

**NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL AND CONFERENCE OPINION**

Title: Biological and Conference Opinion on United States Air Force, Eglin Gulf Testing and Training Range (EGTTR) Activities

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

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Office of Protected Resources, National Marine Fisheries
Service, National Oceanic and Atmospheric Administration

Approved:



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1 INTRODUCTION

The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with National Marine Fisheries Service (NMFS), the United States Fish and Wildlife Service (USFWS), or both (the Services), depending upon the endangered species, threatened species, or designated critical habitat, the agency must consult with NMFS, USFWS, or both (50 C.F.R. §402.14(a)). If a Federal agency determines that an action “may affect, but is not likely to adversely affect” endangered species, threatened species, or designated critical habitat and NMFS, the USFWS, or both concur with that determination, consultation concludes informally (50 C.F.R. §402.14(b)).

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

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

The action agency for this consultation is the United States Air Force (Air Force). The Air Force proposes to conduct air-to-surface testing and training activities in the Eglin Gulf Testing and Training Range (EGTTR) of the Gulf of Mexico.

Consultation in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §402), and agency policy and guidance (USFWS and NMFS 1998) was conducted by NMFS Office of Protected Resource’s ESA Interagency Cooperation Division. This biological opinion (opinion), conference report, and incidental take statement were prepared by NMFS Office of Protected Resource’s ESA Interagency Cooperation

Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

This document represents NMFS' opinion on the effects of these actions on endangered and threatened species and designated critical habitat that has been designated for those species. A complete record of this consultation is on file at NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

On December 17, 1998, NMFS Southeast Regional Office (SERO) issued an opinion on the Air Force Special Operations Command's proposed air-to-surface gunnery testing by AC-130s in the W-151 range area in the Gulf of Mexico. The opinion concurs with the Air Force's finding that ESA-listed whales are not likely to be adversely affected by the EGTTR activities, but ESA-listed sea turtle species are likely to be adversely affected. The opinion concluded the EGTTR activities is not likely to jeopardize the continued existence of five ESA-listed species of sea turtles (i.e., green, hawksbill, Kemp's ridley, leatherback, and loggerhead) that occur in the Gulf of Mexico.

On October 20, 2004, NMFS SERO issued an opinion on the Air Force Special Operations Command use of the EGTTR. The opinion concluded that the Air Force Special Operations Command's EGTTR mission activities were not likely to jeopardize the continued existence of threatened or endangered species under NMFS jurisdiction, or destroy or adversely modify critical habitat that has been designated for those species. This opinion replaced the opinion dated December 17, 1998, concerning specific EGTTR mission activities.

On October 25, 2004, NMFS SERO issued an opinion on the Eglin Air Force Base's (AFB) Naval Explosive Ordinance Disposal School training five-year plan. NMFS SERO concluded that the Naval Explosive Ordinance Disposal School training missions and their associated actions were not likely to jeopardize the continued existence of threatened or endangered species under NMFS' jurisdiction or destroy or adversely modify critical habitat that has been designated for those species. The Naval Explosive Ordinance Disposal School mission activities in the EGTTR analyzed in NMFS SERO's 2004 opinion were never conducted at Eglin AFB due to safety concerns with transferring explosives under bridges for access into the Gulf of Mexico.

On March 14, 2005, NMFS SERO issued an opinion on Eglin AFB's Precision Strike Weapons tests five-year plan. NMFS SERO concluded that the EGTTR Precision Strike Weapon tests and their associated actions were not likely to jeopardize the continued existence of threatened or endangered species under NMFS jurisdiction or destroy or adversely modify critical habitat that has been designated for those species.

On March 20, 2008, NMFS SERO issued an opinion on Eglin AFB's Advanced Littoral Reconnaissance Technologies testing. NMFS SERO concluded that the Advanced Littoral Reconnaissance Technologies testing and its associated actions occurring from the time the

opinion was issued until 2020 were not likely to jeopardize the continued existence of threatened or endangered species under NMFS jurisdiction, or destroy or adversely modify designated critical habitat.

On December 15, 2014, NMFS SERO issued an opinion on Eglin AFB's proposed action to conduct maritime strike operations within the EGTTR. NMFS SERO concluded that the maritime strike operations and maritime testing were not likely to jeopardize the continued existence of threatened or endangered species under the jurisdiction of NMFS.

This programmatic opinion and conference report for the Air Force's ongoing EGTTR activities combines all of these previous opinions (i.e., December 1998, October 2004, October 2004, March 2005, March 2008, December 2014).

1.2 Consultation History

On September 16, 2015, NMFS SERO received a request for formal consultation pursuant to section 7(a)(2) of the ESA for the Air Force's proposed EGTTR activities into the foreseeable future.

On December 1, 2015, the formal consultation for the Air Force's proposed EGTTR activities was transferred from NMFS SERO to NMFS ESA Interagency Cooperation Division. The Air Force was also informed of this transition.

On March 8, 2016, the NMFS' ESA Interagency Cooperation Division and the Air Force agreed upon a formal consultation completion date of September 8, 2016.

On March 15, 2016, the NMFS' ESA Interagency Cooperation Division initiated formal consultation with the Air Force for EGTTR activities.

On March 17, 2016, the Air Force replied to the initiation response confirming a mutual agreement for consultations extending beyond the statutory timeline of 135 days to complete the opinion to September 8, 2016.

On July 19, 2016, the NMFS' ESA Interagency Cooperation Division and the Air Force agreed to a revised timeline and a formal consultation completion date of December 2016.

On November 21, 2016, the NMFS' ESA Interagency Cooperation Division and the Air Force agreed to a revised timeline and a formal consultation completion date of January 9, 2017.

2 DESCRIPTION OF THE PROPOSED ACTION

“Action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies.

This opinion and conference report addresses the Air Force's air-to-surface testing and training activities in the EGTTR. This opinion and conference report supersedes all previous biological opinions on Air Force EGTTR activities.

NMFS recognizes that while Air Force testing and training requirements change over time in response to global or geopolitical events and other factors, the general types of activities addressed by this consultation are expected to continue into the reasonably foreseeable future, along with the associated effects. Therefore, as part of our effects analysis, we assumed that the testing and training activities proposed by the Air Force would continue into the reasonably foreseeable future at levels similar to that assessed in this opinion and conference report and described in the EGTTR environmental assessment and biological assessment.

The tempo of training and testing within the EGTTR action area is subject to variation within the scope of the activities described in the Air Force's EGTTR environmental assessment, programmatic biological assessment, and this opinion and conference report. Annual variation in the number of training and testing events and quantities of operations and explosives could occur based on a variety of reasons.

The Air Force's proposed action consists of testing and training and testing activities, mitigation activities, the action area, and interrelated and interdependent actions as described below.

2.1 Testing and Training Activities

Due to threats to national security, increased testing and training missions involving air-to-surface activities have been directed by the Department of Defense. In this opinion and conference report, air-to-surface activities refer to the firing or dropping of munitions including bombs, missiles, rockets, and gunnery rounds from aircraft toward targets located on the Gulf of Mexico surface. Depending on the requirements of a given mission, munitions may be inert or live. Live munitions may detonate above, at, or slightly below the water surface. All activities described in this document will occur within the boundaries of the EGTTR (Figure 2). Missions consisting of live bombs, missiles, and rockets that detonate at or below the water surface will occur at a site in W-151A that has been designated specifically for these types of activities. This site is located approximately 27.4 km (14.8 nautical miles [nmi]) offshore from Santa Rosa Island, at a water depth of about 35 m (115 ft). Typically, test data collection is conducted from an instrumentation barge known as the Gulf Range Armament Test Vessel (GRATV) anchored on-site, which provides a platform for cameras and weapon-tracking equipment. Therefore, the mission area is referred to as the GRATV target location. The target location site within W-151A is shown in Figure 3. Alternative site locations may be selected within an eight km (4.3 nautical miles) radius around the GRATV point. This alternative area is shown on Figure 3 as the Alternative Target Location Area. Gunnery operations are limited to occur only over continental shelf waters (shoreward of the 200 m [656 ft] bathymetry line) in W-151. Missions that involve detonations will occur in W-151 (primarily W-151A subarea), and shoreward of the 200 m (656 ft) bathymetry line. Aircraft operations will continue to be conducted in all other warning areas, but no releases are proposed outside of W-151. The missions may occur during any season or month. Missions involving the use of live bombs and missiles will occur during daylight hours; however, some activities, such as gunnery training, may occur during day or night. Detailed

descriptions for each individual mission activity are included in the following sections, organized by action proponent.

2.1.1 86th Fighter Weapons Squadron System Evaluation Program

The 86th Fighter Weapons Squadron proposes to evaluate several weapon systems including live and inert munitions and swarm missions. Prior to system testing the Air Force will follow target area clearance procedures for public safety and protected marine species.

Live and Inert Munitions Testing

The 86th Fighter Weapons Squadron proposes to use multiple types of live and inert munitions in the EGTTR against small boat targets for their Maritime Weapons System Evaluation Program (WSEP) Operation Testing Program. The purpose of the testing is to continue the development of tactics, techniques, and procedures for Air Force strike aircraft to counter small maneuvering hostile surface vessels.

Maritime WSEP activities involve using multiple types of aircraft with inert and live munitions in the EGTTR, including bombs, missiles, and gunnery rounds (Table 1). Because the focus of the tests would be weapon/target interaction, no particular aircraft would be specified for a given test as long as it met the delivery requirements. Various Air Force active duty units, National Guard, Navy, and Air Force reserve units would participate as interceptors and weapons release aircrews, with multiple types of aircraft typically operating within the same airspace.

Tests would be conducted at the GRATV target location in various sea states and weather conditions, up to a wave height of 1.2 m (4 ft). Live munitions would be deployed against static (anchored), towed, and remotely controlled boat targets. Static and controlled targets would consist of stripped boat hulls with plywood simulated systems and, in some cases, heat sources. Moving targets would be towed by remotely controlled high speed maneuverable surface target boats. Damaged boats would be recovered for data collection. Test data collection would be conducted from the GRATV. High speed maneuverable surface target boats would be remotely controlled from a facility on Eglin Main Base and would follow set track lines with specific waypoints at least 3.7 to 5.6 km (2 to 3 nmi) away from the GRATV. Additional air assets such as chase aircraft or unmanned aerial vehicles would transit to the target area and set up flight orbits to provide aerial video of the mission site including weapon impacts on boat targets and assisting with range clearing activities. Missions would be controlled from the Eglin Central Control Facility on Main Base, which is on land at Eglin AFB.

Table 1. Maritime Weapons System Evaluation Program munitions and example aircraft.

Munitions	Aircraft
AGM-114 (Hellfire)	
AGM-176 (Griffin)	
AGM-65 (Mavericks)	F-15 fighter aircraft
AIM -9X	F-16 fighter aircraft
BDU-56	F-18 fighter aircraft
CBU-105 (WCMD)	F-22 fighter aircraft
GBU-12/GBU-54	F-35 fighter aircraft
GBU-10/GBU-24	AC-130 gunship
GBU-31	A-10 fighter aircraft
GBU-38	B-1 bomber aircraft
PGU-13/B	B-52 bomber aircraft
PGU-27	B-2 bomber aircraft
2.75 in Rockets	MQ-1
7.62mm/50 Cal	MQ-9
GBU-39 (Laser SDB)	
GBU-53 (SDB II)	

AGM=Air-to-Ground Missile; AIM=Air Intercept Missile; BDU=Bomb, Dummy Unit; CBU=Cluster Bomb Unit; GBU=Guided Bomb Unit; mm=millimeters; PGU=Projectile Gun Unit; SDB=Small Diameter Bomb; WCMD=Wind-Corrected Munitions Dispenser

Live munitions would be set to detonate either in the air, instantaneously upon contact with a target boat, or after a slight delay (up to ten millisecond) after impact, which would correspond to a water depth of about 1.5 to 3.1 m (5 to 10 ft). The annual number, height, or depth of detonation, explosive material, and net explosive weight of each munition associated with Maritime WSEP is provided in

Table 2. The quantity of live munitions tested is considered necessary to provide the intended level of tactics and weapons evaluation, including a number of replicate tests sufficient for an acceptable confidence level regarding munitions capabilities.

In addition to the live munitions described above, 86th Fighter Weapons Squadron also proposes to expend inert munitions in W-151. The expected number of each munition type expended during a typical year is included in

Table 2. There is no particular limit on the number of inert items that may be expended, and actual numbers may vary somewhat from those shown in the table.

Table 2. Maritime Weapons Systems Evaluation Program annual munitions use in the Eglin Gulf Testing and Training Range.

Type of Munition	Number of Munitions	Detonations Scenario	Warhead – explosive material	Net Explosive Weight (lbs)
GBU-10 or GBU-24	2	Surface or Subsurface	MK-84 - Tritonal	945
GBU-12 or GBU-54 (LJDAM)	6	Surface or Subsurface	MK-82 - Tritonal	192
AGM-65 (Maverick)	6	Surface	WDU-24/B penetrating blast-fragmentation warhead	86

Type of Munition	Number of Munitions	Detonations Scenario	Warhead – explosive material	Net Explosive Weight (lbs)
CBU-105	4	Airburst	10 BLU-108 submunitions with 4 projectiles, parachute, rocket motor & altimeter. 10.69 lbs NEW/submunition (includes 2.15 lbs/projectile)	107.63
GBU-39 (LSDB)	4	Airburst, Surface or Subsurface	AFX-757 (Insensitive munition)	37
AGM-114 (Hellfire)	30	Airburst or Surface, Subsurface	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge.	20
GBU-53 (SDB II)	4	Airburst, Surface or Subsurface	PBX-N-109 Aluminized Enhanced Blast, Scored Frag Case, Copper Shape Charge	22.84
AGM-176 (Griffin)	10	Airburst or Surface	Blast fragmentation	4.58
Rockets (including APKWS)	100	Surface	Comp B-4 HEI	10
PGU-13 HEI 30 mm	1,000	Surface	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A Gun System	0.1
AIM-9X	4	Surface	PBXN-3	68
GBU-10	21	Inert	NA	NA
GBU-12	27	Inert	NA	NA
GBU-24	17	Inert	NA	NA
GBU-31	6	Inert	NA	NA
GBU-38	3	Inert	NA	NA
GBU-54	16	Inert	NA	NA
BDU-56	13	Inert	NA	NA
AIM-9X	3	Inert	NA	NA
PGU-27	46,000	Inert	NA	NA

AGM=air-to-ground missile; AIM=air intercept missile; APKWS=Advanced Precision Kill Weapon System; BDU=Bomb, Dummy Unit; CBU=Cluster Bomb Unit; GBU=Guided Bomb Unit; HEI=high explosive incendiary; lbs=pounds; LJDAM=laser joint direct attack munition; LSDB=Laser Small Diameter Bombs; MK = mark; mm=millimeters; NA=not applicable; NEW=net explosive weight; PBX=plastic-bonded explosive; PGU=Projectile Gun Unit; RDX=research department explosive; SDB=Small Diameter Bomb

Pre-Test Target Area Clearance Procedures for Public Safety and Protected Marine Species

A human safety zone will be established around the test area prior to each mission, and will be enforced by up to 20 to 25 safety boats. The size of this zone will vary, depending upon the particular munition and delivery method used in a given test. A composite safety footprint has been developed for previous tests using live munitions, and incorporated the average of all munitions deployed. This composite safety footprint consisted of a circle with a 46.7 km-wide (29 mile-wide diameter circle [23.3 km or 14.5 mile-wide radius]), which was converted to an octagon shape for ease of support vessel placement and range clearance. This is a footprint for

human safety concerns, in which the Air Force takes a composite (average) of all weapons, and factor in aircraft speed, altitude of release, and other safety considerations to create a safety zone (or footprint) for each mission that must exclude humans. The GRATV is located approximately 3.2 km (two miles) north of the center of the octagon. Other than the types of vessels identified in 33 C.F.R. §334.720 (i.e., Gulf of Mexico, South from Choctawhatchee Bay; Guided Missiles Test Operations Area, Headquarters Air Proving Ground Command, Air Force, Eglin AFB, Florida), all nonparticipating vessels (such as recreational fishing vessels) will be excluded from entering the safety footprint while it is active, which is expected to be up to four hours per mission on test days (multiple munitions may be deployed within the four-hour time period). The Eglin Test and Range Safety Office will position the safety support vessels around the safety footprint to ensure commercial and recreational boats do not accidentally enter the area. Before delivering the ordnance, mission aircraft may make a dry run (no munitions deployed) over the target area to ensure that it is clear of nonparticipating vessels, although this action is not necessarily performed before all releases. The Eglin Test and Range Safety Office will monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. To inform the public, the Eglin Test and Range Safety Office will request that the U.S. Coast Guard release a Notice to Mariners prior to the closure of the safety footprint around the target location. In addition, 96th Range Support Squadron personnel will also distribute flyers with maps at public docks and to vessels in Destin Pass showing the closed area and explaining why it is closed.

In addition to actions carried out to ensure human safety during live missions, measures designed to avoid or minimize impacts to protected marine species have been developed in cooperation with NMFS. A separate zone around the target will be established for marine species protection, based on the distance to which energy- and pressure-related impact zones could extend for the various types of live ordnance. The dimensions of this zone will be different than those of the human safety zone and will depend on the specific munitions being released. Trained marine species observers will survey the protection zone before each mission. More detail on mitigation implemented to minimize potential effects to protected species is in section 2.2 of this opinion and conference report.

Up to four video cameras will also be positioned on the GRATV anchored on-site. The cameras will primarily be used to document the weapons' performance against targets, but could also be used to monitor for the presence of unauthorized vessels and protected species. An Eglin Natural Resources representative will be located in Eglin AFB's Central Control Facility on Main Base, along with mission personnel, to view the live video feed before and during test activities. All cameras have a zoom capability of up to at least a 300 millimeter (mm) (11.8 in) equivalent. At this setting, when targets are at a distance of 3.2 km (2 nmi) from the GRATV, the field of view would be 59.4 by 44.5 m (195 by 146 ft). Video observers can detect an item with a minimum size of one square foot (ft²) up to 4,000 m (13,123 ft) away. The Air Force is in the process of acquiring cameras with even greater zoom capability (up to a 1,200 mm [47.2 in] zoom lens).

Missions will not proceed until the target area is confirmed to be clear of protected species (when live munitions are used) and unauthorized vessels. In addition, the test will not be conducted if all video cameras are not operational.

Post-Test Activities

Potential post-test activities consist of Air Force explosive ordnance disposal personnel detonating in place any munitions components or items remaining on the target boats that would be considered unexploded ordnance, debris retrieval, and post-mission protected species surveys. Unexploded bombs, missiles, or other similarly large items would sink to the seafloor and would not be recovered or detonated. However, smaller unexploded items such as cluster bomb submunitions could remain intact on target boats. Each CBU-105 contains ten submunition cylinders, and each cylinder contains four sub-submunitions (skeets), which fire inert projectiles. Therefore, there is a total of 40 skeets per bomb. On test days involving the release of CBU-105s, the Eglin explosive ordnance disposal team would be on hand to inspect floating targets and identify and render safe any unexploded ordnance, including fuses, classified components, or intact munitions. In the rare instance that unexploded ordnance cannot be removed, proper disposal methods would be employed (typically accomplished by use of C-4 explosive); however, these types of scenarios are not considered likely. Once the area has been cleared by the Eglin explosive ordnance disposal team (typically one hour after the release of CBU-105s), the range will be re-opened for the debris clean-up team and the protected species survey vessels (when live munitions are used). Depending on the specific weapon system used and the location or position of the unexploded ordnance, the test area could be closed for an extended period of time.

Following completion of the live mission (and declaration of the target area by explosive ordnance disposal as safe, when applicable), several Air Force vessel crews would engage in target debris retrieval. Large, mostly intact damaged target vessels may be towed, while smaller pieces of debris would be netted or lifted aboard Air Force vessels and taken to shore for disposal. The Air Force would also conduct post-mission monitoring for protected species once the range is confirmed to be safe to enter (more detail provided in section 2.2 of this opinion and conference report).

Swarm Missions

To counter small boat threats, aircrews would test and train in performing electronically simulated targeting and attack techniques (no ordnance is used, either live or inert) against groups of fast moving, human-piloted boats simulating a coordinated attack on an objective (e.g., another vessel) in the Gulf of Mexico. These missions are called “swarm” missions due to the number of boats involved. The target fleet typically consists of up to 30 boats (the actual number may vary) divided into multiple squadrons of four or five boats that travel along predetermined transects and possibly perform predetermined maneuvers as directed by Air Force personnel. The boats would range in size from 6.1 to 13.7 m (20 to 45 ft) and would travel at speeds of 20 to 40

knots, depending on sea state. Additional numbers of vessels, formations and maneuvers are possible depending on real-world threats and situations.

Aircraft would be directed from the Central Control Facility by the 86th Fighter Weapons Squadron mission director. Aircraft would perform tactical maneuvers including dives, dive recoveries, and pull-up procedures. Aircraft participating in swarm missions would not carry bombs, and aircraft guns would be mechanically “safed” (unable to fire). Due to the lack of munitions (live or inert), the pre- and post-mission activities described for live testing would not be conducted. Specifically, there would be no safety zone establishment, explosive ordnance disposal clearance, debris retrieval, or protected species surveys.

2.1.2 Advanced Systems Employment Project

The proposed Advanced Systems Employment Project action includes evaluating upgrades to numerous research and development, as well as Air Force hardware and software, initiatives. F-16, F-15E, and BAC1-11 aircraft would be used to deploy a variety of pods, air-to-air missiles, bombs, and other munitions. Pods are sensors or electronic hardware that are deployed outside of the aircraft but remain attached. Many of the missions are conducted over Eglin land ranges. However, inert instrumented Mk-84 Joint Direct Attack Munition bombs would be expended in W-151. Bombs would be dropped on target boats located 32.2 to 40.2 km (20 to 25 miles) offshore. A maximum of 12 over-water missions could be conducted annually, although the number could be as low as four. There would be no live ordnance associated with Advanced Systems Employment Project actions in the EGTTR.

2.1.3 Air Force Special Operations Command Training

The Air Force Special Operations Command conducts various training activities with multiple types of munitions in nearshore waters of the EGTTR (W-151). Training activities include air-to-surface gunnery, small diameter bomb, and missile proficiency training. The following subsections describe the proposed actions.

AC-130 Air-To-Surface Gunnery

Air-to-surface gunnery missions involve firing of live gunnery rounds at targets on the water surface in the EGTTR. Ordnance used in this training includes 25 mm high explosive incendiary, 30 mm high explosive incendiary, 40 mm high explosive incendiary, and 105 mm high explosive incendiary rounds. Net explosive weight ranges from about 0.03 to 2.1 kg (0.07 to 4.7 lbs). The training round variant was developed as a means to mitigate acoustic impacts on marine mammals that could not be adequately surveyed at night by aircraft sensors. Today’s AC-130 aircraft sensors allow for effective nighttime visual surveys, but with reduced explosive material, the TR rounds remain a valuable mitigation for reducing acoustic impacts. Sensors are essentially cameras, infrared or thermal, that can detect anything from enemies, such as boats, heat signatures, or even marine mammals.

The AC-130 primarily shoots 30-,40-, and 105-mm rounds and the sensors are used to detect their targets (boats or flares) before they begin shooting. Gunnery rounds can be either full up high explosive incendiary or training round that have reduced explosive material. All gunnery rounds are considered high explosive incendiary, meaning they detonate upon impact, unless otherwise noted. Training rounds are different and are noted in the Air Forces BA (e.g., 105-mm training round), which means they have less explosive material than a full up round (e.g., 105-mm full up).

Water ranges within the EGTTR that are typically used for gunnery operations include W-151A, W-151B, W-151C, and W-151D. However, W-151A is the most frequently used water range due to its proximity to Hurlburt Field (where the gunnery flights originate). AC-130s normally transit from Hurlburt Field to the water ranges at a minimum of 1,219 m (4,000 ft) above surface level. Potential target sites are typically established at least 24.1 km (13 nmi) from the coast (beyond the 22 km [12 nmi] territorial sea boundary). Targets consist of either an MK-25 floating flare or an inflatable target. For missions where flares are used, the aircrew scans a 9.3 km (five nautical miles) radius around the potential target area to ensure it is clear of surface craft, protected species, and other objects that would make the site unsuitable. Scanning is accomplished using radar, electro optical, infrared sensors, and visual means. Electro optical is a digital viewing platform on the aircraft to see certain sensors data on a screen. This optical data can be transferred (commonly seen in military commands where battlefield video is displayed on screens). An alternative area is selected if any non-mission vessels are detected within the 9.3 km (five nmi) search area, or if protected marine species were sighted within the injury impact zone. Once the scan is completed, the marking flare is dropped onto the water surface. The flare's burn time is typically ten to 20 minutes, but could be less if actually hit by one of the rounds. However, flares may burn as long as 40 minutes.

Missions using an inflatable target proceed under the same general protocol. A tow boat transits to a potential target site located at least 24.1 km (15 miles) from the coast. The AC-130 then arrives at the site and, as with missions using flares, the aircrew scans an appropriate area around the potential target area using visual observation and the aircraft's sensors. An alternative area would be selected if any protected marine species or non-mission vessels were detected within the applicable search areas. Once the scan is complete, the 6.1 m (20 ft) target is inflated and deployed into the water. The tow boat then proceeds to pull the target, which is attached to a 671 m (2,200 ft) cable. The target continues to float even when struck by ordnance and deflated. After the mission, the tow boat recovers any floating debris produced by rounds striking the target, although little debris is expected.

After target deployment, the firing sequence is initiated. A typical gunship mission lasts approximately five hours without air-to-air refueling, and six hours when refueling is accomplished. A typical mission includes:

- 30 minutes to take off and perform airborne sensor alignment; align visual sensor and electro optical to heads-up display.
- 1½ to two hours of dry fire (no ordnance expended); this time includes transition time.
- 1½ to two hours of live fire; this time includes clearing the area and transiting to and from the range; actual firing activities typically do not exceed 30 minutes.
- One hour air-to-air refueling, if included in the mission.
- 30 minutes transition work (takeoffs, approaches, landings, and pattern work).

A heads up display refers to proper focusing and bore sighting of cameras and electro optical sensors. It is essentially a visual representation of instruments that allows aircraft operators to maintain situational awareness throughout the mission. Transition time is flight time from take-off on land to the mission area and setting up for live fire. Depending on location it could take up to two hours. Nothing is expended during this part of the mission.

The guns are fired during the live fire phase of the mission. The actual firing can last from 30 to 90 minutes but is typically completed in 30 minutes. The number and type of munitions deployed during a mission varies with each type of mission flown. Training rounds for the 105 mm (4.1 in) ammunition are used during nighttime training.

Live fire events are continuous, with pauses during the firing usually well under a minute and rarely from two to five minutes. Firing pauses would only exceed ten minutes in one of the following situations: (1) surface boat traffic caused the mission to relocate; (2) aircraft, gun, or targeting system malfunction occurs; or (3) more flares needed to be deployed. The Eglin Test and Range Safety Office has described the gunnery missions as having 95 percent containment within a five m (16.4 ft) radius around the target (i.e., 95 percent of the rounds strike the water within five m of the target).

Gunnery missions may occur any season of year, during daytime or nighttime hours. As a conservation measure to avoid impacts to the federally ESA-listed sperm whale and other deep water marine mammal species, Air Force Special Operations Command has agreed to conduct all gunnery missions within (shoreward of) the 200 m (656 ft) water depth contour, which transects portions of W-151A, W-151D, and W-151F. All of W-151B lies shoreward of the shelf break (Figure 3).

The quantity of live rounds expended is based on estimates provided by Air Force Special Operations Command regarding the annual number of missions and number of rounds per mission. The 105 mm full up rounds are typically used during daytime missions, while 105 mm training rounds are always used at night. The total anticipated number of missions and rounds that will be expended for daytime and nighttime activities annually is shown in Table 3.

Table 3. Summary of annual Air Force Special Operations Command AC-130 gunnery operations.

Category	Expendable	Number of Missions	Rounds per Mission	Quantity
Daytime Missions	105 mm HE (FU)	25	30	750
	40 mm HE		64	1,600
	30 mm HE		500	12,500
	25 mm HE		560	14,000
Nighttime Missions	105 mm HE (TR)	45	30	1,350
	40 mm HE		64	2,880
	30 mm HE		500	22,500
	25 mm HE		560	25,200
Total		70		80,780

AFSOC=Air Force Special Operations Command; FU=full up; HE=High Explosive; mm=millimeter; TR=training round

The primary mitigation/minimization measure consists of pre- and post-mission visual monitoring, which may also be supplemented with infrared and electro optical monitoring as applicable. After arriving at the target site, aircrews will commence visual scans and continue observing during ascending orbits until reaching operational altitude. Monitoring will continue throughout the mission and during a post-mission descent to an altitude of approximately 1,829 m (6,000 ft). If protected species are detected at any time, the mission will halt immediately and relocate as necessary or be suspended until the animal(s) have left the area. Additional management measures include sea state restrictions, use of the 105 mm training rounds at night, use of ramp-up procedures (beginning with the smallest round during calibration and proceeding to increasingly larger rounds), and complying with the requirement to conduct all missions shoreward of the 200 m (656 ft) isobath. No mortality or injury to protected marine species has been documented as a result of previous Air Force Special Operations Command gunnery missions.

Small Diameter Bomb and Griffin/Hellfire Missile Training

Air Force Special Operations Command has been tasked to develop protocols and training for strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. Training involves the use of live air-to-ground (AGM)-114P/R Hellfire Missiles, AGM-176 Griffin Missiles, and GBU-39 small diameter bomb munitions in the EGTTR against small towed boats. Air Force Special Operations Command expects to expend up to 100 AGM-114P/R missiles, 200 AGM-176 missiles, and 30 guided bomb unit (GBU)-39 laser or global positioning system-guided small diameter bombs annually. All of these weapons are capable of airburst, point, or delayed fuzing detonations. However, only airburst detonations will occur under the proposed action.

The capability to counter small vessels is categorized as a joint urgent operational need. A joint urgent operational need is defined as an urgent operation need identified by a combatant commander that, if not addressed immediately, will seriously endanger personnel or pose a major threat to ongoing operations. Currently, the majority of Air Force Special Operations Command

crews deploy into combat with no actual experience in AGM-176, AGM-114P/R, or GBU-39 weapons delivery, significantly increasing the potential to miss their intended targets during combat missions.

Mitigation/minimization practices would be implemented for live detonations. Because all munitions would be detonated in the air, no protected species surveys would be necessary. However, human safety measures would be carried out. The specific measures would depend on the mission location (GRATV target location, beyond the 200 m [656 ft] isobaths, etc.).

CV-22 Training

CV-22 aircraft training in W-151 (primarily W-151A and W-151F) would involve the firing of 0.50 caliber/7.62 mm ammunition at flares floating on the water surface. There would be approximately 50 training missions annually, with 300 each of 0.50 caliber and 7.62 mm rounds used per mission. Therefore, a total of 30,000 rounds would be expended annually. Flight procedures for CV-22 training would be similar to those described for AC-130 gunnery missions above, except that CV-22 aircraft typically operate at much lower altitudes (30.5 to 304.8 m [100 to 1,000 ft] above surface level) than AC-130 gunships. Aircrews would maintain Visual Flight Rules cloud clearances and a minimum altitude of 30.5 m (100 ft) above water height at all times. Weather must be sufficient to maintain a 5.6 km (3 nmi) clearance around the target area. Aircraft must have proper weather to conduct missions. Visual Flight Rules provide pilots with requirements for weather conditions that are suitable for flying without needing to solely rely on the aircraft's instrumentation. If fog or cloud cover is outside of Visual Flight Rules cloud clearances, the mission is cancelled. This is for human safety of the Air Force's airmen.

Live fire would be conducted only when sea surface conditions do not exceed Beaufort sea state four (wind speed 16 knots, wave height three ft, fairly frequent white caps). Similar to AC-130 missions, crews would conduct a visual survey of the target area (three nautical mile-radius for non-mission vessels and a protected species zone based on requirements described in section 2.2.2) at a maximum altitude of 305 m (1,000 ft) to ensure the area is clear of protected species and indicators before live fire begins. Pre- and post- live-fire clearing searches are anticipated to take about five minutes to accomplish. After live-fire operations, the crew would scan the target area utilizing all available visual scanners and operable sensors for any injured or dead marine species. Missions would only be conducted shoreward of the 200 m (656 ft) depth contour, as described for AC-130 gunnery training above.

Summary of Air Force Special Operations Command Activities in the EGTTR

Table 4 summarizes all Air Force Special Operations Command live air-to-surface training operations in the EGTTR.

Table 4. Total annual Air Force Special Operations Command air-to-surface training operations.

Munition	Net Explosive Weight (lbs)	Annual Releases	Detonation Scenario	Location
7.62 mm/.50 cal	NA	30,000	NA	W-151A, W-151F
25 mm	0.067	39,200	Surface	W-151A, W-151B, W-151D
30 mm	0.1	35,000	Surface	
40 mm	0.87	4,480	Surface	
105 mm FU	4.7	750	Surface	
105 mm TR	0.35	1,350	Surface	
AGM-176 (Griffin missile)	4.58	200	Airburst	W-151
AGM-114P/R (Hellfire missile)	20	100	Airburst	
GBU-39 (SDB I)	37	30	Airburst	

AGM=Air-to-Ground Missile; cal=caliber; FU=full up; GBU=Guided Bomb Unit; lbs=pounds; mm=millimeter; NA=not applicable; SDB=Small Diameter Bomb; TR=training round

2.1.4 413th Flight Test Squadron

The United States Special Operations Command has requested the 413th Flight Test Squadron demonstrate the feasibility and capability of the Precision Strike Package and the Stand-Off Precision Guided Munitions missile system on the AC-130 aircraft. United States Special Operations Command, in conjunction with Air Force Operations, Plans and Requirements (A3) Operations at Wright-Patterson AFB (in Ohio), is fielding the new AC-130J for flight characterization, as well as testing and evaluation. Air Force Special Operations Command is integrating some of the same weapons on the AC-130W. Therefore, the activities described below for the 413th Flight Test Squadron may involve either of these aircraft variants.

AC-130J Precision Strike Package Testing

The proposed AC-130J gunnery testing associated with the 413th Flight Test Squadron's Precision Strike Package would be similar to that described above for Air Force Special Operations Command AC-130 gunnery training in terms of location and general procedures. Testing would occur in W-151A and would involve firing either (1) projectile gun unit (PGU)-44/B (105 mm [4.1 in] high explosive with fuse munition unit-153/B point detonation/delay fuse) or PGU-43B target practice rounds (105 mm training rounds) from a 105 mm M102 (U.S. Air Force designation M137A1) light-weight Howitzer cannon, or (2) PGU-13 HEI, PGU-46 high explosive incendiary rounds, or PGU-15 target practice rounds (inert) from a 30 mm (1.2 in) GAU-23/A gun system. An MK-25 flare would be dropped prior to firing and used as a target. Mitigation/minimization measures would be the same as those described for Air Force Special Operations Command's AC-130 gunnery missions. Table 5 shows types of rounds fired, as well as the total number of missions and rounds proposed to be expended each year. All missions are conducted shoreward of the continental shelf break (Figure 3).

Table 5. Summary of 413th Flight Test Squadron precision strike package gunnery testing.

Expendable	Net Explosive Weight (lbs)	Number of Missions Per Year	Rounds Per Mission	Total Number of Rounds Per Year
PGU-13/46 (30 mm)	0.1	3	33	99
PGU-44 (105 mm FU)	4.7	4	15	60
PGU-43B TP (105 mm TR)	0.35	4	15	60

FU=full up; lbs=pounds; mm=millimeter; PGU=Projectile Gun Unit; TP=target practice; TR=training round

AC-130J and AC-130W Stand-Off Precision Guided Munitions Testing

The Stand-Off Precision Guided Munitions proposed for use in this testing include AGM-176 Griffin missiles, AGM-114 Hellfire missiles, GBU-39/B small diameter bombs, and GBU-39B/B laser small diameter bombs (LSDBs). The purpose of this testing is to demonstrate the feasibility and capability of the Stand-Off Precision Guided Munitions on AC-130 aircraft. Initial actions will consist of various ground tests, including systems testing and static drops. After ground testing is completed, captive carry, store separation, and weapon employment tests will be conducted. Captive-carry missions will be conducted with an instrumented measurement vehicle to collect environmental data or an inert telemetry missile in order to evaluate the integration of the Stand-Off Precision Guided Munitions with the AC-130J. Captive carry missions are when the aircraft has munitions loaded, but they do not release anything from the aircraft. They are used to train airmen with every aspect of the mission except release of weapons. Store separation missions will require a telemetry missile with an inert warhead and a live motor, if applicable, to verify that the weapon can be employed without significant risk to the aircraft. Store separation tests are actual release of an inert weapon from the aircraft to make sure it safely releases from the aircraft. This is accomplished before an actual weapon employment test so they know it won't hang on the aircraft.

Weapon employment missions will be flown using any combination of inert and/or live weapons for a final end-to-end check of the system. Missions may be conducted over land or water ranges, with water ranges used for small diameter bomb/laser small diameter bomb and Griffin missile tests. It is expected that over-water testing would be conducted at the GRATV target location. The target will be laser designated with a standard range instrumentation designator. Plywood targets, as well as stationary and moving vehicles, will be used for the end-to-end functionality tests. They will be set up so that the integrated laser targeting camera can capture the laser spot on the target, and so that the high-speed digital video can record the impact. The integrated laser targeting cameras and digital cameras will be mounted in such a way as to have a clear view of the target while being a safe distance from any debris from the impact.

Similar to preceding mission descriptions, pre- and post-test surveys will be conducted within the applicable human and protected species safety zones. Surveys would be conducted from vessels,

aircraft, and possibly live video feed. Table 6 shows the annual number of munitions expended annually for Stand-Off Precision Guided Munitions testing.

Table 6. Summary of 413th Flight Test Squadron Stand-Off Precision Guided Munitions annual testing.

Expendable	Net Explosive Weight (lbs)	Approximate Number Released/Year*	Detonation Scenario
AGM-176 (Griffin)	4.58	10	Surface
AGM-114 (Hellfire)	20	10	Surface
GBU-39 (SDB I)	37	6	Surface
GBU-39 (LSDB)	37	10	Surface

AGM=Air-to-Ground Missile; GBU=Guided Bomb Unit; lbs=pounds; LSDB=Laser Small Diameter Bomb; SDB=Small Diameter Bomb; SOPGM=Stand-Off Precision Guided Munitions *Total number of munitions over a four-year period divided by four

Total expendables released annually in the EGTTR under 413th Flight Test Squadron air-to-surface testing operations are shown in Table 7.

Table 7. Total Annual 413th Flight Test Squadron air-to-surface testing activities.

Munition	Net Explosive Weight (lbs)	Annual Releases	Detonation Scenario	Location
30 mm	0.1	99	Surface	W-151A
105 mm FU	4.7	60	Surface	
105 mm TR	0.35	60	Surface	
AGM-176 (Griffin)	4.58	10	Surface	W-151
AGM-114 (Hellfire)	20	10	Surface	
GBU-39 (SDB I)	37	6	Surface	
GBU-39 (LSDB)	37	10	Surface	

AGM=Air-to-Ground Missile; FU=full up; GBU=Guided Bomb Unit; lbs=pounds; LSDB=Laser Small Diameter Bomb; SDB=Small Diameter Bomb; TR=training round

2.1.5 780th Test Squadron

Testing activities conducted by the 780th Test Squadron include Precision Strike Weapon, Longbow missile littoral testing, and several other future actions. Each activity category is described below.

Precision Strike Weapon

The U.S. Air Force Life Cycle Management Center and U.S. Navy, in cooperation with the 780th Test Squadron, propose to conduct Precision Strike Weapon test missions utilizing resources within the Eglin Military Complex, including sites in the EGTTR. The weapons proposed for use in testing are the AGM-158 A and B (Joint Air-to-Surface Standoff Missile) and the GBU-39/B (small diameter bomb I).

The Joint Air-to-Surface Standoff Missile is a precision cruise missile designed for launch from outside area defenses against hardened, medium-hardened, soft, and area type targets. The Joint Air-to-Surface Standoff Missile has a range of more than 370 km (200 nmi) and carries a 454 kg (1,000 lbs) warhead. The Joint Air-to-Surface Standoff Missile has approximately 136 kg (300 lbs) of 2,4,6-trinitrotoluene equivalent net explosive weight. The specific explosive used is AFX-757, a type of plastic bonded explosive. The Joint Air-to-Surface Standoff Missile would be launched more than 370 km (200 nmi) from the target location. Platforms for the launch include B-1, B-2, B-52, F-16, F-18, and F-15E aircraft. Launch from the aircraft would occur at altitudes greater than 7,620 m (25,000 ft). The Joint Air-to-Surface Standoff Missile would cruise at altitudes greater than 3,658 m (12,000 ft) for the majority of the flight profile until making the terminal maneuver toward the target.

The small diameter bomb is a guided bomb that is an important element of the Air Force's Global Strike Task Force. The small diameter bomb I carries a 98 kg (217 lbs) warhead with approximately 16.8 kg (37 lbs) net explosive weight. The explosive used is AFX-757. The SD small diameter bomb I may be launched from over 93 km (50 nmi) away from the target location. Platforms for the launch include F-15E, F-16, and AC-130W aircraft. Launch from the aircraft occurs at altitudes greater than 1,524 m (5,000 ft) above ground level (AGL). The small diameter bomb I then commences a non-powered glide to the intended target.

Up to two live and four inert Joint Air-to-Surface Standoff Missiles per year may be launched to impact a target at the GRATV target location. The Joint Air-to-Surface Standoff Missile would detonate upon impact with the target. Although impact would typically occur about 1.5 m (five ft) above the water surface, detonations are assumed to occur at the water surface for purposes of impacts analysis.

Additionally, up to six live and 12 inert small diameter bomb s could also be deployed against targets in the same target area. Two small diameter bomb-Is may be launched simultaneously during two of the live missions and four of the inert missions. Detonation of the small diameter bomb s would occur under one of two scenarios:

- Detonation upon impact with the target
- Height of burst test, which involves detonation 2.2 to 4.5 m (7 to 14 ft) in the air above the surface target

There would generally be only one detonation per test event, and thus no more than one detonation in any 24-hour period. In instances of a simultaneous small diameter bomb launch scenario, two bombs are deployed from the same aircraft at nearly the same time to strike the same target. It is expected that the bombs would strike the target within five seconds or less of each another. Under this scenario, the detonations are considered a single event (net explosive weight is doubled) for the purpose of acoustic modeling and marine species impacts analysis. Modeling both detonations as a single event results in a conservative impact estimate. Refer to

section 3.2 below for a complete description of the acoustic modeling conducted in support of this document. Precision Strike Weapon munitions are shown in Table 8.

Table 8. Summary of annual precision strike weapon tests proposed for the Eglin Gulf Testing and Training Range.

Weapon	Number of Live Tests/Year	Number of Live Munitions Released	Number of Inert Tests/Year	Number of Inert Munitions Released
AGM-158 (JASSM)	2	2	4	4
GBU-39 (SDB I) Single Launch	2	2	4	4
GBU-39 (SDB I) Simultaneous Launch	2	4	4	8

AGM=Air-to-Ground Missile; GBU=Guided Bomb Unit; JASSM=Joint Air-to-Surface Standoff Missile; SDB=Small Diameter Bomb

Chase aircraft (F-15, F-16, and/or T-38) will accompany each launch. These aircraft will follow the test items during captive carry and free flight but will not follow either item below a predetermined altitude. Other assets on site may include an E-9 turboprop aircraft circling around the target location. Tanker aircraft including KC-10s and KC-135s would also be used. The GRATV may also be on location to hold instrumentation, and would be anchored up to 304.8 m (1,000 ft) away from the target location.

Based on availability, one of two potential target types are used during Precision Strike Weapon tests. The first is a Container Express target that consists of up to five containers strapped, braced, and welded together to form a single structure. The dimensions of each container are approximately 2.4 m by 2.4 m by 12.2 m (8 ft by 8 ft by 40 ft). Each container contains 200 55-gallon steel drums (filled with air and sealed) to provide buoyancy. The second type of target is a hopper barge, which is a non-self-propelled vessel typically used for transportation of bulk cargo. A typical hopper barge is approximately 9.1 m by 3.7 m by 38.1 m (30 ft by 12 ft by 125 ft). The targets are held in place by a four-point anchoring system using cables.

The Container Express target is constructed on land and shipped to the target location two to three days prior to the test. The barge target is also stationed at the target location two to three days prior to the test. During an inert mission, the Joint Air-to-Surface Standoff Missile passes through the target and the warhead sinks to the bottom of the Gulf of Mexico. Immediately following impact, the Joint Air-to-Surface Standoff Missile recovery team will pick up surface debris originating from the missile and target. Depending on the test schedule, the target may remain in the Gulf of Mexico for up to one month at a time. If the target is significantly damaged, and it is deemed impractical and unsafe to retrieve it, the target remains may be sunk through coordination with the U.S. Coast Guard or Tyndall AFB. Coordination with the U.S. Army Corps of Engineers would be required prior to sinking a target.

Precision Strike Weapon test activities will occur in W-151 at the GRATV target location. Targets are located in approximately 35 to 36.6 m (115 to 120 ft) of water, 27.4 km (14.8 nmi) offshore of Test Area A-3 on Santa Rosa Island. This area is the same as the Maritime WSEP test site. Test missions may occur during any time of the year, but during daylight hours only.

In addition to the above description, future (Phase 2) testing of the Joint Air-to-Surface Standoff Missile and small diameter bomb is planned by the Air Force Operational Test and Evaluation Center (Table 9). Air Force Operational Test and Evaluation Center proposes to expend two live and one inert GBU-53 (small diameter bomb II) weapons in the EGTTR. The live weapons would be deployed against moving boats with a length of 9.1 to 12.2 m (30 to 40 ft), while the inert weapon would be used against a smaller fiberglass boat. Details of Phase 2 Joint Air-to-Surface Standoff Missile testing are currently unknown; this testing is therefore not included as part of the proposed action of this opinion and conference report.

Table 9. Summary of Phase 1 and Phase 2 precision strike weapon live tests.

Weapon	Net Explosive Weight (lbs)	Number of Live Munitions Released	Number of Inert Munitions Released
AGM-158 (JASSM)	300	2	4
GBU-39 (SDB I)	37	2	4
GBU-39 (SDB I) Simultaneous Launch*	74	2	4
GBU-53 (SDB II)	22.84	2	1

AGM=Air-to-Ground Missile; GBU=Guided Bomb Unit; JASSM=Joint Air-to-Surface Standoff Missile; lbs=pounds; SDB=Small Diameter Bomb *NEW is doubled for each simultaneous launch

Longbow Littoral Testing

The 780th Test Squadron (780 TS/OGMT) proposes to collect data on the ability of the Longbow missile (AGM-114L) to track and impact moving boat targets in both the Lock On Before Launch (LOBL) and Lock On After Launch (LOAL) modes, and at varying launch elevation angles. A secondary objective of the tests is to acquire telemetry data to evaluate tracking quality. Missiles are typically launched from an Avenger system (a mobile missile launch system) mounted to a High Mobility Multipurpose Wheeled Vehicle (HMMWV). The HMMWV is located either at the shoreline of Eglin's Santa Rosa Island property or on a barge or boat in W-151A. Missiles could also be launched from an AH-64D Apache helicopter. Missiles launched from Santa Rosa Island are outside the EGTTR boundary and would result in in-air detonations; therefore, no impacts to protected species in the marine environment are anticipated and not included in this opinion and conference report. Beach impacts from the missile launches were analyzed in the Santa Rosa Island programmatic opinion by the USFWS (USFWS 2012). The targets consist of small (approximately 7.6 m [25 ft] in length), remotely controlled fiberglass boats. The distance of the targets from the missile launch site is either 1.5 or 4 km (0.9 or 2.5 miles).

Up to 16 live Longbow missiles could be launched annually in the EGTTR (Table 10). The net explosive weight of each missile is 16.3 kg (35.95 lbs). All missiles will contain a proximity fuse, with detonations occurring at a minimum height of one to three meters (3.3 to 9.8 ft) above the water. There will be no detonations below the surface. Management actions include human safety zone clearance and pre- and post-mission protected marine species surveys.

Table 10. Annual longbow munitions proposed for the Eglin Gulf Testing and Training Range.

Type of Munition	Total Number of Live Munitions	Detonation Location	Warhead – Explosive Material	Net Explosive Weight (lbs)
AGM-114 L (Longbow)	16	1 to 3 m height (airburst)	High Explosive Anti-Tank (HEAT) tandem anti-armor metal augmented charge	35.95

AGM=Air-to-Ground Missile; m=meters; lbs=pounds

Future Actions

The 780th Test Squadron plans to conduct other various testing activities that involve targets on the water surface in the EGTTR. Many of the missions will target small boats or barges. Weapons will primarily be delivered by aircraft, although a rail gun will be used for one test. Live warheads will be used for some missions, while others will involve inert warheads with a live fuse (typically contains a very small net explosive weight). Total munitions for the five-year period of 2017 to 2021 are listed in Table 11. As with the preceding missions using live weapons, safety zone enforcement and pre- and post-mission marine species monitoring will be required.

Table 11. 780th Test Squadron annual munitions, other future actions.

Munition	Net Explosive Weight (lbs)	Number of Releases	Proposed Location	Target Type	Detonation Type
Joint Air-Ground Missile	27.41	2	W-151 (Subareas A, S5, and S6)	HSMST or Boston Whaler Type Boat	1 – Point Detonation 1 - Airburst
Navy Rail Gun	Inert	19	W-151	Barge	Penetrating Rod
	1	5	W-151	Barge	Airburst
JDAM – Extended Range	Inert	3	W-151	Water surface (2) Barge (1)	Inert
Navy HAAWC	Inert	2	W-151	Water surface	Inert
Laser SDB	0.4 (fuse)	4 maximum	W-151A	Small boats	Airburst or Surface
SDB II Guided Test Vehicle	0.4 (fuse)	4	W-151A	Small boats	Surface

HAAWC=High Altitude Anti-Submarine Warfare Weapon Capability; HSMST=High Speed Maneuverable Surface Target; JDAM=Joint Direct Attack Munition; SDB=Small Diameter Bomb; lbs=pounds

Summary of Combined 780th Test Squadron Activities

Total expendables proposed to be released annually in the EGTTR under 780th Test Squadron air-to-surface testing operations, including Precision Strike Weapon, Longbow, and other various missions, are shown in Table 12.

Table 12. Total annual 780th Test Squadron air-to-surface testing activities.

Munition	Net Explosive Weight (lbs)	Annual Releases	Detonation Scenario	Location
Live AGM-158 (JASSM)	300	2	Surface	W-151A
Inert AGM-158 (JASSM)	NA	4	NA	
Live GBU-39 (SDB I)	37	2	Surface	
Inert GBU-39 (SDB I)	NA	4	NA	
Live GBU-39 (SDB I) Simultaneous Launch*	74	2	Surface	
Inert GBU-39 (SDB I) Simultaneous Launch*	NA	4	NA	
Live GBU-53 (SDB II)	22.84	2	Surface	
Inert GBU-53 (SDB II)	NA	1	NA	
AGM-114 L (Longbow)	35.95	16	Airburst	
Joint Air-to-Ground Missile	27.41	1	Surface	
		1	Airburst	
Live Navy Rail Gun	1	1	Airburst	
Inert Navy Rail Gun	NA	19	NA	
JDAM Extended Range	NA	3	NA	
Navy HAAWC	NA	2	NA	
Inert GBU-39 (LSDB) with live fuse	0.4	4	Airburst or surface	
Inert GBU-53 (SDB II with live fuse)	0.4	4	Surface	

AGM=air-to-ground missile; HAAWC=High Altitude Anti-Submarine Warfare Weapon Capability; GBU=Guided Bomb Unit; JASSM=Joint Air-to-Surface Standoff Missile; JDAM=joint direct attack munition; lbs=pounds; LSDB=Laser Small Diameter Bomb; NA=not applicable; SDB=Small Diameter Bomb; *NEW is doubled for each simultaneous launch

2.1.6 96th Test Wing Inert Munitions

The 96th Test Wing, Eglin's host wing, provides developmental test and evaluation for a wide variety of air-delivered weapons and other systems. The 96th Test Wing proposes to expend approximately nine inert bombs annually in the EGTTR. The weight of each bomb would be 907.2 kg (2,000 lbs), but there would be no warhead. There is no limit on the number of inert items that may be expended, and actual numbers used by the 96th Test Wing may vary.

2.1.7 96th Operations Group

The 96th Operations Group, which conducts the 96th Test Wing's primary missions of developmental testing and evaluation of conventional munitions, and command and control systems, anticipates support of air-to-surface missions for several user groups on an infrequent

basis. Sub-surface detonations would be at 1.5 to 3 m (5 to 10 ft) below the surface. Projected annual munitions expenditures and detonation scenarios are listed in Table 13.

Table 13. Annual munitions for 96th operations group support.

Munition	Net Explosive Weight (lbs)	Detonation Scenario	Number of Annual Releases
GBU-10 or GBU-24	945	Subsurface	1
GBU-12 or GBU-54	192	Subsurface	1
AGM-65 (Maverick)	86	Surface	2
GBU-39 (SDB I or LSDB)	37	Subsurface	4
AGM-114 (Hellfire)	20	Subsurface	20
105 mm full-up	4.7	Surface	125
40 mm	0.9	Surface	600
Live fuse	0.4	Surface	200
30 mm	0.1	Surface	5,000

AGM=Air-to-Ground Missile; GBU=Guided Bomb Unit; lbs=pounds; mm=millimeter; SDB=Small Diameter Bomb

2.1.8 Summary of Expendables Used in Air-To-Surface Testing and Training

Table 14 shows the inclusive list of munitions expendables associated with all air-to-surface test and training missions included in the proposed action.

Table 14. Summary of expendables proposed for test and training missions in the Eglin Gulf Testing and Training Range.

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	Number of Annual Releases
86 th FWS/Maritime WSEP Live Munitions	GBU-10 or GBU-24	945	Surface or subsurface	2
	GBU-12 or GBU-54 (LJDAM)	192	Surface or subsurface	6
	AGM-65 (Maverick)	86	Surface	6
	CBU-105	107.63	Airburst	4
	GBU-39 (LSDB)	37	Airburst, Surface, or Subsurface	4
	AGM-114 (Hellfire)	20	Airburst, Surface, or Subsurface	30
	GBU-53 (SDB II)	22.84	Airburst, Surface, or Subsurface	4
	AGM-176 (Griffin)	4.58	Airburst or Surface	10
	2.75-in Rockets (including APKWS)	10	Surface	100
	PGU-13 HEI (30 mm)	0.1	Surface	1,000
86 th FWS/Maritime WSEP Inert Munitions	AIM-9X	68	Surface	4
	GBU-10	NA	NA	21
	GBU-12	NA	NA	27
	GBU-25	NA	NA	17
	GBU-31	NA	NA	6
	GBU-38	NA	NA	3
	GBU-54	NA	NA	16
BDU-56	NA	NA	13	

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	Number of Annual Releases
	AIM-9X	NA	NA	3
	PGU-27	NA	NA	46,000
ASEP	Mk-84 Bomb (inert)	NA	NA	12
AFSOC/Air-to-Surface Training Operations	7.62 mm/.50 cal	NA	NA	30,000
	25 mm	0.067	Surface	39,200
	30 mm	0.1	Surface	35,000
	40 mm	0.87	Surface	4,480
	105 mm FU	4.7	Surface	750
	105 mm TR	0.35	Surface	1,350
	AGM-176 (Griffin)	4.58	Airburst	200
	AGM-114P/R (Hellfire)	20	Airburst	100
413 FLTS/Air-to-Surface Testing Activities	GBU-39 (SDB I)	37	Airburst	30
	30 mm	0.1	Surface	99
	105 mm FU	4.7	Surface	60
	105 mm TR	0.35	Surface	60
	AGM-176 (Griffin)	4.58	Surface	10
	AGM-114 (Hellfire)	20	Surface	10
	GBU-39 (SDB I or LSDB)	37	Surface	16
780 TS/Air-to-Surface Testing Activities	Live AGM-158 (JASSM)	300	Surface	2
	Inert AGM-158 (JASSM)	NA	NA	4
	Live GBU-39 (SDB I)	37	Airburst or Surface	2
	Inert GBU-39 (SDB I)	NA	NA	4
	Live GBU-39 (SDB I) Simultaneous Launch*	74	Airburst or Surface	2
	Inert GBU-39 (SDB I) Simultaneous Launch*	N/A	NA	4
	Live GBU-53 (SDB II)	22.84	Surface	2
	Inert GBU-53 (SDB II)	NA	NA	1
	AGM-114 L (Longbow)	35.95	Airburst	16
	Joint Air-to-Ground Missile	27.41	Surface	1
			Airburst	1
	Live Navy Rail Gun	1	Airburst	1
	Inert Navy Rail Gun	NA	NA	19
	JDAM Extended Range	NA	NA	3
	Navy High Altitude Anti-Submarine Warfare Weapon Capability (HAAWC)	NA	NA	2
	Inert GBU-39 (LSDB) with live fuse	0.4	Airburst or surface	4
Inert GBU-53 (SDB II with live fuse)	0.4	Surface	4	
96 th TW Inert Munitions	Bomb (2,000 lbs)	NA	NA	9
96 Operations Group	GBU-10 or GBU-24	945	Subsurface	1
	GBU-12 or GBU-54	192	Subsurface	1
	AGM-65 (Maverick)	86	Surface	2
	GBU-39 (SDB I or LSDB)	37	Subsurface	4
	AGM-114 (Hellfire)	20	Subsurface	20
	105 mm full-up	4.7	Surface	125
	40 mm	0.9	Surface	600

Organization/Activity	Munition	NEW (lbs)	Detonation Scenario	Number of Annual Releases
	Live fuse	0.4	Surface	200
	30 mm	0.1	Surface	5,000

413 FLTS=413th Flight Test Squadron; 86th FWS=86th Fighter Weapons Squadron; 96th TW=96th Test Wing; AFSOC=Air Force Special Operations Command; AGM=air-to-ground missile; AIM=air intercept missile; APKWS=Advanced Precision Kill Weapon System; ASEP=Advanced Systems Employment Project; BDU=Bomb, Dummy Unit; cal=caliber; CBU=Cluster Bomb Unit; FU=full up; GBU=Guided Bomb Unit; HEI=high explosive incendiary; JASSM=Joint Air-to-Surface Standoff Missile; JDAM=joint direct attack munition; lbs=pounds; LJDAM=laser joint direct attack munition; LSDB=Laser Small Diameter Bomb; Mk=mark; mm=millimeter; ms=millisecond; NA=Not Applicable; NEW=net explosive weight; PGU=Projectile Gun Unit; SDB=Small Diameter Bomb; TR=training round; WSEP=Weapons System Evaluation Program; *NEW is doubled for each simultaneous launch

2.2 Air Force Mitigation Activities

Mitigations may include any supplemental activities that help reduce or eliminate potential adverse impacts to marine resources. Monitoring procedures are described in the following subsections and will be implemented as described in section 2.2.5.

2.2.1 Trained Observers

All monitoring will be conducted by personnel who have completed Eglin AFB's Marine Species Observer Training Course that was tailored for specific mission activities and was developed in cooperation with NMFS. This training includes a summary of environmental laws, consequences of noncompliance, description of an observer's role, pictures and descriptions of protected species and protected species indicators, survey methods, monitoring requirements, and reporting procedures. The training will be provided to user groups either electronically or in-person by an Eglin Natural Resources Office representative. Any person acting as an observer for a particular mission must have completed the training within one year of the mission. Names of personnel who have completed the training will be submitted to the Eglin Natural Resources Office along with the date of completion. In cases where multiple survey platforms are required to cover large survey areas, a Lead Biologist will be designated to head up all monitoring efforts and coordinate sighting information with the Test Director or Safety Officer.

2.2.2 Pre- and Post-Mission Monitoring

For each live mission with surface or sub-surface detonations, at a minimum pre- and post-mission monitoring will be required. A live mission is defined as having a weapon expended that contains explosive material and would detonate. A non-live mission may expend inert weapons or anything non-explosive. Eglin AFB Range Group and Test Wing identifies and contracts marine biologists and personnel in the Marine Operations group who are trained in protected species surveys to accomplish all permit requirements. Eglin Natural Resources implements annual training requirements and refresher trainings for all personnel who would conduct pre- and post-mission surveys for protected species (including sea turtles and marine mammals). The purposes of pre-mission monitoring are to (1) evaluate the mission site for environmental

suitability, and (2) verify that the zone of influence is free of visually detectable sea turtles and potential sea turtle indicators as well as marine mammals. The duration of pre-mission surveys will depend on the area required to be surveyed, survey platforms (vessels versus aircraft), and any potential lapse in time between the end of the surveys to the beginning of the mission (further detail provided in section 2.2.5). This lapse would typically occur when survey vessels are required to vacate the human safety zone prior to the aircraft releasing the munitions. Maritime WSEP is an example of a mission that uses five survey vessels for pre-monitoring; this mission's airspace does not allow for aerial surveys. All sea turtle sightings, number of individuals, location, and behavior of the animals will be documented on report forms that will be submitted to the Eglin Natural Resources Office after each mission. Missions shall be postponed, relocated, or cancelled based on the presence of protected species within the survey areas.

Post-mission monitoring is designed to determine the effectiveness of pre-mission mitigation by reporting sightings of any dead or injured sea turtles and marine mammals. The duration of post-mission surveys will vary based on survey platform and any potential time lapse between the last detonation of the mission and when the post-mission surveys can begin. This lapse would typically occur when survey vessels are stationed on the perimeter of the human safety zone and are required to wait until the range has been declared clear. Similar to pre-mission surveys, all sightings would be properly documented on report forms and submitted to the Eglin Natural Resources Office.

If any sea turtles are observed to have been killed or injured as a result of the mission, the Eglin Natural Resources Office would be contacted immediately. Observers would document the species or description of the animal, location, behavior, and, if practicable, take pictures and maintain visual contact with the animal(s). The Eglin Natural Resources Office would then contact the Sea Turtle Stranding and Salvage Network state coordinator (Dr. Alan Foley at 904-696-5904), the Florida Fish and Wildlife Conservation Commission Wildlife Alert Hotline (1-888-404-3922), the Emerald Coast Wildlife Refuge (850-650-1880), and the Gulfarium (850-243-9046), and either await further instructions or until a response team has arrived on site, if feasible. Last known global positioning system points would be provided to the Stranding Coordinator.

2.2.3 Beaufort Sea State Conditions

Weather conducive to sea turtle and marine mammal monitoring is required to effectively implement the pre- and post-mission surveys. Wind speed and the resulting surface conditions of the Gulf of Mexico are critical factors affecting observation effectiveness. Higher winds typically increase wave height and create "white cap" conditions, both of which limit an observer's ability to locate marine species at or near the surface. Air-to-surface missions will be delayed or rescheduled if the Beaufort sea state is greater than number four (described in Table 15) at the time of the mission. Protected species observers or the Lead Biologist will make the

final determination of whether or not conditions are conducive to sighting protected species. In addition, the missions will occur no earlier than two hours after sunrise and no later than two hours prior to sunset to ensure adequate daylight for pre- and post-mission monitoring, with the exception of Air Force Special Operations Command and 413th Flight Test Squadron gunnery missions. In those cases, aircrews will utilize aircraft instrumentation and sensors to monitor the area.

Table 15. Beaufort sea state scale for Eglin Gulf Testing and Training Range pre-mission surveys.

Beaufort Sea State Number	Sea Conditions
0	Flat calm, no waves or ripples.
1	Light air, winds 1 to 2 knots; wave height to 1 ft; ripples without crests.
2	Light breeze, winds 3 to 6 knots; wave height 1 to 2 ft; small wavelets, crests not breaking.
3	Gentle breeze, winds 7 to 10 knots; wave height 2 to 3.5 ft; large wavelets, scattered whitecaps.
4	Moderate breeze, winds 11 to 16 knots; wave height 3.5 to 6 ft; breaking crests, numerous whitecaps.

Visibility is also a critical factor for flight safety issues when aerial surveys are being conducted. Therefore, a minimum ceiling of 305 m (1,000 ft) and visibility of 5.6 km (3 nmi) is required to support monitoring efforts and flight safety concerns.

2.2.4 Determination of Survey Areas

Eglin is seeking to obtain authorizations under the MMPA for incidental takes of non-ESA-listed marine mammals resulting from this proposed action. Under the MMPA Incidental Take Authorization process, monitoring procedures for marine mammals are being developed that would also apply to sea turtles. The ranges that are presented in section 6.6 of Eglin AFB's Request for a Letter of Authorization (LOA) represent a radius of impact for a given threshold of each munition/detonation scenario. These ranges, in combination with the sea turtle impact ranges, will be used for determining the size of the area required to be monitored during pre-mission surveys for each activity. For missions involving live munitions other than gunnery rounds, an area extending out to the Atlantic spotted dolphin Level A Harassment permanent threshold shift (PTS) range or the sea turtle impairment impact range (whichever is larger) for the largest munition being released during that mission is proposed to be monitored prior to release of the first live ordnance. Depending on the mission, the corresponding radius could be between 46 m (151 ft) for a live fuse surface detonation with 0.2 kg (0.4 lbs) net explosive weight up to 2,156 m (7,073.5 ft) for a GBU-10 subsurface detonation with 428.6 kg (945 lbs) net explosive weight. For missions that will experience a time delay to account for survey platforms evacuating the human safety zone after pre-missions surveys are completed, Eglin AFB proposes to include a buffer to the survey area that would extend to the Atlantic spotted dolphin Level B Harassment TTS zone for the largest munition being released during that

mission. In all cases, this would more than double the survey area from that of the Level A Harassment PTS zone, ranging from a 126 up to 461 percent increase in survey area. This buffer will reduce the potential for any protected species (marine mammal or sea turtle) outside the area during pre-mission surveys swimming into their respective injury or mortality zones during a mission.

Missions that consist solely of gunnery testing and training operations will survey larger areas than would be necessary based solely on acoustic impact zones because of previously established safety profiles and the Air Force's ability to conduct aerial surveys of large areas from mission aircraft during this activity. These ranges are shown in Table 16.

Table 16. Monitoring area radii for gunnery missions.

Aircraft	Gunnery Round	Monitoring Area	Monitoring Altitude (ft)	Operational Altitude (ft)
AC-130 Gunship	25-mm, 30-mm, 40-mm, 105-mm (Full Up and Training Round)	9,260 m (5 nmi)	6,000	15,000 – 20,000
CV-22 Osprey	.50 cal, 7.62 mm	5,556 m (3 nmi)	1,000	1,000

cal=caliber; ft=feet; FU=full up; m=meters; mm=millimeter; nmi=nautical miles; TR=training round

2.2.5 Description of Monitoring Activities

The following monitoring options have been developed to support various types of air-to-surface mission activities that may be conducted in the EGTTR. Eglin users must meet specific test or training objectives, safety requirements, and have different assets available to execute the pre- and post-mission surveys.

Vessel-Based Monitoring

Pre-mission surveys conducted from surface vessels will typically begin at sunrise. Trained observers will be aboard designated vessels to conduct protected species surveys before and after each mission. These vessels will be dedicated solely to monitoring for protected marine species and species indicators during the pre-mission surveys. For missions that require multiple vessels to conduct surveys based on the size of the survey area, a Lead Biologist will be designated to coordinate all survey efforts, compile sighting information from the other vessels, function as the point of contact between the survey vessels and Tower Control, and provide final recommendations to the Safety Officer/Test Director on the suitability of the mission site based on environmental conditions and survey results.

Survey vessels will run pre-determined line transects, or survey routes, that will provide full coverage of the survey area. Monitoring activities will be conducted from the highest point feasible on the vessels. There will be at least two dedicated observers on each vessel, and they will utilize optical equipment with sufficient magnification to allow observation of surfaced animals. All observers will use binoculars with a minimum power zoom of eight. Survey routes ensure the entire area of the survey area is visually scanned by trained observers. The spacing

between transects is determined by factoring in how far an observer can see with binoculars in varying environmental conditions.

Roles and Responsibilities

All sighting information from pre-mission surveys will be communicated to the Lead Biologist on a pre-determined radio channel to reduce overall radio chatter and potential confusion. After compiling all the sighting information from the other survey vessels, the Lead Biologist will inform Tower Control on whether the area is clear of protected species or not. If the range is not clear, the Lead Biologist will provide recommendations on whether the mission should be delayed or cancelled. A mission delay recommendation would occur, for example, if a small number of protected species are in the zone of influence but appear to be on a heading away from the mission area. The delay would continue until the Lead Biologist has confirmed that the animals are no longer in the zone of influence and traveling on a heading away from the mission site. On the other hand, a mission cancellation recommendation could occur if one or more protected species in the zone of influence are found and there is no indication that they would leave the area on their own preference within a reasonable timeframe. Tower Control will relay the Lead Biologist's recommendation to the Safety Officer. The Safety Officer and Test Director will collaborate regarding range conditions based on the information provided by the Lead Biologist and the status of range clearing vessels. Ultimately, the Safety Officer will have final authority on decisions regarding delays and cancellations of missions.

Human Safety Zone Enforcement

For missions that occur relatively close to shore and therefore have the potential to endanger civilian boat traffic, a large number of range clearing boats (approximately 20 to 25) will be stationed around the mission site to prevent non-participating vessels from entering the human safety zone. Based on a composite footprint from previous similar missions, range clearing boats would be located approximately 24 km (13 nmi) from the detonation point (Figure 1). Actual distance will vary based on the type the munition being deployed and its release parameters. These range clearing boats are typically at their guard stations (Figure 1) by sunrise before commercial and recreational boaters have an opportunity to enter the safety zone. Two range clearing boats are stationed in the East Pass to distribute flyers and maps to civilian boaters as they exit the pass and enter the Gulf of Mexico, informing them of the area closures.

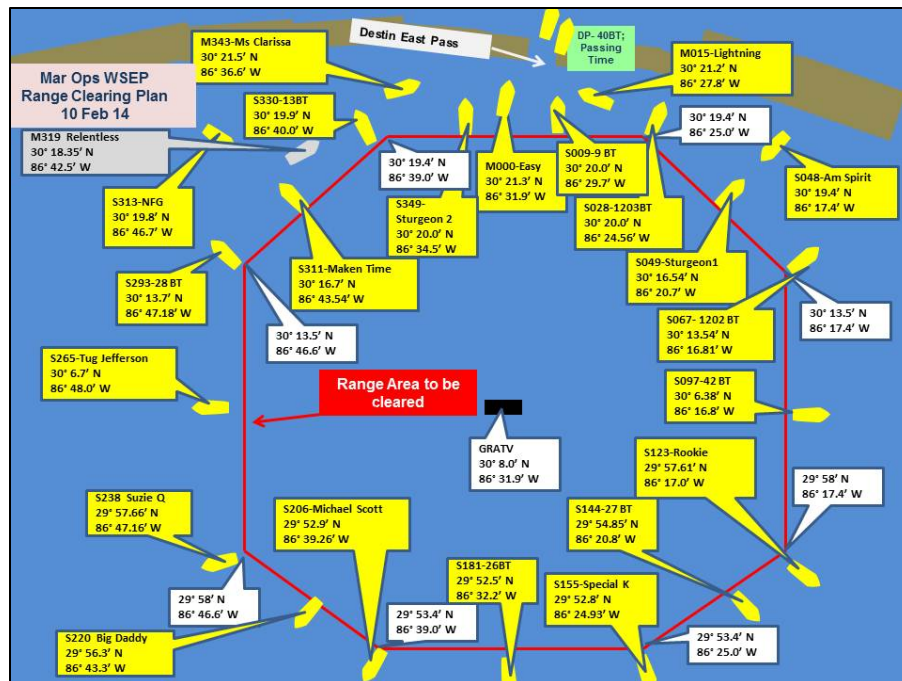


Figure 1. Example range area to be cleared for human safety zone during activities in the Eglin Gulf Testing and Training Range.

Survey vessels are also required to abide by the human safety zone enforcement. When feasible, they typically aim to complete the pre-mission surveys at least 30 minutes prior to mission start time to transit from the end point of their survey routes to the safety zone periphery. Observers will continue monitoring for sea turtles from outside the safety zone during the mission, but effectiveness will be limited as each vessel will remain at a designated station to assist with range clearing activities. Additional measures are taken to address this time lapse, which may include surveying an additional buffer area or employing supplemental monitoring as described later in this section.

Air Force Support Vessels

Air Force support vessels will consist of a combination of Air Force and civil service/civilian personnel responsible for mission site/target set up and range clearing activities. Air Force personnel will be within the mission area (on boats and the GRATV) for each mission well in advance of weapon deployment, typically near sunrise. They will perform a variety of tasks including target preparation, equipment checks, etc., and will opportunistically observe for sea turtles and indicators as feasible throughout test preparation. However, such observations are considered incidental and would only occur as time and schedule permits. Any sightings would be relayed to the Lead Biologist.

The Eglin Safety Officer, in cooperation with the Santa Rosa Island Tower Control at Test Site A-13B and Central Control Facility, will coordinate and manage all range clearing efforts and be in direct communication with the survey vessel team, typically through the Lead Biologist. The

Safety Officer will monitor all radio communications, but Tower will relay messages between the vessels and the Safety Officer. The Safety Officer and Tower Control will also be in continual contact with the Test Director throughout the mission and will convey information regarding range clearing progress and protected species survey status. Final decisions regarding mission execution, including possible mission delay or cancellation based on protected species sightings or civilian boat traffic interference, will be the responsibility of the Safety Officer, with concurrence from the Test Director.

Aerial-Based Monitoring

Aerial-based monitoring is only used during pre- and post-mission surveys for gunnery missions or for any mission activities involving the AC-130 gunships or CV-22 gunships because of the sensors they have on the aircraft. Helicopters aren't typically used as part of Eglin AFB's missions so the ability to use them for aerial monitoring is very limited and not anticipated because of airspace constraints from having multiple aircraft in the same area.

Aircraft typically provide an excellent viewing platform for detection of sea turtles at or near the surface. Depending on the mission, the aerial survey team would either consist of Eglin Natural Resources personnel or their designees aboard a non-mission aircraft or the mission aircrew who will subsequently conduct the mission. A description of each follows.

Non-Mission Aircraft

For non-mission aircraft, the pilot will be instructed in protected marine species survey techniques and will be familiar with marine species expected to occur in the area. One person in the aircraft would act as data recorder and is responsible for relaying the location, species (if possible), direction of movement, and number of animals sighted to the Lead Biologist. The aerial team will also identify protected species indicators such as large schools of fish and large, active groups of birds. Pilots will fly the aircraft in such a manner that the entire zone of influence (and a buffer, if required) will be monitored. Sea turtle sightings from the aerial survey team will be compiled by the Lead Biologist and communicated to the Test Director or Safety Officer. Similar to survey vessel requirements, all non-mission personnel will be required to exit the human safety zone before the mission can commence. As a result, the zone of influence may not be monitored up to immediate deployment of live weapons. Due to this fact, the aerial team may be required to survey an additional buffer zone, unless other monitoring assets, such as live video monitoring, can be employed.

Mission Aircraft

Some mission aircraft have the capability to conduct aerial surveys immediately prior to releasing munitions. In those instances, aircrews who have completed the marine species observer training will conduct several dry passes over the target area to ensure the area is clear of all protected species. For mission aircraft that fall under this category, aircrews will operate at

reasonable and safe altitudes (dependent on the aircraft) appropriate to either visually scan the sea surface or will utilize available instrumentation and sensors to detect protected species. Typical missions that would fall under this category are air-to-surface gunnery operations from AC-130 and CV-22 gunships. In some cases, other aerial platforms may be available to supplement monitoring activities for pre-mission surveys and during the missions.

AC-130 and CV-22 Gunship Procedures

After arriving at the mission site and prior to initiating firing events, gunships will conduct at least two complete orbits around the survey area at a minimum safe airspeed around the mission site at the appropriate monitoring altitude. Provided that sea turtles (and other protected species or indicators) are not detected, the aircraft will then begin the ascent to operational altitude, continuing to orbit the target area as it climbs. The initial orbits occur over a time frame of approximately ten to 15 minutes. Monitoring for sea turtles, vessels, and other objects will continue throughout the mission. If a towed target is used, mission personnel will ensure that the target remains in the center portion of the survey area to ensure gunnery impacts would not extend past the zone of influence area.

During the low-altitude orbits and climb, the aircrew will visually scan the sea surface within the aircraft's orbit circle for the presence of sea turtles. Primary emphasis for the surface scan will be upon the flight crew in the cockpit and personnel stationed in the tail observer bubble and starboard viewing window. During nighttime missions, crews will use night vision goggles during observation. In addition to visual surveys, aircraft optical and electronic sensors will also be used for site clearance. AC-130 gunships are equipped with low-light television cameras and AN/AAQ-26 infrared detection sets. The television cameras operate in a range of visible and near-visible light. Infrared systems are capable of detecting differences in temperature from thermal energy (heat) radiated from living bodies, or from reflected and scattered thermal energy. In contrast to typical night-vision devices, visible light is not necessary for object detection. Infrared systems are equally effective during day or night use. The infrared detection sets are capable of detecting very small thermal differences. See the NMFS *Federal Register* Notice of Incidental Harassment Authorization (73 FR 246, December 22, 2008) for a further description of AC-130 sensor capabilities. CV-22 aircraft have similar visual scanners and operable sensors; however, they operate at much lower altitudes than the AC-130 gunships, and no high explosive rounds will be fired from these aircraft.

If any sea turtles are detected during pre-mission surveys or during the mission, activities will be immediately halted until the zone of influence area is clear of all protected species, or the mission will be relocated to another target area. If the mission is relocated, the pre-mission survey procedures will be repeated. In addition, if multiple firing missions are conducted within the same flight, clearance procedures will precede each mission.

Gunship crews will conduct a post-mission survey beginning at the operational altitude and proceeding through a spiraling descent to the designated monitoring altitude. It is anticipated that the descent will occur over a three- to five-minute time period. During this time, aircrews will use the similar equipment and instrumentation to scan the water surface for animals that may have been impacted during the gunnery exercise. During daytime missions, visual scans will be used as well.

Other Mission Aircraft

For missions other than gunnery activities, at least two ordnance delivery aircraft will typically participate in each live weapon release. Prior to the release, Air Force pilots aboard mission aircraft may make a dry run over the target area to ensure it is clear of non-participating vessels before ordnance is deployed. Observation effectiveness may vary among aircraft types. Jets will fly at a minimum speed of 300 knots indicated air speed (approximately 345 miles per hour, depending on atmospheric conditions) and at a minimum altitude of 305 m (1,000 ft). Due to the limited flyover duration and potentially high speed and altitude, observation for marine species would probably be only marginally effective at best, and pilots will, therefore, not participate in species surveys.

Video-Based Monitoring

Video-based monitoring may be accomplished via live high-definition video feed transmitted to Central Control Facility. Video monitoring typically facilitates data collection for the mission, but can also allow remote viewing of the area for determination of environmental conditions and the presence of marine species up to the release time of live munitions. There are multiple sources of video that can be streamed to multiple monitors within Central Control Facility. When authorized for specific missions (e.g., Maritime WSEP), a trained marine species observer from the Eglin Natural Resources Office will monitor all live video feed transmitted to Central Control Facility and will report any sea turtle sightings to the Safety Officer, who will also be at Central Control Facility. Employing this measure typically resolves any time lapses incurred from survey vessels or aircraft leaving the safety zone after pre-mission surveys are completed but before the mission can begin.

The primary platform for video monitoring would be through the GRATV. Four video cameras are typically positioned on the GRATV (anchored on-site) to allow for real-time monitoring and data collection during the mission. The cameras will also be used to monitor for the presence of protected species. The GRATV will typically be located about 183 m (600 ft) from the target area, which is well within the zooming capability ranges of the video cameras.

Supplemental video monitoring can also be accomplished through the employment of additional aerial assets. Eglin's Aerostat Balloon provides aerial imagery of weapon impacts and instrumentation relay. When utilized, it is tethered to a boat anchored near the GRATV, but outside weapon impact areas. The balloon can be deployed to an altitude up to 610 m (2,000 ft)

above sea level. It is equipped with a high-definition camera system that is remotely controlled to pivot and focus on a specific target or location within the mission site. The video feed from the camera system is transmitted to Central Control Facility. Eglin AFB may also employ other assets such as Intelligence, Surveillance, and Reconnaissance aircraft to provide real-time imagery or relay targeting pod videos from mission aircraft. Unmanned aerial vehicles may also be employed to provide aerial video surveillance. While each of these platforms may not be available for all missions, they typically can be used in combination with each other and with the GRATV cameras to supplement sea turtle monitoring efforts.

Even with a variety of platforms potentially available to supply video feeds to Central Control Facility, the entire zone of influence may not be visible for the entire duration of the mission. However, the targets and immediately surrounding areas will typically be in the field of view of the GRATV cameras and the observer will be able to identify any protected species that may enter the target area before weapon releases. In addition, the observer will be able to determine if any animals were injured immediately following the detonations. Should a protected marine species be detected on the live video, the weapon release can be stopped almost immediately because the video camera observer is in direct contact with Test Director and Safety Officer at Central Control Facility.

The protected species survey vessels and the video camera observer will have open lines of communication to facilitate real-time reporting of sea turtle sightings and other relevant information, such as safety concerns and presence of non-participating vessels in the human safety zone. Direct radio communication between all surface vessels, GRATV personnel, and the Tower Control will be maintained throughout the mission. The Range Safety Officer will monitor all radio communications from Central Control Facility and information between the Safety Officer and the support vessels will be relayed via Tower Control. Boat captains are able to communicate to mission personnel working the A-13 radar tower on Santa Rosa Island by VHF radio. The A-13 radar tower serves as a communication relay between the vessels and personnel at Central Control Facility located on Eglin Main Base. The video observer sits in the Central Control Facility to watch the video feed coming in from the cameras and is in the same room as the Safety Officer and Project Engineer who are directing the mission and making real-time decisions on when the mission is ready to proceed or not. Messages between the Safety Officer and boat captains are sent through the Santa Rosa Island A-13 radar tower.

2.2.6 Operational Mitigation Measures for Gunnery Actions

Eglin AFB has identified and required implementation of three operational mitigation measures for gunnery missions, including development of the 105-mm TR, use of ramp-up procedures, and eliminating missions conducted over waters beyond the continental shelf. The largest type of ammunition used during gunnery missions is a 105-mm round, which contains 2.1 kg (4.7 lbs) of high explosive. This is several times more high explosive than that found in the next largest round (40 mm [1.6 in]). As a mitigation technique, the Air Force developed a 105-mm training

round that contains only 0.2 kg (0.35 lbs) of high explosive. The training round was developed to substantially reduce the risk of harassment during nighttime operations, when visual surveying for protected species was of limited effectiveness.

Ramp-up procedures refer to the process of beginning with the least impactful action and proceeding to subsequently more impactful actions. In the case of air-to-surface gunnery activities, ramp-up procedures entail beginning a mission with the lowest caliber munition and proceeding to the highest, which means the munitions would be fired in the order of 25 mm, 40 mm, and 105 mm. The rationale for the procedure is that this process may allow marine species to perceive steadily increasing noise levels and to react, if necessary, before the noise reaches a threshold of significance.

The AC-130 gunships' weapons are used in two phases. First, the guns are checked for functionality and calibrated. This step requires an abbreviated period of live fire. After the guns are determined to be ready for use, the aircraft deploys a flare onto the water surface as a target, and the mission proceeds under various test and training scenarios. This second phase involves a more extended period of live fire and can incorporate use of one or any combination of the munitions available (25 mm, 40 mm, and 105 mm rounds). The two phases used by AC-130 gunships' weapons are considered a ramp-up procedure.

The ramp-up procedure will be required for the initial calibration phase and, after this phase, the guns may be fired in any order. Eglin AFB believes this process will allow marine species the opportunity to respond to increasing noise levels. If an animal leaves the area during ramp-up, it is unlikely to return while the live-fire mission is proceeding. This protocol provides a more realistic training experience for aircrews. In combat situations, gunship crews would not necessarily fire the complete ammunition load of a given caliber gun before proceeding to another gun. Rather, a combination of guns might be used as required by real-time situations. An additional benefit of this protocol is that mechanical or ammunition problems on an individual gun can be resolved while live fire continues with functioning weapons. This diminishes the possibility of a lengthy pause in live fire which, if greater than ten minutes, would necessitate re-initiation of protected species surveys.

Many marine mammal species found in the Gulf of Mexico, including the ESA-listed sperm whale, occur with greater regularity in waters over and beyond the continental shelf break. As a conservation measure to avoid impacts to the sperm whale, Air Force Special Operations Command has agreed to conduct all gunnery missions within (shoreward of) the 200 m (656 ft) isobath, which is considered to be the shelf break in this document.

2.2.7 Coordination with Eglin Natural Resources of Monitoring Requirements

Prior to conducting live missions, proponents (i.e., Air Force military personnel) will coordinate with the Eglin Natural Resources Office to be briefed on their mitigation and monitoring

requirements. Throughout coordination efforts, mission assets available for monitoring will be identified and an implementation plan will be developed. Based on the assets, survey routes will be designed to incorporate the size of the monitoring area and whether a buffer will be required. Training and reporting requirements will also be communicated to the proponents.

Monitoring Options Proposed to be Employed by Known Proponents and Missions

Table 17 lists known proponents and the monitoring platforms that may be employed for species monitoring before, during, and after live air-to-surface missions. The Eglin Natural Resources Office will ensure all practical measures will be implemented to the maximum extent possible while meeting mission objectives.

Table 17. Monitoring options available for live air-to-surface mission proponents operating in the Eglin Gulf Testing and Training Range.

Mission (see section 2.1 for complete description)	Monitoring Platform		
	Vessel	Aerial	Video
86 th Fighter Weapons Squadron Maritime Weapons System Evaluation Program	•		•
Air Force Special Operations Command Training			
Air-to-Surface Gunnery		•	
Small Diameter Bomb/Griffin Missile Training		•	
CV-22 Training		•	
413 th Flight Test Squadron			
AC-130J Precision Strike Package Testing		•	
AC-130J Stand-Off Precision Guided Munitions Testing		•	
780 th Test Squadron			
Precision Strike Weapon	•	•	
Longbow Littoral Testing	•		

2.2.8 Mitigation Effectiveness

The effectiveness of the mitigation measures described above depends largely on the ability to visually locate sea turtles at or near the water surface, as visual observation is the primary measure used. NMFS has evaluated the effectiveness of visual observation for a similar previous Air Force action in the same area of the Gulf of Mexico (Precision Strike Weapon testing). Mitigation effectiveness estimates for Precision Strike Weapon testing was primarily based on aerial surveys, with supplemental surveys conducted from boats and video cameras. Similar to many of the air-to-surface activities described in this document, observers were required to leave the mission area one hour prior to detonation due to human safety requirements. Under such a scenario, NMFS estimated the mitigation effectiveness to be 30 percent. That is, the number of sea turtle takes estimated for each criterion could reasonably be reduced by 30 percent. Aerial surveys are not feasible for all missions evaluated in this BA, and observation will be conducted from vessels and video cameras. Therefore, survey effectiveness is not quantified in this document but is likely less than the 30 percent estimated for Precision Strike Weapon testing.

2.3 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 C.F.R. §402.02). The EGTTR action area encompasses land, near shore, and sea based training and testing areas including danger zones, warning areas, military operations areas, and military training routes off the coast of Florida in the Gulf of Mexico (Figure 2, Figure 3).

All of the Air Force's activities will take place within the EGTTR, which is defined as the airspace over the Gulf of Mexico beginning 5.6 km (3 nmi) from shore. The surface waters under the EGTTR airspace consists of greater than 349,850 km² (102,000 nmi²) in the Gulf of Mexico. The EGTTR is sub-divided into blocks consisting of Warning Areas W-155, W-151, W-470, W-168, and W-174, as well as Eglin Water Test Areas (noted as EWTAs on Figure 2) one through six. Most of the Warning Area blocks are further subdivided into smaller airspace units for scheduling purposes. Warning Area W-155 is occasionally scheduled to support missions by Eglin AFB, but controlled by the U.S. Navy. Most of the Air Force's proposed activities will occur in W-151, and the great majority will occur specifically in sub-area W-151A due to its proximity to shore. All detonations and associated acoustic impacts will occur in W-151, primarily W-151A subarea, and all shoreward of the 200 m (656 ft) bathymetry line. Aircraft operations will continue to be conducted in all other warning areas, but no releases are proposed outside of W-151.

2.3.1 W-151

The inshore and offshore boundaries of W-151 are roughly parallel to the shoreline contour. The shoreward boundary is 5.6 km (3 nmi) from shore, while the seaward boundary extends approximately 157.4 to 185.2 km (85 to 100 nmi) offshore, depending on the specific location. W-151 covers a surface area of approximately 35,146 km² (10,247 nmi²), and includes water depths ranging from about 20 to 700 m (66 to 2,297 ft). This range of depth includes continental shelf and slope waters. Approximately half of W-151 lies over the continental shelf.

2.3.2 W-151A

W-151A occurs directly south of Eglin AFB and extends approximately 111 km (60 nmi) offshore and has a surface area of 8,797 km² (2,565 nmi²). Water depths range from about 30 to 350 m (98 to 1,148 ft) and include continental shelf and slope waters. Most of W-151A occurs over the continental shelf, in water depths less than 250 m (820 ft).

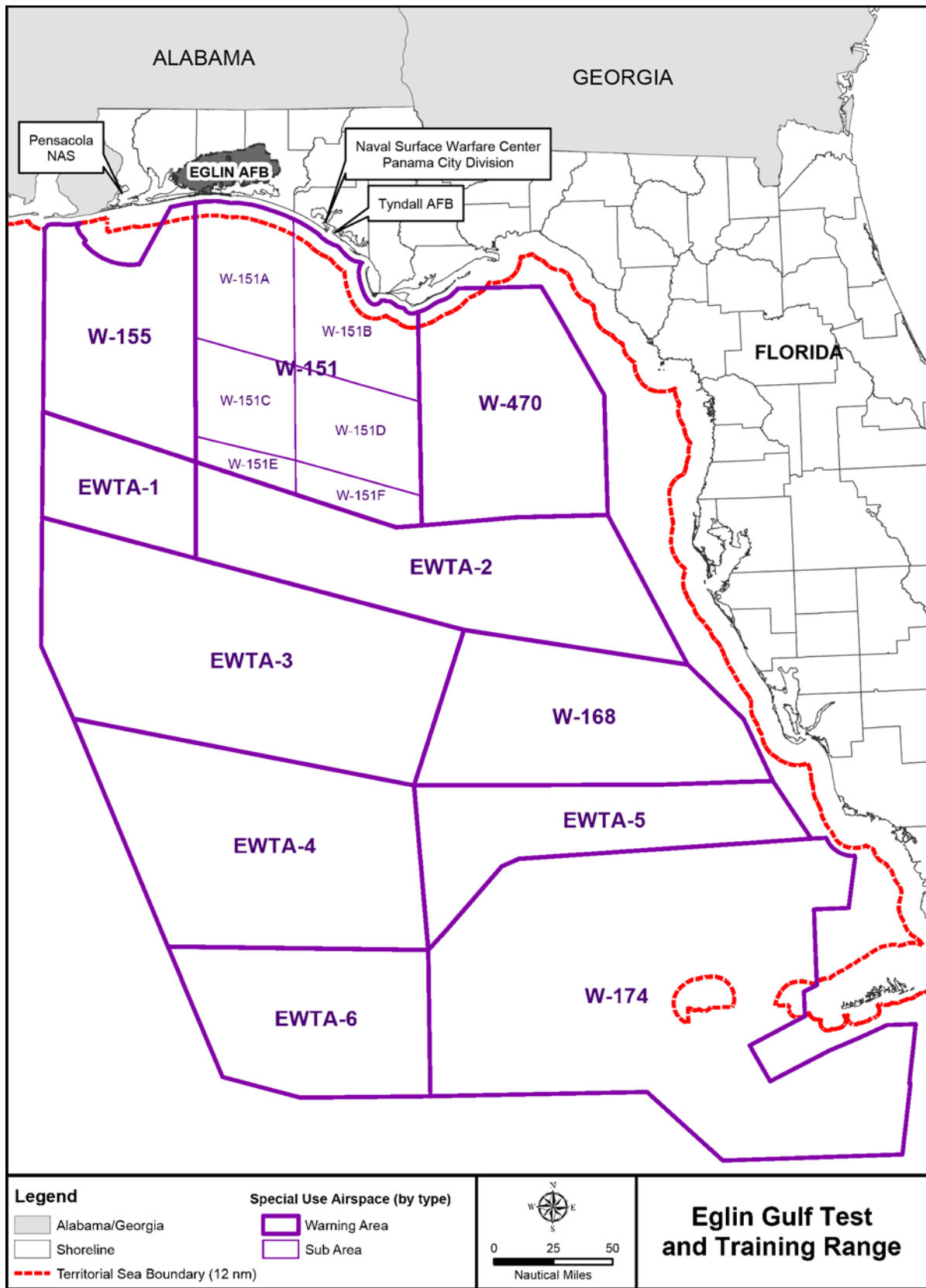


Figure 2. The Eglin Gulf Test and Training Range.

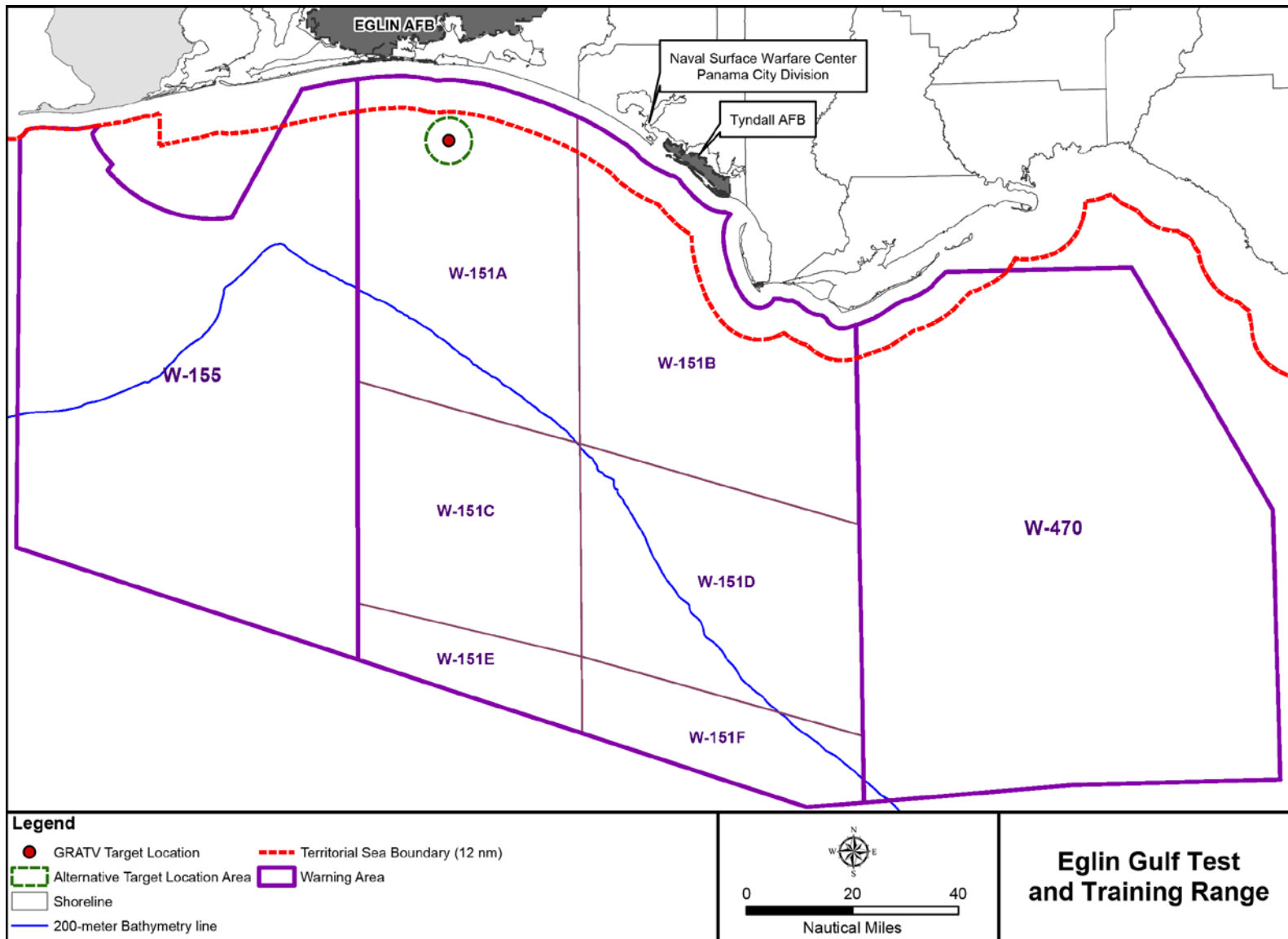


Figure 3. The Gulf Range Armament Test Vessel target location.

2.4 Interrelated and Interdependent Actions

Interrelated actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent use, apart from the action under consideration. NMFS determined that there are no interrelated or interdependent actions outside the scope of this consultation.

3 OVERVIEW OF THE ASSESSMENT FRAMEWORK

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

“To jeopardize the continued existence of an ESA-listed species” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 C.F.R. §402.02). The jeopardy analysis considers both survival and recovery of the species.

Section 7 assessment involves the following steps:

- 1) We identify the proposed action and those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors.
- 2) We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.
- 3) We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, impacts of state or private actions that are contemporaneous with the consultation in process.
- 4) We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or sub-populations to which those individuals belong. This is our exposure analysis.
- 5) We evaluate the available evidence to determine how those ESA-listed species are likely to respond given their probable exposure. We also consider how the action may affect designated critical habitat. This is our response analyses.

- 6) We assess the consequences of these responses to the individuals that have been exposed to the populations those individuals represent, and the species those populations comprise. This is our risk analysis.
- 7) The adverse modification analysis considers the impacts of the proposed action on the essential habitat features and conservation value of designated critical habitat.
- 8) We describe any cumulative effects of the proposed action in the action area.

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

- 9) We integrate and synthesize the above factors by considering the effects of the action, the environmental baseline, and the cumulative effects to determine whether the action could reasonably be expected to:
 - a) Reduce appreciably the likelihood of both survival and recovery of the ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or
 - b) Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the status of the species and critical habitat.
- 10) We state our conclusions regarding jeopardy and the destruction or adverse modification of designated critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative to the action. The reasonable and prudent alternative must remove the likelihood of jeopardy to the continued existence of ESA-listed species and adverse modification to their designated critical habitat. A reasonable and prudent alternative meeting this requirement must also meet other regulatory requirements.

3.1 Evidence Available for the Consultation

To conduct these analyses, we considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. A considerable body of scientific information on anthropogenic sounds and their effects on marine mammals, sea turtles, fishes, and other aquatic organisms is available. NMFS' status reviews for ESA-listed species also provide information on the status of the species including, but not limited to, their resiliency, population trends, and specific threats to recovery

that contributes to our *Status of ESA-listed Resources, Environmental Baseline, and Risk Analyses* sections.

To comply with our obligation to use the best scientific and commercial data available, we conducted electronic literature searches throughout the consultation, including within NMFS Office of Protected Resource's electronic library. We examined the information provided in the Air Force's request for ESA consultation package, including an environmental assessment, programmatic biological assessment, and supplemental information provided throughout the consultation period. Also considered were draft or final recovery plans for the endangered or threatened species that are considered in this document, and publications that we identified, gathered, and examined from the public scientific literature, including new information that has become available since the issuance of the previous biological opinions on Air Force EGTTR activities.

Considering the information that was available, this consultation and our opinion and conference report include uncertainty about the basic hearing capabilities of some ESA-listed species, how these taxa use sounds as environmental cues, how they perceive acoustic features of their environment, the importance of sound to the normal behavioral and social ecology of species, the mechanisms by which human-generated sources affect the behavior and physiology (including the non-auditory physiology) of exposed individuals, and the circumstance that are likely to produce outcomes that have adverse consequences for individuals and populations of exposed species.

3.2 The Air Force's Acoustic Exposure Analysis

To estimate potential exposure of sea turtles¹ to sounds from detonations, the Air Force used acoustic modeling and information on sea turtle density and depth distribution in the action area. We summarize the Air Force's exposure analysis below. A comprehensive description of this analysis is included in the Air Force's Programmatic Biological Assessment and appendices for the Eglin Gulf Test and Training Range (Department of the Air Force 2015). We verified the methodology and data used by the Air Force for their exposure analysis and accept the modeling conclusions on exposure of sea turtles. Acoustic modeling is used as a tool to evaluate potential impacts, estimate the number of incidental takes of ESA-listed species, and for mitigation purposes. NMFS takes into consideration the model used and its results in determining the potential impacts to ESA-listed species; however, it is just a component of NMFS' analysis during the ESA section 7 process as NMFS also takes into consideration other factors associated with the proposed action, such as geographic location, duration of activities, context, intensity, etc. Takes generated by modeling are used as estimates, not absolutes, and are factored into NMFS's analysis accordingly. NMFS acknowledges that other models may be available;

¹ As documented in section 4.1 of this opinion and conference report, sperm whales (and other ESA-listed marine mammals) are not expected to occur in the location where detonations will occur.

however, for the Air Force's proposed action, NMFS believes the acoustic impact modeling conducted by Eglin AFB represents the best available approach and it results in a conservative estimate of exposures.

The sources of information used to estimate potential detonation (pressure and noise) effects on sea turtles includes: (1) the zone of influence; (2) the number of detonations (events); and (3) the density of animals within the zone of influence. The zone of influence is the area or volume of ocean in which sea turtles could be exposed to various pressure or acoustic energy levels caused by exploding ordnance. Noise and pressure effects area were evaluated only for detonations occurring at and beneath the water surface. In-air detonations were not included in the impacts analysis because of the negligible transmission of energy and pressure across the air/water interface. Based on the acoustic modeling fully described in the Air Force's biological assessment and appendix, as well as the thresholds described below in section 3.2.1, threshold radii or ranges to effect (i.e., for mortality, injury, impairment, and behavioral response) were estimated for each event (see section 3.2.2 for the ranges to effect). The ranges were used to calculate the total area (circle) of the zones of influence for each criterion/threshold and detonation scenario.

Table 14 in section 2.1.8 above of this opinion and conference report lists the expendables proposed for testing and training missions in the EGTTR. The number of events generally corresponds to the number of live ordnance items used. Small diameter bomb launches and gunnery rounds of 25, 30, and 40 mm gunnery rounds, events where multiple detonations in close proximity occurring over a short period of time (from less than a second to a few seconds), were modeled differently than events where only one detonation will occur (Table 20). These differences are further described in the Air Force's biological assessment and acoustic modeling appendix. The 7.62 and 0.50 caliber rounds were not included in the analysis as they do not contain high energy material and do not detonate or introduce energy or pressure into the water column.

The estimated number of sea turtles potentially exposed to the various impact thresholds was then calculated as the product of the zone of influence, number of events per year, and animal density (as described in section 3.2.3) (Department of the Air Force 2015). This methodology was used to estimate incidental take from EGTTR activities. Results from this analysis (i.e., take estimates) are reflected in the effects section (see section 6.4) and incidental take statement (see section 9).

3.2.1 Thresholds

The Air Force's acoustic modeling calculated the maximum range, or radius, from the detonation point to where the various thresholds extend for all events. Table 18 lists the thresholds used in the analysis for all events and the following sections describe how these thresholds were determined. Thresholds are defined in terms of both peak noise level (dB) and pressure in pounds per square inch (psi) for all criteria.

Table 18. Sea turtle exposure thresholds for single underwater detonation events.

Mortality and Serious Injury	Impairment	Disturbance	Behavioral Response
>229 dB re: 1 μ Pa (peak) SPL	>224 dB re: 1 μ Pa (peak) SPL	>200 dB re: 1 μ Pa (peak) SPL	>180 dB re: 1 μ Pa (peak) SPL
40 psi	23 psi	1.45 psi	0.14 psi

Impairment=temporary hearing loss; SPL=sound pressure level; psi=pounds per square inch

Mortality and Injury

The greatest potential for direct, non-auditory tissue impacts to sea turtles is primary blast injury and barotrauma after exposure to the shock waves from the explosions. Primary blast injuries result from the initial compression of a body exposed to the high pressure of a blast or shock wave. Primary blast injury is usually limited to gas-containing structures (e.g., lung and gut) and the pressure-sensitive components of the auditory system (discussed below) (Craig and Hearn 1998), although additional injuries could include concussive brain damage and cranial, skeletal, or shell fractures (Ketten 1995). Barotrauma refers to injuries caused when large pressure changes occur across tissue interfaces, normally at the boundaries of air-filled tissues such as the lungs. Primary blast injury to the respiratory system may be fatal depending on the severity of the trauma. Rupture of the lung may introduce air into the vascular system, producing air blockages that can restrict oxygen delivery to the brain and heart. Although often secondary in life-threatening severity to pulmonary blast trauma, the gastrointestinal tract can also suffer bruising and tearing from blast exposure, particularly in air-containing regions of the tract. Potential traumas include internal bleeding, bowel perforation, tissue tears, and ruptures of the hollow abdominal organs. Although hemorrhage of solid organs (e.g., liver, spleen, and kidney) from blast exposure is possible, rupture of these organs is rarely encountered. Non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection. Rupture of the tympanic membrane, or the tympanum in the case of sea turtles, while not necessarily a serious or life-threatening injury, may lead to permanent hearing loss (Ketten 1995; Ketten 1998). No data exist that correlate the sensitivity of the sea turtle tympanum and middle and inner ear trauma associated with shock waves from underwater explosions (Viada et al. 2008).

Though no published data are available on the specific effects of explosives on sea turtles (Popper et al. 2014b), there is a considerable body of laboratory data on actual injuries from impulsive sounds, usually from explosive pulses, obtained from tests with a variety of vertebrate species (Goertner et al. 1994; Richmond et al. 1973; Yelverton et al. 1973). Without data specific to sea turtles, data from tests with other vertebrates were used to predict exposure levels at which mortality or serious injury would likely occur. In submerged terrestrial animals, gas-containing internal organs, such as lungs and intestines, were the principle damage sites from shock waves (Richmond et al. 1973; Yelverton et al. 1973). Slight contusions to the gastrointestinal tract were reported during small charge tests when the peak was 237 dB re: 1 μ Pa (Richmond et al. 1973). Based on levels that caused mortality and potential mortal injury in fishes (Hubbs and Rechnitzer 1952), Popper et al. (2014b) suggested that mortality and potential mortal injury could occur at

levels ranging from 229 to 234 dB (peak). For the purposes of this consultation, the threshold for estimating mortality and serious injury) of sea turtles from exposure to detonations is based on this value (i.e., 229 dB peak). We do not assume all sea turtles exposed to sound at this level to die, though non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection Popper et al. (2014b). This injury threshold is inclusive of the threshold at which we would expect PTS to occur².

Impairment

The criteria used to determine impairment will be based on the range at which a sea turtle would be expected to experience temporary threshold shift (TTS). To date, no known data are available on potential hearing impairments (e.g., TTS) in sea turtles. Sea turtles, based on their auditory anatomy (Lenhardt et al. 1985; Moein Bartol and Musick 2003; Wartzok and Ketten 1999; Wever 1978; Wyneken 2001), almost certainly have poorer absolute sensitivity (i.e., higher thresholds) across much of their hearing range than do the mid-frequency cetacean species. Therefore, applying TTS criteria derived from mid-frequency cetaceans to sea turtles provides a protective approach to estimating acoustic impacts to sea turtles (TTS data are not available for low-frequency cetaceans). Based on best available science regarding TTS in marine vertebrates (Finneran et al. 2005; Finneran et al. 2000; Finneran et al. 2002; Nachtigall et al. 2003; Nachtigall et al. 2004; Schlundt et al. 2000) and the lack of information regarding TTS in sea turtles, the peak pressure of 224 dB re: 1 μ Pa (23 pounds per square inch [psi]) is used to estimate exposures resulting in TTS for sea turtles.

Behavioral Response

A sea turtle's behavioral responses to sound are assumed to be variable and context specific. For instance, a single explosion may cause a brief startle reaction. A sea turtle may swim farther away from the sound source, increase swimming speed, change surfacing time, and decrease foraging if the stressor continues to occur (e.g., from a series of explosions).

Nedwell et al. (2007) proposed a set of guidelines for fish behavior following a concept that uses the level of noise above a species' hearing ability as benchmarks for expected behavioral changes. The authors proposed that 0 to 50 dB above hearing ability elicits a short-term, minor reaction in a small number of individuals; 50 to 90 dB elicits a stronger reaction by the majority of individuals; 90 dB and above elicits a strong avoidance reaction by virtually all individuals; and above 110 dB is the tolerance limit of sound that will be unbearably loud. Nedwell's

² Because sea turtle PTS data from impulsive exposures do not exist, onset of PTS levels for these animals are estimated by adding 6 dB to the peak pressure-based thresholds for TTS. These relationships were derived by Southall, B. L., and coauthors. 2007. Marine mammal noise and exposure criteria: initial scientific recommendations. *Aquatic Mammals* 33:411-521. from impulsive noise TTS growth rates in chinchillas. This results in onset of PTS thresholds of 230 dB re 1 μ Pa peak pressure for sea turtles.

proposed method is based on limited data for fish; however, we have no similar data on a graduated response to noise for sea turtles. Therefore, we are using Nedwell's data on fish as a surrogate for expected sea turtle responses in this opinion and conference report. We will further analyze the available information on the behavioral response of sea turtles in the context of Nedwell's concept as we apply it to sea turtles.

Underwater auditory evoked potentials (AEPs) to measure hearing abilities in sea turtles found their sensitivity to be about 110 dB re: 1 μ Pa at 200 to 400 Hz (Martin et al. 2012). Behavioral measurements to the same sounds resulted in hearing sensitivities about 6 to 7 dB lower than the AEPs. Lavender et al. (2014) measured AEPs in loggerhead sea turtles and found hearing sensitivity to be about 120 dB re: 1 μ Pa between 200 to 400 Hz. However, behavioral audiograms should average 28 dB lower threshold than AEPs. Although behavioral methods of testing can provide different measurements of hearing ability than AEPs in a number of species, Lavender et al. (2014) acknowledged that collecting behavioral data is not always practical when compared with AEP data collection and there are a number of testing factors that can account for the differences. Therefore, we will use the more conservative AEP hearing data and apply a most sensitive hearing ability of 110 dB re: 1 μ Pa at 200 to 400 Hz for this analysis. Applying Nedwell's conceptual model for fish to sea turtles, we find predicted increases in behavioral responses at the exposure levels in Table 19.

Table 19. Range of general behavioral effects in sea turtles with increased underwater noise levels.

Decibel (dB) Level (peak)	Response Category	Number of Animals
110-160	Discountable effects of audible sounds, minor responses possible, but within normal range of behavioral variation	Very few
> 160-200	Some swimming and diving responses becoming stronger and more frequent at higher exposures	Few at 160 dB (peak), 30% at 180 dB (peak), to most at 200 dB (peak)
> 200-220	Strong avoidance response	Some at 200 dB (peak) to all at 220 dB (peak)
> 220	Intolerable	All individuals

To verify the validity of this approach, we compared the response categories to behavioral reactions reported in the literature. Behavioral reactions of sea turtles (DeRuiter and Doukara 2010; McCauley et al. 2000a; McCauley et al. 2000b) have been reported in response to airgun noise. Behavioral responses in sea turtles may be important if they disrupt feeding, mating, or sheltering of individuals. A few studies of sea turtle behavior to impulsive sounds (DeRuiter and Larbi Doukara 2012; McCauley et al. 2000b; Moein Bartol et al. 1995; O'Hara and Wilcox 1990) are consistent with the response categories derived using the approach described by Nedwell et al. (2007). In a controlled study, McCauley et al. (2003) reported that two sea turtles obtained from a rehabilitation facility consistently showed increased swimming responses when exposed to levels of 166 dB re: 1 μ Pa (rms). Above 175 dB re: 1 μ Pa root mean squared pressure their behavior became more erratic possibly indicating the turtles were in an agitated state. DeRuiter

and Larbi Doukara (2012) conducted a field study involving a large sample size involving observations of free-ranging sea turtles exposed to airgun noise. This study reported ten percent of disturbance behaviors began at received levels of 171 dB re: 1 μ Pa (peak), 30 percent at 179 dB re: 1 μ Pa (peak), and 50 percent at 191 dB re: 1 μ Pa (peak). Comparing the two studies, McCauley's 166 dB (rms) level corresponds to an approximately 40 to 50 percent diving response reported in the DeRuiter and Doukara study.

For this consultation, we rely on the thresholds described in Table 19 in order to estimate instances of behavioral response or disturbance. Based on the best available information, including the DeRuiter and Larbi Doukara (2012) study and applying Nedwell's conceptual model, we expect sea turtles to show a diving or swimming response at 180 dB (peak). This response is expected to increase until disturbance responses begin at levels above 200 dB (peak) that cause an animal to leave the area (see Table 19).

3.2.2 Ranges to Effect

Table 20 lists the estimated threshold radii or ranges to effect for each event. The ranges were used to calculate the total area (circle) of the zones of influence for each criterion/threshold and detonation scenario.

Table 20. Sea turtle threshold radii (m) for Eglin Gulf Testing and Training Range air-to-surface testing and training ordnance.

Munition	NEW (lbs)	Detonation Scenario	Mortality and Serious Injury	Impairment	Disturbance	Behavioral Response
GBU-10 or GBU-24	945	Surface	770	1,280	2,509	199,323
		Subsurface	771	1,281	2,509	199,323
AGM-158 (JASSM)	300	Surface	524	873	1,712	136,001
GBU-12 or GBU-54	192	Surface	452	752	1,475	117,148
		Subsurface	453	753	1,476	117,256
AGM-65 (Maverick)	86	Surface	345	575	1,127	89,521
GBU-39 (Double)	74	Surface	328	546	1,072	85,177
AIM-9X	68	Surface	319	532	1,042	82,779
GBU-39 (SDB I or LSDB)	37	Surface	259	433	850	67,532
		Subsurface	262	435	853	67,719
Joint Air-to-Ground Missile	27.41	Surface	234	392	768	61,025
GBU-53 (SDB II)	22.84	Surface	220	368	723	57,425
		Subsurface	223	370	726	57,637
AGM-114 (Hellfire)	20	Surface	211	352	692	54,942
		Subsurface	213	354	694	55,145
AGM-176 (Griffin)	4.58	Surface	129	216	422	33,534
2.75 Rockets	10	Surface	167	279	547	43,480
105 mm FU	4.7	Surface	130	218	426	33,844

Munition	NEW (lbs)	Detonation Scenario	Mortality and Serious Injury	Impairment	Disturbance	Behavioral Response
40 mm burst	0.87	Surface	74	124	243	19,331
Live fuse	0.4	Surface	57	95	187	14,881
105 mm TR	0.35	Surface	55	91	179	14,225
30 mm burst	0.1	Surface	36	60	118	9,389
25 mm burst	0.067	Surface	32	53	103	8,200

AGM=Air-to-Ground Missile; AIM=Air Intercept Missile; EGTTR=Eglin Gulf Test and Training Range; GBU=Guided Bomb Unit; FU=full up; JASSM=Joint Air-to-Surface Standoff Missile; lbs=pounds; LSDB=Laser Small Diameter Bomb; mm=millimeter; NEW=net explosive weight; SDB=Small Diameter Bomb; TR=training round

3.2.3 Sea Turtle Density Estimates

The Air Force used density estimates of sea turtles in the EGTTR that are presented in Garrison (2008) or Epperly et al. (2002), depending on the species. Garrison (2008)'s estimates for the loggerhead, Kemp's ridley, and leatherback were obtained from a habitat modeling project conducted in portions of the EGTTR. As part of the habitat modeling effort, NMFS' Southeast Fisheries Science Center conducted link transect aerial surveys of the continental shelf and coastal waters of the eastern Gulf of Mexico during winter (February 2007, water temperatures of 12 to 15° C) and summer (July/August 2007, water temperatures greater than 26° C). The surveys covered nearshore and continental shelf waters (to a maximum depth of 200 m [656.2 ft]), with the majority of effort concentrated in waters from the shoreline to 20 m (65.6 ft) depth. Marine species encounter rates during the surveys were corrected for sighting probability and the probability of animals being on the surface. The survey data were combined with remotely sensed environmental data/habitat parameters (i.e., water depth, sea surface temperature, and chlorophyll-a concentration) to develop habitat models. The habitat modeling approach spatially projects the species-habitat relationship based on distribution of environmental factors, resulting in predicted densities for un-sampled locations and times. The spatial density model can therefore be used to predict relative density in unobserved areas and at different times of year based on sea surface temperature and chlorophyll datasets derived from satellite data. Similarly, the spatial density model can be used to predict relative density for any sub-region within the surveyed area.

Garrison (2008) produced sea turtle density estimates at various spatial scales within the EGTTR. At the largest scale, density data were aggregated into four principal strata categories: North-Inshore, North-Offshore, South-Inshore, and South-Offshore. These densities were provided in the published survey report. It should be noted that these aggregated densities were not corrected for the availability of sea turtles at the surface, and the resulting negative bias is likely large. Unpublished densities were also provided to Eglin AFB for smaller blocks (sub-areas) corresponding to airspace units, and a number of these sub-areas were combined to form larger zones. Densities in these smaller areas were provided to Eglin AFB in Excel spreadsheets by the report author. Unlike the aggregated estimates, sub-area densities were corrected for animal surface availability.

For both large areas and sub-areas, regions occurring entirely within waters deeper than 200 m (656 ft) were excluded from predictions, and those straddling the 200 m isobath were clipped to remove deep water areas. In addition, because of limited survey effort, density estimates beyond 150 m (492.1 ft) water depth were considered invalid. The environmental conditions encountered during the survey periods (February and July/August) do not necessarily reflect the range of conditions potentially encountered throughout the year. In particular, the transition seasons of spring (April to May) and fall (October to November) have a very different range of water temperatures. Accordingly, for predictions outside of the survey period of geographical range, it is necessary to evaluate the statistical variance in predicted values when attempting to apply the model. The coefficient of variation of predicted quantity is used to measure the validity of model predictions. According to Garrison (2008), the best predictions have coefficient of variance values of approximately 0.2. When coefficient of variances approach 0.7, and particularly when they exceed 1.0, the resulting model predictions are extremely uncertain and are considered invalid. For this reason, density estimates from months with unacceptably high coefficients of variation were not included in the seasonal density estimates in favor of averaging the remaining monthly densities in which have higher confidence in their predicted densities (coefficients of variation greater than 0.7).

Based upon the preceding discussion, density estimates shown in Table 18 for loggerhead, Kemp's ridley, and leatherback sea turtles correspond to the average of the median monthly densities provided by Garrison (2008) for sub-area 137, as shown in Figure 4. Within this block, density values were provided based upon one-year and five-year monthly averages for sea surface temperature and chlorophyll. For the purposes of this document, the five year monthly average was used.

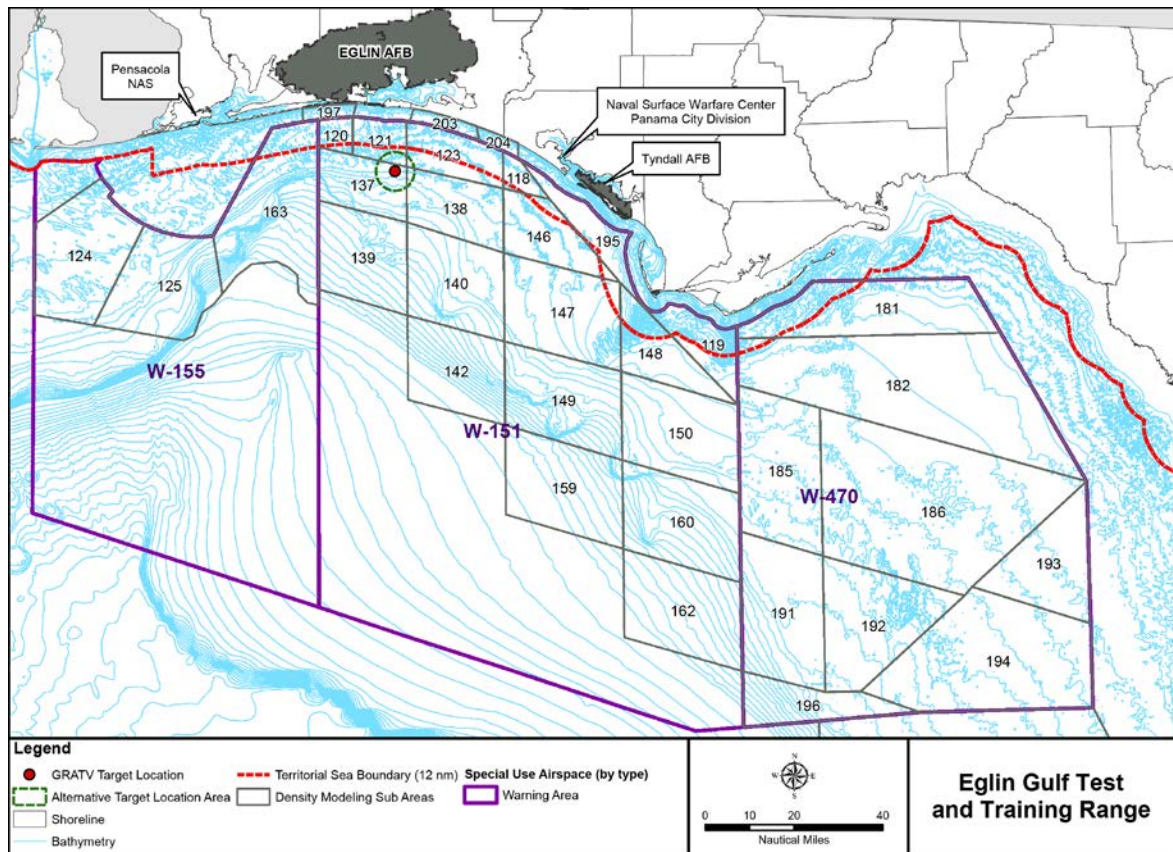


Figure 4. Sub-areas included in Garrison (2008).

Habitat modeling resulted in prediction of relatively high green sea turtle densities in warm, offshore waters of the northern Gulf of Mexico. However, Garrison (2008) cautions that prediction is highly suspect, and that these results should only be applied from southwest Florida to the Dry Tortugas. Therefore, densities from habitat modeling (Garrison 2008) for the green sea turtle were not used. Model results for leatherback sea turtles are also less reliable due to overall low observation numbers, but Garrison (2008) does not suggest discounting leatherback density in estimates in the northern Gulf of Mexico.

Density estimates for green sea turtles were derived from Epperly et al. (2002). This study focused on sea turtle bycatch and used aerial surveys. The surveys were conducted by NMFS personnel each autumn between 1992 to 1996. Results were stratified into inshore (0 to 18.3 m [0 to 60 ft]) and offshore (18.3 to 73.1 m [60 to 239.8 ft]) areas, as well as into western and eastern geographic zones. The eastern offshore stratum is most applicable to the affected air-to surface mission area. Results were also presented for upper and lower 95 percent confidence intervals. The density corresponding to the upper confidence interval of the 10 to 40 fathom (18.3 to 73.2 m [60 to 240.2 ft]) stratum was used by the Air Force. Density estimates were not adjusted for sighting or availability bias, likely resulting in underestimation of true density. Therefore, the authors presented the values as minimum density estimates. To account for the potential for negative bias associated with sighting and availability bias, Eglin AFB adjusted the minimum

density estimate for green sea turtles. Time spent at the surface is likely influenced by factors such as species, age of the animal, geographic location, behavioral activity, time of day, and others. Some researchers (Cardona et al. 2005; Polovina et al. 2004; Polovina et al. 2003) have reported various sea turtle species spending up to 35 to 40 percent to their time at the surface. However, Renaud and Carpenter (1994) found that four tagged loggerhead individuals in the Gulf of Mexico were submerged to 90 to 95 percent of the time, depending on the season. Considering the above information, Eglin AFB has adjusted the green sea turtle density estimate based on a 90 percent dive profile (i.e., sea turtles are assumed to spend an average of 90 percent of their time underwater and 10 percent of their time at the surface). The green sea turtle density data derived from Epperly et al. (2002) and included in the acoustic model used the same estimate for summer and winter because seasonality was not specified. The density estimates by sea turtle species assumes a uniform distribution within the affected area (animals per km²) due to insufficient data to calculate density for smaller areas. This likely does not reflect patchiness of animals that may be concentrated in areas of importance such as for food availability.

Table 21. Sea turtle density estimates.

Species	Density Estimate (animals per km ²)	
	Summer (May – October)	Winter (November – April)
Loggerhead Sea Turtle ¹	0.708*	2.565*
Kemp's Ridley Sea Turtle ¹	0.052	1.107
Leatherback Sea Turtle ¹	0.321**	0.276**
Green Sea Turtle ²	0.165	0.165

¹Source: Garrison (2008); adjusted for observer and availability bias by author.

²Source: Epperly et al. (2002); adjusted for sighting or availability bias by authors, but adjusted by Eglin AFB.

*May and November density estimates not included in the seasonal average calculations due to unacceptably high coefficient of variation (CV) values.

**May, June, September, October, November, and December density estimates not included in the seasonal average calculations due to unacceptably high CV values.

Separate density estimates for each species of sea turtle are given for summer (May to October) and winter (November to April) because missions may occur at any time of the year. Also, the water temperature during these seasons affects noise propagation and the results of the Air Force's acoustic modeling. The Air Force assumed that half of the missions would occur in winter and half in summer because the timing of missions is not specified. The density estimates from months with unacceptably high coefficients of variation were not included in the seasonal density estimates in favor of averaging the remaining monthly densities in which have higher confidence in their predicted densities (coefficients of variation greater than 0.7) (see Table 18).

Sea turtles are not evenly distributed in the water column. Separate depth use distribution was analyzed for each species of sea turtle by looking at data from tagging and other technologies with behavioral and physiological parameters. Regardless of bottom depth, animals may regularly conduct shallow or deep dives depending on species. The Air Force applied a depth distribution adjustment to sea turtle densities by species to account for location in the water

column. The depth (vertical) distribution data (Table 22) was combined with regular (horizontal) density data to provide a three-dimensional density estimate of animals whenever possible to allow for more accurate modeling of the potential number of exposures to sea turtles from explosives during EGTTR activities.

Table 22. Sea turtle depth distribution.

Species	Depth Distribution	Reference
Loggerhead Sea Turtle	33% at <1 m, 15% at 1-3 m, 12% at 4-6 m, 8% at 7-10 m, 25% at 11-25 m, and 7% at >25 m	Dellinger and Freitas (2001)
Kemp's Ridley and Green Sea Turtle	33% at <1 m, 15% at 1-3 m, 12% at 4-6 m, 8% at 7-10 m, 25% at 11-25 m, and 7% at >25 m	Dellinger and Freitas (2001)
Leatherback Sea Turtle	28% at <6 m, 36% at 6-12 m, 24% at 13-51 m, 7% at 52-102 m, 3% at 103-150 m, and 2% at >150 m	Eckert (2006)

m=meters

4 STATUS OF ESA-LISTED SPECIES

This section identifies the ESA-listed species that occur within the action area and may be affected by the proposed action (Table 23). It then summarizes the biology and ecology of those species and what is known about their life histories in the action area.

Table 23. Threatened and endangered species under NMFS jurisdiction that may be affected by the proposed action in the Eglin Gulf Testing and Training Range.

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals - Cetaceans			
Bryde's whale (<i>Balaenoptera edeni</i>)	P – 81 FR 88639	-- --	-- --
Gulf of Mexico DPS			
Sperm Whale (<i>Physeter macrocephalus</i>)	E – 35 FR 18319	-- --	75 FR 81584
Sea Turtles			
Green Turtle (<i>Chelonia mydas</i>)	E – 43 FR 32800	63 FR 46693	October 1991
North Atlantic DPS	T – 81 FR 20057		
Hawksbill Turtle (<i>Eretmochelys imbricata</i>)	E – 35 FR 8491	63 FR 46693	57 FR 38818
Kemp's Ridley Turtle (<i>Lepidochelys kempii</i>)	E – 35 FR 18319	-- --	75 FR 12496
Leatherback Turtle (<i>Dermochelys coriacea</i>)	E – 35 FR 8491	44 FR 17710	63 FR 28359
Loggerhead Turtle (<i>Caretta caretta</i>) – Northwest Atlantic DPS	E – 76 FR 58868	-- --	63 FR 28359
Fishes			
Gulf Sturgeon (<i>Acipenser oxyrinchus desotoi</i>)	T – 56 FR 49653	68 FR 13370	Recovery Plan

E=Endangered; P=Proposed; T=Threatened

4.1 ESA-listed Species and Critical Habitat Not Likely to be Adversely Affected

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

The second criterion is the probability of a response given exposure. ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the species ESA-listed in Table 23 and we summarize our results below.

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

Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated.

Insignificant is the appropriate effect conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed species may be expected to be affected, but not harmed or harassed.

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

4.1.1 Bryde's Whale – Gulf of Mexico Distinct Population Segment

Bryde's whale gulf of Mexico DPS was proposed for listing under the ESA (Table 23). The Bryde's whale is a large baleen whale found in tropical and subtropical waters worldwide. In a recent genetic analysis of mitochondrial DNA samples taken from Bryde's whales in the Gulf of Mexico, Rosel and Wilcox (2014) found that the Gulf of Mexico population was genetically distinct from all other Bryde's whales worldwide and the genetic diversity within the population is exceedingly low.

Bryde's whales are the only species of baleen whales that occur in the Gulf of Mexico year-round. From looking at whaling logbooks, the historical distribution of Bryde's whales in the Gulf of Mexico included the northeastern, north-central, and southern Gulf of Mexico, which was much broader than it is currently. Over the past 25 years, sightings of Bryde's whales have been consistently along a very narrow depth corridor in the northeastern Gulf of Mexico, located in the De Soto Canyon area (Maze-Foley and Mullin 2007; MMIQT 2015; Mullin and Hoggard 2000a; Mullin 2007). LaBrecque et al. (2015) designated this areas, home to the small resident population of Bryde's whale in the northeastern Gulf of Mexico, as a Biologically Important Area. A small number of additional sightings of unidentified baleen and Bryde's/sei-type whales have occurred outside of the Biologically Important Area along the shelf break in the western Gulf of Mexico, southwest of Louisiana, and south of the Louisiana-Texas border.

All of the abundance estimates for Bryde's whales in the northern Gulf of Mexico are based on various aerial- or ship-based line-transect surveys conducted from 1991 to 2012 (Buckland et al. 2005; Rosel et al. 2016). The abundance estimate used for management of the "Northern Gulf of Mexico Bryde's whale stock" is 33 individuals (Waring et al. 2013) and Duke University researchers estimated an abundance of 44 individuals based on the averages of 23 years of survey data (Roberts et al. 2016). No analysis has been conducted to evaluate abundance trends for the Gulf of Mexico DPS of Bryde's whale and most likely less than 100 individuals exist.

Little information exists on the behavior, foraging ecology, and reproduction and growth of Bryde's whales in the Gulf of Mexico. Maze-Foley and Mullin (2007) found Gulf of Mexico DPS Bryde's whales to have a mean group size of two, which is similar to group sizes of Eden's and Bryde's whales (Wade and Gerrodette 1993). A Gulf of Mexico DPS Bryde's whale tagged in De Soto Canyon spent 47 percent of its time within 15 m (49.2 ft) of the surface during the day and 88 percent of its time within 15 m (49.2 ft) of the surface during the night (81 FR 88639). The tagged whale dove to depths of up to 271 m (889.1 ft), with foraging lunges apparent at the deepest depths. It was likely foraging at or just above the seafloor where diel-vertical-migrating schooling fish form tight aggregations. Gulf of Mexico DPS Bryde's whales do not appear to forage at or near the surface. They are thought to generally feed primarily in the water column on schooling fish such as anchovy, sardine, mackerel, herring, and small crustaceans (Kato 2002). These prey occur throughout the Gulf of Mexico and Biologically Important Area.

Taylor et al. (2007) estimated that Bryde's whales worldwide may reproduce every two to three years and reach sexual maturity at age nine. Given the basic biology of baleen whales, it is likely that under normal conditions, the female Gulf of Mexico DPS Bryde's whales produce a calf every two to three years. The largest known Bryde's whale was a lactating female 12.6 m (41.3 ft) in length (Rosel and Wilcox 2014). While no calves have been reported during stock assessment surveys, two stranded calves have been reported in Florida in 1988 and 2006.

Baleen whale species produce a variety of highly stereotyped, low-frequency tonal and broadband calls for communication purposes (Richardson et al. 1995a). These calls are thought

to function in a reproductive or territorial context, provide individual identification, and communicate the presence of danger or food (Richardson et al. 1995a). Bryde's whales worldwide produce a variety of calls that are distinctive among geographic regions that may be useful for delineating subspecies or populations (Oleson et al. 2003; Širović et al. 2014). In the Gulf of Mexico, Širović et al. (2014) reported Bryde's whale call types composed of downsweeps, and downsweep sequences and localized these calls. Rice et al. (2014) detected these sequences, as well as two stereotyped tonal call types that originated from Bryde's whales in the Gulf of Mexico. One call type has been definitively identified to free-ranging Gulf of Mexico DPS Bryde's whales (Širović et al. 2014), four additional call types have been proposed as likely candidates (Rice et al. 2014; Širović et al. 2014), and two call types have been described from a captive juvenile during rehabilitation (Edds et al. 1993). Based on these data, the calls by the Gulf of Mexico DPS Bryde's whales are consistent with, but different from those previously reported for Bryde's whales worldwide (Rice et al. 2014).

Threats to the Gulf of Mexico DPS of Bryde's whales includes energy exploration and development, oil spills and spill response, harmful algal blooms, persistent organic pollutants and heavy metals, historical whaling, scientific research, disease and parasites, predation, the inadequacy of existing regulatory mechanisms, vessel collision, military activities, fishing gear entanglements, trophic impacts due to commercial harvest of prey, climate change, plastics and marine debris, aquaculture, anthropogenic noise, and effects of a small population.

Gulf of Mexico DPS Bryde's whales are generally observed between the 100 to 302 m (328.1 to 990.8 ft) isobaths in the eastern Gulf of Mexico from the head of De Soto Canyon (south of Pensacola, Florida) to northwest of Tampa Bay, Florida, during abundance surveys in all oceanic waters of the U.S. Gulf of Mexico (LaBrecque et al, 2015). The Air Force's EGTTR activities take place in relatively shallow water (i.e., 35 to 50 m [114.8 to 164 ft] depth), and most activities appear to occur outside the Biologically Important Area. No live air-to-surface activities with detonations occurring at or below the water surface will be conducted beyond the 200 m (656 ft) isobath (considered to represent the continental shelf break). Given the low probability of occurrence of Gulf of Mexico DPS Bryde's whales shallower than 100 m depth (328 ft), the potential effects from vessel movement and aircraft or weapons noise are so unlikely as to be discountable. Due to the likelihood that the pieces of debris from munitions and targets will be dispersed over a large enough area and sink to an area shallower than 200 m (656 ft), the potential effects from ingestion of debris from munitions or targets is discountable.

The Air Force made a no effect determination for Bryde's whale, but NMFS concludes that the EGTTR activities proposed to be conducted in the action area for the reasonably foreseeable future may affect, but are not likely to adversely affect the proposed Gulf of Mexico DPS of Bryde's whales. NMFS believes that this is a more appropriate conclusion because some Air Force activities occur within this species' range (e.g., aircraft overflight) and stressors from some activities do have the potential for an adverse effect, even if such an effect is not reasonably certain to occur (e.g., effects are possible, though not likely, from munition debris and target

fragments). In section 6.2 of this opinion and conference report we discuss further the stressors that are not likely to adversely affect ESA-listed marine mammals, including Bryde's whales. In this section, we provide rationale as to why the effects of aircraft noise, vessel noise, weapons launch noise, munition debris and target fragments, secondary stressors, and direct physical strike on ESA-listed marine mammals are insignificant or discountable. Additionally, because this species does not occur in areas where detonations will occur, NMFS does not expect adverse affects from acoustic stressors from explosive detonations to Gulf of Mexico DPS Bryde's whales. We conclude that explosive detonations are so unlikely to adversely affect Gulf of Mexico DPS Bryde's whales as to be discountable. Explosive detonations and other stressors from EGTTR activities are not likely to adversely affect Gulf of Mexico DPS Bryde's whales.

4.1.2 Sperm Whale

In the western North Atlantic, sperm whales range from Greenland south into the Gulf of Mexico and the Caribbean, where they are common, especially in deep basins off of the continental shelf (Romero et al. 2001; Wardle et al. 2001). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Hansen et al. 1996b; Mullin et al. 1994a).

Sperm whales have a strong preference for waters deeper than 1,000 m (3,281 ft) (Reeves and Whitehead 1997; Watkins 1977), although Berzin (1971) reported that they are restricted to waters deeper than 300 m (984.3 ft). They are rarely found in waters less than 300 m in depth (Clarke 1956b; Rice 1989), but have been observed near Long Island, New York in water between 40 and 55 meters (131 and 180 ft) deep (Scott and Sadove 1997). When they are found closer to shore, it is usually associated with sharp increases in topography where upwelling occurs and biological production is high, indicating the presence of a good food supply (Clarke 1956b). Such areas include oceanic islands and along the outer continental shelf.

Cold-core eddy features are also attractive to sperm whales in the Gulf of Mexico, likely because of the large numbers of squid that are drawn to the high concentrations of plankton associated with these features (Biggs et al. 2000; Davis et al. 2000c; Davis et al. 2000d; Davis et al. 2000e; Davis et al. 2002; Wormuth et al. 2000).

Sperm whales are the most common large whale in the northern Gulf of Mexico, found throughout this area year-round in offshore waters (Fulling et al. 2003; Hansen et al. 1996a; Maze-Foley and Mullin 2006; Mullin and Fulling 2004; Mullin and Hoggard 2000b; Mullin et al. 2004; Mullin et al. 1994b), with particularly high concentrations along the continental slope in water depths greater than 1,000 m (3,281 ft) and in or near cyclonic cold-core eddies due to enhanced productivity here (Davis et al. 2007; O'Hern and Biggs. 2009; Palka and Johnson 2007). Southern Gulf of Mexico occurrence, abundance, and habitat use are poorly known, but sperm whales are at least present in continental slope waters of the western Bay of Campeche (Ortega Ortiz 2002).

In order to prevent impacts to sperm whales, no live air-to-surface activities with detonations occurring at or below the water surface will be conducted beyond the 200 m (656 ft) isobath

(considered to represent the continental shelf break). Given the low probability of occurrence of sperm whales shallower than 200 m depth (656.2 ft), the potential effects from explosive detonations, vessel movement, and aircraft or weapons noise are so unlikely as to be discountable. In section 6.2 of this opinion and conference report we discuss further the stressors that are not likely to adversely affect ESA-listed marine mammals, including sperm whales. In this section, we provide rationale as to why the effects of aircraft noise, vessel noise, weapons launch noise, munition debris and target fragments, secondary stressors, and direct physical strike on ESA-listed marine mammals are insignificant or discountable. Therefore, NMFS concurs with the Air Force's conclusion that the testing and training activities proposed to be conducted in action area for the reasonably foreseeable future are not likely to adversely affect sperm whales. As a result, sperm whales are not considered further in this opinion and conference report.

4.1.3 Hawksbill Sea Turtle

Hawksbill sea turtles appear to be rare visitors to the Gulf of Mexico, with Florida and Texas being the only Gulf states with regular sightings (Hildebrand 1983; Keinath et al. 1991; Lee and Palmer 1981; NMFS and USFWS 1993; Parker 1995; Plotkin 1995a; Rabalais and Rabalais 1980; Rester and Condrey 1996; Witzell 1983). There were only five reported hawksbill strandings in the area during the ten-year period from 2003 to 2012 (NMFS 2013b). The greatest hawksbill turtle numbers in the Southeastern U.S. are found in the autumn off Southern Florida and in the Florida Keys where they commonly nest on beaches, but hawksbills can occur year-round (Musick and Limpus 1997a; NMFS and USFWS 2007a). Individuals stranded in Texas are generally young (hatchlings or yearlings) and originate from Mexican nesting beaches (Amos 1989; Collard and Ogren 1990a; Hildebrand 1983; Landry and Costa 1999).

Given that this species is considered an irregular inhabitant in the Northern Gulf of Mexico and the effects of the action are focused in the Northern Gulf of Mexico, effects to hawksbill sea turtles from EGTTR activities are so unlikely as to be discountable. Therefore, NMFS concurs with the Air Force's conclusion that the testing and training activities proposed to be conducted in action area for the reasonably foreseeable future are not likely to adversely affect hawksbill sea turtles. As a result, hawksbill sea turtles are not considered further in this opinion and conference report.

4.1.4 Gulf Sturgeon

The Gulf sturgeon is an anadromous fish found in riverine, estuarine, and nearshore marine environments of coastal states along the Gulf of Mexico. Adult Gulf sturgeon occupy fresh water during the warm months, which is when spawning occurs, and migrate into estuarine and marine waters in the fall to forage and overwinter. The species' present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi east to the Suwannee River in Florida. Sporadic occurrences have been recorded as far west as the Rio Grande River between Texas and Mexico and as far east and south as Florida Bay (Reynolds 1993; Wooley and Croteau 1985). When in open waters of the Gulf of Mexico, sturgeon are generally thought

to remain near the shoreline, although factors such as water depth or prey distribution may be more important factors than distance from land. For example, Gulf sturgeon have been observed off the Suwannee River area as far as 16.7 km (9 nmi) from shore (USFWS and NMFS 2003).

Eglin AFB has studied Gulf sturgeon occurrence and distribution near the northern boundary of the EGTTR for several years. Initial results suggested that sturgeon remain very close to shore off Santa Rosa Island (within 1,000 m [0.6 mile]). However, a more offshore distribution was noted during the last year of the study, when over 80 percent of sturgeon detections were recorded at a receiver 1,250 m (4,101 ft) from shore. Given the commonly cited detection range of 500 m (1,640 ft), some individuals could have been at least 1,750 m (approximately 1 mile) from shore. However, the extent of offshore distribution could not be determined because receivers were not placed farther out in the Gulf of Mexico. The 1,750 m (5,741 ft) distance does not approach the EGTTR boundary 4.8 km (3 miles) offshore from the Florida Gulf coast or the primary air-to-surface test area located 27.4 km (17 miles) offshore.

There is a low probability that Gulf sturgeon will occur in portions of the action area where explosive detonations will occur. For this reason, we conclude that explosive detonations are so unlikely to adversely affect Gulf sturgeon as to be discountable. In section 6.2 of this opinion and conference report we discuss further the stressors that are not likely to adversely affect ESA-listed species, including Gulf sturgeon. The effects of aircraft noise, vessel noise, weapons launch noise, munition debris and target fragments, secondary stressors, and direct physical strike on Gulf sturgeon are insignificant or discountable. Therefore, NMFS concurs with the Air Force's conclusion that the testing and training activities proposed to be conducted in action area for the reasonably foreseeable future are not likely to adversely affect Gulf sturgeon. As a result, the Gulf sturgeon is not considered further in this opinion and conference report.

4.1.5 Loggerhead Critical Habitat

On July 10, 2014, NMFS issued a final rule to designate critical habitat for the Northwest Atlantic DPS of the loggerhead sea turtle (79 FR 39855, effective August 11, 2014). Under the rule, 38 occupied marine areas within the range of the Northwest Atlantic DPS are included in the marine component of designated critical habitat and contain at least one or a combination of the following habitat types: nearshore reproductive habitat, winter area, breeding area, constricted migratory corridor, and *Sargassum* habitat. Of those, only nearshore reproductive habitat and *Sargassum* habitat areas were designated in the northern Gulf of Mexico.

Nearshore reproductive habitat describes nearshore waters adjacent to nesting beaches that are used by hatchlings to move into the open-water environment as well as by nesting females to transit between beach and open water. This includes nearshore waters out to 1.6 km (1 mile) offshore. Thirty-six units of nearshore reproductive critical habitat have been identified. This includes waters off three high density/expansion nesting beaches not designated as terrestrial critical habitat by the USFWS because they occur on military lands with an associated Integrated Natural Resources Management Plan in place. Since Eglin's Integrated Natural Resources Management Plan does not address waters off the nesting beaches on Santa Rosa Island,

nearshore reproductive habitat has been designated from the shoreline of these beaches out to 1.6 km (1 mile) in the Gulf of Mexico.

The *Sargassum* habitat portion of the marine designation consists of the western Gulf of Mexico from the 10 m (32.8 ft) bathymetry line starting at the mouth of the Mississippi River and proceeding west and south to the outer boundary of the U.S. Exclusive Economic Zone. The southern boundary is the U.S. Exclusive Economic Zone from the 10 m (32.8 ft) bathymetry line off of Texas to the Gulf of Mexico-Atlantic Ocean border. The eastern edge follows the 10 m (32.8 ft) bathymetry line from the mouth of the Mississippi River then goes in a straight line to the northernmost boundary of the Loop Current and follows along its eastern edge to the Gulf of Mexico-Atlantic Ocean border.

Neither of these habitat types overlaps with areas used for live air-to-surface test or training missions. For this reason, effects to loggerhead critical habitat from EGTTR activities are so unlikely as to be discountable. Therefore, NMFS concurs with the Air Force's conclusion that the testing and training activities proposed to be conducted in action area for the reasonably foreseeable future are not likely to destroy or adversely modify loggerhead critical habitat. As a result, loggerhead critical habitat is not considered further in this opinion and conference report.

4.2 ESA-listed Species and Critical Habitat Likely to be Adversely Affected

This opinion and conference report examines the status of each species that would be affected by the proposed action. The status is determined by the level of risk that the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 C.F.R. §402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the *Federal Register*, status reviews, recovery plans, scientific literature, and on this NMFS Web site: [<http://www.nmfs.noaa.gov/pr/species/index.htm>].

4.2.1 Green Sea Turtle – North Atlantic Distinct Population Segment

Green sea turtles are distinguished by their smooth carapace with four pairs of costal scutes, a single pair of elongated prefrontal scales between the eyes, and a serrated upper and lower jaw (Carr 1952; Hirth 1971; Pritchard and Trebbau 1984). A green turtle's carapace (top shell) is smooth and can be shades of black, gray, green, brown, and yellow. Their plastron (bottom shell) is yellowish white. Green sea turtles are the largest of all the hard-shelled sea turtles, but have a comparatively small head. While hatchlings are just 50 mm (two inches) long, adults can grow to more than 0.91 m (3 ft) long and weigh 136 to 159 kg (300 to 350 lbs). Adult green turtles are unique among sea turtles in that they are herbivorous, feeding primarily on sea grasses and algae. This diet is thought to give them greenish colored fat from which they take their name.

Scientists estimate green turtles reach sexual maturity anywhere between 20 and 50 years, at which time females begin returning to their natal beaches (i.e., the same beaches where they were born) every two to four years to lay eggs.

4.2.1.1 Populations

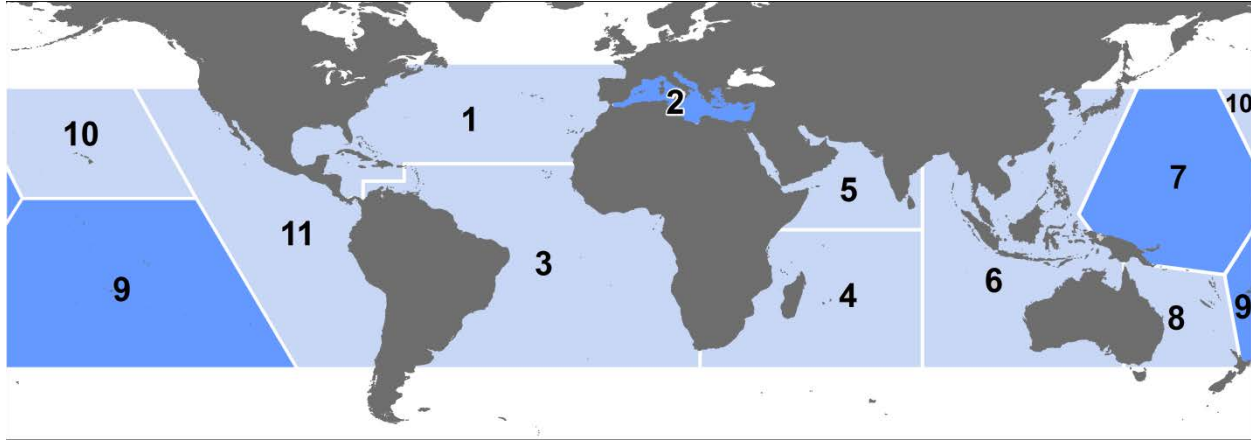


Figure 5. Threatened (light blue) and endangered (dark blue) green sea turtle distinct population segments (DPSs): (1) North Atlantic, (2) Mediterranean, (3) South Atlantic, (4) South Indian, (5) North Indian, (6) East Indian-West Pacific, (7) Central West Pacific, (8) Southwest Pacific, (9) Central South Pacific, (10) Central North Pacific, and (11) East Pacific (map source: 81 FR 20057).

The green sea turtles in the EGTTR action area occur in the threatened North Atlantic DPS. The population dynamics of green turtles and all of the other sea turtles we consider in this opinion and conference report are usually described based on the distribution and habit of nesting females as opposed to their male counterparts. The spatial structure of male sea turtles and their fidelity to specific coastal areas is unknown; however, we describe sea turtle populations based on the nesting beaches that female sea turtles return to when they mature. We make inferences about the growth or decline of sea turtle populations based on the status and trend of their nests.

4.2.1.2 Distribution

Green turtles appear to prefer waters that usually remain around 20° C in the coldest months. During warm spells (e.g., El Niño), green turtles may be found considerably north of their normal distribution (Hirth 1971). Stinson (1984) found green turtles to appear most frequently in U.S. coastal waters with temperatures higher than 18° C.

The range of the North Atlantic DPS extends from the boundary of South and Central America, north along the coast to include Panama, Costa Rica, Nicaragua, Honduras, Belize, Mexico, and the U.S. It extends due east across the Atlantic Ocean at 48° North and follows the coast south to include the northern portion of the Islamic Republic of Mauritania (Mauritania) on the African continent to 19° North. It extends west at 19° North to the Caribbean basin to 65.1° West, then due south to 14° North, 65.1° West, then due west to 14° North, 77° West, and due south to 7.5° North, 77° West, the boundary of South and Central America. It includes Puerto Rico, the

Bahamas, Cuba, Turks and Caicos Islands, Republic of Haiti, Dominican Republic, Cayman Islands, and Jamaica. The North Atlantic DPS includes the Florida breeding population (81 FR 20058).

4.2.1.3 Migration and Movement

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick and Limpus 1997b; Plotkin 2003). They are known to migrate seasonally between northern and southern areas. After departing as hatchlings and residing in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), female green sea turtles make their way back to the same beach from which they hatched (Carr et al. 1978; Meylan et al. 1990). At approximately 20 to 25 cm (7.9 to 9.8 in) carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal 1997). Green sea turtles spend the majority of their lives in coastal foraging grounds (MacDonald et al. 2012). These areas include both open coastline and protected bays and lagoons. While in these areas, green sea turtles rely on marine algae and seagrass as their primary dietary constituents, although some populations also forage heavily on invertebrates. Although green sea turtles in tropical areas seem to undergo a sudden, permanent switch in habitat from oceanic to neritic habitats, individuals in more temperate areas seem to utilize a wider array of habitats dependent upon oceanographic conditions (González Carman et al. 2012). There is some evidence that individuals move from shallow seagrass beds during the day to deeper areas at night (Hazel 2009).

4.2.1.4 Habitat

Green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating *Sargassum* spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000).

4.2.1.5 Growth and Reproduction

Most green sea turtles exhibit particularly slow growth rates, which have been attributed to their largely plant-based diet (Bjorndal 1982). Growth rates of juveniles vary substantially among populations, ranging from less than one cm per year (Green 1993) to greater than five cm per year (McDonald Dutton and Dutton 1998), likely due to differences in diet quality, duration of foraging season (Chaloupka et al. 2004), and density of turtles in foraging areas (Balazs and Chaloupka 2004; Bjorndal et al. 2000a; Seminoff et al. 2002b). Hart et al. (2013a) found growth rates of green sea turtles in the U.S. Virgin Islands to range from zero to 9.5 cm (zero to 3.7 in) annually (mean of 4.1, SD 2.4). The largest growth rates were in the 30 to 39 cm (11.8 to 15.4 in) class. If individuals do not feed sufficiently, growth is stunted and apparently does not

compensate even when greater-than-needed resources are available (Roark et al. 2009). It is estimated that green sea turtles reach a maximum size just under 100 cm (39.3 inches) in carapace length (Tanaka 2009). A female-bias (i.e., more females) has been identified from studies of green sea turtles (Wibbels 2003).

Consistent with slow growth, age-to-maturity for green sea turtles appears to be the longest of any sea turtle species and ranges from approximately 20 to 40 years or more (Balazs 1982; Chaloupka et al. 2004; Chaloupka and Musick 1997; Frazer and Ehrhart 1985a; Hirth 1997; Limpus and Chaloupka 1997; Seminoff et al. 2002b; Zug et al. 2002; Zug and Glor 1998). Estimates of reproductive longevity range from 17 to 23 years (Carr et al. 1978; Chaloupka et al. 2004; Fitzsimmons et al. 1995). Based on reasonable means of three nests per season and 100 eggs per nest (Hirth 1997), a female may deposit nine to 33 clutches, or about 900 to 3,300 eggs, during her lifetime. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

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

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

Green turtle nesting sites in the North Atlantic are some of the most studied in the world, with time series exceeding 35 years in Florida. This DPS seems to prefer nesting on Florida barrier island beaches that receive high wave energy and have coarse sands, steep slopes, and prominent foredunes. Seventy-three nesting sites were identified within the North Atlantic DPS, although some represent numerous individual beaches. There are six nesting sites in Brevard and Palm

Beach counties in Florida that have reported 1,001 to 5,000 nesting females and several other nesting beaches with 50 to 1,000 nesting females. In the Southeastern U.S., nesting occurs between May and September (Witherington et al. 2006a). Eglin AFB property supports the highest number of green sea turtle nests in Northwest Florida.

4.2.1.6 Feeding

Adult green sea turtles are unique among sea turtles in that they are herbivorous, feeding primarily on sea grasses and algae. This diet is thought to give them greenish-colored fat, from which they take their name. While offshore and sometimes in coastal habitats, green sea turtles are not obligate plant-eaters as widely believed, and instead may consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Godley et al. 1998; Hart et al. 2013b; Hatase et al. 2006b; Heithaus et al. 2002; Parker and Balazs in press; Seminoff et al. 2002a). Although populations can consume a variety of prey and be considered generalists as a whole, individuals maintain a highly-selective diet over long time frames (Vander Zanden et al. 2013). Localized movement in foraging areas can be strongly influenced by tidal movement (Berkson 1967). Foraging within seagrass ecosystems by green sea turtles can be significant enough to alter habitat and ecological parameters, such as species composition (Lal et al. 2010).

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, we presume that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (Hazel et al. 2009; NMFS and USFWS 1998). Data from Australia indicate green sea turtles rarely dive deep, staying in upper eight m (26.2 ft) of the water column (Hazel et al. 2009). Daytime dives were shorter and shallower than were nighttime dives (Ballorain et al. 2013; Hazel et al. 2009).

In their coastal habitat, green turtles typically make dives shallower than 30.5 m (100 ft) (Hatase et al. 2006a; Hays et al. 2000; Hochscheid et al. 2005; Houghton et al. 2002) and often do not exceed 16.8 m (55 ft) (Hays et al. 2000; Rice and Balazs 2008), although they are known to feed and rest at depths of 19.8 to 50.3 m (65 to 165 ft) (Balazs 1980; Brill et al. 1995).

4.2.1.7 Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 1994; Lenhardt 2002b; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 to 1,600 Hz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 to 1,600 Hz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999b). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3,000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1,000 Hz and almost no responses beyond 3,000 or 4,000 Hz (Patterson 1966).

4.2.1.8 Status and Trends

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. Green sea turtles from the North Atlantic DPS are listed as threatened under the ESA as of May 6, 2016. The estimated total number of nesting females in the North Atlantic DPS is 167,424 females at 73 sites (81 FR 20058). Nesting data indicate long-term increases at all major nesting sites, with a few stronghold populations. The high nesting abundance, increasing trends, connectivity, and spatial diversity provide the North Atlantic DPS with some resilience against current threats (i.e., the threats have not prevented positive population growth in recent years).

The green sea turtle five-year status review considered primary nesting sites in the Atlantic and Caribbean, and reviewed nest count trends from eight geographic areas (NMFS 2015c). Trend data, where sufficient for analysis, suggests most populations are stable or increasing. Despite the apparent global increase in numbers, the positive overall trend should be viewed cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004).

4.2.1.9 Natural Threats

The North Atlantic DPS is threatened by several natural factors including predation, cold stunning in the panhandle of Florida, natural storms and red tide, and disease. Raccoons, feral hogs, foxes, and coyotes take significant numbers of turtle eggs, despite major nesting beaches in the North Atlantic DPS having nest protection programs. Adults face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo “cold stunning” if water temperatures drop below a threshold level, which can be lethal. Periodic hurricanes and other weather events are generally localized, but with increased storm intensity and frequency as predicted with climate changes, the negative effects of hurricanes on shorelines may last longer and pose a greater threat to the DPS than once thought. Similarly, harmful algal blooms, such as a red tide, also affect green sea turtles in the North Atlantic DPS. In Florida, the species that causes most red tides is *Karenia brevis*, a dinoflagellate that produces a toxin (Redlow et al. 2002). Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle’s body, has been found to infect green turtles, most commonly juveniles (Williams Jr. et al. 1994). For unknown reasons, the frequency of fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing sub-populations, including the North Atlantic DPS along nearshore reefs of Florida.

4.2.1.10 Anthropogenic Threats

The North Atlantic DPS of green sea turtles is also threatened by anthropogenic factors including: current and projected destruction, modification, or curtailment of its habitat or range (i.e., propeller scarring, anchor damage, dredging, sand mining, beachfront lighting, erosion, sea level rise, etc.), legal and illegal harvest of turtles and eggs, pollutants causing degraded foraging habitat and eutrophication, ingestion of contaminants such as tar balls and plastics that aggregate in convergent zones where *Sargassum* aggregates, inadequate regulation mechanisms (deaths via fisheries, entanglement, bycatch, etc.), and other factors (i.e., vessel strikes and boat traffic, climate change) (81 FR 20058).

At nesting beaches, green sea turtles rely on intact dune structures, native vegetation, and normal beach temperatures for nesting (Ackerman 1997). Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). 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 nesting females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). Furthermore, the presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991). In addition to impacting the terrestrial zone, anthropogenic disturbances also threaten coastal marine habitats, particularly areas rich in seagrass and marine algae. These impacts include contamination from herbicides, pesticides, oil spills, and other chemicals, as well as structural degradation from excessive boat anchoring and dredging (Francour et al. 1999; Lee Long et al. 2000; Waycott et al. 2005). Green sea turtles have been found to contain the organochlorines (including dichlorodiphenyltrichloroethane and polychlorinated biphenyl (Gardner et al. 2003; Miao et al. 2001)) and polychlorinated biphenyl levels found in eggs are considered far higher than what is fit for human consumption (Van de Merwe et al. 2009). Heavy metals (Barbieri 2009) and arsenic (Van de Merwe et al. 2009) have also been found in various tissues and life stages also occurs in very high levels in green sea turtles. These contaminants have the potential to cause deficiencies in endocrine, developmental, and reproductive health, and depress immune function in loggerhead sea turtles (Keller et al. 2006a; Storelli et al. 2007c). Ingestion of plastic and other marine debris is another source of morbidity and mortality (Stamper et al. 2009) as well as bycatch in fisheries (Petersen et al. 2009), which is common throughout the Southeastern United States. Lastly, the introduction of alien algae species threatens the stability of some coastal ecosystems and may lead to the elimination of preferred dietary species of green sea turtles (De Weede 1996).

4.2.1.11 Critical Habitat

On September 2, 1998, critical habitat for green sea turtles was designated in coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693). Aspects of these areas that are

important for green sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for green sea turtle prey. No critical habitat is designated within the EGTTR action area for this species.

4.2.2 Loggerhead Sea Turtle – Northwest Atlantic Distinct Population Segment

Loggerhead sea turtles have large heads that support strong jaws and have a slightly heart-shaped carapace that is reddish-brown in adults and subadults and a pale yellow plastron. Hatchlings lack the reddish-brown coloration of adults and juveniles. Adults can weight up to 113 kg (250 lbs) and can grow to more than one meter (three feet) while hatchlings can weight approximately 20 g (0.05 lbs) and can be about four cm (two inches) in length.

4.2.2.1 Populations

Five groupings represent loggerhead sea turtles by major sea or ocean basin: Atlantic, Pacific, and Indian oceans, as well as Caribbean and Mediterranean Seas. As with other sea turtles, populations are frequently divided by nesting aggregation (Hutchinson and Dutton 2007). On September 22, 2011, NMFS designated nine DPSs of loggerhead sea turtles: South Atlantic Ocean, Northwest Atlantic Ocean, Southeast Indo-Pacific Ocean and Southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, and South Pacific Ocean DPSs as endangered (76 FR 58868). The Northwest Atlantic Ocean DPS is the only one that occurs entirely within the action area, with geographic boundaries between 60° North latitude and the equator as the north and south boundaries, respectively, and 40° West longitude as the east boundary. These population boundaries for the Northwest Atlantic DPS is based on based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. Western Atlantic nesting locations include The Bahamas, Brazil, and numerous locations from the Yucatán Peninsula to North Carolina (Addison 1997; Addison and Morford 1996; Marcovaldi and Chaloupka 2007). Five sub-populations (recovery units) have been identified for this group based on genetic differences and a combination of geographic distribution of nesting densities and geographic separation: Northern Gulf of Mexico, Southern, Dry Tortugas, Florida Panhandle, and Yucatán. Each discrete population segment is genetically unique, often identified by unique mitochondrial DNA haplotypes, and these unique haplotypes could represent adaptive differences; the loss of any one discrete population segment would represent a significant loss of genetic diversity. Genetic studies indicate that, although females routinely return to natal beaches and there is a limited exchange of nesting females among these recovery units (Encalada et al. 1998; Foote et al. 2000; Hawkes et al. 2005), males may breed with females from multiple populations and facilitate gene flow (Bowen et al. 2005).

4.2.2.2 Reproduction and Growth

Loggerhead nesting is confined to lower latitudes temperate and subtropic zones but absent from tropical areas (NMFS and USFWS 1991b; NRC 1990a; Witherington et al. 2006b). The life cycle of loggerhead sea turtles can be divided into seven stages: eggs and hatchlings, small

juveniles, large juveniles, subadults, novice breeders, first year emigrants, and mature breeders (Crouse et al. 1987). Hatchling loggerheads migrate to the ocean (to which they are drawn by near ultraviolet light Kawamura et al. 2009), where they are generally believed to lead a pelagic existence for as long as seven to 12 years (NMFS 2005a). Based on growth rate estimates, the duration of the open-ocean juvenile stage for North Atlantic loggerhead sea is roughly 8.2 years (Bjorndal et al. 2000b). As adults, individuals may experience a secondary growth pulse associated with shifting into neritic habitats, although growth is generally monotypic (declines with age Casale et al. 2009a; Casale et al. 2009b). Individually-based variables likely have a high impact on individual-to-individual growth rates (Casale et al. 2009b). At 15 to 38 years, loggerhead sea turtles become sexually mature, although the age at which they reach maturity varies widely among populations (Casale et al. 2009b; Frazer and Ehrhart 1985b; Frazer et al. 1994; NMFS 2001b; Witherington et al. 2006b). However, based on new data from tag returns, strandings, and nesting surveys, NMFS (2001b) estimated ages of maturity ranging from 20 to 38 years and a benthic immature stage lasting from 14 to 32 years.

Loggerhead mating likely occurs along migration routes to nesting beaches, as well as offshore from nesting beaches several weeks prior to the onset of nesting (Dodd 1988a; NMFS and USFWS 1998d). Females usually breed every two to three years, but can vary from one to seven years (Dodd 1988a; Richardson et al. 1978). Females lay an average of 4.1 nests per season (Murphy and Hopkins 1984), although recent satellite telemetry from nesting females along southwest Florida support 5.4 nests per female per season, with increasing numbers of eggs per nest during the course of the season (Tucker 2009). The authors suggest that this finding warrants revision of the number of females nesting in the region. The western Atlantic breeding season is March to August. Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Collectively the Northwest Atlantic Ocean hosts the most significant nesting assemblage of loggerhead sea turtles in the western hemisphere and is one of the two largest loggerhead nesting assemblages in the world (greater than 10,000 females nesting per year). Nesting in the Northern Gulf of Mexico does occur, although primarily in Florida, with rare nesting along North and South Padre Island in Texas from April through September, with a peak in June and July (Dodd 1988b; Dodd Jr. 1988; Hildebrand 1983; Weishampel et al. 2006; Williams-Walls et al. 1983) and in smaller nesting aggregations (100 to 999 nesting females).

4.2.2.3 Migration and Movement

As post-hatchlings, Northwest Atlantic loggerheads use the North Atlantic Gyre and become associated with *Sargassum* spp. habitats, driftlines, and other convergence zones (Carr 1986). Loggerheads may occur in both offshore habitats (particularly around oil platforms and reefs, where prey and shelter are available; (Davis et al. 2000b; Fritts et al. 1983a; Gitschlag and Herczeg 1994; Lohofener et al. 1990; Rosman et al. 1987), as well as shallow bays and sounds (which may be important developmental habitat for late juveniles in the eastern Gulf of Mexico; (Davis et al. 2000b; Lohofener et al. 1990; USAF 1996).

Sighting and stranding records support loggerhead sea turtles to be common, year-round residents of the Gulf of Mexico, although their abundance is much greater in the northeastern region versus the northwestern (Davis et al. 2000b; Fritts et al. 1983a; Landry and Costa 1999). An estimated 12 percent of all Northwestern Atlantic Ocean loggerhead sea turtles reside in the eastern Gulf of Mexico, with the vast majority in western Florida waters (Davis et al. 2000a; TEWG 1998d). Offshore abundance in continental slope waters increases during the winter in the eastern Gulf of Mexico, as cooler inshore waters force individuals into warmer offshore areas (Davis et al. 2000b). Adult loggerheads make lengthy migrations from nesting beaches to foraging grounds (TEWG 1998b), but inhabit shallow water habitats with large expanses of open ocean access, such as Florida Bay, as year-round resident foraging areas. In the Gulf of Mexico, larger females tend to disperse more broadly after nesting than smaller individuals, which tend to stay closer to the nesting location (Girard et al. 2009). Loggerheads from the Northwest Atlantic, Northeast Atlantic, and Mediterranean Sea population segments may comeingle on oceanic foraging grounds as juveniles, although there has been conflicting evidence as to whether these immature loggerheads roam the oceans in currents and eddies and mix from different natal origins or distribute on a latitudinal basis that corresponds with their natal beaches (Monzon-Arguello et al. 2009; Wallace et al. 2009).

Nonetheless, adult females from the Northern Gulf of Mexico Recovery Unit remained in the Gulf of Mexico, including off the Yucatan Peninsula of Mexico (Foley et al. 2008), and satellite telemetry and flipper tag return data revealed that there is no evidence of movement of adults south of the equator or east of 40° West longitude.

4.2.2.4 Gender, Age, and Survivorship

Little is known about sea turtle longevity, although Dodd (1988a) estimated the maximum female life span of loggerheads at 47 to 62 years. Heppell et al. (2003a) estimated annual survivorship to be 0.81 (Southeast U.S. adult females) and 0.68 to 0.89 (Southeast U.S. benthic juveniles). Another recent estimate suggested a survival rate of 0.41 or 0.60 (CIs 0.20 to 0.65 and 0.40 to 0.78, respectively), depending upon assumptions within the study (Sasso et al. 2011). Survival rates for hatchlings during their first year are likely very low (Heppell et al. 2003a; Heppell et al. 2003).

4.2.2.5 Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 2002a; Lenhardt 1994; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Bartol et al. (1999b) reported effective hearing range for juvenile loggerhead turtles is from at least 250 to 750 Hz. Both yearling and two-year old loggerheads had the lowest hearing threshold at 500 Hz (yearling: about 81 dB re: 1 μ Pa and two-year-olds: about 86 dB re: 1 μ Pa), with thresholds increasing rapidly above and below that frequency (Moein Bartol and Ketten 2006).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3,000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1,000 Hz and almost no responses beyond 3,000 or 4,000 Hz (Patterson 1966).

4.2.2.6 Status and Trends

The greatest concentration of loggerheads occurs in the Atlantic Ocean and the adjacent Caribbean Sea, primarily on the Atlantic coast of Florida (EuroTurtle 2006 as cited in LGL Ltd. 2007; Márquez 1990). There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). An important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates well.

Among the five sub-populations, loggerhead females lay 53,000 to 92,000 nests per year in the Southeastern U.S. and the Gulf of Mexico, and the total number of nesting females is 32,000 to 56,000. All of these are currently in decline or data are insufficient to assess trends (NMFS 2001b; TEWG 1998c). Loggerhead sea turtles from the northern nesting aggregation, which represents about nine percent of the loggerhead nests in the Northwestern Atlantic, comprise 25 to 59 percent of individuals foraging from Georgia up to the northeast U.S. (Bass et al. 1998; Norrgard 1995; Rankin-Baransky 1997; Sears 1994; Sears et al. 1995). Loggerheads associated with the South Florida nesting aggregation occur in higher frequencies in the Gulf of Mexico (where they represent about ten percent of the loggerhead captures).

The peninsular Florida recovery unit is the largest loggerhead nesting assemblage in the Northwest Atlantic and represents approximately 87 percent of all nesting effort in the Northwest Atlantic Ocean DPS (Ehrhart et al. 2003). The Northern U.S. Recovery Unit is the second largest recovery unit within the DPS and is declining significantly at 1.3 percent annually since 1983 (NMFS and FWS, 2008). A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females annually (NMFS and USFWS 2008). The statewide estimated total for 2010 was 73,702 (FWRI nesting database). An analysis of index nesting beach data shows a 26 percent nesting decline between 1989 and 2008, and a mean annual rate of decline of 1.6 percent despite a large increase in nesting for 2008, to 38,643 nests (FWRI nesting database) (NMFS and USFWS 2008; Witherington et al. 2009). In 2009, nesting levels, while still higher than the lows of 2004, 2006, and 2007, dropped below 2008 levels to approximately 32,717 nests, but in 2010 a large increase was seen, with 47,880 nests on the index nesting beaches (FWRI nesting database). The 2010 index nesting number is the largest since 2000. With the addition of data through 2010, the nesting trend for the northwestern Atlantic DPS is slightly negative and not statistically different from zero (no trend) (NMFS and

USFWS 2010). Preliminary, unofficial reports indicate that 2011 nesting may be a high nesting year on par with 2010. Nesting for the Florida panhandle in 2012 and 2013 increased to levels comparable to the late 1990's, with a record level in 2012.

Because of its size, the South Florida sub-population of loggerheads may be critical to the survival of the species in the Atlantic (NMFS 2006e; NMFS and USFWS 1991b). The South Florida population increased at approximately 5.3 percent per year from 1978 to 1990, and was initially increasing at 3.9 to 4.2 percent after 1990. An analysis of nesting data from 1989 to 2005, a period of more consistent and accurate surveys than in previous years, showed a detectable trend and more recently (1998 to 2005), has shown evidence of a declining trend of approximately 22.3 percent (FFWCC 2007a; FFWCC 2007b; Witherington et al. 2009). This is likely due to a decline in the number of nesting females within the population (Witherington et al. 2009). Loggerhead nesting is thought to consist of just 60 nesting females in the Caribbean and Gulf of Mexico (NMFS 2006f). Based upon the small sizes of almost all nesting aggregations in the Atlantic, the large numbers of individuals killed in fisheries, and the decline of the only large nesting aggregation, we suspect that the extinction probabilities of loggerhead sea turtle populations in the Atlantic are only slightly lower than those of populations in the Pacific, and therefore suspect that this population is likely to decline in the reasonably foreseeable future, primarily as a result of fishery bycatch (69 FR [128]: 40734 to 40758, July 6, 2004).

4.2.2.7 Natural Threats

Sea turtles face predation primarily by sharks and to a lesser extent by killer whales. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects. In January 2010, an unusually large cold-stunning event occurred throughout the Southeast U.S., with well over 3,000 sea turtles (mostly greens but also hundreds of loggerheads) found cold-stunned. Most survived, but several hundred were found dead or died after being discovered in a cold-stunned state. Predation of eggs and hatchlings on almost all beaches throughout the Northwest Atlantic is occurs often, most commonly eaten by raccoons and ghost crabs (Barton and Roth 2008). In the water, hatchlings are hunted by herons, gulls, dogfish, and sharks. Heavy loads of barnacles are associated with unhealthy or dead stranded loggerheads (Deem et al. 2009). Disease and endoparasites may also impact loggerheads found in the Northwest Atlantic. Heavy infestations of endoparasites may cause or contribute to debilitation or mortality in loggerhead turtles. Although many health problems have been described in wild populations through the necropsy of stranded turtles, the significance of diseases on the ecology of wild loggerhead populations is unknown.

4.2.2.8 Anthropogenic Threats

Anthropogenic threats impacting loggerhead nesting habitat are numerous: coastal development and construction, placement of erosion control structures, placement of nearshore shoreline stabilization structures, beachfront lighting, vehicular and pedestrian traffic, sand extraction,

beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (Baldwin 1992; Margaritoulis et al. 2003; Mazaris et al. 2009b; USFWS 1998). Surprisingly, beach nourishment also hampers nesting success, but only in the first year post-nourishment before hatching success increases (Brock et al. 2009). The construction of armoring structures, groins, jetties, seawalls, rock revetments, etc. erode beaches and create barriers to nesting beaches. The proportion of coastline that is armored is approximately 18 percent (239 km) in Florida (Witherington et al. 2006a), not including several structures that do not fit the definition of armoring (i.e., dune crossovers, cabanas, etc.). On the Atlantic coast of Florida, there was a significant negative relationship between loggerhead nesting density and distance from the nearest of 17 ocean inlets, suggesting that beach instability from both erosion and accretion may discourage loggerhead nesting in these areas (Witherington et al. 2005).

Stormwater and other water source runoff from coastal development is frequently discharged directly onto Northwest Atlantic beaches, creating localized erosion and washing out sea turtle nests. Another threat involves lighted beaches, causing tens of thousands of hatchlings from several hundred nests in Florida disorientation or misorientation, although this number is likely a vast underestimation (Nelson et al. 2002). The introduction of non-native vegetation may form impenetrable root mats that can invade and desiccate eggs, as well as trap hatchlings.

Loggerhead sea turtles face numerous threats in the marine environment as well, including oil and gas exploration, marine pollution, trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries, underwater explosions, dredging, offshore artificial lighting, power plant entrapment, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, harmful algal blooms, and poaching. Bycatch of loggerheads in commercial and recreational fisheries in the Northwest Atlantic is a significant threat facing the species in this region. A variety of fishing gears that incidentally capture loggerhead turtles are employed including gillnets, trawls, hook and line, longlines, seines, dredges, pound nets, and various types of pots/traps. Among these, gillnets, longlines, and trawl gear contribute to the vast majority of bycatch mortality of loggerheads annually throughout their range in the Gulf of Mexico (Richards 2008). Offshore longline tuna and swordfish longline fisheries are also a serious concern for the survival and recovery of loggerhead sea turtles and appear to affect the largest individuals more than younger age classes (Aguilar et al. 1995; Bolten et al. 1994; Carruthers et al. 2009; Howell et al. 2008; Marshall et al. 2009; Petersen et al. 2009; Tomás et al. 2008). A significant number of loggerheads are estimated to still be killed annually in shrimp trawls throughout the Northwest Atlantic despite efforts to reduce mortality via the introduction of turtle excluder devices. In the U.S. Southeast food shrimp trawl fishery, NMFS estimated the annual mortality of loggerheads in the Gulf of Mexico and southeastern U.S. Atlantic Ocean as 3,948 individuals (95 percent confidence intervals, 1,221 to 8,498) (NMFS 2002b). However, shrimping effort in the southeastern United States has reportedly declined; a revised estimate of annual loggerhead mortality for the Gulf of Mexico segment of the Southeast food shrimp trawl fishery is 647 individuals (NMFS 2014b). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in

fisheries worldwide. This estimate is likely at least two orders of magnitude too low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010); many of which are expected to be loggerhead sea turtles.

Climate change may also have significant implications on loggerhead populations. In addition to potential loss of nesting habitat due to sea level rise, loggerhead sea turtles are very sensitive to temperature as a determinant of sex while incubating. Ambient temperature increase by just one to two degrees Celsius can potentially change hatchling sex ratios to all or nearly all female in tropical and subtropical areas (Hawkes et al. 2007a). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds correlate to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009a; Schofield et al. 2009). Increasing ocean temperatures may also lead to reduced primary productivity and eventual food availability. Warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009).

Tissue taken from loggerheads sometimes contain very high levels of organochlorines (Alava et al. 2006; Corsolini et al. 2000a; Gardner et al. 2003; Keller et al. 2005; Keller et al. 2004a; Keller et al. 2004b; McKenzie et al. 1999; Monagas et al. 2008; Oros et al. 2009; Perugini et al. 2006; Rybitski et al. 1995; Storelli et al. 2007a). It appears that levels of organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2004c; Keller et al. 2006b; Oros et al. 2009). These contaminants could cause deficiencies in endocrine, developmental, and reproductive health (Storelli et al. 2007a). It is likely that the omnivorous nature of loggerheads makes them more prone to bioaccumulating toxins than other sea turtle species (Godley et al. 1999; McKenzie et al. 1999). Heavy metals have also been found in a variety of tissues in levels that increase with turtle size (Anan et al. 2001; Fujihara et al. 2003; Garcia-Fernandez et al. 2009; Gardner et al. 2006; Godley et al. 1999; Saeki et al. 2000; Storelli et al. 2008a). Loggerhead sea turtles have higher mercury levels than any other sea turtle studied (Godley et al. 1999; Pugh and Becker 2001a) and arsenic occurs at levels several fold more concentrated in loggerhead sea turtles than marine mammals or seabirds.

4.2.3 Kemp's Ridley Sea Turtle

Adult Kemp's ridleys are the smallest species of sea turtle in the world. The straight carapace length is approximately 65 cm (26 in) and adults weigh less than 45 kg (99 lbs) (USFWS and NMFS 1992a). Their top carapace is often as long as it is wide and it contains five pairs of costal scutes. Dive times range from a few seconds to a maximum of 167 minutes, with routine dives lasting between 16.7 to 33.7 minutes. Kemp's ridley sea turtles spend between 89 to 96 percent of their time submerged.

4.2.3.1 Distribution

Kemp's ridley sea turtle has a restricted distribution (Morreale et al. 2007b), inhabiting the Gulf of Mexico and Northwest Atlantic Ocean, as far north as the Grand Banks (Watson et al. 2004)

and Nova Scotia (Bleakney 1955b). Once thought to only inhabit the Gulf of Mexico and along the Atlantic coast of the United States (TEWG 2000a), recent records support Kemp's ridley sea turtles distribution extending into the Mediterranean Sea on occasion (Tomas and Raga 2008a). Sightings in the Mediterranean Sea have increased, which may be due to misidentified loggerhead sea turtles, increased hatchling production at the nesting beaches, or a migration expansion by the Kemp's ridley to exploit valuable foraging grounds in the region (Tomas and Raga 2008b). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Mexican side of the Gulf of Mexico.

4.2.3.2 Movement and Migration

Hatchling dispersal is not well known, but is likely influenced by the oceanic currents in the western Gulf of Mexico (NMFS et al. 2011; Putman et al. 2013). Kemp's ridley hatchlings enter the Gulf of Mexico from beaches near Rancho Nuevo, Mexico, and are presumably carried by major oceanic currents (e.g., anticyclonic Mexican Current) into various areas of the Gulf of Mexico and North Atlantic. The narrow shelf off Rancho Nuevo may enhance the probability of hatchlings reaching a western boundary current in a short period of time, possibly less than 24 hours (Collard and Ogren 1990b; Witherington et al. 2012). This period is within four days of hatching, which is thought to be the extent of the hatchling's reserve energy stores from the nutrient rich yolk sac (Kraemer and Bennett 1981). Ocean circulation conditions offshore of Tamaulipas and Veracruz nesting beaches may also facilitate hatchling transport to the pelagic environment within four days and subsequent migration to foraging grounds within two years (Putman et al. 2010). Pelagic juveniles spend approximately two years in the ocean prior to recruiting to nearshore waters (Epperly et al. 2013; Ogren 1989a; Snover et al. 2007a; Zug et al. 1997a). During this oceanic stage, juveniles either remain in the current system of the northern and western Gulf of Mexico or are transported to the Gulf Stream of the northwest Atlantic Ocean (Collard and Ogren 1990b; Putman et al. 2013; Putman et al. 2010). Some individuals are transported to the eastern Atlantic Ocean, including the Mediterranean Sea (Brongersma 1982). In the Gulf of Mexico, juveniles make seasonal east, west, and south migrations and move further offshore during the winter as water temperatures drop (Lyn et al. 2012; Renaud and Williams 2005; Schmid and Witzell 2006), whereas neritic juveniles along the Atlantic coast of the United States make seasonal north and south migrations (NMFS et al. 2011).

Tracking of post-nesting females from Rancho Nuevo and Texas beaches indicates that turtles move along coastal migratory corridors either to the north or south from the nesting beach (Byles 1989b; Byles and Plotkin 1994; Renaud 1995b; Renaud et al. 1996; Shaver 1999; Shaver 2002). These migratory corridors appear to extend throughout the coastal areas of the Gulf of Mexico and most turtles appear to travel in waters less than 50 meters (164 feet) depth (Shaver et al. 2005b). Turtles that headed north and east traveled as far as southwest Florida, whereas those that headed south and east traveled as far as the Yucatan Peninsula, Mexico (Morreale et al. 2007a). In general, data suggests that the turtles head north or south from the nesting beach and

then settle into resident feeding areas for several months or more offshore various coastal locations in the Gulf of Mexico (Morreale et al. 2007b; Shaver et al. 2013).

Kemp's ridleys in south Florida begin to migrate northward during spring. With each passing month, the waters to the north become warmer and turtles migrate further to Long Island Sound and even Nova Scotia in late summer (Bleakney 1955a). During winter, individuals return south in response to local water temperatures (Schmid 1998a); the turtles in the northernmost areas begin their southward movement first. By early November, turtles from New York and New Jersey merge with turtles from the Chesapeake Bay (Byles 1988; Keinath 1993; Lutcavage and Musick 1985; Renaud 1995b) and North Carolina inshore waters (Epperly et al. 1995a; Epperly et al. 1995b; Musick et al. 1994).

Following migration, Kemp's ridley sea turtles settle into resident feeding areas for several months (Byles and Plotkin 1994; Morreale et al. 2007a). Females may begin returning along relatively shallow migratory corridors toward the nesting beach in the winter in order to arrive at the nesting beach by early spring. Males and immature turtles had smaller core foraging areas (Shaver et al. 2005b) compared to females (Seney and Landry 2011), which may indicate that females require larger foraging areas to meet their nutritional needs.

4.2.3.3 Reproduction

Approximately 60 percent of Kemp's ridley nesting occurs along an approximate 40.2 km (25 mile) stretch of beach near Rancho Nuevo, Tamaulipas, Mexico from late March to July, with limited nesting to the north (100 nests along Texas in 2006) and south (several hundred nests near Tampico, Mexico in 2006 USFWS 2006) and the heaviest nesting occurring in May. Nesting at this location may be particularly important because hatchlings can more easily migrate to foraging grounds (Putman et al. 2010). Nesting also occurs in Veracruz and a few historical records exist for Campeche, Mexico. In the United States, nesting occurs primarily in Texas (especially Padre Island), and occasionally in Florida, Alabama, Georgia, South Carolina, and North Carolina.

Kemp's ridley sea turtles reach maturity at seven to 15 years of age. It is presumed that most mating takes place near the nesting beach (Morreale et al. 2007b; Rostal 2007a). The female is capable of storing the sperm in the upper oviduct after mating and will then use that sperm to fertilize eggs after each ovulation during the nesting season (Rostal 2007a). The female will initially ovulate within a few days after successful mating and lay her first clutch approximately two to four weeks later; if a turtle nests more than once a season, subsequent ovulations occur within approximately 48 hours after each nesting. The ovary of a reproductively active female will have follicles that begin to enlarge approximately four to six months prior to mating. A variety of steroid hormones and pituitary hormones are believed to coordinate ovulation and egg production (Rostal 2007a).

The Kemp's ridley sea turtle tends to nest in large aggregations or arribadas (Bernardo and Plotkin 2007). The period between Kemp's ridley arribadas averages approximately 25 days, but

the precise timing of the arribadas is unpredictable (Bernardo and Plotkin 2007; Rostal et al. 1997). Like all sea turtles, Kemp's ridley sea turtles nest multiple times in a single nesting season. The most recent analysis suggests approximately 3.075 nests per nesting season per female (Rostal 2007b). The annual average number of eggs per nest (clutch size) is 95 to 112 with 42 to 62 days of incubation prior to hatching (Guzman-Hernandez et al. 2007; Zoo 2010). The period between nesting seasons for each female is approximately 1.8 to two years (Marquez et al. 1989; Rostal 2007b; TEWG 2000a). The nesting beach at Rancho Nuevo may produce a "natural" hatchling sex ratio that is female-biased, which can potentially increase egg production as those turtles reach sexual maturity (Coyne and Landry Jr. 2007; Wibbels 2007). If males become a limiting factor in the reproductive ecology of the Kemp's ridley, then reproductive output in the population could decrease (Coyne 2000). Low fertility, however, has not been reported in the population.

Kemp's ridley sea turtles are rare nesters on Eglin AFB beaches and were documented for the first time in 2008 when three nests were deposited on Santa Rosa Island. Nesting has continued since that time.

4.2.3.4 Growth

Growth rates vary by geography and ontogeny (Marquez M. 2001). Generally, growth rates in the Gulf of Mexico are greater (approximately seven cm per year (Fontaine et al. 1989; Landry et al. 2005; Schmid and Woodhead 2000) than in the Atlantic Ocean (less than approximately six cm [2.4 in] per year; (Morreale and Standora 1998; Schmid and Woodhead 2000)). Growth rates change over life stages (Chaloupka and Zug 1997). Post-hatchlings undergo rapid growth for the first year, but most experience a decline in growth around ages two to three (Snover et al. 2007a). Growth rates seem to be stable and somewhat linear by ages three to five. Growth was 16.9 cm (6.7 in) in the first year, reaching an average carapace size of 21 cm (8.3 in) per year by age one (Snover et al. 2007a). Kemp's ridleys require approximately 1.5 to two years to grow from a hatchling to a size of approximately 20.1 cm (7.9 in) long, at which size they are capable of making a transition to a benthic coastal immature stage, but can range from one to four years or more (Caillouet et al. 1995; Ogren 1989b; Schmid 1998b; Schmid and Witzell 1997b; Snover et al. 2007b; TEWG 2000a; Zug et al. 1997b). Based on the size of nesting females, it is assumed that turtles must attain a size of approximately 60 cm (23.6 in) long prior to maturing (Marquez-M. 1994). Growth models based on mark-recapture data suggest that a time period of seven to nine years would be required for this growth from benthic immature to mature size (Schmid and Witzell 1997b; Snover et al. 2007b). Currently, age to sexual maturity is believed to range from approximately ten to 17 years for Kemp's ridleys (Caillouet Jr. et al. 1995; Schmid and Witzell 1997a; Snover et al. 2007a; Snover et al. 2007b). However, estimates of ten to 13 years was common in previous studies (Caillouet et al. 1995; Schmid and Witzell 1997b; TEWG 2000a).

4.2.3.5 Habitat

Stranding data indicate that immature turtles in this benthic stage are found in coastal habitats of the entire Gulf of Mexico and U.S. Atlantic coast (Morreale et al. 2007a; TEWG 2000a).

Developmental habitats for juveniles occur throughout the entire coastal Gulf of Mexico and U.S. Atlantic coast northward to New England (Morreale et al. 2007a; Schmid 1998b; Wibbels et al. 2005). Key foraging areas in the Gulf of Mexico include Sabine Pass, Texas; Caillou Bay and Calcasieu Pass, Louisiana; Big Gulley, Alabama; Cedar Keys, Florida; and Ten Thousand Islands, Florida (Carr and Caldwell 1956; Coyne et al. 1995; Ogren 1989b; Schmid 1998b; Schmid et al. 2002; Witzell et al. 2005a). Foraging areas studied along the Atlantic coast include Pamlico Sound, Chesapeake Bay, Long Island Sound, Charleston Harbor, and Delaware Bay. Near-shore waters of 36.6 m (120 ft) or less provide the primary marine habitat for adults, although it is not uncommon for adults to venture into deeper waters (Byles 1989a; Mysing and Vanselous 1989; Renaud et al. 1996; Shaver et al. 2005a; Shaver and Wibbels 2007a). Other suitable habitats identified in the Gulf of Mexico include the west coast of Florida (particularly the Cedar Keys area), the eastern coast of Alabama (including Mobile Bay), the mouth of the Mississippi River, and coastal waters off western Louisiana and eastern Texas.

Benthic coastal waters of Louisiana and Texas seem to be preferred foraging areas for Kemp's ridley sea turtles (particularly passes and beachfronts), although individuals may travel along the entire coastal margin of the Gulf of Mexico (Landry and Costa 1999; Landry et al. 1996; Renaud 1995a). They are often found over sandy or muddy bottoms where they can forage for crabs, mollusks, fish, and shrimp. Sightings are less frequent during winter and spring, but this is likely due to lesser sighting effort during these times (Keinath et al. 1996; Shoop and Kenney 1992b).

4.2.3.6 Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 2002a; Lenhardt 1994; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Juvenile Kemp's ridleys can hear from 100 to 500 Hz, with a maximum sensitivity between 100 and 200 Hz at thresholds of 110 dB re: 1 μ Pa (Moein Bartol and Ketten 2006).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3,000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1,000 Hz and almost no responses beyond 3,000 or 4,000 Hz (Patterson 1966).

4.2.3.7 Status and Trends

The Kemp's ridley is considered the most endangered sea turtle in the world and has the lowest population level (NRC 1990b; USFWS 1999). During the mid-20th century, the Kemp's ridley was abundant in the Gulf of Mexico. Historic information indicates that tens of thousands of Kemp's ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). From 1978 through the 1980s, arribadas were 200 turtles or less, and by 1985, the total number of nests at Rancho Nuevo had dropped to approximately 702 for the entire nesting season, or a

projection of roughly 250 turtles (TEWG 2000a; USFWS and NMFS 1992b). Beginning in the 1990s, an increasing number of beaches in Mexico were being monitored for nesting, and the number of nests at Rancho Nuevo increased to 1,430 in 1995 (CONANP 2009a; CONANP 2009b). In 2006, approximately 7,866 nests were laid at Rancho Nuevo with the total number of nests for all the beaches in Mexico estimated at about 12,000 nests, which amounted to about 4,000 nesting females based upon three nests per female per season (Rostal 2007b; Rostal et al. 1997; USFWS 2006). Considering remigration rates, the population included approximately 7,000 to 8,000 adult female turtles at that time (Marquez et al. 1989; Rostal 2007b; TEWG 2000a). The 2007 nesting season included an arribada of over 4,000 turtles over a three-day period at Rancho Nuevo (P. Burchfield, pers. comm. in NMFS and USFWS 2007c). The increased recruitment of new adults is illustrated in the proportion of first time nesters, which increased from six percent in 1981 to 41 percent in 1994. Average population growth was estimated at 13 percent per year between 1991 and 1995 (TEWG 1998c). Nesting in Mexico was 20,913 in 2009, 13,832 in 2010, 21,126 in 2011, 22,458 in 2012, 16,944 in 2013, and 12,060 in 2014 (NMFS and USWFS 2015).

Nesting has also expanded geographically, with a headstart program reestablishing nesting on South Padre Island starting in 1978. Growth remained slow until 1988, when rates of return started to grow slowly (Shaver and Wibbels 2007b). Nesting rose from six in 1996 to 128 in 2007, 195 in 2008, and 197 in 2009. Texas nesting then experienced a decline similar to that seen in Mexico for 2010, with 141 nests (National Park Service data, <http://www.nps.gov/pais/naturescience/strp.htm>), but nesting rebounded in 2011 with a record 199 nests, 209 in 2012, 153 in 2013, and 119 in 2014 (National Park Service data, <http://www.nps.gov/pais/naturescience/current-season.htm>; (NMFS and USWFS 2015).

Gallaway et al. (2013) estimated the female population size for age two and older in 2012 to be 188,713. Assuming females comprise 76 percent (sex ratio = 0.76; TEWG 1998, 2000) of the population, they estimated the total population of age two years and over at 248,307. Based on the number of hatchlings released in 2011 and 2012 (over one million) and recognizing mortality over the first two years is high, Gallaway et al. (2013) thought the total population, including hatchlings younger than two years, may exceed one million turtles. It is important to note that 2012 was the highest year for recorded nests since monitoring began, and in 2014, the number of nests (all beaches) was almost half of the 2012 number; thus, the population estimate would be much lower.

Recent modeling suggests that Kemp's ridley populations may increase substantially in the future. Heppell et al. (2005) suggest that the population is expected to increase at least 12 to 16 percent per year, and that the population could reach at least 10,000 females nesting on Mexico beaches by 2015. Modeling reported by NMFS et al. (2011) predicts that the population is expected to increase 19 percent per year from 2010 to 2020. Approximately 25,000 nests would be needed to reach an estimated 10,000 nesting females (based on an average 2.5 nests per nesting female) and 40,000 nesting females per season over a six year period (one criterion for

delisting) was predicted to occur by 2024. Given the recent decline in nest numbers, the population is not projected to grow at former rates (e.g., 15 percent per year from 1988 to 2003; (Heppell et al. 2005)).

4.2.3.8 Natural Threats

Kemp's ridley sea turtles face threats by several natural sources. Predation of eggs and hatchlings on the beach is limited because the majority of nests are transferred to protected hatcheries. Predation in the water by sharks and to a lesser extent by killer whales may affect adult Kemp's ridley populations and predatory fish likely prey on hatchlings. While the disease fibropapillomatosis has been reported in a few Kemp's ridleys (Guillen and Villalobos 2000), the frequency of this disease in this species is low and is not a major source of concern. Similarly, blooms of the harmful algae *Karenia brevis* has been found in immature Kemp's ridleys in western Florida (Fauquier et al. 2013), although the instances of harm to this species from harmful algal blooms seems low relative to other species of sea turtles. All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can pose lethal effects. Kemp's ridley sea turtles are particularly prone to "cold stunning" if water temperatures drop below a certain threshold. This can pose lethal effects to Kemp's ridley turtles and is more common along Cape Cod (Innis et al. 2009). From 2006 to 2010, the number of cold-stunned turtles on Cape Cod beaches averaged 115 Kemp's ridleys. Damage from hurricanes and other natural weather forces may harm beaches where nesting of Kemp's ridley turtles occurs.

4.2.3.9 Anthropogenic Threats

Population decline has been reduced due to the virtual elimination of sea turtle and egg harvesting, as well as assistance in hatching and raising hatchlings (head-start). However, habitat destruction, fisheries impacts, toxins, and climate change have the potential to affect the Kemp's ridley populations.

Habitat destruction remains a concern in the form of shoreline development, especially in more commercialized areas that contain nesting sites. Because Kemp's ridley sea turtles have one primary nesting beach, this species is particularly susceptible to habitat destruction by human-caused events, including the potential for oil spills, especially in the Gulf of Mexico since it is an area of high-density offshore oil exploration and extraction.

Habitat destruction is also occurring as a result of activities that directly impact bottom habitats; primarily bottom trawling, dredge fishing, dredging of channels, and dredging associated with beach nourishment activities. Trawling destroys habitat utilized by Kemp's ridley sea turtles for feeding and construction activities can produce hazardous runoff. Bycatch is also a source of mortality for Kemp's ridley sea turtles (McClellan et al. 2009), and the vast majority of fisheries interactions with sea turtles in the U.S. are either Kemp's ridley's or loggerhead sea turtles (Finkbeiner et al. 2011). Finkbeiner et al. (2011) estimated that annual bycatch interactions total at least 98,300 individuals annually for U.S. Atlantic fisheries (resulting in 2,700 mortalities or

more). NMFS (2014b) estimated that the shrimp fishery interact with 430,787 Kemp's ridleys of which 76,954 are captured and almost 60 percent (44,247) of these are killed each year.

Toxin burdens in Kemp's ridley sea turtles include dichlorodiphenyltrichloroethane, dichlorodiphenyldichloroethylene, polychlorinated biphenyls, perfluorooctanoic acid, perfluorooctanesulfonic acid, chlordane, and other organochlorines (Keller et al. 2005; Keller et al. 2004a; Lake et al. 1994; Rybitski et al. 1995). These contaminants have the potential to cause deficiencies in endocrine, developmental and reproductive health, and are known to depress immune function in loggerhead sea turtles (Keller et al. 2006b; Storelli et al. 2007b). Along with loggerheads, Kemp's ridley sea turtles have higher levels of polychlorinated biphenyl and dichlorodiphenyltrichloroethane than leatherback and green sea turtles (Pugh and Becker 2001b). Perfluorinated compounds in the forms of perfluorooctanoic acid and perfluorooctanesulfonic acid have been identified in the blood of Kemp's ridley turtles (Keller et al. 2005) and perfluorinated carboxylic acids have also been detected. It is likely that age and habitat are linked to perfluorinated chemical bioaccumulation. Blood levels of metals are lower in Kemp's ridley sea turtles than in other sea turtles species or similar to them (Innis et al. 2008; Orvik 1997). The higher level of contaminants found in Kemp's ridley sea turtles are likely due to this species tendency to feed higher on the food chain than other sea turtles.

4.2.4 Leatherback Sea Turtle

The leatherback sea turtle is the largest and deepest diving sea turtle in the world. The average dive depths range from 35 to 122 m (155 to 400 ft) with maximum depths of over 1,000 m (3,281 ft). The average dive durations range from 6.9 to 14.5 minutes with maximum times of 42 minutes. Mature adults can reach lengths of over 2 m (6.6 ft) and weigh close to 900 kg (2,000 lbs), although adults typically weigh between 200 to 700 kg (441 to 1,543 lbs). The leatherback sea turtle is the only sea turtle that lacks a hard, bony shell. The carapace is approximately 4 cm (1.6 in) thick and consists of a leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones.

4.2.4.1 Population Designations

Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Detailed population structure is unknown, but is likely dependent upon nesting beach location.

Previous genetic analyses of leatherbacks using only mitochondrial DNA resulted in an earlier determination that within the Atlantic basin there are at least three genetically different nesting populations: the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1999). Further genetic analyses using microsatellite markers in nuclear DNA along with the mitochondrial DNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007a). Leatherbacks nest along the east coast of Florida from March through

June, from Brevard County south to Palm Beach County (NMFS and USFWS 2007d). Nesting in Puerto Rico begins around March and continues through August. Females remain in the general vicinity of the nesting habitat between nestings, with total residence in the nesting and inter-nesting habitat lasting up to four months (Eckert et al. 1989; Keinath and Musick 1993).

Nesting occurs in Puerto Rico, St. Croix, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Suriname, and French Guiana (Bräutigam and Eckert 2006; Márquez 1990; Spotila et al. 1996).

4.2.4.2 Distribution

Leatherbacks are globally distributed, ranging farther than any other sea turtle species, having evolved physiological and anatomical adaptations that allow them to exploit cold waters (Frair et al. 1972; Greer et al. 1973; USFWS 1995). High-latitude leatherback range in the Atlantic includes the North and Barents Seas, Newfoundland and Labrador, Uruguay, Argentina, and South Africa (Goff and Lien 1988; Hughes et al. 1998; Luschi et al. 2003; Luschi et al. 2006; Márquez 1990; Threlfall 1978). Pacific ranges extend to Alaska, Chile, and New Zealand (Brito 1998; Gill 1997; Hodge and Wing 2000). Leatherbacks also occur in Mediterranean Sea and Indian Ocean waters (Casale et al. 2003; Hamann et al. 2006).

Associations exist with continental shelf and pelagic environments and sightings occur in offshore waters of 7 to 27° C (CETAP 1982). Juvenile leatherbacks usually stay in warmer, tropical waters greater than 21° C (Eckert 2002). Males and females show some degree of natal homing to annual breeding sites (James et al. 2005).

4.2.4.3 Growth and Reproduction

Leatherback sea turtles nest on beaches in the tropics and sub-tropics in the western Atlantic Ocean from the Southeastern U.S. to southern Brazil, and in the eastern Atlantic from Mauritania to Angola. The most significant nesting beaches in the Atlantic Ocean are located in Florida, United States Virgin Islands, Puerto Rico, Costa Rica, Panama, Colombia, Trinidad and Tobago, Guyana, Suriname, French Guiana, and southern Brazil (Bräutigam and Eckert 2006; Márquez 1990; Spotila et al. 1996). The nesting season in United States waters is from March through July.

Clutch frequency per year ranges between five and seven with a maximum observed frequency of 13 (reviewed by (Eckert et al. 2012)). The average number of eggs per clutch varies by region: Atlantic Ocean (85 eggs), western Pacific Ocean (85 eggs), eastern Pacific Ocean (65 eggs) and Indian Ocean (greater than 100 eggs) (reviewed by (Eckert et al. 2012)). The eggs incubate for 55 to 75 days before hatching. The remigration interval averages between two and three years, but can be longer likely due to environmental conditions (reviewed by (Eckert et al. 2012)).

Breeding has been documented to span an average 16 (up to 19) years in South Africa (Nel et al. 2013) and 19 years in the U.S. Virgin Islands (reviewed by (Eckert et al. 2012)).

Leatherbacks grow rapidly (approximately 32 cm in carapace length each year) from hatchling to juvenile size, which is relatively faster than other sea turtle species and surprising given

leatherbacks subsist on low caloric prey (Jones et al. 2011). Extremely rapid growth may be possible because leatherbacks have evolved a mechanism that allows fast penetration of vascular canals into the fast growing cartilaginous matrix of their bones (Rhodin et al. 1996). Similarly, it has been thought that leatherbacks reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range of three to six years (Rhodin 1985) to 13 to 14 years (Zug and Parham 1996). However, recent research suggests otherwise, with western North Atlantic leatherbacks possibly not maturing until as late as 29 years of age (Avens and Goshe 2007).

4.2.4.4 Habitat

Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Grant and Ferrell 1993; Schroeder and Thompson 1987; Shoop and Kenney 1992a; Starbird et al. 1993). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011; Collard 1990; Davenport and Balazs 1991; Frazier 2001; HDLNR 2002). Aerial surveys off the western U.S. support continental slope waters as having greater leatherback occurrence than shelf waters (Bowlby et al. 1994; Carretta and Forney 1993; Green et al. 1992b; Green et al. 1993). Nesting sites appear to be related to beaches with relatively high exposure to wind or wind-generated waves (Santana Garcon et al. 2010).

Areas above 30° North in the Atlantic appear to be popular foraging locations (Fossette et al. 2009b). Northern foraging areas were proposed for waters between 35° and 50° North along North American, Nova Scotia, the Gulf of Saint-Laurent, in the western and northern Gulf Stream, the Northeast Atlantic, the Azores front and northeast of the Azores Islands, north of the Canary Islands. Southern foraging was proposed to occur between 5 and 15° North in the Mauritania upwelling, south of the Cape Verde islands, over the Guinea Dome area, and off Venezuela, Guyana and Suriname.

4.2.4.5 Migration and Movement

Leatherback sea turtles migrate throughout open ocean convergence zones and upwelling areas, along continental margins, and in archipelagic waters (Eckert 1998; Eckert 1999; Morreale et al. 1994). In a single year, a leatherback may swim more than 9,600 km (5,184 nautical miles) to nesting and foraging areas throughout ocean basins (Benson et al. 2007a; Benson et al. 2007b; Eckert 1998; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; Sale et al. 2006). Much of this travel may be due to movements within current and eddy features, moving individuals along (Sale and Luschi 2009). Return to nesting beaches may be accomplished by a form of geomagnetic navigation and use of local cues (Sale and Luschi 2009). Leatherback females will either remain in nearshore waters between nesting events, or range widely, presumably to feed on available prey (Byrne et al. 2009; Fossette et al. 2009a).

Fossette et al. (2009b) identified three main migratory strategies in leatherbacks in the North Atlantic (almost all of studied individuals were female). One involved 12 individuals traveling to northern latitudes during summer/fall and returning to waters during winter and spring. Another strategy used by six individuals was similar to this, but instead of a southward movement in fall, individuals overwintered in northern latitudes (30 to 40° North, 25 to 30° West) and moved into the Irish Sea or Bay of Biscay during spring before moving south to between 5 and 10° in winter, where they remained or returned to the northwest Atlantic. A third strategy, which was followed by three females remaining in tropical waters for the first year subsequent to nesting and moving to northern latitudes during summer/fall and spending winter and spring in latitudes of 40 to 50° North.

Leatherbacks occur along the Southeastern U.S. year-round, with peak abundance in summer (TEWG 2007c). In spring, leatherback sea turtles appear to be concentrated near the coast, while other times of the year they are spread out at least to the Gulf Stream. From August 2009 through August 2010 off Jacksonville, Florida, surveys sighted 48 leatherback sea turtles, while simultaneous vessel surveys sighted four leatherback sea turtles (Ramsey 2013).

Leatherback sea turtles feed, rest, and migrate regularly in the northern Gulf of Mexico, inhabiting deep offshore waters in the vicinity of De Soto Canyon (Davis et al. 2000a; Landry and Costa 1999). Leatherback sea turtles feed in shallow waters on the continental shelf waters along the Florida Panhandle, the Mississippi River Delta, and the Texas coast on dense aggregations of jellyfish and salps (Collard 1990).

Satellite tracking data reveal that leatherback females leaving Mexican and Central American nesting beaches migrate towards the equator and into Southern Hemisphere waters, some passing the Galápagos Islands, and disperse south of 10° South (Dutton et al. 2006; Shillinger et al. 2010). However, observations of leatherbacks in the Galápagos Islands are rare (Zárate et al. 2010).

Nesting site selection in the southwest Pacific appears to favor sites with higher wind and wave exposure, possibly as a means to aid hatchling dispersal (Garcon et al. 2010). Individuals nesting in Malaysia undergo migrations to tropical feeding areas, taking five to seven months to arrive there from nesting locations (Benson et al. 2011). Additional foraging occurs in temperate locations, including across the Pacific basin along the U.S. west coast; individuals take ten to 12 months to migrate here (Benson et al. 2011). Individuals nesting during the boreal summer move to feeding areas in the North China Sea, while boreal winter nesters moved across the Equator to forage in the Southern Hemisphere (Benson et al. 2011).

4.2.4.6 Sex Ratio

A significant female bias exists in all leatherback populations thus far studied. An examination of strandings and in-water sighting data from the U.S. Atlantic and Gulf of Mexico coasts indicates that 60 percent of individuals were female. Studies of Suriname nesting beach temperatures suggest a female bias in hatchlings, with estimated percentages of females hatched

over the course of each season at 75.4, 65.8, and 92.2 percent in 1985, 1986, and 1987, respectively (Plotkin 1995b). Binckley et al. (1998) found a heavy female bias upon examining hatchling gonad histology on the Pacific coast of Costa Rica, and estimated male to female ratios over three seasons of 0:100, 6.5:93.5, and 25.7:74.3. James et al. (2007) also found a heavy female bias (1.86:1) as well as a primarily large sub-adult and adult size distribution. Leatherback sex determination is affected by nest temperature, with higher temperatures producing a greater proportion of females (Mrosovsky 1994; Witzell et al. 2005b).

4.2.4.7 Hearing

Sea turtles are low-frequency hearing specialists, typically hearing frequencies from 30 to 2,000 Hz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol et al. 1999b; Lenhardt 2002a; Lenhardt 1994; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3,000 Hz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1,000 Hz and almost no responses beyond 3,000 or 4,000 Hz (Patterson 1966).

4.2.4.8 Status and Trends

Leatherback sea turtles received protection on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act and, since 1973, have been listed as endangered under the ESA, but declines in nesting have continued worldwide. Breeding females were initially estimated at 29,000 to 40,000, but were later refined to approximately 115,000 (Pritchard 1971; Pritchard 1982). Spotila et al. (1996) estimated 34,500 females, but later issued an update of 35,860 (Spotila 2004b).

Overall, an increasing or stable population trend is seen in most areas of the Atlantic Ocean (TEWG 2007a). The population of leatherbacks nesting on Gabon beaches has been suggested as being the world's largest, with 36,185 to 126,480 clutches being laid by 5,865 to 20,499 females annually from 2002 to 2007 (Witt et al. 2009). The total number of females utilizing Gabon nesting beaches is estimated to be 15,730 to 41,373 (Witt et al. 2009). North Atlantic leatherbacks likely number 34,000 to 94,000 individuals, with females numbering 18,800 and the eastern Atlantic segment numbering 4,700 (TEWG 2007a). Trends and numbers include only nesting females and are not a complete demographic or geographic cross-section. In 1996, the entire Western Atlantic population was characterized as stable at best (Spotila et al. 1996), with roughly 18,800 nesting females. A subsequent analysis indicated that by 2000, the western Atlantic nesting population had decreased to about 15,000 nesting females (NMFS 2011a). Spotila et al. (1996) estimated that the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, totaled approximately 27,600 nesting females, with an estimated range of 20,082 to 35,133. This is consistent with other estimates of 34,000 to

95,000 total adults (20,000 to 56,000 adult females; 10,000 to 21,000 nesting females) (TEWG 2007c).

The largest nesting aggregation in the western North Atlantic occurs in French Guiana and Suriname, likely belongs to a metapopulation whose limits remain unknown (Rivalan et al. 2006). The French Guiana nesting aggregation has declined approximately 15 percent annually since 1987 (NMFS 2001c). However, from 1979 to 1986, the number of nests increased approximately 15 percent annually, possibly indicating the decline may be linked with the erosion cycle of Guiana beaches (NMFS 2006e). Suriname nesting numbers have recently increased from more than 10,000 nests annually since 1999 and a peak of 30,000 nests in 2001. Overall, Suriname and French Guiana nesting trends towards an increase (Girondot et al. 2007; Hilterman and Goverse 2003). Florida and U.S. Caribbean nesting since the early 1980s has increased approximately 0.3 percent and 7.5 percent per year, respectively, but lags behind the French Guiana coast and elsewhere in magnitude (NMFS/SEFSC 2001). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007c).

The Caribbean coast of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troeng et al. 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population likely was not growing between 1995 and 2005 (TEWG 2007c). Other modeling of the nesting data for Tortuguero indicates a 67.8 percent decline between 1995 and 2006 (Troeng et al. 2007).

In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 ranged from 469 to 882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 percent (TEWG 2007c).

At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1 percent from 1986 to 2004 (TEWG 2007c).

The Florida nesting stock is of growing importance, with total nests between 800 to 900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (NMFS 2011a). Using data from the index nesting beach surveys, the TEWG (2007c) estimated a significant annual nesting growth rate of one percent between 1989 and 2005. Stewart et al. (2011) evaluated nest counts from 68 Florida beaches over 30 years (1979 to 2008) and found that nesting increased at all beaches with trends ranging from 3.1 to 16.3 percent per year, with an overall increase of 10.2 percent per year. In 2007, a record 517 leatherback nests were observed on the index beaches in Florida, with 265 in 2008, and then an increase to a new record of 615 nests in 2009, and a slight decline in 2010 back to 552 nests (FWC Index Nesting Beach database). In May and June 2000, nesting was documented for the first time in Okaloosa County on Eglin AFB's Santa Rosa Island property. Since then, one leatherback sea turtle nest was found on Eglin AFB's property in 2012. The most recent population estimate for leatherback sea

turtles from the North Atlantic as a whole is between 34,000 to 90,000 adult individuals (20,000 to 56,000 adult females) (TEWG 2007c).

Heavy declines have occurred at all major Pacific basin rookeries, as well as Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. This includes a nesting decline of 23 percent between 1984 to 1996 at Mexiquillo, Michoacán, Mexico (Sarti et al. 1996). According to reports from the late 1970s and early 1980s, three beaches on the Pacific coast of Mexico supported as many as half of all leatherback turtle nests for the eastern Pacific. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 individuals during 1998 to 1999 and 1999 to 2000 (Sarti et al. 2000). Spotila et al. (2000) reported the decline of the leatherback turtle population at Playa Grande, Costa Rica, which had been the fourth largest nesting colony in the world. Between 1988 and 1999, the nesting colony declined from 1,367 to 117 female leatherback turtles. Based on their models, Spotila et al. (2000) estimated that the colony could fall to less than 50 females by 2003 to 2004. Fewer than 1,000 females nested on the Pacific coast of Mexico from 1995 to 1996 and fewer than 700 females are estimated for Central America (Spotila et al. 2000). The number of leatherback turtles nesting in Las Baulas National Park declined rapidly during the 1990s, from about 1,500 females during the 1988 to 1989 nesting season, to about 800 in 1990 to 1991 and 1991 to 1992 to 193 in 1993 to 1994 (Williams et al. 1996) and 117 in 1998 to 1999 (Spotila et al. 2000). Spotila (2004a) reported that between 59 and 435 leatherbacks nest at Las Baulas each year depending on the El Niño–La Niña cycle. Only an Indonesian nesting assemblage has remained relatively abundant in the Pacific basin. The largest extant leatherback nesting assemblage in the Indo-Pacific lies on the northern Vogelkop coast of Irian Jaya (West Papua), Indonesia, with roughly 3,000 nests recorded annually (Putrawidjaja 2000; Suárez et al. 2000) (Dutton et al. 2007). The Western Pacific leatherback metapopulation harbors the last remaining nesting aggregation of significant size in the Pacific with approximately 2,700 to 4,500 breeding females (Dutton et al. 2007; Hitipeuw et al. 2007). The total number of nests per year for the Jamursba-Medi leatherback nesting population ranged between a high of 6,373 nests in 1996 and a low of 1,537 nests in 2010 (Hitipeuw et al. 2007).

Declines in the western Pacific are equally severe. Nesting at Terengganu, Malaysia is one percent of that in 1950s (Chan and Liew 1996). The South China Sea and East Pacific nesting colonies have undergone catastrophic collapse. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). The number of nesting leatherbacks has declined by an estimated 95 percent over the past 20 years in the Pacific (Gilman 2009). Drastic overharvesting of eggs and mortality from fishing activities is likely responsible for this tremendous decline (Eckert 1997; Sarti et al. 1996).

Overall, leatherback nesting populations are declining dramatically in the Pacific Ocean, yet appear stable in many nesting areas of the Atlantic Ocean and South Africa in the Indian Ocean. Leatherback females in the Pacific Ocean, particularly those originating from the eastern Pacific, are smaller and less productive than females in the Atlantic Ocean and Indian Ocean (i.e., South

Africa). Adult size and fecundity may affect population trends, and studies largely attribute greater variability in resource abundance and distribution in the eastern Pacific Ocean compared to the Atlantic Ocean and southeastern Indian Ocean to the differences in ocean basin population trends (reviewed by (Saba 2013; Wallace and Saba 2009)).

4.2.4.9 Natural Threats

Leatherback sea turtles are threatened by impacts to their beaches and coastal and pelagic marine habitat, including tsunamis, shifting mudflats, and hurricanes. Predation primarily by sharks and to a lesser extent by killer whales (Pitman and Dutton 2004) occurs in marine environments and hatchlings are often preyed upon by dogs and pigs. Leatherback hatching success is particularly sensitive to nesting site selection, as nests that are overwashed have significantly lower hatching success and leatherbacks nest closer to the high-tide line than other sea turtle species (Caut et al. 2009b).

4.2.4.10 Anthropogenic Threats

Leatherback nesting and marine environments are facing increasing impacts through widespread development and tourism along nesting beaches (Hamann et al. 2006; Hernandez et al. 2007; Maison 2006; Santidrián Tomillo et al. 2007). Structural impacts to beaches include building and piling construction, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). In some areas, timber and marine debris accumulation as well as sand mining reduce available nesting habitat (Bourgeois et al. 2009; Chacón Chaverri 1999; Formia et al. 2003; Laurance et al. 2008). Lights on or adjacent to nesting beaches alter nesting adult behavior and is often fatal to emerging hatchlings as they are drawn to light sources and away from the sea (Bourgeois et al. 2009; Cowan et al. 2002; Deem et al. 2007; Witherington 1992; Witherington and Bjorndal 1991). Plastic ingestion is very common in leatherbacks and can block gastrointestinal tracts leading to death (Mrosovsky et al. 2009). Along the coast of Peru, 13 percent of 140 leatherback carcasses were found to contain plastic bags and film (Fritts 1982). Although global warming may expand foraging habitats into higher latitude waters, increasing temperatures may increase feminization of nests (Hawkes et al. 2007b; James et al. 2006; McMahon and Hays 2006; Mrosovsky et al. 1984). Rising sea levels may also inundate nests on some beaches. Egg collection is widespread and attributed to catastrophic declines, such as in Malaysia. Harvest of females along nesting beaches is of concern worldwide.

Bycatch, particularly by longline fisheries, is a major source of mortality for leatherback sea turtles (Crognale et al. 2008; Fossette et al. 2009a; Gless et al. 2008; Petersen et al. 2009). Wallace et al. (2010) estimated that between 1990 and 2008, at least 85,000 sea turtles were captured as bycatch in fisheries worldwide. This estimate is likely at least two orders of magnitude too low, resulting in a likely bycatch of nearly half a million sea turtles annually (Wallace et al. 2010); some of these turtles are expected to be leatherbacks.

Spotila (2000) concluded that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific Ocean during the 1990s is 1,500

animals. He estimates that this represented about a 23 percent mortality rate (or 33 percent if most mortality was focused on the East Pacific population). In the Pacific Ocean, between 1,000 and 1,300 leatherback sea turtles are estimated to have been captured and killed in longline fisheries in 2000 (Lewison et al. 2004). Shallow-set longline fisheries based out of Hawaii are estimated to have captured and killed several hundred leatherback sea turtles before they were closed in 2001. When they were re-opened in 2004, with substantial modifications to protect sea turtles, these fisheries were estimated to have captured and killed about one or two leatherback sea turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawaii are estimated to have captured about 19 leatherback sea turtles, killing about five of these sea turtles.

Donoso and Dutton (2010) found that 284 leatherbacks were bycaught between 2001 and 2005 as part of the Chilean longline fishery, with two individuals observed dead; leatherbacks were the most frequently bycaught sea turtle species. Between eight and 17 leatherback turtles likely died annually between 1990 and 2000 in interactions with the California/Oregon drift gillnet fishery; 500 leatherback turtles are estimated to die annually in Chilean and Peruvian fisheries; 200 leatherback turtles are estimated to die in direct harvests in Indonesia; and, before 1992, the North Pacific driftnet fisheries for squid, tuna, and billfish captured an estimated 1,000 leatherback turtles each year, killing about 111 of them each year. Currently, the U.S. tuna and swordfish longline fisheries managed under the Highly Migratory Species Fishery Management Plan are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each three-year period starting in 2007 (NMFS 2004a). In 2010, there were 26 observed interactions between leatherback sea turtles and longline gear used in the Highly Migratory Species fishery (Garrison and Stokes 2011). All leatherbacks were released alive, with all gear removed for the majority of captures. While 2010 total estimates are not yet available, in 2009, 285.8 (95 percent CI: 209.6 to 389.7) leatherback sea turtles are estimated to have been taken in the longline fisheries managed under the Highly Migratory Species Fishery Management Plan based on the observed takes (Garrison and Stokes 2010). Finkbeiner et al. (2011) estimated hundreds of interactions in U.S. Pacific fisheries (resulting in about ten mortalities).

We know little about the effects of contaminants on leatherback sea turtles. The metals arsenic, cadmium, copper, mercury, selenium, and zinc bioaccumulate, with cadmium in highest concentration in leatherbacks versus any other marine vertebrate (Caurant et al. 1999; Gordon et al. 1998). A diet of primarily jellyfish, which have high cadmium concentrations, is likely the cause (Caurant et al. 1999). Organochlorine pesticides have also been found (McKenzie et al. 1999). Polychlorinated biphenyl concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (PCB 209: 500-530 ng/g wet weight Davenport et al. 1990; Oros et al. 2009).

4.2.4.11 Critical Habitat

There is no designated critical habitat for leatherback sea turtles in the EGTTR action area. On March 23, 1979, leatherback designated critical habitat was identified adjacent to Sandy Point, St. Croix, U.S. Virgin Islands from the 183 m (600 ft) isobath to mean high tide level between

17° 42' 12" North and 65° 50' 00" West (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. However, studies do not currently support significant critical habitat deterioration.

On January 26, 2012, the NMFS designated critical habitat for leatherback sea turtles in waters along Washington State and Oregon (Cape Flattery to Cape Blanco; 64,760 km² [18,881 nmi²]) and California (Point Arena to Point Arguello; 43,798 km² [12,769.4 nmi²]). The areas do not overlap any portion of the EGTTR action area. The primary constituent element of these areas includes the occurrence of prey species, primarily scyphomedusae of the order Semaestomeae (*Chrysaora*, *Aurelia*, *Phacellophora*, and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

5 ENVIRONMENTAL BASELINE

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

5.1 Department of Defense Activities

The air space over the Gulf of Mexico is used extensively by the Department of Defense for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf of Mexico. The western Gulf of Mexico has four warning areas that are used for military operations. The areas total approximately 21 million acres or 58 percent of the area. In addition, six blocks in the western Gulf of Mexico are used by the Navy for mine warfare testing and training. The central Gulf of Mexico has five designated military warning areas that are used for military operations. These areas total approximately 11.3 million acres. Portions of the Eglin Water Test Areas comprise an additional 0.5 million acres in the Central Planning Area (CPA). The total 11.8 million acres is about 25 percent of the area of the CPA.

Formal consultations on overall U.S. Navy activities in the Atlantic (including the Gulf of Mexico) have been completed, including the U.S. Navy activities in East Coast Training Ranges (June 1, 2011); U.S. Navy Atlantic Fleet Sonar Training Activities (January 20, 2011); U.S. Navy Atlantic Fleet Sonar Training Activities LOA 2012 to 2014; U.S. Navy active sonar training along the Atlantic Coast and Gulf of Mexico (December 19, 2011); activities in GOMEX Range Complex from November 2010 to November 2015 (March 17 2011); the U.S. Navy East Coast Training Ranges (Virginia Capes, Cherry Point, and Jacksonville) (June 2010); and U.S. Navy's Atlantic Fleet Training and Testing Activities (November 14, 2013). These opinions concluded that although there is a potential for some U.S. Navy activities to affect

ESA-listed species, those effects were not expected to impact any species on a population level. Therefore, the activities were determined not likely to jeopardize the continued existence of any ESA-listed species.

A consultation evaluating the impacts from U.S. Air Force search-and-rescue training operations in the Gulf of Mexico was completed in 1999 (NMFS 1999). NMFS more recently completed five consultations on Eglin AFB testing and training activities in the Gulf of Mexico. These consultations concluded that the incidental take of sea turtles is likely to occur. These opinions have issued incidental take for these actions: Eglin Gulf Testing and Training Range (NMFS 2004c), the Precision Strike Weapons Tests (NMFS 2005c), the Santa Rosa Island Mission Utilization Plan (NMFS 2005d), Naval Explosive Ordnance Disposal School (NMFS 2004b), Eglin Maritime Strike Operations Tactics Development and Evaluation (NMFS 2013a). These consultations determined the training operations would adversely affect sea turtles but not jeopardize their continued existence. They further determined that because the activities were to be completed over shelf waters, they were not likely to adversely affect sperm whales.

5.1.1 United States Navy Atlantic Fleet Training and Testing Activities

The Atlantic Fleet Training and Testing Final Environmental Impact Statement/Overseas Environmental Impact Statement action area is in the western Atlantic Ocean and encompasses the east coast of North America and the Gulf of Mexico (Figure 6, Figure 7, Figure 8). The action area covers approximately 2.6 million square nautical miles (nmi²) of ocean area, and includes designated Navy operating areas and special use airspace. Navy pierside locations and port transit channels where sonar maintenance and testing occur, and bays and civilian ports where training occurs are also included in the action area.

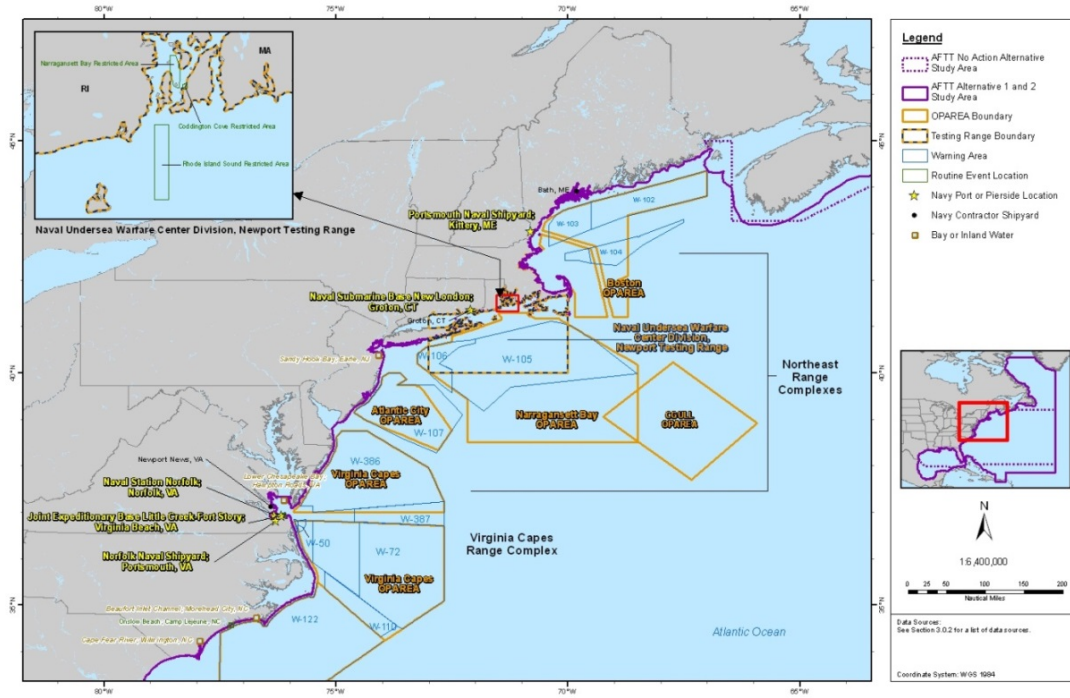


Figure 6. Atlantic Fleet Training and Testing Action Area, Mid-Atlantic U.S.

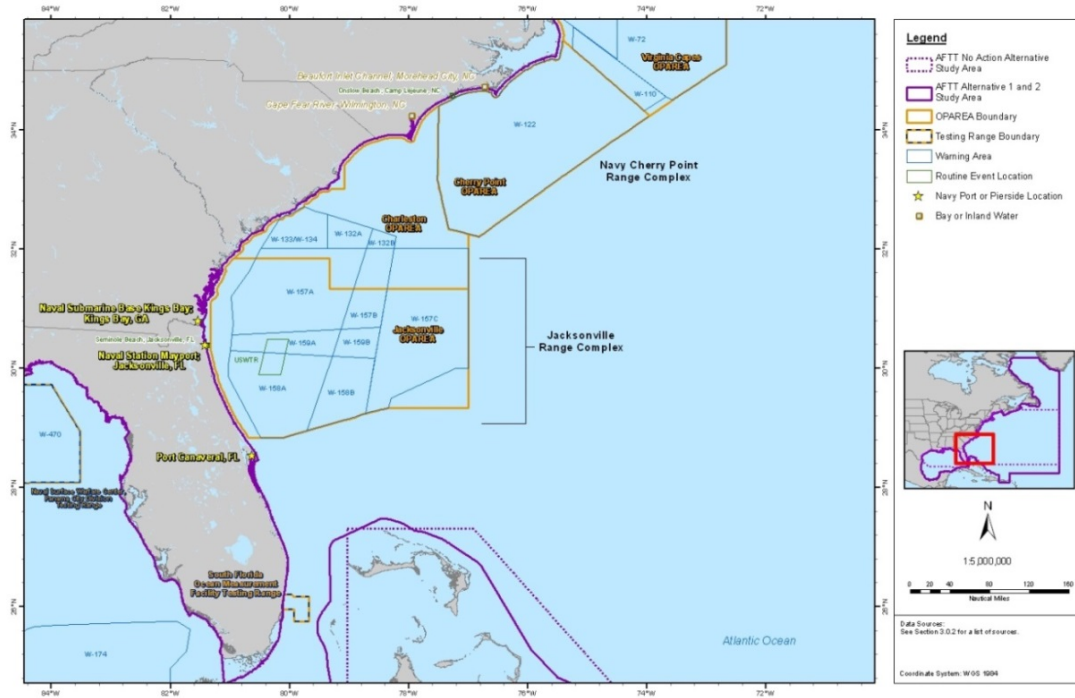


Figure 7. Atlantic Fleet Training and Testing Action Area, Southeastern, U.S.



Figure 8. Atlantic Fleet Training and Testing Action Area, Gulf of Mexico, U.S.

Specific activities that occur during U.S. Navy training and testing exercises as part of Atlantic Fleet Training and Testing include, but are not limited to, the activities listed in Table 24. Furthermore, the take authorized incidental to annual and non-annual training and testing exercises are described in Table 25 and Table 26.

Table 24. Typical warfare training exercises and the activities associated with each exercise.

Training Exercises	Activities
Anti-air warfare	radar search, detection, identification, and firing anti-air missiles or cannon fire
Amphibious warfare	naval gunfire, shore assaults, boat raids, airfield or port seizures, reconnaissance, and air strike and close air support training
Strike warfare	manned and unmanned air, surface, submarine, and naval special warfare assets using precision-guided munitions, non-guided munitions, rockets, and other ordnance
Anti-surface warfare	cannons, air-launched cruise missiles, torpedoes, naval guns, surface-to-surface missiles, and anti-ship cruise missiles
Anti-submarine warfare	detection and tracking of other vessels using various sensors and torpedoes
Electronic warfare	flares, chaff, radar
Mine warfare	underwater explosives, bullet-like projectiles
Naval special warfare	submerged vehicles, gunnery, underwater explosives

Table 25. Incidental take authorized under U.S. Navy Atlantic Fleet training and testing.

ESA-Listed Species	Annual and Non-Annual Training Exercises				
	Acoustic Stressors				Vessel Strike
	Harass (Behavioral & Temporary Threshold Shift)	Harm (PTS)	Harm (GI Tract, Slight Lung Injury, Other)	Mortality	Injury or Mortality
Sea Turtles					
Hardshell Sea Turtles ¹	12,216 per year*	22/year	4/year	2/year	**
Kemp's Ridley Sea Turtle	302 per year*	2/year	1/year	1/year	**
Leatherback Sea Turtle	8,909 per year*	23/year	2/year	1/year	**
Loggerhead Sea Turtle	16,812 per year*	34/year	7/year	4/year	**

¹ The hardshell sea turtles category including hawksbill, green, Kemp's ridley, and loggerhead sea turtles addresses take where specific take by species cannot be quantified.

NOTE: Non-annual events, those events that may only take place a few times over the five-year period and do not reoccur every year; take from non-annual activities is included with annual take to represent a maximum potential take in any given year.

*Behavioral responses of sea turtles to impulsive and non-impulsive sound stressors is not well studied and cannot be quantified in this opinion and conference report. This number for turtles includes only modeled TTS but does not exclude associated behavioral responses that could occur. Take from behavioral disturbance will be exceeded if activity levels as proposed are exceeded.

** Unspecified Number. While the potential for serious injury and mortality of sea turtles from vessel strike exists, it is very difficult to estimate the number and species composition of turtles that could be "taken" in the Atlantic Fleet Training and Testing Study Area in transit zones and range complexes. Take will be exceeded if activity levels as proposed are exceeded.

Table 26. Incidental take authorized to annual and non-annual training and testing exercises.

ESA-Listed Species	Annual and Non-Annual Testing Activities				
	Acoustic Stressors				Vessel Strike
	Harass (Behavioral & Temporary Threshold Shift)	Harm (PTS)	Harm (GI Tract, Slight Lung Injury, Other)	Mortality	Injury or Mortality
Sea Turtles					
Hardshell Sea Turtles ¹	5,132 per year*	10/year	242/year	49/year	**
Kemp's Ridley Sea Turtle	292 per year*	0	17/year	4/year	**
Leatherback Sea Turtle	6,362 per year*	29/year	162/year	57/year	**
Loggerhead Sea Turtle	1,017 per year*	15/year	578/year	81/year	**

¹ The hardshell sea turtles category including hawksbill, green, Kemp's ridley, and loggerhead sea turtles

NOTE: Non-annual events, those events that may only take place a few times over the five-year period and do not reoccur every year; take from non-annual activities is included with annual take to represent a maximum potential take in any given year.

*Behavioral responses of sea turtles to impulsive and non-impulsive sound stressors is not well studied and cannot be quantified in this opinion and conference report. This number for turtles includes only modeled TTS but does not exclude associated behavioral responses that could occur. Take from behavioral disturbance will be exceeded if activity levels as proposed are exceeded.

** Unspecified Number. While the potential for serious injury and mortality of sea turtles from vessel strike exists, it is very difficult to estimate the number and species composition of turtles that could be "taken" in the Atlantic Fleet Training and Testing Study Area in transit zones and testing and training range complexes. Take will be exceeded if activity levels as proposed are exceeded.

Potential noise-related stressors associated with these activities include vessel and aircraft noise, sonar, sensors, swimmer defense airguns, and noise from explosive ordnance and munitions detonations. A more comprehensive description of these activities is in the Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2013). NMFS issued an opinion on the effects of these activities in November 2013. The opinion concluded that the Navy's training and testing activities were likely to adversely affect, but not likely to jeopardize the survival or recovery of hawksbill, green, Kemp's ridley, loggerhead, and leatherback sea turtles in the Atlantic Fleet Training and Testing action area during the five-year period.

5.1.1 United States Navy Research, Development, Test, and Evaluation Activities in Panama City, Florida

The action area for these activities encompassed the coastal waters at the U.S. Naval Surface Warfare Center, Panama City, Florida, including waters within and adjacent to the Pensacola and Panama City Operating Areas, warning areas W-155, W-151- and W-470 (Figure 9).

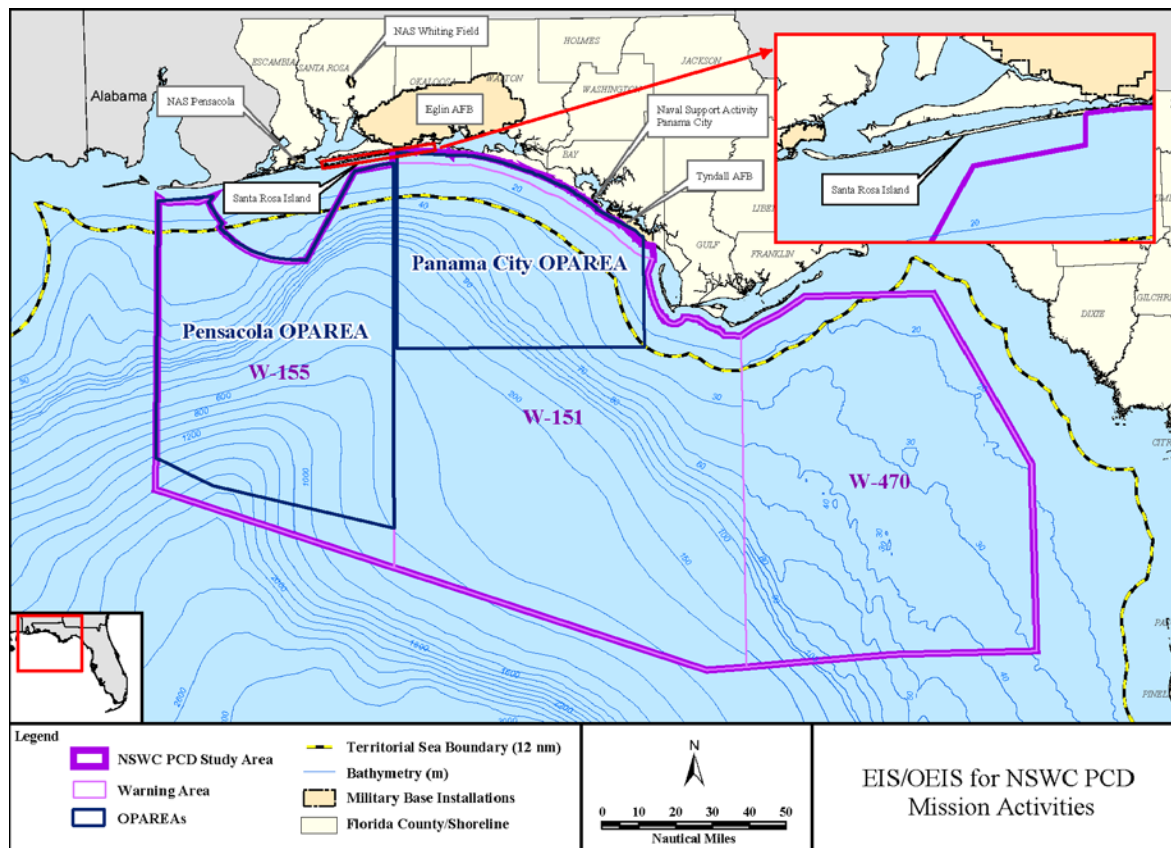


Figure 9. The action area for the U.S. Navy Research, Development, Test, and Evaluation Activities in Panama City, Florida.

In particular, Research, Development, Test, and Evaluation activities at the U.S. Navy's Naval Surface Warfare Center Panama City Division action area primarily consisted of eight operations between 2012 and 2014: (1) air operations, (2) surface operations, (3) subsurface operations, (4) sonar operations, (5) electromagnetic operations, (6) laser operations, (7) ordnance operations,

and (8) projectile firing.

Table 27 describes the number of hours each operation was proposed to take each year from January 2012 through January 2014.

Table 27. Specific activities that the U.S. Navy proposed to conduct at the Naval Surface Warfare Center in Panama City, Florida each year from January 2012 through January 2014.

Activity	Occurrence in Territorial Waters	Occurrence in Non-Territorial Waters	Total
Aircraft operations (hours)			
Helicopters	771	330	1,101
Fixed wing	3	12	15
Surface operations (hours)			
Boats	5,418	1,806	7,224
Landing Craft Air Cushions	164	55	219
Sub-surface operations			
Mine-like objects (items)	559	239	798
Versatile exercise mine (items)	118	50	168
Crawlers (hours)	114	0	114
Unmanned underwater vehicles (hours)	1,506	0	1,506
Sonar operations (hours)			
Mid-frequency active	73	4	77
High-frequency active (>10 kHz)	822	455	1,277
Electromagnetic operations (hours)			
Electromagnetic energy	514	221	735
Laser operations (hours)			
Laser line scan	211	237	448
Light Imaging Detection and Ranging (LIDAR)	263	289	552
Directional	53	0	53
Ordnance operations (detonations)			
Ordnance weights 0.45 - 4.5 kg	51	0	51
Ordnance weights 5 - 34 kg	3	0	3
Ordnance weights 34 - 272 kg	0	16	16
Line charges (lines)	3	0	3
Projectile firing (rounds)			
5-in	0	60	60
40 mm	0	480	480

30 mm	0	600	600
20 mm	0	2,967	2,967
76 mm	0	240	240
25 mm	0	525	525
Small arms	0	6,000	6,000

From these operations, the amounts of take that ESA-listed species were expected to be exposed to in the Panama City Range Complex from 2012 to 2014 are listed in

Table 28. NMFS concluded that exposure to these Research, Development, Test, and Evaluation activities could disrupt one or more behavioral patterns that are essential to an individual animal's life history or to the animal's contribution to a population. However, because of the short duration and low repetition rate of any changes in behavior, NMFS expected those individuals to be able to compensate for those behavioral changes (as they do when in response to other short-term changes in their behavior), thereby not likely to jeopardize the continued existence of ESA-listed species in the action area.

Table 28. Expected take of listed individuals due to exposure to activities at the Naval Surface Warfare Center in Panama City.

Species	Estimated "Take"		Form of "Take"
	Annually	Total	
Sperm whale	2	4	Harassment
Leatherback sea turtle	3	6	Harassment
Loggerhead sea turtle – Northwest Atlantic DPS	4	8	Harassment
Hardshell sea turtle (green, hawksbill, or Kemp's ridley)	3	6	Harassment

5.2 Other Federal Actions

NMFS conducts section 7 consultations to address the effects of federally permitted fisheries and other federal actions on threatened and endangered species, and when appropriate, has authorized the incidental taking of these species. Each of those consultations sought to minimize the adverse impacts of the action on sea turtles and any designated critical habitat in the opinion's action area, when applicable. The summary below includes federal actions in the action area that have concluded or are currently in consultation under section 7 of the ESA as well as the effects these actions have had on these ESA-listed species and critical habitat in the action area.

5.2.1 Fisheries

Recreational and commercial fisheries operating in federal waters of the Gulf of Mexico have interacted with (e.g., caught as bycatch, entangled) sea turtles in the past. Threatened and endangered sea turtles are adversely affected by several types of fishing gear in the action area.

Gillnet, hook-and-line (i.e., longline and vertical line), and trawl gear have all been reported as interacting with sea turtles.

For all fisheries for which there is a fishery management plan or for which any federal action is taken to manage that fishery, the impacts have been evaluated via section 7 consultation. Formal section 7 consultations have been conducted on the following fisheries: Coastal Migratory Pelagics, Gulf of Mexico Reef Fish, Spiny Lobster, Southeastern Shrimp Trawl, Atlantic Highly Migratory Species Pelagic Longline, and Highly Migratory Species Atlantic Shark and Smoothhound fisheries. NMFS issued an incidental take statement (ITS) for the take of ESA-listed species in each of the fisheries. A summary of each consultation is provided below, but more detailed information can be found in the respective opinions (NMFS 2007a; NMFS 2011c; NMFS 2012a).

5.2.1.1 Coastal Migratory Pelagics Fishery

In 2015, NMFS completed a section 7 consultation on the continued authorization of the coastal migratory pelagics fishery in the Gulf of Mexico and South Atlantic (NMFS 2015b). In the Gulf of Mexico, hook-and-line, gillnet, and cast net gears are used, while the recreational sector uses hook-and-line gear. The hook-and-line effort is primarily trolling. The opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize the continued existence of any of these species.

5.2.1.2 Gulf of Mexico Reef Fish Fishery

The Gulf of Mexico reef fish fishery uses two basic types of gear: spear or powerhead and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod-and-reel). The hook-and-line components of the fishery interact with sea turtles, with trap gear being phased-out completely by February 2007.

Prior to 2008, the reef fish fishery was believed to have relatively moderate levels of sea turtle bycatch attributed to the hook-and-line component of the fishery (i.e., approximately 107 captures and 41 mortalities annually, all species combined, for the entire fishery) (NMFS 2005b). In 2008, SEFSC observer programs and subsequent analyses indicated that the overall amount and extent of incidental take for sea turtles specified in the incidental take statement of the 2005 opinion on the reef fish fishery had been severely exceeded by the bottom longline component of the fishery: approximately 974 captures and at least 325 mortalities were estimated for the period July 2006 to 2007.

In response, NMFS published an Emergency Rule prohibiting the use of bottom longline gear in the reef fish fishery shoreward of a line approximating the 50-fathom depth contour in the eastern Gulf of Mexico, essentially closing the bottom longline sector of the reef fish fishery in the eastern Gulf of Mexico for six months pending the implementation of a long-term management strategy. The Gulf of Mexico Fishery Management Council developed a long-term management strategy via a new amendment (Amendment 31 to the Reef Fish Fishery

Management Plan). The amendment included: (1) a prohibition on the use of bottom longline gear in the Gulf of Mexico reef fish fishery, shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida from June to August; and (2) a reduction in the number of bottom longline vessels operating in the fishery via an endorsement program and a restriction on the total number of hooks that may be possessed onboard each Gulf of Mexico reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing.

On October 13, 2009, NMFS Southeast Regional Office completed an opinion that analyzed the expected effects of the continued operation of the Gulf of Mexico reef fish fishery under the changes proposed in Amendment 31 (NMFS-SEFSC 2009). The opinion concluded that sea turtle takes would be substantially reduced compared to the fishery as it was previously prosecuted and that operation of the fishery is not likely to jeopardize the continued existence of any sea turtle species. Amendment 31 was implemented on May 26, 2010. In August 2011, consultation was reinitiated to address the Deepwater Horizon oil release event and potential changes to the environmental baseline. Reinitiation of consultation was not related to any material change in the fishery itself, violations of any terms and conditions of the 2009 opinion, or an exceedance of the incidental take statement. The resulting September 30, 2011 opinion concluded that the continued operation of the Gulf of Mexico reef fish fishery is not likely to jeopardize the continued existence of any listed sea turtles (NMFS 2011b).

5.2.1.3 Spiny Lobster Fishery

NMFS completed a section 7 consultation on the Gulf of Mexico and South Atlantic Spiny Lobster Fishery Management Plan on August 27, 2009 (NMFS 2009b). The commercial component of the fishery consists of diving, bully net, and trapping sectors while recreational fishers are authorized to use bully net and hand-harvest gears. Of the gears used, only traps are expected to result in adverse effects on sea turtles. The consultation determined the continued authorization of the fishery is not likely to jeopardize any listed species. An incidental take statement was issued for sea turtle takes in the commercial trap sector of the fishery. Fishing activity is limited to waters off south Florida and, although the Fishery Management Plan does authorize the use of traps in federal waters, historic and current effort is very limited. Thus, potential adverse effects on sea turtles are believed to also be very limited (e.g., no more than a couple of sea turtle entanglements annually).

5.2.1.4 Southeast Shrimp Trawl Fisheries

NMFS has prepared opinions on the Southeastern shrimp trawling fisheries numerous times over the years (most recently 2012 and 2014). The consultation history is closely tied to the lengthy regulatory history governing the use of turtle exclusion devices and a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries.

Shrimp trawling increased dramatically in the action area between the 1940s and the 1960s. By the late 1970s, there was evidence thousands of sea turtles were being killed annually in the Southeast (NRC 1990c). In 1990, the NRC concluded the Southeast shrimp trawl fishery affected more sea turtles than all other activities combined and was the most significant anthropogenic source of sea turtle mortality in U.S. waters (NRC 1990c).

The level of annual mortality described in NRC (1990c) is believed to have continued until 1992 through 1994, when U.S. law required all shrimp trawlers in the Atlantic and Gulf of Mexico to use turtle exclusion devices, allowing at least some sea turtles to escape nets before drowning (NMFS 2002a)³. Turtle excluder devices approved for use have had to demonstrate 97 percent effectiveness in excluding sea turtles from trawls in controlled testing. These regulations have been refined over the years to ensure that turtle exclusion devices effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use.

Despite the apparent success of turtle exclusion devices for some species of sea turtles (e.g., Kemp's ridleys), it was later discovered that turtle exclusion devices were not adequately protecting all species and size classes of sea turtles. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimension in turtle exclusion devices in use at that time were too small for some sea turtles and that as many as 47 percent of the loggerheads stranding annually along the Atlantic and Gulf of Mexico were too large to fit the existing openings. On December 2, 2002, NMFS completed an opinion on shrimp trawling in the Southeastern United States (NMFS 2002a) under proposed revisions to the turtle exclusion devices regulations requiring larger escape openings (68 FR 8456 2003). This opinion determined that the shrimp trawl fishery, under the revised turtle exclusion devices regulations, would not jeopardize the continued existence of any sea turtle species. The determination was based in part on the opinion's analysis that shows the revised turtle exclusion devices regulations are expected to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks. In February 2003, NMFS implemented the revisions to the turtle exclusion device regulations.

On May 9, 2012, NMFS completed an opinion that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act (NMFS 2012c). The opinion also considered a proposed amendment to the sea turtle conservation regulations to withdraw the alternative tow-time restriction (at 50 CFR 223.206(d)(2)(ii)(A)(3)) for skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) and instead require all of those vessels to use turtle exclusion devices. The opinion concluded that the proposed action was not likely to jeopardize the continued existence of any sea turtle species. An incidental take statement was provided that used anticipated trawl effort and fleet turtle exclusion devices compliance (i.e., compliance resulting in overall average sea turtle catch rates in the shrimp otter trawl fleet at or below 12 percent) as surrogates for sea turtle takes. On November 21, 2012, NMFS determined that a final rule requiring turtle exclusion devices in skimmer trawls, pusher-head trawls, and wing nets was not warranted and withdrew the proposal. The decision to not implement the final rule created a change to the proposed action analyzed in the 2012 opinion and triggered the need to reinitiate consultation. Consequently, NMFS reinitiated consultation on November 26, 2012 and the

³ Turtle excluder devices were mandatory on all shrimping vessels. However, certain shrimpers (e.g., fishers using skimmer trawls or targeting bait shrimp) could operate without turtle excluder devices if they agreed to follow specific tow-time restrictions.

consultation was completed in April 2014. It was determined the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act was not likely jeopardize the continued existence of any sea turtle species. The incidental take statement maintained the use of anticipated trawl effort and fleet turtle exclusion devices compliance as surrogates for numerical sea turtle takes.

On December 16, 2016, NMFS published a proposed rule to withdraw the alternative tow time restriction and require all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing, with the exception of vessels participating in the Biscayne Bay wing net fishery prosecuted in Miami-Dade County, Florida, to use turtle excluder devices designed to exclude small sea turtles in their nets. The intent of this proposed rule is to reduce bycatch and mortality of sea turtles in southeastern U.S. shrimp fisheries, and to aid in the protection and recovery of ESA-listed sea turtle populations. NMFS also proposed to amend the definition of tow times to better clarify the intent and purpose of tow times to reduce sea turtle mortality, and to refine additional portions of the turtle excluder device requirements to avoid potential confusion (81 FR 91097).

5.2.1.5 Atlantic Highly Migratory Species Pelagic Longline Fisheries

Atlantic pelagic longline fisheries targeting swordfish and tuna are also known to incidentally capture and kill large numbers of loggerhead and leatherback sea turtles. The fishery mainly interacts with leatherback sea turtles and pelagic juvenile loggerhead sea turtles; thus, younger, smaller loggerhead sea turtles than the other fisheries described in this *environmental baseline*.

Over the past two decades, NMFS has conducted numerous consultations on this fishery, some of which required reasonable and prudent alternatives to avoid jeopardy of loggerhead and/or leatherback sea turtles. The estimated historical total number of loggerhead and leatherback sea turtles caught between 1992 to 2002 (all geographic areas) is 10,034 loggerhead and 9,302 leatherback sea turtles, of which 81 and 121 were estimated to be dead when brought to the vessel (NMFS 2004d). This does not account for post-release mortalities, which historically, were likely substantial.

NMFS reinitiated consultation in 2003 on the pelagic longline component of this fishery as a result of exceeded incidental take levels for loggerheads and leatherbacks (NMFS 2004d). The resulting 2004 opinion stated the long-term continued operation of this sector of the fishery was likely to jeopardize the continued existence of leatherback sea turtles, but reasonable and prudent alternatives were implemented allowing for the continued authorization of pelagic longline fishing that would avoid jeopardizing the continued existence of leatherback sea turtles.

On July 6, 2004, NMFS published a final rule to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734 2004). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality. The rulemaking, based on the results of the three-year Northeast Distant Closed Area research experiment and other available sea turtle bycatch reduction studies, is

expected to have significantly benefitted endangered and threatened sea turtles by reducing mortality attributed to this fishery.

On March 31, 2014, the NMFS, Office of Sustainable Fisheries, Highly Migratory Species Management Division requested that the Southeast Regional Office reinitiate formal section 7 consultation for the Atlantic pelagic longline fishery based on the availability of information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered (see 50 C.F.R. § 402.16 (b)). Specifically, the request is based on information indicating that the net mortality rate and total mortality estimates for leatherback sea turtles specified in the reasonable and prudent alternative were exceeded (although the take level specified in the incidental take statement has not been exceeded), changes in information about leatherback and loggerhead sea turtle populations, and new information about sea turtle mortality associated with pelagic longline gear. That consultation is still ongoing.

5.2.1.6 Highly Migratory Species Atlantic Shark and Smoothhound Fisheries

These fisheries include commercial shark bottom longline and gillnet fisheries and recreational shark fisheries under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (Highly Migratory Species Fishery Management Plan). NMFS has formally consulted three times on the effects of Highly Migratory Species shark fisheries on sea turtles (i.e., (NMFS 2003a; NMFS 2008; NMFS 2012b). NMFS also authorized a federal smoothhound fishery that will be managed as part of the Highly Migratory Species shark fisheries. NMFS (2012b) analyzed the potential adverse effects from the smoothhound fishery on sea turtles for the first time. Both bottom longline and gillnet are known to adversely affect sea turtles. From 2007 to 2011, the sandbar shark research fishery had 100 percent observer coverage, with four to six percent observer coverage in the remaining shark fisheries. During that period, ten sea turtle takes (all loggerheads) were observed on bottom longline gear in the sandbar shark research fishery and five were taken outside the research fishery. The five non-research fishery takes were extrapolated to the entire fishery, providing an estimate of 45.6 sea turtle takes (all loggerheads) for non-sandbar shark research fishery from 2007 to 2010 (Carlson and Richards 2011). No sea turtle takes were observed in the non-research fishery in 2011 (NMFS unpublished data). Since the research fishery has a 100 percent observer coverage requirement, those observed takes were not extrapolated (Carlson and Richards 2011). Because few smoothhound trips were observed, no sea turtle captures were documented in the smoothhound fishery.

The most recent ESA section 7 consultation was completed on December 12, 2012 on the continued operation of those fisheries and Amendments 3 and 4 to the Consolidated Highly Migratory Species Fishery Management Plan (NMFS 2012b). NMFS concluded that the proposed action was not likely to jeopardize the continued existence of sea turtles and an incidental take statement was provided authorizing take. ESA consultation was reinitiated on this fishery in 2015.

5.2.2 Vessel Activity

Vessels have the potential to affect sea turtles through collisions and the production of noise. Vessels are the greatest contributors to increases in low-frequency ambient noise in the sea (Andrew et al. 2011). It is predicted that ambient ocean noise will continue to increase at a rate of ½ dB per year (Ross 2005). Sound levels and tones produced are generally related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and vessels underway with a full load, or those pushing or towing a load, are noisier than unladen vessels. Vessels operating at high speeds have the potential to strike sea turtles or marine mammals with their hulls or propellers. Vessel activity can also result in death of coral larvae from cavitation in propellers. Potential sources of adverse effects from federal vessel operations in the action area include operations of the U.S. Department of Defense, Bureau of Ocean Energy Management/Bureau of Safety and Environmental Enforcement, Federal Energy Regulatory Commission, United States Coast Guard, NOAA, and U.S. Army Corps of Engineers.

5.2.3 Oil and Gas Operations

Oil and gas operations involve a variety of activities that adversely affect sea turtles in the action area. These activities include vessels making supply deliveries, drilling operations, seismic surveys, and oil rig removals.

5.2.3.1 Oil and Gas Vessel Operations

Offshore supply boats running from shore bases to offshore outer continental shelf oil and gas structures is one of the industry activities considered in previous section 7 consultations. The most recent opinion on Bureau of Ocean Energy Management lease sales and operations determined that vessels would adversely affect sea turtles, but not jeopardize their continued existence (NMFS 2007b). In response to terms and conditions of previous opinions, and in an effort to minimize the potential for vessel strikes and sea turtles, Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement issued Joint Notice to Lessees (2012-G01), “Vessel Strike Avoidance and Injured/Dead Protected Species Reporting.” Industry-related vessel traffic is a part of the current Environmental Baseline in the Gulf of Mexico and is expected to continue over the foreseeable future.

5.2.3.2 Lease Sales and Drilling Operations

The sale of outer continental shelf leases in the Gulf of Mexico and the resulting exploration and development of these leases for oil and natural gas resources is another activity affecting the status of ESA-listed species in the action area. Bureau of Ocean Energy Management administers the Outer Continental Shelf Lands Act and authorizes the exploration and development of wells in Gulf leases. As technology has advanced over the past several decades, oil exploration and development has moved further offshore into deeper waters of the Gulf. The development of wells often involves additional activities such as the installation of platforms, pipelines, and other infrastructure. Once operational, a platform will generate a variety of wastes including a variety of effluents and emissions. Each of these wastes can contribute to the baseline. Additionally, although the release of oil is prohibited, accidental oil spills can occur from loss of

well control and thus adversely affect sea turtles in the Gulf of Mexico. Previous opinions have considered the effects resulting from the variety of actions associated with lease sales and development. These opinions determined that sea turtles would be adversely affected though the effects are not likely to jeopardize their continued existence.

5.2.3.3 Seismic Surveys

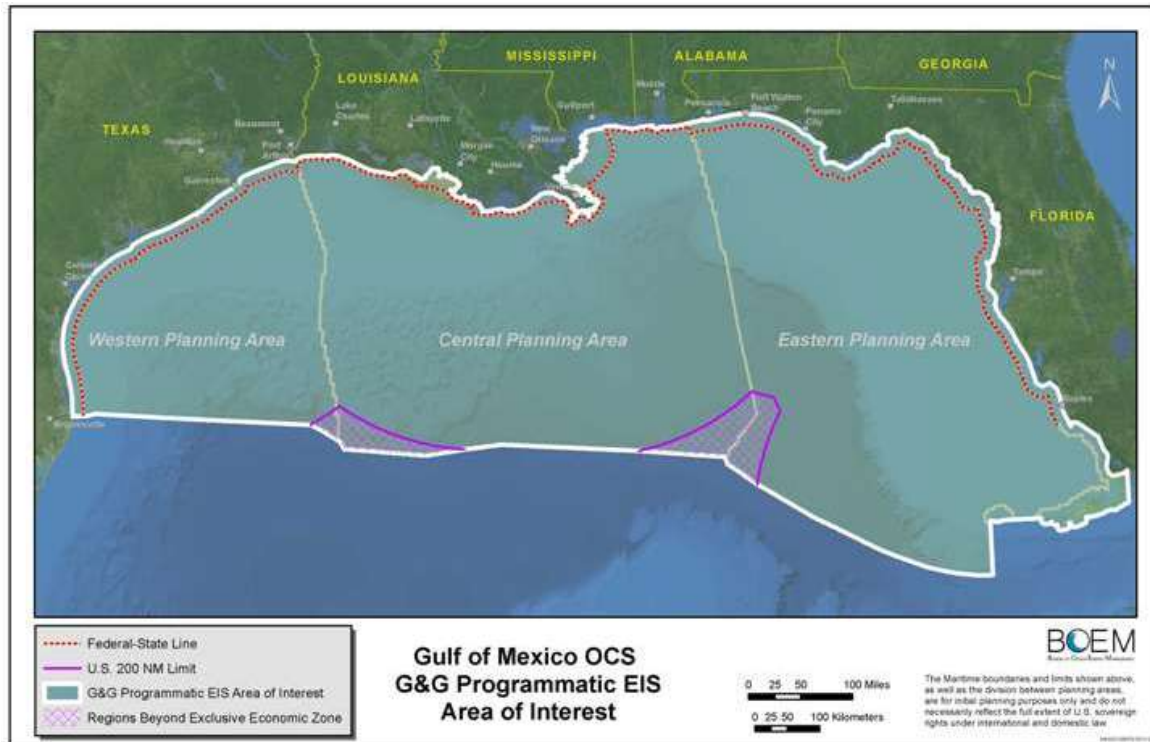


Figure 10. The Gulf of Mexico Outer Continental Shelf Atlantic Geophysical and Geotechnical programmatic area of interest.

Seismic exploration is an integral part of oil and gas discovery, development, and production in the Gulf of Mexico. Seismic surveys are routinely conducted in virtually all water depths (Figure 10). NMFS considered the effects of seismic operations in an opinion issued to Bureau of Ocean Energy Management on its 2007 to 2012 outer continental shelf Gulf of Mexico program. This opinion concluded that seismic surveys, with Bureau of Ocean Energy Management-required mitigation, were not likely to adversely affect sea turtles. Required mitigations can be found in the Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement Joint NTL 2012-G-02, “Implementation of Seismic Survey Mitigation Measures and Protected Species Observer Program.”

5.2.3.4 Oil Rig Removals

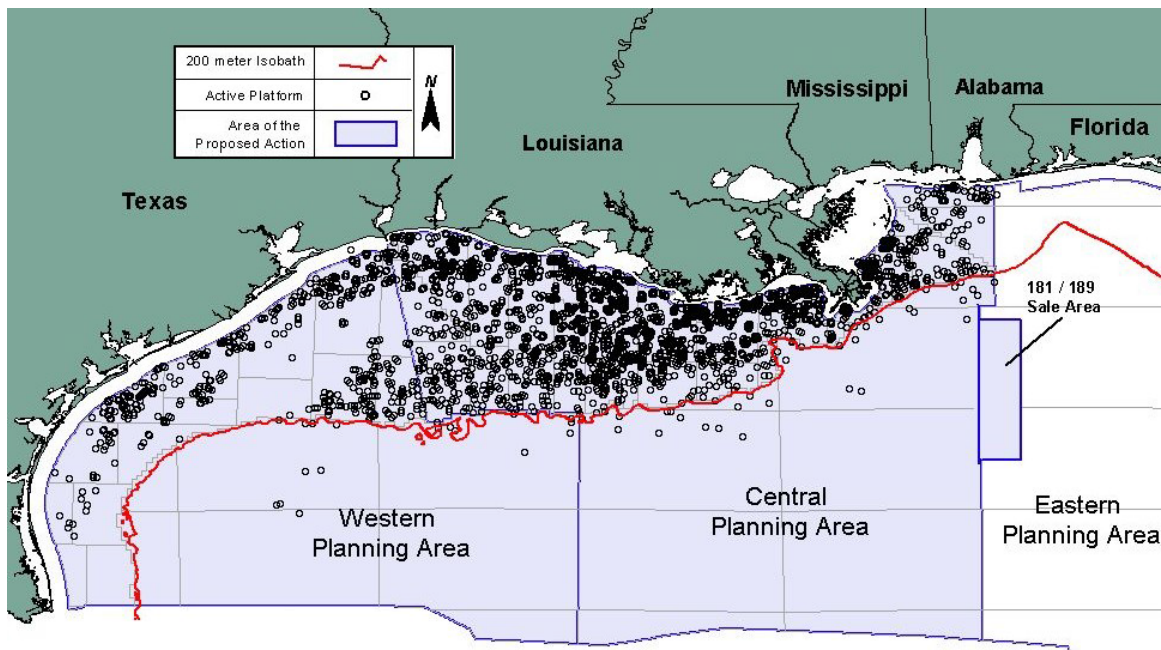


Figure 11. Area of the proposed action showing active platform distribution. Only the platforms in the central and eastern planning areas off of the coast of Alabama and Florida are within the current Eglin Gulf Testing and Training Range action area.

Both the U.S. Army Corps of Engineers and Bureau of Safety and Environmental Enforcement permit the removal of oil rigs in the Gulf of Mexico. Since 1947, when production in the Gulf of Mexico first began, 5981 structures have been installed in the Gulf of Mexico and over 2000 structures have been removed. Figure 11 shows the locations of the platforms and wells, respectively. Although the majority of decommissions (or removals) follow depletion of a reservoir, a few are removed because of structural damage from collision with a barge, hurricane event, or other causes. These removals often use explosives to sever associated pile structures which can impact a variety of species, including any ESA-listed species, in the action area. The U.S. Army Corps of Engineers oversees rig removals in state waters while the Bureau of Safety and Environmental Enforcement permits those platforms in federal waters of the outer continental shelf. The U.S. Army Corps of Engineers consults with NMFS on a project-by-project basis for decommissioning activities that use explosives in state waters. In regards to rig removals in federal waters, the Bureau of Safety and Environmental Enforcement consults with NMFS on possible adverse effects. As of 2006, there were over 4,000 bottom-founded, “traditional” structures (e.g., jacketed platforms, caissons, and well protectors) and 29,500 well-related structures in the Gulf of Mexico. During the ten-year period from 1994 to 2003, there was an average of 156 platform removals per year, with over 60 percent using explosive severing tools. During the same period, the number of platform installations was slightly lower, with an average of 116 structure commissionings taking place per year.

A formal ESA section 7 consultation was completed in 2006 (NMFS 2007b) and in 2008 and the incidental take statement was amended following completion of the MMPA rule. This opinion

found that the permitting of structure removals in the Gulf of Mexico is likely to adversely affect, but not result in jeopardy for loggerhead, Kemp's ridley, green, hawksbill, or leatherback sea turtles. An incidental take, by injury or mortality, of three sea turtles per year or 18 sea turtles during the six year-period of the opinion is anticipated during detonations. Most of these are predicted to be loggerhead sea turtles. Thus, a reasonable estimate is 15 loggerheads and three total of any of the other species (Kemp's ridley, green, hawksbill, or leatherback) for a six-year period. Sea turtles have not been captured in site clearance trawl nets. NMFS anticipated one sea turtle of any species may be captured in a trawl net over the six-year period.

In addition to the take by injury or mortality from detonations and capture in a trawl net, take of sea turtles, by harassment, was anticipated. Up to 84 sea turtles per year may be exposed to detonations and other aspects of removal operations, some of which would be harassed. As with injury, mostly loggerheads would be harassed but the other sea turtle species may be harassed as well. Assuming all exposed sea turtles are harassed, since NMFS cannot determine which individuals will be, NMFS anticipated up to 84 sea turtles of any species would be taken annually by harassment. These take estimates were based on the Mineral Management Service's projections of 170 to 273 explosive-severance removals per year (see Table 7). In addition to the Reasonable and Prudent Measures within the incidental take statement, Bureau of Ocean Energy Management also issued "Decommissioning Guidance for Wells and Platforms" (Notice to Lessees 2010-G05) to inform lessees about mitigation and reporting requirements. The removal of non-operating oil platforms is expected to continue to affect protected sea turtles over the foreseeable future.

5.2.4 Dredging

Coastal navigation channels are often dredged to support commercial shipping and recreational boating. Dredging activities can pose significant impacts to aquatic ecosystems by: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant resuspension; (4) noise/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000). Additionally, beach nourishment projects typically require dredging to source sand, often from nearshore sandy bottom habitats. Increasing coastal development and ongoing beach erosion is expected to result in increased demands by coastal communities, especially beach resort towns, for periodic privately funded or federally sponsored beach renourishment projects.

Marine dredging vessels are common within U.S. coastal waters. Although the underwater noises from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites ("borrow areas") have been identified as sources of sea turtle mortality. Hopper dredges can lethally harm sea turtles by entraining them in dredge drag arms and impeller pumps. Hopper dredges in the dredging mode are capable of moving relatively quickly

and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes a resting or swimming organism.

To reduce take of listed species, relocation trawling may be utilized to capture and move sea turtles. In relocation trawling, a boat equipped with nets precedes the dredge to capture sea turtles and then releases the animals out of the dredge pathway, thus avoiding lethal take. Relocation trawling has been successful and routinely moves sea turtles in the Gulf of Mexico.

In 2003, NMFS completed a regional opinion in the Gulf of Mexico that includes impacts to sea turtles from hopper dredging for maintenance (NMFS 2003b). NMFS determined that (1) Gulf of Mexico hopper dredging would adversely affect four sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads) but is not likely to jeopardize their continued existence, and (2) dredging in the Gulf of Mexico is not likely to adversely affect leatherback sea turtles. An incidental take statement for those species adversely affected was issued. This ESA consultation was reinitiated in 2015.

Numerous other opinions analyzed hopper dredging projects that did not fall under the scope of actions contemplated by the regional opinion, including: the dredging of Ship Shoal in the Gulf of Mexico Central Planning Area for coastal restoration projects in 2005, the Gulfport Harbor Navigation Project in 2007, the East Pass dredging in Destin, Florida in 2009, the Mississippi Coastal Improvements Program in 2010, and the dredging of City of Mexico beach canal inlet in 2012. Each of the above free-standing opinions had its own incidental take statement and determined that hopper dredging during the proposed actions is not likely to jeopardize the continued existence of any ESA-listed species or adversely modify critical habitat of any listed species.

NMFS has previously determined in dredging opinions that non-hopper type dredging methods (e.g., clamshell or bucket dredging, cutterhead dredging, pipeline dredging, sidecast dredging) are slower and not likely to adversely affect ESA-listed species. NMFS has no new information that would alter that finding.

5.2.5 Construction and Operation of Public Fishing Piers

Since the active hurricane seasons of 2004 and 2005, a number of fishing piers have either been built or rebuilt along the Gulf Coast, particularly in Mississippi. The U.S. Army Corps of Engineers permits the building of these structures and in some cases, FEMA provides funding. NMFS concluded that the fishing likely to occur following the completion of each pier project was likely to adversely affect certain species of sea turtles, but was not likely to jeopardize their continued existence. Incidental capture of sea turtles does not generally result in immediate mortality, though some captures result in severe injuries which may later lead to death. We expect fishing effort to continue at Gulf piers in the foreseeable future.

5.2.6 Aquaculture

On June 24, 2015, NMFS completed a section 7 consultation on the final rule for the fishery management plan for Regulating Offshore Marine Aquaculture in the Gulf of Mexico (Aquaculture fishery management plan). The consultation considered, among other things, risk

of entanglement and potential impacts to water quality from the permitting of up to 20 offshore aquaculture operations in federal waters of the Gulf of Mexico over a ten-year period. The consultation concluded that the Aquaculture fishery management plan was not likely to adversely affect listed species or designated critical habitat under NMFS's purview. With respect to entanglement risks, entanglement can be greatly reduced through the use of rigid, durable materials and by keeping lines taut, and that in practice, most offshore marine aquaculture facilities are constructed under these specifications. The Aquaculture fishery management plan requires applicants to provide documentation sufficient to evaluate a system's ability to withstand physical stresses and that there is anecdotal evidence that supports the conclusion that interactions are rare. On January 11, 2016, NOAA published the final rule implementing the Aquaculture fishery management plan, the nation's first regional regulatory program for offshore aquaculture in federal waters.

5.2.7 Scientific Research Permits under Section 10 of the ESA

Regulations developed under the ESA allow for the issuance of permits allowing take of certain ESA-listed species for the purposes of scientific research under section 10(a)(1)(a) of the ESA. Since issuance of the scientific research permits is a federal activity, issuance of the permit by NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species or adverse modification of its critical habitat.

Sea turtles are the focus of research activities authorized by section 10 permits under the ESA. Most takes authorized under these permits are nonlethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations. Scientific research permits issued by NMFS currently authorize studies on green, loggerhead, Kemp's ridley, hawksbill, and leatherback sea turtles in the Gulf of Mexico, some of which extend into portions of the action area. Currently, there are 23 scientific research permits with approximately 36,349 authorized annual non-lethal takes of green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles that could occur in the Gulf of Mexico. The issuance of these research permits was considered in section 7 consultations by NMFS. Authorized research on ESA-listed sea turtles includes capture, handling, restraint, tagging, biopsy, blood sampling, lavage, ultrasound, and tetracycline injection.

5.3 State or Private Actions

As discussed below, numerous state and private activities also affect the ESA-listed resources considered in this opinion and conference report.

5.3.1 State Fisheries

Several coastal state fisheries are known to incidentally take listed species, but information on these fisheries is sparse (NMFS 2001a). Various fishing methods used in these commercial and recreational fisheries, including trawling, pot fisheries, gillnets, and vertical line are known to incidentally take sea turtles (NMFS 2001a). The past and current effects of state fisheries on listed species are currently not determinable. Most state data are based on extremely low

observer coverage or sea turtles were not part of data collection; however, available data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem. The 2001 Highly Migratory Species Fishery Management Plan opinion has an excellent summary of turtles taken in state fisheries throughout the action area (NMFS 2001a).

In addition to commercial state fisheries, protected sea turtles can also be incidentally captured by hook and line recreational fishers. Observations of state recreational fisheries have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles are known to bite baited hooks. Further, observations show that loggerheads and Kemp's ridleys frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties. A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead sea turtles can be found in the Turtle Expert Working Group reports (TEWG 1998a; TEWG 2000b).

The Florida stone crab fishery used to be managed via a federal fishery management plan. NMFS completed a section 7 consultation on the Gulf of Mexico Stone Crab fishery management plan on September 28, 2009 (NMFS 2009a). On October 28, 2011, NMFS repealed the federal fishery management plan for this fishery, and the fishery is now managed exclusively by the State of Florida. The commercial component of the fishery is traps; recreational fishers use traps or wade/dive for stone crabs. Of the gears used, only commercial traps are expected to result in adverse effects on ESA-listed species. The number of commercial traps actually in the water is very difficult to estimate, and the number of traps used recreationally is unquantifiable with any degree of accuracy. The consultation determined the action was likely to adversely affect sea turtles, but would not jeopardize their continued existence. An incidental take statement was issued for takes in the commercial trap sector of the fishery.

Although few of these state regulated fisheries are currently authorized to incidentally take listed species, several state agencies have approached NMFS to discuss applications for a section 10(a)(1)(B) incidental take permit. Since NMFS's issuance of a section 10(a)(1)(B) permit requires formal consultation under section 7 of the ESA, any fisheries that come under a section 10(a)(1)(B) permit in the future will likewise be subject to section 7 consultation. Although the past and current effects of these fisheries on listed species are currently not determinable, NMFS believes that ongoing state fishing activities may be responsible for seasonally high levels of observed strandings of sea turtles on the Gulf of Mexico coast.

5.3.2 Vessel Traffic

Commercial traffic and recreational boating pursuits can have adverse effects on sea turtles via propeller and boat strike damage. The Sea Turtle Stranding and Salvage Network includes many records of vessel interactions (propeller injury) with sea turtles off Gulf of Mexico coastal states such as Florida, where there are high levels of vessel traffic. Looking at vessel interactions from stranding data, not all records indicate where a potential vessel strike occurred, as a turtle could have been injured/killed at one location and then drifted with currents for a considerable distance before coming ashore.

Given these variables, it is difficult to definitively evaluate potential risk to sea turtles stemming from specific vessel traffic. This difficulty is compounded by a general lack of information on vessel use trends, particularly in regard to offshore vessel traffic.

5.3.3 Oil and Gas Activities

Each Gulf state participates in the oil and gas industry, with Texas and Louisiana among the nation's leading states in terms of crude oil and natural gas production. State oil and gas exploration, production, and development are expected to result in similar effects to protected species as reported in the analysis of federal activities for oil and gas lease sale opinions, including impacts associated with the explosive removal of offshore structures, seismic exploration, marine debris, oil spills, and vessel operation. Oil refineries, processing facilities, and pipelines along the Gulf Coast also may impact ESA-listed species through construction activities or pollution.

Florida has minor oil and gas reserves and few other energy resources. Legislation currently does not allow energy development within 100 to 125 miles of Florida until 2022. Most of Florida's minor crude oil production comes from onshore fields in the northwestern Panhandle and from smaller fields in the south. Florida has no oil refineries and relies on petroleum products delivered by tanker and barge to marine terminals near the state's major coastal cities. Florida receives most of its natural gas supply from the Gulf Coast Region via two major interstate pipelines: (1) the Florida Gas Transmission line, which runs from Texas through the Florida Panhandle to Miami, and (2) the Gulfstream pipeline, an underwater link from Mississippi and Alabama to Central Florida. With the completion of the Cypress Pipeline in May 2007, the Jacksonville area has also begun receiving supplies from the liquefied natural gas import terminal at Elba Island, Georgia. To help meet Florida's growing demand for natural gas, companies have proposed building a new liquefied natural gas import terminal in the federal waters off Florida's Gulf Coast that would be connected via underwater pipeline to Florida's existing natural gas pipeline system.

Alabama is rich in onshore energy resources, but not offshore waters. Alabama produces a small amount of crude oil from reserves located in the Black Warrior Basin in the north and the Gulf Coast in the south. One petroleum refinery is located near the Port of Mobile, a second is located in Tuscaloosa on the Black Warrior River, and a third is located in Atmore in the southern part of the state. Most offshore energy is in the form of natural gas. In 2005, gas production flowed through 47 fixed structures Alabama's state waters. Alabama receives additional supplies of natural gas transported by pipeline mainly from the Gulf of Mexico, Louisiana, and Texas. The Southeast Supply Header pipeline, transporting natural gas from the Perryville Hub in Texas to Southern Alabama, came online in September 2008. This pipeline is intended to give Alabama consumers an alternative to the offshore supply.

5.3.4 Aquaculture

NOAA estimates that commercial marine aquaculture in waters of the Gulf of Mexico was a \$61 million industry in 2013 (NMFS 2015a). Commercial marine aquaculture in the Gulf of Mexico mainly consists of oysters and clam culture in coastal areas; shrimp and red drum are also

cultured in tanks and ponds. There are currently no net pen aquaculture operations in Gulf of Mexico state waters, although Florida has developed specific best management practices for net pen culture in their state waters (Services 2007). Some states have instituted best management practices for aquaculture operations to help reduce and mitigate any potential environmental impacts.

Stock enhancement is the practice of releasing cultured fish into the wild to supplement natural populations. Several states in the Gulf of Mexico, including Florida, have active stock enhancement programs for red drum, spotted sea trout, southern flounder, snook, and bay scallops. In addition, aquaculture-based restoration activities to rebuild oyster reefs also occur throughout the Gulf of Mexico.

Aquaculture has the potential to impact protected species via entanglement and/or other interaction with aquaculture gear (i.e., buoys, nets, and lines), introduction or transfer of pathogens, increased vessel traffic, impacts to habitat and benthic organisms, and water quality. In most cases, aquaculture operations need to obtain a permit authorized by the U.S. Army Corps of Engineers under section 10 of the Rivers and Harbors Act (DWH Trustees 2015). Additionally, finfish operations which produce 45,359 kg (100,000 lbs) or more annually are also required to obtain a National Pollutant Discharge Elimination System from the Environmental Protection Agency. Issuance of such permits is a federal action and would be subject to ESA section 7 consultation.

5.4 *Deepwater Horizon* Oil Spill and Response

On April 20, 2010, while working on an exploratory well approximately 50 miles offshore of Louisiana, the semi-submersible drilling rig *Deepwater Horizon* experienced an explosion and fire. The rig subsequently sank and oil and natural gas began leaking into the Gulf of Mexico. Oil flowed for 86 days until the well was finally capped on July 15, 2010. Millions of barrels of oil were released into the Gulf of Mexico. Oil spread from the deep ocean to the surface and nearshore environment, from Texas to Florida. In response to this uncontrolled oil discharge, approximately 1.84 million gallons of chemical dispersant was applied both subsurface and on the surface to attempt to break down the oil. Further response activities included hundreds of oil patches burned at the sea surface, synthetic-based drilling muds released on the sea floor, deployment of boom and construction of berms to prevent oil from reaching the shore, and disruptive mechanical collection and removal of oil that reached the shore. Each of these activities resulted in additional environmental consequences (DWH Trustees 2015).

The investigation conducted under the National Resource Damage Assessment regulations under the Oil Pollution Act (33 U.S.C. 2701 *et seq.*) assessed natural resource damages stemming from the *Deepwater Horizon* oil spill. The investigation evaluated whether a pathway could be established from the discharge to the exposed resource (e.g., the ESA-listed species), whether the resource had been exposed to the oil or chemical dispersants, and the injury caused by that exposure. The oil released into the environment was found to be toxic to a wide range of organisms, including fish, invertebrates, plankton, birds, and mammals, causing a wide array of

toxic effects including death, disease, reduced growth, impaired reproduction, and physiological impairments that reduce the fitness of organisms (their ability to survive and reproduce). In addition to direct injuries to individual organisms, the *Deepwater Horizon* incident resulted in injuries to habitats used by ESA-listed species including marsh habitats, shoreline beaches, floating *Sargassum* habitats offshore, and submerged aquatic vegetation.

An assessment has been completed on the injury to Gulf of Mexico marine life, including sea turtles, resulting from the spill (DWH Trustees 2015). Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. The spill resulted in the direct mortality of many sea turtles, and it may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future.

In the first three weeks of June 2010, during the *Deepwater Horizon* oil spill event, over 120 sea turtle strandings were documented in Mississippi and Alabama, none of which exhibited any signs of external oiling to indicate effects associated with the spill. A total of 644 sea turtle strandings were documented in 2010 in Louisiana, Mississippi, and Alabama, 561 (87 percent) of which were Kemp's ridleys. During March through May of 2011, 267 sea turtle strandings were documented in Mississippi and Alabama alone. A total of 525 sea turtle strandings were documented in 2011 in Louisiana, Mississippi, and Alabama, with the majority (455) occurring from March through July, 390 (86 percent) of which were Kemp's ridleys. During 2012, a total of 384 sea turtles were documented in Louisiana, Mississippi, and Alabama. Of these, 343 (89 percent) were Kemp's ridleys. During 2014, a total of 285 strandings were documented in Louisiana, Mississippi, and Alabama, of these, 229 (approximately 80 percent) were Kemp's ridleys. Strandings since 2010 are significantly greater than documented in prior years; a total of 42 and 73 strandings were documented in Louisiana, Mississippi, and Alabama during 2008 and 2009, respectively. It should be noted that monitoring for stranding has increased considerably due to the *Deepwater Horizon* oil spill event.

Impacts to loggerhead sea turtles occurred to offshore small juveniles as well as large juveniles and adults. A total of 30,800 small juvenile loggerheads (7.3 percent of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. Of those exposed, 10,700 small juvenile loggerheads are estimated to have died as a result of the exposure. In contrast to small juveniles, loggerheads represented a large proportion of the adults and large juveniles exposed to and killed by the oil, with 30,000 estimated exposures (almost 52 percent of all exposures for those age/size classes) and an estimated 3,600 mortalities. A total of 265 nests (27,618 eggs) were also translocated during response efforts, with 14,216 hatchlings released (the fate of which is unknown) (DWH Trustees 2015).

While impacts to large benthic juvenile and adult green sea turtles were likely, those effects could not be adequately quantified. Quantifiable impacts to green sea turtles were limited to offshore small juveniles and nests/hatchlings. A total of 154,000 small juvenile greens (36.6 percent of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. An estimated 57,300 small juveniles greens died as a result of the exposure. A total of four nests (580 eggs) were also translocated during response efforts, with 455 hatchlings released (the fate of which is unknown) (DWH Trustees 2015).

A total of 217,000 small juvenile Kemp's ridleys were estimated to have been exposed to oil. The Trustees estimated total abundance of oceanic juvenile Kemp's ridleys during 2010 as approximately 430,000 individuals and approximately half these were estimated to have been exposed to oil. Of these, up to 90,300 are estimated to have died as a result of the *Deepwater Horizon* event. Based on estimated total abundance of oceanic juvenile Kemp's ridleys during 2010, approximately 20 percent were killed during that year. Impacts to large juveniles (three+ years old) and adults were also high. An estimated 21,990 of these turtles were exposed to oil (about 22 percent of the total estimated population for those age classes), with an estimated 3,110 mortalities (an estimated three percent of the population for those age classes). The loss of near-mature and mature females could have contributed to the documented post-2010 decline in the previously predicted nesting trajectory. The estimated number of unrealized Kemp's ridley nests is between 1,300 and 2,000, which translates to approximately 65,000 and 95,000 unrealized hatchlings (DWH Trustees 2015). However, this is a minimum estimate because of the overall potential effect of *Deepwater Horizon* oil on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years. These sublethal effects could have slowed growth and maturation rates, increased remigration intervals, and/or decreased clutch frequency (number of nests per female per nesting season). The nature of the *Deepwater Horizon* effect on Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation. Additionally, 483 eggs from five nests were translocated, with 125 hatchlings ultimately released (DWH Trustees 2015).

Available information indicates leatherback sea turtles were affected by the spill to a lesser degree than other sea turtle species, at least directly. Leatherbacks were documented in the spill area, but the number of affected leatherbacks was not able to be estimated. However, given that the northern Gulf of Mexico is important habitat for leatherback migration and foraging (TEWG 2007b) and documentation of leatherbacks in the *Deepwater Horizon* oil spill zone during the spill period, the Trustees concluded that leatherbacks were exposed to *Deepwater Horizon* oil, and some portion of those exposed leatherbacks likely died.

Additional unquantified impacts of the *Deepwater Horizon* oil spill on sea turtles may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources that could lead to compromised growth and/or reproductive

potential. No information is currently available to determine the extent of those impacts, if they occurred.

5.5 Marine Debris

The discharge of debris into the marine environment is a continuing threat to the status of ESA-listed resources in the action area, regardless of whether the debris is discharged intentionally or accidentally. Marine debris may originate from a variety of sources, though specific origins of debris are difficult to identify. Debris can originate from land-based sources, but can also originate from improper disposal, accidental loss, or natural disasters (Watters et al. 2010) as well as a variety of marine industries including fishing, oil and gas, and shipping. A worldwide review of marine debris identifies plastic as the primary form of marine debris (Derraik 2002). Many of the plastics discharged to the sea can withstand years of saltwater exposure without disintegrating or dissolving. Further, floating materials have been shown to concentrate in ocean gyres and convergence zones where *Sargassum* and consequently juvenile sea turtles are known to occur (Carr 1987b). In the Gulf of Mexico, marine debris ranges from large concentrations of litter (i.e., cigarette butts and plastic bottles) that find their way through storm drains to beaches and coastal habitats to large derelict vessels that disturb marshes and seagrass habitats.

Marine debris has the potential to impact protected species through ingestion or entanglement (Gregory 2009). Recently weaned juveniles, who are investigating multiple types of prey items, may be particularly vulnerable to ingesting non-food items (Baird and Hooker 2000; Schuyler et al. 2013). This can have significant implications for an animal's survival, potentially leading to starvation, malnutrition, or internal injuries from consumption. All sea turtles are susceptible to ingesting marine debris, though leatherbacks show a marked tendency to ingest plastic which they misidentify as jellyfish – a primary food source (Balazs 1985a). Ingested debris may block the digestive tract or remain in the stomach for extended periods, thereby reducing the feeding drive, causing ulcerations and injury to the stomach lining, or perhaps even providing a source of toxic chemicals (Laist 1987; Laist 1997). Weakened animals are then more susceptible to predators and disease and are also less fit to migrate, breed, or, in the case of turtles, nest successfully (McCauley and Bjorndal 1999). Parker et al. (2005) conducted a diet analysis of 52 loggerhead sea turtles collected as bycatch from 1990 to 1992 in the high seas drift gillnet fishery in the central north Pacific. The authors found that 34.6 percent of the individuals sampled had anthropogenic debris in their stomachs (e.g., plastic, Styrofoam, paper, rubber, etc.). Similarly, a study of green sea turtles found that 61 percent of those observed stranded had ingested some form of marine debris, including rope or string, which may have originated from fishing gear (Bugoni et al. 2001).

In 2014, the NOAA Marine Debris Program compiled a report summarizing information on the entanglement of marine species in marine debris in the United States (Balazs 1985a; Program 2014). Information cited in that report relevant to ESA-listed species in the action area is described below. The report noted that sea turtles are particularly vulnerable to entanglement and

ingestion of marine debris because they tend to align themselves with oceanic fronts, convergences, rip, and driftlines where marine debris often occurs (Balazs 1985b; Carr 1987a). Balazs (1985a) listed 52 cases of sea turtle entanglement between 1973 and 1984. While most of these reports were from Hawaii, reports from Florida also occurred. Combining data from the Gulf of Mexico, Southeast U.S., Northeast U.S., and U.S. Caribbean, (Teas and Witzell 1995) reported 52 sea turtle entanglements per year from stranding network beach observations from 1980 to 1992. More recently, the Florida Entanglement Working Group reported 1,217 sea turtles that were entangled or had ingested marine debris from 1997 to 2009 (Bassos-Hull and Powell 2012). While there are several documented cases of ESA-listed species entangled with marine debris in the action area, the report also noted that estimates of entanglement in marine debris in the United States are likely underestimated (Program 2014).

5.6 Pollution

Pollution from a variety of sources including atmospheric loading of pollutants such as polychlorinated biphenyls, stormwater from coastal or river communities, and discharges from ships and industries affect ESA-listed species in the action area. Sources of marine pollution are often difficult to attribute to specific federal, state, local, or private actions.

There are studies on organic contaminants and trace metal accumulation in green, leatherback, and loggerhead sea turtles (Aguirre et al. 1994; Caurant et al. 1999; Corsolini et al. 2000b). McKenzie et al. (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtle tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles (Storelli et al. 2008b). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with sea turtle size were observed in green turtles, most likely attributable to a change in diet with age. (Sakai et al. 1995) documented the presence of metal residues occurring in loggerhead sea turtle organs and eggs. Storelli et al. (1998) analyzed tissues from 12 loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, 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). No information on detrimental threshold concentrations is available and little is known about the consequences of exposure of organochlorine compounds to sea turtles. Research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

Natural seeps provide a large petroleum input to the offshore Gulf of Mexico. The total amount of natural oil seepage per year, from thousands of natural seeps over the entire 600,000 square miles of the Gulf of Mexico, is estimated to be between 220,000 and 550,000 barrels (MacDonald 2012). This volume of oil slowly enters the deep sea from thousands of locations

over a huge area annually and is expected to continue into the reasonably foreseeable future. In contrast, the *Deepwater Horizon* spill released about six to 15 times the volume of oil from a single location in just 87 days. As it is a natural occurrence, the rate of natural oil seepage is expected to continue into the reasonably foreseeable future.

The development of marinas and docks in inshore waters can negatively impact nearshore habitats. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations do not likely affect the more pelagic waters of the action area, the species of sea turtles analyzed in this opinion and conference report travel between nearshore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles. Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material. Larger oil spills may result from accidents, although these events would be rare. No direct adverse effects on ESA-listed species resulting from fishing vessel fuel spills have been documented.

5.7 Disease

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

Fibropapillomatosis is the most significant cause of stranding and mortality in green turtles in Hawaii, accounting for 28 percent of standings' with an 88 percent mortality rate of afflicted stranded turtles (Chaloupka et al. 2008). While the disease appears to have regressed over time (Chaloupka et al. 2009), it persists in the population at levels of spatial variability (Van Houtan et al. 2010). Van Houtan et al. (2010) also suggest a potential relationship exists between the expression of Fibropapillomatosis and the State's land use, waste-water management practices, and invasive macroalgae.

5.8 Nutrient Loading and Hypoxia

Nutrient loading from land-based sources, such as coastal communities and agricultural operations stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. An example is the large area of the Louisiana continental shelf where seasonally depleted oxygen levels (less than two mg per liter) are caused by

eutrophication from both point and non-point sources. This definition of hypoxia is based on the oxygen levels that cause a behavioral response in most demersal fish, crabs, and shrimp to move away from these water (Rabalais et al. 2010). The oxygen depletion, referred to as hypoxia, begins in late spring, reaches a maximum in mid-summer, and disappears in the fall. The hypoxic zone in the Gulf of Mexico reaches up to 22,000 km² and averaged 13,500 km² from 1985 to 2005. It is the second largest human-caused hypoxic zone in the coastal ocean (Rabalais et al. 2010). The hypoxic zone negatively impacts sea turtles and prey availability which in turn can affect survival and reproductive fitness.

5.9 Anthropogenic Sound

Noise generated by human activity may adversely affect ESA-listed species in the action area. Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Jasny et al. 2005; NRC 2003; Richardson and Wursig 1995). Anthropogenic noise is generated by commercial and recreational vessels, aircraft, commercial sonar, military activities, seismic exploration, in-water construction activities, and other human activities. These activities occur within the action area to varying degrees throughout the year. The effects of noise on ESA-listed species can range from behavioral disturbance to physical damage (Richardson et al. 1995b).

Seismic surveys using towed airguns also occur within the action area and are the primary exploration technique to locate oil and gas deposits, fault structure, and other geological hazards. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of ten to 20 seconds for extended periods (NRC 2003). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235 to 240 dB at dominant frequencies of 5 to 300 Hz (NRC 2003). Most of the sound energy is at frequencies below 500 Hz. As documented previously, NMFS considered the effects of seismic operations in an opinion issued to the Bureau of Ocean Energy Management on its 2007 to 2012 Ocean Continental Shelf Gulf of Mexico program. This opinion concluded that seismic surveys, with Bureau of Ocean Energy Management-required mitigation, were not likely to adversely affect sea turtles.

Through ESA consultation with NMFS, the U.S. Navy implemented mitigation measures to reduce the potential effects of underwater sound from military training and testing activities on ESA-listed resources in the Gulf of Mexico. Mitigation measures include employing lookouts and implementing mitigation zones when training and testing using active sonar or explosives.

Noise from pile driving or other activities during in-water construction may also cause injury or behavioral responses in sea turtles. For example, Popper et al. (2014b) in their “Sound Exposure Guidelines for Sea Turtles and Fishes,” a technical report developed and approved by Accredited Standards Committee S3/SC 1 Animal Bioacoustics, determined that mortality and potential mortal injury could occur if a sea turtle is subject to cumulative sound exposure levels from pile

driving of 210 dB or peak levels of greater than 207 dB. The authors further determined that recoverable injury, temporary threshold shift, masking, or behavioral reactions all could occur from exposure to sound from pile driving, depending on how close the sea turtle was to the sound source. In-water construction projects in the Gulf of Mexico, including those involving pile driving, are permitted by the U.S. Army Corps of Engineers and are subject to section 7 consultation. Many construction projects in the Gulf of Mexico include measures as part of the proposed action in order to reduce the potential for high levels of sound exposure to ESA-listed resources from construction activities including using a vibratory hammer, operating according to seasonal work windows, and the use of noise abatement measures (e.g., bubble curtains, Temporary Noise Attenuation Pile⁴).

It is clear that impacts may result from increased levels of anthropogenic-induced background noise or high intensity, short-term anthropogenic sounds. The majority of impacts will likely be short-term behavioral responses, although more serious impacts are possible. Despite the potential for these impacts to affect individual animals, information is not currently available to determine the potential population level effect of anthropogenic sound levels in the marine environment (MMC 2007) on ESA-listed sea turtles. More information would be required including, but not limited to, empirical data on how sound impacts an individual's growth and vital rates, how these changes impact that individual's ability to reproduce successfully, and then the relative influence of that individual's reproductive success on the population being considered. As a result, the consequences of anthropogenic sound on threatened and endangered sea turtles at the population or species scale remain uncertain.

5.10 Invasive Species

Invasive species have been referred to as one of the top four threats to the world's oceans (Pughiuc 2010; Raaymakers 2003; Raaymakers and Hilliard 2002; Terdalkar et al. 2005; Wambiji et al. 2007). A variety of vectors are thought to have introduced non-native species to the Gulf of Mexico including, but not limited to, aquarium and pet trades, recreation, and ballast water discharges from ocean-going vessels. Common impacts of invasive species are alteration of habitat and nutrient availability, as well as altering species composition and diversity within an ecosystem (Strayer 2010).

Shifts in the base of food webs, a common result of the introduction of invasive species, can fundamentally alter predator-prey dynamics up and across food chains (Moncheva and Kamburska 2002), potentially affecting prey availability and habitat suitability for ESA-listed species. For example, the Asian tiger prawn was introduced to the Gulf of Mexico and poses a significant threat to native shrimp, crabs, and mollusks as a predator. It also is known to carry diseases not native to certain areas of the Gulf (e.g., the Texas coast) that could infect and devastate native shrimp and blue crab populations. Since loggerhead sea turtles in coastal waters

⁴ Temporary Noise Attenuation Pile are sleeves placed over the pile during installation consisting of a casing lined with noise-insulating foam.

are omnivorous and known to feed on crabs and mollusks (Graham et al. 2003b; NMFS 2010), the invasion of Asian tiger prawn could affect food availability for loggerheads in coastal areas of the Gulf of Mexico. The Australian jellyfish predate on larval fishes and invertebrates and can negatively impact the recruitment of fish species such as red drum and spotted seatrout (Chilton et al. 2011; Graham et al. 2003a), potentially resulting in impacts throughout the food web. Lionfish is another invasive species that has been found in the Gulf of Mexico (Schofield 2010). The species is known to predate on coral and more than 70 species of native fish, potentially leading to food web changes that could affect ESA-listed species (NMFS 2014a). Red tide dinoflagellates have been introduced into the Gulf of Mexico via ballast water discharges and have the potential to undergo extreme seasonal population fluctuations. During bloom conditions, high levels of neurotoxins are released into local and regional surface water and air that can cause illness and death in fishes, sea turtles, marine mammals, and invertebrates (as well as their larvae) (Hallegraeff and Bolch 1992; Hallegraeff 1998; Hamer et al. 2001; Hamer et al. 2000; Lilly et al. 2002; McMinn et al. 1997). The brown alga, *Aureococcus anophagefferens*, causes brown tide when it blooms, causing diebacks of eelgrass habitat due to blooms decreasing light availability and failure of scallops and mussels to recruit (Doblin et al. 2004).

Several states in the Gulf of Mexico have Aquatic Nuisance Species management plans in place describing efforts to detect and monitor aquatic nuisance species, prevention efforts to stop their introduction and spread, and control efforts to reduce their impacts. The federal government (e.g., NOAA, United States Geological Survey) is also leading efforts to prevent and control the spread of invasive species in the Gulf of Mexico. For example, NOAA's Office of National Marine Sanctuaries has developed a lionfish management plan to guide the prevention, early detection, control, management, and research at the Florida Keys and the Flower Garden Banks.

5.11 Climate Change

This section provides a general overview of climate change and its potential impacts on marine organisms.

The Fifth Assessment Synthesis Reports from the Working Groups on the Intergovernmental Panel on Climate Change conclude that climate change is unequivocal (IPCC 2014). The Report concludes oceans have warmed, with ocean warming the greatest near the surface (e.g., the upper 75 m [246 ft] have warmed by 0.11°C per decade over the period 1971 to 2010) (IPCC 2014). Global mean sea level rose by 0.19 m (0.6 ft) between 1901 and 2010, and the rate of sea level rise since the mid-nineteenth century has been greater than the mean rate during the previous two millennia (IPCC 2014). The Intergovernmental Panel on Climate Change projects a rise of the world's oceans from 0.26 to 0.98 m (0.85 to 3.22 ft) by the end of the century, depending on the level of greenhouse gas emissions. Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014) and this rise has been linked to climate change.

Climate change is also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, heat waves, and droughts (IPCC 2014).

Specific to the Southeastern U.S., climate change is projected to lead to a number of impacts including increases in air and water temperatures, decreased water availability, an increase in the frequency of severe weather events, and ecosystem change. Average annual temperatures are predicted to increase four to nine degrees Fahrenheit (USGCRP 2009). It is suggested that heavier rainfall is expected, separated by increased dry periods, which would result in increased risk of flooding and drought (IPCC 2014). (Biasutti et al. 2012) noted that sea level rise is likely the greatest threat to coastal areas of the Gulf of Mexico, as even small amounts of sea level rise could inundate significant areas of the region. Figure 12 illustrates sea level projections for the continental United States. Areas experiencing little to no change in mean sea level are illustrated in green. Areas illustrated with positive sea level trends (yellow-to-red) are experiencing both global sea level rise and lowering or sinking of the local land, causing an apparently exaggerated rate of relative sea level rise. For example, some areas in Texas and Louisiana are experiencing subsiding land elevations, which are further exacerbating effects of sea level rise (NOAA 2013).

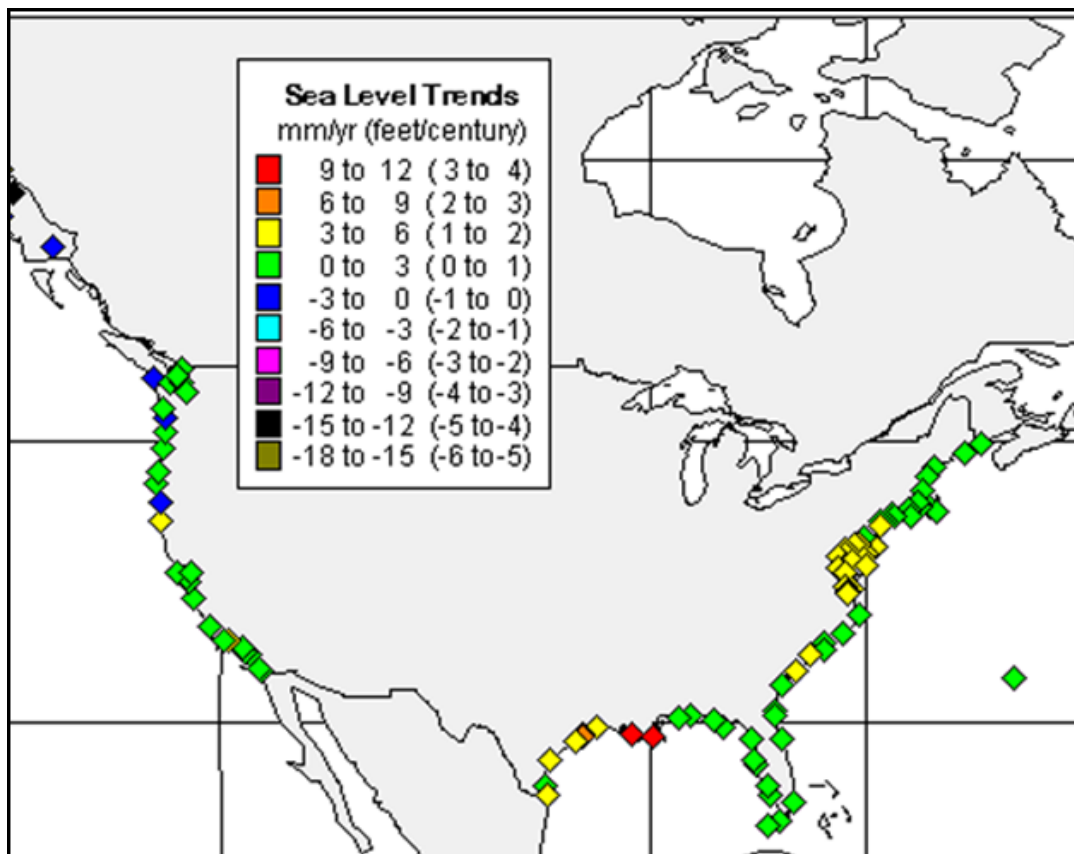


Figure 12. Regional mean sea level trends. Source: (IPCC 2014).

Climate change is expected to have a number of impacts on the aquatic ecosystem of the northern Gulf of Mexico (IPCC 2014), likely resulting in impacts to marine species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. Sea level rise and increasingly frequent coastal storms and hurricanes and associated storm surges will affect shorelines, altering coastal wetland hydrology, geomorphology, biotic structure, and nutrient cycling (Michener et al. 1997). Furthermore, an increase in atmospheric carbon dioxide concentrations is projected to increase freshwater discharge from the Mississippi River to the coastal ocean, decrease aquatic oxygen content, and expand the hypoxic zone in the northern Gulf of Mexico (Justic et al. 1997). Sea level rise could result in more frequent flooding of low-lying areas, which would permanently alter some ecological communities (Simmonds and Isaac 2007; USGCRP 2009).

Though predicting the precise consequences of climate change on highly mobile marine species, such as many of those considered in this opinion and conference report is difficult, (Simmonds and Isaac 2007) recent research has indicated a range of consequences already occurring. Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined top predator distribution and diversity and predicted that some species would experience gains in available core habitat (e.g., leatherback sea turtle) and some would to experience losses (e.g., loggerhead sea turtles, blue whales).

Similarly, climate-mediated changes in important prey species populations are likely to affect predator populations. For ESA-listed species that undergo long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Elliott. 2009). Specific to the Gulf of Mexico, Fodrie et al. (2009) observed measurable changes in nearshore fish assemblages in the northern Gulf of Mexico. Such changes in community structure have the potential to affect ESA-listed species that occupy these nearshore habitats (e.g., sea turtles).

Changes in global climatic patterns are expected to have profound effects on coastlines worldwide, potentially having significant consequences for the species considered in this opinion and conference report that are partially dependent on terrestrial habitat areas (i.e., sea turtles). For example, rising sea levels are projected to inundate some sea turtle nesting beaches (Caut et al. 2009a; Fodrie et al. 2009; Wilkinson and Souter 2008), change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). The loss of nesting beaches may have catastrophic effects on global sea turtle populations if they are unable to colonize new beaches, or if new beaches do not provide the habitat attributes (e.g., sand depth, temperature regimes, and refuge) necessary for egg survival. Additionally, increasing temperatures in sea turtle nests, as is expected with climate change, alters sex ratios, reduces incubation times (producing smaller hatchlings), and reduces nesting success due to exceeded

thermal tolerances (Fuentes et al. 2009a; Fuentes et al. 2010; Fuentes et al. 2009b; Glen et al. 2003).

In some locations, rising sea levels are projected to inundate some sea turtle nesting beaches (Caut et al. 2009a; Wilkinson and Souter 2008), change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). The loss of nesting beaches may have catastrophic effects on sea turtle populations if they are unable to colonize new beaches, or if new beaches do not provide the habitat attributes (e.g., sand depth, temperature regimes, and refuge) necessary for egg survival. As stated in the proposed rule (80 FR 15271), it remains unclear how nesting habitat loss will impact future nesting in the Hawaiian Islands. Additionally, increasing temperatures in sea turtle nests, as is expected with climate change, alters sex ratios, reduces incubation times (producing smaller hatchlings), and reduces nesting success due to exceeded thermal tolerances (Fuentes et al. 2009a; Fuentes et al. 2010; Fuentes et al. 2009b; Glen et al. 2003). Changes in global temperatures could also affect juvenile and adult distribution patterns. Possible changes to ocean currents and dynamics may result in negative effects to natural dispersal during a complex life cycle (Houtan and Halley 2011), and possible nest mortality linked to erosion may result from increased storm frequency (Van Houtan and Bass 2007) and intensity (Keller et al. 2009). All of these temperature related impacts have the potential to significantly impact sea turtle reproductive success and ultimately, long-term species viability.

Poloczanska et al. (2009) noted that extant marine turtle species have survived past climatic shifts, including glacial periods and warm events, and therefore, may have the ability to adapt to ongoing climate change (e.g., by finding new nesting beaches). However, the authors also suggested since the current rate of warming is very rapid, expected changes may outpace sea turtles' ability to adapt. Hawkes et al. (2009) stated that if turtles cannot adapt quickly, they may face local to widespread extirpations (cited in 80 FR 15271).

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

5.12 Summary and Synthesis of Environmental Baseline

In summary, several factors are presently adversely affecting ESA-listed species in the action area. These factors include, but are not limited to, Department of Defense activities, fisheries, vessel activity, oil and gas activities, research permits allowing take under the ESA, aquaculture, decommissioning of platforms, marine debris, pollution, disease, nutrient loading and hypoxia,

anthropogenic sound, invasive species, and climate change. These factors are ongoing and are expected to occur contemporaneously with the proposed action. Increased shoreline and coastal development is expected to exacerbate and increase the magnitude and effect of many of these factors (e.g., pollution). Also of note, the *Deepwater Horizon* oil spill and response resulted in a wide range of adverse impacts to several of the ESA-listed species considered in this opinion and conference report. Additionally, certain regulatory, conservation, and recovery actions aimed at benefiting ESA-listed resources help shape the environmental baseline.

6 EFFECTS OF THE ACTION ON ESA-LISTED SPECIES AND CRITICAL HABITAT

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

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

6.1 Stressors Associated with the Proposed Action

The potential stressors to ESA-listed species from the Air Force’s proposed action in the EGTTR action area are physical disturbance, boat strikes, debris, and effects from noise and pressure produced by detonations (Table 29). We assessed the potential for each of these stressors to adversely affect ESA-listed species in the action area (Table 30) and summarized below.

Table 29. Air Force stressor categories and description of the stressors analyzed in this opinion and conference report.

Stressor	Description of Stressor
Acoustic (launch and detonation noise from explosives, aircraft noise)	<p>Effects on species from acoustic sources (e.g., explosives) are dependent on a number of factors, including the proximity of the animal to the sound source, and the duration, frequency, and intensity of the sound.</p> <p>Underwater sound propagation is highly dependent upon environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location will be different than near the source due to the interaction of many factors, including propagation loss; how the sound is reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation.</p> <p>Detonations would occur near the water's surface over waters generally less than 200 m (656 ft) deep.</p> <p>Noise associated with munitions firing and explosives at the surface could occur anywhere within the impact area. Sound could be generated by the launch or dropping of the munitions, the munition flying through the air, the detonation at the surface of the water, or through vibrations from detonations that propagate through the water.</p>
Physical disturbance and strike (military)	<p>Physical disturbances, including direct strikes on ESA-listed animals, may occur in association with munitions deployment and materials expended from detonations at the water surface.</p> <p>Military expended materials include all pieces and fragments from explosive munitions, which have the potential to contribute to</p>
Ingestion of munition debris fragments	<p>Sea turtles could ingest fragments of exploded bombs and missiles.</p> <p>Fragments would result from fractures in the munitions casing and would vary in size depending on the size of the net explosive weight and munition type. The solid metal materials should quickly sink through the water column and settle to the seafloor.</p>

<p>Secondary stressors (explosion byproducts, metals, and chemicals)</p>	<p>Secondary stressors associated with explosive ordnance activities could pose indirect impacts to ESA-listed marine species through habitat degradation, habitat alteration, or an effect on prey availability. Effects to habitat and prey availability may result from: (1) explosives, (2) explosion byproducts and unexploded ordnance, (3) metals, or (4) chemicals.</p> <p>In addition to directly impacting marine species, explosions could impact other species in the food web, including prey species that ESA-listed marine species feed on. The impacts of explosions would differ depending upon the type of prey species in the detonation area.</p> <p>Explosion byproducts are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Metals are introduced into seawater and sediments as a result of explosive ordnance activities.</p>
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Table 30. Stressors associated with the EGTTR activities in the action area and NMFS's effects determination for ESA-listed species. The species in bold are those that are likely to be adversely affected by the Air Force's ongoing EGTTR activities.

Species Common Name	Overall ESA Determination	Effect Determinations by Stressor						
		Acoustic			Physical		Ingestion	Secondary
		Explosives	Weapons Firing/Launch Noise	Aircraft and Vessel Noise	Military Expended Materials	Vessel or Munition Strike	Munitions	Explosion Byproducts, Metals, Chemicals, and Food Web Effects
Bryde's Whale – Gulf of Mexico DPS	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sperm Whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Gulf Sturgeon	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Hawksbill Sea Turtle	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Green Sea Turtle – North Atlantic DPS	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Loggerhead Sea Turtle – Northwest Atlantic DPS	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Kemp's Ridley Sea Turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Leatherback Sea Turtle	LAA	LAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

6.2 Stressors Not Likely to Adversely Affect ESA-Listed Species

The following section discusses stressors that are not likely to adversely affect ESA-listed species. If a stressor is likely to adversely affect any of the ESA-listed species in the action area, it is carried forward in our effects analysis.

6.2.1 Effects of Aircraft Noise

Many of the activities that the Air Force conducts in the action area involve some level of activity from aircraft, including helicopters, bombers, and fighter jets. Low-flying aircraft produce sounds that marine mammals and sea turtles can hear when they occur at or near the ocean's surface. Underwater sounds from aircraft are strongest just below the surface and directly under the aircraft. Sounds from aircraft would not have physical effects on marine mammals or sea turtles, but represent acoustic stimuli (primarily low-frequency sounds from engines and rotors) that have been reported to affect the behavior of some marine mammals and sea turtles. It should also be noted that the air-sea interface constitutes a substantial sound barrier, with sound waves in the water being reduced by a factor of more than a thousand when they cross this boundary (Hildebrand 2005).

We did not estimate the number of ESA-listed fish, marine mammals, or sea turtles that are likely to be exposed to noise from aircraft overflight or other fixed or rotary-wing aircraft operations at altitudes low enough for the sounds to be prominent at, or immediately below, the ocean's surface. We assume any ESA-listed species that occur in the action area during activities that involve aircraft are likely to be exposed to minor acoustic stimuli associated with aircraft traffic.

The lack of substantial sound propagation in to the water column from aircraft indicates there is a low probability of exposing fish to aircraft noise at perceivable levels. In the event an ESA-listed fish species (e.g., Gulf sturgeon) was exposed to aircraft noise, it would likely result in very minor temporary behavioral responses such as a startle response.

Studies have shown that aircraft presence and operation can result in changes in behavior of cetaceans (Arcangeli and Crosti 2009; Holt et al. 2009; Luksenburg and Parsons 2009b; Noren et al. 2009; Patenaude et al. 2002; Richter et al. 2006; Richter et al. 2003b; Smultea et al. 2008). In a review of aircraft noise effects on marine mammals, Luksenburg and Parsons (2009a) determined that the sensitivity of whales and dolphins to aircraft noise may depend on the animals' behavioral state at the time of exposure (e.g. resting, socializing, foraging or travelling) as well as the altitude and lateral distance of the aircraft to the animals. While resting animals seemed to be disturbed the most, low flying aircraft with close lateral distances over shallow water elicited stronger disturbance responses than higher flying aircraft with greater lateral distances over deeper water (Patenaude et al. 2002; Smultea et al. 2008) in Luksenburg and Parsons (2009a).

Thorough reviews on the behavioral reactions of marine mammals to aircraft and missile overflight are presented in Richardson et al. (1995c), Efroymsen et al. (2000), Luksenburg and

Parsons (2009b), and Holst et al. (2011). The most common responses of cetaceans to aircraft overflights were short surfacing durations, abrupt dives, and percussive behavior (breaching and tail slapping) (Nowacek et al. 2007). Other behavioral responses such as flushing and fleeing the area of the source of the noise have also been observed (Holst et al. 2011; Manci et al. 1988). Richardson et al. (1995c) noted that marine mammal reactions to aircraft overflight largely consisted of opportunistic and anecdotal observations. These observations lack a clear distinction between reactions potentially caused by the noise of the aircraft and the visual cue an aircraft presents. In addition, it was suggested that variations in the responses noted were due to other undocumented factors associated with overflight (Richardson et al. 1995c). These factors could include aircraft type (single engine, multi-engine, jet turbine), flight path (centered on the animal, off to one side, circling, level and slow), environmental factors such as wind speed, sea state, cloud cover, and locations where native subsistence hunting continues.

Mysticetes either ignore or occasionally dive in response to aircraft overflights (Efroymsen et al. 2000; Koski et al. 1998). Richardson et al. (1995c) reported that while data on the reactions of mysticetes is meager and largely anecdotal, there is no evidence that single or occasional aircraft flying above mysticetes causes long-term displacement of these mammals. In general, overflights above 305 m (1,000 ft) do not cause a reaction.

Variable responses to aircraft have been observed in toothed whales, though overall little change in behavior has been observed during flyovers. Toothed whale responses to aircrafts include diving, slapping the water with their flukes or flippers, swimming away from the direction of the aircraft, or not visibly reacting (Richardson et al. 1995c). Several authors have reported that sperm whales did not react to fixed-wing aircraft or helicopters in some circumstances (Au and Perryman 1982b; Clarke 1956a; Gambell 1968; Green et al. 1992a) and reacted in others (Clarke 1956a; Fritts et al. 1983b; Mullin et al. 1991; Patenaude et al. 2002; Richter et al. 2006; Richter et al. 2003a; Smultea et al. 2008; Wursig et al. 1998). Smultea et al. (2008) studied the response of sperm whales to low-altitude (233 to 269 m [764.4 to 882.5 ft]) flights by a small fixed-wing airplane near Kauai and reviewed data available from other studies. They concluded that sperm whales responded behaviorally to aircraft passes in about 12 percent of encounters. All of the reactions consisted of sudden dives and occurred when the aircraft was less than 360 m (1,181.1 ft) from the whales (lateral distance). They concluded that the sperm whales had perceived the aircraft as a predatory stimulus and responded with defensive behavior. In at least one case, Smultea et al. (2008) reported that the sperm whales formed a semi-circular “fan” formation that was similar to defensive formations reported by other investigators.

Other authors have corroborated the variability in sperm whales’ reactions to fixed-wing aircraft or helicopters (Green et al. 1992b; Richter et al. 2006; Richter et al. 2003b; Smultea et al. 2008; Wursig et al. 1998). In one study, sperm whales showed no reaction to a helicopter until they encountered the downdrafts from the rotors (Richardson et al. 1995c). A group of sperm whales responded to a circling aircraft (altitude of 244 to 335 m [800 to 1,100 ft]) by moving closer together and forming a defensive fan-shaped semicircle, with their heads facing outward. Several

individuals in the group turned on their sides, apparently to look up toward the aircraft (Smultea et al. 2008). Whale-watching aircraft apparently caused sperm whales to turn more sharply but did not affect blow interval, surface time, time to first click, or the frequency of aerial behavior (Richter et al. 2003b). Air Force aircraft do not fly at low altitude, hover over, or follow whales and so are not expected to evoke this type of response.

Based on sea turtle sensory biology (Bartol et al. 1999a; Ketten and Bartol 2005; Ketten and Bartol 2006; Lenhardt et al. 1994; Ridgway et al. 1969), sound from low flying aircraft could be heard by a sea turtle that is at or near the surface. Turtles might also detect low flying aircraft via visual cues such as the aircraft's shadow. Hazel et al. (2007) suggested that green turtles rely more on visual cues than auditory cues when reacting to approaching water vessels. This suggests that sea turtles might not respond to aircraft overflights based on noise alone.

In conclusion, the low number of aircraft flights, typical altitudes of flights, sporadic occurrence of flights, limited duration of flights, deep water depths in some of the action area, and the lack of substantial sound propagation into the water column from aircraft indicate there is a low probability of exposing ESA-listed fish, marine mammals, and sea turtles to aircraft noise at perceivable levels. In the event an ESA-listed species was exposed to aircraft noise, it would likely result in temporary behavioral responses. These behavioral responses would not increase the likelihood of injury from significantly disrupting breeding, feeding, or sheltering and would not rise to the level of take. Therefore, the effects of aircraft noise on ESA-listed species are insignificant and not likely to adversely affect them.

6.2.2 Effects of Vessel Noise

Gulf sturgeon may be exposed to noise from vessels in nearshore environments when Air Force vessels transit from Eglin AFB to locations where explosive detonations will occur. According to Popper et al. (2014a), there is no direct evidence of mortality or injury to fish from vessel noise. Further, TTS from continuous sound sources (e.g., vessel noise) has only been documented in fish species that have specializations for enhanced sensitivity to sound. Gulf sturgeon do not have such specializations. Data for species which do not have these specializations have shown no TTS in response to long term exposure to continuous noise sources (Popper et al. 2014a). This includes a study of rainbow trout (*Oncorhynchus mykiss*) exposed to increased noise for nine months in an aquaculture facility. The study also did not document any negative effects on the health of the fish from this increased exposure to noise (Popper et al. 2014a; Wysocki et al. 2007b). Popper et al. (2014a) suggest that low frequency vessel noise (primarily from shipping traffic) may mask sounds of biological importance. Gulf sturgeon do not have hearing specializations (which would indicate they may rely heavily on hearing for essential life functions) and they are able to rely on alternative mechanisms (e.g., sight, lateral line system) to detect prey, avoid predators, and orient in the water column (Popper et al. 2014a). Additionally, any potential masking would be temporary as both the fish and vessel would be transiting the action area (likely at different speeds and in different directions). For these reasons, we do not

expect any short-term instances of masking to have any fitness consequences for any individual Gulf sturgeon. Vessel activity may result in changes in fish behavior (Popper et al. 2014a). However, any behavioral responses to vessel noise are expected to be temporary (e.g., a startle response, brief avoidance behavior) and we do not expect these reactions to have any measurable effects on any individual's fitness.

Numerous studies of interactions between surface vessels and marine mammals have demonstrated that free-ranging marine mammals engage in avoidance behavior when surface vessels move toward them. It is not clear whether these responses are caused by the physical presence of a surface vessel, the underwater noise generated by the vessel, or an interaction between the two (Amaral and Carlson 2005; Au and Green 2000; Bain et al. 2006; Bauer 1986; Bejder et al. 1999; Bejder and Lusseau. 2008; Bejder et al. 2009; Bryant et al. 1984; Corkeron 1995; Erbe 2002; Félix 2001; Goodwin and Cotton 2004; Lemon et al. 2006; Lusseau 2003; Lusseau 2006; Magalhaes et al. 2002; Nowacek et al. 2001; Richter et al. 2003b; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002b; Wursig et al. 1998). However, several authors suggest that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994). These studies suggest that the behavioral responses of marine mammals to surface vessels are similar to their behavioral responses to predators.

Based on the suite of studies of cetacean behavior to vessel approaches (Au and Perryman 1982a; Bain et al. 2006; Bauer and Herman 1986; Bejder et al. 1999; Bejder et al. 2006a; Bejder et al. 2006b; Bryant et al. 1984; Corkeron 1995; David 2002; Felix 2001; Goodwin and Cotton 2004; Hewitt 1985; Lusseau 2003; Lusseau 2006; Magalhaes et al. 2002; Nowacek et al. 2001; Richter et al. 2006; Richter et al. 2003b; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams and Ashe 2007; Williams et al. 2002b; Wursig et al. 1998) (Acevedo 1991b; Aguilar Soto et al. 2006; Arcangeli and Crosti 2009; Au and Green 2000; Christiansen et al. 2010; Erbe 2002; Noren et al. 2009; Stensland and Berggren 2007; Stockin et al. 2008; Williams et al. 2009), the set of variables that help determine whether marine mammals are likely to be disturbed by surface vessels include:

- *Number of vessels.* The behavioral repertoire marine mammals have used to avoid interactions with surface vessels appears to depend on the number of vessels in their perceptual field (the area within which animals detect acoustic, visual, or other cues) and the animal's assessment of the risks associated with those vessels (the primary index of risk is probably vessel proximity relative to the animal's flight initiation distance) (Sims et al. 2012).
- Below a threshold number of vessels (which probably varies from one species to another, although groups of marine mammals probably share sets of patterns), studies have shown that whales will attempt to avoid an interaction using horizontal avoidance behavior. Above that threshold, studies have shown that marine mammals will tend to avoid

interactions using vertical avoidance behavior, although some marine mammals will combine horizontal avoidance behavior with vertical avoidance behavior (Bryant et al. 1984; David 2002; Kruse 1991; Lusseau 2003; Nowacek et al. 2001; Stensland and Berggren 2007; Williams and Ashe 2007);

- *The distance between vessel and marine mammals* when the animal perceives that an approach has started and during the course of the interaction (Au and Perryman 1982a; David 2002; Hewitt 1985; Kruse 1991; Lundquist et al. 2012; Lusseau 2003; Tseng et al. 2011);
- *The vessel's speed and vector* (David 2002);
- *The predictability of the vessel's path*. That is, cetaceans are more likely to respond to approaching vessels when vessels stay on a single or predictable path (Acevedo 1991a; Angradi et al. 1993; Browning and Harland. 1999; Lusseau 2003; Lusseau 2006; Williams et al. 2002a) than when it engages in frequent course changes (Evans et al. 1994; Lusseau 2006; Williams et al. 2002a);
- *Noise associated with the vessel* (particularly engine noise) and the rate at which the engine noise increases (which the animal may treat as evidence of the vessel's speed) (David 2002; Lusseau 2003; Lusseau 2006; Polagye et al. 2011);
- *The type of vessel* (displacement versus planing), which marine mammals may be interpret as evidence of a vessel's maneuverability (Goodwin and Cotton 2004);
- *The behavioral state of the marine mammals* (David 2002; Lusseau 2003; Lusseau 2006; Wursig et al. 1998). For example, Würsig et al. (Würsig et al. 1998) concluded that whales were more likely to engage in avoidance responses when the whales were milling or resting than during other behavioral states.

Most of the investigations reported that animals tended to reduce their visibility at the water's surface and move horizontally away from the source of disturbance or adopt erratic swimming strategies (Corkeron 1995; Lundquist et al. 2012; Lusseau 2003; Lusseau 2004; Nowacek et al. 2001; Van Parijs and Corkeron 2001; Williams et al. 2002a; Williams et al. 2002b). In the process, their dive times increased, vocalizations and jumping were reduced (with the exception of beaked whales), individuals in groups move closer together, swimming speeds increased, and their direction of travel took them away from the source of disturbance (Baker and Herman 1989; Edds and Macfarlane 1987; Evans et al. 1992; Kruse 1991). Some individuals also dove and remained motionless, waiting until the vessel moved past their location. Most animals finding themselves in confined spaces, such as shallow bays, during vessel approaches tended to move towards more open, deeper waters (Kruse 1991). We assume that this movement would give them greater opportunities to avoid or evade vessels as conditions warranted.

Würsig et al. (1998) studied the behavior of cetaceans in the northern Gulf of Mexico in response to survey vessels and aircraft. They reported that false killer whales either did not respond or approached the ship (most commonly to ride the bow). Four of 15 sperm whales avoided the ship while the remainder appeared to ignore its approach.

Although most of these studies focused on small cetaceans (for example, bottlenose dolphins, spinner dolphins, spotted dolphins, harbor porpoises, beluga whales, and killer whales), studies of large whales have reported similar results for fin and sperm whales (David 2002). Baker et al. (1983) reported that humpbacks in Hawaii responded to vessels at distances of two to four km (1.1 to 2.2 nmi). Richardson et al. (1985) reported that bowhead whales (*Balaena mysticetus*) swam in the opposite direction of approaching seismic vessels at distances between one and four km (0.5 to 2.2 nmi) and engage in evasive behavior at distances under 1 km. Fin whales also responded to vessels at a distance of about one km (Edds and Macfarlane 1987). A study by Lundquist (2012) on dusky dolphins concluded that repeated disturbance from tour vessel traffic may interrupt social interactions, and postulated that those repeated disturbances may carry energetic costs, or otherwise affect individual fitness. However, they were unable to determine if such disturbances were likely to cause long-term harm. For behavioral responses to result in energetic costs that result in long-term harm, such disturbances would likely need to be sustained for a significant duration or extent where individuals exposed would not be able to select alternate habitat to recover and feed. Air Force EGTTR activities would not likely result in such prolonged exposures or preclusion of individuals from feeding, breeding, or sheltering habitat.

The majority of vessels used during Air Force EGTTR activities are relatively small boats, ranging in size from 7.6 to 12.2 m (25 to 40 ft) (e.g., during Swarm missions). Most of the vessel activity associated with the proposed action will occur in areas where ESA-listed marine mammals are not expected to occur (i.e., in relatively shallow water areas where detonations will occur). If an ESA-listed marine mammal (e.g., sperm whale) and an Air Force vessel were to co-occur, the available evidence leads us to expect marine mammals to treat Air Force vessels as stressors. However, most avoidance responses would consist of slow movements away from vessels the animals perceive are on an approaching course, perhaps accompanied by slightly longer dives. Most of the changes in behavior would consist of a temporary shift from behavioral states that have low energy requirements (resting or milling) to behavioral states with higher energy requirements (active swimming or traveling) and then returning to the resting or milling behavior. ESA-listed sea turtles may have a brief startle response, but may also ignore Air Force vessels entirely and continue behaving as if the vessels and any risks associated with those vessels did not exist (Hazel et al. 2007).

Given the short duration of vessel noise stressors, the infrequency of this stressor, and the temporary nature of biological responses of fish, marine mammals, and sea turtles to this stressor, these ESA-listed species are either not likely to respond or are not likely to respond in ways that might be adverse (the responses might represent an approach or attentive movement, a small change in orientation in the waters, etc.). In conclusion, ESA-listed species are either not

likely to respond to vessel noise or are not likely to measurably respond in ways that would significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Therefore, the effects of noise from Air Force vessels on ESA-listed species are insignificant and not likely to adversely affect them.

6.2.3 Effects of Weapons Launch Noise

Munitions are not expected to have sound waves emanating from the firing source that would be of sufficient intensity to propagate a sound wave into the water that could adversely affect ESA-listed species. This is partially due to the height above the surface of the water that the munition and other weapons would be released from (i.e., between 1,219.2 and 7,620 m [4,000 and 25,000 ft]), but also due to minimal transmission of sound from air to water (Hildebrand 2005). Even if an animal were exposed to noise from a weapons launch, at most we would expect a temporary behavioral response, similar to how an animal may respond to aircraft noise.

In conclusion, due to the short duration and sporadic nature of munition firing, the low likelihood that an ESA-listed animal would be close enough to detect sound from munition firing above the surface of the water, and the high likelihood that any ESA-listed animal able to detect noise from weapons firing would only react very briefly, an increase in the likelihood of injury from significant disruption of breeding, feeding, or sheltering for ESA-listed marine mammals or sea turtles is not likely. Therefore, the effects of weapons launch noise on ESA-listed fish, marine mammals, and sea turtles are insignificant and not likely to adversely affect them.

6.2.4 Effects of Munitions Debris and Target Fragments

The only materials small enough to be ingested by sea turtles are gunnery rounds, fragments from explosive ordnance (bombs and missiles), and pieces of damaged targets. The gunnery rounds and detonations are expected to pass through boats and other targets and fragments will likely sink quickly and settle on the seafloor. Pieces of damaged targets (i.e., plastic, plywood, and parachutes) could be suspended in the water column or sink to the seafloor. The potential for ingestion of debris is a function of the amount of debris generated, location of the debris, and the species' feeding methods. Floating materials, such as target debris, could be eaten by species that feed at or near the surface (e.g., leatherback sea turtles, juvenile loggerheads), while items such as munitions (gunnery round and other small debris) sinking to the seafloor could be ingested by bottom-feeding species such as loggerhead, Kemp's ridley, and green sea turtles. Sea turtles could be directly or indirectly impacted by debris through ingestion or entanglement.

Animals may attempt to ingest a piece of debris and then reject it after realizing it is not a food item. If ingested, effects on an individual sea turtle would depend on the size and shape of the debris item relative to the size of the animal. Ingestion of items does not necessarily result in injury or mortality to the individual if the item does not become embedded in tissue (Wells et al. 2008). It is likely that most ingested material would pass through the digestive tract of the animal. Therefore, impacts of fragment ingestion would be limited to the unlikely event where a

sea turtle might suffer a negative response from ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system.

After missions involving boat targets are completed, boat crews would clean up the area by removing floating debris (particularly larger debris), but it is likely that numerous pieces small enough to be ingested by a sea turtle would remain in the water. The probability of a sea turtle ingesting debris at the sea surface is low due to items being dispersed by currents and the wind and due to the patchy distribution of turtles in the northern Gulf of Mexico. Given this, and the limited time most debris will spend in the water column, it is not reasonably expected these items will be accidentally ingested by ESA-listed species not accustomed to foraging on the sea floor. The seafloor in the W-151 action area is sandy with little relief and few bottom features, which is expected to have sporadic and low-density food items (e.g., submerged vegetation, benthic invertebrates, etc.) for sea turtle species. Debris is expected to accumulate at the GRATV target location due to the high number of missions planned. This could possibly function as habitat for benthic species and attract sea turtles as well as increase the potential of ingesting small debris in this location relative to others. Debris on the seafloor is expected to be colonized by attaching and encrusting organisms over time, which would reduce the potential for ingestion by animals.

The Air Force projects that about 40 parachutes during CBU-105 munitions could be deposited in the action area each year. Sea turtles could potentially become entangled in the parachute or the attached cords and lines at the sea surface, water column, or seafloor. An entangled animal may be able to free itself or it could result in behavioral impacts, injury, decreased feeding ability, or death. It is unknown the rate that a parachute would sink and the time it may spend in the water column, but it is expected to move some distance due to currents and wind before eventually reaching the seafloor. Parachutes on the seafloor are expected to be covered by sediment as well as colonized by attaching and encrusting organisms over time, which would reduce the potential for ingestion by animals. The probability of a sea turtle becoming entangled in parachutes is low due to the small number used during EGTTR activities, the patchy distribution of animals, and eventual covering of parachutes by sediments on the seafloor.

In conclusion, ESA-listed fish and sea turtles are so unlikely to ingest expended material or become entangled in parachutes as to be discountable. Therefore, the munitions debris and target fragments are not likely to adversely affect ESA-listed fish and sea turtles. Gulf of Mexico DPS of Bryde's whales and sperm whales would not be expected to encounter munitions debris and other target fragments due to the lack of co-occurrence of this species and munitions activities. The likelihood of a Gulf of Mexico DPS Bryde's whale and sperm whale encountering debris from EGTTR activities is so low as to be considered discountable. Therefore, munitions debris and target fragments are not likely to adversely affect Gulf of Mexico DPS Bryde's whales and sperm whales.

6.2.5 Effects of Secondary Stressors

The use of explosive ordnance could pose indirect impacts to ESA-listed species through impacts to their habitat or prey. Underwater explosions may reduce available prey items for ESA-listed

species by either directly killing prey or by scaring them from the area. Behavioral avoidance of explosive ordnance by prey species may facilitate behavioral avoidance of additional explosives by ESA-listed species as they follow their food source as it flees. This benefit would remove ESA-listed species from blast locations while not interrupting feeding behavior. Due to the infrequent use of explosives and the limited area where explosives are used, it is not expected their use will have a persistent effect on prey availability or the health of the aquatic food web.

Metals used to construct the bombs and missile used by the Air Force include aluminum, steel, and lead. Aluminum is also present in some explosive materials such as tritonal and AFX-757. Metals would be expected to settle to the seafloor after munitions are detonated. Metal ions would slowly leach into the substrate and the water column, causing elevated concentrations in a small localized area around munition fragments. Some of the metals, such as aluminum, occur naturally in the ocean at varying concentrations and would not necessarily impact the substrate or water column. Other metals, such as lead, could cause toxicity in microbial communities in the substrate (Department of the Air Force 2016). However, such effects would be localized and would not significantly affect the overall habitat quality of sediments in the action area. In addition, metal fragments would corrode, degrade, and become encrusted over time. It is extremely unlikely that marine mammals and sea turtles would be indirectly impacted by metals via the water column or sediment because of the small area that could be affected, dilution of any potentially harmful elements leached into the water column, and the low density of ESA-listed species in the area where metals may occur.

Chemical materials include explosive byproducts. Explosive byproducts would be introduced into the water column through detonation of live munitions. Explosive materials associated with EGTTR activity munitions include tritonal and research department explosive, among others. Tritonal is primarily composed of trinitrotoluene. Research department explosive is sometimes referred to as cyclotrimethylenetrinitramine. Various byproducts are produced during and immediately after detonation of research department explosive. During the very brief time that a detonation is in progress, intermediate products may include carbon ions, nitrogen ions, oxygen ions, water, hydrogen cyanide, carbon monoxide, nitrogen gas, nitrous oxide, cyanic acid, and carbon dioxide (Becker 1995). However, reactions quickly occur between the intermediates, and the final products consist mainly of water, carbon monoxide, carbon dioxide, and nitrogen gas, although small amounts of other compounds may be produced as well. Chemicals introduced to the water column would be quickly dispersed by waves, currents, and tidal action and eventually be distributed throughout the surrounding open ocean waters. A portion of the carbon compounds, such as carbon monoxide and carbon dioxide, would likely become integrated into the carbonate system (alkalinity and pH buffering capacity of seawater). Some of the nitrogen and carbon compounds, including petroleum products, would be metabolized or assimilated during protein synthesis by phytoplankton and bacteria. Most of the gas products that do not react with the water or become assimilated by organisms would be released to the atmosphere. Due to dilution, mixing, and transformation, none of these chemicals are expected to have significant impacts on ESA-listed species or the marine environment.

Explosive material that is not consumed in a detonation could sink to the substrate and bind to sediments. However, the quantity of such materials is expected to be inconsequential. When munitions function properly, nearly full combustion of the explosive materials occurs, and only extremely small amounts of raw material remain. Additionally, trinitrotoluene decomposes when exposed to sunlight/ultraviolet radiation and is also degraded by microbial activity (Becker 1995). Several types of microorganisms have been shown to metabolize trinitrotoluene. Similarly, Research department explosive (a more powerful explosive than trinitrotoluene) is decomposed by hydrolysis, ultraviolet radiation exposure, and biodegradation (Department of the Air Force 2016).

In conclusion, given the information provided above, the effect of any low level exposure of ESA-listed fish, marine mammals, and sea turtles to explosives byproducts, metals, and chemicals is insignificant. Therefore, secondary stressors from EGTTR activities are not likely to adversely affect ESA-listed species.

6.2.6 Potential for Direct Physical Strike

This section evaluates the potential for the munitions and vessels used by the Air Force to physically strike an ESA-listed species. While this is possible, the potential direct strike by munitions (e.g., expended gunnery rounds, inert bombs, and missiles) is considered highly unlikely. The velocity of bombs and the missile will decrease quickly after the initial impact with the water, thereby decreasing the risk of direct physical strike to animals swimming in the water column at a depth below a few meters. Therefore, the potential for being struck by a bomb or munition would most likely be limited to marine mammals or sea turtles located at the water surface or in the water column close to the surface. In order to be struck, an animal would have to be at the water surface at the same time and location where the weapon would impact the surface of the water. While this is possible, the low densities (see section 3.2.3 above of this opinion and conference report) and dispersed distribution of ESA-listed marine mammals and sea turtles in the action area, as well as the low number of bombs and missiles used in the proposed action, suggest this is highly unlikely. Pre-mission surveys of the impact area (see section 2.2.2 above) would reduce this likelihood even further as a bomb or missile launch would not occur if a marine mammal or sea turtle is observed in proximity to the impact area until the animal has left the area. For these reasons, the likelihood of explosive ordnance physically striking an ESA-listed marine mammal or sea turtle during the EGTTR activities is so unlikely as to be considered discountable. Therefore, potential physical strike of munitions from EGTTR activities is not likely to adversely affect ESA-listed species.

A relatively large number of vessels could be present in a test or training area depending on the specific mission. These vessels include target boats, safety boats, swarm mission boats, and other mission-related support boats. Vessels could be moving at various speeds or stationary at any given time. Animals could be behaviorally disturbed by the operation or approach of vessels in the action area depending on factors such as speed and direction of the vessel, location of the animal in the water column, and distance between the vessel and the animal. The distance, noise

level, or change in water pressure required to alert a sea turtle to an approaching vessel is unknown; however, it is assumed that, most often, an animal would become aware and respond by attempting to swim away or dive. In contrast, a sea turtle may not respond at all to an approaching vessel (Hazel et al. 2007). Behavioral reactions could interrupt important activities such as feeding and resting, and require energy expenditure. Although an avoidance response would cause a behavioral change and reduce the amount of energy available for other biological functions, physical threats would be infrequent and brief in duration, and the energy expense is likely within the normal range experienced by a sea turtle over a short time period.

The potential for a vessel to strike a sea turtle is limited to a sea turtle located at or just beneath the water surface. The effects of a direct vessel strike could range from slight injury to death. Loggerhead sea turtles found dead or debilitated in Florida have been found with propeller wounds. The number and speed of vessels operated in an area should be considered in assessing the risk of collision between a vessel and an animal. The EGTTR activities with the greatest potential for impact from vessel strike would be swarm missions, where 25 to 30 boats would be operated in a small area at relatively high speeds (up to 30 knots). A typical scenario would involve up to three swarm missions per year, with up to four days per mission and three to four hours of boat operation per day. Depending on need and scheduling availability, a greater number of missions could occur per year. Other missions would involve lower numbers of boats and/or boats operated at lower speeds. Although the number of boats associated with air-to-surface testing and training activities would not appreciably change the typical overall background level of boat traffic in the action area, where a large number of recreational and commercial fishing boats regularly operate, there is an increased probability for sea turtles present during swarm missions to be struck.

The potential for a vessel to strike a Gulf sturgeon is limited to a fish located just beneath the water surface. The effects of a direct vessel strike could range from slight injury to death. Gulf sturgeon in the action area would be highly mobile, and would be expected to actively avoid any oncoming vessels associated with EGTTR activities.

While the possibility exists, the potential for direct strike of ESA-listed species by Air Force vessels is considered highly unlikely due to the low densities and general dispersed distribution of ESA-listed species in the action area (see section 3.2.2 of this opinion and conference report), and the relatively short surface intervals of sea turtles, as well as the intermittent schedule of swarm and other missions involving surface vessels in the action area. Also, mitigation measures that will be implemented such as avoiding large *Sargassum* spp. mats where ESA-listed sea turtles may be concentrated is expected to further reduce the potential of vessel strikes. Despite Air Force testing and training activities occurring in the action area for a number of years, the Air Force reports that no marine mammals or sea turtles have been struck by vessels during EGTTR activities (A. Robydek [Eglin AFB], personal communication to H. Goldstein [NMFS] on December 14, 2016). In conclusion, ESA-listed fish, marine mammals, and sea turtles are so unlikely to be struck by an Air Force vessel as to be discountable. Therefore, vessel strike from EGTTR activities is not likely to adversely affect ESA-listed species.

6.3 Mitigation to Minimize or Avoid Exposure

The Air Force will implement visual aerial or vessel surveys within the impact area prior to the release of munitions in order to minimize effects to ESA-listed marine mammals and sea turtles (described in section 2.2.2 of this opinion and conference report). Personnel conducting these surveys are trained and experienced at conducting protected species surveys, which helps to ensure the surveys are as effective as possible. Surveys begin as close to weapon release as possible, reducing the likelihood that protected species could enter the impact area during the time between the survey and detonation. The surveys will evaluate the mission site for environmental suitability, and verify that the impact areas are free of visually detectable sea turtles and potential sea turtle indicators. Survey aircraft or vessels will run pre-determined line transects to provide coverage of the entire survey area. Lastly, due to the speed and altitude of fixed-wing aircraft during protected species surveys, these mission and non-mission aircraft may fly the survey pattern multiple times within a 30-minute time period to help ensure that protected species are not missed in impact zones. Air-to-surface missions will also be delayed or rescheduled if the Beaufort sea state is greater than number four at the time of the mission, minimizing the likelihood that protected species in the detonation area would not be observed. We assume that surveys would be more effective at identifying larger individuals (e.g., large whales) than smaller individuals (e.g., juvenile sea turtles).

6.4 Exposure and Response of Sea Turtles to Detonations

The only stressor we determined was likely to adversely affect ESA-listed species during the Air Force's proposed EGTTR activities was acoustic stressors from explosive detonations. Little information exists regarding the impacts of underwater explosives on sea turtles. As discussed in section 3.2 of this opinion and conference report, the effects of explosions on turtles are usually inferred from documented effects to other vertebrates. Potential impacts include non-injurious and injurious effects. Non-injurious effects include acoustic annoyance, tactile detection, or physical discomfort. A momentary startle response or temporary disorientation could result from detonations of low intensity or of sufficient distance to be detected, but not injurious (Viada et al. 2008). Injurious effects include non-lethal and lethal injury (Viada et al. 2008).

The Air Force's analysis to estimate potential exposure of sea turtles to sounds from detonations is summarized in section 3.2 of this opinion and conference report and fully described in the Air Force's biological assessment (Department of the Air Force 2015) and associated appendices. We verified the methodology and data used by the Air Force for their exposure analysis and accept the modeling conclusions on exposure of sea turtles. Sea turtles, at the sea surface and underwater, exposed to underwater explosions from the EGTTR activities may experience effects that include mortality and serious injury, impairment, disturbance, and behavioral responses, as defined in section 3.2 of this opinion and conference report.

Table 31 indicates the resulting number of sea turtles estimated to be affected in the absence of mitigation measures. The numbers represent total impacts for all detonations combined. This exposure analysis is conservative because it does not take into account the mitigation measures

employed by the Air Force to minimize impacts to sea turtles. These measures would be expected to decrease the potential for explosive impacts.

Table 31. Number of sea turtles estimated to be affected annually by air-to-surface testing and training missions on the Eglin Gulf Testing and Training Range.

Species	Mortality and Serious Injury	Impairment	Disturbance	Behavioral response
Loggerhead Sea Turtle	57	79	2,148	22,610
Kemp's Ridley Sea Turtle	29	40	1,079	10,905
Green Sea Turtle	28	39	1,056	11,139
Leatherback Sea Turtle	10	17	436	5,257

*Number of animals impacted by higher thresholds subtracted from less impactful thresholds.

6.4.1 Response to Mortality and Injury

The criteria used to estimate the number of sea turtles that will be killed or seriously injured is based on a study exposing fish to the effect of an underwater explosion as opposed to a sea turtle. As cited in Popper et al. (2014a); Popper et al. (2014b), Ketten et al. (2005) found that sea turtle cadavers are highly resistant to damage from even high level explosives. Further, as documented in Richmond et al. (1973), injuries of terrestrial vertebrates exposed to even higher levels of sound from explosives (i.e., sound levels that would cause slight contusions to the gastrointestinal tract) were not necessarily lethal. For these reasons, we believe that the thresholds used to estimate mortality and injury in this consultation are highly conservative. Not all turtles that are exposed to received levels strong enough to cause slight contusions to the gastrointestinal tract, or be injured in other ways, would be expected to die. However, non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection.

Death of an individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years.

We do not have information to estimate what percentage of injured sea turtles will die. Therefore, in our analysis on the potential population level effects of this action on ESA-listed sea turtles, we assume that all sea turtles estimated to be seriously injured will die (in addition to those estimated to be killed). In assuming that all of these turtles will die, our analysis of the potential for the Air Force's proposed action to result in population level effects is conservative. The potential population level effects of the estimated levels of mortality and serious injury on ESA-listed sea turtles is discussed in section 7 of this opinion and conference report.

6.4.2 Response to Permanent Threshold Shift and Temporary Threshold Shift

Hearing loss could effectively reduce the distance over which sea turtles can detect biologically relevant sounds. Hearing loss due to auditory fatigue is also known as threshold shift, a reduction in hearing sensitivity at certain frequencies. Threshold shift is the difference between hearing thresholds measured before and after an intense, fatiguing sound exposure. Threshold shift occurs when hair cells in the ear fatigue, causing them to become less sensitive over a small range of frequencies related to the sound source to which an animal was exposed. The actual amount of threshold shift depends on the amplitude, duration, frequency, and temporal pattern of the sound exposure. No studies are published on inducing threshold shift in sea turtles; therefore, the potential for the impact on sea turtles is inferred from studies of threshold shift in other animals. Temporary threshold shift is a hearing loss that recovers to the original hearing threshold over a period. An animal may not even be aware of a TTS. It does not become deaf, but requires a louder sound stimulus (relative to the amount of TTS) to detect a sound within the affected frequencies. Temporary threshold shift may last several minutes to several days, depending on the intensity and duration of the sound exposure that induced the threshold shift (including multiple exposures). Permanent threshold shift is a permanent hearing loss at a certain frequency range. Permanent threshold shift is non-recoverable due to the destruction of tissues within the auditory system. The animal does not become deaf, but requires a louder sound stimulus (relative to the amount of PTS) to detect a sound within the affected frequencies.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. As a result, we do not expect instances of TTS and PTS to have fitness consequences for individual turtles.

6.4.3 Response to Disturbance and Behavioral Response

Sea turtles occurring beyond the ranges of mortality, injury, and impairment were estimated to be affected by Air Force EGTTR activities. A range of effects could occur at these lower exposure levels including masking, temporary habitat displacement, or short term behavioral responses (e.g., a startle response, changes in respiration, alteration of swim speed, or direction). The response of a sea turtle to an explosion from EGTTR activities will depend on the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the explosion and whether it is perceived as approaching or moving away could also affect the way a sea turtle responds.

Auditory masking occurs when a sound prevents or limits the distance over which an animal detects other biologically relevant sounds. When a noise has a sound level above the sound of interest, and in a similar frequency band, auditory masking could occur. Any sound above ambient noise levels and within an animal's hearing range could cause masking. The degree of masking increases with increasing noise levels; a noise that is just-detectable over ambient levels is unlikely to actually cause any substantial masking, whereas a louder noise may mask sounds over a wider frequency range. In addition, a continuous sound would have more potential for masking than an intermittent sound source (e.g., explosives). Another important distinction between masking and hearing loss is that masking only occurs in the presence of the sound stimulus, whereas hearing loss can persist after the stimulus is gone. Intermittent explosive use will not result in prolonged periods of time where masking could occur, reducing the likelihood of the proposed action causing masking that could result in negative fitness impacts to ESA-listed sea turtles. For this reason, the effect of any masking that could be caused by explosive detonations is insignificant. Therefore, masking is not likely to adversely affect ESA-listed species.

In instances where a sea turtle avoids the area where detonations are occurring (i.e., instances of disturbance), this is expected to result in an energy expenditure to move away from the detonations, and the potential for lost feeding or resting opportunities. However, any instances of disturbance are expected to be temporary in nature, with the animal returning to the area shortly after detonations cease. Because most activities would consist of a limited number of detonations and exposures would not occur over long durations, there would be an opportunity to recover from any incurred energetic cost. Disturbance could also result in lost feeding or resting opportunities because the animal may be required to leave an area where it is conducting those activities. However, to result in fitness consequences for the animal, we would have to assume that an individual turtle could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, if an animal's rest was disrupted, we would expect the individual would be able to resume resting immediately after the detonations ceased or rest in alternative locations once the animal moves from the area. For these reasons, disturbance of sea turtles from EGTTR activities is unlikely to lead to fitness consequences to individual sea turtles or long-term consequences for the ESA-listed sea turtles considered in this opinion and conference report.

Similar to disturbance, behavioral responses could result in temporary disruptions to important behaviors including feeding and resting. However, most often these would be no more than startle responses with the animal resuming normal behaviors immediately following the sound exposure (i.e., seconds). To result in fitness consequences for the animal, we would have to assume that an individual turtle could not compensate for lost feeding opportunities by feeding shortly after cessation of acoustic exposure, or feeding at a later time. There is no indication this is the case, particularly since food sources would still be available in the environment

immediately after the detonation occurs. Similarly, if an animal's rest was disrupted, we would expect the individual would be able to resume resting immediately after the detonations ceased. For these reasons, behavioral responses of sea turtles to EGTTR activities are unlikely to lead to fitness consequences to individual sea turtles or long-term consequences for the population. This assessment pertains to behavioral responses quantitatively estimated to occur in the Air Force's acoustic analysis, but also any lower level exposures (i.e., that could occur at levels down to 166 dB re: 1 μ Pa (rms) per McCauley et al. (2000a) that may occur.

It is also possible that behavioral reactions could lead to negative physiological consequences. For example, Garcia-Parraga et al. (2014) reported evidence of decompression sickness (e.g., gas embolism) in sea turtles following capture in trawls or gillnets, with a higher incidence of decompression sickness when caught in deeper waters. It is possible that a sea turtle could have an extreme behavioral avoidance reaction (e.g., surfacing too quickly in an attempt to avoid noise) that could lead to decompression sickness-like symptoms and fitness consequences. However, it should be noted that this is the first, and to our knowledge, only study that has documented decompression sickness-like symptoms in sea turtles. Previous research has suggested sea turtles are protected against decompression sickness through anatomical, physiological, and behavioral adaptations (Berkson 1967; Castellini 2012; Fossette et al. 2010; Lutcavage and Lutz 1997; Piantadosi and Thalmann 2004). Given this uncertainty in the available literature and the lack of evidence that this sort of extreme behavioral avoidance reaction would be expected, we do not believe such a reaction is likely to occur. Because decompression sickness is not likely to occur, it is not likely to adversely affect ESA-listed sea turtles and we do not consider it further in this opinion and conference report.

6.5 Cumulative Effects

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

During this consultation, NMFS searched for information on future state, tribal, local, or private actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the *Environmental Baseline*, which we expect will continue into the future. Anthropogenic effects include commercial and recreational fishing, military training and testing activities, vessel traffic, oil and gas activities, scientific research, ocean noise, and pollution. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time.

7 INTEGRATION AND SYNTHESIS

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (section 6) to the environmental baseline (section 5 above) and the cumulative effects (section 6.4) to formulate the agency's opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (section 4).

The following discussions separately summarize the probable risks the proposed action poses to threatened and endangered species and critical habitat that are likely to be exposed. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this opinion and conference report. The only stressor associated with the proposed action that we determined was likely to adversely affect ESA-listed species was exposure to acoustic stressors from explosive detonations.

7.1 Green Sea Turtle – North Atlantic Distinct Population Segment

In determining whether the Air Force's EGTTR activities in the action area are likely to jeopardize the survival and recovery of green sea turtles from the North Atlantic DPS, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of ESA-listed Resources*, and those effects of future non-Federal activities that are reasonably certain to occur within the action area in the reasonably foreseeable future. The Air Force's EGTTR activities in the action area are expected to continue at similar levels into the reasonably foreseeable future. Many of these activities will occur without any green turtles from the North Atlantic DPS being exposed to acoustic stressors from explosive detonations. Those individuals that are exposed would only be so periodically or episodically.

As described in the *Status of ESA-listed Resources* and *Environmental Baseline* sections of this opinion and conference report, some of the primary anthropogenic threats to the survival and recovery of green sea turtles from the North Atlantic DPS are overharvest (directed harvest of both eggs and adults), incidental capture in commercial fisheries, human development of coastlines, climate change, and impacts to terrestrial nesting habitat. Harvest of sea turtles has been greatly reduced in some locations, though it still occurs in other parts of the world (e.g., Central and South America, Africa). Further, efforts have been made in some areas to reduce incidental capture in fisheries, but the problem persists. The Air Force's EGTTR activities have not been identified as a primary threat to ESA-listed sea turtles. Trend data for the North Atlantic DPS of green sea turtles, where sufficient for analysis, suggest most populations are stable or increasing. Despite the apparent increase in numbers, the positive overall trend should be viewed

cautiously because trend data are available for just over half of all sites examined and very few data sets span a full green sea turtle generation (Seminoff 2004) (80 FR 20057).

We determined that detonations conducted during the Air Force's EGTTR activities conducted annually and into the reasonably foreseeable future are likely to cause mortality and serious injury, impairment, disturbance, and behavioral responses to ESA-listed green sea turtles in the action area. We estimated that 11,139 green turtles from the North Atlantic DPS will experience a behavioral response, 1,056 will be disturbed, 39 will be impaired, and 28 will be seriously injured or will die.

As described further in section 6.4.3 above, potential behavioral responses of North Atlantic DPS green sea turtles from exposure to detonations could include startle reactions, disruption of feeding or migration, changes in respiration, alteration of swim speed, or alteration of swim direction. Instances of disturbance are expected to result in a sea turtle avoiding the area of sound exposure. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences, we would have to assume that an individual sea turtle detects and responds to the detonation, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses and instances of disturbance to green sea turtles from exposure to detonations are unlikely to lead to fitness consequences to individual sea turtles or long-term implications for the population.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. For these reasons, and as further described in section 6.4.3 above, we determined that instances of impairment (i.e., TTS) and PTS would not be expected to result in fitness consequences for individual turtles.

Based on our analysis of air-to-surface testing and training missions, we expect 28 green sea turtles from the North Atlantic DPS to be seriously injured or killed by the Air Force's EGTTR activities annually and continuing into the reasonably foreseeable future. Death of an individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years. It should be emphasized that the thresholds used to estimate mortality and serious injury in this consultation are highly conservative. Not all turtles that are exposed to received levels strong enough to cause slight contusions to the gastrointestinal tract, or be injured in other ways, would be expected to die. However, non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection. In assuming that all of these turtles will die, our analysis of the potential for the Air Force's proposed action to result in population level effects is conservative.

As stated previously, the North Atlantic DPS of green sea turtles is estimated to have a nesting abundance of 167,424 females at 73 nesting sites. We do not have sufficient information to assign sea turtles killed by the Air Force's EGTTR activities to individual nesting populations so we consider the potential for this level of mortality to impact the entirety of the listed entity. Assuming a worst case scenario (i.e., that all killed turtles were female), we can estimate that removing 28 females from this population in one year would reduce the reproductive potential of this population by 0.017 percent. We do not consider this an appreciable reduction in the numbers of female green sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the threatened North Atlantic DPS of green sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The 1991 recovery plan for the threatened U.S. Atlantic population of green sea turtles identifies beach armoring, beach nourishment, beach cleaning, increased human presence, recreational beach equipment, beach vehicular driving, exotic vegetation, nest depredation, oil and gas operations, dredging, pollution, commercial fisheries bycatch, boat collision, entrapment, underwater explosions, artificial lighting, entanglement, ingestion of marine debris, poaching, predation, disease and parasites as the major threats occurring within the waters of the Gulf of Mexico and sets criteria for the delisting of this entity. Delisting requires identifying regional stocks to source beaches, maintenance of stocks above 5,000 nesting females annually for at least six years, nesting populations at source beaches are stable or increasing for 25 years, maintenance of healthy foraging areas, increases of foraging populations, completion of all priority one tasks, and the finalization of management plans and international agreements.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from the Air Force's EGTTR activities that will be conducted in the action area on an annual basis or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of ESA-listed Resources* or *Environmental Baseline*), would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival of North Atlantic DPS green sea turtles in the wild by reducing the reproduction, numbers, or distribution of this species considered in this opinion and conference report. We also conclude that effects from ongoing EGTTR activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of North Atlantic DPS green sea turtles in the wild by reducing the reproduction, numbers, or distribution of the species. Some impulsive acoustic stressors will kill small numbers of sea turtles. However, neither the lethal or sub-lethal effects of Air Force EGTTR activities will result in appreciable reduction in reproductive capability of the species. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of sub-populations in the Gulf of Mexico or to these species as listed pursuant to the ESA.

7.2 Loggerhead Sea Turtle – Northwest Atlantic Distinct Population Segment

In determining whether the Air Force's EGTTR activities in the action area are likely to jeopardize the survival and recovery of loggerhead sea turtles from the Northwest Atlantic DPS, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of ESA-listed Resources*, and those effects of future non-Federal activities that are reasonably certain to occur within the action area in the reasonably foreseeable future. The Air Force's EGTTR activities in the action area are expected to continue at similar levels into the reasonably foreseeable future. Many of these activities will occur without any loggerhead sea turtles from the Northwest Atlantic DPS being exposed to sound fields associated with EGTTR activities. Those individuals that are exposed would only be so periodically or episodically.

As described in the *Status of ESA-listed Resources* and *Environmental Baseline* sections of this opinion and conference report, some of the primary anthropogenic threats to the survival and recovery of loggerhead sea turtles from the Northwest Atlantic DPS are overharvest (directed harvest of both eggs and adults), incidental capture in commercial fisheries, human development of coastlines, interactions, climate change, impacts to terrestrial nesting habitat. Harvest of sea turtles has been greatly reduced in some locations, though it still occurs in other parts of the world. Further, efforts have been made in some areas to reduce incidental capture in fisheries, but the problem persists. The Air Force's EGTTR activities have not been identified as a primary threat to ESA-listed sea turtles. Trend data for the Northwest Atlantic DPS of loggerhead sea turtles suggest all sub-populations are currently in decline or data are insufficient to access trends. The most current nesting trend for the Northwest Atlantic DPS, from 1989 to 2010, is very slightly negative, but the rate of decline is not statistically different from zero (76 FR 58868).

We determined that detonations conducted during the Air Force's EGTTR activities conducted annually and into the reasonably foreseeable future are likely to cause mortality and serious injury, impairment, disturbance, and behavioral responses to ESA-listed loggerhead sea turtles in the action area. We estimated that 22,610 loggerhead turtles from the Northwest Atlantic DPS will experience a behavioral response, 2,148 will be disturbed, 79 will be impaired, and 57 will be seriously injured or will die.

As described further in section 6.4.3, potential behavioral responses of Northwest Atlantic DPS loggerhead sea turtles from exposure to detonations could include startle reactions, disruption of feeding or migration, changes in respiration, alteration of swim speed, or alteration of swim direction. Instances of disturbance are expected to result in a sea turtle avoiding the area of sound exposure. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences, we would have to assume that an individual sea turtle detects and responds to the detonation, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses and instances of disturbance to loggerhead sea turtles from exposure to detonations are unlikely to lead to fitness consequences to individual sea turtles or long-term implications for the population.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. For these reasons, and as further described in section 6.4.2, we determined that instances of impairment (i.e., TTS) and PTS would not be expected to result in fitness consequences for individual turtles.

Based on our analysis of air-to-surface testing and training missions, we expect 57 loggerhead sea turtles from the Northwest Atlantic DPS to be seriously injured or killed by the Air Force's EGTTR activities annually and continuing into the reasonably foreseeable future. Death of an

individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years. It should be emphasized that the thresholds used to estimate mortality and serious injury in this consultation are highly conservative. Not all turtles that are exposed to received levels strong enough to cause slight contusions to the gastrointestinal tract, or be injured in other ways, would be expected to die. However, non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection. In assuming that all of these turtles will die, our analysis of the potential for the Air Force's proposed action to result in population level effects is conservative.

As stated previously, the Northwest Atlantic DPS of loggerhead sea turtles is estimated to have a nesting abundance of 32,000 to 56,000 females (NMFS 2001b; TEWG 1998c). We do not have sufficient information to assign sea turtles killed by the Air Force's EGTTR activities to individual nesting populations so when evaluating the potential for this level of mortality to impact species survival and recovery, we considered the entirety of the listed entity. Assuming a worst case scenario (i.e., that all killed turtles were female), we can estimate that removing 57 females from this population in one year would reduce the reproductive potential of this population by 0.18 percent. We do not consider this an appreciable reduction in the numbers of female loggerhead sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the endangered Northwest Atlantic DPS of loggerhead sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The 2009 recovery plan for the endangered Northwest Atlantic DPS of loggerhead sea turtles identifies major threats and their remedies specific to loggerhead recovery. The recovery plan identifies illegal harvesting, beach cleaning, human presence, recreational beach equipment, beach vehicular driving, military activities, beach sand placement, beach armoring, sand fences, stormwater outfalls, pollution, debris, predation, exotic vegetation, climate change, natural catastrophes, commercial fisheries bycatch, dredging, oil and gas activities, vessel strikes, disease and parasites, and harmful algal blooms as the major threats occurring in the waters of the Gulf of Mexico and sets criteria for the delisting of this entity. Delisting requires that the annual rate of increase over a generation time of 50 years is two percent or greater resulting in a total annual number of nests of 14,000 or greater for the northern recovery unit; the annual rate of increase over a generation time of 50 years is statistically detectable resulting in a total annual number of nests of 106,100 or greater for the peninsular Florida recovery unit; the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of 1,100 or greater for the Dry Tortugas recovery unit; the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual

number of nests of 4,000 or greater for the northern Gulf of Mexico recovery unit; the total annual number of nests at a minimum of three nesting assemblages, each averaging greater than 100 nests annually has increased over a generation time of 50 years for the greater Caribbean recovery unit; the increase in number of nests must be a result of corresponding increases in number of nesting females; trends in abundance on foraging grounds; and trends in stranding relative to in-water abundance.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from the Air Force's EGTTR activities that will be conducted in the action area on an annual basis or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of ESA-listed Resources* or *Environmental Baseline*), would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival of loggerhead sea turtles from the Northwest Atlantic DPS in the wild by reducing the reproduction or distribution of this species. We also conclude that effects from ongoing EGTTR activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of loggerhead sea turtles from the Northwest Atlantic DPS in the wild by reducing the reproduction or distribution of the species. Some detonations will kill small numbers of sea turtles (relative to the population). However, neither the lethal or sub-lethal effects of the Air Force's EGTTR activities will result in appreciable reduction in reproductive capability at the population or range-wide level. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of sub-populations in the Gulf of Mexico or to these species as listed pursuant to the ESA.

7.3 Kemp's Ridley Sea Turtle

In determining whether the Air Force's EGTTR activities in the action area are likely to jeopardize the survival and recovery of Kemp's ridley sea turtles, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of ESA-listed Resources*, and those effects of future non-Federal activities that are reasonably certain to occur within the action area in the reasonably foreseeable future. The Air Force's EGTTR activities in the action area are expected to continue at similar levels into the reasonably foreseeable future. Many of these activities will occur without any Kemp's ridley sea turtles being exposed to sound fields associated with EGTTR activities. Those individuals that are exposed would only be so periodically or episodically.

As described in the *Status of ESA-Listed Resources* and *Environmental Baseline* sections of this opinion and conference report, some of the primary anthropogenic threats to the survival and recovery of Kemp's ridley sea turtles are overharvest (directed harvest of both eggs and adults), incidental capture in commercial fisheries, habitat destruction, human development of coastlines, interactions, climate change, pollution, and impacts to terrestrial nesting habitat. Harvest of sea turtles has been greatly reduced in some locations, though it still occurs in other parts of the world. Further, efforts have been made in some areas to reduce incidental capture in fisheries, but the problem persists. The Air Force's EGTTR activities have not been identified as a primary

threat to ESA-listed sea turtles. Recent calculations of nesting females determined from nest counts show that the population trend is increasing, with an estimate of 4,047 nesters in 2006 and 5,500 in 2007 (NMFS and USFWS 2007b). Trend data suggests that the population is expected to increase at least 12 to 16 percent per year.

We determined that detonations conducted during the Air Force's EGTTR activities conducted annually and into the reasonably foreseeable future are likely to cause mortality and serious injury, impairment, disturbance, and behavioral responses to ESA-listed Kemp's ridley sea turtles in the action area. We estimated that 10,905 Kemp's ridley sea turtles will experience a behavioral response, 1,079 will be disturbed, 40 will be impaired, and 29 will be seriously injured or will die.

As described further in section 6.4.3, potential behavioral responses of Kemp's ridley sea turtles from exposure to detonations could include startle reactions, disruption of feeding or migration, changes in respiration, alteration of swim speed, or alteration of swim direction. Instances of disturbance are expected to result in a sea turtle avoiding the area of sound exposure. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences, we would have to assume that an individual sea turtle detects and responds to the detonation, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses and instances of disturbance to Kemp's ridley sea turtles from exposure to detonations are unlikely to lead to fitness consequences to individual sea turtles or long-term implications for the population.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). Additionally, they are not known to produce sounds underwater for communication. For these reasons, and as further described in section 6.4.2 above, we determined that instances of

impairment (i.e., TTS) and PTS would not be expected to result in fitness consequences for individual turtles.

Based on our analysis of air-to-surface testing and training missions, we expect 29 Kemp's ridley sea turtles to be seriously injured or killed by the Air Force's EGTTR activities annually and continuing into the reasonably foreseeable future. Death of an individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years. It should be emphasized that the thresholds used to estimate mortality and serious injury in this consultation are highly conservative. Not all turtles that are exposed to received levels strong enough to cause slight contusions to the gastrointestinal tract, or be injured in other ways, would be expected to die. However, non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection. In assuming that all of these turtles will die, our analysis of the potential for the Air Force's proposed action to result in population level effects is conservative.

According to NMFS' latest status review on Kemp's ridley sea turtles (NMFS and USWFS 2015), the estimated female population size of age two and over Kemp's ridleys in 2012 was 188,713 turtles. We do not have sufficient information to assign sea turtles killed by the Air Force's EGTTR activities to individual nesting populations so when evaluating the potential for this level of mortality to impact species survival and recovery, we considered the entirety of the listed entity. Assuming a worst case scenario (i.e., where all turtles killed were age two and over females), removing 29 females from this population in one year would reduce the reproductive potential of this population by 0.015 percent. We do not consider this an appreciable reduction in the numbers of female Kemp's ridley sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the endangered Kemp's ridley sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The 2011 bi-national recovery plan for the Caribbean, Atlantic, and Gulf of Mexico populations of Kemp's ridley sea turtles identifies major threats occurring in Gulf of Mexico and sets criteria for the downlisting and delisting the species. Identified threats include illegal harvest, beach cleaning, human presence, recreational beach equipment, beach vehicular driving, beach nourishment, oil and gas operations, pollution, predation, pathogens and disease, invasive species, climate change, natural catastrophe, fisheries bycatch, and dredges. Downlisting requires (1) a population of at least 10,000 nesting females in a season distributed at the primary resting beaches in Mexico is attained; (2) recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico attained to ensure a

minimum level of known production through in situ incubation, incubation in corrals, or a combination of both. Delisting requires (1) an average population of at least 40,000 nesting females per season over a six-year period distributed among nesting beaches in Mexico and the U.S. is attained; (2) ensure average annual recruitment of hatchlings over a six-year period from in situ nests and beach corrals is sufficient to maintain a population of at least 40,000 nesting females per nesting season distributed among nesting beaches in Mexico and the U.S. into the future; (3) long-term habitat protection; (4) identifying regional stocks to source beaches, stability in the number of nesting females over ten years, increases of foraging populations, and the finalization of management plans and international agreements.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from the Air Force's EGTTR activities that will be conducted in the action area on an annual basis or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of ESA-listed Resources* or *Environmental Baseline*), would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival of Kemp's ridley sea turtles in the wild by reducing the reproduction or distribution of this species. We also conclude that effects from ongoing EGTTR activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of Kemp's ridley sea turtles in the wild by reducing the reproduction, numbers, or distribution of this species. Some impulsive acoustic stressors will kill small numbers of sea turtles. However, neither the lethal or sub-lethal effects of the Air Force's EGTTR activities will result in appreciable reduction in reproductive capability of the species. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of sub-populations in the Gulf of Mexico or to these species as listed pursuant to the ESA.

7.4 Leatherback Sea Turtle

In determining whether the Air Force's EGTTR activities in the action area are likely to jeopardize the survival and recovery of the leatherback sea turtles, we assessed effects of the action against the aggregate effects of everything in the *Environmental Baseline* that has led to the current *Status of ESA-listed Resources*, and those effects of future non-Federal activities that are reasonably certain to occur within the action area in the reasonably foreseeable future. The Air Force's EGTTR activities in the action area are expected to continue at similar levels into the reasonably foreseeable future. Many of these activities will occur without any leatherback sea turtles being exposed to sound fields associated with EGTTR activities. Those individuals that are exposed would only be so periodically or episodically.

As described in the *Status of ESA-listed Resources* and *Environmental Baseline* sections of this opinion and conference report, some of the primary anthropogenic threats to the survival and recovery of leatherback sea turtles are overharvest (directed harvest of both eggs and adults), incidental capture in commercial fisheries, human development of coastlines, interactions, climate change, pollution, and impacts to terrestrial nesting habitat. Harvest of sea turtles has

been greatly reduced in some locations, though it still occurs in other parts of the world. Further, efforts have been made in some areas to reduce incidental capture in fisheries, but the problem persists. The Air Force's EGTTR activities have not been identified as a primary threat to ESA-listed sea turtles. According to NMFS' latest status review, there is an increasing or stable population trend for all areas of the Atlantic, with the exception of the Western Caribbean and West Africa (NMFS USFWS 2013). In Florida, the number of nests has been increasing by 10.2 percent annually since 1979 (Stewart et al. 2011).

We determined that detonations conducted during the Air Force's EGTTR activities conducted annually and into the reasonably foreseeable future are likely to cause mortality and serious injury, impairment, disturbance, and behavioral responses to ESA-listed leatherback sea turtles in the action area. We estimated that 5,257 leatherback sea turtles will experience a behavioral response, 436 will be disturbed, 17 will be impaired, and ten will be seriously injured or will die.

As described further in section 6.4.3, potential behavioral responses of leatherback sea turtles from exposure to detonations could include startle reactions, disruption of feeding or migration, changes in respiration, alteration of swim speed, or alteration of swim direction. Instances of disturbance are expected to result in a sea turtle avoiding the area of sound exposure. Any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. To result in significant fitness consequences, we would have to assume that an individual sea turtle detects and responds to the detonation, and that it could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since foraging habitat would still be available in the environment following the cessation of acoustic exposure. Similarly, we expect temporary disruptions of migration and swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following the cessation of the sound exposure. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses and instances of disturbance to leatherback sea turtles from exposure to detonations are unlikely to lead to fitness consequences to individual sea turtles or long-term implications for the population.

Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003). 90Additionally, they are not known to produce sounds underwater for communication.

For these reasons, and as further described in section 6.4.2, we determined that instances of impairment (i.e., TTS) and PTS would not be expected to result in fitness consequences for individual turtles.

Based on our analysis of air-to-surface testing and training missions, we expect ten leatherback sea turtles to be seriously injured or killed by the Air Force's EGTTR activities annually and continuing into the reasonably foreseeable future. Death of an individual sea turtle would have a direct fitness consequence to the individual leading to lost reproductive potential that the individual might contribute to the population or sub-population. This lost reproductive potential will vary depending on the sex (male or female) and maturity of the individual. The death of a male would have less of an effect on the population than the loss of a female. Loss of a sexually mature female will have immediate effects on recruitment while lost reproductive potential from mortality of a juvenile female might not be realized for several years. It should be emphasized that the thresholds used to estimate mortality and serious injury in this consultation are highly conservative. Not all turtles that are exposed to received levels strong enough to cause slight contusions to the gastrointestinal tract, or be injured in other ways, would be expected to die. However, non-lethal injuries could increase a sea turtle's risk of predation, disease, or infection. In assuming that all of these turtles will die, our analysis of the potential for the Air Force's proposed action to result in population level effects is conservative.

As stated previously, the leatherback sea turtles is estimated to have a nesting abundance of 20,000 to 56,000 adult females in the North Atlantic (TEWG 2007c). We do not have sufficient information to assign sea turtles killed by the Air Force's EGTTR activities to individual nesting populations so when evaluating the potential for this level of mortality to impact species survival and recovery, we considered the entirety of the listed entity. Assuming a worst case scenario where all leatherbacks killed by Air Force EGTTR activities had reached reproductive maturity (i.e., were adults), removing ten turtles from this population in one year would reduce the reproductive potential of this population by 0.05 percent. We do not consider this an appreciable reduction in the numbers of leatherback sea turtles or the reproductive rate of the population, either on an annual basis or continuing into the reasonably foreseeable future. Because we do not expect this level of mortality to result in an appreciable reduction in the numbers or reproductive rate of the endangered leatherback sea turtles, we do not expect this level of mortality to impact the survival or recovery of this population.

The 1991 recovery plan for the U.S. Caribbean, Atlantic, and Gulf of Mexico populations of leatherback sea turtles identifies illegal harvest, beach erosion, beach armoring, beach nourishment, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, hatchling mortality, beach vehicular driving, entanglement, ingestion of marine debris, fisheries bycatch, boat collisions, oil and gas operations, and pollution as the major threats occurring in Gulf of Mexico and sets criteria for the delisting the species. Delisting can be considered if (1) the adult female population increases over the next 25 years, as evidence by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S.

Virgin Islands, and along the east coast of Florida; (2) nesting habitat encompassing at least 75 percent of nesting activity in the U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership; (3) all priority one tasks have been successfully implemented (see the recovery plan for more details) as well as the finalization of management plans.

Based on the evidence available, including the *Environmental Baseline* and *Cumulative Effects*, stressors resulting from the Air Force's EGTTR activities that will be conducted in the action area on an annual basis or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the *Status of ESA-listed Resources* or *Environmental Baseline*), would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival of leatherback sea turtles in the wild by reducing the reproduction or distribution of this species. We also conclude that effects from ongoing EGTTR activities continuing into the reasonably foreseeable future would not be expected, directly or indirectly, to appreciably reduce the likelihood of recovery of leatherback sea turtles in the wild by reducing the reproduction, numbers, or distribution of this species. Some impulsive acoustic stressors will kill small numbers of sea turtles. However, neither the lethal or sub-lethal effects of the Air Force's EGTTR activities will result in appreciable reduction in reproductive capability at the population or range-wide level. Therefore, we do not anticipate any measurable or detectable reductions in survival rate or trajectory of sub-populations in the Gulf of Mexico or to these species as listed pursuant to the ESA.

8 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of green turtles from the North Atlantic DPS, Kemp's ridley, loggerhead sea turtles from the Northwest Atlantic DPS, and leatherback sea turtles and not likely to destroy or adversely modify designated critical habitat for loggerhead sea turtles from the Northwest Atlantic DPS. We find that these same proposed actions are not likely to adversely affect proposed threatened or endangered Bryde's whales from the Gulf of Mexico DPS, endangered sperm whales, endangered hawksbill sea turtles, and threatened Gulf sturgeon.

9 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibits 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 NMFS to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise

lawful activity. Section 7(b)(4) and section 7(o)(2) provide that taking is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

For sea turtle species, we applied “harass” to mean an intentional or negligent action that has the potential to injure an animal or disrupt its normal behavior to a point where such behaviors are abandoned or significantly altered.

9.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions while the extent of take or “the extent of land or marine area that may be affected by an action” may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (51 FR 19953). The amount of take resulting from the Air Force’s EGTTR activities and evaluated in this opinion and conference report was estimated based on the best information available. The methodology used to estimate the amount of take resulting from the EGTTR activities is summarized in section 3.2 of this opinion and conference report and fully described in the Air Force’s biological assessment (Department of the Air Force 2015) and associated appendices.

Based on the analysis in the opinion and conference report, NMFS anticipates that the proposed action would result in the mortality, injury, and impairment of North Atlantic DPS of green, Kemp’s ridley, Northwest Atlantic DPS of loggerhead, and leatherback sea turtles. Table 32 indicates the number of mortalities and serious injuries, non-injurious impairment, disturbance, and behavioral responses that could potentially occur annually from surface and subsurface detonations in the absence of monitoring and mitigation measures. The estimated number of sea turtles exposed was based on modeling done by the Air Force (see Section 3.2). NMFS and the Air Force expect the monitoring and mitigation measures to decrease the number of individual sea turtles potentially impacted.

Table 32. ESA-listed sea turtles takes incidental to the Air Force’s Eglin Gulf Testing and Training Range activities.

ESA-Listed Species	Mortality and Serious Injury	Impairment	Disturbance	Behavioral Response
Green Sea Turtle – North Atlantic DPS	28	39	1,056	11,139
Kemp’s Ridley Sea Turtle	29	40	1,079	10,905
Loggerhead Sea Turtle – Northwest Atlantic DPS	57	79	2,148	22,610
Leatherback Sea Turtle	10	17	436	5,257

9.2 Effects of the Take

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

9.3 Reasonable and Prudent Measures

The measures described below are nondiscretionary, and must be undertaken by the Air Force so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

“Reasonable and prudent measures” are nondiscretionary measures to minimize the amount or extent of incidental take (50 C.F.R. §402.02). NMFS believes the reasonable and prudent measures described below are necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

- (1) The Air Force shall have measures in place to limit the potential for interactions with ESA-listed species that may rise to the level of take as a result of the proposed action described in this opinion and conference report.
- (2) The Air Force shall report all interactions resulting in take with any ESA-listed species resulting from the proposed action that are observed.

9.3.1 Monitoring

As discussed above in this opinion and conference report, the estimated take of ESA-listed species from acoustic stressors is based on Air Force modeling, which represents the best available means of numerically quantifying take. As the level of modeled impulse acoustic activities increases, the level of take is likely to increase as well. For non-lethal take from acoustic sources specified above, feasible monitoring techniques for detecting and calculating actual take of sea turtles do not exist. We are not aware of any other feasible or available means of determining when estimated take levels may be exceeded. Therefore, we must rely on Air Force modeling, and the link between explosive use and the level of take, to determine when anticipated take levels have been exceeded. Reinitiation of consultation shall be required if Air Force monitoring detects any unanticipated form of take of ESA-listed species not specified above.

9.3.2 Reporting

The Air Force shall submit reports that identify the general location, timing, and other aspects of EGTTR activities, and any potential to exceed levels of training and testing analyzed in this opinion and conference report they conduct in the EGTTR action area to help assess the actual amount or extent of take incidental to training and testing activities.

9.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Air Force must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outlines the mitigation, monitoring, and reporting measures required by the section 7 regulations (50 C.F.R. §402.14(i)). These terms and conditions are non-discretionary, and the Air Force must comply with them in order to implement the reasonable and prudent measures (50 C.F.R. §402.14). The Air Force has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 C.F.R. §402.14). If the Air Force fail to ensure compliance with these terms and conditions and their implementing reasonable and prudent measures, the protective coverage of section 7(o)(2) may lapse.

- (1) The following terms and conditions implement reasonable and prudent measure 1:

The Air Force must implement all mitigation and monitoring measures during EGTTR activities as described in the biological assessment and consultation initiation package, and in section 9.3. above of this opinion and conference report.

The Air Force shall have trained observers on vessels to document any strikes or near misses of ESA-listed species during missions.

- (2) The following terms and conditions implement reasonable and prudent measure 2:

If a dead or injured sea turtle is observed during or following proposed EGTTR activities, the Air Force shall immediately (within 24 hours of the discovery) contact NMFS and appropriate stranding networks. See section 2.2.2 for contact information.

On an annual basis, the Air Force shall submit a report to NMFS SERO and ESA Interagency Cooperation Division, containing the following information:

Date and time of the EGTTR missions;

A complete description of the pre-exercise and post-exercise activities related to mitigating and monitoring the effects of the EGTTR missions on sea turtles;

Results of the protected species monitoring including numbers (by species if possible) of any sea turtles noted injured or killed as a result of the EGTTR missions and number of sea turtles (by species if possible) that may have been harassed due to presence within the zone of influence.

10 CONSERVATION RECOMMENDATIONS

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

- (1) We recommend the Air Force monitor sighting, location, and stranding data for ESA-listed species in proximity to the EGTTR action area.
- (2) We recommend the Air Force coordinate with NMFS to improve sea turtle abundance and density estimates in the EGTTR action area.
- (3) We recommend the Air Force coordinate with NMFS to explore methods to better quantify incidental take of sea turtles not rising to the level of TTS.
- (4) We recommend the Air Force coordinate with NMFS to explore methods to better quantify the risk of vessel strike to sea turtles in the EGTTR action area.

In order for NMFS' Office of Protected Resources ESA Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their designated critical habitat, the Air Force should notify the ESA Interagency Cooperation Division of any conservation recommendations they implement in their final action.

11 REINITIATION OF CONSULTATION

This concludes formal consultation for the Air Force's EGTTR activities. As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or designated critical habitat in a manner or to an extent not considered in this opinion and conference report, (3) the agency action is subsequently modified in a manner that causes an effect to the ESA-listed species or critical habitat designated that was not considered in this opinion and conference report, or (4) a new species is ESA-listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the Air Force must contact the ESA Interagency Cooperation Division, Office of Protected Resources immediately.

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