Tortuguero, Costa Rica	17,402-37,290 AF	(Troëng & Rankin 2005)
Aves Island, Venezuela	335-443 AF	(Vera 2007)
Galibi Reserve, Suriname	1,803 AF	(Weijerman et al. 1998)
Isla Trindade, Brazil	1,500-2,000 AF	(Moreira & Bjorndal 2006)
Ascension Island, UK	3,500 AF	(Broderick et al. 2006)
Poilao Island, Guinea-Bissau	7,000-29,000 AN	(Catry et al. 2009)
Bioko Island, Equatorial Guinea	1,255-1,681 AN	(Tomas et al. 1999)
Turkey	214-231 AF	(Broderick et al. 2002)
Cyprus	121-127 AF	(Broderick et al. 2002)
Israel / Palestine	1-3 AF	(Kuller 1999)
Syria	100 AN	(Rees et al. 2005)
Indo-Pacific Oceans		
Eparces Islands	2,000-11,000 AF	(Le Gall et al. 1986)
Comoros Islands	5,000 AF	S. Ahamada, pers. comm. 2001

Location	Abundance	Reference
Seychelles Islands	3,535-4,755 AF	J. Mortimer, pers. comm. 2002
Kenya	200-300 AF	(Okemwa & Wamukota 2006)
Ras al Hadd, Oman	44,000 AN	S. Al-Saady, pers. comm. 2007
Sharma, Yemen	15 AF	(Saad 1999)
Karan Island, Saudi Arabia	408-559 AF	(Pilcher 2000)
Jana and Juraid Islands, Saudi Arabia	643 AN	(Pilcher 2000)
Hawkes Bay and Sandspit, Pakistan	600 AN	(Asrar 1999)
Gujarat, India	461 AN	(Sunderraj et al. 2006)
Sri Lanka	184 AF	(Kapurisinghe 2006)
Thamihla Kyun, Myanmar	<250,000 EH	(Thorbjarnarson et al. 2000)
Pangumbahan, Indonesia	400,000 EH	(Schulz 1987)
Suka Made, Indonesia	395 AN	C. Limpus, pers. comm. 2002
Western Australia	3,000-30,000 AN	R. Prince, pers. comm. 2001
Gulf of Thailand	250 AN	Charuchinda pers. comm. 2001
Vietnam	239 AF	(Hamann et al. 2006a)
Berau Islands, Indonesia	4,000-5,000 AF	(Schulz 1984)
Turtle Islands, Philippines	1.4 million EP	(Cruz 2002)
Sabah Turtle Islands, Malaysia	8,000 AN	(Chan 2006)
Sipadan, Malaysia	800 AN	(Chan 2006)
Sarawak, Malaysia	2,000 AN	(Liew 2002)
Enu Island (Aru Islands)	540 AF	Dethmers, in preparation
Terengganu, Malaysia	2,200 AN	(Chan 2006)
Heron Island and southern GBR	5,000-10,000 AF	(Maison et al. 2010)
Raine Island and northern GBR	10,000-25,000 AF	(Limpus et al. 2003) (Maison et al. 2010)
Coringa-Herald Reserve, Australia	1,445 AF	(Maison et al. 2010)
Guam	45 AF	(Cummings 2002)
Phoenix Islands, Kiribati	100-300 AF	(Maison et al. 2010)
Ogasawara Islands, Japan	500 AF	(Maison et al. 2010)
Micronesia	500-1,000 AF	(Maison et al. 2010)
Marshall Islands	100-500 AF	(Maison et al. 2010)
New Caledonia	1,000-2,000 AF	(Maison et al. 2010)
French Frigate Shoals, Hawaii	400 AF	(Balazs & Chaloupka 2006)
Michoacán, Mexico	1,395 AF	C. Delgado, pers. comm. 2006
Central American Coast	184-344 AN	(López & Arauz 2003)
Galapagos Islands, Ecuador	1,650 AF	(Zárate et al. 2006)

Threats

Habitat loss threatens the species globally. Nesting habitat is destroyed by human development, including: construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997b). Lights on or adjacent to nesting beaches is often fatal to emerging hatchlings (Witherington & Bjorndal 1991) and alters the behavior of nesting adults (Witherington 1992). Anthropogenic disturbances also threaten coastal marine habitats, particularly areas rich in seagrass and marine algae. These impacts include contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999; Lee Long et al. 2000; Waycott et al.

2005). Further, the introduction of alien algae species threatens the stability of some coastal ecosystems and may lead to the elimination of preferred dietary species of green sea turtles (De Weede 1996). In the Pacific, where populations are declining, direct take of turtles and eggs poses the most serious threat (NMFS & USFWS 1998). Many green sea turtles exhibit fibropapillomatosis, a tumor forming disease, which may interfere with movement and foraging (Aguirre & Lutz 2004). Very few green sea turtles are bycaught in U.S. fisheries (Finkbeiner et al. 2011a), but low-level bycatch has been documented in longline fisheries (Petersen et al. 2009). Hatchlings are preyed upon by seabirds and sharks; eggs are preyed upon by dogs, pigs, rats, and crabs (Bell et al. 1994; Witzell 1981). Anthropogenic climate change may further destroy nesting habitat via sea level rise and may cause the widespread failure of nests via increased temperatures (Fuentes et al. 2010).

Life history

Female green sea turtles reach sexual maturity at 20 years of age or greater and reproduce for 17 – 23 years (Chaloupka et al. 2004; Chaloupka & Musick 1997; Hirth 1997; Limpus & Chaloupka 1997; Seminoff et al. 2002b; Zug et al. 2002; Zug & Glor 1998)). They return to their natal beaches to nest every 2 – 5 years (Hirth 1997) to deposit 1 – 7 clutches (usually 2-3) at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest (Balazs 1983). Hatchlings emerge from the nest and orient towards a light source, such as light shining off the ocean. Juvenile green sea turtles occupy pelagic, benthic, and coastal foraging habitats until they mature and return to their natal beach for parturition (Carr et al. 1978; Meylan et al. 1990). Green sea turtles exhibit slow growth rates, as a result of their herbivorous diet (Bjorndal 1982). They reach a maximum size just under 100 cm in carapace length (Tanaka 2009).

Migration and movement

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick & Limpus 1997; Plotkin 2003). Green sea turtles spend the majority of their lives in coastal foraging grounds, including open coastline and protected bays and lagoons. Adult females migrate to their natal beaches to nest.

Diet

Green sea turtles are not obligate herbivores; they also forage on invertebrates especially as juveniles (Godley et al. 1998; Hatase et al. 2006; Heithaus et al. 2002; Parker & Balazs in press; Seminoff et al. 2002a). A shift to a more herbivorous diet occurs when individuals move into neritic habitats, usually at 30 – 62 cm in carapace length (Cardona et al. 2010).

Diving

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, we presume 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 (Hazel et al. 2009; NMFS & USFWS 1998). The maximum recorded dive depth for an adult green turtle was just over 106 m (Berkson 1967), while subadults routinely dive to 20 m for 9-23 min, with a maximum recorded dive of over 1 h (Brill et al. 1995; I-Jiunn 2009).

Critical habitat

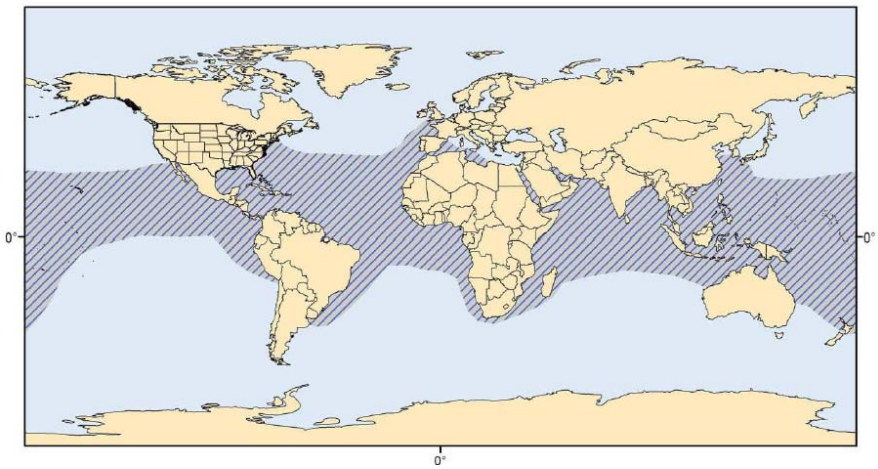
In 1998, critical habitat for green sea turtles was designated in coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693). Aspects of these areas that are important for green sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for green sea turtle prey.

Hawksbill sea turtle (*Eretmochelys imbricata)*

Species description and distribution

The hawksbill sea turtle has a sharp, curved beak-like mouth, which it uses to grasp sponges, its primary prey. It has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans (Fig. 5).

Figure 5. Range of the hawksbill sea turtle (http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm)



Status

In 1970, the hawksbill sea turtle received protection under the Endangered Species Conservation Act (35 FR 8495). In 1973, it was listed as endangered under the ESA (35 FR 8491). The International Union for Conservation of Nature (IUCN) has classified the species as critically endangered (Mortimer & Donnelly 2008).

Population designations, abundance and trends

Surveys at 83 nesting sites worldwide indicate 21,212 – 28,138 females nest annually (NMFS and USFWS 2007). Long-term data exists for 58 sites for with historic trends, all of which indicate a decline over the past 20 to 100 years. Among 42 sites for which recent trend data are available, 10 (24 percent) are increasing, three (seven percent) are stable, and 29 (69 percent) are decreasing. Populations are distinguished generally by ocean basin (i.e., Atlantic, Pacific, and Indian) and more specifically by nesting location.

Atlantic Ocean. The surveys described above estimate that 3,072 – 5,603 females nest annually on Atlantic beaches (NMFS and USFWS 2007). Nesting sites include: Antigua, the Turks and Caicos, Barbados, the Bahamas, Puerto Rico, the U.S. Virgin Islands, the Dominican Republic, Sao Tome, Guadaloupe, Trinidad and Tobago, Jamaica, Martinique, Cuba, Mexico, Costa Rica, Guatemala, Venezuela, Bijagos Archipelago, Guinea-Bissau, and Brazil. The Atlantic populations appear to be doing better than those in the Pacific. Within the Atlantic, more population increases have been recorded in the Insular Caribbean than along the Western Caribbean Mainland or the eastern Atlantic (NMFS and USFWS 2007).

Pacific Ocean. The surveys described above estimate that 10,010 – 12,483 females nest annually on Pacific beaches (NMFS and USFWS 2007). Nesting sites include: Australia, Indonesia, Malaysia, Japan, Papua New Guinea, the Philippines, Thailand, Vietnam, Oceania, and the eastern Pacific. Almost all Pacific populations are declining in abundance (NMFS and USFWS 2007). The two exceptions are Hawaii and the eastern Pacific, which appear to be increasing in abundance (Gaos et al. 2010).

Indian Ocean. T The surveys described above estimate that 8,130 – 10,052 females nest annually on Indian Ocean beaches (NMFS and USFWS 2007). Nesting sites include: western Australia, Andaman and Nicobar Islands,

Maldives, Seychelles, Burma, East Africa, Egypt, Oman, Saudi Arabia, Sudan, and Yemen. The Indian Ocean populations appear to be doing better than those in the Pacific.

Threats

The greatest threats to hawksbill sea turtles are overharvesting of turtles and eggs, degradation of habitat, and fisheries interactions. Hawksbills are harvested for their meat and carapace, which is sold as tortoiseshell (Mortimer & Donnelly 2008). Eggs are taken at high levels, especially in Southeast Asia where collection approaches 100 percent in some areas (Mortimer & Donnelly 2008). Because hawksbills prefer to nest under vegetation (Horrocks & Scott 1991; Mortimer 1982), they are particularly impacted by beachfront development and clearing of dune vegetation (Mortimer & Donnelly in review). Lights on or adjacent to nesting beaches is often fatal to emerging hatchlings (Witherington & Bjorndal 1991) and alters the behavior of nesting adults (Witherington 1992). In addition to impacting the terrestrial zone, anthropogenic disturbances also threaten coastal marine habitats. These impacts include contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999; Lee Long et al. 2000; Waycott et al. 2005). Finkbeiner et al. (2011a) estimated that annual bycatch interactions total at least 20 individuals annually for U.S. Atlantic fisheries (resulting in less than ten mortalities) and no or very few interactions in U.S. Pacific fisheries. Hatchlings are preyed upon by seabirds and sharks. Eggs are preyed upon by dogs, pigs, rats, and crabs (Ficetola 2008). Anthropogenic climate change may further destroy nesting habitat via sea level rise, but increased temperatures may help the species by skewing the hatchling sex ratio toward female (Wibbels 2003).

Life history

The best estimate of age at sexual maturity for hawksbill sea turtles is about 20-40 years (Chaloupka and Limpus 1997, Crouse 1999a). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to their nesting beach or to courtship stations along the migratory corridor (Meylan 1999). Females nest an average of 3 – 5 times per season (Meylan and Donnelly 1999, Richardson et al. 1999). Clutch size is larger on average (up to 250 eggs) than that of other sea turtles (Hirth 1980). Hatchlings migrate to and remain in pelagic habitats until they reach approximately 22-25 cm in straight carapace length (Meylan 1988, Meylan and Donnelly 1999). As juveniles, they take up residency in coastal waters to forage and grow.

Habitat

Hawksbill sea turtles are highly migratory and use a wide range habitats during their lifetimes (Musick & 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 & Limpus 1997) and observations of newly hatched hawksbills attracted to floating weed have been made (Hornell 1927; Mellgren & Mann 1996; Mellgren et al. 1994). Juvenile hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Bjorndal & Bolten 2010; Musick & Limpus 1997), and mud flats (R. von Brandis, unpublished data in NMFS and USFWS 2007). As adults, hawksbills are typically associated with coral reefs, which are among the world's most endangered marine ecosystems (Wilkinson 2000a). 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). Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Diet

As adults, hawksbills feed on sponges and corals (Leon & Bjorndal 2002; Meylan 1988). Data from oceanic stage hawksbills are limited, but indicate a diet of plant and animal material (Bjorndal 1997).

Diving

Hawksbill diving ability increases with age and body size (Blumenthal et al. 2009). Hawksbills have long dive

durations, although dive depths are not particularly deep. Adult females along St. Croix reportedly have average dive times of 56 min, with a maximum time of 73.5 min (Starbird et al. 1999). Average day and night dive times were 34–65 and 42–74 min, respectively. Immature individuals have much shorter dives of 8.6–14 min to a mean depth of 4.7 m while foraging (Van Dam & Diez 1997).

Critical habitat

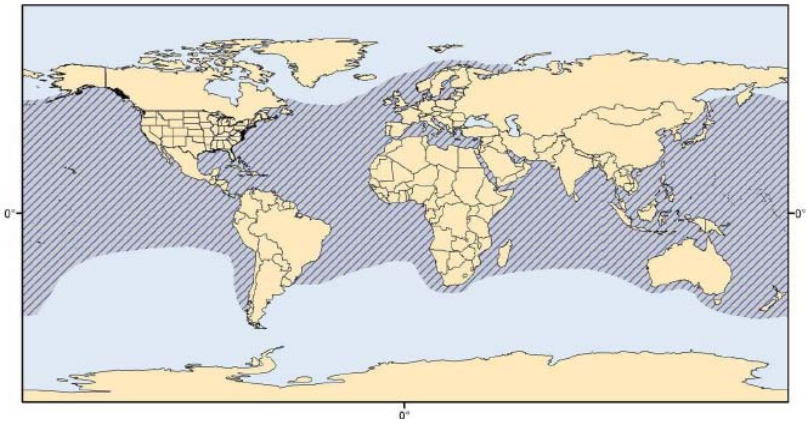
On September 2, 1998, NMFS established critical habitat for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey.

Leatherback sea turtle (*Dermochelys coriacea*)

Species description and distribution

The leatherback is the largest of all sea turtles (up to 916 kg; Eckert & Luginbuhl 1988) and the only species lacking a hard, bony carapace. Its slightly flexible carapace is made primarily of tough, oil saturated connective tissue. The species has an extensive distribution, ranging from tropical to subpolar latitudes (Fig. 6). This unique reptile is able to withstand broad temperature extremes because of its large body size (Paladino et al. 1990), thick peripheral insulation (Goff & Stenson 1988), counter-current heat exchange (Greer et al. 1973), and thermoregulatory behavior (Bostrom et al. 2010).

Figure 6. Range of the leatherback turtle.



Status

The leatherback sea turtle has been listed as endangered under the ESA since 1973 and, prior to that, under the Endangered Species Conservation Act (35 FR 8491). The species is considered to be critically endangered worldwide (Sarti Martinez 2000).

Population designations, abundance, and trends

The global population of adult females has declined over 70 percent in less than one generation, from an estimated 115,000 adult females in 1980 to 34,500 adult females in 1995 (Pritchard 1982; Spotila et al. 1996), driven by dramatic reductions in several Pacific populations (Sarti Martinez 2000). Nesting aggregations occur in six broad geographic regions: eastern Atlantic, western Atlantic, eastern Pacific, western Pacific, and Indian. Genetic studies indicate the reproductive isolation of these designations, which are distinguished by the presence of unique mitochondrial DNA haplotypes or significant differences in haplotype frequencies (Dutton et al. 1999; Dutton et al. 2007).

Eastern Atlantic. In 2007, the Turtle Expert Working Group provided a population estimate of 34,000-94,000 adult leatherbacks in the North Atlantic Ocean (TEWG 2007), including both eastern and western Atlantic stocks. Based on genetic and tagging data, there are at least two stocks (eastern and western Atlantic) and possibly as many as seven (TEWG 2007). Nesting occurs in the eastern Atlantic, from Mauritania to Angola (Fretey et al. 2007). Gabon hosts the world's largest population of leatherbacks, estimated at 15,730- 41,373 females (Witt et al. 2009). Population dynamics are relatively stable in the Atlantic, but estimates fluctuate considerably due to individual variance in remigration intervals, clutch number, and inconsistent nest site fidelity (TEWG 2007).

Western Atlantic. In 2007, the Turtle Expert Working Group provided a population estimate of 34,000-94,000 adult leatherbacks in the North Atlantic Ocean (TEWG 2007), including both eastern and western Atlantic stocks. In the western Atlantic and Caribbean Sea, nesting occurs on beaches in Puerto Rico, St. Croix, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Sao Tome and Principe, French Guiana, Suriname, and Florida (Bräutigam & Eckert 2006; Márquez 1990; Spotila et al. 1996). Population dynamics are relatively stable in the Atlantic, but estimates fluctuate considerably due to individual variance in remigration intervals, clutch number, and inconsistent nest site fidelity (TEWG 2007).

Eastern Pacific. In the eastern Pacific, the estimated number of adult females declined by from 4638 to 1690 (64 percent) between the years of 1995 and 2000 (Spotila et al. 1996; Spotila et al. 2000). The largest nesting aggregations of this region occur on the beaches of Mexico and Costa Rica. There has been a steady decline in the number of females observed at the four major nesting sites in Mexico: Mexiquillo, Tierra Colorada, Cahuitan, and Barra de la Cruz (Sarti Martinez et al. 2007). At Las Baulas National Park, the largest leatherback rookery in Costa Rica, the nesting population declined 83 percent (from 1367 to 231 adult females) from 1988 to 1999 (Fig.7; Reina et al. 2002).

Western Pacific. The western Pacific region supports an estimated 2100-5700 breeding females (Dutton et al. 2007). The largest leatherback rookeries occur at the Jamursba-Medi and Wermon beaches of Papua, Indonesia (Hitipeuw et al. 2007). There are also significant nesting aggregations on beaches throughout Papua New Guinea, Vanuatu, and the Solomon Islands (Benson et al. 2007; Dutton et al. 2007; Hitipeuw et al. 2007). It is difficult to describe leatherback abundance trends in the western Pacific because new nesting aggregations are continually being found, and historical data is limited to one location. At Jamursba-Medi, an estimated 300-900 females nest annually (Hitipeuw et al. 2007). Though these estimates are similar to those reported in the 1990s (Dutton et al. 2007; Spotila et al. 1996), they are lower than those from the early 1980s (Fig. 7; Hitipeuw et al. 2007). We do not include the Terengganu, Malaysia rookery here because it is genetically differentiated from western Pacific populations (Dutton et al. 2007), suggesting long-term reproductive isolation possibly as a result of previous barriers to gene flow (e.g., the Sunda Shelf).

Indian. The once large rookery at Terengganu, Malaysia is now functionally extinct. Beaches that once supported over 3000 females nesting annually, now host 2 or 3 females per year, representing a 99 percent decline since 1950 (Chan & Liew 1989; Chan et al. 1988). At present, the largest nesting aggregations in the Indian Ocean occur on Andaman and Nicobar Islands (India), where 400-500 females nest annually (Andrews & Shanker 2002). Significant nesting aggregations also occur in Sri Lanka, South Africa, and Mozambique (Hamann et al. 2006b). We tentatively group all Indian Ocean rookeries, but no genetic or tagging data are available to assess the stock structure of these populations.

Threats

Leatherbacks face a multitude of threats. Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Crognale et al. 2008; Fossette et al. 2009; Gless et al. 2008; Petersen et al. 2009). Harvest of females along nesting beaches is of concern worldwide. Egg collection is widespread and has contributed to catastrophic declines, such as in Malaysia. There is increasing development and tourism along

nesting beaches (Hernandez et al. 2007; Maison 2006; Santidrián Tomillo et al. 2007). Structural impacts to beaches include: building and piling construction, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997b). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009; Chacón Chaverri 1999; Formia et al. 2003; Laurance et al. 2008). Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea (Bourgeois et al. 2009; Cowan et al. 2002; Deem et al. 2007; Witherington 1992; Witherington & Bjorndal 1991). Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009). Although global climate change may expand foraging habitats into higher latitude waters, increasing temperatures may increase feminization of nests (Hawkes et al. 2007b; James et al. 2006; McMahon & Hays 2006; Mrosovsky et al. 1984). It may also result in rising sea levels, which may inundate nests on some beaches. Natural threats include: predation on adults by sharks and killer whales (Pitman & Dutton 2004); predation on hatchlings by seabirds, land predators, and sharks; and tidal inundation of nests (Caut et al. 2009).

Life history

Both males and females exhibit some degree of philopatry, returning to their natal beaches for breeding and nesting (James et al. 2005b). Age to maturity remains elusive, with estimates ranging from 5 to 29 years (Avens et al. 2009; Spotila et al. 1996). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing >80 g (Reina et al. 2002; Wallace et al. 2007). Females remigrate every 1-7 years, with most turtles returning every two years to nest in French Guiana (Rivalan et al. 2005) and every three years in Las Baulas, Costa Rica (Reina et al. 2002). The remigration interval for western Pacific leatherbacks is unknown but estimated as "several years" (Benson et al. 2011). According to Wallace (2007), high seasonal and lifetime fecundity likely reflect compensation for high and unpredictable mortality during early life history stages.

Migration and movement

Leatherback sea turtles migrate long distances between tropical nesting beaches temperate forage areas (i.e., remigration). Leatherbacks weigh ~33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005a; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches (Casey et al. 2010; Rivalan et al. 2005; Sherrill-Mix & James 2008). Therefore, their remigration intervals (the time between breeding seasons) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004). Eastern Pacific leatherbacks use a consistent migration corridor to forage in the South Pacific Gyre, a low-productivity region (Shillinger et al. 2008). Western Pacific turtles that nest during the boreal summer migrate to forage in temperate waters of the North Pacific or tropical waters of the South China Sea; those that nest during the boreal winter forage in temperate and tropical waters of the southern hemisphere (Benson et al. 2011). Post-nesting, western Atlantic leatherbacks migrate to foraging areas in the North Atlantic or the equatorial eastern Atlantic (Eckert et al. 2006; Eckert 2006; Ferraroli et al. 2004; Hays et al. 2004). Eastern Atlantic leatherbacks migrate to foraging areas in the equatorial Atlantic, temperate waters off South America, or temperate waters off southern Africa (Witt et al. 2011).

Diet

Leatherbacks feed primarily on jellyfish, such as *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974), and tunicates (salps, pyrosomas). These gelatinous zooplankton are relatively nutrient-poor (Doyle et al. 2007), such that leatherbacks must consume large quantities to support their body weight.

Diving

Leatherbacks are deep divers with a maximum-recorded depth of over 4000 m (Eckert et al. 1989; López-Mendilaharsu et al. 2009). Dives are typically 50-84 m (Standora et al. 1984) and last 1-14 min (Eckert et al. 1989; Eckert et al. 1996; Harvey et al. 2006; López-Mendilaharsu et al. 2009). The depth of their dives often corresponds with the vertical distribution of their prey (Harvey et al. 2006; Hodge & Wing 2000).

Habitat
Juveniles leatherbacks are restricted to tropical waters (≥26 °C); after they exceed 100 cm in carapace length, they are able to move into the temperate waters that comprise their primary foraging habitat (Eckert 2002). Adults migrate to areas of high prey density, often concentrated by oceanographic features such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011; Collard 1990; Davenport & Balazs 1991; Frazier 2001; HDLNR 2002). Leatherbacks off the western United States are more likely to occur in continental slope waters than shelf waters (Bowlby et al. 1994; Carretta & Forney 1993; Green et al. 1992; Green et al. 1993). Leatherbacks also require sandy beach habitat for nesting. In the southwest Pacific, females appear to favor nesting sites with higher wind and wave exposure, possibly as a means to aid hatchling dispersal (Garcon et al. 2010).

Critical Habitat
In 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 m isobath to mean high tide level between 17° 42'12" N and 65°50'00" W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. However, studies do not support significant critical habitat deterioration. On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle (50 CFR Part 226). This designation includes approximately 43,798 km^2 stretching along the California coast from Point Arena to Point Arguello east of the 3,000 m depth contour; and 64,760 km^2 stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 m depth contour (Fig. 5). The designated areas comprise approximately 108,558 km^2 of marine habitat and include waters from the ocean surface down to a maximum depth of 80 m.

Shortnose sturgeon, (*Acipenser brevirostrum)*
Species' description and distribution
Shortnose sturgeon occur along the Atlantic Coast of North America, from the St. John River in Canada to the St. Johns River in Florida.

Listing status
Shortnose sturgeon were listed as endangered in 1967 (32 FR 4001) pursuant to the Endangered Species Preservation Act of 1966. In 1973, shortnose sturgeon were listed as endangered by the ESA. Shortnose sturgeon are still listed as Vulnerable on the International Union for Conservation of Nature and Natural Resources Red List. NMFS has not designated critical habitat for shortnose sturgeon.

Population designations, abundance, and trends
The shortnose sturgeon recovery plan (NMFS 1998) describes 19 shortnose sturgeon population segments that exist in the wild (Table 5). Two additional, geographically distinct populations occur behind dams in the Connecticut River (above the Holyoke Dam) and in Lake Marion on the Santee-Cooper River system in South Carolina (above the Wilson and Pinopolis Dams). Although these populations are geographically isolated, genetic analyses suggest that the shortnose sturgeon living downstream of the dams are not significantly different than those living upstream (Quattro *et al.* 2002, Wirgin *et al.* 2005).

Rogers and Weber (1995), Kahnle *et al.* (1998), and Collins *et al.* (2000) concluded that shortnose sturgeon are extinct from the St. Johns River in Florida and the St. Marys River along the Florida and Georgia border. In 2002, a shortnose sturgeon was captured in the St. Johns River, FL (FFWCC 2007), suggesting either immigration or a small remnant population. Rogers and Weber (1995) also concluded that shortnose sturgeon have become extinct in Georgia's Satilla River.

Table 5. Known shortnose sturgeon population densities

Population/Subpopulation	Distribution	Datum	Estimate	Confidence Interval	Source
Saint John River	Canada	1973/1977	18,000	30%	Dadswell 1979
Kennebecasis River	Canada	1998 – 2005	2,068	801 - 11,277	COSEWIC 2005
Kennbec River	ME	1977/1981	7,200	5,046 - 10,765	Squiers *et al.* 1982
		2003	9,500	6,942 - 13,358	Squiers 2003
Androscoggin River	ME		3,000		Squiers *et al.* 1993
Merrimack River	MA	1989 – 1990	33	18 - 89	NMFS 1998
Connecticut River	MA, CT	2003	-	1,500 - 1,800	Connecticut DEP 2003
		1998-2002	-	1,042 - 1,580	Savoy 2004
Above Holyoke Dam		1976 – 1977	515	317 - 898	Taubert 1980, NMFS 1998
		1977 – 1978	370	235 - 623	Taubert 1980, NMFS 1998
		1976 – 1978	714	280 - 2,856	Taubert 1980, NMFS 1998
		1976 – 1978	297	267 - 618	Taubert 1980, NMFS 1998
Below Holyoke Dam		1988 – 1993	895	799 - 1,018	Savoy and Shake 1992, NMFS 1998
Hudson River	NY	1980	30,311		Dovel 1979, NMFS 1998
		1995	38,000	26,427 - 55,072	Bain *et al.* 1995, NMFS 1998
		1997	61,000	52,898 - 72,191	Bain *et al.* 2000
Delaware River	NJ, DE, PA	1981/1984	12,796	10,288 - 16,367	Hastings *et al.* 1987
		1999/2003	12,047	10,757 - 13,589	Brundage and O'Herron 2003
Chesapeake Bay	MD, VA	no data	-	-	
Potomac River	MD, VA	no data	-	-	
Neuse River	NC	2001-2002	extirpated		Oakley 2003
Cape Fear River	NC	1997	>100		Kynard 1997, NMFS 1998
Cooper River	SC	1996-1998	200	87-301	Cooke *et al.* 2005
Savannah River	SC, GA	1984-1992	1,676		Smith *et al.* 1995, NMFS 1998
		1984-1992		96-1075	NMFS 1998
Ogeechee River	GA	1990s	266		Bryce *et al.* 2002
		1993	266	236 - 300	Kirk *et al.* 2005
		1993	361	326 - 400	Rogers and Weber 1994
		1999/2000	195	-	Bryce *et al.* 2002
		2000	147	105 - 249	Kirk *et al.* 2005
		2004	174	97 - 874	Kirk *et al.* 2005
		2007	368	244-745	Peterson 2007 annual report
Altamaha River	GA	1988	2,862	1,069 - 4,226	NMFS 1998
		1990	798	645 - 1,045	NMFS 1998
		1993	468	315 - 903	NMFS 1998
		2003-2005	6,320	4,387-9,249	DeVries 2006
Saint Johns River	FL	2002	1	-	FFWCC 2007

Despite the longevity of sturgeon, the viability of sturgeon populations are highly sensitive to increases in juvenile mortality that result in chronic reductions in the number of sub-adults that recruit into the adult breeding population (Anders *et al.* 2002, Gross *et al.* 2002, Secor *et al.* 2002). This relationship caused Secor *et al.* (2002) to conclude that sturgeon populations can be grouped into two demographic categories: populations that have reliable (albeit periodic) natural recruitment and those that do not. The shortnose sturgeon populations without reliable natural

recruitment are at risk of becoming critically endangered, extinct in the wild, or extinct over portions or the entirety of their range.

Several authors have also demonstrated that sturgeon populations generally, and shortnose sturgeon populations in particular, are much more sensitive to adult mortality than other species of fish (Boreman 1997, Gross *et al.* 2002, Secor *et al.* 2002). These authors concluded that sturgeon populations cannot survive fishing related mortalities that exceed five percent of an adult spawning run and they are vulnerable to declines and local extinction if juveniles die from fishing related mortalities.

Based on the information available, most extant shortnose sturgeon populations in the northern portion of the species range, from the Delaware River north to the St. John River in Canada, appear to have sufficient juvenile survival to provide at least periodic recruitment into the adult age classes combined with relatively low adult mortality rates sufficient to maintain the viability of most of these populations. As a result, most of these populations appear to be relatively large and stable (Table 5).

Life history

Shortnose sturgeon are anadromous fish that live primarily in slower moving rivers or nearshore estuaries near large river systems. They are benthic omnivores that feed on crustaceans, insect larvae, worms and mollusks (Moser and Ross 1995, NMFS 1998, Collins *et al.* 2008) but they have also been observed feeding off plant surfaces and on fish bait (Dadswell *et al.* 1984).

During the summer and winter, adult shortnose sturgeon occur in freshwater reaches of rivers or river reaches that are influenced by tides; as a result, they often occupy only a few short reaches of a river's entire length (Buckley and Kynard 1985). During the summer, at the southern end of their range, shortnose sturgeon congregate in cool, deep, areas of rivers where adult and juvenile sturgeon can take refuge from high temperatures (Flournoy *et al.* 1992, Rogers and Weber 1994, Rogers and Weber 1995, Weber 1996). Juvenile shortnose sturgeon generally move upstream for the spring and summer seasons and downstream for fall and winter; however, these movements usually occur above the salt- and freshwater interface of the rivers they inhabit (Dadswell *et al.* 1984, Hall *et al.* 1991). Because they rarely leave their natal rivers, Kieffer and Kynard (1993) considered shortnose sturgeon to be freshwater amphidromous (*i.e.* adults spawn in freshwater but regularly enter saltwater habitats during their life). Adult shortnose sturgeon prefer deep downstream areas with soft substrate and vegetated bottoms, if present.

Shortnose sturgeon in the northern portion of the species' range live longer than individuals in the southern portion of the species' range (Gilbert 1989). The maximum age reported for female shortnose sturgeon are: 67 years in the St. John River (New Brunswick), 40 years for the Kennebec River, 37 years for the Hudson River, 34 years in the Connecticut River, 20 years in the Pee Dee River, and 10 years in the Altamaha River (Gilbert 1989 using data presented in Dadswell *et al.* 1984). Male shortnose sturgeon appear to have shorter life spans (Gilbert 1989).

Atlantic sturgeon, *Acipenser oxyrinchus*

Species description and distribution

Atlantic sturgeon are large fish with a long protruding snout. They lack scales and instead have armor-like plates along the dorsal, lateral, and ventral sides. Their historical range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (Smith and Clugston 1997, NMFS 2007). Atlantic sturgeon have been documented as far south as Bermuda and Venezuela (Lee *et al.* 1980).

Listing status

Five DPSs of Atlantic sturgeon have been listed under the ESA. The Gulf of Maine DPS was listed as threatened while the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered (77 FR 5880, 77 FR 5914). NMFS has not designated critical habitat for Atlantic sturgeon.

Population designations, abundance, and trends
Atlantic sturgeon throughout their range exhibit ecological separation during spawning that has resulted in multiple, genetically distinct, interbreeding population segments. Studies have consistently found populations to be genetically diverse and indicate that there are between 7 and 10 populations that can be statistically differentiated (King *et al.* 2001, Waldman *et al.* 2002, Wirgin *et al.* 2002, Wirgin *et al.* 2005, Grunwald *et al.* 2008). However, there is some disagreement among studies, and results do not include samples from all rivers inhabited by Atlantic sturgeon. NMFS (77 FR 5880, 77 FR 5914) identified five DPSs in the United States: the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic. Overall, the genetic markers used in this analysis resulted in an average accuracy of 88% for determining a sturgeon's natal river origin, but an average accuracy of 94% for correctly classifying it to one of five DPSs.

Prior to 1890, Atlantic sturgeon populations were at or near carrying capacity. Between 1890 and 1905, Atlantic sturgeon (and shortnose sturgeon) populations were drastically reduced for sale of meat and caviar. Between 1920 and 1998, the harvest level remained very low due to small remnant populations. Prompted by research on juvenile production between 1985 and 1995 (Peterson *et al.* 2000), the Atlantic sturgeon fishery was closed by the Atlantic States Marine Fisheries Commission in 1998, when a coastwide fishing moratorium was imposed for 20-40 years, or at least until 20 year classes of mature female Atlantic sturgeon were present (ASMFC 1998).

Since the closure of the Atlantic sturgeon fishery, the only assessments of adult spawning populations have been made in the Hudson and Altamaha Rivers. While Atlantic sturgeon have been captured, tagged, and tracked through estuaries and rivers along the East Coast, no other estimates of spawning run size or juvenile population sizes have been made. Estimating the number of spawning adults relies on the assumptions that 1) all adults that migrate into the freshwater portion of a river are native to that river and 2) all adults are making that upstream migration with the intention of spawning. Kahnle *et al. (*2007) reported that approximately 870 adults per year returned to the Hudson River between 1985 and 1995. Peterson *et al.* (2008) reported that approximately 324 and 386 adults per year returned to the Altamaha River in 2004 and 2005, respectively.

Juvenile Atlantic sturgeon abundance may be a more precise way to measure the status of Atlantic sturgeon populations because it is believed that all age-1 and age-2 juveniles are restricted to their natal rivers (Dovel and Berggren 1983, Bain *et al.* 1999), avoiding the assumptions noted above. Peterson *et al.* (2000) reported that there were approximately 4,300 age-1 and -2 Atlantic sturgeon in the Hudson River between 1985 and 1995. Schueller and Peterson (2010) reported that age-1 and -2 Atlantic sturgeon population densities ranged from 1,000 to 2,000 individuals over a 4 year period from 2004 to 2007.

Threats
Sturgeon are often caught as bycatch in other fisheries, and this poses a major threat to the species. Most Atlantic sturgeon managers and researchers consider water quality as a moderate risk to every DPS in the United States (ASSRT 2007). During all stages of development, Atlantic sturgeon are sensitive to temperatures above 28°C (Niklitschek and Secor 2005, Kahn and Mohead 2010, Niklitschek and Secor 2010) and dissolved oxygen levels below 4.3 to 4.7 parts per million (Secor and Niklitschek 2002, Niklitschek and Secor 2009a). Juvenile sturgeon are also stressed by high salinities until they mature and out migrate. Additionally, sturgeons generally and Atlantic sturgeon specifically are sensitive to pesticides, heavy metals, and other toxins in the aquatic environment.

Life history
While intensely studied since the 1970s, many important aspects of Atlantic sturgeon life history are still unknown. The general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, iteroparous, anadromous species. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (reviewed in Murawski and Pacheco 1977, Smith and Clugston 1997). Atlantic sturgeon spawn in freshwater, but spend most of their sub-adult and adult life in the

marine environment. While few specific spawning locations have been identified in the United States, through genetic analysis, many rivers are known to support reproducing populations. Early life stage Atlantic sturgeon coupled with upstream movements of adults suggest spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Smith 1985, Bain 1997, Smith and Clugston 1997, Kahnle *et al.* 1998). Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Some rivers may also support a fall spawning migration.

Sub-adult and adult Atlantic sturgeon undertake long marine migrations and utilize habitat up and down the East Coast for rearing, feeding, and migrating (Dovel and Berggren 1983, Bain 1997, Stevenson 1997). These migratory sub-adults, as well as adults, are normally located in shallow (10-50m) near shore areas dominated by gravel and sand substrate (Stein *et al.* 2004). Tagging and genetic data indicate that sub-adult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Once in marine waters, sub-adults undergo rapid growth (Dovel and Berggren 1983, Stevenson 1997). Despite extensive mixing in coastal waters, Atlantic sturgeon display high site fidelity to their natal streams. Straying between rivers within a proposed DPS would sometimes exceed five migrants per generation, but between DPSs was usually less than one migrant per generation, with the exception of fish from the Delaware River straying more frequently to southern rivers (Grundwald *et al.* 2008).

Atlantic sturgeon have been aged to 60 years (Mangin 1964); however, this should be taken as an approximation because the age validation studies conducted to date show ages cannot be reliably estimated after 15-20 years (Stevenson and Secor 1999). Vital parameters of sturgeon populations generally show clinal variation with faster growth, earlier age at maturation, and shorter life span in more southern systems. Spawning intervals range from one to five years for male Atlantic sturgeon (Smith 1985, Collins *et al.* 2000, Schueller and Peterson 2010) and three to five years for females (Vladykov and Greely 1963, Stevenson and Secor 1999, Schueller and Peterson 2010). Fecundity of Atlantic sturgeon has been correlated with age and body size (ranging from 400,000 – 8 million eggs) (Smith *et al.* 1982, Van Eenennaam and Doroshov 1998, Dadswell 2006). The average age at which 50 percent of maximum lifetime egg production is achieved estimated to be 29 years, approximately 3-10 times longer than for other bony fish species examined (Boreman 1997).

Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Gilbert 1989; Smith and Clugston 1997). Hatching occurs approximately 94-140 hrs after egg deposition, and larvae assume a demersal existence (Smith *et al.* 1980). The yolksac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds over a 6 – 12 day period (Kynard and Horgan 2002). During the first half of their migration downstream, movement is limited to night. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia (Kynard and Horgan 2002). During the latter half of migration when larvae are more fully developed, movement to rearing grounds occurs both day and night. Juvenile sturgeon continue to move further downstream into brackish waters, and eventually become residents in estuarine waters for months or years.

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, leatherback, and loggerhead sea turtles and Atlantic and shortnose sturgeon 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, disease and parasites, fisheries interactions, habitat degradation, climate change, marine debris, poaching, contaminants, scientific research, and conservation and management efforts.

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. Turtle mortality associated with shrimp trawls was estimated to be 10 times greater than that of all other human-related factors combined (Smith 1990). Most bycaught turtles were neritic juveniles, the life stage most critical to the stability and recovery of sea turtle populations (Crouse et al. 1987; Crowder et al. 1994).

Harvest records indicate that fisheries for sturgeon were conducted in every major coastal river along the Atlantic coast at one time and were concentrated during the spawning migration (Smith 1985). By 1860, commercial fisheries were established in Delaware, Georgia, Maryland, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, and Virginia (Smith 1990). Records of landings were first kept in 1880 when the U.S. Fisheries Commission started compiling statistical information on commercial fishery landings (ASMFC 1990). Harvest in these early years was heavy, and approximately 3350 metric tons were landed in 1890 (Smith & Clugston 1997). The majority of the fishery for a fifty-year time period (from 1870-1920) was conducted on the Delaware River and the Chesapeake Bay System with New Jersey and Delaware reporting the greatest landings. Landings reported until 1967 likely included both Atlantic and shortnose sturgeon. Shortnose sturgeon were granted federal protection in 1967, and therefore harvest was illegal in subsequent years. During the 1970's and 1980's, the focus of fishing effort shifted to South Carolina, North Carolina, and Georgia, which accounted for nearly 80% of the total U.S. landings. Catch between 1990 and 1996 was centered in the Hudson River and coastal New York and New Jersey (Smith & Clugston 1997). Bycatch of Atlantic sturgeon has been reported in many different fisheries conducted in rivers, estuaries, the nearshore ocean, and the exclusive economic zone. Since Atlantic sturgeon spend portions of their lives in all these areas, they are subject to incidental capture. Atlantic sturgeon recaptures came from commercial fisheries ranging from Maine to North Carolina. The majority of recaptures (61 percent) came from ocean waters within 4.8 km of shore, 20 percent of the recaptures came from rivers and estuaries, 18 percent from the EEZ, and one percent were captured at unreported locations (Atlantic Sturgeon Status Review Team 2007); however, effects of bycatch at the species level are not readily available.

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 sea walls, rock revetments, and sandbag installations. It can be reduced by beach renourishment projects, which result in altered beach and sand characteristics, affecting nesting activity and nest success. 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 & Scott 1991; Mortimer 1982), they are particularly affected by beachfront development and clearing of dune vegetation (Mortimer & 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 percent of some olive ridley hatchlings disoriented upon emergence in some years (Karnad et al. 2009; Witherington 1992; Witherington & Bjorndal 1991). 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 (Francour et al. 1999; Lee Long et al. 2000; Waycott et al. 2005). 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. 1997a). Hawksbills are typically associated with coral reefs, which are among the world's most endangered marine ecosystems (Wilkinson 2000b).

Loss of habitat and poor water quality contributed to the decline of sturgeon since European settlement; however, the importance of this threat has varied over time and from river to river. Some important aspects of habitat quality, especially water quality, have improved during the last 25 – 30 years. Dams for hydropower generation and flood control can have profound effects on anadromous species by blocking access to spawning habitat, changing free-flowing rivers to reservoirs, and altering downstream flows and water temperatures. Riverine, nearshore, and offshore areas are dredged for commercial shipping and recreational boating, construction of infrastructure, and marine mining. Dredging activities pose significant impacts to aquatic ecosystems by removing, disturbing and resuspending bottom sediments. Indirect harm to sturgeon from either mechanical or hydraulic dredging includes destruction of benthic feeding areas, disruption of spawning migrations, and deposition of resuspended fine sediments in spawning habitat.

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. Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009).

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 & Witherington. 1987). Egg poaching is a more serious problem in Puerto Rico (Matos 1987).

Poaching is likely a threat to sturgeon, but its impact to individual population segments is unknown. Poaching may be more prevalent where legal markets for sturgeon exist from importations, commercial harvest, or commercial culture.

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 (Anan et al. 2001; Barbieri 2009; Fujihara et al. 2003; Garcia-Fernandez et al. 2009; Gardner et al. 2006; Godley et al. 1999; Saeki et al. 2000; Storelli et al. 2008). Cadmium has been found in leatherbacks at the highest concentration compared to any other marine vertebrate (Caurant et al. 1999; Gordon et al. 1998). 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 (Alava et al. 2006; Corsolini et al. 2000; Gardner et al. 2003; Keller et al. 2005; Keller et al. 2004a; Keller et al. 2004b; McKenzie et al. 1999; Miao et al. 2001; Monagas et al. 2008; Oros et al. 2009; Perugini et al. 2006; Rybitski et al. 1995; Storelli et al. 2007). 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; Davenport et al. 1990; Oros et al. 2009). 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. 2004c; Keller et al. 2006; 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).

Life histories of Atlantic and shortnose sturgeon (i.e., long lifespan, extended residence in estuarine habitats, benthic foraging) predispose sturgeon to long-term, repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979, NMFS 1998). However, there has been little work on the effects of contaminants on sturgeon to date. Shortnose sturgeon collected from the Delaware and Kennebec Rivers had total toxicity equivalent concentrations of polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), PCBs, DDE, aluminum, cadmium, and copper above adverse effect concentration levels reported in the literature (ERC 2002, 2003). Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not known (Ruelle and Henry 1992, Ruelle and Keenlyne 1993). High levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron *et al*. 1992, Longwell *et al*. 1992, Hammerschmidt *et al.* 2002, Giesy *et al.* 1986, Mac and Edsall 1991, Matta *et al*. 1998, Billsson *et al.* 1998), reduced survival of larval fish (Berlin *et al.* 1981, Giesy *et al*. 1986), delayed maturity (Jorgensen *et al.* 2004) and posterior malformations (Billsson e*t al.* 1998). Pesticide exposure in fish may affect anti-predator and homing behavior, reproductive function, physiological maturity, swimming speed, and distance (Beauvais *et al*. 2000, Scholz *et al*. 2000, Moore and Waring 2001, Waring and Moore 2004). Sensitivity to environmental contaminants also varies by life stage. Early life stages of fish appear to be more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Dwyer *et al*. (2005) compared the relative sensitivities of common surrogate species used in contaminant studies to 17 listed species including shortnose and Atlantic sturgeons. The study examined 96-hour acute water exposures using early life stages where mortality is an endpoint. Chemicals tested were carbaryl, copper, 4-nonphenol, pentachlorophenal (PCP) and permethrin. Of the listed species, Atlantic and shortnose sturgeon were ranked the two most sensitive species tested (Dwyer *et al.* 2005). Additionally, a study examining the effects of coal tar, a byproduct of the process of destructive distillation of bituminous coal, indicated that components of coal tar are toxic to shortnose sturgeon embryos and larvae in whole sediment flow-through and coal tar elutriate static renewal (Kocan *et al.* 1993).

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 percent in the late 1980s to a record high of 20.5 percent in 2004 (NMFS, unpublished data).

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. Rising temperatures may increase feminization of leatherback nests (Hawkes et al. 2007b; James et al. 2006; McMahon & Hays 2006; Mrosovsky et al. 1984). 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. 2007a). 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. 2009a; 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).

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. There are currently 25 active permits directed towards sea turtles in the Atlantic Ocean. Seven permits, including the proposed action, authorize takes for sea turtle mortality.

Atlantic and shortnose sturgeon have been the focus of field studies since the 1970s. The primary purposes of most studies are for monitoring populations and gathering data for physiological, behavioral and ecological studies. The Permits Division recently issued 12 scientific research permits for take of Atlantic sturgeon and 11 scientific research permits targeting shortnose sturgeon.

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 & 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).

Yellow perch, sharks, and seals are predators of shortnose sturgeon juveniles (NMFS 1998).

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. Leatherback hatching success is particularly sensitive to nesting site selection, as nests that are overwashed have significantly lower hatching success and leatherbacks nest closer to the high-tide line than other sea turtle species (Caut *et al.* 2009).

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. 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 & 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 & 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 & 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).

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 and turtle excluder device (TED) requirements. 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. 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 who 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 ACTION

Pursuant to Section 7(a)(2) of the ESA, Federal agencies are directed to insure 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. 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 consequences. The proposed permit would authorize non-lethal "takes" by harassment of listed species during activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. For this Opinion, we define harassment as an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to the population the animal represents. This is similar to the U.S. Fish and Wildlife Service's regulatory definition of "harass" pursuant to the ESA (50 CFR 17.3).

Exposure Analyses

In accordance with Section 10(a)(1)(A) of the Endangered Species Act, the Permits Division determines the maximum number of exempted annual takes allowed (Tables 1 and 2), should the permit be issued. Because this is a new permit, it is not possible to look at previous effort to determine how many turtles are likely to be exposed to the proposed activities. In the past, the Virginia Institute of Marine Science collected turtles from Virginia pound nets and performed similar research activities. They collected 14 Kemp's ridley, three loggerhead, and one green turtle over four years (2007 – 2010; Permit No. 1527). Unlike the proposed research, they did not capture turtles for the sole purpose of research.

The proposed number of takes is 200 turtles for all activities. This includes 110 subadult or adult loggerhead sea turtles of either sex; 56 juvenile, subadult, or adult Kemp's ridley of either sex; 25 juvenile, subadult, or adult green sea turtles of either sex; three juvenile or subadult hawksbill sea turtles of either sex; and four juvenile or subadult leatherback sea turtles of either sex. The proposed take numbers are not unreasonable, and it is possible that 200 sea turtles would be exposed to the activities described above.

Stocks Exposed

Loggerhead turtles from the Northern U.S., Peninsular Florida, Northern Gulf of Mexico, Dry Tortugas, and Greater Caribbean nesting subpopulations of the Loggerhead Northwest Atlantic Ocean DPS are likely to be exposed to all activities. Kemps ridley turtles are likely to be exposed to all activities. Turtles of the Atlantic stocks of green, hawksbill, and leatherback species are likely to be exposed to all activities. Shortnose sturgeon of the Hudson River, Delaware River, Chesapeake Bay, and Potomac River stocks are likely to be exposed to capture via tangle netting. Atlantic sturgeons of the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are likely to be exposed to capture via tangle netting.

Duration of Exposure

For net captures, the duration of exposure would be short because the researchers would remove all turtles and release all bycaught sturgeon immediately. For sea turtle captured in pound nets, sea turtles would be held for up to 48 hours. For turtles taken into captivity, the length of stay would not exceed 48 hours. All turtle research activities would require a maximum of 90 minutes.

Potential Stressors and Response Analyses

For each activity listed below, we identify potential physical, chemical, or biotic stressors. We then describe likely responses to such stressors. Animal responses to human disturbance are similar to their responses to potential predators (Beale & Monaghan 2004; Frid & Dill 2002; Gill & Sutherland 2001; Lima 1998; Romero 2004). These responses include interruptions of essential behavior and physiological processes such as feeding, mating, resting, digestion, etc. Each of these can result in stress, injury, and increased susceptibility to disease and predation (Frid & Dill 2002; Romero 2004).

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. When possible, we base the likelihood of a response on previously collected data describing the species' responses to similar stressors; however, when that data is not available, we use information from other species to proximate the target species' response.

Critical habitat

The action area does not overlap with critical habitat of any endangered or listed species. None of the activities are likely to affect critical habitat of any species.

Sea turtle response to survey and close approach

The researchers propose to survey and approach sea turtles. These activities simulate predatory behavior. Turtles would likely respond by diving or swimming away from the vessel, which could interfere with foraging or resting behavior. Their response, however, would be transient and would not reduce foraging to an extent that would reduce their fitness. Surveys and close approaches also increase the potential for collision with turtles. This could result in injury or death. The researchers would operate their vessels at slow speeds and would be actively looking for turtles. They would approach all turtles slowly and cautiously. Given these precautions, the risk of a collision is discountable, i.e., unlikely to occur. Though survey and close approach activities are likely to adversely affect sea turtles, they would not reduce the fitness of any individual.

Sea turtle response to capture by netting

The researchers propose to capture turtles in hand and hoop nets. As with any net, there is potential for entanglement, injury, and drowning; however, we think that the likelihood of these outcomes is discountable. The researchers would actively handle these nets; i.e., they would not leave the nets unattended. They would place these nets around the turtle and would immediately release the turtle if injury seemed imminent. The turtle would not be submerged long enough to drown. The turtle would likely experience stress as a result of capture; however, the response would be transient and would not reduce the fitness of any individual. Therefore, capture of sea turtles via hand or hoop nets is likely to adversely affect an individual but is not likely to reduce its fitness.

The researchers propose to capture sea turtles in tangle nets. There is potential for entanglement, injury, and drowning in a tangle net because a portion of the net is submerged for short periods of time. To reduce the likelihood of such outcomes, the researchers would continuously monitor the nets for movement and check the net every 30 minutes or less (every 20 minutes or less for water temperatures $\leq 10^{o}$C or $\geq 30^{o}$C). An entangled turtle is likely to likely experience stress as a result of capture. Its weight and movement would cause the floats to sink and the net to move, signaling the researchers of its presence. Because they would quickly remove the turtle from the net, the stress caused to the turtle is expected to be transient. We do not expect entangled turtles to drown or experience any long-term fitness consequences. While capture of sea turtles via tangle nets is likely to adversely affect sea turtles, it is not likely to reduce their fitness.

Sea turtle response to being held in pound nets
Turtles would also be captured by fishermen in dredge mitigation trawls and pound nets. The turtles captured in dredge mitigation trawls would be immediately transferred to the researchers. We do not expect this transfer to adversely affect sea turtles. The turtles captured in the pound nets would be held for up to 48 hours before being transferred to the researchers. During this time, the turtle would be swimming freely and feeding on prey also captured by the pound net. Sea turtles are not likely to be adversely affected by being held within the pound net.

Sea turtle response to handling, carapace marking, photography, measuring, weighing, and sonography
The researchers propose to handle, measure, weigh, mark, photograph, and ultrasound turtles. They would measure and weigh turtles as quickly as possible. The Permits Division would require the researchers to follow procedures designed to minimize the risk of either introducing or transmitting pathogens. They would use non-toxic paints to mark the carapace. Ultrasound is non-invasive and would have no effect on turtles (Owens 1999). Turtles would be handled with care, kept moist, protected from temperature extremes, and returned to the sea. These activities are simple and non-invasive. Turtles are likely to respond with raised levels of stress hormones; however, we expect these responses to be transient and to have no lasting effects. We do not expect any injury associated with these activities. Though these activities are likely to adversely affect sea turtles, we do not expect any individual to experience a loss in fitness.

Sea turtle response to flipper tagging and PIT tagging
The researchers propose to attach flipper and PIT tags to turtles. Tagging activities are minimally invasive. 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. We expect 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. 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, tagging is likely to adversely affect sea turtles, but it is not likely to reduce the fitness of any individual.

Sea turtle response to specimen collection and epibiota removal
The researchers proposed to collect biological specimens from sea turtles. They would collect blood, tissue, scute, and muscle samples; obtain swabs from fecal, oral and nasal cavities; and remove tumors and epibiota from external surfaces. Swabbing is minimally invasive or opportunistic and not expected to adversely affect sea turtles. The removal of tumors and epibiota would be beneficial to the turtle. Blood, tissue, and muscle collection require penetration of the skin, which would likely cause pain and discomfort for the turtle; there is also potential for infection. Sample collection sites would be disinfected with alcohol or other antiseptic prior to sampling. The researchers would draw a small amount of blood (3 ml per 1 kg), which is not expected to increase the heart rate or stress hormones of turtles (E. Stabenau, pers. comm. to P. Opay, NMFS, 2005). The pain and discomfort experienced by the turtle would be temporary and would not have any lasting effects. These activities are likely to adversely affect sea turtles but are not likely to reduce their fitness.

Sea turtle response to instrument attachment
The researchers propose to attach instruments to sea turtles. Transmitters attached to the carapace of turtles have the potential to increase hydrodynamic drag and affect lift and pitch (Watson & Granger 1998); however, Seminoff et al. (2002a) found that instrumented green turtles returned to areas of initial capture. This suggests that the transmitters and the tagging experience left no lasting effect on habitat use patterns. Furthermore, video camera-equipped green turtles exhibited normal diving behavior and sufficient swimming speeds (Seminoff et al. 2006). The Permits Division would require conditions to mitigate adverse impacts to instrumented turtles. Total weight of the instrument(s) would not exceed five percent of the turtle's body mass. The researchers would attach the

instrument as quickly as possible to minimize stress. They would attach the instrument to ensure that it is as hydrodynamic as possible and poses minimal risk of entanglement. We expect the short-term stresses resulting from instrument attachment to be minimal, and we do not expect the instrument(s) to interfere with the turtles' normal activities after they are released. Therefore, instrument attachment is likely to adversely affect turtles, but it is not likely to reduce their fitness.

Sea turtle response to transport and release
The researchers would transport sea turtles in small boats to and from a medical facility. They would release sea turtles at the capture site. We do not expect these activities to adversely affect sea turtles.

Sturgeon response to incidental capture
The researchers propose to use tangle nets to capture sea turtles. Incidentally, they may capture shortnose or Atlantic sturgeon. Nets are often used to capture sturgeon for directed research, with recommended soak times of 1 hour or less. Using this protocol, over 3,800 sturgeon were captured between 2005 and 2009, without a single mortality (Kahn & Mohead 2010). The researchers propose soak times of 30 minutes or less. Therefore, we do not expect any sturgeon mortalities as a result of capture in tangle nets. Sturgeon are likely to experience discomfort as a result of capture in tangle nets, but we expect this response to be transient. We do not expect any long term responses. Therefore, tangle nets are likely to adversely affect sturgeon, but they are not likely to reduce the fitness of any individuals.

RISK ANALYSES

Fitness is defined as the individual's growth, survival, annual reproductive success and lifetime reproductive success. As described above, the fitness of individuals would not be reduced by the proposed actions. Therefore, we do not expect the viability of any sea turtle or sturgeon populations or species to be affected by the proposed action.

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 foreign non-governmental organizations, state departments of fish and game, state legislature websites, and Nexis. 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 EFFECTS

The narrative that follows integrates and synthesizes the information contained in the *Status of the Species*, the *Environmental Baseline*, and the *Effects of the Action* sections of this Opinion to assess the risk the proposed activities pose to ESA listed sea turtles and shortnose and Atlantic sturgeon. There are no known cumulative effects (i.e., from future state, local, tribal, or private actions) that fold into our risk assessment for this species.

The Permits Division proposes to issue scientific research permit No. 16134 to the VA Aquarium, which would conduct scientific research on sea turtles in Mid-Atlantic coastal areas. The researchers propose to survey, capture, handle, tag, sample, track, and release sea turtles. They would use several methods to capture turtles including: dip nets, hoop nets, and tangle nets. Atlantic and shortnose sturgeon are likely to be captured incidentally during tangle

netting. The researchers would also tag and collect samples from turtles caught in pound nets and dredge mitigating trawls.

The species that would be affected by the action include: loggerhead sea turtle, Northern Atlantic DPS; Kemp's ridley sea turtle; hawksbill sea turtle; green sea turtle; leatherback sea turtle; shortnose sturgeon; and Atlantic sturgeon New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs. As described in the *Status of the Species* and Environmental Baseline sections, turtle populations in the action area experienced declines as a result of over-harvesting (meat and eggs) and fisheries interaction (bycatch). Most species are recovering and showing increases in population size. The sturgeon species experienced declines as a result of overfishing. Current population sizes appear to be stable, though bycatch still threatens the future of these species.

The proposed activities would adversely affect sea turtle and sturgeon species. Capture by nets is likely to adversely affect sea turtles and sturgeon, but it is not likely to reduce the fitness of any individual. Handling, tagging, sampling, and attaching instruments is likely to adversely affect sea turtles, but it is not likely to reduce the fitness of any individual. Because the fitness of individuals is not threatened, population viability and species persistence are not threatened. Furthermore, none of the activities would affect critical habitat of any listed species.

CONCLUSION

After reviewing the current *Status of the Species*; the *Environmental Baseline* for the *Action Area*; the anticipated effects of the proposed activities; and the *Cumulative Effects*, it is our Biological Opinion that the activities authorized by the issuance of scientific research permit No. 16134, as proposed, are not likely to jeopardize the continued existence of green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles or the continued existence of bycaught Atlantic (New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs) or shortnose sturgeon. It is also our Opinion that the activities authorized are not likely to result in the destruction or adverse modification of designated critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act 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 USFWS 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. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, 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 section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Permits Division so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Permits Division has a continuing duty to regulate the activity covered by this incidental take statement. If the Permits Division 1) fails to assume and implement the terms and conditions or 2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the applicant must report progress of the action and its impact on the species to NMFS as specified in the incidental take statement [50 CFR 402.14(i)(3)].

Amount or Extent of Take
Despite mitigation measures aimed at reducing the negative impacts of this project to shortnose and Atlantic sturgeon, NMFS anticipates that the proposed action could potentially result in incidental take of these listed species. Seven sturgeon of either species and any DPS are anticipated to be incidentally captured annually during the five years of this research. This incidental take may include either sex and any life stage. No lethal takes of listed sturgeon are authorized during this project. Should any of these limits be exceeded during project activities, the reinitiation provisions of this Opinion would apply.

Reasonable and Prudent Measures
Reasonable and prudent measures (RPMs) are non-discretionary measures to avoid or minimize take that must be carried out by cooperators for the exemption in section 7(o)(2) to apply. The Permits Division has the continuing duty to regulate the activities covered in this incidental take statement where discretionary Federal involvement or control over the action has been retained or is authorized by law. The protective coverage of section 7(o)(2) may lapse if the Permits Division fails to exercise its discretion to require adherence to terms and conditions of the incidental take statement, or to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Similarly, if any applicant fails to act in accordance with the terms and conditions of the incidental take statement, protective coverage may lapse.

We believe that full application of the project design and mitigation measures included as part of the proposed action, together with use of the RPMs and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of shortnose and Atlantic sturgeon during the proposed action. The RPMs require the Permits Division to:

1. Ensure completion of a monitoring and reporting program to confirm this Opinion is meeting its objective of limiting the extent of take and minimizing take from permitted activities.
2. Minimize the impact of incidental take resulting from capturing and handling shortnose and Atlantic sturgeon.

Terms and Conditions
To be exempt from the prohibitions of section 9 of the ESA, the Permits Division and the applicant must comply with the following terms and conditions, which implement the RPMs described above. Partial compliance with these terms and conditions may invalidate this take exemption, result in more take than anticipated, and lead us to a different conclusion regarding whether the proposed action will result in jeopardy or the destruction or adverse modification of critical habitat.

To implement RPM 1 (monitoring), the Permits Division shall:

- Report any sturgeon interactions to the NMFS' Chief of the Endangered Species Act Interagency Cooperation Division, Office of Protected Resources.
- Report total captures of shortnose and Atlantic sturgeon in the annual reports that would be required under proposed Permit 16134.

To implement RPM 2 (minimize impact), the Permits Division shall:

- Require the permit holder to handle fish with care, and return them to the water as quickly as possible. As described in the conditions in permit 16134, efforts must be made to return the fish to neutral buoyancy prior to and during release. Air must be released by gently applying ventral pressure in a posterior to anterior direction. The specimen must then be propelled rapidly downward during release.
- Suspend all permitted activities in event the incidental takes are exceeded or if a serious injury or mortality occurs. The permit holder is then required to report the incident to the Permits Division within two business days and also submit a written incident report. The Permits Division would then either allow

permitted activities to resume with modifications, or revoke the permit based on review of the incident report and in consideration of the Terms and Conditions of the permit.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act 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 the sea turtle recovery team 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.

2. *Estimation of actual levels of "take."* The Permits Division should review the annual reports and final reports submitted by researchers that have conducted research on sea turtles as well as any data and results that can be obtained from the permit holders. This should be used to estimate the numbers of sea turtles killed and harassed by these investigations, and how the harassment affects the life history of individual animals. The results of the study should be provided to us for use in the consultations of future research activities.

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

REINITIATION NOTICE

This concludes formal consultation and conference on the proposal to issue scientific research permit (No. 16134). As described 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 proposed 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, NMFS Office of Protected Resources – Permits and Conservation Division must immediately request reinitiation of Section 7 consultation.

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