

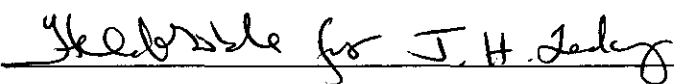
**NOAA's National Marine Fisheries Service  
Endangered Species Act Section 7 Consultation**

**Biological Opinion**

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

**Activity Considered:** The Proposal to Issue Permit No. 16146 to Dr. Kristen Hart of the United States Geological Survey for Research on the Biology, Distribution, and Abundance of Sea Turtles at Buck Island Reef National Monument, United States Virgin Islands, pursuant to section 10(a)(1)(A) of the Endangered Species Act

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

**Approved by:** 

**Date:** Dec. 15, 2011

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 *et seq.*) 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" listed species or designated critical habitat, that agency is required to consult formally with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the listed resources that may be affected. Federal agencies are exempt from this requirement if they have concluded that an action "may affect", but is "unlikely to adversely affect" listed species or designated critical habitat, and NMFS and/or USFWS concur with that conclusion (50 CFR 402.14[b]).

For the actions described in this document, the action agency is NMFS' Office of Protected Resources – Permits and Conservation Division (Permits Division). The consulting agency is NMFS' Office of Protected Resources – Endangered Species Act Interagency Cooperation Division (ESA Interagency Cooperation Division). This document represents NMFS' Biological Opinion (Opinion) of the effects of the proposed research activities on listed threatened and endangered species and designated critical habitat in accordance with section 7 of the ESA. This Opinion is based on information submitted by the Permits Division as part of their initiation package (i.e. draft environmental assessment and draft permit), recovery plans, published and unpublished

scientific information on the biology and ecology of the listed species affected, and other relevant sources of information.

## **CONSULTATION HISTORY**

On September 6, 2011, the Permits Division requested consultation with the ESA Interagency Cooperation Division on a proposed action to issue scientific research permit No. 16146 to Dr. Kristen Hart of the United States Geological Survey (USGS) for research on listed sea turtles located off Buck Island Reef National Monument (BIRNM), United States Virgin Islands (USVI). The permit would be valid for five years from the date of issuance. The initiation package included the permit application from the applicant, a draft of the proposed permit, and the draft Environmental Assessment detailing the anticipated effects of the proposed action.

Upon reviewing the initiation package, the ESA Interagency Cooperation Division initiated formal consultation on September 6, 2011.

## **BIOLOGICAL OPINION**

### **DESCRIPTION OF THE PROPOSED ACTION**

The Permits Division proposes to issue permit No. 16146 to Dr. Kristen Hart of the USGS for scientific research activities resulting in direct “takes”<sup>1</sup> of listed loggerhead (*Caretta caretta*) [Northwest Atlantic Ocean Distinct Population Segment (DPS)], green (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricata*) sea turtles in BIRNM, USVI, pursuant to section 10(a)(1)(A) of the ESA. Takes are expected to be in the form of capture, wounding, and harassment<sup>2</sup>. Capture of listed sea turtles would occur using dipnets, cast nets, tangle nets, rodeo, and hand capture while snorkeling. Wounding would occur due to flipper and passive integrated transponder (PIT) tag insertion as well as from blood and tissue sampling. Harassment would occur from capture, handling, measuring, weighing, tagging (using flipper, PIT, satellite, acoustic, and data-logging

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1 The ESA defines “take” as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct

2 The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act defines harassment as “any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal population in the wild or has the potential to disturb a marine mammal or marine mammal population in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering” [16 U.S.C. 1362(18)(A)]. The latter portion of this definition (that is, “...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering”) is almost identical to the USFWS’ regulatory definition of “harass” pursuant to the ESA. For this Opinion, “harassment” is defined similarly: 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.

tags), lavage, tissue sampling, blood sampling, fecal sampling, and transport to land-based facilities during inclement weather or other extenuating circumstances.

The objective of the research is to document habitat-use patterns over time, increase understanding of genetic stock structure, and estimate vital rates and local population abundance of loggerhead, green, and hawksbill sea turtles around BIRNM. The permit would be valid for five years from the date of issuance. This ESA Section 7 consultation considers the effects of the proposed research studies on listed species and designated critical habitat occurring within the action area. **Table 1** below displays the take of listed species for permit No. 16146 as proposed by the Permits Division. No mortality is currently authorized as part of the proposed action and all captured turtles are expected to be released alive.

**Table 1. Proposed Takes of Listed Species for Permit No. 16146**

SPECIES	NO. ANIMALS	TAKE ACTION	OBSERVE/ COLLECT METHOD	PROCEDURES
Green Sea Turtle	140	Capture/ Handle/ Release	Hand and/or Dip Net; Rodeo, Tangle Net, Cast Net	Count/Survey; Epibiota removal; Lavage; Mark, carapace (temporary); Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Recapture (gear removal); Sample, blood; Sample, Fecal; Sample, tissue; Weigh
Green Sea Turtle*	20	Capture/ Handle/ Release	Hand and/or Dip Net; Rodeo, Tangle Net, Cast Net	Instrument, drill carapace attachment; Instrument, epoxy attachment (e.g., satellite tag, VHF tag)
Hawksbill Sea Turtle	160	Capture/ Handle/ Release	Hand and/or Dip Net; Rodeo, Tangle Net, Cast Net	Count/Survey; Epibiota removal; Lavage; Mark, carapace (temporary); Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Recapture (gear removal); Sample, blood; Sample, Fecal; Sample, tissue; Weigh
Hawksbill Sea Turtle*	30	Capture/ Handle/ Release	Hand and/or Dip Net; Rodeo, Tangle Net, Cast Net	Instrument, drill carapace attachment; Instrument, epoxy attachment (e.g., satellite tag, VHF tag)
Loggerhead Sea Turtle	15	Capture/ Handle/ Release	Hand and/or Dip Net; Rodeo, Tangle Net, Cast Net	Count/Survey; Epibiota removal; Instrument, drill carapace attachment; Instrument, epoxy attachment (e.g., satellite tag, VHF tag); Lavage; Mark, carapace (temporary); Mark, flipper tag; Mark, PIT tag; Measure; Photograph/Video; Recapture (gear removal); Sample, blood; Sample, Fecal; Sample, tissue; Weigh

\*Note: Green and hawksbill sea turtles fitted with satellite and/or VHF tags represent additional take to sea turtles already captured (i.e. these numbers represent a subset of the 140 green and 160 hawksbill sea turtles captured for other research activities).

Researchers will perform preliminary, gridded surveys across all aquatic habitats less than 20 meters deep within BIRNM to log turtle sightings. The applicant would use this information to identify high-density areas to focus their research efforts. After identifying the high density areas around BIRNM, researchers will conduct multiple sampling trips each year with each trip lasting approximately seven to ten days to complete. Sampling trips are expected to occur several months apart rather than occurring consecutively. The following is a summary of the research activities to be performed during each sampling trip:

### *Capture*

Researchers would capture turtles using three different netting methods (i.e., dip-nets, cast nets, tangle nets) and two different hand capture techniques (i.e., in-water rodeo capture and hand capture while snorkeling) depending on the situation and the size of the individual. The applicant proposes to capture up to 160 green, 180 hawksbill, and 15 loggerhead sea turtles each year (see **Table 1** above).

Dip nets and cast nets would be used when turtles are spotted at or near the surface in shallow water. One meter by one meter dip nets with 15 foot (ft) long handles would be used to lift turtles out of the water and on to the boat deck. Cast nets encircle the turtle and capture it when researchers pull the “draw” string that clinches the lead weights together. Tangle nets are stationary nets set in the water that capture sea turtles as they passively swim into them. Tangle nets will be 100-250 meters long and 4-5 meters deep and composed of 20 centimeter (cm) stretch-mesh multifilament nylon netting. Large, moving bullet floats are attached every 3-4 meters at the surface to help researchers identify when an animal has become entangled. In addition to the monitoring at the surface, tangle nets will be physically checked at least every 30 minutes (min) with snorkelers who will constantly swim the length of the net during the time it is deployed in the water. Once an individual is entangled, the animal will be immediately freed of the net and will be brought on board for further processing. Any bycatch will be freed of the net and released.

Researchers also intend to capture sea turtles using in-water rodeo and hand capture while snorkeling. Under the rodeo capture method, two researchers would enter the water and grab the turtle at the nucha and rear end of the carapace and then grab one limb to help restrain the animal before guiding it to the surface. Diver-assisted captures would involve slow ascent to ensure no rapid change in depth. Once at the surface, the researchers will guide the turtle to the boat and two additional researchers would help lift the turtle onto a foam pad on board the boat deck. The boat’s engines would remain in neutral during this process. For hand capture underwater, researchers may also surface and guide the turtle to a moored boat, although the techniques utilized for restraining the turtle would be the same.

### *Handling, Size Measurements, and Carapace Marking*

Under ideal weather conditions, all captured turtles will be brought on board and held for no more than 1.5 hours (hr) each in order for researchers to complete all proposed tasks. Upon capture, each turtle will be placed in its own padded rectangular plastic tub approximately two ft wide by three ft long by one ft deep. Two to four boxes containing one turtle each will be on board the 26 ft research vessel at any one time. In situations of bad weather or other extenuating circumstances, researchers will transport captured turtles to a holding facility on land until conditions allow for researchers to return to the sample site. Under these situations, researchers will secure the boxes to the boat with lines, cover the turtles' eyes with a wet towel, and navigate slowly and safely to the destination. On land, the turtles will be kept in a cool environment to avoid overheating and the towels will remain wet and over the turtles eyes to minimize stress to the animal. Turtles will then be released close to the area where they were captured as weather conditions allow.

On board the vessel, researchers will take standard morphometric measurements (straight carapace length and width) using Forestry Suppliers calipers. Turtles will be weighed by placing each individual on a five foot by five foot small mesh net, looping the hook end of a spring scale into the net, and lifting the scale to measure the turtle's weight/mass. Each turtle will also be photographed and the carapace will be marked with a temporary white paint to help researchers identify turtles that have been already been caught.

### *Blood Sampling*

For adult and subadult sea turtles weighing over five kilograms (kg), researchers will take 20 milliliter (ml) blood samples using a vacutainer hub and a sterile, 21-gauge, 1-1.5 inch (in) needle (for adults) or a 23 gauge, 0.5 in needle (for subadults) inserted into the dorso-cervical sinus. Prior to inserting the sterile vacutainer needle, the turtle will be positioned with the head lower than the rest of the body and the blood draw site will be prepped with 70 percent ethanol and Betadine or alcohol to prevent infection. A maximum of four blood sticks (two on each side of the neck) would be attempted per individual. Blood samples in tubes would be kept on ice in a small cooler for up to four hrs before being transferred to a lysis buffer or being centrifuged and subsequently frozen.

### *Skin/Tissue Sampling*

Researchers will take a small [six millimeters (mm) in diameter] skin/tissue sample from each captured turtle using new, sterile, AcuPunch biopsy tools. The sampling area would be cleaned and disinfected prior to and after the procedure to avoid infection. Samples would be stored in ethanol or in a 20 percent DMSO buffer saturated in salt for further processing. In accordance with permit conditions, researchers will refrain from taking samples from any compromised individuals (e.g., those that are emaciated or having heavy parasite loads, bacterial infections, etc.).

### *Fecal Sampling*

Researchers will also collect fecal samples from captured turtles either opportunistically or by digital extraction from the cloaca. For the latter, turtles will be temporarily overturned and restrained while one researcher wearing lubricated latex gloves will insert

fingers into the turtle's cloaca to feel for and extract fecal matter. Collected fecal matter will be placed into either a polyethylene bag or a conical centrifuge tube and placed on ice. As a condition of the proposed permit, turtles must be larger than 50 cm straight carapace length (SCL) for researchers to perform digital fecal extraction.

#### *Gastric (Oral) Lavage*

Turtles larger than 25 cm SCL would be subject to lavage. For each oral lavage attempt, the turtle will be placed on their carapace so that their head is positioned lower than the dome of the carapace to facilitate optimal drainage of the food contents. A thin stainless steel pry bar, cleaned prior to insertion with ethanol, will be used to separate the maxilla and mandible. Pry bars will be rounded and smooth in shape in order to avoid damaging the mouth cavity. A standard veterinary mouth gag would be inserted at the anterior end of the mouth. Lavage would be conducted using a two-tube method, with one tube used to pump water into the turtle and one tube used for expelling food and water into a collection bucket.

After the tip of the retrieval tube has been lubricated with vegetable oil, it is gently inserted into the esophagus. Obstruction of entry to the esophagus by the glottis can be overcome by using the pry bar to gently depress the glottis. After the water insertion tube passes the esophageal muscle groups (but prior to full insertion towards the food bolus), researchers will begin to pump water into the turtle using a hand operated bilge pump. Care is taken not to deliver water at pressures or volumes greater than what is easily expelled by the turtle. Return flow should begin within seconds of water entering the turtle. If no water is retrieved, the tube will be withdrawn slightly to allow free entry of water into the tube. If no water exits after 15-20 seconds, the gastric lavage will be halted and the tube will be removed and reinserted to attempt the procedure again; however, the entire process (including any re-insertions) will not exceed three minutes to reduce the chance of the turtle inhaling during the process.

Gastric lavage is deemed successful once food particles are seen traveling into the collection bucket. After food samples are collected, the use of the bilge pump will be ceased and water and food are then allowed to drain until all flow has stopped. The researchers will keep the turtles' heads elevated to allow for drainage of any remaining water towards the esophagus. Turtles will be held in this position until regular breathing resumes. Food samples from gastric lavage will be stored in 10 percent formalin solution and will be sorted under the methods described for fecal sampling.

#### *Flipper and PIT Tagging*

All captured sea turtles will be tagged with four Inconel flipper tags and one PIT tag. Double tagging minimizes the probability of complete tag loss of sampled turtles during the study. All tags and application sites will be cleaned and scrubbed with Betadine or alcohol prior to application to avoid infection. To avoid injury and to minimize tag loss, researchers would ensure that flipper tags are securely folded over and strategically located to accommodate future growth in young turtles. All PIT tags will be applied within the soft, fleshy area dorsal to the wrist bones of the front flipper. Researchers will insert the needle at a seam between scales, nearly parallel with the skin of the flipper and

with the needle directed proximally. Gauze with antiseptic would be placed with slight pressure over the entry point after the needle has been withdrawn, until no bleeding persists.

#### *Satellite Transmitter, Acoustic Transmitter, and Data-Logging Tag Attachment*

Researchers are proposing to attach satellite transmitters, acoustic transmitters, and/or data-logging tags (i.e., accelerometers that measure pitch, yaw, and roll) to a subset of the sea turtles captured (i.e., 20 green, 30 hawksbill, and 15 loggerhead, respectively). Only turtles larger than 30 cm SCL will be attached with transmitters and only turtles larger than 45 cm SCL will be fitted with more than one of these tag types to ensure that the combined materials will not exceed five percent of the turtle's body weight. In addition, the cool-setting epoxy used to secure the transmitter base will be streamlined for hydrodynamics to minimize buoyancy and/or drag. These methods are common practice and will serve to minimize effects to a turtle's overall swimming ability. All sea turtles fitted with these types of tags will undergo all of the other workup procedures (see sections above) prior to being fitted with tags.

The carapace would be cleaned at the tag site (i.e., anterior vertebral scute) to remove epibionts and sanded lightly before tag attachment. For turtles attached with acoustic tags, Vemco V16 acoustic transmitters [approximately 16 mm diameter, 54-98 mm long, and weighing 9-16 grams (g)] will be attached at the base of the carapace along the posterior marginal scutes. Acoustic transmitters are attached with either cool-setting epoxy or by drill and wire, which would be affixed to the ends of the rear marginal scutes. For turtles fitted with satellite tags, Wildlife Computers SPOT5 satellite tags (approximately 71 mm long x 54 mm wide x 24 mm high, and weighing 115 g) will be centered on the anterior carapace. For turtles fitted with data-logging accelerometer tags, Cefas or Vemco accelerometers (approximately 40 mm long x 28 mm wide x 16.3 mm high, and weighing 7.3 g) would be attached to the highest point of the carapace. If animals are recaptured during the life of the permit and the tag is found to be no longer functioning (e.g., dead battery), the tag would be removed before release. Acoustically tagged animals would be passively monitored/tracked through a suite of fixed acoustic receivers in the area. Researchers expect that based on the expected tag configurations and battery life, satellite tags will remain attached to sea turtles for approximately one year while acoustic tags may remain attached up to seven years.

#### Mitigation Measures

The following section documents the mitigation measures associated with proposed permit No. 16146 to mitigate effects to targeted and any non-targeted protected species during research activities. More detailed information may be found in the draft permit and Environmental Assessment documents. The proposed permit includes the following conditions (among others):

1. In the event a serious injury or mortality<sup>3</sup> of a protected species occurs, the Researchers must suspend permitted activities and contact the Chief of the

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<sup>3</sup> The permit does not allow for unintentional serious injury and mortality caused by the presence or actions of researchers. This includes, but is not limited to; deaths resulting from infections related to sampling

Permits Division by phone within two business days. Researchers must also submit a written incident report. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of the permit.

2. If authorized take is exceeded, the Researchers must cease all permitted activities and notify the Chief of the Permits Division by phone as soon as possible but not later than two business days. Researchers must also submit a written incident report within two weeks of the incident. The incident report must include a complete description of the events and identification of steps that will be taken to reduce the potential for additional exceedance of authorized take.
3. For entanglement netting:
  - a. Nets used to catch turtles must be of large enough mesh size to diminish bycatch of other species.
  - b. Highly visible buoys must be attached to the float line of each net and spaced at intervals of every 10 yards or less.
  - c. Nets must be checked at intervals of less than 30 min, and more frequently whenever turtles or other organisms are observed in the net. If water temperatures are less than or equal to 10 degrees Celsius ( $^{\circ}\text{C}$ ) or greater than or equal to  $30^{\circ}\text{C}$ , nets must be checked at less than 20 min 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.
  - d. The float line of all nets must be observed at all times for movements that indicate an animal has encountered the net. When this occurs the net must be immediately checked.
  - e. Researchers must plan for unexpected circumstances or demands of the research activities and have the ability and resources to meet this net checking condition at all times (e.g. if one animal is very entangled and requires extra time and effort to remove from the net, researchers must have sufficient staff and resources to continue checking the rest of the net at the same time).
  - f. Nets must not be put in the water when marine mammals are observed within the vicinity of the research, and the marine mammals must be allowed to either leave or pass through the area safely before net setting is initiated.

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procedures; and deaths or injuries sustained by animals during capture and handling, or while attempting to avoid researchers or escape capture.



- g. Should any marine mammals enter the research area after the nets have been set, the lead line must be raised and dropped in an attempt to make marine mammals in the vicinity aware of the net.
  - h. If marine mammals remain within the vicinity of the research area, nets must be removed.
  - i. If a marine mammal is entangled, researchers must stop netting activities and immediately free the animal, notify the appropriate NMFS Regional Stranding Coordinator as soon as possible, and report the incident to the Chief of the Permits Division. Permitted activities will be suspended until the Permits Division has granted approval to continue research.
4. For general handling, resuscitation, and release of sea turtles:
- a. Handle turtles according to procedures specified in 50 CFR 223.206(d)(1)(i). Use care when handling live animals to minimize any possible injury.
  - b. Use appropriate resuscitation techniques on any comatose turtle prior to returning it to the water.
  - c. When possible, transfer injured animals to rehabilitation facilities and allow them an appropriate period of recovery before return to the wild.
  - d. Name an experienced veterinarian, veterinary technician, or rehabilitation facility for emergencies.
  - e. If an animal becomes highly stressed, injured, or comatose, researchers must contact a veterinarian immediately. Based on the instructions of the veterinarian, if necessary, the animal must be immediately transferred to the veterinarian or to a rehabilitation facility to receive veterinary care.

The Permit Holder is responsible for following the status of any sea turtle transported to rehab as a result of permitted activities and reporting the final disposition (death, permanent injury, recovery, and return to wild, etc.) of the animal to the Chief of the Permits Division.

- f. For compromised or injured sea turtles:
  - i. The Permit Holder may conduct activities authorized by this permit on compromised or injured sea turtles, but only if the activities will not further compromise the animal. Care must be taken to minimize handling time and reduce further stress to the animal.

- ii. Compromised or injured sea turtles must not be handled or sampled by other permit holders working under separate research permits if their activities would further compromise the animal.
  - g. Turtles are to be protected from temperature extremes of heat and cold, provided adequate air flow, and kept moist during sampling. Turtles must be placed on pads for cushioning and this surface must be cleaned and disinfected between turtles. The area surrounding the turtle must not contain any materials that could be accidentally ingested.
  - h. During release, turtles must be lowered as close to the water's surface as possible to prevent potential injuries.
  - i. Researchers must carefully observe newly released turtles and record observations on the turtle's apparent ability to swim and dive in a normal manner. If a turtle is not behaving normally within one hour of release, the turtle must be recaptured and taken to a rehabilitation facility.
5. For handling, measuring, weighing, and marking:
- a. Researchers must clean and disinfect all equipment (tagging equipment, tape measures, etc.) that comes in contact with sea turtles between the processing of each turtle.
  - b. Researchers must maintain a separate set of sampling equipment for handling animals displaying fibropapillomas tumors or lesions. All equipment that comes in contact with the turtle must be cleaned and disinfected between the processing of each turtle.
  - c. Researchers must clean and disinfect flipper tags (e.g., to remove oil residue) before use. Applicators must be cleaned (and disinfected when appropriate, e.g., contaminated with fluids) between animals. The application site must be cleaned and then scrubbed with a disinfectant (e.g., Betadine) before the tag pierces the animal's skin.
  - d. For PIT tagging:
    - i. Use new, sterile tag applicators (needles). The application site must be cleaned and then scrubbed with a disinfectant (e.g. Betadine) before the applicator pierces the animal's skin. If it has been exposed to fluids from another animal, the injector handle must be disinfected between animals.
    - ii. Researchers must examine turtles for existing flipper and PIT tags before attaching or inserting new ones. If existing tags are found, the tag identification numbers must be recorded and included in the annual report. Researchers must have PIT tag readers capable of reading 125, 128, 134.2, and 400 kilohertz (kHz) tags.

- e. For painting of the carapace:
  - i. Researchers must use non-toxic paints that do not contain xylene or toluene.
  - ii. For turtles approximately four years old or younger, paint must be applied without crossing suture lines (margins) if the paint will remain on the shell for three months or more.
  - iii. For juvenile turtles older than four years of age, paint must be applied without crossing suture lines (margins) if the paint will remain on the shell for one year or more.
  - iv. For adult turtles, paint must be applied without crossing suture lines (margins) if the paint will remain on the shell for two years or more.

6. For blood sampling:

- a. Blood samples must be taken by experienced personnel.
- b. New disposable needles must be used on each animal. Care should be taken to ensure no injury results from the sampling.
- c. Collection sites must always be scrubbed with alcohol or another antiseptic prior to sampling.
- d. Care should be taken to ensure no injury results from the sampling. If an animal cannot be adequately immobilized for blood sampling or conditions on the boat preclude the safety and health of the turtle, samples must not be taken.
- e. Attempts (needle insertions) to extract blood from the neck must be limited to a total of four, two on either side.
- f. A single sample must not exceed three ml per 1 kg of animal.
- g. Sampling period- Within a 45-day period of time, the cumulative blood volume taken from a single turtle must not exceed the maximum safe limit described above. If more than 50 percent of the maximum safe limit is taken, in a single event or cumulatively from repeat sampling events, from a single turtle within a 45-day period that turtle must not be re-sampled for three months from the last blood sampling event.
- h. Research coordination- Researchers must, to the maximum extent practicable, attempt to determine if any of the turtles they blood sample may have been sampled within the past three months or will be sampled

within the next three months by other researchers. The permit holder must contact the other researchers working in the area that could capture the same turtles to ensure that none of the above limits are exceeded.

7. For biopsy (tissue-skin) sampling:
  - a. A new biopsy punch must be used on each turtle.
  - b. Sterile techniques must be used at all times. Samples must be collected from the trailing edge of a flipper if possible and practicable (preference should be given to a rear flipper if practicable). The tissue surface must be thoroughly swabbed once with both Betadine and alcohol, sampled, and then thoroughly swabbed again with just Betadine. The procedure area and hands must be clean.
  - c. If it can be easily determined (through markings, tag number, etc.) that a sea turtle has been recaptured and has been already sampled under this permit, no further biopsy samples must be collected from the animal over the permit year.
8. Transfer of biological samples- The transfer of any biological samples from the Permit Holder to researchers other than those specifically identified in the application requires written approval from the Chief of the Permits Division.
9. For gastric lavage:
  - a. The actual lavaging of the turtle must not exceed three min.
  - b. Once the samples have been collected, water must be turned off and water and food allowed to drain until all flow has stopped. The posterior of the turtles must be elevated slightly to assist in drainage.
  - c. Equipment (e.g. lavage tubes) that comes in contact with sea turtles must be cleaned and disinfected before use on another animal.
  - d. Researchers must thoroughly clean equipment prior to disinfection (viruses can remain protected in organic matter, the disinfectant can't get to them if they're protected in this manner).
  - e. Disinfectants must be used according to label directions; however, exposure time should be increased for rough and/or porous items (a dip and rinse is not sufficient). Disinfection can be compromised (incomplete) if items are contaminated with debris and/or have rough or porous surfaces.

- f. Care must be taken that disinfecting solutions are clean and active and that proper rinsing occurs after disinfection.
  - g. A separate set of equipment must be used for infected and non-infected animals.
10. For fecal sampling- Turtles must be larger than 50 cm SCL for digital extraction of feces.
11. For instrument tagging and marking:
- a. The total combined weight of all transmitter attachments (i.e., TDRs, VHF, sonic, or satellite tags) must not exceed five percent of the body mass of the animal.
  - b. Each attachment must be made so that there is no risk of entanglement. The transmitter attachment must either contain a weak link (where appropriate) or have no gap between the transmitter and the turtle that could result in entanglement. The lanyard length (if used) must be less than  $\frac{1}{2}$  of the carapace length of the turtle. It must include a corrodible, breakaway link that will corrode and release the tag-transmitter after the tag-transmitter life is finished.
  - c. Researchers must make attachments as hydrodynamic as possible.
  - d. Adequate ventilation around the head of the turtle must be provided during the attachment of satellite tags or attachment of radio/sonic tags if attachment materials produce fumes. To prevent skin or eye contact with harmful chemicals used to apply tags, turtles must not be held in water during the application process.
  - e. When drilling through marginal scutes, a separate drill bit must be used for each turtle. Bits may be reused if sterilized by autoclave before reuse.
12. For transport and holding- Turtles must be transported via a climate-controlled environment, protected from temperature extremes and kept moist (if appropriate). The turtles must be placed on pads for cushioning. The area surrounding the turtle must not contain any materials that could be accidentally ingested.
13. For bycatch: All incidentally captured species (e.g. fishes) must be released alive as soon as possible.
14. For any manatees encountered- The following conditions to the permit are provided by the USFWS to prevent adverse interactions with endangered Florida manatees:

- a. Vessel personnel must be informed that it is illegal to intentionally or unintentionally harm, harass, or otherwise "take" manatees, and to obey all posted manatee protection speed zones, Federal manatee sanctuary and refuge restrictions, and other similar state and local regulations while conducting in-water activities. Such information shall be provided in writing to all vessel personnel prior to beginning the permitted research.
- b. Crew involved in research activities must wear polarized sunglasses to reduce glare while on the water and keep a look out for manatee. The crew shall include at least one member experienced in and dedicated to watching for manatee during all in-water activities.
- c. All vessels engaged in netting and trapping shall operate at the slowest speed consistent with those activities. All netting and trapping shall be restricted to the hours between one half-hour after sunrise to one-half hour before sunset.
- d. Rope attaching floats to nets or traps shall not have kinks or contain slack that could present an entanglement hazard to manatees.
- e. All nets and traps must be continuously monitored. Netting activities must cease if a manatee is sighted within a 100-foot radius of the research vessel or the net, and may resume only when the animal is no longer within this safety zone, or 30 min has elapsed since the manatee was last observed within the safety zone.
- f. If a manatee is accidentally captured:
  - i. Devote all research staff efforts to freeing the animal. Remember that a manatee must breathe and surface approximately every 4 minutes. The Permit Holder or Principal Investigator (PI) must brief all research participants to ensure that they understand that freeing a manatee can be dangerous. This briefing will caution people to keep fingers out of the nets, that no jewelry should be worn, that they be careful to stay away from the manatee's paddle, and that they give the animal adequate time and room to breathe as they are freeing it.
  - ii. As appropriate, turn off the vessel motors or put the engine in neutral. Propellers can seriously injure or kill manatees.
  - iii. Release tension on the net to allow the animal the opportunity to free itself. Exercise caution when attempting to assist the animal in freeing itself. Manatees are docile animals but can thrash violently if captured or become entangled in a net. A 1,200 to 3,500 pound (lb) manatee can cause extensive damage to nets

while trying to escape or breathe, so quick action is essential to protect both the manatee and the net. Ensure that the animal does not escape with net still attached to it.

- iv. Contact the Florida Fish and Wildlife Conservation Commission, Division of Law Enforcement immediately to report any incidents. If a manatee is injured, the sooner the animal receives treatment, the better its chance of recovery. Immediately contact Nicole Adimey of the USFWS to report any gear or vessel interactions with manatees. Also contact NMFS (Chief of the Permits Division) as soon as possible.

15. For submerged aquatic vegetation (SAV; e.g., seagrass), coral communities, live or hard bottom ecosystems:

- a. Researchers shall take all practicable steps to identify SAV, coral communities, and live/hard bottom habitats and avoid setting gear in such areas.
- b. Researchers must use strategies to identify SAV, coral, and live or hard bottom types and avoid adverse impacts to essential fish habitat, including the use of tools such as charts, geographic information system software (GIS), sonar, fish finders, or other electronic devices to help determine characteristics and suitability of bottom habitat prior to using gear.
- c. If research gear is lost, diligent efforts shall be made to recover the lost gear to avoid further damage to benthic habitat and impacts related to “ghost fishing”.
- d. For sea grass species- Researchers must avoid conducting research over, on, or immediately adjacent to any non-listed sea grass species. If these non-listed species cannot be avoided, then the following avoidance/minimization measures must be implemented:
  - i. In order to reduce the potential for sea grass damage, anchors must be set by hand when water visibility is acceptable. Anchors must be placed in unvegetated areas within seagrass meadows or areas having relatively sparse vegetation coverage. Anchor removal must be conducted in a manner that would avoid the dragging of anchors and anchor chains.
  - ii. Researchers must take great care to avoid damaging any sea grass species and if the potential for anchor or net drag is evident researchers must suspend research activities immediately.
  - iii. Researchers must be careful not to tread or trample on seagrass and coral reef habitat.

- e. For coral or hard/live bottom habitats- No gear may be set, anchored on, or pulled across coral or hard/live habitats.
16. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities.
17. The PI must be onsite during any activities conducted under this permit unless a Co-Investigator (CI) is present to act in place of the PI. Research assistants cannot conduct permitted activities in the absence of the PI or a CI.
18. Persons who require state or Federal licenses to conduct activities authorized under the permit (e.g. veterinarians, pilots) must be duly licensed when undertaking such activities.
19. The Permit holder must submit annual reports to the Chief of the Permits Division and a final report must be submitted within 180 days after expiration of the permit, or, if the research concludes prior to permit expiration, within 180 days of completion of the research.
20. Research results must be published or otherwise made available to the scientific community in a reasonable period of time.
21. The Permit Holder must provide written notification of planned field work at least two weeks prior to initiation of a field trip/season. If there will be multiple field trips/seasons in a permit year, a single summary notification may be submitted per year.
  - a. Notification must include the locations of the intended field study and/or survey routes, estimated dates of activities, number and roles of participants
  - b. Notification must be sent the Southeast Region's Assistant Regional Administrator(s) for Protected Resources
22. To the maximum extent practicable, the Permit Holder must coordinate permitted activities with activities of other Permit Holders conducting the same or similar activities on the same species, in the same locations, or at the same times of year to avoid unnecessary disturbance of animals.
23. In addition to the terms and conditions of this permit, Researchers must comply with protocols provided by the Regional Administrators related to coordination of research, including additional mitigation and monitoring protocols deemed necessary to minimize unnecessary duplication, harassment, or other adverse impacts from multiple permit holders.



## APPROACH TO THE ASSESSMENT

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

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

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

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

When individual listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions are likely to reduce the abundance, reproduction, or growth rates (or increase the variance in these measures) of the

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

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

Reducing the viability of a population is not always *sufficient* to reduce the viability of the species those populations comprise. Therefore, in the final step of our analyses, we determine if reductions in a population's viability are likely to reduce the viability of the species those populations comprise using changes in a species' reproduction, numbers, distribution, estimates of extinction risk, or probability of being conserved. In this step of our analyses, we use the species' status (established in the *Status of the Species* section) as our point of reference. Our final jeopardy 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.

Destruction or adverse modification<sup>4</sup> determinations must be based on an action's effects on the conservation value of habitat that has been designated as critical to threatened or endangered species. If an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if primary or secondary constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species are likely to respond to that

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<sup>4</sup> We are aware that several courts have ruled that the definition of destruction or adverse modification that appears in the section 7 regulations at 50 CFR 402.02 is invalid and do not rely on that definition for the determinations we make in this Opinion. Instead, as we explain in the text, we use the "conservation value" of critical habitat for our determinations which focuses on the designated area's ability to contribute to the conservation of the species for which the area was designated.

exposure. If primary or secondary constituent elements of designated critical habitat (or physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) are likely to respond given exposure to the direct and/or indirect consequences of the proposed action on the natural environment, we ask if those responses are likely to be sufficient to reduce the quantity, quality, or availability of those constituent elements or physical, chemical, or biotic phenomena.

If the quantity, quality, or availability of the primary or secondary constituent elements of the area of designated critical habitat (or physical, chemical, or biotic phenomena) are reduced, we ask if those reductions are likely to be sufficient to reduce the conservation value of the designated critical habitat for listed species in the action area. In this step of our assessment, we combine information about the contribution of constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species, particularly for older critical habitat designations that have no constituent elements) to the conservation value of those areas of critical habitat that occur in the action area, given the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area.

If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation. In this step of our assessment, we combine information about the constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species) that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. We use the conservation value of the entire designated critical habitat as our point of reference for this comparison. For example, if the designated critical habitat has limited current value or potential value for the conservation of listed species that limited value is our point of reference for our assessment.

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 State or Tribal natural resource agencies, reports from non-governmental organizations involved in marine conservation issues, the information provided by the Permits Division when it initiates formal consultation, and the general scientific literature. We supplement this evidence with reports and other documents – environmental assessments, environmental impact statements, and monitoring reports – prepared by other federal and state agencies whose operations extend into the marine environment.

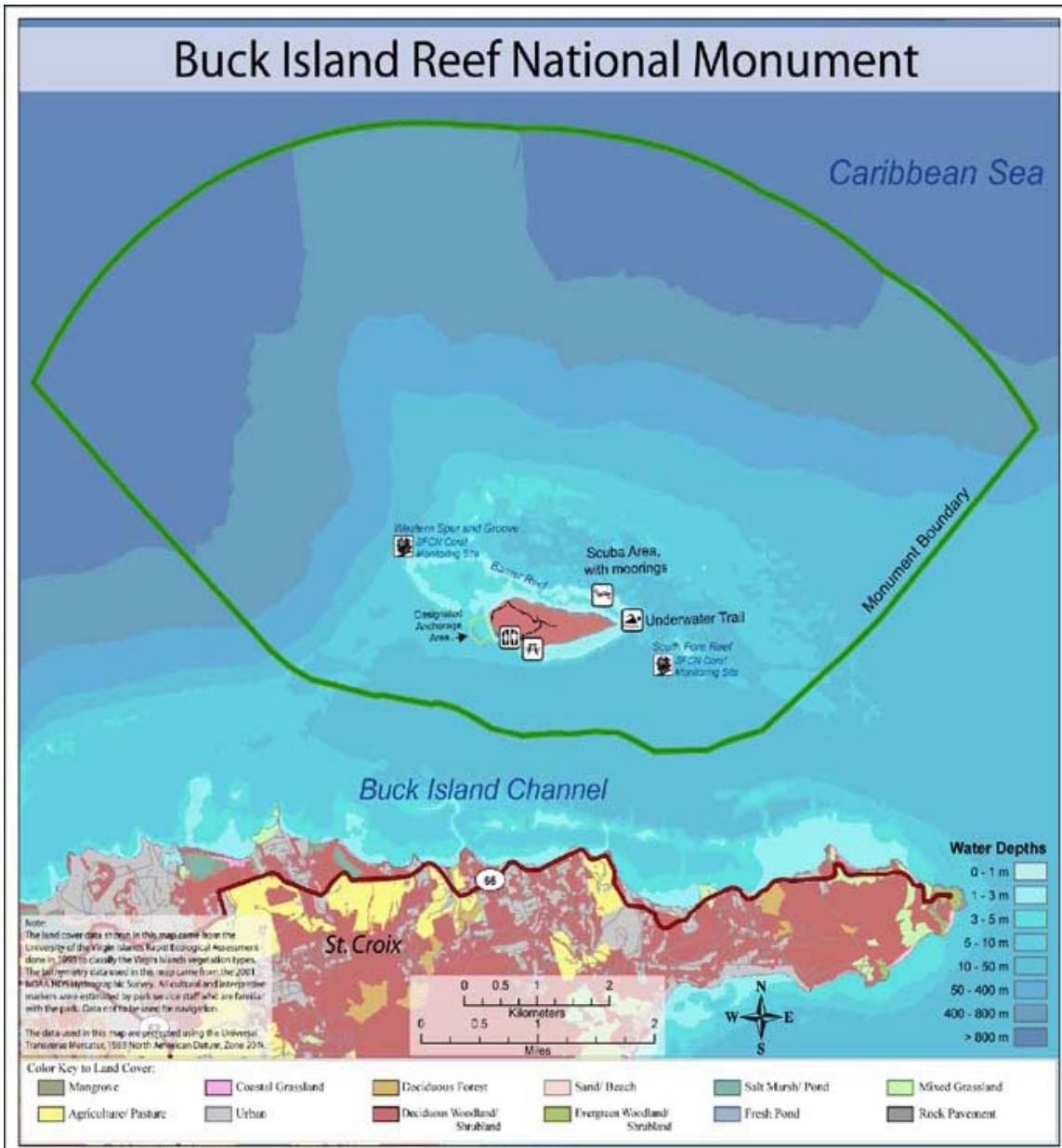
During each consultation, we conduct electronic searches of the general scientific literature using *American Fisheries Society*, *Google Scholar*, *ScienceDirect*, *BioOne*, *Conference Papers Index*, *JSTOR*, and *Aquatic Sciences and Fisheries Abstracts* search engines, among others. We supplement these searches with electronic searches of

doctoral dissertations and master's theses. These searches specifically try to identify data or other information that supports a particular conclusion (for example, a study that suggests sea turtles will exhibit a particular response to a particular tagging procedure) as well as data that does not support that conclusion.

We rank the results of these searches based on the quality of their study design, sample sizes, level of scrutiny prior to and during publication, and study results. Carefully designed field experiments (for example, experiments that control potentially confounding variables) are rated higher than field experiments that are not designed to control those variables. Carefully designed field experiments are generally ranked higher than computer simulations. Studies that produce large sample sizes with small variances are generally ranked higher than studies with small sample sizes or large variances. Finally, in keeping with the direction from the U.S. Congress 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)], when data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks associated with incorrectly concluding an action has no adverse effect on a listed species when, in fact, such adverse effects are likely (i.e. avoiding statistical Type II error in our decisions).

## **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.” In-water work will be concentrated within the BIRNM boundary in water up to 20 m deep (i.e., lighter blue colors within two miles from the shore of Buck Island in **Figure 1** below). BIRNM is located about 1.5 miles north of the eastern side of the island of St. Croix. The monument, which is under the jurisdiction of the National Park Service (NPS), encompasses a small, uninhabited island surrounded by a mosaic of coral reefs, seagrasses and sand patches (Pittman et al., 2008). Acoustic receivers will likely be deployed around the BIRNM boundary, as well as in habitats where sea turtle sightings are concentrated. Therefore, for the purposes of this consultation, the action area is the entire BIRNM as shown in **Figure 1**.



**Figure 1:** Map of the Action Area. Buck Island Reef National Monument contained within the green border. Map included in the research application provided in the Permits Division’s initiation package.

## STATUS OF THE SPECIES

The ESA Interagency Cooperation Division has determined that the following ESA-listed species and designated critical habitat occur within the action area and may be affected by proposed action:

<u>LISTED RESOURCE</u>	<u>SCIENTIFIC NAME</u>	<u>LISTING</u>
<b>Cetaceans</b>		
Blue whale	<i>Balaenoptera musculus</i>	Endangered
Fin whale	<i>Balaenoptera physalus</i>	Endangered
Humpback whale	<i>Megaptera novaeangliae</i>	Endangered
Sei whale	<i>Balaenoptera borealis</i>	Endangered
Sperm whale	<i>Physeter macrocephalus</i>	Endangered
<b>Sea Turtles</b>		
Loggerhead sea turtle Northwest Atlantic Ocean DPS <sup>5</sup>	<i>Caretta caretta</i>	Threatened
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Endangered
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered
Green sea turtle	<i>Chelonia mydas</i>	Threatened/Endangered <sup>6</sup>
Olive ridley sea turtle	<i>Lepidochelys olivacea</i>	Threatened/Endangered <sup>7</sup>
<b>Invertebrates</b>		
Elkhorn Coral	<i>Acropora palmata</i>	Threatened
Staghorn Coral	<i>Acropora cervicornis</i>	Threatened
<b>Critical Habitat</b>		
Elkhorn Coral Critical Habitat		Designated
Staghorn Coral Critical Habitat		Designated

Listed Resources Not Likely to be Adversely Affected

*Blue, Fin, Humpback, Sei, and Sperm Whales*

The ranges of endangered blue, fin, humpback, sei, and sperm whales extend into the action area. However, these species are typically located further offshore in deeper waters than the areas targeted by the proposed research (waters less than 20 m deep). It is highly unlikely that any listed cetacean would be encountered, and thus exposed, to the effects of the proposed action. We consider any potential threats of a ship strike or entanglement to be discountable based on the depths of the targeted research and the onboard and in-water monitoring to be conducted. Therefore, issuance of permit No. 16146 is not likely to adversely affect any listed cetaceans and these species will not be considered further in this Opinion.

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5 A distinct population segment, is a vertebrate population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. The ESA provides for listing species, subspecies, or distinct population segments of vertebrate species.

6 Green sea turtles in U.S. waters are listed as threatened except for the Florida and Mexico Pacific coast breeding colonies, which are listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters.

7 Olive ridley sea turtles are listed as threatened except for Mexico's Pacific coast breeding colony which is listed as endangered.

*Olive Ridley Sea Turtle, Leatherback Sea Turtle, and Leatherback Sea Turtle Designated Critical Habitat*

Some non-nesting Olive ridleys are known to occur near Isla Margarita, Trinidad, and Curaçao in the lower Caribbean region although the species is generally the least abundant marine turtle in the Western Atlantic region and sightings are generally rare in areas north of Suriname, French Guiana, and Brazil (Marcovaldi, 2001; Spotilla, 2004). We expect it extremely unlikely that any Olive ridleys would be exposed to the effects of the proposed action given their rarity in most areas of the Caribbean and the fact that researchers are experienced at conducting turtle surveys and are expected to restrict their research to the targeted species. Therefore, issuance of permit No. 16146 is not likely to adversely affect Olive ridley sea turtles and this species will not be considered further in this Opinion.

Leatherback sea turtles inhabit the waters off the coast of St. Croix and critical habitat is designated on Sandy Point beach and adjacent marine waters from the hundred fathom (182.9 m) curve shoreward to the level of mean high tide (44 FR 17710) on the southwestern corner St. Croix. The potential exists for leatherbacks to be incidentally harassed through net capture (particularly for set nets) based on their known occurrence in St. Croix waters. However, no designated critical habitat exists in the action area as Buck Island is located off the northeast coast and most leatherbacks are expected to occur in deeper waters than those targeted by the researchers. Sandy Point's broad, sandy beaches are located near the shelf edge, thereby allowing the deep-diving leatherbacks to stay in deep water right up to the beach while the waters surrounding Buck Island are shallower and are not considered preferred nesting habitat for the species. Leatherbacks are seldom seen on the shores of Buck Island and park biologists have not spotted any individuals in the water during previous surveys conducted in the action area (Lundgren, personal communication, 2011). Thus, we expect it highly unlikely that any leatherbacks would be exposed to the effects of the proposed action based on these previous observations. Also, the researchers are experienced at identifying sea turtles and the onboard and inwater monitoring to be conducted would restrict activities to the targeted species. Therefore, the issuance of permit No. 16146 is not likely to adversely affect leatherback sea turtles and this species will not be considered further in this Opinion. Similarly, critical habitat designated for the species off Sandy Point beach would not be affected.

*Elkhorn and Staghorn Corals and their Joint Critical Habitat*

Two listed invertebrate species (elkhorn and staghorn coral) and their joint critical habitat occur within the action area and could therefore be subjected to physical disturbance from vessels or nets used for smalltooth sawfish capture or from unexpected contaminant or fuel spill. Permit conditions will require the researchers to avoid impacting sediment or habitat for coral or other live bottom communities. Specific permit conditions include avoiding setting gear over such areas as well as taking steps to recover lost gear, avoiding anchoring in areas where these communities exist, and avoiding treading or trampling on these areas where in-water work does occur. The research team has experience performing similar types of surveys in these areas and is expected to avoid live bottom

areas containing listed corals or areas containing the essential features of elkhorn/staghorn coral critical habitat (i.e. natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover). Researchers are also expected to take all proper precautions to avoid any physical disturbance or minimizing the impact of an accidental fuel spill. NMFS believes that listed corals as well as their critical habitat are highly unlikely to be exposed to effects from the proposed action based on these measures contained in the proposed permit and any potential threats are discountable. Therefore, the proposed action is not likely to adversely affect elkhorn coral, staghorn coral, or their critical habitat and these listed resources will not be considered further in this Opinion.

#### Listed Resources Likely to be Adversely Affected

The sections below provide information on the status of listed resources likely to be adversely affected by the proposed action. The biology and ecology of these species as well as their global status and trends are described below, and inform the effects analysis for this Opinion.

#### ***Loggerhead Sea Turtle Northwest Atlantic Ocean DPS***

##### *Species Description, Distribution, and Population Structure*

Adult and subadult loggerhead sea turtles are characterized as having a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 11 or 12 pairs of marginal scutes, five pairs of costals, five vertebrals, and a nuchal (pre-central) scute that is in contact with the first pair of costal scutes. Hatchlings lack the reddish tinge and vary from light to dark brown dorsally. Both pairs of appendages are dark brown and have distinct white margins. Hatchling mean body mass is about 20 g and mean SCL is about 45 mm (Dodd, 1988).

In the most recent status review conducted for the species, the loggerhead biological review team identified 60°N latitude and the equator as the north-south boundaries and 40°W longitude as the east boundary of the Northwest Atlantic Ocean population segment based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies (Conant et al., 2009). The majority of loggerhead nesting in the Northwest Atlantic is concentrated along the U.S. coast from southern Virginia to Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas, off the southwestern coast of Cuba, and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands (Addison and Morford, 1996; Addison, 1997; Gavilan, 2001). From a global perspective, the loggerhead nesting aggregation in the southeastern U.S. is second in size only to the nesting aggregations in the Arabian Sea off Oman, making it one of the most important nesting aggregations for the species.

Non-nesting, adult female loggerheads are reported in nearshore and offshore waters throughout the U.S. and Caribbean Sea (Foley et al., 2008) and recent tagging studies conducted in the Gulf of Mexico suggest that sea turtles nesting along the Gulf coast of Florida and the Florida Panhandle generally do not leave the region for extended periods



throughout the year [Turtle Expert Working Group (TEWG), 2009]. Significant numbers of male and female loggerheads forage in shallow water habitats with large expanses of open ocean access (such as Florida Bay) year-round while juveniles are also found in enclosed, shallow water estuarine environments (Epperly et al., 1995).

In terms of population structure for the Northwest Atlantic Ocean DPS, NMFS and USFWS (2008) identified and evaluated five separate recovery units (i.e., nesting subpopulations): the Northern U.S. (Florida/Georgia border to southern Virginia); Peninsular Florida (Florida/Georgia border south through Pinellas County, excluding the islands west of Key West, Florida); Dry Tortugas (islands west of Key West, Florida); Northern Gulf of Mexico (Franklin County, Florida, west through Texas); and Greater Caribbean (Mexico through French Guiana, The Bahamas, Lesser and Greater Antilles). All Northwest Atlantic recovery units are reproductively isolated from populations occurring within the Northeast Atlantic, South Atlantic, and Mediterranean Sea. For the purposes of this consultation, we assume that all sea turtles targeted by the researchers would be members of the Greater Caribbean nesting subpopulations based on the proposed study area.

#### *Life History Information*

Loggerhead sea turtles reach sexual maturity between 20 and 38 years of age, although this varies widely among populations (Frazer and Ehrhart, 1985; NMFS, 2001). The annual mating season for loggerhead sea turtles occurs from late March to early June, and eggs are laid throughout the summer months. Female loggerheads deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins, 1984) and have an average remigration interval of 3.7 years (Tucker, 2010). Mean clutch size varies from 100 to 126 eggs for nests occurring along the southeastern U.S. coast (Dodd, 1988). Sand temperatures prevailing during the middle third of the incubation period often determine the sex of hatchlings (Mrosovsky and Yntema, 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings. The pivotal temperature (i.e., the incubation temperature that produces equal numbers of males and females) in loggerheads is approximately 29°C (Limpus et al., 1983; Mrosovsky, 1988; Marcovaldi et al., 1997).

As post-hatchlings, loggerheads hatched on U.S. beaches migrate offshore and become associated with *Sargassum spp.* habitats, driftlines, and other convergence zones (Carr, 1986; Witherington, 2002). They are believed to lead a pelagic existence in the North Atlantic Gyre for a period as long as 7-12 years (Bolten et al., 1998) although Snover (2002) suggests a much longer oceanic juvenile stage duration with a range of 9-24 years and a mean of 14.8 years. Stranding records indicate that when immature loggerheads reach 40-60 cm SCL, they then travel to coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell et al., 2002). Other studies, however, have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Laurent et al., 1998; Bolten, 2003). These studies suggest some turtles may either remain in the pelagic habitat in the North Atlantic longer

than hypothesized or move back and forth between pelagic and coastal habitats interchangeably (Witzell et al., 2002).

After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south to Florida, The Bahamas, Cuba, and the Gulf of Mexico (neritic refers to the inshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters). Benthic, immature loggerheads foraging in northeastern U.S. waters are also known to migrate southward in the fall as water temperatures cool and then migrate back northward in spring (Epperly et al., 1995; Keinath, 1993; Morreale and Sandora, 1998; Shoop and Kenney, 1992). Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd, 1988). Sub-adult and adult loggerheads are primarily found in coastal waters and prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

#### *Listing Status*

The loggerhead sea turtle was originally listed as threatened throughout its range on July 28, 1978. On September 22, 2011, NMFS published a final rule to list nine separate DPSs under the ESA with four listed as threatened (i.e., Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean DPSs) and five listed as endangered (i.e., Mediterranean Sea, North Indian Ocean, North Pacific Ocean, South Pacific Ocean, and Northeast Atlantic Ocean DPSs). All sea turtles affected by this proposed action are expected to be members of the threatened Northwest Atlantic Ocean DPS. Critical habitat has not been designated for loggerhead sea turtles at the time of this consultation.

#### *Abundance and Trends*

For nesting subpopulations occurring in the Northwest Atlantic, the Peninsular Florida and Northern U.S. units support the greatest numbers of nesting females (i.e. over 10,000 for the Peninsular Florida unit and over 1,000 for the Northern U.S. unit) while the other three nesting subpopulations (i.e., Northern Gulf of Mexico, Dry Tortugas, and Greater Caribbean units) contain fewer than 1,000 nesting females based on count data (Baldwin et al., 2003; Ehrhart et al., 2003; Kamezaki et al., 2003, Limpus and Limpus, 2003; Margaritoulis et al., 2003; TEWG, 2009).

According to the most recent status reviews for the species, all nesting subpopulations occurring in the Northwest Atlantic Ocean show declining trends in the annual number of nests for which they were adequate data (NMFS and USFWS, 2008; Conant et al, 2009; TEWG, 2009). The Peninsular Florida nesting subpopulation, which represents approximately 87 percent of all nesting effort in the Northwest Atlantic Ocean DPS has declined 26 percent over a recent 20 year study period (1989–2008) with a greater decline (41 percent) occurring in the latter 10 years of the study (NMFS and USFWS, 2008; Witherington et al., 2009). The second largest nesting subpopulation (i.e., Northern U.S.) also saw annual declines of 1.3 percent since 1983 (NMFS and USFWS, 2008) while the third largest recovery unit (i.e. Greater Caribbean) saw annual declines of over 5 percent occurring over the period 1995-2006 (TEWG, 2009). The two smallest nesting

subpopulations (i.e., Northern Gulf of Mexico and Dry Tortugas) have also seen declines in nest counts since the mid 1990's; however, these units represent only a small fraction in loggerhead nesting and are not considered to be good indicators of the overall trend. In addition, a detailed analysis of Florida's long-term loggerhead nesting data (1989-2011) revealed that following a 24 percent increase between 1989 and 1998, nest counts for Florida beaches declined 16 percent between 1998 and 2011. The most recent nest counts in 2011 were close to the average for the preceding five-year period suggesting the recent trend may be stabilizing [Florida Fish and Wildlife Conservation Commission (FWC), 2011]. While BIRNM is not known as a primary nesting site, 13 loggerhead nests by at least two separate females have been observed on Buck Island beaches since 2003 although the reason for this recent nesting activity is unknown (Pollack et al., 2009).

At present, there are no reliable estimates of population size of loggerheads occurring in the pelagic and oceanic environments (Bjorndal and Bolten, 2000); however, recent data collected from in-water studies reveal some patterns of abundance and/or size composition of loggerheads occurring in the Northwest Atlantic. The 2009 TEWG report summarized in-water capture and strandings data<sup>8</sup> spanning over four decades from the late 1970's through the late 2000's. Data from the southeastern U.S. (from central North Carolina through central Florida) indicated a possible increase in the abundance of neritic loggerheads captured over the past one to two decades while aerial surveys and one other in-water study conducted in the northeastern U.S. (north of Cape Hatteras, N.C.) indicate a decrease in abundance over similar periods (TEWG, 2009). This increase in catch rates for the southeastern U.S. was not consistent with the declines in nesting seen over the same time period. The authors suggested that the apparent increase in in-water catch rates in the southeastern U.S. coupled with a shift in median size of captured juveniles may indicate there is a relatively large cohort that will be reaching sexual maturity in the near future. However, additional data from the review suggests that any increase in adults may be temporary because in-water studies throughout the entire eastern U.S. also indicated a substantial decrease in the abundance of smaller sized juveniles which, in turn, would indicate possible recruitment failure. The authors stated these trends should be viewed with caution given the limited number and size of studies dedicated to assessing in-water abundance of loggerheads and that more research conducted over a longer time series needs to be completed to determine what impact, if any, these trends have on recruitment and/or survival rates.

The loggerhead sea turtle biological review team recently conducted two independent analyses using nesting data (including counts of nesting females or nests) to assess extinction risks for the identified DPS using methods developed by Snover and Heppell (2009). The analysis performed for the status review indicated that the Northwest

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<sup>8</sup> Data was compiled from turtle captures recorded for the St. Lucie Power Plan in Florida since 1976 (see Bresette et al., 2003), entanglement surveys conducted in the Indian River in Florida since 1982 (see Ehrhart et al., 2007), fishery-independent trawl surveys off the southeastern U.S. (see SCMRI, 2000), pound-net captures off North Carolina (see Epperly et al., 2007) and off New York (see Morreale and Standora, 1998; Morreale et al., 2005), and strandings data maintained by the Sea Turtle Stranding and Salvage Network.

Atlantic Ocean DPS had a high likelihood of quasi-extinction over a wide range of quasi-extinction threshold values, suggesting that the DPS is likely to continue to decline in future years (Conant et al., 2009).

### *Current Threats*

Loggerhead sea turtles face numerous natural and anthropogenic threats that help shape its status and affect the ability of the species to recover. As many of the threats affecting loggerheads are either the same or similar in nature to threats affecting other listed sea turtle species, many of the threats identified in this section below are discussed in a general sense for all listed sea turtles rather than solely for loggerheads. Threats specific to a particular species are then discussed in the corresponding status sections where appropriate.

Sea turtles have been impacted historically by domestic fishery operations that often capture, injure, and even kill sea turtles at various life stages. In the U.S., the bottom trawl, sink gillnets, hook and line gear, and bottom longline managed in the Northeast Multispecies Fishery are known to frequently capture sea turtles during normal fishery operations (Watson et al., 2004; Epperly et al., 1995; Lewison et al., 2003, Lewison et al., 2004; Richards, 2007) while the lines used for pot gear for the U.S. Lobster and Red Crab fisheries cause entanglement resulting in injury to flippers, drowning, and increased vulnerability to boat collisions (Lutcavage et al., 1997). In addition, various trawl, gillnet, longline, and hook gears used for the Monkfish, Spiny Dogfish, Summer Flounder, Scup, Black Sea Bass, and Atlantic Highly Migratory Species fisheries managed in the U.S. impact sea turtles at various degrees.

While sea turtle bycatch varies depending on the fishery, the Southeast shrimp trawl fishery affects more sea turtles than all other activities combined (NRC, 1990). Although participants in these fisheries are required to use Turtle Exclusion Devices (TEDs) that reduce the number of sea turtle captures by an estimated 97 percent, these fisheries are still expected to capture about 185,000 sea turtles each year, of which 5,000 end up dead (NMFS, 2002). Loggerhead and Kemp's ridley sea turtles account for the majority of the annual take with 163,160 loggerheads (3,948 mortalities) and 155,503 Kemp's ridleys (4,208 mortalities) captured on an annual basis followed by 18,757 greens (514 mortalities) and 640 hawksbills (all mortalities) (NMFS, 2002). In recent years, low shrimp prices, rising fuel costs, competition with imported products, and impacts from hurricanes in the Gulf of Mexico have all impacted shrimp fleets. As a result, interactions and mortalities in the Gulf of Mexico, notably for loggerheads, have been substantially less than projected in the 2002 Opinion, with 61,299 loggerheads (1,451 mortalities) reported taken during the 2009 fishing season (NMFS-SEFSC, 2011). While the numbers reported by NMFS-SEFSC appear to show decreased levels of interaction with loggerheads and possibly other species affected by the proposed action, there is concern that many sea turtles that die from entanglement in commercial fishing gear tend to sink rather than strand ashore thus making it difficult to accurately determine the extent of such mortalities.

In the Caribbean region, sea turtles are impacted by the Atlantic pelagic longline, Caribbean reef fish, and spiny lobster fisheries in addition to various state and artisanal fisheries. The estimated number of loggerhead sea turtles caught by pelagic longline fisheries during the period 1992-2002 for all geographic areas was 10,034 individuals of which 81 were estimated to be dead when brought to the vessel (NMFS, 2004). Actual mortalities associated with pelagic longline were likely substantially higher given the fact that these numbers did not include post-release mortalities as a result of hooking injuries. The 3-year anticipated takes for the Caribbean reef fish fishery were 75 green (all lethal) and 51 hawksbills (48 lethal) while the 3-year anticipated takes for the spiny lobster fishery were 3 loggerhead (lethal or non-lethal), 3 green (lethal or non-lethal), and 1 hawksbill (lethal or non-lethal) (NMFS, 2009; NMFS, 2011), respectively. Following a jeopardy biological opinion for the Atlantic pelagic longline fisheries issued by NMFS in 2004, NMFS published a final rule to implement management measures to reduce the impact of pelagic longlining on Atlantic sea turtles which included mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment. While these measures are expected to reduce the population level impact of pelagic longlining on sea turtle populations in the Atlantic, pelagic longlining will continue to impact the ability of listed sea turtles to survive and recover given the large numbers of sea turtles caught each year. While interactions with sea turtles is less documented for state and artisanal fisheries operating in USVI, methods employed by fishers in St. Croix include trap-fishing, net-fishing, line-fishing, spear-fishing, and diving for lobster and conch [The Nature Conservancy (TNC), 2002; Valdés-Pizzini et al., 2010].

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries, further exacerbating the ability of sea turtles to survive and recover on a more global scale. For example, pelagic, immature loggerhead sea turtles circumnavigating the Atlantic are exposed to international longline fisheries including the Azorean, Spanish, and various other fleets (Aguilar et al., 1995; Bolten et al., 1994; Crouse, 1999). Bottom set lines in the coastal waters of Madeira, Portugal, are reported to take an estimated 500 pelagic immature loggerheads each year (Dellinger and Encarnacao, 2000) and gillnet fishing is known to occur in many foreign waters, including (but not limited to) the northwest Atlantic, western Mediterranean, South America, West Africa, Central America, and the Caribbean. In addition to the reported takes, there are many unreported takes or incomplete records by foreign fleets, making it difficult to characterize the total impact that international fishing pressure is having on listed sea turtles. Nevertheless, international fisheries represent a continuing threat to listed sea turtles' survival and recovery throughout their respective ranges.

There are also many non-fishery impacts affecting the status of sea turtle species, both in the marine and terrestrial environment. In nearshore waters of the U.S., the construction and maintenance of Federal navigation channels has been identified as a source of sea turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles (NMFS, 1997). Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. Other nearshore threats include harassment and/or injury resulting from private

and commercial vessel operations, military detonations and training exercises, and scientific research activities.

Coastal development can deter or interfere with nesting, affect nesting success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage et al., 1997; Bouchard et al., 1998). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to females and may evoke a change in the natural behaviors of both adults and hatchlings (Ackerman, 1997; Witherington et al., 2003; Witherington et al., 2007). Mosier (1998) reported that fewer loggerheads made nesting attempts on beaches fronted by seawalls and found that when turtles did emerge in the presence of armoring structures, more returned to the water without nesting than those on non-armored beaches. Armoring structures can also eliminate a turtle's access to upper regions of the beach/dune system and subsequently cause turtles to nest at lower elevations which increases the risk of repeated tidal inundation and impact thermal regimes that can influence sex ratios. In addition, coastal development is usually accompanied by artificial lighting which has been known to alter the behavior of nesting adults (Witherington, 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal, 1991).

Multiple municipal, industrial and household sources as well as atmospheric transport introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g. DDT and PCBs), and other pollutants that may cause adverse health effects to listed species including sea turtles (Iwata et al., 1993; Grant and Ross, 2002; Garrett, 2004; Hartwell, 2004). Loggerheads may be particularly affected by organochlorine contaminants as they were observed to have the highest organochlorine contaminant concentrations in sampled tissues (Storelli et al., 2008). It is thought that dietary preferences were likely to be the main differentiating factor among species. Storelli et al. (1998) analyzed tissues from twelve loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises (Law et al., 1991). Recent efforts have led to improvements in regional water quality, although the more persistent chemicals are still detected and are expected to endure for years (Mearns, 2001; Grant and Ross, 2002).

Acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges may directly injure individuals through skin contact with oils (Geraci, 1990), inhalation at the water's surface and ingesting compounds while feeding (Matkin and Saulitis, 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area. At the time of this consultation, NMFS has reported that 481 Kemp's ridley, 67 loggerheads, 29 green, and 32 unspecified sea turtles have been found dead in the vicinity of the *Deepwater Horizon* spill event that occurred in the

northcentral Gulf of Mexico from April-October, 2010, although the cause of death is not immediately certain for all carcasses recovered (NMFS, unpublished data<sup>9</sup>).

Climate change and variability are identified as major causes of changing marine productivity and may therefore influence sea turtle prey abundance in foraging areas throughout the globe (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic (Fromentin and Planque, 1996) and decadal trends in the North Atlantic Oscillation (NAO) (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that act as important migratory pathways for various life stages of sea turtles. All reptiles including sea turtles have a tremendous dependence on their thermal environment for regulating physiological processes and for driving behavioral adaptations (Spotila et al., 1997). Atmospheric warming creates habitat alteration which in turn may change sex ratios and affect reproductive periodicity for nesting sea turtles. Climate variability may also increase hurricane activity leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests. However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate variability may have to these species from year to year.

Heppell et al. (2003) showed that the growth of loggerhead sea turtle populations were particularly sensitive to changes in annual survival of both juvenile and adult sea turtles, and Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles may adversely affect large segments of the total loggerhead sea turtle population. These studies suggest the species is particularly vulnerable to new sources of mortality as well as demographic and environmental stochasticity all of which are often difficult to predict with any certainty.

### ***Hawksbill Sea Turtle***

#### *Species Description, Distribution, and Population Structure*

Hawksbill sea turtles are small to medium-sized (45 to 68 kilograms on average) although nesting females are known to weigh up to 80 kilograms in the Caribbean (Pritchard et al., 1983). The carapace is usually serrated and has a "tortoise-shell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The plastron of a hawksbill turtle is typically yellow. The head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges, their primary food source as adults, and other invertebrates. The shells of hatchlings are 42 mm long and are mostly brown and somewhat heart-shaped (Hillis and Mackay, 1989; van Dam and Sarti, 1989; Eckert, 1995).

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<sup>9</sup> Sea turtle mortality and nest relocation data associated with the *Deepwater Horizon* Oil spill event is available at: <http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm>.

Hawksbill turtles have a circumtropical distribution and usually occur between latitudes 30° N and 30° S in the Atlantic, Pacific, and Indian Oceans. In the western Atlantic, Hawksbills are widely distributed throughout the Caribbean Sea, off the coasts of Florida and Texas in the continental U.S., in the Greater and Lesser Antilles, and along the mainland of Central America south to Brazil (Lund, 1985; Plotkin and Amos, 1988; Amos, 1989; Groombridge and Luxmoore, 1989; Plotkin and Amos, 1990; NMFS and USFWS, 1998; Meylan and Donnelly, 1999). They are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus, 1997; Plotkin, 2003). Adult hawksbill turtles are capable of migrating long distances between nesting beaches and foraging areas. For instance, a female hawksbill sea turtle tagged in BIRNM was later identified 1,160 miles (1,866 kilometers) away in the Miskito Cays in Nicaragua (Spotila, 2004).

Hawksbill sea turtles nest on insular and sandy beaches throughout the tropics and subtropics. Nesting occurs in at least 70 countries, although much of it now only occurs at low densities compared to other sea turtle species (NMFS and USFWS, 2007a). It is believed that the widely dispersed nesting areas as well as the often low densities seen on nesting beaches is likely a result of overexploitation of previously large colonies that have since been depleted over time (Meylan and Donnelly, 1999). The most significant nesting within the U.S. occurs in Puerto Rico and the USVI, specifically on Mona Island and BIRNM, respectively. Although nesting within the continental U.S. is typically rare, it can also occur along the southeast coast of Florida and the Florida Keys. In addition to nesting beaches in the U.S. Caribbean, the largest hawksbill nesting population in the Western Atlantic occurs in the Yucatán Península of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (Spotila, 2004; Garduño-Andrade et al., 1999). In the U.S. Pacific, hawksbills nest on main island beaches in Hawaii, primarily along the east coast of the island. Hawksbill nesting has also been documented in American Samoa and Guam. More information on nesting in other ocean basins may be found in the five year status review for the species (NMFS and USFWS, 2007a).

Mitochondrial DNA studies show that reproductive populations are effectively isolated over ecological time scales (Bass et al., 1996). Substantial efforts have been made to determine the nesting population origins of hawksbill sea turtles assembled in foraging grounds, and genetic research has shown that hawksbills of multiple nesting origins commonly mix in foraging areas (Bowen et al., 1996). The fact that hawksbills exhibit site fidelity to their natal beaches suggests that if subpopulations become extirpated they may not be replenished by recruitment from other nesting rookeries (Bass et al., 1996).

#### *Life History Information*

Hawksbill sea turtles exhibit slow growth rates although they are known to vary within and among populations from a low of 1-3 cm per year measured in the Indo-Pacific (Chaloupka and Limpus, 1997; Whiting, 2000; Mortimer et al., 2002; Mortimer et al., 2003) to a high of 5 cm or more per year measured at some sites in the Caribbean (Leon and Diez, 1999; Diez and van Dam, 2002). Differences in growth rates are likely due to differences in diet and/or density of turtles at foraging sites and overall time spent



foraging (Bjorndal et al, 2000; Chaloupka et al., 2004). Consistent with slow growth, age to maturity for the species is also long, taking between 20 and 40 years depending on the region (Chaloupka and Musick, 1997; Limpus and Miller, 2000). Hawksbills in the western Atlantic are known to mature faster (i.e. 20 more years) than turtles found in the Indo-Pacific (i.e. 30-40 years) based on studies performed in these areas (Boulon, 1983; Boulon, 1994; Limpus and Miller, 2000; Diez and van Dam, 2002). Males are typically mature when their length reaches 69 cm while females are typically mature at 75 cm (Limpus, 1992; Eckert, 1992). Female hawksbills return to their natal beaches every 2-3 years to nest (Witzell 1983; Van Dam et al., 1991) and generally lay 3-5 nests per season (Richardson et al., 1999). Compared with other sea turtles, clutch size for hawksbills can be quite high (e.g., up to 250 eggs per clutch) (Hirth, 1980).

Hawksbills may undertake developmental migrations (migrations as immatures) and reproductive migrations that involve travel over hundreds or thousands of kilometers (Meylan, 1999a). Post-hatchlings (oceanic stage juveniles) are believed to occupy the "pelagic" environment, taking shelter in floating algal mats and drift lines of flotsam and jetsam in the Atlantic and Pacific oceans (Musick and Limpus, 1997) before recruiting to more neritic, coastal foraging grounds. In the Caribbean, hawksbills are known to exclusively feed on sponges (Meylan, 1988; van Dam and Diez, 1997) although at times they have been seen foraging on other food items, notably corallimorphs and zooanthids (van Dam and Diez, 1997; Mayor et al., 1998; Leon and Diez, 2000).

Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest and exhibit a high degree of fidelity to their nest sites. Movements of reproductive males are less certain, but are presumed to involve migrations to the nesting beach or to courtship stations along the migratory corridor. Hawksbills show a high fidelity to their foraging areas as well (van Dam and Diez, 1998). Foraging sites are typically areas associated with coral reefs although hawksbills are also found around rocky outcrops and high energy shoals which are optimum sites for sponge growth. They can also inhabit seagrass pastures in mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Bjorndal, 1997; van Dam and Diez, 1998).

#### *Listing Status*

The hawksbill sea turtle was listed as endangered under the ESA on June 2, 1970 (35 FR 8491). Critical habitat was designated On June 2, 1998 in coastal waters surrounding Mona and Monito Islands in Puerto Rico (63 FR 46693). No critical habitat exists within the action area for this consultation.

#### *Abundance and Trends*

There are currently no reliable estimates of population abundance and trends for non-nesting hawksbills at the time of this consultation; therefore, nesting beach data is currently the primary information source for evaluating trends in global abundance. Most hawksbill populations around the globe are either declining, depleted, and/or remnants of larger aggregations (NMFS and USFWS, 2007a). The largest nesting population of hawksbills appears to occur in Australia where approximately 2,000 hawksbills nest off

the northwest coast and about 6,000 to 8,000 nest off the Great Barrier Reef each year (Spotila, 2004). Additionally, about 2,000 hawksbills nest each year in Indonesia and 1,000 nest in the Republic of Seychelles (Spotila, 2004). In the U.S., about 500-1,000 hawksbill nests are laid on Mona Island, Puerto Rico (Diez and van Dam, 2007) and another 56-150 nests are laid on Buck Island off St. Croix (Meylan, 1999b; Mortimer and Donnelly, 2008). Nesting also occurs to a lesser extent on other additional beaches on St. Croix, St. John, St. Thomas, Culebra Island, Vieques Island, and mainland Puerto Rico.

Mortimer and Donnelly (2008) reviewed nesting data for 83 nesting concentrations organized among 10 different ocean regions (i.e. Insular Caribbean, Western Caribbean Mainland, Southwestern Atlantic Ocean, Eastern Atlantic Ocean, Southwestern Indian Ocean, Northwestern Indian Ocean, Central Indian Ocean, Eastern Indian Ocean, Western Pacific Ocean, Central Pacific Ocean, and Eastern Pacific Ocean). Historic trends (i.e., 20-100 year time period) were determined for 58 of the 83 sites while recent abundance trends (i.e., within the past 20 years) were also determined for 42 of the 83 sites. Among the 58 sites where historic trends could be determined, all showed a declining trend during the long term period although among the 42 sites where recent trend data was available, 10 appeared to be increasing, 3 appeared to be stable, and 29 appeared to be decreasing. With respect to regional trends, nesting populations in the Atlantic (especially in the Insular Caribbean and Western Caribbean Mainland) are generally doing better than those in the Indo-Pacific regions. For instance, 9 of the 10 sites showing recent increases were all located in the Caribbean. Nesting concentrations in the Pacific Ocean appear to be performing the worst of all regions despite the fact that the region currently supports more nesting hawksbills than in either the Atlantic or Indian Oceans (Mortimer and Donnelly, 2008).

Buck Island and St. Croix's East End beaches support two remnant populations of between 17-30 nesting females per season (Hillis and Mackay, 1989; Mackay, 2006). While the proportion of hawksbills nesting on Buck Island represent a small proportion of the total hawksbill nesting occurring in the greater Caribbean region, Mortimer and Donnelly (2008) report an increasing trend in nesting at that site based on data collected from 2001-2006. This increase is likely due to the conservation measures implemented when BIRNM was expanded in 2001. More information about site specific trends for can be found in the most recent five year status review for the species (see NMFS and USFWS, 2007a).

### *Current Threats*

The historical decline of the species is primarily attributed to centuries of exploitation for the beautifully patterned shell which made it a highly attractive species to target (Parsons, 1972). The fact that reproductive females exhibit a high fidelity for nest sites and the tendency of hawksbills to nest at regular intervals within a season made them an easy target for capture on nesting beaches. The tortoiseshell from hundreds of thousands of turtles in the western Caribbean region was imported into the United Kingdom and France during the 19th and early 20th centuries (Parsons, 1972) and additional hundreds of thousands of turtles contributed to the region's trade with Japan prior to 1993 when a

zero quota was imposed (Milliken and Tokunaga, 1987 *as cited in* Bräutigam and Eckert, 2006).

The continuing demand for the hawksbill's shell as well as other products (leather, oil, perfume, and cosmetics) represents an ongoing threat to recovery of the species. The British Virgin Islands, Cayman Islands, Cuba, Haiti, and the Turks and Caicos Islands (U.K.) all permit some form of legal take of hawksbill turtles. In the northern Caribbean, hawksbills continue to be harvested for their shells, which are often carved into hair clips, combs, jewelry, and other trinkets (Marquez, 1990; Stapleton and Stapleton, 2006). Additionally, hawksbills are harvested for their eggs and meat while whole stuffed turtles are sold as curios in the tourist trade. Also, hawksbill sea turtle products are openly available in the Dominican Republic and Jamaica despite a prohibition on harvesting hawksbills and their eggs (Fleming, 2001). In Cuba, 500 turtles are legally captured each year and while current nesting trends are unknown, the number of nesting females is suspected to be declining in some areas (Carrillo et al., 1999; Moncada et al., 1999). While the international trade in the shell of this species is prohibited between those countries that have signed the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), illegal trade is still occurring and remains an ongoing threat to hawksbill survival and recovery throughout its range.

Due to their preference to feed on sponges associated with coral reefs, hawksbill sea turtles are particularly sensitive to losses of coral reef communities. Coral reefs are vulnerable to destruction and degradation caused by human activities (e.g. nutrient pollution, sedimentation, contaminant spills, vessel groundings and anchoring, recreational uses, etc.) and are also highly sensitive to the effects of climate change (e.g. higher incidences of disease and coral bleaching) (Wilkinson, 2004; Crabbe, 2008). Continued loss of coral reef communities (especially in the greater Caribbean region) is expected to impact foraging and represents a major threat to recovery of the species.

Hawksbill sea turtles are also susceptible to capture in nearshore artisanal fishing gear such as drift-netting, long-lining, set-netting, and trawl fisheries with gill nets and artisanal hook and line representing the greatest impact to the species in the greater Caribbean region [National Research Council (NRC), 1990; Lutcavage et al., 1997; Epperly, 2003].

Hawksbills are also currently subject to the same suite of threats on both nesting beaches and in the marine environment that affect other sea turtles (e.g. interaction with federal and state fisheries, coastal construction, oil spills, climate change affecting sex ratios, etc.) as discussed in the loggerhead sea turtle status section above.

### ***Green Sea Turtle***

#### *Species Description, Distribution, and Population Structure*

Green sea turtles have a smooth carapace with four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They typically have a black dorsal surface and a white ventral surface although the carapace of green sea turtles in the

Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, brown and black in starburst or irregular patterns (Lagueux, 2001).

Green sea turtles are distributed circumglobally, mainly in waters between the northern and southern 20° C isotherms (Hirth, 1971) and nesting occurs in more than 80 countries worldwide (Hirth, 1997). The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica, and Raine Island, on the Great Barrier Reef in Australia. The complete nesting range of green sea turtles within the southeastern U.S. includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina as well as the USVI and Puerto Rico (NMFS and USFWS, 1991; Dow et al., 2007). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties. For more information on green sea turtle nesting in other ocean basins, refer to the 1991 Recovery Plan for the Atlantic Green Turtle (NMFS and USFWS, 1991) or the 2007 Green Sea Turtle 5-Year Status Review (NMFS and USFWS, 2007b).

In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts. Important feeding areas in Florida include the Indian River Lagoon System, the Florida Keys, Florida Bay, Homosassa, Crystal River, Cedar Key, St. Joseph Bay, and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven, 1992; Guseman and Ehrhart, 1992). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth, 1971), and the northwestern coast of the Yucatan Peninsula. Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs (Hays et al., 2001) and, like loggerheads, are known to migrate from northern areas in the summer back to warmer southern waters to the south in the fall and winter to avoid seasonally cold seawater temperatures.

In terms of genetic structure, regional subpopulations show distinctive mitochondrial DNA properties for each nesting rookery (Bowen et al., 1992; Fitzsimmons et al., 2006). Despite the genetic differences, turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. However, such mixing occurs at extremely low levels in Hawaiian foraging areas, perhaps making this central Pacific population the most isolated of all green turtle populations occurring worldwide (Dutton et al., 2008).

#### *Life History Information*

Green sea turtles exhibit particularly slow growth rates [about 1-5 centimeters per year (Green, 1993; McDonald-Dutton and Dutton, 1998)] and also have one of the longest age to maturity of any sea turtle species [i.e. 20-50 years (Chaloupka and Musick, 1997; Hirth, 1997)]. The slow growth rates are believed to be a consequence of their largely herbivorous, low-net energy diet (Bjorndal, 1982). Upon reaching sexual maturity, females begin returning to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs, 1982; Frazer and Ehrhart, 1985) and are capable of migrating

significant distances (hundreds to thousands of kilometers) between foraging and nesting areas. While females lay eggs every 2-4 years, males are known to reproduce every year (Balazs, 1983).

In the southeastern U.S., females generally nest between June and September, while peak nesting occurs in June and July (Witherington and Ehrhart, 1989). During the nesting season, females nest at approximately two-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart, 1996). Clutch size often varies among subpopulations, but mean clutch size is around 110-115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart, 1989), which will incubate for approximately two months before hatching. It is apparent that survivorship at any particular nesting site is greatly influenced by the level of anthropogenic stressors, with the more pristine and less disturbed nesting sites (e.g., Great Barrier Reef in Australia) showing higher survivorship values than nesting sites known to be highly disturbed (e.g., Nicaragua) (Campbell and Lagueux, 2005; Chaloupka and Limpus, 2005).

After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years, feeding close to the surface on a variety of marine algae associated with drift lines and other debris. This early oceanic phase remains one of the most poorly understood aspects of green turtle life history (NMFS and USFWS, 2007b). However, growth studies using skeletochronology indicate that green sea turtles in the Western Atlantic shift from this oceanic phase to nearshore development habitats (protected lagoons and open coastal areas rich in sea grass and marine algae) after approximately 5-6 years (Zug and Glor, 1998; Bresette et al., 2006). As adults, they feed almost exclusively on sea grasses and algae in shallow bays, lagoons, and reefs (Rebel, 1974) although some populations are known to also feed heavily on invertebrates (Carballo et al., 2002). While in coastal habitats, green sea turtles exhibit site fidelity to specific foraging and nesting grounds and it is clear they are capable of “homing in” on these sites if displaced (McMichael et al., 2003).

Reproductive migrations of Florida green turtles have been identified through flipper tagging and/or satellite telemetry. Based on these studies, the majority of adult female Florida green turtles are believed to reside in nearshore foraging areas throughout the Florida Keys from Key Largo to the Dry Tortugas and in the waters southwest of Cape Sable, Florida, with some post-nesting turtles also residing in Bahamian waters as well (NMFS and USFWS, 2007b).

#### *Listing Status*

The green sea turtle was listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations which were listed as endangered. Due to difficulties in distinguishing between individuals from the Florida breeding population from other populations, green sea turtles are considered endangered wherever they occur in U.S. waters and are treated as such in this Opinion. Critical habitat for the green sea turtle has been designated on September 2, 1998, for the waters surrounding Isla Culebra, Puerto Rico, and its associated keys. No critical habitat exists in the action area for this consultation.

### *Abundance and Trends*

A summary of current nesting trends<sup>10</sup> is provided in the most recent status review for the species (i.e., NMFS and USFWS, 2007b) in which the authors collected and organized abundance data from 46 individual nesting concentrations organized by ocean region (i.e. Western Atlantic Ocean, Central Atlantic Ocean, Eastern Atlantic Ocean, Mediterranean Sea, Western Indian Ocean, Northern Indian Ocean, Eastern Indian Ocean, Southeast Asia, Western Pacific Ocean, Central Pacific Ocean, and Eastern Pacific Ocean). The authors found it was possible to determine trends at 23 of the 46 nesting sites and found that 10 appeared to be increasing, 9 appeared to be stable, and 4 appeared to be decreasing. With respect to regional trends, the Pacific, the Western Atlantic, and the Central Atlantic regions appeared to show more positive trends (i.e., more nesting sites increasing than decreasing) while the Southeast Asia, Eastern Indian Ocean, and possibly the Mediterranean Sea regions appeared to show more negative trends (i.e., more nesting sites decreasing than increasing). We must note that these regional determinations should be viewed with caution since trend data was only available for about half of the total nesting concentration sites examined in the review and that site specific data availability appeared to vary across all regions.

The western Atlantic region (focus of this Opinion) was one of the best performing in terms of abundance in the entire review as there were no sites that appeared to be decreasing based on the data collected. Positive trends were reported for the Florida nesting concentration in the U.S., Cuyo and Holbox nesting concentrations in Mexico, Tortuguero nesting concentration in Costa Rica, and Galibi Reserve nesting concentration in Suriname while the other two nesting concentrations included in the review (i.e., Aves Island off Venezuela and Isla Trindade off Brazil) were reported to be stable. More information about site specific trends for the other major ocean regions can be found in the most recent five year status review for the species (see NMFS and USFWS, 2007b).

By far, the largest known nesting assemblage in the western Atlantic region occurs at Tortuguero, Costa Rica. According to monitoring data on nest counts as well as documented emergences (both nesting and non-nesting events), there appears to be an increasing trend in this nesting assemblage since monitoring began in the early 1970's. For instance, from 1971-1975 there were approximately 41,250 average emergences documented per year and this number increased to an average of 72,200 emergences documented per year from 1992-1996 (Bjorndal et al., 1999). Troëng and Rankin (2005) collected nest counts from 1999-2003 and also reported increasing trends in the population consistent with the earlier studies.

In the continental U.S., green turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida where an estimated 200-1,100 females nest each year (Meylan et al., 1994; Weishampel et al., 2003). Occasional nesting has also been documented along the Gulf coast of Florida as well as the beaches on the Florida Panhandle. According to data collected from Florida's Index Nesting Beach

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<sup>10</sup> Estimates of abundance were largely based on annual numbers of nesting females or deposited nests at each site. In some cases, abundance was based on egg production or egg harvest rates (see NMFS and USFWS, 2007b).

Survey from 1989-2011, green turtle nest counts across Florida have increased approximately tenfold from a low of 267 in the early 1990's to a high of 10,701 measured most recently in 2011 (FWC, 2011). While the increase in nest counts seen across Florida beaches is encouraging, these numbers only reflect one segment of the population (nesting females) and thus should not be taken to reflect the true population trend for the region.

St. Croix supports an average of 100 nests per year (Mackay, 2006) with a majority of nesting occurring on East End beaches south of the action area. While Buck Island generally supports a small number of nests (around 8-10 nests per year) the waters surrounding Buck Island remain an important foraging ground for juveniles (Phillips and Hillis-Starr, 2002). Accurate estimates of non-nesting individuals are unavailable at the time of this consultation due to a lack of in-water studies conducted in and around St. Croix.

#### *Current Threats*

The principal cause of the historical, worldwide decline of the green sea turtle was long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. Egg removal and poaching of nesting females continues to be a problem for the greater threatened populations nesting throughout the south Pacific, Eastern Atlantic, Indian Ocean and some areas in the Caribbean (as summarized in Seminoff, 2004). Removal of eggs each nesting season can severely impact juvenile cohorts that would have recruited from the post-hatchling phase while poaching of nesting females reduces the abundance of reproductive adults as well as potential for annual egg production. Both these impacts lead to declines in overall survival and reproduction for these respective populations. In addition to illegal poaching, direct harvest of adult and juveniles occurs heavily in the Caribbean Sea, Southeast Asia, Eastern Pacific, and Western Indian Ocean (NMFS and USFWS, 2007b). Despite substantial declines in the population of green sea turtles in these respective regions, intentional harvest remains legal in many countries and remains a threat to populations worldwide.

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation. Therefore, direct destruction of foraging areas due to dredging, boat anchorage, deposition of spoil, and siltation may have considerable effects on the distribution of foraging green turtles (Coston-Clements and Hoss, 1983; Williams, 1988). Eutrophication, heavy metals, radioactive elements, and hydrocarbons all may reduce the extent, quality, and productivity of foraging grounds as well (Frazier, 1980; McKenzie et al., 1999; Storelli and Marcotrigiano, 2003). Various types of marine debris such as plastics, oil, and tar tends to collect on pelagic drift lines that young green turtles inhabit (Carr, 1987; Moore et al., 2001) and can lead to death through ingestion (Balazs, 1985; Bjorndal et al., 1994). Another major threat from man-made debris is the entanglement of turtles in discarded monofilament fishing line and abandoned netting (Balazs, 1985).

Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body, has been found to infect green sea turtles, most commonly juveniles (Williams et al., 1994). The occurrence of fibropapilloma tumors may result in

impaired foraging, breathing, or swimming ability possibly leading to death in some cases making it a serious threat to the survival and recovery of the species.

Another growing problem affecting green sea turtles is the increasing female bias in the sex ratio of green sea turtle hatchlings, likely related to global climate change and imperfect egg hatchery strategies (Tiwoh and Cabanban, 2000; Hays et al., 2003a; Baker et al., 2006). At least one site (i.e. Ascension Island) has had an increase of mean sand temperature in recent years (Hays et al., 2003a). It is expected that similar rises in sand temperatures on nesting beaches may alter sex ratios towards a highly female bias and significantly impact the ability of the species to survive and recover in the wild.

Green sea turtles are also currently subject to the same suite of threats on both nesting beaches and in the marine environment that affect other sea turtles (e.g. interaction with federal and state fisheries, coastal construction, oil spills, etc.) as discussed in the loggerhead sea turtle status section above.

## **ENVIRONMENTAL BASELINE**

By regulation, environmental baselines for biological 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 purpose of the *Environmental Baseline* section is to step down from the species level discussion in the *Status of the Species* section and establish the current and projected viability or fitness of individuals and populations within the action area so that the effects of the proposed research activities can be measured and assessed. The following sections summarize the natural phenomena as well as the anthropogenic activities that have affected and continue to affect listed sea turtles within the action area.

### Natural Sources of Stress and Mortality

#### *Disease and Red Tide Events*

A disease known as fibropapilloma is a major threat to listed turtles in many areas of the world including the action area. 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). The disease has been recorded in many green turtle populations around the world and is also known to affect other sea turtle species such as loggerheads (Huerta et al., 2002).

Harmful algal blooms known as red tide events have been recorded in the USVI in the past (Glenn Morris Jr. et al., 1980; Friedman et al., 2008) and can impact sea turtles in the action area. During four red tide events along the west coast of Florida, sea turtle stranding trends indicated that these events were acting as a mortality factor (Redlow et



al., 2003) and it is expected that similar impacts are felt elsewhere in the greater Caribbean, including the USVI.

#### *Predation*

Predation of sea turtle eggs and hatchlings by native and introduced species occurs in the action area for nests laid on Buck Island. Various animals such as dogs, pigs, goats, horses, and mongooses harass nesting females and prey upon nests and hatchlings. Prior to an extensive mongoose eradication program, it was estimated that more than 50 percent of hawksbill nests were destroyed annually on Buck Island as a result of predation (Small, 1982; Nellis and Small, 1983).

#### *Hurricanes and Tropical Storms*

Hurricanes and tropical storms are common in the greater Caribbean region and have the potential to directly injure or kill sea turtles, destroy nests, and/or modify habitat in the action area. Within the last two decades, several major hurricanes (e.g., Hugo in 1989, Luis and Marilyn in 1995, Bertha and Hortense in 1996, Georges in 1998, Lenny in 1999, Debby in 2000, etc.) have impacted nesting and foraging habitat in the USVI at various degrees (Tobias, 2004; Rothenberger et al., 2008). Most seriously affected were the shallow water elkhorn and staghorn coral colonies that comprised the bank-barrier reef system and inshore reefs around St. Croix. These coral communities provide foraging habitat for sea turtles, especially hawksbill and green sea turtles. By the 1990's, many coral reef monitoring sites in the USVI had no more than 25 percent total coral cover and higher macroalgal cover than in previous decades and a lot of this disturbance was attributed to storm damage as well as a coral bleaching event that occurred in 2005 (see section below for more information on coral bleaching) (Rogers et al., 2008). With more intense storms expected in the coming years based on recent climate modeling, it is expected that sea turtles and their habitat will be further impacted (Goldenburg et al., 2001; Webster et al., 2005; IPCC, 2007) and may result in a decrease in hatching success and hatchling emergence (Martin, 1996; Ross, 2005; Pike and Stiner, 2007; Prusty et al., 2007; Van Houton and Bass, 2007).

#### *Climate Change and Variability*

Naturally occurring climatic patterns, such as El Niño and La Niña events, as well as longer time-scale climate variability are identified as major causes of changing marine productivity and may therefore influence listed species' prey abundance and affect habitat conditions in the action area (Mantua et al., 1997; Francis et al., 1998; Beamish et al., 1999; Hare et al., 1999; Benson and Trites, 2002). Decadal trends in the North Atlantic Oscillation (NAO) (Hurrell, 1995) can affect the position of the Gulf Stream (Taylor et al., 1998) and other circulation patterns in the North Atlantic that act as important migratory pathways for multiple life stages of sea turtles. However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate variability may have to these species from year to year.

Increasing air temperatures are a particular concern for nesting sea turtles in the action area as sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a

thermal tolerance range of 25-35°C (Ackerman, 1997). Based on modeling done for loggerhead sea turtles, a 2°C increase in air temperature would be expected to result in production of 100 percent females while a 3°C increase in air temperature would likely exceed the thermal threshold of turtle clutches, resulting in death (Hawkes et al., 2007). Glen et al. (2003) also reported that incubation temperatures for green sea turtles appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures; however, it is unknown whether this effect is species specific or what impact this has on offspring survival. Thus, changes in air temperature as a result of global climate change may alter sex ratios and may reduce hatchling production on nesting beaches (Hawkes et al., 2007; Hamann et al., 2007).

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

Increasing sea surface temperatures can cause stress to coral and result in bleaching that degrades sea turtle foraging habitat in and around the action area. Bleaching results in a loss of zooxanthellae and a reduction in an important source of energy that can lead to coral death. Coupled with increasing carbon dioxide (CO<sub>2</sub>) concentrations which lower the pH of seawater and reduce the capacity of corals and other organisms to produce calcium carbonate skeletons, these stressors reduce the resiliency of corals and further alter foraging habitat for sea turtles. The most significant bleaching event to date in the USVI occurred in 2005 when sea surface temperatures exceeded the 29.5°C coral bleaching threshold for twelve weeks, and maximum temperatures exceeded 30°C (Woody et al., 2008). Following the 2005 bleaching event, monitoring data indicated that total coral cover had reduced to less than 12 percent for many Caribbean reefs including a loss of 53 percent cover of more pronounced reef building corals such as Elkhorn corals at long-term monitoring sites around BIRNM (Rogers et al., 2008; Rothenberger et al., 2008). Higher sea surface temperatures will increase the duration and magnitude of these types of bleaching events that can further degrade sea turtle foraging habitat in the action area in the near future.

Seagrass communities, which are particularly important to green sea turtles given their herbivorous diet, could also be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Short and Neckles, 1999; Bjork et al., 2008). These threats are expected to continue and have a negative effect on habitat and food availability for green sea turtles in the action area.

## Anthropogenic Sources of Stress and Mortality

### *Illegal Fishing and Poaching*

Sea turtles in the action area continue to feel effects from historical commercial fishing pressure that influenced their current populations occurring in and around the action area before the expansion and establishment of no-take zones in the waters surrounding Buck Island (see *Status of the Species* section for more information). While fishing activities are currently banned within BIRNM, illegal fishing allegedly continues to take place in the deeper parts of the monument although compliance has improved in recent years due to greater surveillance by enforcement patrols (Pittman et al., 2008). Gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries all interact with sea turtles and it is expected that some sea turtles continue to be exposed to these effects in the action area as a result of illegal fishing practices.

While poaching of eggs, juveniles, and adult sea turtles in the action area has declined over the years, isolated incidents of illegal poaching are still known to occur and remain a threat to sea turtles nesting on Buck Island (Phillips and Hillis-Starr, 2002). Despite protective legislation, there is still a demand for sea turtle meat and eggs and more poaching is known to occur on St. Croix than on other USVI islands (Boulon Jr., 2000). While the research program on Buck Island as well as enforcement has helped curtail illegal poaching, we anticipate that some sea turtle nests continue to be prey upon by poachers in the action area although the magnitude of this impact is unknown.

### *Coastal Pollution*

Water quality monitoring studies in waters around the USVI indicate that surface waters are affected by increasing point and non-point source pollution from failing septic systems, discharges from vessels, failure of best management practices on construction sites, and failure of on-site disposal methods (Rothenberger et al., 2008). These factors result in increased sedimentation and nutrient transport, bacterial contamination, and trash and other debris entering surface and nearshore waters from developed areas. Water quality in most areas continues to decline as indicated by the designation of 69 areas as impaired in 2006 versus 50 in 2005 (Rothenberger et al., 2008). Pollution from manufacturing centers is particularly affecting water quality in the St. Croix district (Swingle et al., 1970). Contaminants such as chlordane, DDE, DDT, dieldrin, PCBs, cadmium, mercury, and selenium settle to the bottom and are later consumed by benthic feeders, such as macroinvertebrates, and then work their way higher into the food web. These compounds may enter the aquatic environment via wastewater treatment plants, agricultural facilities, as well as runoff from farms (Folmar et al., 1996, Culp et al., 2000, Wildhaber et al., 2000, Wallin et al., 2002).

The HOVENSA (formerly Hess Oil Virgin Islands Corporation) complex located on St. Croix is among the top ten largest refineries in the world and second largest in the United States (Valdés-Pizzini et al., 2010). Established in the 1960's, the oil refinery is capable of processing up to a half million barrels of oil a day. While no major spill events have been recorded off St. Croix, the threat of a major spill is increased due to the large number of oil tankers moving to and from the refinery on a daily basis as well as the threat of hurricanes that can cause damage to vessels. Oil spills impact sea turtles and

other wildlife directly through three primary pathways: ingestion – when animals swallow oil particles directly or consume prey items that have been exposed to oil, absorption – when animals come into direct contact with oil, and inhalation – when animals breathe volatile organics released from oil or from “dispersants” applied by response teams in an effort to increase the rate of degradation of the oil in seawater. When large quantities of oil enter a body of water, direct mortality of wildlife and chronic conditions such as various forms of cancer becomes more likely (Lutcavage et al., 1997). Oil spills in the vicinity of nesting beaches just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts and McGehee, 1982; Lutcavage et al., 1997; Witherington, 1999). Continuous low-level exposure to oil in the form of tarballs, slicks, or elevated background concentrations also challenge animals facing other natural and anthropogenic stresses. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease (Keller et al., 2004; Keller et al., 2006). In addition, chronic exposure may impair a turtle’s overall fitness so that it is less able to withstand other stressors throughout the species life history (Milton et al., 2003).

The earlier life stages are usually at greater risk from an oil spill than adults since they usually spend a greater portion of their time at the sea surface, thereby increasing their risk of exposure to floating oil slicks (Lutcavage et al., 1995). Tarballs in a turtle’s gut are likely to have a variety of effects – starvation from gut blockage, decreased absorption efficiency, absorption of toxins, effects of general intestinal blockage (such as local necrosis or ulceration), interference with fat metabolism, and buoyancy problems caused by the buildup of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats), among others. Lutz and Lutcavage (1989) reported hatchlings found with their beaks and esophagi blocked with tarballs, apparently dying of starvation. Frazier (1980) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell apparently plays an important role in navigation and orientation. A related problem is the possibility that an oil spill impacting nesting beaches may affect the locational imprinting of hatchlings, and thus impair their ability to return to their natal beaches to breed and nest (Milton et al., 2003).

Habitat in the action area may also be degraded by various sources of marine debris such as plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear (Rothenberger et al., 2008). Marine debris is introduced into the marine environment through ocean dumping, littering, hurricane or strong storms surges, or hydrologic transport of these materials from land-based sources.

#### *Tourism and Vessel Interactions*

BIRNM is the number one tourist destination for the island of St. Croix with a growing number of daytime visitors and tourists who come to the island to partake in various recreational activities such as snorkeling, sailing, boating, hiking, and picnicking. The National Park Service has six commercial companies that offer daytrips to the park year-round and visitor use has increased from 20,000 annual visitors in 2003 to over 30,000 in 2006 (Rothenberger et al., 2008). Vessels operating in the action area can adversely

affect listed sea turtles through direct ship strikes and/or other physical and behavioral disturbance. Turtles swimming or feeding at or just beneath the surface of the water are vulnerable to boat and vessel strikes, potentially resulting in serious propeller injuries and even death (Hazel et al., 2007). While the threats of serious injury or mortality are considered minimal within the BIRNM compared to other heavy use areas, it is expected that the potential for serious injuries as a result of boating activities will increase with the corresponding rise in St. Croix's tourism sector.

Vessel groundings can cause damage to coral reefs and seagrass communities which both degrades foraging habitat for sea turtles throughout the Caribbean. Turgeon et al. (2002) reported that large vessel groundings occur in the USVI more than twice a year which presents a problem to the region. In addition to anchorage and groundings, careless diver activities such as standing on top of sensitive reef sites as well as breaking off small sections of branching corals have added to the already mounting stress on reefs in the region (Talge, 1990; Talge, 1992; Roupheal and Inglis, 1997; Turgeon et al., 2002). The cumulative effects of such damage can cause substantial localized damage to reef communities and degrade foraging habitat for sea turtles in the action area (Garrabou et al., 1998; Hawkins et al., 1999; Plathong et al., 2000). As the tourism sector increases, it is expected that threats to reefs from tourism activities and increased development of the coastline will only add to the current stress on sea turtles and their habitat in and around the action area.

#### *Scientific Research Activities*

Sea turtles have been the subject to scientific non-lethal research activities in the action area, as authorized by NMFS and USFWS permits. Since 1988, hawksbill sea turtle nesting on Buck Island has been monitored by NPS staff using saturation tagging protocols (see Phillips and Hillis-Starr, 2002). Also, in-water captures by NPS staff since 1994 has provided information on growth rates, movement patterns, habitat use, sex ratios, and general ecology. Overall, activities include turtle and nest monitoring, capture, flipper and PIT tagging, satellite and acoustic tagging, and blood and tissue sampling.

Another active permit held by NMFS' Southeast Fisheries Science Center (SEFSC) (permit No. 1551) authorizes multiple activities that may occur in part in the action area, although the research is more broadly focused in the greater Caribbean sea in addition to the Gulf of Mexico and North Atlantic thus diluting the relative exposure that may be occurring within the specific action area assessed in this consultation. Nevertheless, we expect that some research activities including exposure to aerial and vessel surveys, capture by hand and various nets, flipper and PIT tagging, satellite tagging, gastric lavage, blood and tissue sampling, fecal sampling, laparoscopy, skin and organ biopsy, tetracycline marking, and feeding of stomach temperature pills may occur in the action area and surrounding waters particularly if researchers were targeting hawksbill and green sea turtles in the Caribbean region. The biological opinion issued for permit No. 1551 analyzed effects and concluded that only short term injury and/or stress is likely to occur with no long term fitness or population-level consequences for the affected sea turtle species (NMFS, 2008).

All permits for sea turtles contain conditions requiring the permit holders to coordinate their activities and, to the extent possible, share data to avoid unnecessary duplication of research. While these measures help minimize the repeated exposure of individuals, our ability to detect long-term consequences from research activities will depend on several factors including improving our evaluation of sub-lethal effects as well as funding and prioritizing studies investigating long term survival and reproduction of individuals subjected to repeated exposures over time.

#### *Conservation and Management Efforts*

Several conservation and management efforts have been undertaken in the action area that benefits sea turtles. BIRNM was originally designated by the U.S. Department of Interior in 1961 according to Presidential Proclamation 3443 in order to preserve the island and the surrounding submerged lands. The original monument encompassed 880 acres [approximately 3.56 square kilometers (km<sup>2</sup>)] and marine areas were zoned to form a protected “Marine Garden” (259 acres or approximately 1.04 km<sup>2</sup>), which included extensive stands of elkhorn coral and an area with restricted fishing (445 acres or approximately 1.8 km<sup>2</sup>). The boundaries were slightly modified in 1975 but it was not until 2001 that the monument greatly expanded under Presidential Proclamation 7392 to include 19,015 total acres (77 km<sup>2</sup>) all of which were designated as no-take and restricted anchoring zones (see **Figure 1** in the Action Area section of this Opinion). The current monument is managed by the NPS and represents the first substantial no-take area established for St. Croix. Restrictions on fishing and anchoring greatly benefits sea turtles in the action area by minimizing impacts to their foraging and nesting habitat surrounding Buck Island. Visitors are also prohibited from visiting Buck Island during night hours which reduces impacts to nesting behavior and increases hatchling survival.

NMFS also 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 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. In this section, we describe the potential physical, chemical, and biotic stressors associated with the proposed action, the probability of individuals of listed species being exposed to these stressors, and the probable responses of those individuals (given the probable exposures) based on the best scientific and commercial evidence available. As described in the *Approach to the Assessment* section, for any responses that would be expected to reduce

an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success), the assessment would consider the risk posed to the viability of the population(s) those individuals comprise and to the listed species those populations represent. The purpose of this assessment is to determine if it is reasonable to expect the proposed research activities to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild.

For this consultation, we are particularly concerned with behavioral disruptions that may result in sea turtles that fail to feed or reproduce successfully or fail to complete their life history because these responses are likely to have population-level consequences. The proposed permits would authorize non-lethal "takes" in the form of capture, wounding, and harassment of three species of listed sea turtles (i.e., hawksbill, green, and loggerhead). 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.

#### Exposure Analysis

Exposure analyses identify the co-occurrence of ESA-listed species with the action's effects in space and time, and identify the nature of that co-occurrence. The exposure analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the action's effects and the population(s) or subpopulation(s) those individuals represent. Our exposure analyses are based on the best information available to us including recent population estimates, expected growth rates over the life of the permits, the maximum survey effort expected over the permit period, and data from past surveys conducted in and around the action area.

Under permit No. 16146, researchers will be authorized to capture hawksbill, green, and loggerhead sea turtles in waters surrounding Buck Island up to 20 m deep. Stressors associated with the proposed action include **Table 2** displays the exposure levels expected for listed species as a result of the proposed research activities to be authorized under permit no. 16146. We organized exposure events sequentially by grouping the research activities into three main groups according to expected timing of their occurrence. For instance, sea turtles are first exposed to different forms of capture (i.e., dipnets, cast nets, tangle nets, rodeo, and hand capture while snorkeling). After being successfully captured, sea turtles are brought on board where they are exposed to multiple sampling activities (i.e., measuring, weighing, flipper/PIT tagging, carapace marking, opportunistic fecal sampling, blood sampling, and tissue sampling). Finally, a limited number of sea turtles are then exposed to a third group of activities (i.e., blood sampling, digital fecal extraction, gastric lavage, and satellite/acoustic/data-logging tag attachment) before being released.

Individuals exposed may be of either sex and multiple exposures are expected for each individual over the five-year permit duration. While sea turtles may be exposed multiple times throughout the course of the permit period, exposures would not be continuous

throughout the year as researchers expect to conduct sampling trips several months apart with each trip lasting approximately 7-10 days to complete.

**Table 2. Annual Exposure of Listed Species to Research Activities Proposed for Permit No. 16146 to be Conducted in BIRNM, St. Croix, USVI**

Species	First Level Exposure (Individuals captured by dipnets, cast nets, tangle nets, rodeo, or hand capture while snorkeling)	Second Level Exposure (Individuals exposed to weighing, measurement, photography, skin biopsy, flipper tagging, PIT tagging, carapace marking, and opportunistic fecal sampling)	Third Level Exposure (Individuals exposed to blood sampling, gastric lavage, digital fecal extraction, and satellite/acoustic/data-log tagging)**
Hawksbill sea turtle	160 (juvenile/subadult/adult)	160 (juvenile/subadult/adult)	30 (sub-adult/adult)
Green sea turtle*	140 (juvenile/subadult/adult)	140 (juvenile/subadult/adult)	20 (sub-adult/adult)
Loggerhead sea turtle (Northwest Atlantic Ocean DPS)	15 (juvenile/subadult/adult)	15 (juvenile/subadult/adult)	15 (sub-adult/adult)

\*Green sea turtles may be either members of the endangered Florida Breeding Population or threatened individuals

\*\*Only sea turtles larger than 25 cm SCL will be exposed to gastric lavage. Only sea turtles greater than 30 cm SCL will be fitted with transmitters and only those larger than 45cm SCL will be fitted with more than one type of transmitter. Only sea turtles larger than 45 cm SCL will undergo digital fecal extraction

As part of this exposure analysis, the ESA Interagency Cooperation Division reviewed recent nest surveys on Buck Island conducted by the NPS as well as the most recent population estimates for the USVI for all three species in order to estimate the likely exposure levels anticipated for this proposed action. While some prior in-water surveys around Buck Island have been done, in-water studies are generally limited in the expanded portion of BIRNM making it difficult to accurately estimate exposure in these areas. While nesting data is useful for estimating exposure of nesting females, it does not allow us to accurately estimate exposure for transitory or non-nesting juvenile, sub-adult or adult sea turtles that may be exposed. Given this lack of in-water data, we assessed exposure at the levels proposed by the Permits Division. Subsequent monitoring reports submitted by the researchers should help inform this analysis, especially in terms of in-water usage of the expanded marine waters of BIRNM where very little data exists.

Response Analysis

As discussed in the *Approach to the Assessment* section of this Opinion, response analyses determine how listed resources are likely to respond after being exposed to an action’s effects on the environment or directly on listed animals themselves. For the purposes of consultation, our assessments try to detect potential lethal, sub-lethal, 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.

Stressors associated with the proposed permit include possible injury and/or mortality from ship strikes; stress and/or injury from netting and/or hand capture methods; and stress and/or injury associated with handling, measuring, weighing, PIT tagging, flipper tagging, blood sampling, tissue sampling, carapace marking, fecal sampling, and acoustic/satellite/data-log tag attachments. The following sections document the likely responses of listed sea turtles upon being exposed to these stressors.

#### *Responses to Research Vessels*

Sea turtles may be undergo injury and possible mortality as a result of direct ship strikes or contact with small boat propellers. Turtles swimming or feeding at or just beneath the surface of the water are vulnerable to boat and vessel strikes, potentially resulting in death (Hazel et al., 2007). We evaluated the potential for ship strikes and expect that based on the slow speeds of the vessels along with the experience of the researchers at spotting targeted species, it is extremely unlikely that a ship strike would occur over the course of the permit period. Also, researchers have not recorded any ship strikes in the past in monitoring reports submitted for similar research conducted in the Gulf of Mexico (under permit No. 13307-02). Therefore, we believe it is extremely unlikely that a ship strike would occur and do not expect these types of responses as a result of this proposed action.

Sea turtles may also respond behaviorally by avoiding the oncoming vessel. Behavioral responses by animals to human disturbance are similar to their responses to avoiding predators (Beale and Monaghan, 2004; Frid, 2003; Frid and Dill, 2002; Gill et al., 2001; Harrington and Veitch, 1992; Lima, 1998; Romero, 2004). The avoidance response to an oncoming vessel can interrupt essential behaviors such as foraging, resting, mating, etc. Increased stress from the presence of vessels can also increase an animal's susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker et al., 2006). We anticipate that some turtles may dive upon spotting the vessel, therefore we anticipate this type of avoidance response in sea turtles exposed to the proposed research activities.

#### *Responses to Net and Hand Capture*

Hand capture and capture by dipnets, cast nets, and tangle nets can result in short term stress, injury, or even death to sea turtles depending on the type of capture and duration of exposure (Hays et al., 2003b; Watson et al., 2005; Gilman et al., 2007). Dipnets, cast nets, rodeo and hand capture while snorkeling would target individuals directly, while entanglement nets would be placed in the water and passively capture sea turtles that swim into the net. The passive nature of entanglement nets typically result in a longer duration of exposure to capture since the entangled sea turtle would first need to be spotted before being released of the net whereas turtles caught by the other methods would be immediately brought on board the vessel at the direct moment of capture. We focused our analysis on entanglement netting as this capture method typically results in the greatest range of responses due to the typically longer duration of exposure. We will

assume that those turtles exposed to other direct forms of capture would either respond similarly or to a lesser degree than those exposed to entanglement.

Responses of sea turtles to entanglement range from increased stress and alteration of acid-base balance to physical effects of the line wrapping around the turtle to drowning as a result of forced submergence. The magnitude of the response varies depending on the length of time the turtle spends entangled and/or submerged. As a sea turtle becomes entangled, the netting often wraps around the turtle's appendages so as to prevent the turtle from swimming away. Constriction of appendages may cut off blood flow or cause deep gashes as the sea turtle tries to escape the net. Sea turtles that are forcibly submerged due to entanglement also undergo respiratory and metabolic stress that can lead to severe disturbance of their acid-base balance. For instance, most voluntary dives by sea turtles appear to cause only minor changes in acid-base status (pH level of the blood) (Lutz and Bentley, 1985). However, when a sea turtle is forcibly submerged, they often consume oxygen stores which trigger an activation of anaerobic glycolysis that alters the turtles' internal acid-base balance. With each forced submergence, lactate levels increase as well as the time it takes for the sea turtle to recover to normal conditions (as much as 20 hr after the initial exposure). Therefore, sea turtles are likely more susceptible to lethal metabolic acidosis if they experience multiple forced submergences in a short period of time (Lutcavage and Lutz, 1997). Adult sea turtles are capable of longer voluntary dives than small turtles, so juveniles may be more vulnerable to these types of stress responses than adults.

Hoopes et al. (2000) found that entanglement netting produced notable changes in blood chemistry in wild Kemp's ridley sea turtles, with plasma lactate concentrations showing a 6-fold increase at the time of capture compared with those those measured 6-10 hours post-capture. However, they note that the lactate response resulting from the stress of capture in entanglement netting was relatively slight compared with that reported for trawl capture. Although it appears that net capture can result in temporary changes in blood chemistry of sea turtles, it appears that animals that are immediately placed back into a marine environment after removal from the gear can recover from the short-term stress of capture (Hoopes et al., 2000).

Researchers are expected to monitor entanglement nets both at the surface and underwater (by snorkelers swimming the length of the net) at intervals of less than 30 min, and anticipate that water conditions during the day at BIRNM will allow researchers to minimize the time that sea turtles remain entangled before being brought on board. Any sea turtles that have already been sampled may undergo multiple forced submergences, but the fact that nets will be constantly checked decreases the time that a recapture will spend in the net before being released. The short time that sea turtles will remain entangled should minimize the probability that sea turtles will be injured or reach lactate levels that will cause lethal acidosis. Researchers have not recorded mortalities of sea turtles for research conducted in the past in other areas where entanglement nets have been used. Therefore, we expect that responses of sea turtles to entanglement and other capture methods will be limited to short term stress responses manifested as a change in lactate concentrations in the blood that should subside a short time after being released.

These responses are consistent with those recorded by Hoopes et al. (2000) for wild caught Kemp's ridley sea turtles.

#### *Responses to Handling, Measuring, Weighing, and Photography*

Handling and restraining sea turtles may cause short term stress responses similar to those experienced during capture. The additional on-board holding time imposes an additional stressor on already acidotic turtles (Hoopes et al., 2000). It has been suggested that the muscles used by sea turtles for swimming might also be used during lung ventilation (Butler et al., 1984). Thus, an increase in breathing effort in negatively buoyant animals may cause heightened lactate production. Total handling time is expected to be no more than two hours for captured sea turtles although some turtles may be kept over 24 hours under periods of bad weather or other emergency situations. Researchers would place a foam pad on the bottom of the tub and a cloth will be placed over the turtle's eyes to help calm the turtle and restrict movement. These mitigation measures will reduce serve to minimize the magnitude of the stress response to handling.

NMFS expects that any short term stress response from both capture and handling activities to be conducted onboard would return to normal soon after release based on observations recorded in the past (Hoopes et al., 2000). The total handling time may increase for sea turtles held during periods of inclement weather but similar mitigation measures such as restricting the turtle's movement as well as keeping a moist towel over its head and eyes should reduce the overall stress response from extended holding. As was the case for entanglement net capture, juvenile turtles are expected to be more susceptible to blood lactate levels reaching sufficient levels to cause lethal acidosis; however, any recaptured turtles would be released as soon as possible in order to avoid repeated exposure to stress associated with handling and size measurements. Sea turtles would be identified by tags and/or carapace markings and would be released immediately upon being identified. Also, NMFS is unaware of any sea turtle mortalities resulting from onboard handling activities based on a review of previous monitoring reports. Therefore, we expect that sea turtles would undergo short term stress responses as a result of handling and onboard size measurements that should subside shortly after being released.

#### *Responses to Blood and Tissue Sampling*

Effects to sea turtles of drawing blood samples with syringes and taking tissue samples include minimal discomfort and pain as well as possible hemorrhage or infection at the site of penetration. To mitigate these effects, the needle would be slowly advanced while applying gentle negative pressure to the syringe until blood freely flows into the syringe. Once the blood is collected, direct pressure would be applied to the site to ensure clotting and prevent subsequent blood hemorrhaging (Stoskopf, 1993). Bjorndal et al. (2010) found that turtles exhibited rapid healing at the tissue sampling site with no infection or scarring, and that the sampling did not adversely impact turtle physiology or health. Also, at the time of this consultation, NMFS is unaware of any mortalities or serious injuries resulting from this procedure. Researchers will ensure that the total volume of blood taken from each turtle will not exceed one ml per kg of turtle weight and only subadult and adult turtles over 5 kg will be blood sampled to avoid sampling more

sensitive juveniles to this procedure. The sample site for both blood and tissue sampling will be properly cleaned and disinfected to prevent infection. Based on these measures, we expect responses to skin and blood sampling to be minimal discomfort and minor wounding that should heal relatively quickly after release.

#### *Responses to Carapace Marking*

Non-toxic, white polyester resin paint will be used to mark captured turtles with a specific number for identification and tracking. Carapace marking has been used extensively to identify individual turtles in the past and is non-invasive and temporary way to identify sea turtles without recapturing them (Hendrickson and Hendrickson, 1983; Balazs, 1989; Balazs, 1999; Pike et al., 2005). Therefore, no additional stress beyond those described for capture and handling is expected to result from this procedure.

#### *Responses to Fecal Sampling*

Researchers will collect fecal samples either opportunistically after the turtle defecates or through digital extraction. Opportunistic fecal sampling is non-invasive; therefore, sea turtles would not be expected to respond to fecal sampling collected from holding tanks. Digital fecal sampling involves the researcher inserting fingers into the cloaca to extract fecal materials. This procedure is minimally invasive and may cause some minor discomfort to sea turtles exposed. Only sufficiently large turtles (over 50 cm SCL) would be subject to digital extraction of feces in order to avoid unnecessary scarring or injury to smaller turtles. Digital fecal extraction has been permitted in the past and we are unaware of any significant serious injuries or long term health effects resulting from this type of procedure. Given the information available, we expect that minor stress and discomfort may occur as a result of digital fecal extraction with no significant injuries anticipated.

#### *Responses to Gastric Lavage*

Gastric lavage has been extensively used in the past to successfully sample the gut contents of various vertebrate animal groups without seriously injuring or scarring to the subject animal (Forbes, 1999). This technique has been successfully used on green, hawksbill, olive ridley, and loggerhead turtles ranging in size from 25 to 115 cm curved carapace length (CCL). Forbes (1999) reported that many individual turtles have been lavaged multiple times without any known long term detrimental effect. Individuals have been recaptured from the day after the procedure up to three years later and appeared healthy and exhibiting normal feeding behaviors. Permit conditions require researchers to adequately clean and disinfect materials prior to use and that separate equipment must be used on turtles showing evidence of disease to reduce the transmission of pathogens amongst individuals of the same or different species. The ends of tubing will be rounded by melting them with a flame and allowing them to cool which should help avoid damage to the walls of the esophagus during insertion. NMFS anticipates responses to be limited to short term stress and discomfort as a result of this procedure with no threat of serious injury or mortality consistent with the results reported by Forbes (1999).

### *Responses to Flipper and PIT Tagging*

Flipper tagging activities are minimally invasive although sea turtles can experience some discomfort during the application of the tag. The discomfort is usually short and highly variable between individuals based on past observations (Balazs, 1999). NMFS expects the stresses associated with flipper tags to be minimal and short-term and that the small wound-site resulting from a tag should heal relatively quickly after the sea turtle is released.

PIT tags have been used with a wide variety of animal species that include fish (Clugston, 1996; Skalski et al., 1998; Dare, 2003), amphibians (Thompson, 2004), reptiles (Cheatwood et al., 2003; Germano and Williams, 2005), birds (Boisvert and Sherry, 2000; Green et al., 2004), and mammals (Wright et al., 1998; Aguirre et al., 2002). PIT tags have the advantage of being encased in glass, which makes them inert, and are positioned inside the turtle where loss or damage due to abrasion, breakage, corrosion or age over time is virtually non-existent (Balazs, 1999). When PIT tags are inserted into animals that have large body sizes relative to the size of the tag, empirical studies have generally demonstrated that the tags have no adverse effect on the growth, survival, reproductive success, or behavior of individual animals (Skalski et al., 1998, Hockersmith et al., 2003).

The proposed tagging methods have been regularly employed in sea turtle research in the past with little lasting impact on the individuals tagged (Balazs, 1999). NMFS expects that sea turtles fitted with flipper and PIT tags will undergo minor discomfort and short term wounding resulting from insertion of the tag that would be expected to heal quickly after the sea turtle is released.

### *Responses to Acoustic, Satellite, and Data-Logging Accelerometer Tags*

The attachment of transmitters as well as the subsequent biofouling of the tags themselves over time can increase hydrodynamic drag and affect lift and pitch in sea turtles undergoing this procedure. For example, Watson and Granger (1998) performed wind tunnel tests on a full-scale juvenile green turtle and found that at small flow angles representative of straight-line swimming, a transmitter mounted on the carapace increased drag by 27-30 percent, reduced lift by less than 10 percent, and increased pitch moment by 11-42 percent. These responses could impact movement and affect the sea turtle's ability to feed and avoid predators, both of which could have negative consequences for survival. To reduce the impact on the swimming ability of sea turtles, permit conditions require transmitters to not exceed five percent of the sea turtle's total body weight and be as hydrodynamic as possible.

Based on the results of past tracking of hardshell sea turtles equipped with these types of tag set-ups, NMFS is unaware of the transmitters resulting in any serious injury to sea turtles. Also, to reduce the overall drag effects, only turtles larger than 30 cm SCL will be fitted with transmitters and only sea turtles larger than 45 cm SCL will be fitted with more than one type of transmitter. Given the information available on the effects of similar transmitter/tag set ups as well as the measures proposed by the researchers, we expect that sea turtles exposed to transmitter attachment would undergo short term stress

similar to those expected from handling activities that should quickly dissipate after the sea turtle is released. After release, we anticipate that some minor drag would be felt as the sea turtle swims, but given the results seen in the past, we anticipate that this minimal drag would not cause significant hinderance to swimming, foraging, or migration over the period of time that tags remain attached to the turtle (about a year for satellite tags and up to seven years for acoustic tags).

Sonic tags emit an acoustic signal that can be received underwater with a hydrophone. Triangulation of the acoustic signal allows researchers to determine turtle locations. Sea turtles have low-frequency hearing sensitivity and are potentially affected by sound energy in the band below 1,000 Hz (Lenhardt, 2003). Bartol et al. (1999) found the effective bandpass of the loggerhead sea turtle to be between at least 250 and 1,000 Hz. Ridgeway et al. (1969) found the maximum sensitivity of green sea turtle hearing to fall within 300- 500 Hz with a sharp decline at 750 Hz. Since the sonic tags authorized for sea turtle tracking research would be well above this hearing threshold, these tags would not be heard by the turtles. NMFS would not expect the transmitters to interfere with turtles' normal activities after they are released.

Another important consideration is whether the sounds emitted by the sonic transmitters would attract potential predators, primarily sharks. While hearing data on most sharks species is limited, Casper and Mann (2004) examined the hearing abilities of the nurse shark and found that this species detects low-frequency sounds from 100 to 1,000 Hz, with best sensitivity from 100 to 400 Hz. Also, Nelson (1967) and Casper et al. (2003) found sharks to be most sensitive to sounds at lower frequencies. Thus, sonic transmitters are not expected to attract potential shark predators to the turtles, because the frequency of the sonic tags is well above the 1,000-Hz threshold.

### Risk Analysis

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

As described in the *Response Analysis* section above, the majority of exposures to the proposed research activities are expected to result in short term stress manifested as temporary increases in lactate levels from capture, handling, size measurements, blood and tissue sampling, fecal sampling, carapace marking, gastric lavage, and tagging (flipper, PIT, and satellite/acoustic/data log tags). Some additional stress and discomfort may occur as a result of blood sampling, tissue sampling, digital fecal extraction, and gastric lavage while transmitter attachment may cause some minor drag effects once sea turtles fitted with these types of tags are released. No mortality or serious injury is expected to occur that would cause an absolute reduction in abundance or affect reproduction or nesting behavior.

Researchers are expected to monitor entanglement nets both from the surface and underwater to reduce the duration of exposure and minimize potential injuries associated with entanglement. Any recaptured sea turtles will be easily identified from tags and/or carapace markings and will be released immediately to minimize any additional cumulative stress to the turtle. While we expect that juveniles may be more susceptible to lethal acidosis from repeat exposures over a short time period (Lutcavage and Lutz, 1997), researchers will not be sampling in consecutive months throughout the year and any individuals recaptured during a particular sampling trip will be immediately released to minimize additional stress from handling. Given these procedures, we do not anticipate any individuals from any species to reach stress levels sufficient to cause lethal acidosis. The short term stress associated with capture and handling is not expected to result in any long term fitness consequences to individuals as sea turtles are expected to return to normal lactate levels soon after release (Hoopes et al., 2000). Researchers have performed similar activities in the past and a review of their monitoring records did not indicate any deaths or serious injuries associated with these types of actions and these results are consistent with records on other similar actions that have been permitted in the past.

Sea turtles will be released in the same general area where they were captured in order to minimize interruptions to essential behaviors such as foraging, nesting, or transitory/migratory behaviors. We expect that sea turtles would resume normal behaviors soon after release and would not cause long term avoidance or abandonment of important foraging or nesting habitat in the action area. Hawksbill and green sea turtles sampled in the past on St. Croix have been seen in consecutive sampling seasons based on nesting data reported for both Buck Island (Phillips and Hillis-Starr, 2002) and East End beaches (Mackay, 2006) on St. Croix. Also, Seminoff et al. (2002) reported that sonic tracked green sea turtles eventually returned to areas of initial capture, suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns.

Based on the best scientific information available, we expect that the proposed research activities are not likely to cause a reduction in an individual's growth, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness). As a result, we do not expect activities authorized by the proposed permit to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

## **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 in this Opinion. Future Federal actions, including research authorized under ESA Section 10(a)1(A), 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. Future cumulative effects from these and other types of federal actions will be investigated in future consultations, most

notably in the *Status of the Species* and *Environmental Baseline* sections of Opinions which inform the effects analyses for specific federal actions. Other possible effects that may be acting in conjunction with federal actions and could possibly contribute to a cumulative impact on listed species are described below.

NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as described in the *Environmental Baseline* section of this Opinion. Climatic variability has the potential to affect listed species in the action area in the future; however, the prediction of any specific effects leading to a decision on the future survival and recovery is currently speculative. Nevertheless, possible effects of climatic variability for listed sea turtles include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition, and altered timing of breeding. Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Also, climate variability may increase hurricane activity leading to an increase in debris in nearshore and offshore waters, thereby resulting in increased entanglement, ingestion, or drowning as well as increased physical destruction of sea turtle nests or degradation of coral reefs and seagrass communities within BIRNM.

We also expect anthropogenic effects described in the *Environmental Baseline* will continue, including habitat degradation from pollutants being discharged off the main island of St. Croix, illegal poaching, and interactions with tourist groups, specifically divers. Expected increases in tourism activities would further increase collision risks for sea turtles by the increased traffic itself and/or through habituation of animals to the sounds of oncoming traffic making them more prone to being struck. Despite these concerns, we also expect that ongoing conservation activities as well as education programs funded and implemented by NPS staff and through partnerships with USVI Department of Fish and Wildlife and other non-governmental organizations should help minimize the overall impact that these stressors have on sea turtles and their habitat within BIRNM in the future.

After reviewing the available information, NMFS is not aware of any additional future non-federal activities or potential stressors reasonably certain to occur in the action area that could contribute to a cumulative impact to ESA listed or ESA proposed species affected by the proposed action.

## **INTEGRATION AND SYNTHESIS OF EFFECTS**

The following text integrates and synthesizes the *Description of the Proposed Action*, *Approach to the Assessment*, *Action Area*, *Status of the Species*, *Environmental Baseline*, *Effects of the Proposed Action*, and *Cumulative Effects* sections of this Opinion.

The Permits Division proposes to issue permit No. 16146 to Dr. Kristen Hart of the USGS for scientific research activities resulting in direct “takes” of listed loggerhead



(*Caretta caretta*) (Northwest Atlantic Ocean DPS), green (*Chelonia mydas*), and hawksbill (*Eretmochelys imbricata*) sea turtles in BIRNM, USVI, pursuant to section 10(a)(1)(A) of the ESA. Takes are expected to be in the form of capture, wounding, and harassment. Capture of listed sea turtles would occur using dipnets, cast nets, tangle nets, rodeo, and hand capture while snorkeling. Wounding would occur due to flipper and PIT tag insertion as well as from blood and tissue sampling. Harassment would occur from capture, handling, measuring, weighing, tagging (using flipper, PIT, satellite, acoustic, and data-logging tags), lavage, tissue sampling, blood sampling, fecal sampling, and transport to land-based facilities during inclement weather or other extenuating circumstances. The action area for this consultation includes coastal waters surrounding Buck Island in BIRNM up to 20 m deep.

The objective of the research is to document habitat-use patterns over time, increase understanding of genetic stock structure, and estimate vital rates and local population abundance of loggerhead, green, and hawksbill sea turtles around BIRNM. The permit would be valid for five years from the date of issuance. Researchers are proposing to capture 160 hawksbills, 140 green, and 15 loggerheads annually for research purposes. They also intend to fit satellite/acoustic/data-logging tags on 30 hawksbills, 20 greens, and 15 loggerheads annually. After a review of the available information, the ESA Interagency Cooperation Division assessed exposure of listed sea turtles at the levels proposed by the Permits Division. Sea turtles exposed would be of either sex and some individuals would be exposed multiple times over the course of the permit period (five year duration from the time of issuance).

Mitigation measures include taking precautions to minimize stress to captured animals, appropriately checking entanglement nets to monitor for entangled animals, limiting the amount of blood that can be drawn, limiting exposure of certain activities (e.g., blood sampling, gastric lavage, digital fecal extraction, satellite/acoustic/data-log tagging) to larger sub-adult or adult sea turtles rather than juveniles, using trained and experienced personnel to minimize disturbance, using sterile or appropriately sanitized equipment, and remaining a safe distance from non-target protected species, among others.

As explained in the *Approach to the Assessment* section, risks to listed individuals are measured using changes to an individual's "fitness." When listed plants or animals exposed to an action's effects are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (e.g., Brandon, 1978; Mills and Beatty, 1979; Stearns, 1992; Anderson, 2000). When individuals of listed plants or animals are expected to experience reductions in fitness in response to an action, those fitness reductions can reduce the abundance, reproduction, or growth rates of the populations that those individuals represent (see Stearns, 1992). If we determine that reductions in individual plants' or animals' fitness reduce a population's viability, we consider all available information to determine whether these reductions are likely to appreciably reduce the viability of the species as a whole. To conduct these analyses, we rely on all of the evidence available to us. When data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks

associated with incorrectly concluding an action has no adverse effect on a listed species when, in fact, such adverse effects are likely.

Sea turtles have also been impacted historically most notably through direct harvest as well as domestic and international fishery operations that often capture, injure, and even kill sea turtles at various life stages. The Southeast U.S. Shrimp Fishery (which uses otter trawl gear) has historically been one of the largest fishery threats to sea turtles in the southeastern U.S. (Murray, 2006) and continues to interact with (and kill) large numbers of turtles each year. There are also many non-fishery impacts affecting the status of sea turtle species, including entrainment in Hopper dredges, water pollution from coastal areas and oil spills, degradation of nesting beaches, and harassment and/or injury resulting from private and commercial vessel operations. Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles in the years to come. While many of the species targeted by this proposed action have been showing some signs of recovery based on recent nest counts in the southeastern U.S. and Caribbean regions, the population estimates are still drastically reduced compared to historical estimates and many other nesting populations occurring outside of the U.S. are still in a great state of decline putting these often highly migratory species at an increased risk of extinction.

Taken together, the components of the environmental baseline for the action area include sources of natural mortality – such as predation, disease, storm events, and climate variability – as well as human activities resulting in disturbance, injury, or mortality of individuals and degradation of important foraging and nesting habitat. Strong storm events in the Caribbean are common and affect sea turtles by unearthing nests and damaging coral reef foraging habitat. Increasing air temperatures result in coral bleaching and alteration of sex ratios for sea turtles nesting on Buck Island. Mongoose predation used to be big threat to hawksbills on Buck Island, although an eradication program has since minimized this threat. Anthropogenic activities such as pollution from coastal areas on the St. Croix mainland, poaching of sea turtle eggs, illegal fishing, and interaction with tourism activities continue to threaten sea turtles in the action area. Conservation and management activities such as the expansion of BIRNM in 2001 as well regulations prohibiting all fishing and anchoring within the monument have and will continue to benefit sea turtle populations by minimizing exposure of sea turtles to these stressors within the monument boundaries.

For the exposure analysis conducted for this Opinion, the ESA Interagency Cooperation Division reviewed prior monitoring reports and biological opinions conducted for similar actions. We organized exposure events sequentially by grouping the research activities into three main groups according to expected timing of their occurrence. For instance, sea turtles are first exposed to different forms of capture (i.e., dipnet, cast-net, tangle net, rodeo, or hand capture while snorkeling). After capture, sea turtles are brought on board where they are exposed to multiple sampling activities (e.g., measuring, weighing, flipper/PIT tagging, carapace marking and blood/tissue sampling). Finally, a limited number of those sea turtle are then exposed to a third group of activities (i.e., blood sampling, digital fecal extraction, gastric lavage, and satellite/acoustic/data-log tagging)

before being released. We assessed the responses expected to occur at each stage and evaluated the risks those responses posed to the species affected by the proposed action.

Stressors associated with the proposed permit include possible injury and/or mortality from ship strikes; stress and/or injury from netting and/or hand capture methods; and stress and/or injury associated with handling, measuring, weighing, PIT tagging, flipper tagging, blood sampling, tissue sampling, carapace marking, fecal sampling, and acoustic/satellite/data-log tag attachments.

The avoidance response to an oncoming vessel can interrupt essential behaviors such as foraging, resting, mating, etc. and increased stress from the presence of vessels can also increase an animal's susceptibility to disease and predation (Frid and Dill, 2002; Romero, 2004; Walker et al., 2006). Hand and net capture can result in short term stress, injury, or even death to sea turtles depending on the type of capture and duration of exposure (Hays et al., 2003b; Watson et al., 2005; Gilman et al., 2007). We expect that based on the methods proposed and the mitigation measures included in the proposed permit, responses of sea turtles to entanglement and other capture methods will be limited to short term stress responses manifested as a change in lactate concentrations in the blood that should subside a short time after being released consistent with responses recorded by Hoopes et al. (2000). Juvenile turtles are expected to be more susceptible to blood lactate levels reaching sufficient levels to cause lethal acidosis; however, any recaptured turtles would be released as soon as possible in order to avoid repeated exposure to additional stress.

The sample site for both blood and tissue sampling will be properly cleaned and disinfected to prevent infection. Researchers will also adhere to permit restrictions on blood levels to be drawn and will limit blood sampling, gastric lavage, and digital fecal extraction to larger sub-adult and adult individuals. Also, all equipment to be utilized for gastric lavage will be properly cleaned and multiple sets of equipment will be used to avoid minimize the possibility of disease transmission as a result of this procedure. Based on these measures, we expect responses to skin sampling, blood sampling, gastric lavage, and digital fecal extraction to be minimal discomfort and minor wounding (in the case of blood and tissue samples) that should heal relatively quickly after release. Also, no additional stress beyond those described for capture and handling is expected to result from carapace-marking captured sea turtles.

The proposed tagging methods have been regularly employed in sea turtle research in the past with little lasting impact on the individuals tagged (Balazs, 1999). NMFS expects that sea turtles fitted with flipper and PIT tags will undergo minor discomfort and short term wounding resulting from insertion of the tag that would be expected to heal quickly after the sea turtle is released with no long term fitness consequences expected. The attachment of transmitters for acoustic and satellite tags as well as the subsequent biofouling of the tags themselves over time can increase hydrodynamic drag and affect lift and pitch in sea turtles undergoing this procedure (Watson and Granger, 1998) although permit conditions require transmitters to not exceed five percent of the sea turtle's total body weight and be as hydrodynamic as possible to minimize effects to a sea

turtles' swimming ability. We expect that sea turtles attached with these types of tags would undergo short term stress similar to handling activities with minimal effects to their overall swimming ability over the life of the tag. Also, sonic signals emitted by the acoustic transmitters would not be expected to be heard by sea turtles or their predators, thereby avoiding acoustic impacts to these species from sonic tracking.

The short term stress associated with capture and handling is not expected to result in any long term fitness consequences for sea turtles as a result of the proposed action. Researchers have performed similar activities in the past and a review of their monitoring records did not indicate any deaths or serious injuries associated with these types of actions and these results are consistent with records on other similar actions that have been permitted in and around the action area in recent years. Captured sea turtles will be released in the same general area as when they were captured in order to minimize interruptions to essential behaviors such as feeding that may have been occurring at the time of capture. During a study of sonic tracked turtles by Seminoff et al. (2002), green turtles returned to areas of initial capture, suggesting that the transmitters and the tagging experience left no lasting effect on habitat use patterns. Also, hawksbill and green sea turtles tagged in previous years along Buck Island and East End beaches on St. Croix have returned in subsequent years (Phillips and Hillis-Starr, 2002; Mackay, 2006). We expect similar responses by sea turtles targeted by this proposed action. Based on the best scientific information available, we expect that the research activities to be authorized in the proposed permit are not likely to cause a reduction in an individual's, survival, annual reproductive success, or lifetime reproductive success (i.e. fitness). As a result, we do not expect activities authorized by the proposed permits to have an appreciable effect on the extinction risk of the population(s) these individuals represent or the species those populations comprise.

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. NMFS expects the natural phenomena in the action area (e.g., oceanographic features, storms, natural mortality) will continue to influence listed species as described in the *Environmental Baseline* section of this Opinion. Climatic variability has the potential to affect listed species in the action area in the future; however, the prediction of any specific effects leading to a decision on the future survival and recovery is currently speculative. Nevertheless, possible effects of climatic variability for listed sea turtles and marine fish include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, alterations to prey composition, and altered timing of breeding. Atmospheric warming creates habitat alteration which may change sex ratios and affect reproductive periodicity for nesting sea turtles. Also, climate variability may increase hurricane activity that can further damage nesting beaches and foraging habitat in and around BIRNM.

We also expect anthropogenic effects described in the *Environmental Baseline* will continue, including habitat degradation from pollutants being discharged off the main island of St. Croix, illegal poaching, and interactions with tourist groups, specifically

divers. Expected increases in tourism activities would further increase collision risks for sea turtles by the increased traffic itself and/or through habituation of animals to the sounds of oncoming traffic making them more prone to being struck. Despite these concerns, we also expect that ongoing conservation activities as well as education programs funded and implemented by NPS staff and through partnerships with USVI Department of Fish and Wildlife and other non-governmental organizations should help minimize the overall impact that these stressors have on sea turtles and their habitat within BIRNM in the future.

## **CONCLUSION**

After reviewing the current status of listed species affected by the proposed action, the environmental baseline for the action area, the anticipated effects of the proposed research activities and the possible cumulative effects, it is the ESA Interagency Cooperation Division's opinion that the Permits Division's proposed action of issuing permit No. 16146 to Dr. Kristen Hart, as proposed, is not likely to jeopardize the continued existence hawksbill sea turtles, green sea turtles (both the Florida Breeding Population and non-Florida breeding population), or loggerhead sea turtles (Northwest Atlantic Ocean DPS) under NMFS' jurisdiction. No designated critical habitat would be affected.

## **INCIDENTAL TAKE STATEMENT**

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

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

## **CONSERVATION RECOMMENDATIONS**

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency

activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans or to develop information.

We recommend the following conservation recommendation, which would potentially minimize effects to sea turtles from the proposed research activities:

1. *Applying Satellite/Acoustic Transmitters to Severely Injured or Compromised Sea Turtles.* The Permits Division should encourage researchers to avoid attaching satellite or acoustic transmitters to injured or compromised sea turtles unless the purpose of the research is to determine post-trauma survival. Further stress associated with these types of tagging methods as well as the minimal drag anticipated may further compromise the turtle if it is already in poor health.

### **REINITIATION NOTICE**

This concludes formal consultation and conference on the proposal to issue scientific research permit No. 16146 to Dr. Kristen Hart, USGS, for research on ESA listed sea turtles in BIRNM, St. Croix, USVI. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of 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, the Permits Division must immediately request reinitiation of section 7 consultation.

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