NOAA's National Marine Fisheries Service

Endangered Species Act Section 7 Consultation

Biological and Conference Opinions

Agencies:	United States Navy
	Permits, Conservation and Education Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Activities Considered:	The U.S. Navy's conduct of training operations and Research, Development, Testing and Evaluation (RDT&E) activities within the Gulf of Mexico (GOMEX) Range Complex and promulgation of regulations to authorize the U.S. Navy to "take" marine mammals incidental to the conduct of activities in GOMEX Range Complex from November 2010 to November 2015
Consultation Conducted by:	Endangered Species Division of the Office of Protected Resources, NOAA's National Marine Fisheries Service
Approved by:	[illegible] for J. H. Lecky
Date:	Nov 22, 2010

Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.) requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency "may affect" a listed species or critical habitat that has been designated for such species, that agency is required to consult with either NOAA's National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the listed resources that may be affected.

Section 7(a)(4) of the ESA requires that each Federal agency shall confer with NMFS or USFWS, depending upon the listed resources that may be affected, on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed or result in the destruction or adverse modification of critical habitat proposed to be designated for such species.

This ESA programmatic section 7 consultation and conference considers two proposed actions. The first action is the U.S. Navy's proposed conduct of training and RDT&E activities within certain areas within the Gulf of Mexico. As marine mammals might be "taken" incidental to these activities, the U.S. Navy must also apply for authorization to "take" marine mammals under the Marine Mammal Protection Act

(MMPA), 16 U.S.C. §1371 (a)(5)(A); therefore, the NMFS' Office of Protected Resources Permits, Conservation and Education Division (Permits Division) is proposing to promulgate regulations which would authorize and govern the "taking" of marine mammals. The promulgation of regulations is the second proposed action. The action agencies for this consultation are the U.S. Navy and the Permits Division. The consulting agency is the Office of Protected Resources, Endangered Species Division (F/PR3).

This document represents NMFS' biological and conference opinions (Opinions) on the effects of the proposed actions on endangered and threatened species and their designated critical habitat and is prepared in accordance with section 7 of the ESA. These Opinions are based on information provided in the applications for MMPA regulations, the Biological Evaluation for the Gulf of Mexico Range Complex (December 2008), and addendums (July 2009, and September 2010) , the Gulf of Mexico Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement and appendices (November 2008), other supplemental information provided by the U.S. Navy, published and unpublished scientific information on the biology and ecology of endangered and threatened species, scientific and commercial information such as reports from government agencies and the peer-reviewed literature, biological opinions on similar activities, and other sources of information.

Consultation History

On October 2, 2008, NMFS received an application from the Navy requesting an authorization for the take of marine mammals incidental to proposed training exercises and Research, Development, Testing and Evaluation (RDT&E) activities within the GOMEX Range Complex over the course of five years. The Navy requested authorization to "take" nine species of small cetaceans annually by Level B Harassment (as defined by the Marine Mammal Protection Act), and one individual each of pantropical spotted dolphin and spinner dolphin by Level A Harassment (injury) over the course of the 5-year period.

On January 8, 2009, the U.S. Navy submitted to NMFS Endangered Species Division a request for ESA section 7 formal consultation which included a Biological Evaluation (DoN, United States Fleet Forces, December 2008), the Marine Resources Assessment Update for the Gulf of Mexico Area and the Gulf of Mexico Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement and associated appendices (DoN, United States Fleet Forces, January 2009).

On April 28, 2009, NMFS published a proposed rule in the *Federal Register* announcing receipt of and requesting comments on the U.S. Navy's application requesting an authorization for the take of marine mammals incidental to proposed training operations within the GOMEX Range Complex (74 *Federal Register* 19205). This proposed rule contained the Permits Division's revised "take" estimates for the U.S. Navy's training exercises and RDT&E activities within the GOMEX Range for small cetaceans and sperm whales.

After the January 8, 2009, request for consultation the Navy reprioritized their schedule of activities and notified PR1 that several other Range Complexes and Navy activities required consultation sooner than the GOMEX Complex. PR1 agreed and consultation was delayed on GOMEX as consultation on other Range Complexes proceeded.

On March 9, 2009, the U.S. Fish and Wildlife Service concluded an informal consultation which concurred with the U.S. Navy's determination that the proposed training activities and operations within the GOMEX Range Complex were not likely to adversely affect species under their jurisdiction.

On February 3, 2010, the Permits Division submitted a request for consultation on the issuance of a final rule to authorize the take of marine mammals incidental to proposed training operations within the GOMEX Range Complex over the course of five years. This request was accompanied by the draft final rule.

On July 27 2010, NMFS provided the U.S. Navy and the Permits Division with copies of the draft description of the proposed action for the Opinions. Between August and September 2010, the Endangered Species Division, the U.S. Navy and the Permits Division exchanged information relevant to the consultation.

On September 28, 2010, the U.S. Navy requested formal conference for the proposed endangered Northwest Atlantic Population Segment (DPS) of loggerhead sea turtles and submitted an addendum to their 2008 Biological Evaluation with information regarding the proposed DPS and information on the BP Deepwater Horizon oil spill.

On October 1, 2010, NMFS Endangered Species Division provided the U.S. Navy and the Permits Division with copies of the draft biological and conference opinions on the suite of activities that would be authorized by the regulations the Permits Division proposed to issue pursuant to the Marine Mammal Protection Act. On October 6, 2010 and October 18, 2010, the Permits Division and the U.S. Navy respectively, submitted comments on the draft Opinions. NMFS has reviewed all comments submitted and revised the Opinions as warranted.

Biological and Conference Opinions

Description of the Proposed Actions

These Opinions consider actions proposed by the U.S. Navy's Atlantic Fleet and the National Marine Fisheries Service's Permits, Conservation and Education Division (Permits Division).

The U.S. Navy proposes to continue baseline training operations[1] as well as conduct Research, Development, Testing and Evaluation (RDT&E) of new systems or weapons platforms within the Gulf of Mexico Range Complex (GOMEX). More specifically, the U.S. Navy proposes to:

- continue most training operations at current levels,
- adjust mix and weights of small explosives used at Demolition Pond (but overall use would remain similar to current levels),
- increase inert bombing and gunnery training events,

[1] Baseline training refers to typical training that currently occurs in the GOMEX Range Complex.

- increase use of commercial aircraft for Air Intercept Control and other air training events,
- initiate Strike Fighter Squadron (VFA) 204 Air to Surface inert bomb training, and
- eliminate the use of high explosive bombs during major exercise air-to-surface bombing events. The U.S. Navy will continue to use Non-explosive practice bombs during these types of exercises.

NMFS, upon application from the U.S. Navy, proposes to issue regulations under the Marine Mammal Protection Act of 1972, as amended, to govern the unintentional taking of marine mammals incidental to activities conducted by the Navy's Atlantic Fleet within the Gulf of Mexico (GOMEX) Range Complex for the period of November 2010 through November 2015. These regulations, which allow for the issuance of "Letters of Authorization" (LOAs) for the incidental take of marine mammals during the described activities and specified timeframes, prescribe the permissible methods of taking and other means of effecting the least practicable adverse impact on marine mammal species and their habitat, as well as requirements pertaining to the monitoring and reporting of such taking.

Scope of the Biological and Conference Opinions

On January 16, 2008, a programmatic biological opinion was issued regarding the U.S. Navy Atlantic Fleet's continued conduct of active sonar training (AFAST) along the Atlantic Coast of the United States and in the Gulf of Mexico and associated MMPA regulations authorizing the "take" of marine mammals incidental to those Navy activities. This biological opinion evaluated the effects on listed resources of the Navy's use of sonar (mid- and high-frequencies) aboard aircraft, surface ships and submarines, as well as sonar maintenance, mine warfare training, antisubmarine warfare training and major range events (COMPTUEX and JTFEX). COMPTUEX and JTFEX were analyzed under the 2008 programmatic biological opinion and subsequent opinions (finalized January 21, 2009, and January 21, 2010). Descriptions of these major range events were included in the GOMEX Biological Evaluation (DoN, United States Fleet Forces, December 2008), and the Gulf of Mexico Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DoN, United States Fleet Forces, January 2009) as part of the proposed action for consultation. Portions of these major exercises are expected to be conducted within the GOMEX Range Complex. However, these activities were analyzed as part of the proposed action in the AFAST programmatic and subsequent biological opinions. The U.S. Navy intends to eliminate high explosive bombing from these exercises. As no other changes to the conduct of these exercises will occur, the direct and indirect effects to listed species from these exercises may be less than analyzed previously. We conclude, therefore, that no reinitiation of consultation criteria have been triggered that would cause a reconsideration of these exercises and these exercises will not be analyzed further in these biological and conference opinions. Those requiring more information are referred to the Opinions listed above.

U.S. Navy GOMEX Range Complex Training Exercises and RTD&E Activities Considered in these Opinions

The Navy has trained in the GOMEX Range Complex with systems similar to those currently employed for national defense purposes for over 70 years. Training at the GOMEX Range Complex includes ship and aircraft maneuvers, gunnery and bombing exercises, joint training exercises, and RDT&E of new systems or weapons platforms. The Proposed Action does not indicate major changes to GOMEX Range

Complex facilities, operations, training, or RDT&E capacities. Rather, the Proposed Action would result in relatively small-scale but critical enhancements to the range complex that are necessary if the Navy is to maintain a state of military readiness commensurate with its national defense mission.

Training exercises provide the Navy with proficiency in seven warfare areas: Air Warfare, Amphibious warfare, surface warfare, anti-submarine warfare, strike warfare, electronic combat and naval special warfare. Each of these areas will be discussed in more detail below. Training has historically included ship and aircraft maneuvers, gunnery and bombing exercises, joint training exercises and RDT&E of new systems or weapons platforms. The GOMEX Range Complex also provides training opportunities for logistics or mission area training, including new pilot flight instruction, salvage diver training, underwater demolitions, security force training and specialized diver training.

The purpose of the Navy's activities are to achieve and maintain Fleet readiness using the GOMEX Range Complex to conduct and support current, emerging and future training and RDT&E, expand warfare missions conducted within the GOMEX Range Complex and upgrade and modernize existing capabilities to enhance and sustain Navy training and RDT&E.

Training proceeds on a continuum, advancing through four phases where the numbers involved as well as the intricacy and intensity of the training increases.

Maintenance Phase: Ships and squadrons focus on individual and team training. This level of training could involve the aircrew of a single aircraft flying basic instrument or tactics flights, or fire control crews for a ship's anti-aircraft systems employing their weapons in a simulated environment at a weapons school.

Basic Phase: Continues individual and team training, but the focus shifts to unit-level training, in which all members of the ship or squadron employ their ship or aircraft tactically. This phase is characterized by high-volume, short-duration, individual and unit training exercises. Examples of unit-level training could include a single destroyer conducting damage control, weapons employment, and navigation drills over a two-day underway period, or a two-plane flight of F/A-18s performing defensive maneuvers and weapons delivery training against an opposition force at a nearby bombing range during a two-hour sortie.

Integrated Phase brings all the individual units together as a strike group to synthesize staff actions and coordinate training in a multi-warfare environment. Generally, integrated phase training occurs during a limited number of major exercises, each lasting one to four weeks. This phase includes strike-group-level assessment and certification prior to deployment.

Sustainment Phase begins upon completion of the Integrated Phase, and lasts through deployment and several months following return to homeport. This phase could include several major training exercises with other U.S. and allied services in a joint/coalition environment, as well as a continuation of individual, unit, and integrated-level training exercises. A major sustainment exercise could include elements of a Carrier Strike Group and an Expeditionary Strike Group operating together with units from the U.S. Air Force (USAF) and/or allied navies during a 10-day battle problem.

The following descriptions present only the information necessary and relevant to our assessment of the potential direct or indirect effects of the Navy's proposed action on threatened and endangered species

and their designated critical habitat. This information and more detailed descriptions of the information is available in the Biological Evaluation (DoN, United States Fleet Forces, December 2008) and addendums (July 2009 and September 2010) and the Gulf of Mexico Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement and associated appendices (DoN, United States Fleet Forces, January 2009). Table 1 at the end of this section identifies the specific training activities and number of event/sorties for each activity.

Surface Warfare

Surface Warfare operations detect, localize, and track surface targets, primarily ships. Detected ships are monitored visually and with radar. Operations include identifying surface contacts, engaging with weapons, disengaging, evasion and avoiding attack, including implementation of radio silence and deceptive measures. Training events involving the use of explosive ordnance include air-to-surface Bombing Exercises and small arms training with explosive hand grenades at sea.

<u>Bombing Exercises (BOMBEX)</u>

Air to Surface

Strike fighter and maritime patrol aircraft drop bombs in closely-timed intervals on water targets to destroy or disable enemy ships or boats. This training is conducted within the BOMBEX Hotbox (for High-explosive bombs) and within W-151A and C and W-155B within the Pensacola OPAREA (for Non-Explosive Practice bombs).

Basic Phase (Unit Level Training)

During the Unit Level training two aircraft approach water targets at an altitude between 15,000 to less than 3,000 feet. Unguided non-explosive practice bombs or high explosive bombs are dropped against grounded ship hulks or more commonly MK-58 marine markers as targets. MK-76 and BDU-45 non-explosive practice bombs are the most common weapons used although MK-80 series (non-explosive practice bombs or high explosive bombs) may be used. Typically the bomb is released at less than 3, 000 ft and within a range of 1,000 yards for unguided bombs and above 15,000 ft and in excess of 10 nm for precision guided bombs. No bombs are dropped during night operations. Participating aircraft, support aircraft or ground support personnel illuminate certified targets using laser designators when laser guided weapons are employed.

The U.S. Navy proposes to conduct bombing exercises using F/A-18C/E/F aircraft with non-explosive practice bombs or high explosive bombs with each exercise lasting for 1 hour. For exercises within the HOTBOX using high explosives four bombs are dropped in succession per event. The U.S. Navy proposes to reduce the number of high explosive bombing events in this exercise from 4 events consisting of 16 high explosive bombs deployed annually (8 MK-82 500 lb bombs and 8 MK-83 1,000 lb bombs) to 1 event consisting of 4 high explosive bombs deployed annually.

Training during the Integrated and Sustainment Phases occur as described under the Basic phase except these exercises typically involve an at-sea simulated strike scenario with a flight of four or more aircraft, with or without designated opposition forces.

Gunnery Exercises (GUNEX)

Air to Surface

Fixed wing aircraft deliver gunfire against maritime targets. Air-to-surface GUNEX occurs in the W-155 Hotbox of the Pensacola OPAREA and includes F/A-18s firing 20 mm cannons.

Surface to Surface-Ship

Ship gun crews aboard guided missile cruisers, guided missile destroyers and guided missile frigates shoot at larger targets on the sea surface using the ship's main battery 5" and 76 mm guns and smaller targets with 25mm, 0.50 caliber or 7.62 machine guns to disable or destroy a threat ship. Non-explosive practice munitions are used which sink to the bottom of the ocean. This training exercise is conducted within W-151A and B and W-155A.

There are three types of main battery shipboard guns currently in use: 5-in./54 (aboard guided missile cruisers and guided missile destroyers), 5-in./62 (aboard guided missile destroyers -81 and newer), and 76 mm (aboard guided missile frigates). Both 5-in. guns use the same types of 5-in. projectiles for training exercises. The difference between the 5-in. guns is the longer range of the 5-in./62 because of the larger powder propulsion charge.

Basic Phase (Unit-Level Training)

During the exercise a simulated enemy ship or boat traveling at 5 kts or 30 kts approaches the cruiser, destroyer or frigate from a distance of 10 nm. The target is detected and tracked with the ship's radar and as it approaches to within 5-9 nm, approximately 60 rounds of 5" or 76 mm projectiles (NEPM) are fired close to but not actually hitting the target. The targets vary depending on the training event; however, only one target is used per event. High speed maneuvering towed or remotely controlled targets include the QST-35 Seaborne Powered Target, High Speed Maneuverable Surface Target and remote controlled Jet Ski. Other targets are towed by ship to the training area and include trimaran or radar reflective surface balloon (killer tomato), floating at-sea target (FAST), 55 gallon drum or balloon (weather, Mylar or other target). This exercise lasts about 3 hours.

During Integrated and Sustainment Phase Training, three to five ships will fire at the target. Additional ships will increase the number of rounds fired proportionally with each ship firing 60 rounds.

Maritime Security to include Visit, Board, Search, and Seizure/Maritime Interception Operations (VBSS/MIO)- Ship; anti-piracy operations; and special operations forces

During Maritime Security Operations events, helicopters and/or surface ships intercept/disrupt potentially illegal activities in littoral areas, or on the high seas. These events are conducted within W-151 and W-155 and last for two to three hours.

Basic (Unit Level Training) Phase

During maritime security operations crews aboard Navy surface ships identify, track, and intercept/disrupt illegal activities by approaching and boarding suspected vessels. A U.S. Navy cruiser, guided missile

destroyer, guided missile frigate, amphibious transport dock ship or amphibious dock landing ship can be used for this training exercise. The typical training exercise requires a clandestine approach to the suspect vessel traveling at speeds of 20 kts or greater and a forced boarding. The Navy uses a rigid hull inflatable or other small boat to transport boarding teams to the suspect vessel. Although the boarding teams carry small arms no ordnance is used. After the suspect vessel is boarded the boat stands by until the boarding party completes its search. Boarding parties then return to the small boat at the end of the training exercise. This entire exercise lasts two to three hours. If helicopters are used as described below the 2-3 hour duration of this exercise includes 1.5 hours of helicopter use.

Maritime Security to include VBSS/MIO-Helicopter

Basic (Unit Level Training) Phase and Major Exercise Events

For these training exercises a helicopter (MH-60) transports boarding teams to suspect vessels instead of small boats. Each event involves three helicopters (two at low altitude and one at high altitude) and a suspect vessel. The helicopters either hover overhead or remain in a close flight pattern near the boarded vessel. Navy Special Warfare personnel fast-rope from one helicopter to the suspect vessel to provide armed support as required. As is the case with VBSS/MIO- Ship exercises, no ordnance is used.

Small Arms Training

<u>GUNEX Surface to Surface-Boat</u>

Navy small boat crews use machine guns during daylight or other small ordnance (grenades) during daylight or after nightfall to attack and disable or destroy a surface target that simulates another ship, boat, swimmer, floating mine, or near shore land target. The purpose of this exercise is to develop the marksmanship skills and the small boat handling skills required to employ these weapons. This training exercise takes place within the Harbor Security Group Machine Gun Area, other areas within the Panama City OPAREA and UNDET Area E3 near the Corpus Christi OPAREA using guns and within the UNDET Area E3 using grenades.

Basic (Unit Level Training), Integrated and Sustainment Phase Training

A small boat approaches at high or low speeds, attacks and disables, or destroys a target on the water surface including close to land with 0.50 caliber, 7.62 mm and 40 mm machine guns or concussion grenades (MK3A2, 8 ounce High Explosive). This exercise is usually conducted with live fire but blanks may also be used for safety reasons. When using grenades personnel set the desired detonation depth and drop the grenade over the side of the boat. Each exercise using grenades can include the detonation of up to 10 live grenades, but no more than 20 live grenades per year.

Small boats used for this training include small unit river craft, combat rubber raiding craft, rigid hull inflatable boats, patrol craft and variations of these boats. The boats are inboard or outboard, diesel or gasoline and use either propeller or water jet propulsion. The typical target for this exercise is a 50 gallon steel drum which is allowed to sink to the bottom of the water column at the end of the exercise. Some ranges have ship hulk targets or target silhouettes alongside river banks to provide more realistic training opportunities depending on assigned missions. Each exercise lasts 1-2 hours.

Air Warfare

Air Intercept Control (AIC)

Surface ships and fixed winged aircraft (F/A-18 or E-2C) use their air search radar capability to direct strike fighter aircraft toward threat aircraft to be destroyed by missiles or guns. This training exercise is conducted in W-151 and W-155. The goal of the AIC exercise is the training of both the controllers and the aircraft pilots to intercept and simulate destruction of an opposing aircraft with its own force aircraft using either the aircraft's missile or gun systems. This training is conducted within warning areas W-151 and W-155.

Basic (Unit Level Training) Phase

Air intercept controllers aboard vessels or aircraft (aircraft carriers, guided missile cruisers, guided missile destroyers or E2-C) or on land in Navy School houses use air search radars to track the friendly strike fighter aircraft interceptor and threat aircraft at altitudes above 15,000 ft. Aircraft could be 100 nm apart at start of exercise. As the controller detects the threat aircraft a course and speed is provided to the strike fighter to intercept and engage the threat aircraft. Speeds in excess of 450 knots (kts) may be used during this training exercise. No high explosives are used. Commercial air craft are often used for this training exercise. Several training intercepts are usually conducted over a 1 to 2 hour period.

Integrated and Sustainment Phase training occurs as described above for the basic phase except two to six interceptors may be directed toward larger numbers of threat aircraft.

Strike Warfare

BOMBEX (Air to Ground)

Fixed-wing aircraft (T-45, F-15, F-16 and T-38) drop unguided non-explosive practice munitions (bombs and rockets: MK-76, BDU-33 and MK-82) on land targets during the day or night to destroy enemy vehicles, infrastructure and personnel.

This training exercise is conducted against targets within the SEARAY Target Range and the McMullen Range Complex. Targets may include any combination of fixed and mobile targets including a bull's eye of concentric rings and real or simulated wheeled vehicles, buildings, artillery and missile sites and remote controlled wheeled vehicles. Any ashore BOMBEX target may be actively or passively augmented to provide radar, infrared, or electronic signals, or support laser designation.

Basic (Unit Level Training) Phase

Two aircraft approach and circle a fixed or mobile target from an altitude of 15,000 to less than 3,000 ft. Unguided bombs are released below an altitude of 3,000 ft and within 1,000 yards of the target. Guided bombs are released above 15,000 ft and greater than 10 nm from the target. Night exercises usually employ captive carry (no drop) bombs for safety reasons. Laser designators from the aircraft dropping the bomb, a support aircraft, or ground support personnel are used to illuminate certified targets for use with lasers when using laser guided weapons. These exercises usually last 1 hour.

Integrated and Sustainment Phase

These phases of training typically involve a simulated strike scenario with a flight of four or more aircraft, with or without designated opposing forces. Participating aircraft attack the target using real-world tactics, which may require that several aircraft approach the target and deliver bombs and rockets, simultaneously, from several different altitudes and/or directions.

Gunnery Exercise (GUNEX-air to ground)

Strike fighter aircraft and helicopter crews including Naval Special Warfare personnel attack ground targets with 20 mm cannons during the day or night to destroy or disable enemy vehicles, structures or personnel. Strike fighter pilots can fulfill this training requirement against land targets, such as a bull's eye or target vehicles like trucks or tanks. This exercise occurs at the Yankee Target Ranges within the McMullen Range Complex.

Basic (Unit Level Training), Integrated and Sustainment Training

Two aircraft (F-15 or F-16) flying at 3,000 ft descend to a target several miles away. Each aircraft fires about 30 rounds from a Vulcan M6A1/A2 20 mm cannon before reaching an altitude of 1,000 ft. At approximately 4,000 ft from the target the aircraft breaks off and repeats approach until all ordnance is depleted (about 250 rounds). This exercise lasts about 1 hour.

Amphibious Warfare

Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulation System (IMPASS)

One or more Surface ships use main battery guns to support forces ashore in their battle against threat forces. Because the locations and opportunities for live-fire onshore are limited, a technological solution (IMPASS) has been developed whereas the shore area is simulated at sea enabling the conduct of FIREX training at sea. This exercise is conducted within W-151A and B and W-155A.

To conduct this exercise entirely at sea all land areas, targets and spotters are simulated using IMPASS. IMPASS is an onboard computer system which simulates land and land targets for the ship's systems. The scoring system is deployed by the ship at sea and consists of 5 sonobuoys set in a pentagon-shaped arrangement at 1.3 km intervals. The ship is positioned 12 nm from shore and about 4-5 nm from the sonobuoys. U.S. Navy personnel fire the ship's main battery guns into the sonobuoy array. The sonobuoys detect the ordnance as it hits the sea surface. The ship takes position about 4-5 nm from the

target. One or more rounds are fired at the target, adjustments are made and more shots are fired until the target is hit. To destroy the target one round is fired every 5-7 seconds typically totaling 5 rounds. After 10 or more minutes the exercise is repeated until all rounds allocated for the exercise are depleted. Typical exercises last eight hours in which approximately 5 to 100 rounds of 5-in. non-explosive practice munitions are expended. When training is complete the array is recovered. A ship will normally conduct three FIREXs at different levels of complexity over several months to become fully qualified.

Electronic Combat

Chaff Exercise (CHAFEX)

Ships and fixed-winged aircraft deploy chaff to disrupt threat targeting and missile guidance radars and to defend against an attack. Chaff may be employed offensively, such as before a major strike to "hide" inbound striking aircraft or ships, or defensively in reaction to being detected by an enemy targeting radar. Defensive chaff training is the most common exercise used for training both ships and aircraft, however, exercises are often designed to take advantage of offensive and defensive chaff deployments. Chaff exercises are often conducted with flare and other exercises rather than a standalone exercise.

CHAFFEX-Aircraft Deployed Chaff

Basic (Unit Level Training), Integrated and Sustainment Training

Aircraft chaff exercises involve an aircraft (F/A-18C/E/F) detecting electronic targeting signals from threat radars or missiles, dispensing chaff (RR-129A/L, RR-144A/AL and R-188) in flight and then maneuvering to attack. Aircraft exercises typically last for 1 hour. This training exercise is conducted within W-151A and B and Brownwood MOAs.

(CHAFEX-Ship Deployed Chaff)

Basic (Unit Level Training), Integrated and Sustainment Training

Guided missile cruisers, guided missile destroyers and guided missile frigates detect an electronic targeting signal or the ship's radar detects an inbound threat missile and deploys chaff to disrupt enemy radars to defend against attack. This training exercise is conducted within W-151A and B and W-155A.

Unit Level, Integrated and Sustainment Training

For ships chaff exercises involve deployment of MK-214 or MK-216 from the MK-36 Super Rapid Bloom off-board Countermeasures launcher or other similar systems. The type and amount of chaff deployed depends on the specific exercise situation. Chaff rounds are fired either automatically or manually and the ship maneuvers away from the chaff cloud. Ship exercises typically last 3 hours.

Flare Exercise (FLAREX)

Fixed-winged aircraft deploy flares to disrupt threat infrared missile guidance systems to defend against an attack. These exercises train aircraft personnel in the use of defensive flares designed to confuse infrared sensors or infrared homing missiles, thereby causing the sensor or missile to lock onto the flares

instead of the real aircraft. FLAREX is often conducted with CHAFFEX, as well as other exercises, rather than as a standalone exercise.

Unit Level, Integrated and Sustainment Training

This training exercise is conducted within W-151A and B and Brownwood MOAs.

Aircraft (F/A-16 and F/A-18/C/E/F) detect electronic targeting signals from simulated enemy radars or missiles, deploy flares and maneuver to attack enemy threat. In the typical exercise an aircraft will expend 5 flares during an exercise while flying above 3,000 ft. Types of flares used include MJU-8A/B and MJU-27A/B, MJU-32B, MJU-53B and SM-875/ALE. This exercise typically lasts 1 hour.

Underwater Demolitions

Training at the Demolition Pond consists of detonating underwater explosive charges and provides personnel with experience in placing and detonating underwater explosives to achieve best results.

Navy divers, security forces, salvage divers and explosive ordnance personnel locate barriers or obstacles and use C-4 or other explosive charges less than 5 lbs to destroy them. Most Demolition Pond charges are detonated near the shoreline between 5 and 7 ft below the water's surface in water less than 21 ft deep. Training includes 60 days of salvage diver training, 12 days of explosive ordnance disposal tech training, 10 days of security force training and 8 days of diver training per year. Each training exercise involves 20 to 25 personnel on or near the shore within the Panama City Demolition Pond Area.

Table 1: GOMEX Range Complex Proposed Training Operations

Range Operation	Training Area	Platform	System or Ordnance	Occurrence Per Year	Occurrences Over 5-year Duration of Proposed Action	Typical Occurrence Duration
Surface Warfare						
BOMBEX (Air to Surface[2])	W-151 A/C; W-155B	F/A-18 during major exercises	MK-82(I), BDU-45 (500 pound (lb) NEPM bomb) [3]	11 events (44 bombs)	55 events (220 bombs)	1 hour
			MK-76 (I) (25 lb NEPM)[4]	14 events (140 bombs)	70 events (700 bombs)	1 hour
			MK-83 (I) (1,000 lb NEPM)	4 events (16 bombs)	20 events (80 bombs)	1 hour
	W-151 A/C; W-155B	F/A-18 with Laser Targeting	MK-82(I), BDU-45 (500 lb NEPM)	6 events (24 bombs)	30 events (120 bombs)	1 hour

[2] An event consists of one or more aircraft dropping one or more bombs on a target in closely-timed intervals.
[3] An event consists of a flight of 2 F/A-18s, each dropping 2 bombs.
[4] An event consists of a flight of 2 F/A-18s, each dropping 5 bombs.

Table 1: GOMEX Range Complex Proposed Training Operations						
Range Operation	Training Area	Platform	System or Ordnance	Occurrence Per Year	Occurrences Over 5-year Duration of Proposed Action	Typical Occurrence Duration
			MK-83(I) (1,000 lb NEPM)	2 events (8 bombs)	10 events (40 bombs)	1 hour
	W-155B	F/A-18 VFA-204 Unit Level Training	MK-82(I), BDU-45 (500 lb NEPM bomb)	20 events (80 bombs)	100 e vents (400 bombs)	1 hour
			MK-83(I) (1,000 lb NEPM bomb)	5 events (20 bombs)	25 events (100 bombs)	1 hour
			MK-84(I) (2,000 lb NEPM)	3 events (3 bombs)	15 events (15 bombs)	1 hour
	Pensacola OPAREA BOMBEX Hotbox	F/A-18 VFA-204 Unit Level Training	MK-83 (1,000 lb High Explosive bomb)	1 event (4 bombs)	5 events (20 bombs)	1 hour
GUNEX (Air to Surface)	Pensacola OPAREA BOMBEX Hotbox	F/A-18	20 mm cannon	40 sorties (24,000 rounds)	200 sorties (120,000 rounds)	1 hour
GUNEX (Surface to Surface-Ship)	W-151 A/B, W-155A	CG, DDG, FFG	5 in gun	8 events (400 rounds)	40 events (2,000 rounds)	3 hours
		FFG	76 mm gun	8 events (40 rounds)	40 events (200 rounds)	3 hours
		CG, DDG, FFG	CSW 0.50 caliber M16 gun	8 events (2,400 rounds	40 events (12,000 rounds)	3 hours
			CIWS (BLK 1B)	8 events (6,400 rounds	40 events (32,000 rounds)	3 hours
			25 mm machine gun	8 events (1,600 rounds)	40 events (8,000 rounds)	3 hours
Maritime Security Operations (MSO) to include Visit, Board, Search, and Seizure/Maritime Interception	W-151/W-155	Rigid Hull inflatable boat or similar small boat, and CG, DDG, FFG, LPD or LSD	None	36 events	180 events	2-3 hours

Table 1: GOMEX Range Complex Proposed Training Operations						
Range Operation	Training Area	Platform	System or Ordnance	Occurrence Per Year	Occurrences Over 5-year Duration of Proposed Action	Typical Occurrence Duration
Operations (VBSS/MIO)-Ship						
MSO to include VBSS/MIO-Helicopter	W-151/W-155	H-60	None	18 events	90 events	1.5 hours
Small Arms Training						
GUNEX (Surface to Surface-Boat)	Harbor Security Group Machine Gun Area and broader Panama City OPAREA	Vessels such as combat rubber raiding craft, rigid hull inflatable boats and patrol craft	7.62 mm machine gun	2 events (16,000 rounds	10 events (80,000 rounds)	1-2 hours
GUNEX (Surface to Surface-Boat)	Corpus Christi Underwater Detonations (UNDET) Area E3	Vessels such as combat rubber raiding craft, rigid hull inflatable boats and patrol craft	7.62 mm machine gun (A131), 0.50 caliber (cal) gun (A555), 40 mm gun (B576)	4 events (11,200 rounds 7.62 mm), (10,000 rounds .50 cal), and (2,880 rounds 40 mm)	20 events (56,000 rounds 7.62 mm), (50,000 rounds .50 cal), and (14,400 rounds 40 mm)	1-2 hours
Small Arms Training (Explosive hand grenades)	Corpus Christi Underwater Detonations (UNDET) Area E3	Maritime Expeditionary Support Group (various small boats)	MK3A2 Grenades (0.5 Net Explosive Weight)	6 events (20 grenades)[5]	30 events (100 grenades)	1-2 hours
Air Warfare						
Air Intercept Control	W-151;W-155	F/A-18; E2C	N/A	40 sorties	200 sorties	1-2 hours
Strike Warfare						
BOMBEX (Air to Ground)	SEARAY Target	T-45	MK-76 (25 lb NEPM bomb) and BDU-33 (NEPM bomb)	12,800 sorties (17,640 MK-76 bombs and 3,405 BDU-33 bombs)	64,000 sorties (88,200 MK-76 bombs and 17,025 BDU-33 bombs)	1 hour
	Dixie Target	T-45, F-16	MK-76 (25 lb NEPM bomb)	306 sorties (1,433 bombs)	1,520 sorties (7,165 bombs)	1 hour

[5] 1 event up to 10 grenades but not more than 20 grenades/year

Table 1: GOMEX Range Complex Proposed Training Operations						
Range Operation	Training Area	Platform	System or Ordnance	Occurrence Per Year	Occurrences Over 5-year Duration of Proposed Action	Typical Occurrence Duration
	Yankee Target	F-16, F/15, T-38, T-45	(BDU-33 (NEPM bomb) and MK-82 (500 lb NEPM bomb)	489 sorties (2,400 BDU-33 bombs and 236 MK-82 bombs)	2,445 sorties (12,000 BDU-33 bombs and 1,180 MK-82 bombs)	1 hour
GUNEX (Air to Ground)	Yankee Target	F-16, F-15	20 mm cannon	163 sorties (25,000 rounds)	815 sorties (125,000 rounds)	1 hour
Amphibious Warfare						
Firing Exercise (FIREX) with IMPASS	W-151A/B, W-155A	CG, DDG	5 inch gun (IMPASS)	8 events (800 NEPM rounds)	40 events (4,000 NEPM rounds)	8 hours
Electronic Combat						
Chaff Exercise	W-151A/B	F/A-18	R-144A/AL, R-129A/L	368 sorties (3,680 cartridges)	1,840 sorties (18,400 cartridges)	1 hour
	Brownwood MOAs	F-18 (USMC), F-16 (USAF)	R-188	980 sorties (5,000 cartridges)	4,900 sorties (40,000 cartridges)	1 hour
	W-151 A/B, W-155A	CG, DDG, FFG	MK-214 (Seduction Chaff)	10 events (60 cartridges)	500 events (300 cartridges)	1 hour
	W-151 A/B, W-155A,	CG, DDG, FFG	MK-216 (Distraction Chaff)	4 events (24 cartridges)	20 events (120 cartridges)	1 hour
Flare Exercise	W-151 A/B	F/A-18	MJU-8A/B, MJU-27 A/B, MJU-32B, MJU-53B, SM-875/ALE	368 sorties (1,840 flares)	1,840 sorties (9,200 flares)	1 hour
	Brownwood MOAs	F/A-18 (USMC), F-16 (USAF)	M-206, MJU-7	980 sorties (11,930 canisters)	4,900 sorties (59,650 canisters)	1 hour
Underwater Detonation Training						
Salvage Diver Training	Panama City Demolition Pond	N/A	Various small underwater charges(less than 5 lb each)	60 days	300 days	8 hours
Explosive Ordnance Disposal Tech Training		N/A	Various small underwater charges(less than 5 lb	12 days	60 days	8 hours

Table 1: GOMEX Range Complex Proposed Training Operations						
Range Operation	Training Area	Platform	System or Ordnance	Occurrence Per Year	Occurrences Over 5-year Duration of Proposed Action	Typical Occurrence Duration
			each)			
Security Force Training		N/A	Various small underwater charges(less than 5 lb each)	10 days	50 days	8 hours
Diver Training		N/A	Various small underwater charges(less than 5 lb each)	8 days	40 days	8 hours
These numbers include all basic flight instruction and mission area sorties described under Mission Area Training below.						

Acronyms: Non-explosive practice munitions (NEPM), guided missile cruiser (CG), guided missile destroyer (DDG), guided missile frigate (FFG).

Mission Area Training

Basic Flight Instruction and Flight Maneuver Training

Mission area training is not one of the primary warfare areas, but is used to train entry-level students in the fundamentals of flying so that pilots are prepared for exercises under the primary warfare areas. Student pilots engage in continuous proactive and reactive changes in aircraft attitude, altitude and airspeed. Training includes air combat maneuvers, air intercept control, aerial refueling, student pilot training and reconnaissance. No ordnance is expended during the training.

Basic flight instruction is conducted offshore within the Corpus Christi OPAREA (W-228) and R-2908 (located 3 nm south of the Alabama and Florida shoreline) as well as inland areas (R-4404, Meridian, Pine Hill, Pensacola and Kingsville MOAs and R-6312). Approximately 3,865 sorties are proposed to be flown over W-228 using a number of aircraft (F-15/16/18, E-2/3, (K)C-5/130/135, P-3). Area R-2908 is restricted airspace where the U.S. Navy Blue Angels train to engage in complicated flight maneuvers. The Blue Angels are expected to fly approximately 180 sorties annually using T-34, T-6, T-45, T-39 and TH-57s. The numbers of sorties listed here are included in the numbers of sorties reflected in Table 1 above and do not increase the number of sorties flown within the GOMEX Range Complex.

Flight maneuver training occurs over offshore warning areas (W-92 and W-54 within and adjacent to the New Orleans OPAREA, respectively) and the inland Brownwood MOAs. The U.S. navy proposed to fly approximate 328 sorties per year over areas W-92 and W-54. The numbers of sorties listed here are included in the numbers of sorties reflected in Table 1 above and do not increase the number of sorties flown within the GOMEX Range Complex.

The Navy also proposes to increase use and operation of commercial supersonic and subsonic aircraft within the GOMEX Range Complex to serve as an opposition force for the training of Navy pilots in Air Warfare and other air training events. The number and type of Commercial Air Services (CAS) aircraft supporting the Atlantic Fleet would increase and provide a threat that presents the required number and type of aircraft and missile threats. These CAS aircraft would replace Navy aircraft currently performing this function and would not increase the number of aircraft in the airspace, airspace time, aircraft emissions or use different airspace than is currently used. Furthermore, the areas where each of these training elements is currently conducted would not change. CAS aircraft carry a variety of electronic threat emitters, perform aircraft maneuvers and flight profiles that mimic enemy aircraft and provide air-to-air refueling capabilities.

Research, Development, Training and Evaluation (RDT&E)

RDT&E is conducted principally by Naval Air Systems Command (NAVAIR), Naval Sea Systems Command (NAVSEA), Space and Naval Warfare Systems Command (SPAWAR), and the various commands that report to them. RDT&E operations typically occur in the Panama City and Pensacola OPAREAs. NAVSEA conducts RDT&E on various surface and subsurface systems, and SPAWAR focuses on engineering and fleet support for command, control and communications systems and ocean surveillance. NAVAIR conducts testing of aircraft, aircraft weapons, and the "Integration Testing" of all subsystems (including weapons) with the aircraft.

Tests are used principally for equipment maintenance and to ensure that various types of equipment within a unit work well together for the training exercises described in Table 1. RDT&E events similar to training activities conducted in the GOMEX range Complex are accounted for in the total events for each warfare area.

U.S. Navy Proposed Protective Measures

The Navy's protective measures focus on: (1) avoidance, when feasible; (2) minimization, when avoidance is not feasible; and (3) monitoring. Monitoring is designed to help determine the impacts of the training on listed resources and the efficacy of the mitigation measures, to provide information to supplement future mitigation measures and to track compliance with Marine Mammal Protection Act and ESA take authorizations/exemptions, respectively.

<u>Standard Operating Procedures</u>

The U.S. Navy proposes to continue to implement the following mitigation measures. The Navy considers these measures standard operating procedures since they are implemented on a routine basis.

Personnel Training – Lookouts

The use of shipboard lookouts is a critical component of all Navy standard operating procedures. Navy shipboard lookouts (also referred to as "watchstanders") are highly qualified and experienced observers of the marine environment. Their duties require that they report all objects sighted in the water to the

Officer of the Deck (OOD) (*e.g.*, trash, a periscope, marine mammals, sea turtles) and all disturbances (*e.g.*, surface disturbance, discoloration) that may be indicative of a threat to the vessel and its crew. Lookouts are on station at all times (day and night) when a ship or surfaced submarine is moving through the water.

All personnel serving as lookouts on Navy ships and submarines are required to complete Marine Species Awareness Training (MSAT) as part of their training program. MSAT includes instruction on the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments, general observation at sea, and detecting/identifying marine mammals.

1. All bridge personnel, Commanding Officers, Executive Officers, officers standing watch on the bridge, maritime patrol aircraft aircrews, and Mine Warfare (MIW) helicopter crews will complete MSAT.
2. Navy lookouts will undertake extensive training to qualify as a lookout in accordance with the Lookout Training Handbook (Naval Educational Training [NAVEDTRA] 12968-D).
3. Lookout training will include on-the-job instruction under the supervision of a qualified, experienced lookout. Following successful completion of this supervised training period, lookouts will complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).
4. Lookouts will be trained in the most effective means to ensure quick and effective communication within the command structure to facilitate implementation of protective measures if marine species are spotted.
5. Surface lookouts would scan the water from the ship to the horizon and be responsible for all contacts in their sector. In searching the assigned sector, the lookout would always start at the forward part of the sector and search aft (toward the back). To search and scan, the lookout would hold the binoculars steady so the horizon is in the top third of the field of vision and direct the eyes just below the horizon. The lookout would scan for approximately five seconds in as many small steps as possible across the field seen through the binoculars. They would search the entire sector in approximately five-degree steps, pausing between steps for approximately five seconds to scan the field of view. At the end of the sector search, the glasses would be lowered to allow the eyes to rest for a few seconds, and then the lookout would search back across the sector with the naked eye.
6. At night, lookouts would not continuously sweep the horizon with their eyes. Instead, lookouts would scan the horizon in a series of movements that would allow their eyes to come to periodic rests as they scan the sector. When visually searching at night, they would look a little to one side and out of the corners of their eyes, paying attention to the things on the outer edges of their field of vision. Lookouts will also have night vision devices available for use.

Operating Procedures and Collision Avoidance

1. Prior to major exercises, a Letter of Instruction, Naval Message or Environmental Annex to the Operational Order will be issued to further disseminate the personnel training requirement and general marine species mitigation measures.

2. Commanding Officers will make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.
3. While underway, surface vessels will have at least two lookouts with binoculars; surfaced submarines will have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts will watch for and report to the OOD the presence of marine mammals and sea turtles.
4. On surface vessels equipped with a mid-frequency active sonar, pedestal mounted "Big Eye" 27 (20x110) binoculars will be properly installed and in good working order to assist in the detection of marine mammals and sea turtles in the vicinity of the vessel.
5. Personnel on lookout will employ visual search procedures employing a scanning method in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).
6. After sunset and prior to sunrise, lookouts will employ Night Lookouts Techniques in accordance with the NAVEDTRA 12968-D.
7. While in transit, naval vessels will be alert at all times, use extreme caution, and proceed at a "safe speed" so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.
8. When whales have been sighted in the area, Navy vessels will increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of naval assets and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (*e.g.*, safety, weather).
9. Naval vessels shall maneuver to keep at least 500-yd (460 m) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Restricted maneuverability includes, but is not limited to, situations when vessels are engaged in dredging, submerged operations, launching and recovering aircraft or landing craft, minesweeping operations, replenishment while underway and towing operations that severely restrict a vessel's ability to deviate course. Vessels will take reasonable steps to alert other vessels in the vicinity of the whale.
10. Where feasible and consistent with mission and safety, vessels will avoid closing to within 200-yd (183 m) of sea turtles and marine mammals other than whales (whales addressed above).
11. Floating weeds, algal mats, *Sargassum* rafts, clusters of seabirds, and jellyfish are good indicators of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.
12. Navy aircraft participating in exercises at sea will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections will be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.

13. All vessels will maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records will be kept for a period of 30 days following completion of a major training exercise.

Coordination and Reporting Requirements for Marine Mammals

The Navy will coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during or within 24 hours after completion of training activities. Additionally, the Navy will follow internal chain of command reporting procedures as promulgated through Navy instructions and orders.

Protective Measures for Specific At-Sea Training Events

The U.S. Navy proposes to continue to implement the following mitigation measures as applicable to the specific training exercises.

Surface-to-Surface Gunnery and Firing Exercise Using IMPASS (up to and including 5-inch non-explosive rounds)

Surface to Surface gunnery exercises occur in training areas W-151 A/B, W-155A, Panama City OPAREA (Harbor Security Group Machine Gun Area), and UNDET Area E3 of the GOMEX Range Complex. Firing Exercise Using IMPASS occurs in W-151A/B and W-155A.

1. Lookouts will visually survey for floating weeds, algal mats, and *Sargassum* rafts which may be inhabited by immature sea turtles in the target area. Intended impact will not be within 200 yards (182 m) of known or observed floating weeds, algal mats, *Sargassum* rafts, or coral reefs.

2. A 200-yd (182-m) radius buffer zone will be established around the intended target.

3. From the intended firing position, trained lookouts will survey the buffer zone for marine mammals and sea turtles prior to commencement and during the exercise as long as practicable. Due to the distance between the firing position and the buffer zone, lookouts are only expected to visually detect breaching whales, whale blows, and large pods of dolphins and porpoises.

4. If applicable, target-towing vessels shall maintain a trained lookout for marine mammals and sea turtles. If a marine mammal or sea turtle is sighted in the vicinity, the tow vessel will immediately notify the firing vessel, which will suspend the exercise until the area is clear.

5. The exercise will be conducted only when the buffer zone is visible and marine mammals and sea turtles are not detected within the target area and the buffer zone.

Small Arms Training – Explosive Hand Grenades (e.g. MK3A2 grenades)

This activity occurs in training areas within UNDET Area E3 of the GOMEX Range Complex.

1. Lookouts will visually survey for floating weeds, algal mats, *Sargassum* rafts, marine mammals and sea turtles.
2. A 200 yard (182 m) radius buffer zone will be established around the intended target. The exercises will be conducted only if the buffer is clear of sighted marine mammals and sea turtles.

Small Arms Training – (such as 7.62-mm and CSW .50-caliber M16 non-explosive)

This activity occurs in training areas W-151A/B, W-155A, Panama City OPAREA (HSGMGA), and UNDET Area E3 of the GOMEX Range Complex.

1. Lookouts visually survey for floating weeds, algal mats, *Sargassum* rafts, marine mammals, and sea turtles. Weapons will not be fired in the direction of known or observed floating weeds, algal mats, *Sargassum* rafts, marine mammals, sea turtles, or coral reefs.

Air-to-Surface Gunnery (such as 20-mm non-explosive rounds)

This activity occurs in the BOMBEX Hotbox of the GOMEX Range Complex.

1. If surface vessels are involved, lookouts will visually survey for *Sargassum* rafts, which may be inhabited by immature sea turtles, in the target area. Impact should not occur within 200 yd (182 m) of known or observed floating weeds, algal mats, *Sargassum* rafts, or coral reefs.
2. A 200-yd (182-m) radius buffer zone will be established around the intended target.
3. If surface vessels are involved, lookout(s) will visually survey the buffer zone for marine mammals and sea turtles prior to and during the exercise.
4. Aerial surveillance of the buffer zone for marine mammals and sea turtles will be conducted prior to commencement of the exercise. Aerial surveillance altitude of 500 ft to 1,500 ft is optimum. Aircraft crew/pilot will maintain visual watch during exercises. Release of ordnance through cloud cover is prohibited; aircraft must be able to actually see ordnance impact areas.
5. The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.
6. Target towing craft shall maintain a lookout. If a marine mammal or sea turtle is sighted in the vicinity of the exercise, the tow craft will immediately notify the firing vessel in order to secure gunnery firing until the area is clear.

Air-to-Surface At-Sea Bombing Exercises (MK-83 1,000-lb, MK-84 2,000-lb, and MK-76 25-lb non-explosive bombs)

BOMBEX using non-explosive bombs occurs in three areas in the GOMEX Range Complex: the adjacent areas of W-151A, W-151C, and W-155B (1B/9A/9B) and the BOMBEX Hotbox.

1. If surface vessels are involved, trained lookouts will survey for *Sargassum* rafts, which may be inhabited by immature sea turtles, and for sea turtles and marine mammals. Ordnance will not be targeted to impact within 1,000 yds (914 m) of known or observed *Sargassum* rafts, sea turtles, marine mammals or coral reefs.

2. A 1,000-yd (914-m) radius buffer zone will be established around the intended target.
3. Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.
4. The exercise will be conducted only if marine mammals and sea turtles are not visible within the buffer zone.

Air-to-Surface At-Sea Bombing Exercises [MK-83 1,000 lb high explosive bomb (415.8-lb Net Explosive Weight)]

This activity occurs in W-155A/B (BOMBEX Hotbox) of the GOMEX Range Complex. The location was established to be within 150 nm from shore-based facilities (the established flight distance restriction for F/A-18 jets during unit level training events).

1. If surface vessels are involved, lookouts will survey for *Sargassum* rafts, which may be inhabited by immature sea turtles. Ordnance will not be targeted to impact within 5,100 yd (4663 m) of known or observed *Sargassum* rafts or coral reefs.
2. A buffer zone of 5,100-yd (4663-m) radius will be established around the intended target zone. The exercises will be conducted only if the buffer zone is clear of sighted marine mammals and sea turtles.
3. At-sea BOMBEXs using live ordnance will occur during daylight hours only.
4. Aircraft will visually survey the target and buffer zone for marine mammals and sea turtles prior to and during the exercise. The survey of the impact area will be made by flying at 1,500 ft altitude or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited: aircraft must be able to actually see ordnance impact areas. Survey aircraft should employ most effective search tactics and capabilities.

Detonation of Explosives in the Demolition Pond

This activity occurs in the NSA Panama City Demolition Pond in the GOMEX Range Complex.

1. Visual monitoring will be conducted in the Demolition Pond for manatees, other marine mammals, and sea turtles for any exercise that involves detonation of explosives. The monitoring will be initiated a minimum of 15 min immediately prior to the exercise and will continue until the exercise is completed. If a manatee, other marine mammals, or sea turtle is observed in the Demolition Pond, then detonation of explosives would not take place until the animal has left the Demolition Pond.
2. Detonations over 5-lb net explosive weight will not be conducted in the Demolition Pond.
3. Military expended materials will be collected and removed from the Demolition Pond immediately following all exercises when feasible.

Marine Mammal Protection Act (MMPA) Regulations to Authorize the Taking of Marine Mammals Incidental to the Proposed GOMEX Range Complex Activities

As the Navy anticipates that marine mammals will be "taken" incidental to the activities conducted in the GOMEX Range Complex, the Permits Division upon request from the U.S. Navy, proposes to promulgate regulations governing the "taking" of marine mammals incidental to training and other operations conducted within the GOMEX Range Complex. These regulations would be effective from November 2010 to November 2015 and would allow the Permits Division to issue annual letters of authorization to incidentally harass marine mammals during the Navy's yearly training and RDT&E operations in the GOMEX Range Complex.

The U.S. Navy activities the Permits Division is proposing to issue an incidental "take" authorization for consist of BOMBEX (Air to Surface), Small Arms Training (Explosive hand grenades) and vessel movement to, from and within the GOMEX Range Complex. For a description of these training activities see the *Bombing Exercises (BOMBEX) Air to Surface* and *GUNEX Surface to Surface-Boat Small Arms Training* sections described earlier in these Opinions. The proposed regulations authorize only non-lethal "take" by harassment which may occur incidental to the BOMBEX and GUNEX activities as well as all vessel movements within the GOMEX Range Complex associated with the proposed training exercises.

Permits Division Proposed Protective Measures

As required to satisfy the requirements of the MMPA, the U.S. Navy proposes to implement measures that would allow their training activities to have the least practicable adverse impact on marine mammal species or stocks (which includes considerations of personnel safety, practicality of implementation and impact on the effectiveness of the "military readiness activity"). Those measures are summarized in this section of these Opinions. For a complete description of all the measures applicable to the proposed exercises, readers should refer to the U.S. Navy's application for a Letter of Authorization and the Permits Division's proposed and final rules to authorize the "take" of marine mammals pursuant to the MMPA. When conducting training activities, the mitigation measures contained in the Letter of Authorization must be implemented. These mitigation measures include, but are not limited to:

I. Personnel Training – Lookouts

a. All bridge personnel, Commanding Officers, Executive Officers, officers standing watch on the bridge, maritime patrol aircraft aircrews, and Mine Warfare (MIW) helicopter crews shall complete Marine Species Awareness Training (MSAT).

b. Navy lookouts shall undertake extensive training to qualify as a watchstander in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).

c. Lookout training shall include on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training period, lookouts shall complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).

d. Lookouts shall be trained in the most effective means to ensure quick and effective communication within the command structure to facilitate implementation of protective measures if marine species are spotted.

e. Surface lookouts shall scan the water from the ship to the horizon and be responsible for all contacts in their sector. In searching the assigned sector, the lookout shall always start at the forward part of the sector and search aft (toward the back). To search and scan, the lookout shall hold the binoculars steady so the horizon is in the top third of the field of vision and direct the eyes just below the horizon. The lookout shall scan for approximately five seconds in as many small steps as possible across the field seen through the binoculars. They shall search the entire sector in approximately five-degree steps, pausing between steps for approximately five seconds to scan the field of view. At the end of the sector search, the glasses shall be lowered to allow the eyes to rest for a few seconds, and then the lookout shall search back across the sector with the naked eye.

f. At night, lookouts shall scan the horizon in a series of movements that would allow their eyes to come to periodic rests as they scan the sector. When visually searching at night, they shall look a little to one side and out of the corners of their eyes, paying attention to the things on the outer edges of their field of vision. Lookouts shall also have night vision devices available for use.

II. Operating Procedures & Collision Avoidance

a. Prior to major exercises, a Letter of Instruction, Mitigation Measures Message or Environmental Annex to the Operational Order shall be issued to further disseminate the personnel training requirement and general marine species mitigation measures.

b. Commanding Officers shall make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible consistent with safety of the ship.

c. While underway, surface vessels shall have at least two lookouts with binoculars; surfaced submarines shall have at least one lookout with binoculars. Lookouts already posted for safety of navigation and man-overboard precautions may be used to fill this requirement. As part of their regular duties, lookouts shall watch for and report to the OOD the presence of marine mammals.

d. Personnel on lookout shall employ visual search procedures employing a scanning method in accordance with the Lookout Training Handbook (NAVEDTRA 12968-D).

e. After sunset and prior to sunrise, lookouts shall employ Night Lookouts Techniques in accordance with the NAVEDTRA 12968-D.

f. While in transit, naval vessels shall be alert at all times, use extreme caution, and proceed at a "safe speed" (the minimum speed at which mission goals or safety will not be compromised) so that the vessel can take proper and effective action to avoid a collision with any marine animal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

g. When marine mammals have been sighted in the area, Navy vessels shall increase vigilance and implement measures to avoid collisions with marine mammals and avoid activities that might result in close interaction of naval assets and marine mammals. Such measures shall include changing speed and/or course direction and would be dictated by environmental and other conditions (e.g., safety or weather).

h. Naval vessels shall maneuver to keep at least 500 yds (460 m) away from any observed whale and avoid approaching whales head-on. This requirement does not apply if a vessel's safety is threatened, such as when change of course will create an imminent and serious threat to a person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. Vessels shall take reasonable steps to alert other vessels in the vicinity of the whale.

i. Where feasible and consistent with mission and safety, vessels shall avoid closing to within 200-yd (183 m) of marine mammals other than whales (whales addressed above).

j. Navy aircraft participating in exercises at sea shall conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties. Marine mammal detections shall be immediately reported to assigned Aircraft Control Unit for further dissemination to ships in the vicinity of the marine species as appropriate where it is reasonable to conclude that the course of the ship will likely result in a closing of the distance to the detected marine mammal.

k. All vessels shall maintain logs and records documenting training operations should they be required for event reconstruction purposes. Logs and records shall be kept for a period of 30 days following completion of a major training exercise.

III. Coordination and Reporting Requirements

a. The Navy shall coordinate with the local NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that may occur at any time during or within 24 hours after completion of training activities.

b. The Navy shall follow internal chain of command reporting procedures as promulgated through Navy instructions and orders.

IV. *Mitigation Measures for Specific At-sea Training Events* – If a marine mammal is injured or killed as a result of the proposed Navy training activities (e.g., instances in which it is clear that munitions explosions caused the death), the Navy shall suspend its activities immediately and report such incident to NMFS.

a. Air-to-Surface At-Sea Bombing Exercises [MK-83 1,000 lb high explosive bomb (415.8-lb Net Explosive Weight)]

1. This activity shall only occur in W-155A/B (Hotbox) area of the GOMEX Range Complex OPAREA.

2. Aircraft shall visually survey the target and buffer zone for marine mammals prior to and during the exercise. The survey of the impact area shall be made by flying at 1,500 ft (457 m) altitude or lower, if safe to do so, and at the slowest safe speed. Release of ordnance through cloud cover is prohibited; aircraft must be able to actually see ordnance impact areas.

3. A buffer zone of a 5,100-yard (4,663-m) radius shall be established around the intended target zone. The exercises shall be conducted only if the buffer zone is clear of marine mammals.

4. At-sea BOMBEXs using live ordnance shall occur during daylight hours only.

b. Small Arms Training - Explosive hand grenades (such as the MK3A2 grenades):

1. Lookouts shall visually survey for marine mammals prior to and during exercise.

2. A 200-yd (182-m) radius buffer zone shall be established around the intended target. The exercises shall be conducted only if the buffer zone is clear of marine mammals.

V. Requirements for monitoring and reporting

a. The Holder of the Letter of Authorization issued pursuant to these regulations is required to cooperate with the NMFS when monitoring the impacts of the activity on marine mammals.

b. The Holder of the Authorization must notify NMFS immediately (or as soon as clearance procedures allow) if the underwater explosives used during BOMBEX (Air-to-Surface) or Small Arms Training with MK3A2 grenades are thought to have resulted in the mortality or serious injury of any marine mammals, or in any take of marine mammals other than Level B Harassment.

c. The Navy must conduct all monitoring and required reporting under the Letter of Authorization, including abiding by the GOMEX Range Complex Monitoring Plan, which is incorporated herein by reference, and which requires the Navy to implement, at a minimum, the monitoring activities summarized below.

1. Vessel or aerial surveys

A. The Holder of this Authorization shall visually survey a minimum of 1 explosive event per year. One of the vessel or aerial surveys should involve professionally trained marine mammal observers (MMOs). If it is impossible to conduct the required surveys due to lack of training exercises, the missed annual survey requirement shall roll into the subsequent year to ensure that the appropriate number of surveys (i.e., total of five) occurs over the 5-year period of effectiveness of this subject.

B. When operationally feasible, for specified training events, aerial or vessel surveys shall be used 1-2 days prior to, during (if reasonably safe), and 1-5 days post detonation.

C. Surveys shall include any specified exclusion zone around a particular detonation point plus 2,000 yards beyond the border of the exclusion zone (i.e., the circumference of the area from the border of the exclusion zone extending 2,000 yards outwards). For vessel-based surveys a passive acoustic system (hydrophone or towed array) could be used to determine if marine mammals are in the area before and/or after a detonation event.

D. When conducting a particular survey, the survey team shall collect:

i. Location of sighting;

ii. Species (if not possible, indicate whale, dolphin or pinniped);

iii. Number of individuals;

iv. Whether calves were observed;

v. Initial detection sensor;

vi. Length of time observers maintained visual contact with marine mammal;

vii. Wave height;

viii. Visibility;

ix. Whether sighting was before, during, or after detonations/exercise, and how many minutes before or after;

x. Distance of marine mammal from actual detonations (or target spot if not yet detonated);

xi. Observed behavior - Watchstanders shall report, in plain language and without trying to categorize in any way, the observed behavior of the animal(s) (such as animal closing to bow ride, paralleling course/speed, floating on surface and not swimming etc.), including speed and direction;

xii. Resulting mitigation implementation - Indicate whether explosive detonations were delayed, ceased, modified, or not modified due to marine mammal presence and for how long; and

xiii. If observation occurs while explosives are detonating in the water, indicate munitions type in use at time of marine mammal detection.

2. Passive acoustic monitoring – the Navy shall conduct passive acoustic monitoring when operationally feasible.

   A. Any time a towed hydrophone array is employed during shipboard surveys the towed array shall be deployed during daylight hours for each of the days the ship is at sea.

   B. The towed hydrophone array shall be used to supplement the ship-based systematic line-transect surveys (particularly for species such as beaked whales that are rarely seen).

   C. The array should have the capability of detecting low frequency vocalizations (<1,000 Hz) for baleen whales and relatively high frequency (up to 30 kHz) for odontocetes. The use of two simultaneously deployed arrays can also allow more accurate localization and determination of diving patterns.

3. Marine mammal observers on Navy platforms

   A. MMOs who are selected for aerial or vessel surveys shall, to the extent practicable, be placed on a Navy platform during the exercises being monitored.

   B. The MMO must possess expertise in species identification of regional marine mammal species and experience collecting behavioral data.

C. MMOs shall not be placed aboard Navy platforms for every Navy training event or major exercise. Instead, MMOs should be employed during specifically identified opportunities deemed appropriate for data collection efforts. The events selected for MMO participation shall take into account safety, logistics, and operational concerns.

D. MMOs shall observe from the same height above water as the lookouts.

E. The MMOs shall not be part of the Navy's formal reporting chain of command during their data collection efforts; Navy lookouts shall continue to serve as the primary reporting means within the Navy chain of command for marine mammal sightings. The only exception is that if an animal is observed within the shutdown zone that has not been observed by the lookout, the MMO shall inform the lookout of the sighting and the lookout shall take the appropriate action through the chain of command.

F. The MMOs shall collect species identification, behavior, direction of travel relative to the Navy platform, and distance first observed. Information collected by MMOs should be the same as those collected by the survey team described in (V)(c)(1)(D).

d. General Notification of Injured or Dead Marine Mammals - Navy personnel shall ensure that NMFS (regional stranding coordinator) is notified immediately (or as soon as clearance procedures allow) if an injured or dead marine mammal is found during or shortly after, and in the vicinity of, any Navy training exercise utilizing underwater explosive detonations. The Navy shall provide NMFS with species or description of the animal(s), the condition of the animal(s) (including carcass condition if the animal is dead), location, time of first discovery, observed behaviors (if alive), and photo or video (if available).

e. Annual GOMEX Range Complex Monitoring Plan Report - The Navy shall submit a report annually on March 1 describing the implementation and results (through January 1 of the same year) of the GOMEX Range Complex Monitoring Plan. Data collection methods shall be standardized across range complexes to allow for comparison in different geographic locations. Although additional information will also be gathered, the MMOs collecting marine mammal data pursuant to the GOMEX Range Complex Monitoring Plan shall, at a minimum, provide the same marine mammal observation data required in the data required in (V)(c)(1)(D). The GOMEX Range Complex Monitoring Plan Report may be provided to NMFS within a larger report that includes the required Monitoring Plan Reports from GOMEX Range Complex and multiple range complexes.

f. Annual GOMEX Range Complex Exercise Report - The Navy shall provide the information described below for all of their explosive exercises. Until the Navy is able to report in full the information below, they shall provide an annual update on the Navy’s explosive tracking methods, including improvements from the previous year.

1. Total annual number of each type of explosive exercise conducted in the GOMEX Range Complex.

2. Total annual expended/detonated rounds (missiles, bombs, etc.) for each explosive type.

g. GOMEX Range Complex 5-yr Comprehensive Report - The Navy shall submit to NMFS a draft report that analyzes and summarizes all of the multi-year marine mammal information gathered during the GOMEX Range Complex exercises for which annual reports are required (Annual GOMEX Range Complex Exercise Reports and GOMEX Range Complex Monitoring Plan Reports). This report shall be submitted at the end of the fourth year of the rule (February 2015), covering activities that have occurred through August 1, 2014.

h. The Navy shall respond to NMFS comments and requests for additional information or clarification on the GOMEX Range Complex Comprehensive Report, the Annual GOMEX Range Complex Exercise Report, or the Annual GOMEX Range Complex Monitoring Plan Report (or the multi-Range Complex Annual Monitoring Plan Report, if that is how the Navy chooses to submit the information) if submitted within 3 months of receipt. These reports will be considered final after the Navy has addressed NMFS' comments or provided the requested information, or three months after the submittal of the draft if NMFS does not comment by then.

i. In 2011, the Navy shall convene a Monitoring Workshop in which the Monitoring Workshop participants will be asked to review the Navy's Monitoring Plans and monitoring results and make individual recommendations (to the Navy and NMFS) of ways of improving the Monitoring Plans. The recommendations shall be reviewed by the Navy, in consultation with NMFS, and modifications to the Monitoring Plan shall be made, as appropriate.

Overview of NMFS' Assessment Framework

NMFS uses a series of sequential analyses to assess the effects of federal actions on endangered and threatened species and designated critical habitat. The first analysis identifies those physical, chemical, or biotic aspects of proposed actions that are likely to have individual, interactive, or cumulative direct and indirect effects on the environment (we use the term "potential stressors" for these aspects of an action). As part of this step, we identify the spatial extent of any potential stressors and recognize that the spatial extent of those stressors may change with time (the spatial extent of these stressors is the "action area" for a consultation and in this case also for a conference).

The second step of our analyses starts by determining whether endangered species, threatened species, or designated critical habitat are likely to occur in the same space and at the same time as these potential stressors. If we conclude that such co-occurrence is likely, we then try to estimate the nature of that co-occurrence (these represent our exposure analyses). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an Action's effects and the populations or subpopulations those individuals represent.

Once we identify which listed resources (endangered and threatened species and designated critical habitat) are likely to be exposed to potential stressors associated with an action and the nature of that exposure, in the third step of our analyses we examine the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure (these

represent our response analyses). The final steps of our analyses — establishing the risks those responses pose to listed resources — are different for listed species and designated critical habitat (these represent our risk analyses).

Risk Analyses for Endangered and Threatened Species

Our jeopardy determinations must be based on an action's effects on the continued existence of threatened or endangered species as those "species" have been listed, which can include true biological species, subspecies, or distinct population segments of vertebrate species. Because the continued existence of listed species depends on the fate of the populations that comprise them, the viability (that is, the probability of extinction or probability of persistence) of listed species depends on the viability of the populations that comprise the species. Similarly, the continued existence of populations are determined by the fate of the individuals that comprise them; populations grow or decline as the individuals that comprise the population live, die, grow, mature, migrate, and reproduce (or fail to do so).

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

We measure risks to listed individuals using the individual's current or expected future reproductive success which integrates survival and longevity with current and future reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable response to stressors produced by an Action would reasonably be expected to reduce the individual's current or expected future reproductive success by increasing the individual's likelihood of dying prematurely, having reduced longevity, increasing the age at which individuals become reproductively mature, reducing the age at which individuals stop reproducing, reducing the number of live births individual produce during any reproductive bout, decreasing the number of times an individual is likely to reproduce over its reproductive lifespan (in animals that reproduce multiple times), or causing an individual's progeny to experience any of these phenomena (Brommer et al. 1998, 2000, 2002; Clutton-Brock 1988, Coulson et al. 2006, Crowe et al. 2004, Fox and Gurevitch 2000, Kotiaho et al. 2005, McGraw and Caswell 1996, Newton 1989, Oli and Dobson 2003, Reed 2005, Roff 2002, Stearns 1992, Turchin 2003).

When individual, listed plants or animals are expected to experience reductions in their current or expected future reproductive success, we would expect those reductions to also reduce the abundance, reproduction rates, or growth rates (or increase variance in one or more of these rates) of the populations those individuals represent (see Stearns 1992). Reductions in one or more of these variables (or one of the variables we derive from them) is a necessary condition for reductions in a population's viability, which is itself a necessary condition for reductions in a species' viability. On the other hand, when listed plants or animals exposed to an Action's effects are not expected to experience reductions in fitness, we would not expect the Action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (for example, see Anderson 2000, Mills

and Beatty 1979, Stearns 1992). If we conclude that listed plants or animals are not likely to experience reductions in their fitness, we would conclude our assessment.

If, however, we conclude that listed plants or animals are likely to experience reductions in their current or expected future reproductive success, our assessment tries to determine if those reductions are likely to be sufficient to reduce the viability of the populations those individuals represent (measured using changes in the populations' abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures to make inferences about the population's extinction risks). In this step of our analyses, we use the population's base condition (established in the Environmental Baseline and Status of Listed Resources sections of these Opinions) as our point of reference. Finally, our assessment tries to determine if changes in population viability are likely to be sufficient to reduce the viability of the species those populations comprise. In this step of our analyses, we use the species' status (established in the Status of the Species section of these Opinions) as our point of reference.

Biological and Conference Opinions, then, distinguish among different kinds of "significance" (as that term is commonly used for NEPA analyses). First, we focus on potential physical, chemical, or biotic stressors that are "significant" in the sense of "salient" in the sense of being distinct from ambient or background. We then ask if (a) exposing individuals to those potential stressors is likely to (a) represent a "significant" adverse experience in the life of individuals that have been exposed; (b) exposing individuals to those potential stressors is likely to cause the individuals to experience "significant" physical, chemical, or biotic responses; and (c) any "significant" physical, chemical, or biotic response are likely to have "significant" consequence for the fitness of the individual animal. In the latter two cases (items (b) and (c)), the term "significant" means "clinically or biotically significant" rather than statistically significant.

For populations (or sub-populations, demes, etc.), we are concerned about whether the number of individuals that experience "significant" reductions in fitness and the nature of any fitness reductions are likely to have a "significant" consequence for the viability (= probability of demographic, ecological, or genetic extinction) of the population(s) those individuals represent. Here "significant" also means "clinically or biotically significant" rather than statistically significant.

For "species" (the entity that has been listed as endangered or threatened, not the biological species concept), we are concerned about whether the number of populations that experience "significant" reductions in viability (= increases in their extinction probabilities) and the nature of any reductions in viability are likely to have "significant" consequence for the viability (= probability of demographic, ecological, or genetic extinction) of the "species" those population comprise. Here, again, "significant" also means "clinically or biotically significant" rather than statistically significant.

Risk Analyses for Designated Critical Habitat

Our "destruction or adverse modification" determinations must be based on an action's effects on the conservation value of habitat that has been designated as critical to threatened or endangered species[6]. If

[6] We are aware that several courts have ruled that the definition of destruction or adverse modification that appears in the section 7 regulations at 50 CFR 402.02 is invalid and do not rely on that definition for the determinations we make in this Opinion. Instead, as we explain in the text, we use the "conservation value" of critical habitat for our

an area encompassed in a critical habitat designation is likely to be exposed to the direct or indirect consequences of the proposed action on the natural environment, we ask if primary or secondary constituent elements included in the designation (if there are any) or physical, chemical, or biotic phenomena that give the designated area value for the conservation are likely to respond to that exposure.

In this step of our assessment, we must identify (a) the spatial distribution of stressors and subsidies produced by an action; (b) the temporal distribution of stressors and subsidies produced by an action; (c) changes in the spatial distribution of the stressors with time; (d) the intensity of stressors in space and time; (e) the spatial distribution of constituent elements of designated critical habitat; and (f) the temporal distribution of constituent elements of designated critical habitat.

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

In this step of our assessment, we must identify or make assumptions about (a) the habitat's probable condition before any exposure as our point of reference (that is part of the impact of the Environmental Baseline on the conservation value of the designated critical habitat); (b) the ecology of the habitat at the time of exposure; (c) where the exposure is likely to occur; and (d) when the exposure is likely to occur; (e) the intensity of exposure; (f) the duration of exposure; and (g) the frequency of exposure.

In this step of our assessment, we recognize that the conservation value of critical habitat, like the base condition of individuals and populations, is a dynamic property that changes over time in response to changes in land use patterns, climate (at several spatial scales), ecological processes, changes in the dynamics of biotic components of the habitat, etc. For these reasons, some areas of critical habitat might respond to an exposure when others do not. We also consider how designated critical habitat is likely to respond to any interactions and synergisms between or cumulative effects of pre-existing stressors and proposed stressors.

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

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determinations which focuses on the designated area's ability to contribute to the conservation of the species for which the area was designated.

comparison. For example, if the critical habitat in the action area has limited current value or potential value for the conservation of listed species, that limited value is our point of reference for our assessment.

If the conservation value of designated critical habitat in an action area is reduced, the final step of our analyses asks if those reductions are likely to be sufficient to reduce the conservation value of the entire critical habitat designation. In this step of our assessment, we combine information about the constituent elements of critical habitat (or of the physical, chemical, or biotic phenomena that give the designated area value for the conservation of listed species, particularly for older critical habitat designations that have no constituent elements) that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the action area. We use the conservation value of the entire designated critical habitat as our point of reference for this comparison. For example, if the designated critical habitat has limited current value or potential value for the conservation of listed species, that limited value is our point of reference for our assessment.

Application of this Approach in this Consultation

The primary stressors associated with the training and RTD&E activities within the GOMEX Range Complex consist of:

- Disturbance from surface vessel movements and the risk of vessel collisions from transiting and other vessels involved in training exercises;
- Disturbance from aircraft overflights during training exercises;
- Pressure waves and sound fields associated with underwater explosions during training exercises;
- Military expended materials (chemical components of used ordnance, targets, chaff, flares and marine markers); and
- Military expended materials (ingestion risk of used ordnance and targets associated with training exercises to endangered and threatened species).

The first step of our analysis evaluates the available evidence to determine the likelihood of listed species or critical habitat being exposed to these stressors. Our analysis assumed that these stressors pose no risk to listed species or critical habitat if these stressors do not co-occur with those species or critical habitat in space or time.

<u>Exposure Analyses</u>

As discussed in the introduction to this section of these Opinions, exposure analyses are designed to identify the listed resources that are likely to co-occur with these effects in space and time and the nature of that co-occurrence. Our exposure analyses are designed to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an Action's effects and the populations or subpopulations those individuals represent.

For our exposure analyses, NMFS generally relies on an action agency's estimates of the number of marine mammals that might be "taken" (as that term is defined for the purposes of the MMPA). In a small number of consultations, however, NMFS has conducted separate analyses to estimate the number

of endangered or threatened marine animals that might be exposed to stressors produced by a proposed action to assess the effect of assumptions in an action agency's model on model estimates. For example, NMFS used a model based on components of Hollings' disc equation (1959) to independently estimate the number of marine mammals that might be exposed to U.S. Navy training activities in a few recent consultations that satisfied the following conditions:

- the sole or primary stressor was hull-mounted mid-frequency active sonar, and
- data were available on: the density of endangered or threatened animals in an action area; the ship's speed; the radial distance at which different received levels would be detected from a source given sound speed profiles; and the duration of specific training exercises.

These conditions have been met in five of the 23 consultations NMFS has completed on U.S. Navy training since 2002 (for example, opinions on anti-submarine warfare training on the U.S. Navy's Hawai'i Range Complex and Southern California Range Complex) so NMFS conducted independent exposure analyses and included the results of those analyses in biological opinions on those actions. In the remaining opinions, hull-mounted mid-frequency active sonar was not the primary stressor associated with proposed training or the data for one of the model's variables were not available.

In this consultation, the primary stressor is underwater detonations, not hull-mounted mid-frequency active sonar or any other kind of sonar. Given that the "take" estimates do not appear to be disproportionately high or low given the data available on animal densities we relied solely on the results of acoustic models the U.S. Navy used to prepare its NEPA compliance documents for sea turtles and the exposure estimates from the Permits Division for sperm whales to complete our assessment.

The U.S. Navy has developed a model to determine the acoustic impacts of explosive ordnance on marine mammals. The modeling consists of 5 process components:

- Descriptions of the exercises including the types of weapons and acoustic sources used and their time over which weapons would be fired and weapons characteristics.
- Oceanographic and geo-acoustic data representative of the exercise location and time of year for input into the acoustic propagation model
- An acoustic propagation model to predict energy levels at ranges and depths from the source
- Marine animal density data for the exercise locations
- A final calculation to multiply together the acoustic propagation results, the animal densities and the number of operations.
- The acoustic propagation model predicted energy levels at ranges and depths from the source, in this case, high explosive bombs and explosive grenades.

The U.S. Navy uses several thresholds and criteria to estimate the numbers of listed species that might be exposed to underwater detonations and may be harassed (as that term is defined for the purposes of the MMPA) injured or killed because of that exposure (Table 2). To be consistent the U.S. Navy used the thresholds and criteria established for single explosions for the Seawolf Submarine Shock Test and USS Winston S. Churchill Ship Shock Test to determine exposures for listed species from single explosions resulting from grenade deployment . The U.S. Navy then made additional assumptions to the single explosion thresholds and criteria from the USS Winston S. Churchill Ship Shock Test to determine

exposure to multiple explosions associated with the BOMBEX training. In addition, the U.S. Navy revised the acoustic criterion for small underwater explosions (< 1500 net weight) from 12 pounds per square inch (psi) for peak pressure over all exposures to 23 psi to reflect current acoustic criteria for the onset of temporary threshold shift (TTS) (NOAA, 2006).

Table 2: Criteria and Thresholds for Estimating Exposures for Underwater Detonations

Effect	Criterion	Threshold
Mortality	Onset of Extensive Lung Injury	indexed to 30.5 psi-msec (assumes 100% small animal at 26.9 lb)
Injury (physiological)	50% Tympanic Membrane Rupture	1.17 in-lb/in2 (about 205 dB re: 1 μPa2-s)
Injury (physiological)	Onset Slight Lung Injury	indexed to 13 psi-msec (assumes 100% small animal at 26.9 lb)
Harassment (non-injurious physiological)	TTS	182 dB re: 1 μPa2-s
Harassment (non-injurious physiological)	Temporary Threshold Shift (TTS)	23 psi
Harassment (non-injurious behavioral)	Behavioral Disturbance without TTS	177 dB re: 1 μPa2-s

Although the Navy's and the Permit's Division's estimates are not exposure estimates, per se, they provide some insight into the number of times different species might be exposed to shock waves or sound fields because exposure is a pre-requisite for "take" because an organism that is not exposed, directly or indirectly, to the effects of a stressor, cannot be "taken" by the stressor. The actual number of exposures will usually exceed the number of "takes".

As indicated in Table 2 above underwater detonations at received levels greater than or equal to 177 dB re 1 Pa^2-s sound exposure level (SEL) and at received levels greater than or equal to 182 dB re 1 Pa^2-s SEL or 23 psi-ms are considered thresholds for behavioral harassment (Level B "take") by the Permits Division. Underwater detonations where received levels would be expected to cause 50 percent tympanic membrane rupture, at received levels that would be expected to produce slight lung injury as a result of their exposure are considered thresholds for injury (Level A "take") by the Permits Division. For underwater detonations, we relied entirely on the U.S. Navy's and the Permits Division's exposure estimates. These exposure estimates seemed to be reasonable given the density data for sperm whales and sea turtles within the GOMEX Range Complex and the types and durations of the proposed training exercises and RDT&E activities.

Response Analyses

As discussed in the introduction to this section of these Opinions, once we identified which listed resources were likely to be exposed to underwater detonations associated with the proposed training exercises and RDT&E activities and the nature of that exposure, we examined the scientific and commercial data available to determine whether and how those listed resources are likely to respond given their exposure. As a result, we assume that U.S. Navy training exercises and RDT&E activities primarily affect endangered and threatened species by changing their behavior, although we continue to recognize the risks of physical trauma and noise-induced losses in hearing sensitivity (threshold shift). Second, we expanded our conception of "hearing" to include cognitive processing of auditory cues, rather than a focus solely on the mechanical processes of the ear and auditory nerve. Third, we incorporate the primary mechanisms by which behavioral responses affect the longevity and reproductive success of animals: changing an animal's energy budget, changing an animal's time budget (which is related to changes in an animal's energy budget), forcing animals to make life history trade-offs (for example, engaging in evasive behavior such as deep dives that involve short-term risks while promoting long-term survival), or changes in social interactions among groups of animals (for example, interactions between a cow and her calf). Based on a review of available information, we then determined which of these possible stressors would likely occur and which would be negligible.

Risk Analyses

As discussed in the Introduction to this section, the final steps of our analyses — establishing the risks those responses pose to endangered and threatened species or designated critical habitat — normally begin by identifying the probable risks actions pose to listed individuals that are likely to be exposed to an action's effects. Our analyses then integrate those individuals risks to identify consequences to the populations those individuals represent. Our analyses conclude by determining the consequences of those population-level risks to the species those populations comprise.

We measure risks to listed individuals using the concept of current or expected future reproductive success which integrates survival and longevity with current and future reproductive success. In particular, we examine the scientific and commercial data available to determine if an individual's probable response to stressors produced by an action would reasonably be expected to reduce the individual's current or expected future reproductive success by increasing the individual's likelihood of dying prematurely, having reduced longevity, increasing the age at which individuals become reproductively mature, reducing the age at which individuals stop reproducing, reducing the number of live births individual produce during any reproductive event, decreasing the number of times an individual is likely to reproduce over the reproductive lifespan (in animals that reproduce multiple times), or causing an individual's progeny to experience any of these phenomena.

When individual plants or animals would be expected to experience reductions in their current or expected future reproductive success, we would also expect those reductions to also reduce the abundance, reproduction rates, or growth rates (or increase variance in one or more of these rates) of the populations those individuals represent (see Stearns 1992). If we conclude that listed plants or animals are not likely to experience reductions in their current or expected future reproductive success, we would conclude our assessment. If we conclude that listed plants or animals are likely to experience reductions in their current or expected future reproductive success, we would integrate those individual's risks to

determine if the number of individuals that experience reduced fitness (or the magnitude of any reductions) is likely to be sufficient to reduce the viability of the populations those individuals represent (most commonly measured using changes in the population's abundance, reproduction, spatial structure and connectivity, growth rates, or if the information is available, any variance in these measures to make inferences about a population's probability of becoming demographically, ecologically, or genetically extinct in 10, 25, 50, or 100 years). For this step of our analyses, we would rely on the population's base condition (established in the Environmental Baseline and Status of Listed Resources sections of these Opinions) as our point of reference. For instance, in this consultation we relied on changes in the sperm whale population as measured by the number of individuals of the Gulf of Mexico population that would respond (either behaviorally or physically) to each of the stressors of the proposed action (exposure estimates) to the total number of individuals comprising that population.

Our risk analyses normally conclude by determining whether changes in the viability of one or more populations is or is not likely to be sufficient to reduce the viability of the species those populations comprise. For these analyses, we combine our knowledge of the patterns that accompanied the decline, collapse, or extinction of populations and species that are known to have declined, collapsed, or become extinct in the past in a qualitative assessment as well as a suite of population viability models, if available.

Evidence Available for this Assessment

To conduct these analyses, we considered the evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. Over the past decade, a considerable body of scientific information on anthropogenic sound and its effects on marine mammals and other marine life has become available. Many investigators have studied the potential responses of marine mammals and other marine organisms to human-generated sounds in marine environments or have integrated and synthesized the results of these studies (for example, Abgrail et al. 2008, Bowles et al. 1994; Cox et al. 2006, Croll et al. 1999, 2001; Frankel and Clark 1998; Gisiner 1998, McCauley and Cato 2001; NRC 1994 1996, 2000, 2003, 2005; Norris 1994; Reeves 1992, Richardson et al. 1995, Southall et al. 2007, Tyack 2000, 2007; Wright et al. 2007).

To supplement that body of knowledge, we conducted electronic literature searches using the Library of Congress' First Search and Dissertation Abstracts databases, SCOPUS, Web of Science, and Cambridge Abstract's Aquatic Sciences and Fisheries Abstracts (ASFA) database services. The First Search databases provide access to general biological literature, master's theses, and doctoral dissertations back to 1980; ASFA provides access to journal articles, magazine articles, and conference proceedings back to 1964. Our searches specifically focus on the ArticleFirst, BasicBiosis, Dissertation Abstracts, Proceedings and ECO databases, which index the major journals dealing with issues of ecological risk (for example, the journals Environmental Toxicology and Chemistry, Human and Ecological Risk Assessment), marine mammals (Journal of Mammalogy, Canadian Journal of Zoology, Journal of Zoology, Marine Mammal Science), sea turtles (Copeia, Herpetologia, Journal of Herpetology), ecology (Ambio, Bioscience, Journal of Animal Ecology, Journal of Applied Ecology, Journal of the Marine Biological Association of the UK, Marine Pollution Bulletin, Oikos), bioacoustics (Bioacoustics, Journal of the Acoustical Society of America), and animal behavior (Advances in the Study of Behavior, Animal Behavior, Behavior, Behavioral Ecology and Sociobiology, Ethology).

To supplement our searches, we examined the literature that was cited in documents and any articles we collected through our electronic searches. If, based on a reading of the title or abstract of a reference, the reference appeared to comply with the keywords presented in the preceding paragraph, we acquired the reference. If a reference's title did not allow us to eliminate it as irrelevant to this inquiry, we acquired it.

Despite the information that is available, this assessment involved a large amount of uncertainty about the basic hearing capabilities of marine mammals and sea turtles; how marine animals use sounds as environmental cues, how they perceive acoustic features of their environment; the importance of sound to their normal behavioral and social ecology; the mechanisms by which human-generated sounds affect the behavior and physiology (including the non-auditory physiology) of marine mammals, and the circumstances that are likely to produce outcomes that have adverse consequences for individual marine mammals and marine mammal populations (see NRC 2000 for further discussion of these unknowns).

Treatment of "Cumulative Impacts" (in the sense of NEPA)

The U.S. Council on Environmental Quality defined "cumulative effects" (which we refer to as "cumulative impacts" to distinguish between NEPA and ESA uses of the same term) as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7).

By regulation, the Services assess the effects of a proposed action by adding its direct and indirect effects to the impacts of the activities we identify in an Environmental Baseline (50 CFR 402.02). Although our regulations use the term "adding" the effects of actions to an environmental baseline, we do not assume that the effects of actions are all additive; our assessments consider synergistic effects, multiplicative effects, and antagonistic effects of stressors on endangered species, threatened species, and any critical habitat that has been designated for those species.

A critical question that is rarely asked during cumulative impact analyses is: what effects are being accumulated? When native vegetative communities in terrestrial ecosystems are being converted to multiple housing projects, it would be a relatively simple matter to accumulate the acreage disturbed or destroyed. When chemical pollutants are discharged into a river or stream from non-point sources, it becomes much harder to identify which chemicals are likely to accumulate and how plants or animals are likely to respond to that accumulation. With ephemeral stimuli such as active sonar or underwater detonations, the stressor (the sound or pressure wave) disappears moments after it is introduced into the environment; as a result, it is not likely to accumulate in any meaningful way. What might accumulate, however, are the physical, physiological, behavioral, or social consequences of animals that are exposed to those sounds or pressure waves multiple times.

In practice we address "cumulative impacts" by focusing on individual organisms, which integrate the environments they occupy or interact with indirectly over the course of their lives. In our assessments, we think in terms of the biotic or ecological "costs" of exposing endangered and threatened individuals to a single stressor, a sequence of single stressors, or a suite of stressors (or "stress regime"). At the level of individual organisms, these "costs" consist of incremental reductions in the current or expected future reproductive success of the individuals that result from exposing those individuals to one or more

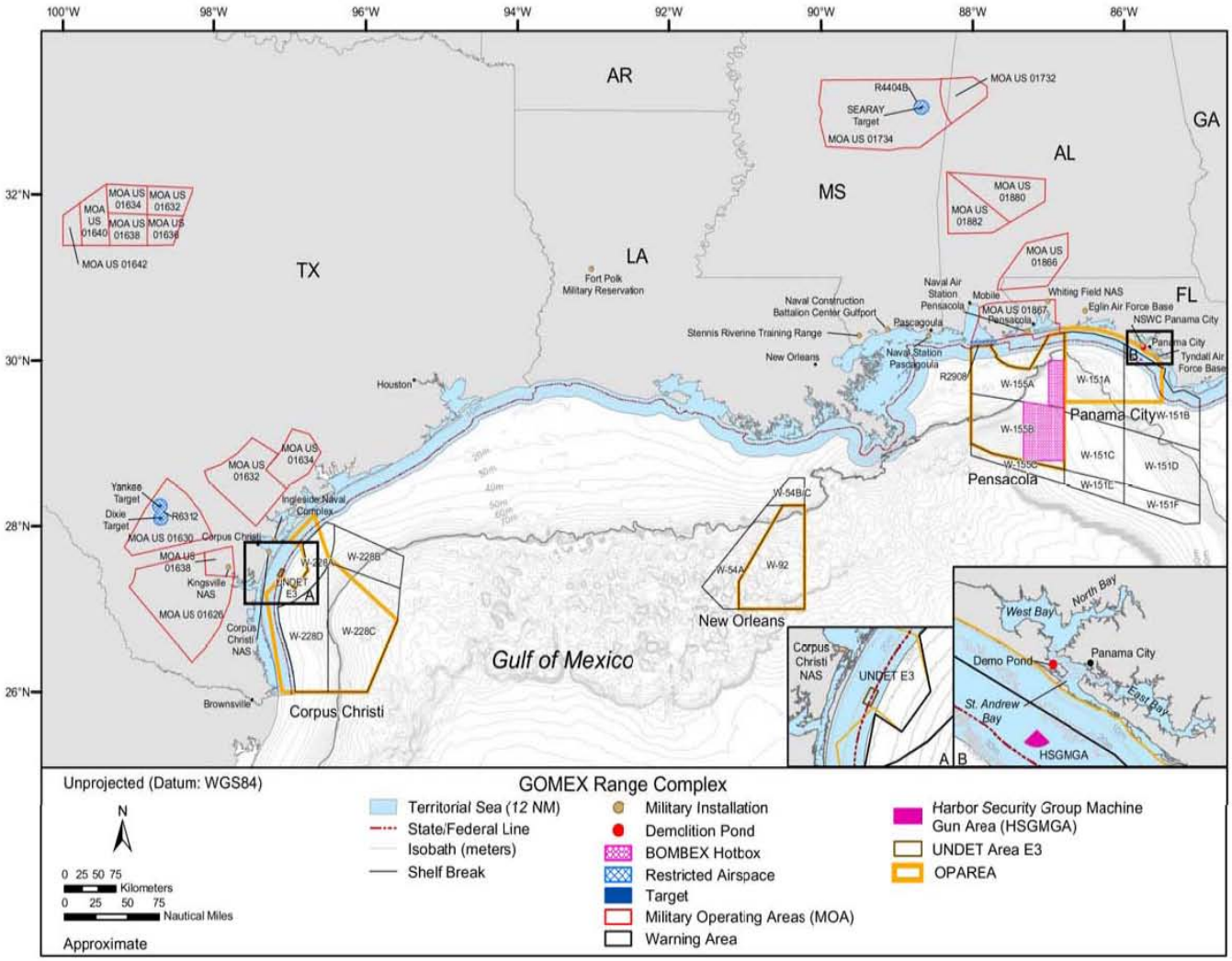
stressors. The “costs” of those exposures might be immediately significant for an organism‘s reproductive success (for example, when an individual dies or loses one of its young) or the “costs” might become significant only over time. The costs of syneristic interactions between two stressors or a sequence of stressors would be expected to be higher than the “costs” incurred without the synergism; the “costs” of antagonistic interactions would be expected to be lower than the “costs” incurred without the antagonism.

We begin our assessments by either qualitatively or quantitatively accumulate the biotic “costs” of exposing endangered or threatened individuals to the threats we identify in the Status of the Species and Environmental Baseline sections of our Biological and Conference Opinions. Then we estimate the probable additional “costs” associated with the proposed action on those individuals and ask whether or to what degree those “costs” would be expected to translate into reductions in the current and expected future reproductive success of those individuals. If those “costs” would be expected to reduce the current and expected future reproductive success of individuals or an endangered or threatened species, we assess the probable effects of those reductions on the population or populations those individuals represent, then continue to assess effects on the endangered or threatened species.

Action Area

The action area for this consultation consists of the water areas surrounding and adjacent to the GOMEX Range Complex (See figure 1 below). The GOMEX Range Complex is located in the coastal and offshore waters of the Gulf of Mexico adjacent to the states of Florida, Mississippi, Louisiana and Texas and extends seaward into waters more than 2,000m deep and includes the Panama City, Pensacola, New Orleans, and Corpus Christi OPAREAs.

Figure 1: Gulf of Mexico Range Complex



Status of Listed Resources

NMFS has determined that the following species and critical habitat designations may occur in the action area for the proposed Atlantic GOMEX Range Complex activities

Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Green sea turtle	*Chelona mydas*	Endangered/Threatened[7]
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened
Loggerhead sea turtle (Northwest Atlantic Ocean Distinct Population Segment (DPS))	*Caretta caretta*	Proposed Endangered[8]
Olive Ridley sea turtle	*Lepidochelys olivacea*	Endangered[9]
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Smalltooth Sawfish (U.S. DPS)	*Pristis pectinata*	Endangered
Largetooth Sawfish	(*Pristis Perotteti*)	Endangered

Critical Habitat

Sea Turtle Critical Habitat

Critical habitat for green sea turtles has been designated on Culebra Island, Puerto Rico (63 FR 46693, September 2, 1998), for hawksbill sea turtles on Mona and Monita Islands, Puerto Rico (63 FR 46693,

[7] Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. Due to the inability to distinguish between the populations away from the nesting beaches, green sea turtles are considered endangered wherever they occur in U.S. waters.

[8] On March 15, 2010 (75 FR 12598), NMFS issued a proposed rule that determined that globally loggerhead sea turtles comprise at least nine distinct population segments (DPSs). Two of these DPSs were proposed as threatened species and the remaining seven DPSs were proposed as endangered.

[9] Olive ridley sea turtles are listed as threatened except for the Mexico breeding population, which is listed as endangered. Due to the inability to distinguish between the populations away from the nesting beaches, olive ridley sea turtles are considered endangered wherever they occur in U.S. waters.

September 2, 1998), and for leatherback sea turtles on Sandy Point on Saint Croix in the U.S. Virgin Islands (44 FR 17710, March 23, 1979).

Gulf Sturgeon Critical Habitat

Critical habitat was designated for Gulf sturgeon on March 19, 2003 (68 FR 13370). Designated critical habitat includes 14 geographic areas (units) among the rivers and tributaries within the Gulf of Mexico and encompasses approximately 2,783 rkm (1,730 river miles (rmi)) and 6,042 square kilometers (km^2) (2,333 square miles (mi^2)) of estuarine and marine habitat.

Smalltooth Sawfish Critical Habitat

Critical habitat was designated for smalltooth sawfish on September 2, 2009 (74 FR 45353). The critical habitat consists of two units: the Charlotte Harbor Estuary Unit, which comprises approximately 221,459 acres of coastal habitat; and the Ten Thousand Islands/Everglades Unit (TTI/E), which comprises approximately 619,013 acres of coastal habitat. The two units are located along the southwestern coast of Florida between Charlotte Harbor and Florida Bay.

Listed Resources Not Considered Further

As described in the Approach to the Assessment, NMFS uses two criteria to identify those endangered or threatened species or critical habitat that are not likely to be adversely affected by the training and RDT&E activities the U.S. Navy proposes to conduct within the GOMEX Range Complex. The first criterion was exposure or some reasonable expectation of a co-occurrence between one or more potential stressor associated with the U.S. Navy's activities and a particular listed species or designated critical habitat. If we conclude that a listed species or designated critical habitat is not likely to be exposed to U.S. Navy activities, then we 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 the exposure. If a species or an essential feature of critical habitat that may be exposed to a particular stressor associated with the Navy's activities are likely to be unaffected by the particular stressor, we would also conclude that the species or critical habitat are not likely to be adversely affected by those activities. Species or critical habitat that met these two criteria are listed below along with the rationale for our conclusions.

Blue Whale

There have only been a few reliable reports of blue whales from the Gulf of Mexico and these have been of animals that had stranded in 1924 and 1940 (Wursig *et al*. 2000). Because blue whales are assumed to occur only accidentally in the Gulf of Mexico, we assume that the likelihood these whales would be exposed to one or more of the stressors associated with the proposed action is sufficiently small as to be discountable. Therefore, we conclude that blue whales are not likely to be adversely affected by the activities the U.S. Navy plans to conduct in waters on and adjacent to the GOMEX Range Complex. This species will not be considered further in these Opinions.

Fin Whale

Fin whales have been reported more frequently than blue whales in the Gulf of Mexico, although many of these reports are probably of Bryde's whales, which are more common in the Gulf. The U.S. Navy's Biological Evaluation (2008) cites nine reports of fin whales in the Gulf of Mexico. Five of these reports cannot be verified leaving four recorded strandings and two confirmed sightings within the Gulf of Mexico (Jefferson and Schiro, 1997 *in* U.S. Navy's Biological Evaluation 2008). Because fin whales are assumed to occur only accidentally in the Gulf of Mexico, we assume that the likelihood that these whales would be exposed to one or more of the stressors associated with the proposed action is sufficiently small as to be discountable. Therefore, we conclude that fin whales are not likely to be adversely affected by the activities the U.S. Navy plans to conduct in waters on and adjacent to the GOMEX Range Complex. This species will not be considered further in these Opinions.

Humpback Whale

Humpback whales are uncommon in the Gulf of Mexico. Over the past few decades, there have been at least 20 reports of humpback whale occurrences off the west coast of Florida, Alabama, the delta of the Mississippi River, and Texas (Galveston). In addition, vocalizations of humpback whales have also been recorded from within the Gulf of Mexico. However, humpback whales that occur in the Gulf of Mexico are assumed to have been inexperienced juveniles that strayed from the normal geographic distribution of these whales in the Caribbean Sea (Weller *et al.*, 1996; Jefferson and Schiro, 1997; Würsig *et al.*, 2000). Because the action area for this consultation lies outside of the normal geographic distribution of humpback whales, we assume that the likelihood that these whales would be exposed to one or more of the stressors associated with the proposed action is sufficiently small as to be discountable. Therefore, we conclude that humpback whales are not likely to be adversely affected by the activities the U.S. Navy plans to conduct in waters on and adjacent to the GOMEX Range Complex. This species will not be considered further in these Opinions.

North Atlantic Right Whale

The Atlantic coast of Florida is considered the southern limit of the North Atlantic right whale's range along North America, so there have only been a few reports of North Atlantic right whales from the Gulf of Mexico: in 1963, two right whales were observed off Sarasota, Florida (Moore and Clark 1963) and a third right whale appeared to have stranded near Freeport, Texas (Schmidly *et al*, 1972). These observations represent either distributional anomalies, normal wanderings of occasional animals, or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States (Waring *et al.*, 2008). The rarity of occurrences in the Gulf and the low abundance of these whales (350 animals) suggest that they are unlikely to occur in the Gulf of Mexico. We assume that the likelihood that these whales would be exposed to one or more of the stressors associated with the proposed action is sufficiently small as to be discountable. Therefore, we conclude that North Atlantic right whales are not likely to be adversely affected by the activities the U.S. Navy plans to conduct in waters on and adjacent to the GOMEX Range Complex. This species will not be considered further in these Opinions.

Sei Whale

There are only five reliable records of sei whales in the Gulf of Mexico. Sei whales are assumed to occur only accidentally in the Gulf of Mexico. Based on this information we conclude that the likelihood of exposing these whales to one or more of the stressors associated with the proposed action is sufficiently small as to be discountable. Therefore, sei whales are not likely to be adversely affected by the activities the U.S. Navy plans to conduct in waters on and adjacent to the GOMEX Range Complex. This species will not be considered further in these Opinions.

Olive Ridley Sea Turtle

Olive ridleys are a pantropical species, occurring worldwide in tropical and warm temperate waters. In the Atlantic Ocean, the olive ridley occurs along the coasts of both Africa and South America but probably not in great abundance. Atlantic olive ridleys nest primarily in the French Guiana, Surinam, and Guyana; however, they are rarely found in the Caribbean Sea and have been documented in Puerto Rico, the Dominican Republic, and Cuba (Foley et al., 2003).

Only three occurrences of olive ridleys have been documented in the vicinity of the GOMEX Range Complex, all of which are strandings from the Florida Keys (Foley *et al*., 2003). These three stranding records represent the northernmost known occurrences of olive ridleys in the northwest Atlantic Ocean. Based on the best scientific and commercial data, olive ridley sea turtles are not expected to occur within the GOMEX Range Complex, and, therefore will not be affected by the proposed action. This species will not be considered further in these Opinions.

Gulf Sturgeon

Gulf sturgeon historically occurred in most of the major river systems of the Gulf of Mexico from the Mississippi River east to the Suwannee River in Florida. In marine waters, gulf sturgeon occur from the central and eastern Gulf of Mexico south to Charlotte Harbor. Gulf sturgeon have been captured in commercial and recreational fisheries off of Louisiana, in the Mississippi Sound and Biloxi Bay, Pensacola Bay, Apalachicola Bay, Tampa Bay and Charlotte Harbor and have been reported from the Rio Grande River on the west to Florida Bay, although these areas are not part of their regular occurrence (Wooley and Crateau 1985, Reynolds 1993).

In Florida, Gulf sturgeon occur in the Appalachicola, Escambia, Blackwater, Choctawhatchee, Ochlockonee, Suwanee, and Yellow Rivers. Because most of the underwater detonations and firing exercises the U.S. Navy plans to conduct would occur further from shore than most gulf sturgeon occur, gulf sturgeon are not likely to be exposed to shock waves or sound fields associated with those activities. This species will not be considered further in these Opinions.

Largetooth Sawfish

Historically, largetooth sawfish are thought to inhabit warm temperate to tropical marine waters in the eastern and western Atlantic and Caribbean. In the western Atlantic, largetooth sawfish occurred from the Caribbean and Gulf of Mexico south through Brazil. In the United States, records from Texas account for nearly all the confirmed records (33 of 39) from 1910 through 1961. Florida and Louisiana account for the rest of the largetooth sawfish records (Burgess *et al.*, 2009 as cited in NMFS 2010a). Waters of the United States were historically on the northern fringe of the species range, however, due to large

declines in abundance no records of largetooth sawfish exist in U.S. waters since the 1960's. This information suggests the United States is no longer part of the species' range (NMFS 2010a). Based on the best scientific and commercial data, largetooth sawfish are not expected to occur within the GOMEX Range Complex, and, therefore will not be affected by the proposed action. This species will not be considered further in these Opinions.

Smalltooth Sawfish

The range of the smalltooth sawfish in the Atlantic has contracted markedly over the past century. Historic capture records within the U.S. range from New York to Texas. However, since the 1990s encounters with the species outside of Florida have been rare. Peninsular Florida, currently and historically, remains the main U.S. region where this species can be found year-round; however, encounter data indicate that smalltooth sawfish can be found with some regularity only in south Florida from Charlotte Harbor (Caloosahatchee River) to Florida Bay (NMFS 2009).

Despite being widely recognized as common throughout their historic range up until the middle of the 20th century, the smalltooth sawfish population declined dramatically during the middle and later parts of the century. Estimates of the magnitude of the decline in the smalltooth sawfish are difficult to make as this species was not well studied. Based on the contraction of the species' range and other anecdotal data, however, Simpfendorfer (2001) estimated that the U.S. population size is currently less than five percent of its size at the time of European settlement. As for the size of the population, Simpfendorfer reluctantly gives an estimate of 2,000 individuals based on his four years of field experience and data collected from the public, but cautions that actual numbers may be plus or minus at least 50 percent.

Since 1971 and prior to 1998, there were only three records (published and/or museum reports and one sighting) of smalltooth sawfish in Texas. The reports occurred in 1978, 1979 and 1984 (NMFS 2000). Since 1998 only one confirmed report was received from Texas. The National Smalltooth Encounter database which was established in 2000 contains reports of smalltooth sawfish sightings and captures between 1998 and 2009. The database contains a total of 899 verified reports, most from recreational fishermen. Most of these encounters have occurred in Florida with the majority of reports from the Caloosahatchee River to Florida Bay. Since 1998 one confirmed report was received from each state of Texas, Georgia, Alabama and Louisiana (NMFS 2009). A total of 22 sawfish encounters were reported (18 of which were juveniles) along the Florida Panhandle from Gulf Beach west of Pensacola Beach, to Shell Point which is east of Panacea. Four juveniles were reported near the Pensacola OPAREA (one within Pensacola Bay and 3 off Pensacola Beach). Four sawfish were reported within the Panama City OPAREA near Panama City Beach outside and to the west of St. Andrew Bay. No sawfish were encountered within St. Andrew Bay where demolition pond activities will occur.

The scarcity of encounter reports outside of Florida, despite awareness raising activities taking place in these areas, suggests that waifs from the Florida population continue to move through these areas of the historic range, but also indicates that few sawfish currently occur in these areas (NMFS 2009). Also, because there have been only 22 reports of sawfish within 11 years indicates that this species does not occur regularly in these areas and when it does it occurs at low densities. Because of this information, the low smalltooth sawfish population numbers and because these fish can only be found with some regularity from the Caloosahatchee River to Florida Bay, we conclude that smalltooth sawfish have a

discountable probability of being exposed to U.S. Navy training activities. This species will not be considered further in these Opinions.

Sea Turtle Critical Habitat

Critical habitat has been designated in Puerto Rico for green sea turtles and hawksbill sea turtles and for leatherback sea turtles in the U.S. Virgin Islands. These areas do not occur within or adjacent to the GOMEX Range Complex where the U.S. Navy activities will be conducted. As a result, we conclude that critical habitat does not co-occur with the potential stressors associated with the U.S. Navy's proposed action and therefore, critical habitat will not be affected by the proposed action. Sea turtle critical habitat will not be considered further in these Opinions.

Smalltooth Sawfish Critical Habitat

Critical habitat for smalltooth sawfish was designated in the Charlotte Harbor Estuary Unit, which comprises approximately 221,459 acres of coastal habitat; and the Ten Thousand Islands/Everglades Unit (TTI/E), which comprises approximately 619,013 acres of coastal habitat. These areas do not occur within or adjacent to any nearshore or offshore training within the GOMEX Range Complex. As a result, we conclude that critical habitat will not co-occur with the potential stressors associated with the U.S. Navy's proposed action and therefore, will not affect designated critical habitat. Smalltooth sawfish critical habitat will not be considered further in these Opinions.

Gulf Sturgeon Critical Habitat

Designated critical habitat for gulf sturgeon occurs in waters within and off the states of Mississippi, Louisiana, Alabama and Florida. The critical habitat listing (68 FR 13370) contains the textual unit descriptions which are the definitive source for determining Gulf sturgeon critical habitat boundaries. The primary constituent elements (PCEs) of Gulf sturgeon critical habitat are abundant prey items; water quality and sediment quality necessary for normal behavior, growth, and viability of all life stages; and safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats. The closest gulf sturgeon designated critical habitat unit to proposed U.S. Navy activities is Unit 11, the Florida Nearshore Gulf of Mexico Unit in Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf Counties in Florida. This unit is defined by the intersection of longitude 87º20.0′W (approximately 1 nm (1.9 km) west of Pensacola Pass and the shoreline forming the western boundary, extending south to the intersection with the southern boundary 1 nm (1.9 km) offshore, turning east to intersect with the eastern boundary at longitude 8517.0'W (near Money Bayou between Cape San Blas and Indian Peninsula), and finally turning north to intersect with the northern boundary at the MHW of the mainland shoreline and the 72 COLREGS lines at passes.

The closet U.S. Navy training activities occur during GUNEX Surface to Surface-Boat Small Arms Training. This small arms training is conducted within the Harbor Security Group Machine Gun Area (HSGMGA) which is located 7.6 nm off the Florida coast as well as other areas further offshore but within the Panama City OPAREA. As designated critical habitat Unit 11 only extends 1 nm from shore, we do not expect U.S. Navy training exercises and RTD&E activities to co-occur with designated critical habitat. As such we do not expect small arms training activities to reduce the quantity, quality, or

availability of the physical, chemical, or biotic resources (prey, migration, etc.) that make the designated area valuable for the survival and recovery of gulf sturgeon. As a result, we conclude that U.S. Navy training and RDT&E activities conducted within the GOMEX Range Complex will not affect gulf sturgeon critical habitat. Gulf sturgeon critical habitat will not be considered further in these Opinions.

Introduction to Species Considered Further in these Opinions

Sperm Whale

Distribution

Sperm whales occur in every ocean except the Arctic Ocean. Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea as far north as Cape Navarin. Mature, female, and immature sperm whales of both sexes are found in more temperate and tropical waters from the equator to around 45° N throughout the year. These groups of adult females and immature sperm whales are rarely found at latitudes higher than 50° N and 50° S (Reeves and Whitehead 1997). Sexually mature males join these groups throughout the winter. During the summer, mature male sperm whales are thought to move north into the Aleutian Islands, Gulf of Alaska, and the Bering Sea.

In the western Atlantic Ocean, sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight. Sperm whales are the most abundant large whale in the Gulf of Mexico and this population appears to be resident.

In the eastern Atlantic Ocean, mature male sperm whales have been recorded as far north as Spitsbergen (Øien, 1990). Recent observations of sperm whales and stranding events involving sperm whales from the eastern North Atlantic suggest that solitary and paired mature male sperm whales predominantly occur in waters off Iceland, the Faroe Islands, and the Norwegian Sea (Gunnlaugsson and Sigurjonsson 1990, Øien 1990, Christensen et al. 1992).

In the Mediterranean Sea sperm whales are found from the Alboran Sea to the Levant Basin, mostly over steep slope and deep offshore waters. Sperm whales are rarely sighted in the Sicilian Channel, and are vagrant in the northern Adriatic and Aegean Seas (Notarbartolo di Sciara and Demma 1997). In the Italian seas sperm whales are more frequently associated with the continental slope off western Liguria, western Sardinia, northern and eastern Sicily, and both coasts of Calabria.

Sperm whales are found throughout the North Pacific and are distributed broadly from tropical and temperate waters to the Bering Sea as far north as Cape Navarin. Mature female and immature sperm whales of both sexes are found in more temperate and tropical waters from the equator to around 45° N throughout the year. However, groups of adult females and immature sperm whales are rarely found at latitudes higher than 50° N and 50° S (Reeves and Whitehead 1997). Sexually mature males join these groups throughout the winter. During the summer, mature male sperm whales are thought to migrate into the Aleutian Islands, Gulf of Alaska, and the Bering Sea.

Sperm whales commonly concentrate around oceanic islands in areas of upwelling, and along the outer continental shelf and mid-ocean waters. Because they inhabit deeper pelagic waters, their distribution does not include the broad continental shelf of the Eastern Bering Sea and these whales generally remain offshore in the eastern Aleutian Islands, Gulf of Alaska, and the Bering Sea.

Sperm whales have a strong preference for the 3,280 feet (1,000 meters) depth contour and seaward. Berzin (1971) reported that they are restricted to waters deeper than 300 meters (984 feet), while Watkins (1977) and Reeves and Whitehead (1997) reported that they are usually not found in waters less than 1,000 meters (3,281 feet) deep. While deep water is their typical habitat, sperm whales have been observed near Long Island, New York, in water between 41-55 meters (135-180 feet; Scott and Sadove 1997). When they are found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956).

Population Structure

The population structure of sperm whales is largely unknown. Lyrholm and Gyllenstein (1998) reported moderate, but statistically significant, differences in sperm whale mitochondrial (mtDNA) between ocean basins, although sperm whales throughout the world appear to be homogenous genetically (Whitehead 2003). Genetic studies also suggest that sperm whales of both genders commonly move across ocean basins and that males, but not females, often breed in ocean basins that are different from the one in which they were born (Whitehead, 2003).

Sperm whales may not form “populations” as that term is normally conceived. Jaquet (1996) outlined a hierarchical social and spatial structure that includes temporary clusters of animals, family units of 10 or 12 females and their young, groups of about 20 animals that remain together for hours or days, “aggregations” and “super-aggregations” of 40 or more whales, and “concentrations” that include 1,000 or more animals (Peterson 1986, Whitehead and Wiegart 1990, Whitehead et al. 1991). The “family unit” forms the foundation for sperm whale society and most females probably spend their entire life in the same family unit (Whitehead 2002). The dynamic nature of these relationships and the large spatial areas they are believed to occupy might complicate or preclude attempts to apply traditional population concepts, which tend to rely on group fidelity to geographic distributions that are relatively static over time.

Atlantic Ocean

Based on harvests of tagged sperm whales or sperm whales with other distinctive marking, sperm whales in the North Atlantic Ocean appear to represent a single population, with the possible exception of the sperm whales that appear to reside in the Gulf of Mexico. Mitchell (1975) reported one sperm whale that was tagged on the Scotian Shelf and killed about 7 years later off Spain. Donovan (1991) reported five to six handheld harpoons from the Azore sperm whale fishery that were recovered from whales killed off northwest Spain, with another Azorean harpoon recovered from a male sperm whale killed off Iceland (Martin 1982). These patterns suggest that at least some sperm whales migrate across the North Atlantic Ocean.

Female and immature animals stay in Atlantic temperate or tropical waters year round. In the western North Atlantic, groups of female and immature sperm whales concentrate in the Caribbean Sea (Gosho et al. 1984) and south of New England in continental-slope and deep-ocean waters along the eastern United States (Blaylock et al. 1995). In eastern Atlantic waters, groups of female and immature sperm whales aggregate in waters off the Azores, Madeira, Canary, and Cape Verde Islands (Tomilin 1967).

Gulf of Mexico

Several investigators have suggested that the sperm whales that occupy the northern Gulf of Mexico are distinct from sperm whales elsewhere in the North Atlantic Ocean based on year-round presence in the Gulf (Schmidly 1981, Fritts 1983, and Hansen et al. 1996, Mullin and Hoggard 2000). More recent studies provide further support that Gulf of Mexico sperm whales are a separate stock based on year round presence in the Gulf and preliminary results of genetics, size distribution and coda vocalizations (Mullin *et al.* 2003, Jaquet 2006; Jochens *et al.* 2008). These studies, like almost all studies to date, rely almost exclusively on sperm whales from the northern Gulf, with greatest density along and deeper than the 1000 m depth contour, and do not adequately represent sperm whales that may occur regularly in the central, western, southern, or eastern Gulf (for example, Ortega-Ortiz 2003). It is very likely, though, that sperm whales of the north-central Gulf, present there throughout the year (Davis et al. 1998), are more numerous than in other parts of the Gulf (Jochens et al 2008). Based on this information NMFS provisionally considers the sperm whale population in the northern Gulf of Mexico as a separate stock, however, the International Whaling Commission (IWC), does not recognize these sperm whales as a separate stock.

Mediterranean Sea

In the Mediterranean Sea sperm whales are found from the Alboran Sea to the Levant Basin, mostly over steep slope and deep offshore waters. Sperm whales are rarely sighted in the Sicilian Channel, and are vagrant in the northern Adriatic and Aegean Seas (Notarbartolo di Sciara and Demma 1997). In the Italian seas sperm whales are more frequently associated with the continental slope off western Liguria, western Sardinia, northern and eastern Sicily, and both coasts of Calabria.

Bayed and Beaubrun (1987) suggested that the frequent observation of neonates in the Mediterranean Sea and the scarcity of sperm whale sightings from the Gibraltar area may be evidence of a resident population of sperm whales in the Mediterranean.

Indian Ocean

In the Northern Indian Ocean the IWC recognized differences between sperm whales in the northern and southern Indian Ocean (Donovan 1991). Little is known about the Northern Indian Ocean population of sperm whales (Perry *et al*. 1999).

Pacific Ocean

Several authors have proposed population structures that recognize at least three sperm whales populations in the North Pacific for management purposes (Kasuya 1991, Bannister and Mitchell 1980). At the same time, the IWC's Scientific Committee designated two sperm whale stocks in the North

Pacific: a western and eastern stock or population (Donovan 1991). The line separating these populations has been debated since their acceptance by the IWC's Scientific Committee. For stock assessment purposes, NMFS recognizes three discrete population centers of sperm whales in the Pacific: (1) Alaska, (2) California-Oregon-Washington, and (3) Hawai'i.

Sperm whales are widely distributed throughout the Hawai'ian Islands throughout the year and are the most abundant large whale in waters off Hawai'i during the summer and fall (Rice 1960, Shallenberger 1981, Lee 1993, and Mobley *et al*. 2000). Sperm whale clicks recorded from hydrophones off Oahu confirm the presence of sperm whales near the Hawai'ian Islands throughout the year (Thompson and Friedl 1982). The primary area of occurrence for the sperm whale is seaward of the shelf break in the Hawai'ian Islands.

Sperm whales have been sighted in the Kauai Channel, the Alenuihaha Channel between Maui and the island of Hawai'i, and off the island of Hawai'i (Lee 1993, Mobley *et al*.1999, Forney *et al*. 2000). Additionally, the sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982). Twenty-one sperm whales were sighted during aerial surveys conducted in Hawai'ian waters conducted from 1993 through 1998. Sperm whales sighted during the survey tended to be on the outer edge of a 50 - 70 km distance from the Hawai'ian Islands, indicating that presence may increase with distance from shore. However, from the results of these surveys, NMFS has calculated a minimum abundance of sperm whales within 46 km of Hawai'i to be 43 individuals (Forney *et al*. 2000).

Southern Ocean

Sperm whales south of the equator are generally treated as a single "population," although the IWC divides these whales into nine different divisions that are based more on evaluations of whaling captures than the biology of sperm whales (Donovan 1991). Several authors, however, have argued that the sperm whales that occur off the Galapagos Islands, mainland Ecuador, and northern Peru are geographically distinct from other sperm whales in the Southern Hemisphere (Rice 1977, Wade and Gerrodette 1993, and Dufault and Whitehead 1995).

Threats to the Species

Natural Threats. Sperm whales are hunted by killer whales (*Orcinus orca*), false killer whales (*Pseudorca crassidens*), and short-finned pilot whales (*Globicephala melas*; Arnbom *et al*. 1987, Palacios and Mate 1996, Rice 1989, Weller *et al*. 1996, Whitehead 1995). Sperm whales have been observed with bleeding wounds on their heads and tail flukes after attacks by these species (Arnbom et al. 1987, Dufault and Whitehead 1995). In October 1997, 25 killer whales were documented to have attacked a group of mature sperm whales off Point Conception, California (pers. Comm. from K Roberts *cited in* Perry *et al*. 1999) and successfully killing one of these mature sperm whales. Sperm whales have also been reported to have papilloma virus (Lambertson *et al*. 1987).

Studies on sperm whales in the North Pacific and North Atlantic Oceans have demonstrated that sperm whales are infected by calciviruses and papillomaviruses (Smith and Latham 1978, Lambertsen *et al*. 1987). In some instances, these diseases have been demonstrated to affect 10 percent of the sperm whales sampled (Lambertsen *et al*. 1987).

Anthropogenic Threats. Three human activities are known to threaten sperm whales: whaling, entanglement in fishing gear, and shipping. Historically, whaling represented the greatest threat to every population of sperm whales and was ultimately responsible for listing sperm whales as an endangered species. Sperm whales were hunted all over the world during the 1800s, largely for its spermaceti oil and ambergris. Harvesting of sperm whales subsided by 1880 when petroleum replaced the need for sperm whale oil (Whitehead 2003).

The actual number of sperm whales killed by whalers remains unknown and some of the estimates of harvest numbers are contradictory. Between 1800 and 1900, the IWC estimated that nearly 250,000 sperm whales were killed globally by whalers. From 1910 to 1982, another 700,000 sperm whales were killed globally by whalers (IWC Statistics 1959-1983). These estimates are substantially higher than a more recent estimate produced by Caretta et al. (2005), however, who estimated that at least 436,000 sperm whales were killed by whalers between 1800 and 1987. Hill and DeMaster (1999) concluded that about 258,000 sperm whales were harvested in the North Pacific between 1947 and 1987 by commercial whalers. They reported that catches in the North Pacific increased until 1968, when 16,357 sperm whales were harvested, then declined after 1968 because of harvest limits imposed by the IWC. Perry et al. (1999) estimated that, on average, more than 20,000 sperm whales were harvested in the Southern Hemisphere each year between 1956 and 1976.

These reports probably underestimate the actual number of sperm whales that were killed by whalers, particularly because they could not have incorporated realistic estimates of the number of sperm whales killed by Soviet whaling fleets, which often went unreported. Between 1947 and 1973, Soviet whaling fleets engaged in illegal whaling in the Indian, North Pacific, and southern Oceans. In the Southern Hemisphere, these whalers killed an estimated 100,000 whales that they did not report to the IWC (Yablokov *et al*. 1998). Illegal catches in the Northern Hemisphere (primarily in the North Pacific) were smaller but still caused sperm whales to disappear from large areas of the North Pacific Ocean (Yablokov and Zemsky 2000).

In addition to large and illegal harvests of sperm whales, Soviet whalers had a disproportionate effect on sperm whale populations because they commonly killed adult females in any reproductive condition (pregnant or lactating) as well as immature sperm whales of either gender.

When the IWC introduced the International Observer Scheme in 1972, the IWC relaxed regulations that limited the minimum length of sperm whales that could be caught from 11.6 meters to 9.2 meters out of a concern that too many male sperm whales were being caught so reducing this size limit would encourage fleets to catch more females. Unfortunately, the IWC's decision had been based on data from the Soviet fleets who commonly reported female sperm whales as males. As a result, the new regulations allowed the Soviet whalers to continue their harvests of female and immature sperm whales legally, with substantial consequences for sperm whale populations. Berzin noted in a report he wrote in 1977, "the result of this was that some breeding areas for sperm whales became deserts" (Berzin 2007).

Although the IWC protected sperm whales from commercial harvest in 1981, whaling operations along the Japanese coast continued to hunt sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). More recently, the Japanese Whaling Association began hunting sperm whales for research. In 2000, the Japanese Whaling Association announced that it planned to kill 10 sperm whales in the Pacific

Ocean for research, which was the first time sperm whales have been hunted since the international ban on commercial whaling. Despite protests from the U.S. government and members of the IWC, the Japanese government harvested 5 sperm whales and 43 Bryde's whales in the last six months of 2000. According to the Japanese Institute of Cetacean Research (Institute of Cetacean Research undated), another 5 sperm whales were killed for research in 2002 – 2003. The consequences of these deaths on the status and trend of sperm whales remains uncertain, given that they probably have not recovered from the legacy of whaling; however, the renewal of a program that intentionally targets and kills sperm whales before we can be certain they recovered from a history of over-harvest places this species at risk in the foreseeable future.

Sperm whales are still hunted for subsistence purposes by whalers from Lamalera, Indonesia, which is on the south coast of the island of Lembata and from Lamakera on the islands of Solor. These whalers hunt in a traditional manner: with bamboo spears and using small wooden outriggers, 10–12 m long and 2 m wide, constructed without nails and with sails woven from palm fronds. The animals are killed by the harpooner leaping onto the back of the animal from the boat to drive in the harpoon. The maximum number of sperm whales killed by these hunters in any given year was 56 sperm whales killed in 1969.

In U.S. waters in the Pacific Ocean, sperm whales are known to have been incidentally captured only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991 - 1995 (Barlow et al. 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longline gear in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

Sperm whales are also killed by ship strikes. In May 1994 a sperm whale that had been struck by a ship was observed south of Nova Scotia (Reeves and Whitehead 1997) and in May 2000 a merchant ship reported a strike in Block Canyon (NMFS, unpublished data), which is a major pathway for sperm whales entering southern New England continental shelf waters in pursuit of migrating squid (CeTAP 1982, Scott and Sadove 1997).

Status

Sperm whales were listed as endangered under the ESA in 1973. Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). They are also protected by the Convention on International Trade in Endangered Species of Wild Flora and Fauna and the MMPA. Critical habitat has not been designated for sperm whales.

The status and trend of sperm whales is largely unknown. Allen and Angliss (2010) reported that population abundance estimates for sperm whales off the coast of Alaska were unreliable and, thus trends for these sperm whales were unknown. Similarly, no information was available to support estimates of

sperm whales status and trends in the western North Atlantic Ocean (Waring et al. 2009), the Indian Ocean (Perry et al. 1999), or the Mediterranean Sea.

Nevertheless, several authors and organizations have published "best estimates" of the global abundance of sperm whales or their abundance in different geographic areas. Based on historic whaling data, 190,000 sperm whales were estimated to have been in the entire North Atlantic, but the IWC considers data that produced this estimate unreliable (Perry et al. 1999). Whitehead (2002) estimated that prior to whaling sperm whales numbered around 1,110,000 and that the current global abundance of sperm whales is around 360,000 (coefficient of variation = 0.36) whales. Whitehead's current population estimate (2002) is about 20% of past global abundance estimates which were based on historic whaling data.

Other , more region specific estimates include Waring et al. (2007) who concluded that the best estimate of the number of sperm whales along the Atlantic coast of the U.S. was 4,029 (coefficient of variation = 0.38) in 1998 and 4,804 (coefficient of variation = 0.38) in 2004, with a minimum estimate of 3,539 sperm whales in the western North Atlantic Ocean. The best estimate for sperm whales in oceanic waters of the northern Gulf of Mexico, pooled from 2003 and 2004 surveys, was 1,665 (CV=0.20) (Waring et al 2009).

Barlow and Taylor (2005) derived two estimates of sperm whale abundance in a 7.8 million km^2 study area in the northeastern temperate Pacific: when they used acoustic detection methods they produced an estimate of 32,100 sperm whales (coefficient of variation = 0.36); when they used visual surveys, they produced an estimate of 26,300 sperm whales (coefficient of variation = 0.81). Ship surveys conducted in 2001 and 2005 for sperm whales were the basis for the most precise and recent estimate of the California/Oregon/Washington population of sperm whales whose abundance is estimated at 2,853 (CV=0.25) animals (Caretta et al 2009). Trends for this population are unknown. The best estimate of the abundance of sperm whales in Hawai'i was 7,082 sperm whales (coefficient of variation = 0.30) based on ship-board surveys conducted in 2002 (Caretta et al 2009).

Mark and recapture data from sperm whales led Whitehead and his co-workers to conclude that sperm whale numbers off the Galapagos Islands decreased by about 20% a year between 1985 and 1995 (Whitehead et al. 1997). In 1985 Whitehead et al. (1997) estimated there were about 4,000 female and immature sperm whales, whereas in 1995 they estimated that there were only a few hundred. They suggested that sperm whales migrated to waters off the Central and South American mainland to feed in productive waters of the Humboldt Current, which had been depopulated of sperm whales as a result of intensive whaling.

The information available on the status and trend of sperm whales do not allow us to make definitive statement about the extinction risks facing sperm whales as a species or particular populations of sperm whales. However, the evidence available suggests that sperm whale populations probably exhibit the dynamics of small populations, causing their population dynamics to become a threat in and of itself. The number of sperm whales killed by Soviet whaling fleets in the 1960s and 1970s would have substantial and adverse consequence for sperm whale populations and their ability to recover from the effects of whaling on their population. The number of adult female killed by Soviet whaling fleets, including pregnant and lactating females whose death would also have resulted in the death of their calves, would have had a devastating effect on sperm whale populations. In addition to decimating their population

size, whaling would have skewed sex ratios in their populations, created gaps in the age structure of their populations, and would have had lasting and adverse effect on the ability of these populations to recover (for example, see Whitehead 2003).

Populations of sperm whales could not have recovered from the overharvests of adult females and immature whales in the 30 to 40 years that have passed since the end of whaling, but the information available does not allow us to determine whether and to what degree those populations might have stabilized or whether they have begun the process of recovering from the effects of whaling. Absent information to the contrary, we assume that sperm whales will have elevated extinction probabilities because of both exogenous threats caused by anthropogenic activities (primarily whaling, entanglement, and ship strikes) and natural phenomena (such as disease, predation, or changes in the distribution and abundance of their prey in response to changing climate) as well as endogenous threats caused by the legacy of overharvests of adult females and immature whales on their populations (that is, a population with a disproportion of adult males and older animals coupled with a small percentage of juvenile whales that recruit into the adult population).

Diving and Social Behavior

Sperm whales are probably the deepest and longest diving mammal: they can dive to depths of at least 2000 meters (6562 ft), and may remain submerged for an hour or more (Watkins et al. 1993). Typical foraging dives last 40 min and descend to about 400 m followed by about 8 min of resting at the surface (Gordon 1987; Papastavrou et al. 1989). However, dives of over 2 hr and as deep as 3,000 m have been recorded (Clarke 1976; Watkins et al. 1985). Descent rates recorded from echo-sounders were approximately 1.7m/sec and nearly vertical (Goold and Jones 1995). There are no data on diurnal differences in dive depths in sperm whales. However, like most diving vertebrates for which there are data (e.g. rorqual whales, fur seals, chinstrap penguins), sperm whales probably make relatively shallow dives at night when organisms from the ocean's deep scattering layers move toward the ocean's surface.

The groups of closely related females and their offspring develop dialects specific to the group (Weilgart and Whitehead 1997) and females other than birth mothers will guard young at the surface (Whitehead 1996) and will nurse young calves (Reeves and Whitehead 1997).

Vocalizations and Hearing

Sperm whales produce loud broad-band clicks from about 0.1 to 20 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). These have source levels estimated at 171 dB re 1 μPa (Levenson 1974). Current evidence suggests that the disproportionately large head of the sperm whale is an adaptation to produce these vocalizations (Norris and Harvey 1972; Cranford 1992; but see Clarke 1979). This suggests that the production of these loud low frequency clicks is extremely important to the survival of individual sperm whales. The function of these vocalizations is relatively well-studied (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). Long series of monotonous regularly spaced clicks are associated with feeding and are thought to be produced for echolocation. Distinctive, short, patterned series of clicks, called codas, are associated with social behavior and intra-group interactions; they are thought to facilitate intra-specific communication, perhaps to maintain social cohesion with the group (Weilgart and Whitehead 1993).

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some modifications to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into the outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by the tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear function to transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing. In a study of the morphology of the mysticete auditory apparatus, Ketten (1997) hypothesized that large mysticetes have acute infrasonic hearing.

The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1975; Watkins et al. 1985). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Sperm whales have moved out of areas after the start of air gun seismic testing (Davis *et al*. 1995). Seismic air guns produce loud, broadband, impulsive noise (source levels are on the order of 250 dB) with “shots” every 15 seconds, 240 shots per hour, 24 hours per day during active tests. Because they spend large amounts of time at depth and use low frequency sound sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll *et al*. 1999). Furthermore, because of their apparent role as important predators of mesopelagic squid and fish, changing the abundance of sperm whales should affect the distribution and abundance of other marine species.

Green Sea Turtle

Distribution

Green turtles are found in the Pacific Ocean, Atlantic Ocean, Indian Ocean, Caribbean Sea, and Mediterranean Sea, primarily in tropical or, to a lesser extent, subtropical waters. These regions can be further divided into nesting aggregations within the eastern, central, and western Pacific Ocean; the western, northern, and eastern Indian Ocean; Mediterranean Sea; and eastern, southern, and western Atlantic Ocean, including the Caribbean Sea.

Green turtles appear to prefer waters that usually remain around 20°C in the coldest month. During warm spells (e.g., El Niño), green turtles may be found considerably north of their normal distribution. Stinson (1984) found green turtles appear most frequently in U.S. coastal waters with temperatures exceeding 18°C. An east Pacific green turtle equipped with a satellite transmitter was tracked along the California coast and showed a distinct preference for waters with temperatures above 20°C (Eckert, unpublished data).

Further, green sea turtles seem to occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher densities of their food items associated with these oceanic phenomena. For example, in the western Atlantic Ocean, drift lines commonly contain floating *Sargassum* capable of providing small turtles with shelter and sufficient buoyancy to raft upon (NMFS and USFWS 1998a). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance from natural predators and humans. Available information indicates that green turtle resting areas are in proximity to their feeding pastures (NMFS 2000).

Population Structure

The population dynamics of green sea turtles and all of the other sea turtles we consider here are usually described based on the distribution and habit of nesting females, rather than 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. Because the patterns of increase or decrease in the abundance of sea turtle nests over time are determined by internal dynamics rather than external dynamics, we make inferences about the growth or decline of sea turtle populations based on the status and trend of their nests.

Primary nesting aggregations of green turtles (i.e. sites with greater than 500 nesting females per year) include: Ascension Island (south Atlantic Ocean), Australia, Brazil, Comoros Islands, Costa Rica, Ecuador (Galapagos Archipelago), Equatorial Guinea (Bioko Island), Guinea-Bissau (Bijagos Archipelago), Iles Eparses Islands (Tromelin Island, Europa Island), Indonesia, Malaysia, Myanmar, Oman, Philippines, Saudi Arabia, Seychelles Islands, Suriname, and United States (Florida; Seminoff 2002, NMFS and USFWS 1998a).

Smaller nesting aggregations include: Angola, Bangladesh, Bikar Atoll, Brazil, Chagos Archipelago, China, Costa Rica, Cuba, Cyprus, Democratic Republic of Yemen, Dominican Republic, d'Entrecasteaux Reef, French Guiana, Ghana, Guyana, India, Iran, Japan, Kenya, Madagascar, Maldives Islands, Mayotte Archipelago, Mexico, Micronesia, Pakistan, Palmerston Atoll, Papua New Guinea, Primieras Islands, Sao Tome é Principe, Sierra Leone, Solomon Islands, Somalia, Sri Lanka, Taiwan, Tanzania, Thailand, Turkey, Scilly Atoll, United States (Hawai'i), Venezuela, and Vietnam (Seminoff 2002).

Molecular genetics techniques have helped researchers gain insight into the distribution and ecology of migrating and nesting green turtles. In the Pacific Ocean, green sea turtles group into two distinct regional clades: (1) western Pacific and South Pacific islands, and (2) eastern Pacific and central Pacific, including the rookery at French Frigate Shoals, Hawai'i. In the eastern Pacific, greens forage coastally from San Diego Bay, California in the north to Mejillones, Chile in the South. Based on mtDNA analyses, green turtles found on foraging grounds along Chile's coast originate from the Galapagos nesting beaches, while those greens foraging in the Gulf of California originate primarily from the Michoacan nesting stock. Green turtles foraging in San Diego Bay and along the Pacific coast of Baja California originate primarily from rookeries of the Islas Revillagigedos (Dutton 2003).

Threats to the Species

Natural Threats. The various habitat types green sea turtles occupy throughout their lives exposes these sea turtles to a wide variety of natural threats. The beaches on which green sea turtles nest and the nests themselves are threatened by hurricanes and tropical storms as well as the storm surges, sand accretion, and rainfall that are associated with hurricanes. Hatchlings are hunted by predators like herons, gulls, dogfish, and sharks. Larger green sea turtles, including adults, are also killed by sharks and other large, marine predators.

Green turtles in the northwest Hawai'ian Islands are afflicted with a tumor disease, fibropapilloma, which is of an unknown etiology and often fatal, as well as spirochidiasis, both of which are the major causes of strandings of this species. The presence of fibropapillomatosis among stranded turtles has increased significantly over the past 17 years, ranging from 47-69 percent during the past decade (Murakawa *et al.* 2000). Green turtles captured off Molokai from 1982-96 showed a massive increase in the disease over this period, peaking at 61% prevalence in 1995 (Balazs *et al.* 1998). Preliminary evidence suggests an association between the distribution of fibropapillomatosis in the Hawai'ian Islands and the distribution of toxic benthic dinoflagellates (*Prorocentrum* spp.) known to produce a tumor promoter, okadaic acid (Landsberg *et al.* 1999). Fibropapillomatosis is considered to decrease growth rates in afflicted turtles and may inhibit the growth rate of Hawai'ian green turtle populations (Balazs *et al.* 1998).

Anthropogenic Threats. Three human activities are known to threaten green sea turtles: overharvests of individual animals, incidental capture in commercial fisheries, and human development of coastlines. Historically, the primary cause of the global decline of green sea turtles populations were the number of eggs and adults captured and killed on nesting beaches in combination with the number of juveniles and adults captured and killed in coastal feeding areas. Some populations of green sea turtles still lose large numbers of eggs, juveniles, and adults to subsistence hunters, local communities that have a tradition of harvesting sea turtles, and poachers in search of turtle eggs and meat.

Directed harvests of eggs and other life stages of green sea turtles were identified as a "major problem" in American Samoa, Guam, Palau, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Republic of the Marshall Islands, and the Unincorporated Islands (Wake, Johnston, Kingman, Palmyra, Jarvis, Howland, Baker, and Midway). In the Atlantic, green sea turtles are captured and killed in turtle fisheries in Colombia, Grenada, the Lesser Antilles, Nicaragua, St. Vincent and the Grenadines (Bräutigam and Eckert 2006); the turtle fishery along the Caribbean coast of Nicaragua has captured more than 11,000 green sea turtles each year for the past 10 years (Bräutigam and Eckert 2006, Lagueux 1998).

Severe overharvests have resulted from a number of factors in modern times: (1) the loss of traditional restrictions limiting the number of turtles taken by island residents; (2) modernized hunting gear; (3) easier boat access to remote islands; (4) extensive commercial exploitation for turtle products in both domestic markets and international trade; (5) loss of the spiritual significance of turtles; (6) inadequate regulations; and (7) lack of enforcement (NMFS and USFWS 1998a).

Green sea turtles are also captured and killed in commercial fisheries. Gillnets account for the highest number of green sea turtles that are captured and killed, but they are also captured and killed in trawls, traps and pots, longlines, and dredges. Along the Atlantic coast of the U.S., NMFS estimated that almost

19,000 green sea turtles are captured in shrimp trawl fisheries each year in the Gulf of Mexico, with 514 of those sea turtles dying as a result of their capture (see Table 3). Each year, several hundred green sea turtles are captured in herring fisheries; mackerel, squid, and butterfish fisheries; monkfish fisheries; pound net fisheries, summer flounder and scup fisheries; Atlantic pelagic longline fisheries; and gillnet fisheries in Pamlico Sound. Although most of these turtles are released alive, these fisheries are expected to kill almost 100 green sea turtles each year; the health effects of being captured on the sea turtles that survive remain unknown.

Green sea turtles are also threatened by domestic or domesticated animals which prey on their nests; artificial lighting that disorients adult female and hatchling sea turtles, which can dramatically increase the mortality rates of hatchling sea turtles; beach replenishment; ingestion and entanglement in marine debris; and environmental contaminants.

Status

Green turtles are listed as threatened under the ESA, except for breeding populations found in Florida and the Pacific coast of Mexico, which are listed as endangered. Seminoff (2002) estimates using a conservative approach that the global green turtle population has declined by 34% to 58% over the last three generations (approximately 150 years). Actual declines may be closer to 70% to 80%. Causes for this decline include harvest of eggs, subadults and adults, incidental capture by fisheries, loss of habitat, and disease.

While some nesting populations of green turtles appear to be stable or increasing in the Atlantic Ocean (e.g. Bujigos Archipelago (Guinea-Bissau), Ascension Island, Tortuguero (Costa Rica), Yucatan Peninsula (Mexico), and Florida), declines of over 50% have been documented in the eastern (Bioko Island, Equatorial Guinea) and western Atlantic (Aves Island, Venezuela). Nesting populations in Turkey (Mediterranean Sea) have declined between 42% and 88% since the late 1970s. Population trend variations also appear in the Indian Ocean. Declines greater than 50% have been documented at Sharma (Republic of Yemen) and Assumption and Aldabra (Seychelles), while no changes have occurred at Karan Island (Saudi Arabia) or at Ras al Hadd (Oman). The number of females nesting annually in the Indian Ocean has increased at the Comoros Islands, Tromelin and maybe Europa Island (Iles Esparses; Seminoff 2002).

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawai'i, as a direct consequence of a historical combination of overexploitation and habitat loss (Eckert 1993, Seminoff 2002). They are also thought to be declining in the Atlantic Ocean. However, like several of the species we have already discussed, the information available on the status and trend of green sea turtles do not allow us to make a definitive statement about the global extinction risks facing these sea turtles or risks facing particular populations (nesting aggregations) of these turtles. With the limited data available on green sea turtles, we do not know whether green sea turtles exist at population sizes large enough to avoid demographic phenomena that are known to increase the extinction probability of species that exist as "small" populations (that is, "small" populations experience phenomena such as demographic stochasticity, inbreeding depression and Allee effects, among others, that cause their population size to become a threat in and of itself) or if green sea turtles are threatened more by exogenous threats such as anthropogenic activities (entanglement, habitat loss, overharvests, etc.) or natural phenomena (such as

disease, predation, or changes in the distribution and abundance of their prey in response to changing climate). Nevertheless, with the exception of the Hawai'i an nesting aggregations, we assume that green sea turtles are endangered because of both anthropogenic and natural threats as well as changes in their population dynamics.

Diving and Social Behavior

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and USFWS 1998a). The maximum recorded dive depth for an adult green turtle was 110 meters (Berkson 1967 *in* Lutcavage and Lutz 1997), while subadults routinely dive 20 meters for 9-23 minutes, with a maximum recorded dive of 66 minutes (Brill *et al.* 1995 *in* Lutcavage and Lutz 1997).

Vocalizations and Hearing

The information on green turtle hearing is very limited. Ridgway *et al.* (1969) studied the auditory evoked potentials of three green sea turtles (in air and through mechanical stimulation of the ear) and concluded that their maximum sensitivity occurred from 300 to 400 Hz with rapid declines for tones at lower and higher frequencies. They reported an upper limit for cochlear potentials without injury of 2000 Hz and a practical limit of about 1000 Hz. This is similar to estimates for loggerhead sea turtles, which had most sensitive hearing between 250 and 1000 Hz, with rapid decline above 1000 Hz (Bartol *et al.* 1999).

In a study of the auditory brainstem responses of subadult green sea turtles, Bartol and Ketten (2006) reported responses to frequencies between 100 and 500 Hz; with highest sensitivity between 200 and 400 Hz. They reported that two juvenile green turtles had hearing sensitivities that were slightly broader in range: they responded to sounds at freqnencies from 100 to 800 Hz, with highest hearing sensitivities from 600 to 700 Hz.

These hearing sensitivities are similar to the hearing sensitivities reported for two terrestrial species: pond turtles (*Pseudemys scripta*) and wood turtles (*Chrysemys inscuplta*). Pond turtles are reported to have best hearing responsiveness between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz and almost no sensitivity above 3000 Hz (Wever and Vernon 1956) the latter has sensitivities up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Peterson 1966).

Hawksbill Sea Turtle

Distribution

Hawksbill sea turtles occur in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean, with individuals from several life history stages occurring regularly along southern Florida and the northern Gulf of Mexico (especially Texas); in the Greater and Lesser Antilles; and along the Central American mainland south to

Brazil. Within the United States, hawksbills are most common in Puerto Rico and its associated islands, and in the U.S. Virgin Islands.

In the continental U.S., hawksbill sea turtles have been reported in every state on the coast of the Gulf of Mexico and along the coast of the Atlantic Ocean from Florida to Massachusetts, except for Connecticut; however, sightings of hawksbill sea turtles north of Florida are rare. The only states where hawksbill sea turtles occur with any regularity are Florida (particularly in the Florida Keys and the reefs off Palm Beach County on Florida's Atlantic coast, where the warm waters of the Gulf Stream pass close to shore) and Texas. In both of these states, most sightings are of post-hatchlings and juveniles that are believed to have originated from nesting beaches in Mexico.

Hawksbill sea turtles have stranded along the almost the entire Atlantic coast of the United States, although most stranding records occur south of Cape Canaveral, Florida, particularly in Palm Beach, Broward and Miami-Dade counties (Florida Sea Turtle Stranding and Salvage database). Hawksbill sea turtles are very rare north of Florida, although they have been recorded as far north as Massachusetts. During their pelagic-stage, hawksbills disperse from the Gulf of Mexico and southern Florida in the Gulfstream Current, which would carry them offshore of Georgia and the Carolinas. As evidence of this, a pelagic-stage hawksbill was captured 37 nautical miles east of Sapelo Island, Georgia in May 1994 (Parker 1995). There are also records of hawksbill sea turtles stranding on the coast of Georgia (Ruckdeschel *et al.* 2000), being captured in pound nets off Savannah, and being captured in summer flounder trawls (Epperly *et al.* 1995), gillnets (Epperly *et al.* 1995), and power plants off Georgia and the Carolinas.

Within United States territories and U.S. dependencies in the Caribbean Region, hawksbill sea turtles nest principally in Puerto Rico and the U.S. Virgin Islands, particularly on Mona Island and Buck Island. They also nest on other beaches on St. Croix, Culebra Island, Vieques Island, mainland Puerto Rico, St. John, and St. Thomas. Within the continental United States, hawksbill sea turtles nest only on beaches along the southeast coast of Florida and in the Florida Keys.

Hawksbill sea turtles occupy different habitats depending on their life history stage. After entering the sea, hawksbill sea turtles occupy pelagic waters and occupy weedlines that accumulate at convergence points. When they grow to about 20-25 cm carapace length, hawksbill sea turtles reenter coastal waters where they inhabit and forage in coral reefs as juveniles, subadults and adults. Hawksbill sea turtles also occur around rocky outcrops and high energy shoals, where sponges grow and provide forage, and they are known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Hildebrand 1987, Amos 1989).

Population Structure

Hawksbill sea turtles, like other sea turtles, are divided into regional groupings that represent major oceans or seas: the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea and Mediterranean Sea. In these regions, the population structure of hawksbill turtles is usually based on the distribution of their nesting aggregations.

Threats to the Species

Natural Threats. The various habitat types hawksbill sea turtles occupy throughout their lives exposes these sea turtles to a wide variety of natural threats. The beaches on which hawksbill sea turtles nest and the nests themselves are threatened by hurricanes and tropical storms as well as the storm surges, sand accretion, and rainfall that are associated with hurricanes. Hatchlings are hunted by predators like herons, gulls, dogfish, and sharks. Adult hawksbill sea turtles are also killed by sharks and other large, marine predators.

Anthropogenic Threats. Three human activities are known to threaten hawkbill sea turtles: overharvests of individual animals, incidental capture in commercial fisheries, and human development of coastlines. Historically, the primary cause of the global decline of hawkbill sea turtle populations was overharvest by humans for subsistence and commercial purposes. In the Atlantic, hawksbill sea turtles are still captured and killed in turtle fisheries in Colombia, Grenada, the Lesser Antilles, Nicaragua, St. Vincent and the Grenadines (Bräutigam and Eckert 2006).

For centuries, hawksbill sea turtles have been captured for their shells, which have commercial value, rather than food (the meat of hawksbill sea turtles is considered to have a bad taste and can be toxic to humans; NMFS and USFWS 1998b). Until recently, tens of thousands of hawksbills were captured and killed each year to meet demand for jewelry, ornamentation, and whole stuffed turtles (Milliken and Tokunaga *1987 cited in* Eckert 1993). In 1988, Japan's imports from Jamaica, Haiti and Cuba represented some 13,383 hawksbills: it is extremely unlikely that this volume could have originated solely from local waters (Greenpeace 1989 *in* Eckert 1993).

Although Japan banned the importation of turtle shell in 1994, domestic harvests of eggs and turtles continue in the United States, its territories, and dependencies, particularly in the Caribbean and Pacific Island territories. Large numbers of nesting and foraging hawksbill sea turtles are captured and killed for trade in Micronesia, the Mexican Pacific coast, southeast Asia and Indonesia (NMFS and USFWS 1998b). In addition to the demand for the hawksbill's shell, there is a demand for other products including leather, oil, perfume, and cosmetics. Before the U.S. certified Japan under the Pelly Amendment, Japan had been importing about 20 metric tons of hawksbill shell per year, representing approximately 19,000 turtles.

The second most important threat to hawksbill sea turtles is the loss of nesting habitat caused by the expansion of resident human populations in coastal areas of the world and increased destruction or modification of coastal ecosystems to support tourism. Hawksbill sea turtles are also captured and killed in commercial fisheries. Along the Atlantic coast of the U.S., NMFS estimated that about 650 hawksbill sea turtles are captured in shrimp trawl fisheries each year in the Gulf of Mexico, with most of those sea turtles dying as a result of their capture (see Table 3). Each year, about 35 hawksbill sea turtles are captured in Atlantic pelagic longline fisheries. Although most of these turtles are released alive, these fisheries are expected to kill about 50 hawksbill sea turtles each year; the health effects of being captured on the sea turtles that survive remain unknown.

Like green sea turtles, hawksbill sea turtles are threatened by domestic or domesticated animals that prey on their nests; artificial lighting that disorients adult female and hatchling sea turtles, which can

dramatically increase the mortality rates of hatchling sea turtles; beach replenishment; ingestion and entanglement in marine debris; and environmental contaminants.

Status

Hawksbill sea turtles were listed as endangered under the ESA in 1970. Under Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, hawksbill sea turtles are identified as "most endangered."

Hawksbill sea turtles are solitary nesters, which makes it difficult to estimate the size of their populations. There are no global estimates of the number of hawksbill sea turtles, but a minimum of 15,000 to 25,000 females are thought to nest annually in more than 60 geopolitical entities (Groombridge and Luxmoore 1989). Moderate populations appear to persist around the Solomon Islands, northern Australia, Palau, Persian Gule islands, Oman, and parts of the Seychelles (Groombridge 1982). In a more recent review, Groombridge and Luxmoore (1989) list Papua New Guinea, Queensland, and Western Australia as likely to host 500-1,000 nesting females per year, while Indonesia and the Seychelles may support >1,000 nesting females. The largest known nesting colony in the world is located on Milman Island, Queensland, Australia where Loop (1995) tagged 365 hawksbills nesting within an 11 week period. With the exception of Mexico, and possibly Cuba, nearly all Wider Caribbean countries are estimated to receive <100 nesting females per year (Meylan 1989).

Of the 65 geopolitical units on which hawksbill sea turtles nest and where hawksbill nesting densities can be estimated, 38 geopolitical units have hawksbill populations that are suspected or known to be declining. Another 18 geopolitical units have experienced well-substantiated declines (NMFS and USFWS 1995). The largest remaining nesting concentrations occur on remote oceanic islands off Australia (Torres Strait) and the Indian Ocean (Seychelles).

Hawksbill sea turtles, like green sea turtles, are thought to be declining globally as a direct consequence of a historical combination of overexploitation and habitat loss. However, like several of the species we have already discussed, the information available on the status and trend of hawksbill sea turtles do not allow us to make definitive statements about the global extinction risks facing these sea turtles or the risks facing particular populations (nesting aggregations) of these turtles. However, the limited data available suggests that several hawksbill sea turtles populations exist at sizes small enough to be classified as "small" populations (that is, populations that exhibit population dynamics that increase the extinction probabilities of the species or several of its populations) while others are large enough to avoid these problems. Exogenous threats such as overharvests and entanglement in fishing gear only increase their probabilities of becoming extinct in the foreseeable future.

Diving and Social Behavior

The duration of foraging dives in hawksbill sea turtles commonly depends on the size of the turtle: larger turtles diving deeper and longer. At a study site in the northern Caribbean, foraging dives were made only during the day and dive durations ranged from 19-26 minutes in duration at depths of 8-10 m. At night, resting dives ranged from 35-47 minutes in duration (Van Dam and Diez, 1997).

Vocalizations and Hearing

There is no information on hawksbill sea turtle vocalizations or hearing. However, we assume that their hearing sensitivities will be similar to those of green and loggerhead sea turtles with their best hearing sensitivity will be in the low frequency range: from 200 to 400 Hz with rapid declines for tones at lower and higher frequencies. Their hearing will probably have a practical upper limit of about 1000 Hz (Bartol *et al*. 1999, Ridgway *et al*. 1969).

These hearing sensitivities are similar to the hearing sensitivities reported for two terrestrial species: pond turtles (*Pseudemys scripta*) and wood turtles (*Chrysemys inscuplta*). Pond turtles are reported to have best hearing responsiveness between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz and almost no sensitivity above 3000 Hz (Wever and Vernon 1956) the latter has sensitivities up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Peterson 1966).

Kemp's Ridley Sea Turtle

Distribution

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

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

Population Structure

As discussed previously, the term "population" refers to groups of individuals whose patterns of increase or decrease in abundance over time are determined by internal dynamics (births resulting from sexual interactions between individuals in the group and deaths of those individuals) rather than external dynamics (immigration or emigration). This definition is a reformulation of definitions articulated by Cole (1957), Futuyma (1986) and Wells and Richmond (1995) and is more restrictive than those uses of 'population' that refer to groups of individuals that co-occur in space and time but do not have internal dynamics that determine whether the size of the group increases or decreases over time (see review by Wells and Richmond 1995). The definition we apply is important to section 7 consultations because such

concepts as ‘population decline,’ ‘population collapse,’ ‘population extinction,’ and ‘population recovery’ apply to the restrictive definition of ‘population’ but do not explicitly apply to alternative definitions.

Unlike the other sea turtles discussed here, adult Kemp’s ridley sea turtles are generally restricted to the Gulf of Mexico. Almost 95 percent of all Kemp’s ridley sea turtle nesting occurs on the beaches of Rancho Nuevo, Tepehuajes, and Barra del Tordo in the State of Tamaulipas, Mexico. Nesting also occurs in Veracruz, Mexico, and Texas, U.S., but on a much smaller scale. Occasional nesting has been documented in North Carolina, South Carolina, and the Gulf and Atlantic coasts of Florida. As a general matter, Kemp’s ridley sea turtles are treated as a single population.

Threats to the Species

Natural Threats. Kemp’s ridley sea turtles are exposed to a wide variety of threats during every stage of their lives. Eggs and hatchlings on nesting beaches are preyed upon by coyotes, raccoons, coatis, skunks, ghost crabs, ants, and to lesser degrees hawks, vultures, grackles, and caracaras (Dodd 1988, Hirth 1971, Witzell 1983). Those hatchlings that reach the ocean are preyed upon by gulls, terns, sharks, and predatory fish (Dodd 1988). Sharks and other large marine predators prey on large juvenile Kemp’s ridley sea turtles.

Because of their restricted geographic distribution, the concentration of most nesting activity at one beach, and the frequency of hurricanes in the Gulf of Mexico, hurricanes represent a substantial threat to Kemp’s ridley sea turtles. For example, in 1988 Hurricane Gilbert struck the primary nesting beach, destroyed many of the nests, and altered the structure of the nesting beach.

Anthropogenic Threats. Several human activities contributed to the endangerment of threaten Kemp’s ridley sea turtles: harvests of eggs on nesting beaches, incidental capture in fisheries, loss of foraging habitat, and marine pollution. In 1947, 40,000 female Kemp’s ridley sea turtles were observed nesting on the beaches at Rancho Nuevo on a single day (Carr 1963, Hildebrand 1963). From the 1940s through the early 1960s, poaching on nests on the beaches of Rancho Nuevo, Mexico, were heavily exploited but beach protection in 1966 helped to curtail this activity (USFWS and NMFS 1992). By the mid-1960s the number of females nesting on the same beaches had declined to about 1,300 on a single day (Chavez *et al*. 1967).

Kemp’s ridley sea turtles have been captured and killed by fishing gear in several Federal and state fisheries throughout their range. They have been captured in gear used in lobster fisheries and monkfish fisheries off the northeastern United States, pound net fisheries off eastern Long Island, the mid-Atlantic, and Chesapeake Bay; fisheries for squid, mackerel, butterfish, bluefish, summer flounder, Atlantic herring, weakfish, and the sargassum fishery. The most significant fishery-related threat to Kemp’s ridley sea turtles has been the number of sea turtles that have been captured and killed in the shrimp trawl fisheries in the Gulf of Mexico.

Kemp’s ridley sea turtles have also been captured and killed as a result of entrainment in power plants along the coast of the United States and coastal dredging.

Recovery actions. Kemp’s ridley sea turtles have benefited from a concentrated recovery effort that began in the mid-1960s when the government of Mexico established a program to protect eggs on the

beach of Rancho Nuevo. In 1977, a Mexican presidential decree included the Rancho Nuevo Nesting Beach Natural Reserve as part of a system of reserves for sea turtles. In 1978, an experiment to "head start" Kemp's ridley sea turtles was implemented as part of a larger effort to recover the species. From 1978 to 1991, under a cooperative beach patrol effort involving personnel from both countries, the number of released hatchlings was increased to a yearly average of 54,676 individuals. In 1990 a complete ban on taking any species of sea turtle was established by the Government of Mexico.

Status

Kemp's ridley sea turtles were listed as endangered on December 2, 1970 (35 FR 18320). There is no designated critical habitat for the Kemp's ridley sea turtle.

In 1947, 40,000 female Kemp's ridley sea turtles were observed nesting on the beaches at Rancho Nuevo on a single day (Carr 1963, Hildebrand 1963). By the early 1970s, the estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. Between the years of 1978 and 1991 only 200 Kemp's ridleys nested annually. Today the Kemp's ridley population appears to be in the early stages of recovery. Nesting has increased steadily over the past decade and the total annual number of nests recorded at Rancho Nuevo and adjacent camps has exceeded 10,000 in recent years. Over 20,000 nests were recorded in 2009 at Rancho Nuevo and adjacent camps. From 2002-2009, a total of 771 Kemp's ridley nests have been documented on the Texas coast. This is more than nine times greater than the 81 nests recorded over the previous 54 years from 1948-2001, indicating an increasing nesting population in Texas. From 2005 through 2009, the number of nests from all monitored beaches indicate approximately 5,500 females are nesting each season in the Gulf of Mexico (NMFS and USFWS 2010b).

The Turtle Expert Working Group (2000) estimated that the population size of Kemp's ridley sea turtles grew at an average rate of l1.3 percent per year (95% C.I. slope = 0.096-0.130) between 1985 and 1998. Over the same time interval, hatchling production increased at a slightly slower rate (9.5% per year). Population models predict the population will grow 12-16% per year, for the near future, assuming current survival rates within each life stage remain constant (Heppell *et al*. 2005 *in* NMFS 2010b).

Vocalizations and Hearing

There is no information on the vocalizations or hearing of Kemp's ridley sea turtles. However, we assume that their hearing sensitivities would be similar to those of green and loggerhead sea turtles: their best hearing sensitivity would be in the low frequency range: from 200 to 400 Hz with rapid declines for tones at lower and higher frequencies. Their hearing would probably have a practical upper limit of about 1000 Hz (Bartol *et al*. 1999, Ridgway *et al*. 1969).

These hearing sensitivities are similar to the hearing sensitivities reported for two terrestrial species: pond turtles (*Pseudemys scripta*) and wood turtles (*Chrysemys inscuplta*). Pond turtles are reported to have best hearing responsiveness between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz and almost no sensitivity above 3000 Hz (Wever and Vernon 1956). Wood turtles have sensitivities up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Peterson 1966).

Leatherback Sea Turtle

Distribution

Leatherback turtles are widely distributed throughout the oceans of the world. The species is found in four main regions of the world: the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The four main regional areas may further be divided into nesting aggregations. Leatherback turtles are found on the western and eastern coasts of the Pacific Ocean, with nesting aggregations in Mexico and Costa Rica (eastern Pacific) and Malaysia, Indonesia, Australia, the Solomon Islands, Papua New Guinea, Thailand, and Fiji (western Pacific). In the Atlantic Ocean, leatherback nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida. In the Caribbean, leatherbacks nest in the U.S. Virgin Islands and Puerto Rico. In the Indian Ocean, leatherback nesting aggregations are reported in India and Sri Lanka.

Leatherback sea turtles are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Morreale *et al.* 1994, Eckert 1998, Eckert 1999). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert 1998). In the North Atlantic Ocean, leatherback turtles regularly occur in deep waters (>328 ft), and an aerial survey study in the north Atlantic sighted leatherback turtles in water depths ranging from 3 to 13,618 ft, with a median sighting depth of 131.6 ft (CeTAP 1982). This same study found leatherbacks in waters ranging from 7 to 27.2°C. In the Pacific Ocean, leatherback turtles have the most extensive range of any living reptile and have been reported in all pelagic waters of the Pacific between 71°N and 47 °S latitude and in all other major pelagic ocean habitats (NMFS and USFWS 1998c). Leatherback turtles lead a completely pelagic existence, foraging widely in temperate waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been hypothesized that leatherback sea turtles probably mate outside of tropical waters, before females swim to their nesting beaches (Eckert and Eckert 1988).

Leatherback turtles are uncommon in the insular Pacific Ocean, but individual leatherback turtles are sometimes encountered in deep water and prominent archipelagoes. To a large extent, the oceanic distribution of leatherback turtles may reflect the distribution and abundance of their macroplanktonic prey, which includes medusae, siphonophores, and salpae in temperate and boreal latitudes (NMFS and USFWS 1995). There is little information available on their diet in subarctic waters.

Population Structure

Leatherback turtles are widely distributed throughout the oceans of the world. The species is divided into four main populations in the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. Leatherbacks also occur in the Mediterranean Sea, although they are not known to nest there. The four main populations are further divided into nesting aggregations. Leatherback turtles are found on the western and eastern coasts of the Pacific Ocean, with nesting aggregations in Mexico and Costa Rica (eastern Pacific) and Malaysia, Indonesia, Australia, the Solomon Islands, Papua New Guinea, Thailand, and Fiji (western Pacific). In the Atlantic Ocean, leatherback nesting aggregations have been documented in Gabon, Sao Tome and Principe, French Guiana, Suriname, and Florida. In the Caribbean, leatherbacks

nest in the U.S. Virgin Islands and Puerto Rico. In the Indian Ocean, leatherback nesting aggregations are reported in India, Sri Lanka, and the Andaman and Nicobar Islands.

Threats to the Species

Natural Threats. The various habitat types leatherback sea turtles occupy throughout their lives exposes these sea turtles to a wide variety of natural threats. The beaches on which leatherback sea turtles nest and the nests themselves are threatened by hurricanes and tropical storms as well as the storm surges, sand accretion, and rainfall that are associated with hurricanes. Hatchlings are hunted by predators like herons, gulls, dogfish, and sharks. Larger leatherback sea turtles, including adults, are also killed by sharks and other large, marine predators.

Anthropogenic Threats. Leatherback sea turtles are endangered by several human activities, including fisheries interactions, entanglement in fishing gear (e.g., gillnets, longlines, lobster pots, weirs), direct harvest, egg collection, the destruction and degradation of nesting and coastal habitat, boat collisions, and ingestion of marine debris (NMFS and USFWS 2007a).

The foremost threat is the number of leatherback turtles killed or injured in fisheries. 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% mortality rate (or 33% if most mortality was focused on the East Pacific population). Spotila (2000) asserts that most of the mortality associated with the Playa Grande nesting site was fishery related.

Leatherback sea turtles are exposed to commercial fisheries in many areas of the Atlantic Ocean. For example, leatherback entanglements in fishing gear are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland and Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are reported taken by the many other nations that participate in Atlantic pelagic longline fisheries (see NMFS 2001, for a complete description of take records), including Taiwan, Brazil, Trinidad, Morocco, Cyprus, Venezuela, Korea, Mexico, Cuba, U.K., Bermuda, People’s Republic of China, Grenada, Canada, Belize, France, and Ireland.

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 Hawai'i 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 1 or 2 leatherback sea turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawai'i are estimated to have captured about 19 leatherback sea turtles, killing about 5 of these sea turtles. A recent biological opinion on these fisheries expected this rate of interaction and deaths to continue into the foreseeable future (NMFS 2008). Leatherback sea turtles have also been and are expected to continue to be captured and killed in the deep-set based longline fisheries based out of Hawai'i and American Samoa.

Shrimp trawls in the Gulf of Mexico capture the largest number of leatherback sea turtles: each year, they have been estimated to capture about 3,000 leatherback sea turtles with 80 of those sea turtles dying as a result. Along the Atlantic coast of the U.S., NMFS estimated that about 800 leatherback sea turtles are captured in pelagic longline fisheries, bottom longline and drift gillnet fisheries for sharks as well as lobster, deep-sea red crab, Jonah crab, dolphin fish and wahoo, and Pamlico Sound gillnet fisheries. Although most of these turtles are released alive, these fisheries combined kill about 300 leatherback sea turtles each year; the health effects of being captured on the sea turtles that survive remain unknown.

Leatherback sea turtles are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo *et al.* 1994; Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback turtle population in French Guiana (Chevalier *et al.* 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux *et al.* 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio, 2000). An estimated 1,000 mature female leatherback turtles are caught annually off of Trinidad and Tobago with mortality estimated to be between 50-95% (Eckert and Lien, 1999). However, many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS 2001). There are known to be many sizeable populations of leatherbacks nesting in West Africa, possibly as many as 20,000 females nesting annually (Fretey 2001). In Ghana, nearly two thirds of the leatherback turtles that come up to nest on the beach are killed by local fishermen.

On some beaches, nearly 100% of the eggs laid have been harvested. Eckert (1996) and Spotila *et al.* (1996) note that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries. Like green and hawksbill sea turtles, leatherback sea turtles are threatened by domestic or domesticated animals that prey on their nests; artificial lighting that disorients adult female and hatchling sea turtles, which can dramatically increase the mortality rates of hatchling sea turtles; beach replenishment; ingestion and entanglement in marine debris; and environmental contaminants.

Status

The leatherback turtles are listed as endangered under the ESA throughout the species' global range. Increases in the number of nesting females have been noted at some sites in the Atlantic Ocean, but these are far outweighed by local extinctions, especially of island populations, and the demise of populations throughout the Pacific, such as in Malaysia and Mexico. Spotila *et al.* (1996) estimated the global population of female leatherback turtles to be only 34,500 (confidence limits: 26,200 to 42,900) nesting females; however, the eastern Pacific population has continued to decline since that estimate, leading some researchers to conclude that the leatherback is now on the verge of extinction in the Pacific Ocean (e.g. Spotila *et al.* 1996, Spotila, *et al.* 2000).

Globally, leatherback turtle populations have been decimated worldwide. In 1980, the global leatherback population was estimated at approximately 115,000 adult females (Pritchard 1982). By 1995, this global population (of adult females) is estimated to have declined to 34,500 (Spotila *et al.* 1996). Populations have declined in Mexico, Costa Rica, Malaysia, India, Sri Lanka, Thailand, Trinidad, Tobago, and Papua New Guinea. Throughout the Pacific, leatherbacks are seriously declining at all major nesting beaches.

In the Atlantic and Caribbean, the largest nesting assemblages of leatherbacks are found in the U.S. Virgin Islands, Puerto Rico, and Florida. Since the early 1980s, nesting data has been collected at these locations. Populations in the eastern Atlantic (*i.e.* off Africa) and Caribbean appear to be stable; however, information regarding the status of the entire leatherback population in the Atlantic is lacking and it is certain that some nesting populations (*e.g.*, St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and USFWS 1995). Data collected in southeast Florida clearly indicate increasing numbers of nests for the past twenty years (9.1-11.5% increase), although it is critical to note that there was also an increase in the survey area in Florida over time (NMFS 2001). However, the largest leatherback rookery in the western North Atlantic remains along the northern coast of South America in French Guiana and Suriname. Recent information suggests that Western Atlantic populations declined from 18,800 nesting females in 1996 (Spotila *et al.* 1996) to 15,000 nesting females by 2000 (Spotila, personal communication *cited in* NMFS 2001). The nesting population of leatherback turtles in the Suriname-French Guiana trans-boundary region has been declining since 1992 (Chevalier and Girondot, 1998). Poaching and fishing gear interactions are believed to be the major contributors to the decline of leatherbacks in the area.

Leatherback sea turtles appear to be in a critical state of decline in the North Pacific Ocean. The leatherback population that nests along the east Pacific Ocean was estimated to be over 91,000 adults in 1980 (Spotila 1996), but is now estimated to number less than 3,000 total adult and subadult animals (Spotila 2000). Leatherback turtles have experienced major declines at all major Pacific basin rookeries. At Mexiquillo, Michoacan, Mexico, Sarti *et al.* (1996) reported an average annual decline in nesting of about 23% between 1984 and 1996. The total number of females nesting on the Pacific coast of Mexico during the 1995-1996 season was estimated at fewer than 1,000. Less than 700 females are estimated for Central America (Spotila 2000). In the western Pacific, the decline is equally severe. Current nestings at Terengganu, Malaysia represent 1% of the levels recorded in the 1950s (Chan and Liew 1996).

While Spotila *et al.* (1996) indicated that turtles may have been shifting their nesting from French Guiana to Suriname due to beach erosion, analyses show that the overall area trend in number of nests has been negative since 1987 at a rate of 15.0 -17.3 % per year (NMFS 2001). If turtles are not nesting elsewhere, it appears that the Western Atlantic portion of the population is being subjected to mortality beyond sustainable levels, resulting in a continued decline in numbers of nesting females.

Based on published estimates of nesting female abundance, leatherback populations are declining at all major Pacific basin nesting beaches, particularly in the last two decades (Spotila *et al.* 1996, NMFS and USFWS 1998c, Spotila *et al.* 2000). Declines in nesting populations have been documented through systematic beach counts or surveys in Malaysia (Rantau Abang, Terengganu), Mexico and Costa Rica. In other leatherback nesting areas, such as Papua New Guinea, Indonesia, and the Solomon Islands, there have been no systematic consistent nesting surveys, so it is difficult to assess the status and trends of leatherback turtles at these beaches. In all areas where leatherback nesting has been documented, however, current nesting populations are reported by scientists, government officials, and local observers to be well below abundance levels of several decades ago. The collapse of these nesting populations was most likely precipitated by a tremendous overharvest of eggs coupled with incidental mortality from fishing (Sarti *et al.* 1996, Eckert, 1997).

Based on recent modeling efforts, some authors concluded that leatherback turtle populations cannot withstand more than a 1% human-related mortality level which translates to 150 nesting females (Spotila *et al.* 1996). As noted previously, there are many human-related sources of mortality to leatherbacks; every year, 1,800 leatherback turtles are expected to be captured or killed as a result of federally-managed activities in the U.S. (this total includes both lethal and non-lethal take). An unknown number of leatherbacks are captured or killed in fisheries managed by states. Spotila *et al.* (1996) recommended not only reducing fishery-related mortalities, but also advocated protecting eggs and hatchlings. Zug and Parham (1996) point out that a combination of the loss of long-lived adults in fishery-related mortalities and a lack of recruitment stemming from elimination of annual influxes of hatchlings because of intense egg harvesting has caused the sharp decline in leatherback populations.

For several years, NMFS' biological opinions have established that leatherback populations currently face high probabilities of extinction as a result of both environmental and demographic stochasticity. Demographic stochasticity, which is chance variation in the birth or death of an individual of the population, is facilitated by the increases in mortality rates of leatherback populations resulting from the premature deaths of individual sea turtles associated with human activities (either removal of eggs or adult females that are killed on nesting beaches or that die as a result of being captured in fisheries) or incidental capture and mortality of individuals in various fisheries.

In the Pacific Ocean, leatherback sea turtles are critically endangered as a direct consequence of a historical combination of overexploitation and habitat loss. The information available suggests that leatherback sea turtles have high probabilities of becoming extinct in the Pacific Ocean unless they are protected from the combined threats of entanglements in fishing gear, overharvests, and loss of their nesting habitat. The limited data available suggests that leatherback sea turtles exist at population sizes small enough to be classified as "small" populations (that is, populations that exhibit population dynamics that increase the extinction probabilities of the species or several of its populations) as evidenced by biases in the male to female ratios in the Pacific. The status of leatherback sea turtles in the Atlantic Ocean remains uncertain.

Diving and Social Behavior

The maximum dive depths for post-nesting female leatherback turtles in the Caribbean have been recorded at 475 meters and over 1,000 meters, with routine dives recorded at between 50 and 84 meters. The maximum dive length recorded for such female leatherback turtles was 37.4 minutes, while routine dives ranged from 4 -14.5 minutes (*in* Lutcavage and Lutz 1997). Leatherback turtles also appear to spend almost the entire portion of each dive traveling to and from maximum depth, suggesting that maximum exploitation of the water column is of paramount importance to the leatherback (Eckert *et al.* 1989).

A total of six adult female leatherback turtles from Playa Grande, Costa Rica were monitored at sea during their internesting intervals and during the 1995 through 1998 nesting seasons. The turtles dived continuously for the majority of their time at sea, spending 57 - 68% of their time submerged. Mean dive depth was 19±1 meters and the mean dive duration was 7.4± 0.6 minutes (Southwood *et al.* 1999). Similarly, Eckert (1999) placed transmitters on nine leatherback females nesting at Mexiquillo Beach and recorded dive behavior during the nesting season. The majority of the dives were less than 150 meters

depth, although maximum depths ranged from 132 meters to over 750 meters. Although the dive durations varied between individuals, the majority of them made a large proportion of very short dives (less than two minutes), although Eckert (1999) speculates that these short duration dives most likely represent just surfacing activity after each dive. Excluding these short dives, five of the turtles had dive durations greater than 24 minutes, while three others had dive durations between 12 - 16 minutes.

Migrating leatherback turtles also spend a majority of time at sea submerged, and they display a pattern of continual diving (Standora *et al.* 1984, *in* Southwood *et al.* 1999). Based on depth profiles of four leatherbacks tagged and tracked from Monterey Bay, California in 2000 and 2001, using satellite-linked dive recorders, most of the dives were to depths of less than 100 meters and most of the time was spent shallower than 80 meters. Based on preliminary analyses of the data, 75-90% of the time the leatherback turtles were at depths less than 80 meters.

Vocalizations and Hearing

There is no information on the vocalizations or hearing of leatherback sea turtles. However, we assume that their hearing sensitivities will be similar to those of green and loggerhead sea turtles: their best hearing sensitivity will be in the low frequency range: from 200 to 400 Hz with rapid declines for tones at lower and higher frequencies. Their hearing will probably have a practical upper limit of about 1000 Hz (Bartol *et al.* 1999, Ridgway *et al.* 1969).

These hearing sensitivities are similar to the hearing sensitivities reported for two terrestrial species: pond turtles (*Pseudemys scripta*) and wood turtles (*Chrysemys inscuplta*). Pond turtles are reported to have best hearing responsiveness between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz and almost no sensitivity above 3000 Hz (Wever and Vernon 1956). Wood turtles have sensitivities up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Peterson 1966).

Loggerhead Sea Turtle

Distribution

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics in the Atlantic, Pacific and Indian Oceans and the Mediterranean Sea (NMFS and USFWS 1998). The majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. Nesting aggregations occur in the eastern Atlantic at Cape Verde, Greece, Libya, Turkey and along the West African Coast. The western Atlantic and Caribbean hosts nesting aggregations along the U.S. east coast from Virginia through the Florida peninsula, the Dry Tortugas and Northern Gulf of Mexico, the Bahamas, the Yucatan Peninsula, Central America and the Caribbean and into South America. Within the Indian Ocean, nesting aggregations occur at Oman, Yemen, Sri Lanka and Madagascar and South Africa. Pacific Ocean nesting sites include western and eastern Australia and Japan.

Adult loggerheads are known to make considerable migrations from nesting beaches to foraging grounds (TEWG 2009); and evidence indicates turtles entering the benthic environment undertake routine

migrations along the coast that are limited by seasonal water temperatures. Small juveniles are found in pelagic waters (e.g., of the North Atlantic and the Mediterranean Sea); and the transition from oceanic to neritic juvenile stages can involve trans-oceanic migrations (Bowen *et al.* 2004). Loggerhead nesting is confined to lower latitudes, concentrated in temperate zones and subtropics; the species generally does not nest in tropical areas (NRC 1990; NMFS and USFWS 1991; Witherington *et al.* 2006). Loggerhead turtles travel to northern waters during spring and summer as water temperatures warm, and southward and offshore toward warmer waters in fall and winter; loggerheads are noted to occur year round in offshore waters of sufficient temperature.

Population Structure

Loggerhead sea turtles, like other sea turtles, are divided into regional groupings that represent major oceans or seas: the Atlantic Ocean, Pacific Ocean, Indian Ocean, Caribbean Sea and Mediterranean Sea. In these regions, the population structure of loggerhead turtles is usually based on the distribution of their nesting aggregations. Loggerhead sea turtles are currently listed globally as a threatened species.

Threats to the Species

Natural Threats. The various habitat types loggerhead sea turtles occupy throughout their lives exposes these sea turtles to a wide variety of natural and anthropogenic threats. The beaches on which loggerhead sea turtles nest and the nests themselves are threatened by hurricanes and tropical storms as well as the storm surges, sand accretion, and rainfall that are associated with hurricanes. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton *et al.* 1994). Hatchlings are hunted by predators like herons, gulls, dogfish, and sharks. Adult loggerhead sea turtles are also killed by sharks and other large, marine predators. Loggerhead sea turtles are also killed by cold stunning, exposure to biotoxins, sharks and other large, marine predators.

Anthropogenic Threats. A wide variety of human activities adversely affect hatchlings and adult female turtles when they are on land, including beach erosion, beach armoring and nourishment; artificial lighting; beach cleaning; human presence on nesting beaches; beach driving; coastal construction and fishing piers that alter patterns of erosion and accretion on nesting beaches; exotic dune and beach vegetation; and poaching. As the size of the human population in coastal areas increases, that population brings with it secondary threats such as exotic fire ants, feral hogs, dogs, and the growth of populations of native species that tolerate human presence (*e.g.*, raccoons, armadillos, and opossums) and which feed on turtle eggs.

When they are in coastal or marine waters, loggerhead turtles are affected by a completely different set of human activities that include discharges of toxic chemicals and other pollutants into the marine ecosystem; underwater explosions; hopper dredging, offshore artificial lighting; entrainment or impingement in power plants; entanglement in marine debris; ingestion of marine debris; boat collisions; poaching, and interactions with commercial fisheries. Interactions with fisheries represent a primary threat because of the number of individuals that are captured and killed in fishing gear each year (Table 3).

Table 3: Number of different species of sea turtles that NMFS expected to be "taken" (generally captured and harassed, harmed, wounded, or killed) and the number that are expected to be killed in commercial fisheries managed by NMFS off the Atlantic Coast, based on numbers contained in incidental take statements in biological opinions on those fisheries. Numbers are generally annual estimates (after Griffin *et al*. 2006 and updated biological opinions since 2006)

Fishery	NMFS Region	Loggerhead		Leatherback		Green		Hawksbill		Total	
		Total Take	# Killed	Total Take	# Killed	Total Take	# Killed	Total Take	# Killed	Total Take	# Killed
Bluefish	NER	6	3	0	0	0	0	0	0	6	3
Deep-sea red crab	NER	1	1	1	1	0	0	0	0	2	2
Herring	NER	6	3	1	1	1	1	0	0	8	5
Jonah crab	NER	0	0	2	2	0	0	0	0	2	2
Lobster	NER	2	2	5	5	0	0	0	0	7	7
Mackerel, squid, butterfish	NER	6	3	1	1	2	2	0	0	9	6
Monkfish	NER	4	1	2	1	2	1	0	0	8	3
Multispecies	NER	1	1	1	1	1	1	0	0	3	3
Pound net (Virginia)	NER	507	2	2	2	3	2	0	0	512	6
Sea scallop	NER	754	484	2	2	2	2	0	0	760	490
Skate	NER	1	1	1	1	1	1	0	0	3	3
Spiny dogfish	NER	3	2	1	1	1	1	0	0	5	4
Stone Crab	SER	16	4	1	0	4	3	1	0		
Summer flounder, scup, sea bass	NER	19	5	0	0	2	2	0	0	21	7
Tilefish	NER	6	3	1	1	0	0	0	0	7	4
Dolphin fish and wahoo	SER	12	2	12	1	2	1	2	1	28	5
Atlantic pelagic	SER	623	146	660	183	35	8	35	8	1353	345
Sargassum	SER	3	3	0	0	0	0	0	0	3	3
Shark bottom longline and drift gillnet	SER	679	346	47	74	2	1	2	1	320	171
Pamlico Sound gillnet	SER	41	3	2	2	168	46	2	2	213	53
Shrimp trawling	SER	163160	3948	3090	80	18757	514	0	640	185007	5182
Totals		**165850**	**4963**	**3822**	**359**	**18883**	**586**	**87***	**652**	**188277**	**6304**

Table 3: Number of different species of sea turtles that NMFS expected to be "taken" (generally captured and harassed, harmed, wounded, or killed) and the number that are expected to be killed in commercial fisheries managed by NMFS off the Atlantic Coast, based on numbers contained in incidental take statements in biological opinions on those fisheries. Numbers are generally annual estimates (after Griffin *et al*. 2006 and updated biological opinions since 2006)

Fishery	NMFS Region	Loggerhead		Leatherback		Green		Hawksbill		Total	
		Total Take	# Killed	Total Take	# Killed	Total Take	# Killed	Total Take	# Killed	Total Take	# Killed

***** The biological opinion on shrimp trawl fisheries did not estimate the number of hawksbill sea turtles that might be captured in the fisheries, although it estimated the number that might be killed. Obviously, the fisheries would have to capture at least 640 hawksbill sea turtles to kill that many sea turtles.

Loggerhead sea turtles are also captured and killed in commercial fisheries. In the Pacific Ocean, between 2,600 and 6,000 loggerhead sea turtles are estimated to have been captured and killed in longline fisheries in 2000 (Lewison *et al.* 2004). Shallow-set Hawai'i based longline fisheries are estimated to have captured and killed several hundred loggerhead 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 fewer than 5 loggerhead sea turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawai'i are estimated to have captured about 45 loggerhead sea turtles, killing about 10 of these sea turtles. A recent biological opinion on these fisheries expected this rate of interaction and deaths to continue into the foreseeable future (NMFS 2008). Loggerhead sea turtles have also been and are expected to continue to be captured and killed in the deep-set based longline fisheries based out of Hawai'i and American Samoa.

Shrimp trawl fisheries account for the highest number of loggerhead sea turtles that are captured and killed, but they are also captured and killed in trawls, traps and pots, longlines, and dredges. Along the Atlantic coast of the U.S., NMFS estimated that almost 163,000 loggerhead sea turtles are captured in shrimp trawl fisheries each year in the Gulf of Mexico, with 3,948 of those sea turtles dying as a result of their capture. Each year, several hundred loggerhead sea turtles are also captured in herring fisheries; mackerel, squid, and butterfish fisheries; monkfish fisheries; pound net fisheries, summer flounder and scup fisheries; Atlantic pelagic longline fisheries; and gillnet fisheries in Pamlico Sound. Although most of these turtles are released alive, these fisheries capture about 2,000 loggehead sea turtles each year, killing almost 700; the effects of capture-related stress on the current or expected future reproductive success of sea turtles remains unknown.

In the pelagic environment, loggerhead sea turtles are exposed to a series of longline fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.* 1995, Bolten *et al.* 1994, Crouse 1999). In the benthic environment in waters off the coastal U.S., loggerheads are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gillnet, pound net, longline, dredge, and trap fisheries.

Like all of the other sea turtles we have discussed, loggerhead sea turtles are threatened by domestic or domesticated animals that prey on their nests; artificial lighting that disorients adult female and hatchling sea turtles, which can dramatically increase the mortality rates of hatchling sea turtles; beach replenishment; ingestion and entanglement in marine debris; and environmental contaminants.

Status

Loggerhead sea turtles are currently listed as threatened under the ESA throughout its global range. In 2010 NMFS and FWS published a proposed rule to list several distinct population segments (DPS) of loggerhead sea turtles (75 FR 12598, March 16, 2010). Two DPSs are proposed for the Pacific Ocean, three in the Indian Ocean, and four in the Atlantic Ocean/Mediterranean Sea (See Table 4).

Table 4: Proposed Loggerhead Sea Turtle Distinct Population Segments			
Population Segment	Historic Range	Population Boundaries	Proposed Status
Mediterranean Sea	Mediterranean Sea Basin	Mediterranean Sea east of 5°36' W. Long.	Endangered
North Indian Ocean	North Indian Ocean Basin	North Indian Ocean north of the equator and south of 30° N. Lat.	Endangered
North Pacific Ocean	North Pacific Ocean Basin	North Pacific north of the equator and south of 60° N. Lat.	Endangered
Northeast Atlantic Ocean	Northeast Atlantic Ocean Basin	Northeast Atlantic Ocean north of the equator, south of 60° N. Lat, east of 40° W. Long, and west of 5°36' W. Long	Endangered
Northwest Atlantic Ocean	Northwest Atlantic Ocean Basin	Northwest Atlantic Ocean north of the equator, south of 60° N. Lat, and west of 40° W. Long	Endangered
South Atlantic Ocean	South Atlantic Ocean	South Atlantic Ocean south of the equator, north of 60° S. Lat, west of 20° E. Long, and east of 67° W. Long	Threatened
South Pacific Ocean	South Pacific Ocean Basin	South Pacific south of the equator, north of 60° S. Lat, west of 67° W. Long, and east of 139° E. Long.	Endangered
Southeast Indo-Pacific Ocean	Southeast Indian Ocean Basin; South Pacific Ocean Basin as far east as 139° E Long	Southeast Indian Ocean south of the equator, north of 60° S. Lat, and east of 80° E. Long; South Pacific Ocean south of the equator, north of 60° S. Lat, and west of 139° E. Long	Endangered
Southwest Indian Ocean	Southwest Indian Ocean Basin	Southwest Indian Ocean north of the equator, south of 30° N. Lat, west of 20° E. Long, and east of 80° E. Long	Threatened

All loggerheads inhabiting the North Pacific Ocean are derived primarily, if not entirely, from Japanese beaches (although low level nesting may occur in areas around the South China Sea). Along the Japanese coast, nine major nesting beaches (greater than 100 nests per season) and six "submajor'' beaches (10–100 nests per season) were identified. Using information collected from these nine beaches Kamezaki *et al.* (2003) found a substantial decline (50–90 percent) in the size of the annual loggerhead nesting population over the last half of the 20th century. Also, nest count data for the last two decades suggests that the North Pacific population is "small" and lacks a robust gene pool when compared to the larger northwest Atlantic and north Indian Ocean loggerhead populations. Small populations are more susceptible to demographic variability which increases their probability of extinction. Available evidence indicates that due to loss of adult and juvenile mortalities from fishery bycatch and, to a lesser degree the loss of nesting habitat, the North Pacific loggerhead population is declining.

In the South Pacific, loggerhead nesting is almost entirely restricted to eastern Australia (primarily Queensland) and New Caledonia, with the majority of nesting occurring in eastern Australia. The total nesting population for Queensland was approximately 3,500 females in the 1976–1977 nesting season (Limpus 1985; Limpus and Reimer, 1994), however, by the 1999-2000 season Limpus and Limpus (2003) estimated this population at less than 500 females. This represents an estimated 50 to 80 percent

decline in the number of breeding females at various Australian rookeries up to 1990 (Limpus and Reimer, 1994) and a decline of approximately 86 percent by 1999 (Limpus and Limpus, 2003).

Information from pilot surveys conducted in 2005 in New Caledonia, combined with oral history information collected, suggests a decline in loggerhead nesting with 60-70 loggerheads nesting on the four surveyed New Caledonia beaches during the 2004–2005 nesting season (Limpus *et al.*,2006). Chaloupka and Limpus (2001) determined that the resident non-breeding loggerhead population on coral reefs of the southern Great Barrier Reef in eastern Australia declined at 3 percent per year from 1985 to the late 1990s. The observed decline was hypothesized as a result of recruitment failure, given few anthropogenic impacts and constant high annual survivorship measured at this foraging habitat (Chaloupka and Limpus, 2001). This decline also coincided with a measured decline in new recruits in these foraging areas (Limpus and Limpus, 2003). Available evidence indicates that due to loss of adult and juvenile mortalities from fishery bycatch the South Pacific population is declining.

Loggerhead sea turtles nesting densities in the North Indian Ocean are the largest in the eastern hemisphere with the vast majority of these nests in Oman (Baldwin *et al.*, 2003). Nesting is rare in the rest of the northern Indian Ocean. Nesting surveys and tagging data were used to extrapolate the number of females nesting at Masirah Island during 1977-78 resulting in 19,000 to 60,000 turtles (assuming 100 percent nesting success) and a partial survey of the island in 1991 estimated 23,000 nesters (Baldwin, 1992; Ross, 1979, 1998). Comparing the nesting data collected after 2008 when nesting surveys were standardized at Masirah to the 1977-78 and 1991 yielded an estimate of 20,000-40,000 nesters (assuming 50 percent nesting success). These estimates suggest a decline in the nesting population over the past three decades which is consistent with observations by local rangers. Mortality across all life stages fishery bycatch and the loss of nesting habitat is likely to cause this population to decline further.

In the southeast Indo-Pacific Ocean, loggerhead nesting is restricted to Western Australia (Dodd, 1988), which is the largest nesting population in Australia (Natural Heritage Trust, 2005 as cited in NMFS and USFWS 2007b). Evidence suggests the nesting population in the Muiron Islands and North West Cape region was depleted before recent beach monitoring programs began although the data are insufficient to determine trends (Nishemura and Nakahigashi, 1990; Poiner *et al.*, 1990; Poiner and Harris, 1996). Juvenile and adult mortality from fishery bycatch presents the greatest threat to this population's probability of extinction.

In the Southwest Indian Ocean, the highest concentration of nesting occurs on the coast of Tongaland, South Africa, where surveys and management practices were instituted in 1963 (Baldwin *et al.*, 2003). Nesting beach data from this region from 1965 to 2008 indicates an increasing nesting population between the first decade of surveys, which documented 500–800 nests annually, and the last 8 years, which documented 1,100–1,500 nests annually (Nel, 2008). These data represent approximately 50 percent of all nesting within South Africa and are believed to be representative of trends in the region. Loggerhead nesting occurs elsewhere in South Africa and Madagascar, but sampling is not consistent and no trend data are available. This population, although small, is increasing but juvenile mortality from fishery bycatch remains a concern.

Loggerheads in the Northwest Atlantic Ocean comprise one of the two largest nesting assemblages in the world and have been identified as the most significant assemblage in the western hemisphere. Data

collected over a period of 10 to 23 years indicates that there has been a significant overall decline in nesting numbers (FWS 2008, Witherington *et al* 2009, TEWG 2009). The annual number of nests has been declining for all subpopulations of Northwest Atlantic loggerheads for which there were adequate data available. Available evidence indicates that this population is declining due to juvenile and adult mortality from fishery bycatch. Five nesting subpopulations have been identified in the Northwest Atlantic Ocean (NMFS and USFWS 2008). Their status follows:

> (1) Northern U.S. (Florida/Georgia border to southern Virginia). The Northern U.S. subpopulation is the second largest unit within the Northwest Atlantic population and has been declining significantly at 1.3 percent annually since 1983 (NMFS and USFWS, 2008);
>
> (2) Peninsular Florida (Florida/Georgia border south through Pinellas County, excluding the islands west of Key West, Florida). The most significant declining trend has been documented for the Peninsular Florida subpopulation, where nesting declined 26 percent over the 20-year period from 1989–2008, and declined 41 percent over the period 1998–2008 (NMFS and USFWS, 2008; Witherington *et al.*, 2009). This subpopulation represents approximately 87 percent of all nesting effort in the Northwest Atlantic Ocean DPS (Ehrhart *et al.*, 2003);
>
> (3) Dry Tortugas (islands west of Key West, Florida). Data are currently not adequate to assess trends in the annual number of nests for this subpopulation;
>
> (4) Northern Gulf of Mexico (Franklin County, Florida, west through Texas). Data are currently not adequate to assess trends in the annual number of nests for this subpopulation; and
>
> (5) Greater Caribbean (Mexico through French Guiana, the Bahamas, Lesser and Greater Antilles). This is the third largest subpopulation within the Northwest Atlantic population, with the majority of nesting at Quintana Roo, Mexico. TEWG (2009) reported a greater than 5 percent annual decline in loggerhead nesting from 1995–2006 at Quintana Roo.

In the northeastern Atlantic, the Cape Verde Islands support the only large nesting population of loggerheads in the region (Fretey, 2001). Nesting occurs at some level on most of the islands in the archipelago with the largest nesting numbers reported from Boa Vista Island where 833 and 1,917 nests were reported in 2001 and 2002, respectively, and between 1998 and 2002 the local project had tagged 2,856 females (Varo Cruz *et al.*, 2007). More recently, in 2005, about 3,121 females were reported (Lopez-Jurado *et al.*, 2007). Elsewhere in the northeastern Atlantic, loggerhead nesting is non-existent or occurs at very low levels. Population trends could not be determined for the Cape Verde population because of limited data; however, evidence of directed killing of nesting females suggests that this nesting population is under severe pressure and likely significantly reduced from historic levels. Available evidence indicates that this population is declining due to ongoing mortality of mature females and eggs, low hatchling and emergence success and mortality of juveniles and adults from fishery bycatch.

Nesting occurs throughout the central and eastern Mediterranean and sporadic nesting has been reported in the western Mediterranean, however, the vast majority of nesting (greater than 80 percent) occurs in Greece and Turkey (Margaritoulis *et al.*, 2003). The documented annual nesting of loggerheads in the Mediterranean averages about 5,000 nests (Margaritoulis *et al.*, 2003). There is no discernible trend in nesting at the two longest monitoring projects in Greece, Laganas Bay (Margaritoulis, 2005) and southern Kyparissia Bay (Margaritoulis and Rees, 2001 as cited in NMFS and USFWS 2007b). However, nesting at two beaches (Rethymno Beach, which accounts for approximately 7 percent of all documented

loggerhead nesting in the Mediterranean) and Fethiye Beach in Turkey which accounts for 10 percent of nesting in Turkey), show a declining trend in 1990–2004 and 1993-2004, respectively (Ilgaz *et al.* 2007 as cited in NMFS and USFWS 2007b, Margaritoulis *et al.*, 2009). Juvenile and adult mortality from fishery bycatch and the loss of nesting habitat, eggs and hatchlings remain a concern for this population.

In the South Atlantic nesting occurs primarily along the mainland coast of Brazil. Prior to 1980, loggerhead nesting populations in Brazil were considered depleted, however, an increasing trend has been reported from 1988 through 2003 on beaches representing more than 75 percent of all loggerhead nesting in Brazil. A total of 4,837 nests were reported from these survey beaches for the 2003–2004 nesting season (Marcovaldi and Chaloupka, 2007). Juvenile mortality from fishery bycatch remains a concern for this population.

Diving and Social Behavior

Studies of loggerhead diving behavior indicate varying mean depths and surface intervals, depending on whether they were located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals). The maximum recorded dive depth for a post-nesting female was 211-233 meters, while mean dive depths for both a post-nesting female and a subadult were 9-22 meters. Routine dive times for a post-nesting female were between 15 and 30 minutes, and for a subadult, between 19 and 30 minutes (Sakamoto *et al.* 1990 *cited in* Lutcavage and Lutz 1997). Two loggerheads tagged by Hawai'i-based longline observers in the North Pacific and attached with satellite-linked dive recorders were tracked for about 5 months. Analysis of the dive data indicates that most of the dives were very shallow - 70% of the dives were no deeper than 5 meters. In addition, the loggerheads spent approximately 40% of their time in the top meter and nearly all of their time at depths shallower than 100 meters. On 5% of the days, the turtles dove deeper than 100 meters; the deepest daily dive recorded was 178 meters (Polovina *et al.* 2003).

Polovina *et al.* (2004) reported that tagged turtles spent 40 percent of their time at the surface and 90 percent of their time at depths shallower than 40 meters. On only five percent of recorded dive days loggerheads dove to depths greater than 100 meters at least once. In the areas that the loggerheads were diving, there was a shallow thermocline at 50 meters. There were also several strong surface temperature fronts the turtles were associated with, one of 20°C at 28°N latitude and another of 17°C at 32°N latitude.

Vocalizations and Hearing

The information on loggerhead turtle hearing is very limited. Bartol *et al.* (1999) studied the auditory evoked potential of loggerhead sea turtles that had been captured in pound nets in tributaries to the Chesapeake Bay in Maryland and Virginia and concluded that loggerhead sea turtles had most sensitive hearing between 250 and 1000 Hz, with rapid decline above 1000 Hz (Bartol *et al.* 1999). This is similar to the results produced by Ridgway *et al.* (1969) who studied the auditory evoked potentials of three green sea turtles (in air and through mechanical stimulation of the ear). They concluded that the maximum sensitivity of green sea turtles occurred from 300 to 400 Hz with rapid declines for tones at lower and higher frequencies. They reported an upper limit for cochlear potentials without injury of 2000 Hz and a practical limit of about 1000 Hz.

These hearing sensitivities are similar to the hearing sensitivities reported for two terrestrial species: pond turtles (*Pseudemys scripta*) and wood turtles (*Chrysemys inscuplta*). Pond turtles are reported to have best hearing responsiveness between 200 and 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz and almost no sensitivity above 3000 Hz (Wever and Vernon 1956). Wood turtles have sensitivities up to about 500 Hz, followed by a rapid decline above 1000 Hz and almost no responses beyond 3000 or 4000 Hz (Peterson 1966).

Environmental Baseline

A number of human activities have contributed to the current status of sperm whales and sea turtles in the action area. In addition to being a biologically important area, the action area has a history of established economic activities and continues to be used for oil, gas, and mineral development; maritime vessel traffic; and recreational and commercial fisheries. These and other activities may affect listed species in the action area. The following information summarizes the principal natural and human phenomena in the northern Gulf of Mexico that are believed to potentially affect the survival and recovery of these species in the wild.

The action area is located in the northern Gulf of Mexico, which is a semitropical, semi-enclosed embayment off the Atlantic Ocean extending from the Florida Keys westward to the southern tip of Texas, following the coastline of five states. The combined coastline of these states totals over 47,000 miles (when including the shores of all barrier islands, wetlands, inland bays, and inland bodies of water; DOC 2008).

Natural Mortality

For the Environmental Baseline, we assume that the same sources of natural mortality for each species within the action area are similar to those sources across the range of the species, as identified in the Status of Listed Resources section. These include natural mortality resulting from parasites, predation and exposure to biotoxins. For example, the giant spirurid nematode (*Crassicauda boopis*) has been attributed to congestive kidney failure and death in some large whale species (Lambertson *et al.* 1986). However, the rates at which natural mortality occur in cetaceans, especially large whale species, are largely unknown. Other natural events, such as fluctuations in sea surface temperatures and severe weather affecting prey availability, may also contribute to large whale and sea turtle natural mortality.

Climate Change

Global climate patterns have a natural year-to-year variability; however, a global warming trend has become apparent based on observations of average air and sea surface temperatures, losses of ice and snow and rising average sea level. This warming trend has varying effects on ecosystems at the regional climate level (EPA 2010) such as that which affects the Gulf of Mexico. Observational evidence from all continents and most oceans shows that many ecosystems are being affected by regional climate changes due to global climate change, particularly temperature increases (IPCC 2007).

Twilley *et al.* (2001) used two climate scenarios with each predicting warmer temperatures (3° F to 7° F throughout the Gulf in summer and 5° F in the eastern Gulf and as much as 10° F in the western Gulf in

the winter). Although global climate change models have predicted an increase in sea-level of 8 to 20 inches along the Gulf Coast over the next 100 years, regional characteristics including the Gulf's flat topography, regional land subsidence, extensive shoreline development, and vulnerability to major storms suggests a more dramatic sea-level increase of 15 inches along most of the Gulf Coast to as much as 44 inches along the Louisiana/Mississippi Delta (Twilley *et al.* 2001). Since 2001, the IPCC (2007) has estimated that sea surface temperatures are warming at a much faster rate than earlier predicted. The 100 year linear warming trend from 1901-2000 was 0.6°C (0.4 to 0.8°C) as compared to the trend from 1906-2005 of 0.74°C (0.56 to 0.92°C). Based on the more recent trend analyses the climate scenarios presented by Twilley *et al.* (2001) may be underestimates.

Changes in air and sea surface temperatures affect the marine environment in several ways. Variations in sea surface temperature can affect an ecological community's composition and structure, alter migration and breeding patterns of fauna and flora and change the frequency and intensity of extreme weather events. Over the long term, increases in sea surface temperature also can reduce the amount of nutrients supplied to surface waters from the deep sea leading to declines in fish populations (EPA 2010), and, therefore, declines in those species whose diets are dominated by fish.

Climatic variability is thought to possibly result in populations of cetaceans relocating from areas they currently use in response to changes in oceanic conditions (MacLeod *et al.* 2005, MacLeod 2009), or sea turtles expanding their range as temperature-dependent distribution limits change (McMahon and Hays 2006). Pike *et al*. (2006) concluded that warming sea surface temperatures may lead to potential fitness consequences in sea turtles resulting from altered seasonality and duration of nesting. Sea turtles will also be affected by loss of historic nesting habitat by elevated sea levels and skewed sex ratios as warming temperatures may lead to the production of female only clutches (Newson *et al*. 2009). Genetic analyses and behavioral data suggest that populations with temperature-dependent sex determination may be unable to evolve rapidly enough to counteract the negative fitness consequences of rapid global temperature change (Hays 2008 *as cited in* Newson *et al.* 2009). However, Hayes *et al.* (2010) suggests that because of the increased frequency of male loggerhead breeding (based on visits to breeding sites) versus female breeding, the ability of males to breed with many females and the ability of females to store sperm and fertilize many clutches, any skewed sex ratios due to climate change can be compensated for and population effects may be ameliorated. Changes in prey composition (e.g., jellyfish) and diminished prey availability are also possible; however, gaps in information on the movements and distribution of marine species, as well as insufficient historical information, complicate any potential conclusions regarding the effects of climate change (Kintisch 2006). As prey reach their temperature tolerance limits in a warming environment, however, they will either relocate to more favorable conditions, habituate or as individual fitness consequences increase, population consequences may be inevitable.

Severe Weather

Climate change is expected to affect the intensity of hurricanes through increasing sea surface temperatures, a key factor that influences hurricane formation and behavior (EPA 2010). The intensity of tropical storms in the Atlantic Ocean, Caribbean, and Gulf of Mexico has risen noticeably over the past 20 years and six of the 10 most active hurricane seasons have occurred since the mid-1990s (EPA 2010). On average one third of the named Atlantic storms eventually pass through the Gulf of Mexico. Severe storms such as hurricanes exhibit high winds and a storm surge that can cause extensive habitat

degradation (e.g., erosion); as well as mixing of the water column in shallower depths, which can release nutrients and prompt short-lived algal blooms (Valiela *et al.* 1998).

Predictions of impacts from these storms are especially difficult, and little is known on the effects of hurricanes on listed species in the action area. Valiela *et al.* (1998) reported that damage to aquatic animals from hurricanes appeared to be minimal. For sea turtles, effects of hurricanes are reported to include destruction of nesting beaches and nests due to inundation or exposure, resulting in transient disturbance of nesting, loss of eggs laid before storms, and inability of hatchlings to reach the surf (Milton et al. 1994, Ross 2005). However, Ross (2005) reported that in one study adult fecundity, nesting periodicity, and nest site location were not changed and adult mortality was negligible following a hurricane in the Indian Ocean. The effects of recent hurricanes in the Gulf of Mexico on sea turtle population numbers and trends are not yet known although Milton *et* al. (1994) reported high levels of sea turtles killed and nests lost due to Hurricane Andrew in 1992. No accounts are available of how the hurricanes affected sperm whales, however, Bassos-Hull and Wells (2007) reported short-term changes within weeks after Hurricane Charley in 2006 including hypoxia and salinity changes, and mangrove and riparian damage, but no long term effects on bottlenose dolphins in Sarasota Bay.

Habitat Degradation

Habitat degradation can occur due to a number of activities that directly or indirectly impact the action area for this consultation. These activities include water pollution/contaminants, oil and gas activities, ocean noise, and marine dredging and construction as discussed below.

The northern Gulf of Mexico is heavily influenced by freshwater input, nutrient and pesticide run-off and other pollutants from the Mississippi-Atchafalaya River Basin. Parts or all of 31 states plus two Canadian provinces drain into the Mississippi River, totaling 41% of the contiguous United States and 14% of North America (Brown *et al.* 2005). The massive influx of nutrients can result in substantial algal blooms that consume available oxygen in the water column, leading to hypoxic or anoxic conditions. Since their discovery in the 1970s hypoxic or "dead zones" have increased in area, duration and frequency throughout the oceans. The largest man-induced dead zone in the U.S. and second in the world only to the Dead Sea occurs in the Northern Gulf of Mexico. This dead zone is distributed across the Louisiana shelf west of the Mississippi River and onto the upper Texas coast, from near shore to as much as 125 km (nm) offshore, and in water depths up to 60 m (Rabalais *et al*. 2007). Hypoxic conditions have been found in all months of the year, but are most persistent and severe in summer (Turner 2005, Rabalais *et al.* 2007). These conditions are correlated with reduced abundance of benthic and demersal organisms, reduced species richness and reduced biomass, and have also been attributed to abandonment of habitat and massive die-offs of organisms that cannot escape to sufficiently oxygenated waters.

Water Pollution

Coastal runoff and river discharges carry large volumes of petrochemical and other contaminants from agricultural activities, cities and industries into the Gulf of Mexico. The coastal waters of the Gulf of Mexico have more sites with high contaminant concentrations than other areas of the coastal United States, due to the large number of waste discharge point sources. Although these contaminant concentrations do not likely affect the more pelagic waters of the action area, the species of turtles analyzed in these

Opinions travel between nearshore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

An extensive review of environmental contaminants in turtles has been conducted by Meyers-Schöne and Walton (1994); however, most of this information relates to freshwater species. High concentrations of chlorobiphenyls and organochlorine pesticides in the eggs of the freshwater snapping turtle, *Chelydra serpentina*, have been correlated with population effects such as decreased hatching success, increased hatchling deformities and disorientation (Bishop *et al.* 1991, 1994).

Very little is known about baseline levels and physiological effects of environmental contaminants on marine turtle populations (Witkowski and Frazier 1982, Bishop *et al.* 1991). There are a few isolated studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Davenport and Wrench 1990, Aguirre *et al.* 1994). Mckenzie *et al.* (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in marine turtle tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous logger-head turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles. It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai *et al.* (1995) found the presence of metal residues occurring in loggerhead turtle organs and eggs. More recently, Storelli *et al.* (1998) analyzed tissues from twelve 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 by Law *et al.* (1991). Keller *et al.* (2006) found that chronic exposure of sea turtles to organochlorine contaminants (such as PCBs and pesticides) may modulate the immune response in these animals by suppressing innate immunity and enhancing certain lymphocyte activity. Polycyclic aromatic hydrocarbons (PAHs) have been documented to affect embryo development in other turtle species (Van Meter *et al.* 2006). More research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles.

The impacts on these activities are difficult to measure. Some researchers have correlated contaminant exposure to possible adverse health effects in marine mammals. Studies of captive harbor seals have demonstrated a link between exposure to organochlorines (*e.g.*, DDT, PCBs, and PAHs) and immunosuppression (Ross *et al*. 1995, Harder *et al.* 1992, De Swart *et al.* 1996). Organochlorines are chemicals that tend to bioaccumulate through the food chain, thereby increasing the potential of indirect exposure to a marine mammal via its food source. During pregnancy and nursing, some of these contaminants can be passed from the mother to developing offspring. Contaminants like organochlorines do not tend to accumulate in significant amounts in invertebrates, but do accumulate in fish and fish-eating animals. Thus, contaminant levels in piscivorous odontocetes have been reported to be one to two orders of magnitude higher compared to planktivorous mysticetes (Borell, 1993, O'Shea and Brownell 1994, O'Hara and Rice 1996, O'Hara *et al.* 1999).

Oil and Gas Activities

While oil and gas is produced within state waters in the Gulf of Mexico, oil and gas production in offshore areas provide about 30 percent of the total crude oil and 13 percent of the total natural gas produced in the United States. Most of the oil and gas production is confined to the western and central portions of the Northern Gulf. Gulf Coast refiners represent about 43 percent of U.S. refining capacity, and are reliant on tanker shipments for a majority of their crude supply, and both tanker and barge shipments for moving significant volumes of petroleum products (U.S. EIA 2010). Oil and gas operations within the Action Area include a number of activities: seismic exploration, drilling and rig removals, vessel traffic and the risk of oil spills.

Oil and gas activities have been increasing in the Gulf of Mexico sparking an increase in deepwater rig activity to supplement decreasing production in other U.S. oil and gas fields (see Table 5). Oil and gas activities already occur in areas inhabited by nesting and foraging sea turtles, however, as oil and gas activities move further offshore into deeper waters, there is an increasing opportunity for overlap between these activities and sperm whales.

Table 5: Oil and Gas Statistics by Water Depth as of September 13, 2010.

Water Depth in Meters	Active Leases	Approved Applications to Drill	Active Platforms
0 to 200	2,225	33,673	3,342
201 to 400	145	1,104	21
401 to 800	337	834	10
801 to 1000	419	506	7
1000 and Above	3,489	1,635	26

(Source: Bureau of Ocean Energy Management, Regulation and Enforcement 2010)

Between 1993 and 2007, Federal offshore oil and gas companies throughout the U.S. produced 7.49 billion barrels of oil (crude oil and condensate) and spilled about 47,800 barrels (crude & refined petroleum spills of 1 barrel or greater) (about 1 barrel of petroleum spilled for every 156,000 barrels produced, MMS 2009, p 84). Recent numbers of barrels of oil spilled within the Action Area will surpass the 1993 to 2007 nation-wide numbers due to the more recent accidental spills.

Substantial damage to offshore oil platforms in the Gulf occurred as a result of hurricanes Katrina and Rita in August and September of 2005. No major oil spills from offshore platforms were reported

although minor sheening was reported (Llanos 2005; MMS 2006). Damaged onshore storage tanks spilled around eight million gallons along the lower Mississippi River and surrounding wetlands (Davis and Farrell 2006); it would not be unreasonable to assume that some of this oil could have been transported into the Gulf of Mexico. While considered relatively rare events, oil spills when they occur can result in acute effects of short duration and limited impact, or they may have long-term population- or ecosystem-level impacts depending on the timing and duration of the spill and the numbers and types of organisms affected (NRC 2003).

On April 20, 2010, an explosion and fire occurred on the offshore drilling rig Deepwater Horizon, which had been drilling an exploratory well in approximately 5,000 feet of water in the Mississippi Canyon Block 252 about 50 miles (80.5 km) off the Louisiana coast. Before the well was capped on July 15, 2010, scientific teams estimate that approximately 5 million barrels of oil is estimated to have leaked from the oil well (Deepwater Horizon Joint Incident Command Center 2010a) with about 804, 877 barrels of oil and 1,774.5 mmcf of gas recovered from the well. Oil spill response activities continue to occur in the Northern Gulf of Mexico. As of August 10, 2010, the Deepwater Horizon Joint Incident Command Center (2010b) reported:

- approximately 3,600 vessels are currently responding on site, including skimmers, tugs, barges, and recovery vessels to assist in containment and cleanup efforts—in addition to dozens of aircraft, remotely operated vehicles, and multiple mobile offshore drilling units;
- more than 34.7 million gallons of an oil-water mix have been recovered;
- approximately 1,84 million gallons of total dispersant have been applied (1.07 million on the surface and 771,000 sub-sea);
- on August 10, 2010, approximately 115 miles of Gulf Coast shoreline is currently experiencing moderate to heavy oil impact (about 104 miles in Louisiana, 9 miles in Mississippi and 2 miles in Florida. Another 244 miles in Louisiana, 90 miles in Mississippi, 63 miles in Alabama and 115 miles in Florida are experiencing light to trace oil impacts. These numbers do not take into account the total miles of shoreline impacted to date; and
- approximately 39, 885 square miles of Federal waters within the Gulf of Mexico remain closed to fishing due to the possibility of contamination representing about 17 percent of Federal waters.

In addition NOAA (2010) reports a number of small cetaceans and sea turtles have been oiled and have succumbed to floating oil in the Action Area (Table 6). One dead, floating sperm whale was also observed, but the carcass could not be recovered.

Table 6: Total Animals Known Affected by Deepwater Horizon Oil Spill as of September 11, 2010.

	Live			Dead			Data Totals	Total animals collected	Total Animals in Rehab	Total Animals died while in Rehab	Total Animals Released
	Visibly Oiled	Not Visibly Oiled	Pending	Visibly Oiled	Not Visibly Oiled	Pending					
Dolphins	2	7	0	4	78	4	95	95	2	4	3
Whales	0	0	0	0	0	1	1	0	0	0	0
Turtles	454	72	0	17	122	438	1102	1102	37	10	26

Totals	456	79	0	21	200	443	1198	1197	39	14	29

In addition to the rescue of live turtles and collection of dead turtles, a number of sea turtle nests and hatchlings from the northern Gulf of Mexico have been relocated to Florida (271 loggerhead, 4 kemp's ridley, and 3 green sea turtle nests and 14,235 loggerhead, 125 kemp's ridley and 316 green sea turtle hatchlings) (NOAA 2010).

Crude oil is a complex mixture of organic compounds, including PAHs. PAHs can bioaccumulate in the food chain depending on the metabolic rate of the organism. In many oil spills, evaporation is the most important process in terms of amount of oil remaining in the water column over time. Oxygen concentrations, nutrients, water temperature, salinity, the physical properties of the oil and the energy level of the environment all play a role in biodegradation rates of oil in water (NRC 2003, 2005). A light crude oil such as that spilled from the Deepwater Horizon well can lose up to 75 percent of its initial volume within a few days.

Sperm whales and sea turtles in the action area expend the vast majority of their time underwater but they require contact with the sea surface to breath. At the surface these animals could experience inhalation of toxic fumes from floating oil leading to brain lesions, stress, and disorientation. Transfer of hydrocarbons through the food chain is initiated by single-cell organisms, such as phytoplankton, which are exposed to hydrocarbons primarily through attachment to organic-rich particles, including plankton and detritus and which are ingested by higher trophic levels (i.e., filter feeders, fish, and mammals). The extent of hydrocarbon levels within an organism is controlled by the breakdown rate of the hydrocarbons in the organism after ingestion (NRC 2003).

The effects of exposure to oil spills on sperm whales and sea turtles in the action area remain unknown, however, we assume that effects described for these species elsewhere would apply within the Gulf of Mexico as well. Geraci (1990) found no conclusive evidence that oil contamination has led to sperm whale mortality, and no adverse effects recorded with any certainty. Some observations indicate possible modification of swimming speed and direction or reduced surface time in oiled waters, but no obvious ill effects were noted (Geraci 1990). For sea turtles, oil spills and the presence of tar in the water can have serious effects on individuals, as sea turtles of all life stages are highly sensitive to chemical contaminations such as oil (NRC 2003a, NOS 2003). Oil on the skin and shell of a marine turtle can affect respiration, salt gland functions, digestive and immune systems, and blood chemistry (NRC 2003, NOS 2003). Oil exposure can increase egg mortality and lead to developmental defects, as well as cause direct mortality in hatchlings, juveniles, and adults (NRC 2003a, NOS 2003). The ingestion of tar pellets is also a concern for these species. Although major oil spills are relatively rare events, chronic exposure to low levels of oil may impair a turtle's overall level of fitness and reduce its ability to withstand other stresses in the environment (NRC 2003a, NOS 2003). However, the level of sea turtle exposure to, and thus the effects of, oil spilled in the action area remain largely unknown. Given the numbers of animals affected by the oil spill and that oil was still flowing from the well during the sea turtle nesting season we can only assume that the numbers in Table 6 above are underestimates of the true numbers affected. Natural and other anthropogenic phenomena can hinder recovery of species injured by oil spills (NOS

2003a) although our ability to distinguish effects from oil spills versus other factors are difficult and lessens over time.

Dispersants were used on the water's surface as well as at depth during the spill and in limited quantities after the well was capped (200 gallons). Dispersants are comprised of three main components: surfactants, solvents and additives and are used to disperse oil on the water's surface into smaller droplets that then sink into the water column (Lindgren *et al* 2001). Dispersants are applied to decrease exposure levels of contaminated surface waters to marine life and shorelines but as a consequence can increase the exposure of intertidal and benthic communities to the oil/dispersant mixtures. As some dispersants can degrade into estrogenic compounds, the potential for endocrine disruption in fish are also a concern (Jobling *et al*. as cited in: EPA 2010c).

Amid concerns regarding toxicity and endocrine effects of dispersants, EPA conducted a series of tests to determine the toxicity of individual dispersants, whether less toxic alternative dispersants were available for use and whether endocrine disruption was possible from dispersant use (EPA 2010b, 2010c, 2010d). Test organisms were endemic to the Gulf of Mexico—mysid shrimp (*Americamysis bahia*) and the inland silverside, (*Menidia beryllina*) a small estuarine fish. The tests were conducted on mixtures of Louisiana Sweet Crude Oil and eight dispersant products approved for use by EPA including Corexit 9500A which was used for the Deepwater Horizon spill.

These results confirm that the dispersant used in response to the oil spill in the Gulf, Corexit 9500A, is not distinguishable from other dispersants tested based on the acute toxicity tests for the test species (EPA 2010b,d). For both the shrimp and the fish species tested all of the dispersants alone were less toxic than the dispersant/oil mixture. These findings agree with information collected by Fingas (2008) from literature reviews of oil spill dispersants. Oil alone was found to be more toxic to mysid shrimp than the eight dispersants when tested alone. Oil alone and the dispersant/oil mixture both had similar toxicity to mysid shrimp in all but one alternative dispersant tested. None of the tests for endocrine disruption indicated that dispersants displayed biologically significant endocrine disrupting activity via the pathways tested. EPA (2010c) reports, however, that there were other routes through which chemicals can cause endocrine disruption, as well as other types of toxicity that were not tested. Tests were not conducted for marine mammals and sea turtles and the effects of the dispersant used are unknown.

In addition to the above mentioned tests, surface water samples collected on August 31, and September 1-2, 2010, along the Gulf coast did not reveal elevated levels of chemicals usually found in oil or dispersant chemical levels above EPA reporting limits. Sediment samples collected along the Gulf coast on August 25 and 30, and September 1-2, 2010, did not reveal elevated levels of chemicals usually found in oil and sediment samples collected along the Gulf coast on August 30, 2010, did not detect levels of dispersant chemicals above the EPA reporting limit. This information suggests that dispersant use can decrease environmental impact to shorelines and organisms within the water column, however, the long term effects on aquatic life and their ecosystems are largely unknown, particularly as oil/dispersants continue to oil Gulf coast shorelines. Reports of underwater plumes of oil/dispersant mixes suggest that other areas of the Gulf could be affected as oil droplets within the plumes continue to disperse and settle into the sediment.

Anthropogenic Noise

The marine mammals that occur in the action area are regularly exposed to several sources of natural and anthropogenic sounds. Anthropogenic noises that could affect ambient noise arise from the following general types of activities in and near the sea, any combination of which can contribute to the total noise at any one place and time. These noises include transportation, dredging, construction; oil, gas, and mineral exploration in offshore areas; geophysical (seismic) surveys; sonars; explosions; and ocean research activities (Richardson *et al.* 1995).

Noise in the marine environment has received a lot of attention in recent years and is likely to continue to receive attention in the foreseeable future. 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 1994, 1996, 2000, 2003b, 2005; Richardson *et al.* 1995). Much of this increase is due to increased shipping as ships become more numerous and of larger tonnage (NRC 2003b). Commercial fishing vessels, cruise ships, transport boats, airplanes, helicopters and recreational boats all contribute to sound into the ocean (NRC 2003). The military uses sound to test the construction of new vessels as well as for naval operations. In some areas where oil and gas production takes place, noise originates from the drilling and production platforms, tankers, vessel and aircraft support, seismic surveys, and the explosive removal of platforms (NRC 2003b). As of September 13, 2010, approximately 3,600 vessels, including skimmers, tugs, barges, and recovery vessels as well as aircraft are currently assisting in containment and cleanup efforts from the Deepwater Horizon spill. Many researchers have described behavioral responses of marine mammals to the sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, geological explorations, etc. (Richardson *et al.* 1995). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated short-term effects of disturbance on humpback whale behavior (Baker *et al.* 1983, Bauer and Herman 1986, Hall 1982, Krieger and Wing 1984), but the long-term effects, if any, are unclear or not detectable. Carretta *et al.* (2001) and Jasny *et al.* (2005) identified the increasing levels of anthropogenic noise as a habitat concern for whales and other cetaceans because of its potential effect on their ability to communicate.

Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (Simmonds and Hutchinson 1996). The Navy estimated that the 60,000 vessels of the world's merchant fleet annually emit low frequency sound into the world's oceans for the equivalent of 21.9 million days, assuming that 80 percent of the merchant ships are at sea at any one time (U.S. Navy 2001). The radiated noise spectrum of merchant ships ranges from 20 to 500 Hz and peaks at approximately 60 Hz. Ross (1976) has estimated that between 1950 and 1975 shipping had caused a rise in ambient ocean noise levels of 10 dB. He predicted that this would increase by another 5 dB by the beginning of the 21st century. NRC (1997) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade since the advent of propeller-driven ships.

Michel *et al.* (2001) suggested an association between long-term exposure to low frequency sounds from shipping and an increased incidence of marine mammal mortalities caused by collisions with shipping. At lower frequencies, the dominant source of this noise is the cumulative effect of ships that are too far away to be heard individually, but because of their great number, contribute substantially to the average noise background.

U.S. Navy Training Activities

The U.S. Navy has conducted and continues to conduct a variety of activities within the Action area. These activities include air-to-air, air-to-surface, and surface-to-surface and subsurface fleet-training and air force exercises as well as RTD&E activities. COMPTUEX and JTFEX are major range events that involve multiple ships, submarines and/or aircraft within the Action Area. Section 7 consultations have been completed for military exercises in the Gulf of Mexico, with activities and effects on species overlapping with the action area for this consultation as discussed below.

U.S. Air Force operations in the Eglin Gulf Test Range in the eastern Gulf of Mexico may also kill or injure sea turtles. The biological opinion on this range (dated October 20, 2004) anticipated air-to-surface gunnery testing may kill an estimated maximum of three loggerheads, one leatherback, one green, and one Kemp's ridley annually. Precision-strike weapons would also be tested in the Gulf and the March 14, 2005, biological opinion on these activities estimated lethal or non-lethal "takes" of one leatherback, ten loggerhead, one Kemp's ridley, and three green sea turtles over five years during these events. The Naval Explosive Ordnance Disposal School biological opinion (dated October 25, 2004) estimated activities in the Gulf to "take" (either lethally or non-lethally) one Kemp's ridley, four loggerheads, and one green turtle over a five-year period.

Two U.S. Navy military readiness and RDT&E activities have recently undergone section 7 consultation and include in-water RDT&E activities at Naval Surface Warfare Center - Panama City (Florida) and continued conduct of active sonar training (Atlantic Fleet Active Sonar Training) within OPAREAs along the U.S. Atlantic seaboard and in the Gulf of Mexico.

NMFS issued a programmatic biological opinion on September 15, 2009, for U.S. Navy activities and MMPA regulations governing the incidental take of those Navy activities over a 5-year period for RDT&E activities at Naval Surface Warfare Center - Panama. This Opinion concluded that activities at the Naval Surface Warfare Center - Panama were likely to adversely affect listed sperm whales as well as green, hawksbill, Kemp's ridley, leatherback and loggerhead sea turtles, but were not likely to jeopardize the continued existence of any of those species. The programmatic opinion did not exempt take of any listed species.

NMFS issued another biological opinion on January 14, 2010, for the issuance of MMPA Letters of Authorization for RDT&E activities at Naval Surface Warfare Center - Panama for 2010-2011 activities and concluded that the Navy's activities were likely to adversely affect listed sperm whales as well as green, hawksbill, Kemp's ridley, leatherback and loggerhead sea turtles, but were not likely to jeopardize the continued existence of any of those species. The Opinion estimated that 2 sperm whales, two leatherback sea turtles, two loggerhead sea turtles and 3 hardshell sea turtles of any species of green, hawksbill, Kemp's ridley or loggerhead sea turtle would experience behavioral changes that would qualify as "harassment" as a result of exposure to air operations, surface operations, subsurface operations, sonar operations, electromagnetic operations, laser operations, ordnance operations, and projectile firing over a 1-year period.

On January 16, 2008, NMFS issued a programmatic biological opinion for U.S. Navy activities and MMPA regulations governing the incidental take of those Navy activities over a 5-year period and two

biological opinions for the issuance of MMPA Letters of Authorization for the Navy's active sonar training activities along the U.S. Atlantic Coast and in the Gulf of Mexico for 2009-2010 (dated January 21, 2009) and 2010-2011 (dated January 21, 2010). All of these Opinions concluded that the Navy's yearly activities were not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat.

The programmatic Opinion did not exempt any take of listed species. The 2009 biological opinion estimated the number of instances in which whales may be exposed to U.S. Navy active sonar training activities along the Atlantic coast and Gulf of Mexico:

880 instances for blue whales, 970 instances for fin whales, 4,620 instances for humpback whales 730 instances for north Atlantic right whales, 1,163 instances for sei whales and 10,734 instances for sperm whales. The whales are expected to change their behavioral patterns in response to the Navy's activities. The 2010 biological opinion also estimated the number of instances that whales may be exposed to U.S. Navy active sonar training: 881 instances for blue whales, 970 instances for fin whales, 4,622 instances for humpback whales, 733 instances for North Atlantic right whales, 1,163 instances for sei whales and 10,734 instances for sperm whales. These whales would also change their behavioral patterns in response to the Navy's activities. Neither Opinion anticipated the take of sea turtles.

Current GOMEX training activities include the same activities discussed in the *Proposed Actions* section of this Opinion with the addition of underwater detonations in GOMEX Range operations associated with mine neutralization exercises and mission area training. The U.S. Navy current operations include detonation of 5, 10, 20 and 60 lb charges per year during mine neutralization in Gulf of Mexico waters. Within Gulf of Mexico waters the U.S. Navy also uses:

- a variety of explosive ordnance resulting in 169 explosions in the water per year from various size bombs (500 and 1,000 lb high explosive), charges (5, 10, 20 and 60 net explosive weight) and grenades;
- approximately 85 targets per year during bombing air-to surface and gunnery surface-to-surface ship exercises within Gulf waters;
- approximately 3,680 chaff cartridges per year;
- approximately 1,840 flares per year.

Air Intercept Control and mission area sorties/events over Gulf of Mexico waters currently number 368 and 40 respectively.

<u>Deep Water Ambient Noise</u>

Urick (1983) provided a discussion of the ambient noise spectrum expected in the deep ocean. Shipping, seismic activity, and weather are primary causes of deep-water ambient noise. Noise levels between 20 and 500 Hz appear to be dominated by distant shipping noise that usually exceeds wind-related noise. Above 300 Hz, the level of wind-related noise might exceed shipping noise. Wind, wave, and precipitation noise originating close to the point of measurement dominate frequencies from 500 to 50,000 Hz. The frequency spectrum and level of ambient noise can be predicted fairly accurately for most deep-water areas based primarily on known shipping traffic density and wind state (wind speed,

Beaufort wind force, or sea state) (Urick 1983). For frequencies between 100 and 500 Hz, Urick (1983) has estimated the average deep water ambient noise spectra to be 73 to 80 dB for areas of heavy shipping traffic and high sea states, and 46 to 58 dB for light shipping and calm seas.

Shallow Water Ambient Noise

In contrast to deep water, ambient noise levels in shallow waters (i.e., coastal areas, bays, harbors, etc.) are subject to wide variations in level and frequency depending on time and location. The primary sources of noise include distant shipping and industrial activities, wind and waves, and marine animals (Urick 1983). At any given time and place, the ambient noise level is a mixture of these noise types. In addition, sound propagation is also affected by the variable shallow water conditions, including the depth, bottom slope, and type of bottom. Where the bottom is reflective, the sound levels tend to be higher than when the bottom is absorptive.

Entrapment and Entanglement in Commercial Fishing Gear

Several commercial fisheries operate in the Action Area for this consultation. The fisheries that have the most significant demographic effect on sea turtles are the shrimp trawl fisheries that occur in the Gulf of Mexico (from the Gulf coast of Florida to Texas). Although participants in these fisheries are required to use Turtle Exclusion Devices, which are estimated to reduce the number of sea turtles trawlers capture by as much as 97 percent, each year these fisheries are expected to capture about 185,000 sea turtles each year and kill about 5,000 of the turtles captured. Loggerhead sea turtles account for most of this total: each of these fisheries are expected to capture about 163,000 loggerhead sea turtles, killing almost 4,000 of them. These are followed by green sea turtles: about 18,700 green sea turtles are expected to be captured each year with more than 500 of them dying as a result of their capture (NMFS 2002).

Portions of the Atlantic pelagic fisheries for swordfish, tuna, shark, and billfish also operate in the Action Area and capture and kill the second highest numbers of sea turtles along the Atlantic coast. These fisheries, which operate in the Gulf of Mexico (as well as off the coasts of South Carolina and Georgia; waters off Florida and southernmost Georgia are closed to the longline component of these fisheries), include purse seine fisheries for tuna, harpoon fisheries for tuna and swordfish, commercial and recreational rod and reel fisheries, gillnet fisheries for shark, driftnet fisheries, pelagic longline fisheries, and bottom longline fisheries.

Between 1986 and 1995, this fishery captured and killed 1 north Atlantic right whale, 2 humpback whales, and two sperm whales. Between 1992 and 1998, the longline components of these fisheries are estimated to have captured more than 10,000 sea turtles (4,585 leatherback sea turtles and 5,280 loggerhead sea turtles), killing 168 of these sea turtles in the process (the latter estimate does not include sea turtles that might have died after being released; Johnson *et al*. 1999, Yeung 1999). Since then, all components of these fisheries are estimated to capture about 1,350 sea turtles each year, killing 345 sea turtles in the process.

In addition, sea turtles are captured and killed in several other Federal fisheries that operate along the Atlantic coast and Gulf of Mexico (see Table 3), although most of these fisheries capture and kill fewer sea turtles than the fisheries discussed in the preceding narratives. Of all the factors that influenced

NMFS' decision to list sea turtles as threatened or endangered, the most significant sources of injury or mortality of juvenile, subadult, and adult sea turtles are those associated with commercial fishing.

The fisheries discussed in this section are expected to continue into the foreseeable future at levels of effort that are roughly equivalent to current levels. As a result, we expect the number of sea turtles that are captured and killed in these fisheries to continue for the foreseeable future. These estimates mean that, every five years, more than 800,000 loggerhead sea turtles would be captured in these fisheries, with more than 23,000 of them dying as a result; about 19,000 leatherback sea turtles would be captured, with about 1,500 of them dying as a result; about 95,000 green sea turtles would be captured, with about 2,900 of them dying; and about 3,200 hawksbill sea turtles would be captured and die.

Ecotourism

In the Gulf of Mexico, ecotourism activities such as whale watching do not appear to affect listed species within the action area. Tours to see nearshore non-listed marine mammal species, such as dolphins have occurred for several years and exhibit increasing trends (Würsig *et al.* 2000). Sperm whales, however, occur further offshore and would require larger vessels to transport people to view them (Würsig *et al.* 2000). Ecotourism related to sea turtles is not known to occur within the action area.

Conservation and Management Efforts

A number of conservation and management efforts have a positive effect on listed species in the action area. Recovery plans under the ESA help guide the protection and conservation of listed species, and final plans are in place for green, hawksbill, Kemp's ridley, loggerhead, and leatherback sea turtles; additionally, a draft recovery plan exists for the sperm whale. NMFS implements conservation and management activities for these species through its Regional offices and Science Centers in cooperation with states, conservation groups, the public, and other federal agencies. For example, an ESA section 6 agreement with the state of Florida has facilitated funding for the Florida Fish and Wildlife Conservation Commission in support of its research, management, and outreach related to sea turtles; this includes activities within the action area.

There has also been recent extensive work on the movements and habitat use of sperm whales in the northern Gulf of Mexico, such as the studies conducted by the Sperm Whale Acoustic Monitoring Program (SWAMP) and the Sperm Whale Seismic Study (SWSS). These studies include habitat cruises, physical oceanographic analyses, and long term satellite tag deployments. Several satellite tags have operated for over 12 months and indicate movements generally along the shelf break (700-1,000 m depth) throughout the Gulf, with some animals (more frequently males) using deeper oceanic waters (Jochens and Biggs 2004; Jochens *et al.* 2006, 2008). Some data from satellite tag deployments also report large-scale movements of individual sperm whales out of the Gulf of Mexico (Jochens *et al.* 2008). The ongoing studies continue to provide detailed information on the habitat preferences and population structure of Gulf of Mexico sperm whales.

Integration of Environmental Baseline

Although listed resources are exposed to a wide variety of past and present state, Federal or private actions and other human activities that have already occurred or continue to occur in the action area as

well as Federal projects in the action area that have already undergone formal or early section 7 consultation, and State or private actions that are contemporaneous with this consultation, the impact of those activities on the status, trend, or the demographic processes of threatened and endangered species remains largely unknown.

Several of the activities described in this *Environmental Baseline* have had significant and adverse consequences for nesting aggregations of sea turtles whose individuals occur in the Action Area. In particular, the commercial fisheries that have been described have captured substantial numbers of green, hawksbill, leatherback, and loggerhead sea turtles each year.

Although only small percentages of these sea turtles are estimated to have died as a result of their capture, the actual number of sea turtles that are estimated to have died in these fisheries each year for the past 5 to 10 years (or longer) still amounts to about 6,000 sea turtles each year. When we add the percentage of sea turtles that have suffered injuries or handling stress sufficient to have caused them to delay the age at which they reach maturity or the frequency at which they return to nesting beaches, the consequences of these fisheries on nesting aggregations of sea turtles would be greater than we have estimated.

These fisheries are expected to continue into the foreseeable future at levels of effort that are roughly equivalent to current levels. As a result, we expect the number of sea turtles that are captured and killed in these fisheries to continue for the foreseeable future. These estimates mean that, every five years, more than 800,000 loggerhead sea turtles would be captured in these fisheries, with more than 23,000 of them dying as a result of that capture; about 19,000 leatherback sea turtles would be captured, with about 1,500 of them dying; about 95,000 green sea turtles would be captured, with about 2,900 of them dying; and about 3,200 hawksbill sea turtles being captured and killed. Given that we are certain that nest counts of species like loggerhead sea turtles have been declining and are currently declining, these additional mortalities seem likely to increase the rate at which nesting aggregations of this species are declining. Even if these mortalities did not increase the rate at which these nesting aggregations are declining, merely continuing the rate at which they are currently declining would be sufficient to increase the probability of nest counts in these nesting aggregations to decline to zero. Because we know that populations of sea turtles cannot increase over time if the number of nest counts decline, the mortalities associated with these fisheries are likely to increase probability of these populations of sea turtles becoming extinct in the wild.

Historically, commercial whaling had occurred in the action area and had caused all of the large whales to decline to the point where the whales faced risks of extinction that were high enough to list them as endangered species. Since the end of commercial whaling, the primary threat to these species has been eliminated. However, all of the whale species have not recovered from those historic declines and scientists cannot determine if those initial declines continue to influence current populations of most large whale species. The relationship between the historic declines and stressors in the marine environment that may keep sperm whales populations depressed are unknown. Relationships between potential stressors in the marine environments and the responses of these species that may keep their populations depressed are unknown.

Recent attention has focused on the emergence of a wide number of anthropogenic sound sources in the action area and their role as a pollutant in the marine environment. Relationships between specific sound

sources, or anthropogenic sound generally, and the responses of marine mammals to those sources are still subject to extensive scientific research and public inquiry but no clear patterns have emerged. As a result, the potential consequences of these activities on threatened and endangered marine mammals remain uncertain.

Listed resources, when exposed to individual stressors or a combination of stressors that are associated with a specific action may suffer insignificant or minor consequences when considered in isolation, but may suffer significant adverse consequences when stressors are added to other stressors, operate synergistically in combination with other stressors, or magnify or multiply the effects of other stressors.

The effects of everyday events, natural and anthropogenic stressors on an individual's ability to survive and reproduce will depend on the individual's condition when exposed to these challenges. Disease, nutritional stress, body burdens of toxic chemicals, age and reproductive state, etc., can "accumulate" to have substantial consequences for an organism exposed to a stressor. That is, exposing animals to individual stressors associated with a specific action given the animal's prior condition (reproductive condition, their state of health, and their prior experience) can have additive, synergistic, magnifying, and multiplicative effect and produce significant, adverse consequences that would not occur if the animal's prior condition had been different.

To date, about 1,200 sea turtles and dolphins have been collected/rescued as a result of the Deepwater Horizon oil spill. Still, thousands of hatchlings have been relocated to Florida waters to insure they do not encounter oil. One dead sperm whale was observed but the cause of death could not be determined. Although reports from EPA indicate that shorelines and sediment levels of oil and dispersant are within acceptable limits, it is unclear whether subsurface oil/dispersant plumes remain in the Gulf. The long-term additive, synergistic, magnifying, or multiplicative effect of spilled oil and dispersants and other natural and anthropogenic stressors within the Action Area remain to be determined.

Effects of the Proposed Actions

Pursuant to Section 7(a)(2) of the ESA, federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. In this section of the Opinion, we describe the probable direct and indirect effects of the proposed action and any interrelated and interdependent actions on threatened and endangered species and designated critical habitat. As critical habitat will not be adversely affected by the proposed actions, only an assessment for listed species will be presented.

The purpose of the following assessment is to determine if it is reasonable to expect the proposed activities occurring over a five-year duration to have effects on listed species that could appreciably reduce their likelihood of surviving and recovering in the wild. We complete this assessment as described in the Approach to the Assessment section, by identifying the probable stressors associated with the direct and indirect effects of the proposed actions and any interrelated or interdependent actions, then using our exposure – response – risk assessment framework. Once we determine the probability of individuals of listed species being exposed to the identified stressors (our exposure analysis), we then determine the probable responses of those individuals given probable exposures (our response analysis). Our exposure

and response analyses are then combined with the Status of the Species and Environmental Baseline sections of this Opinion (our Integration and Synthesis of Effects section) to estimate the probable risks the proposed actions pose to endangered and threatened species (our risk analysis).

For this consultation, we are particularly concerned about behavioral disruptions and physical damage to individual animals that may stem from the proposed actions and that may result in animals that fail to feed or breed successfully or fail to complete their life history. These types of responses are likely to have population-level consequences. The proposed actions would authorize non-lethal "takes" by harassment of listed species during U.S. Navy training and RDT&E activities. The ESA does not define harassment nor has NMFS defined the term pursuant to the ESA through regulation. However, the Marine Mammal Protection Act of 1972, as amended, defines harassment as any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [16 U.S.C. 1362(18)(A)]. For military readiness activities, this definition of "harassment" has been amended to mean "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behaviors are abandoned or significantly altered..." (Public Law 108-136, 2004). The latter portion of this definition (that is, "...causing disruption of behavioral patterns including...migration, breathing, nursing, breeding, feeding, or sheltering") is almost identical to the U.S. Fish and Wildlife Service's regulatory definition of "harass"[10] pursuant to the ESA: For this Biological and Conference Opinion, we define harassment similarly: an intentional or unintentional human act or omission that creates the probability of injury to an individual animal by disrupting one or more behavioral patterns that are essential to the animal's life history or its contribution to its population.

U.S. Navy Activities Not Considered Further in these Opinions

As discussed in the *Approach to this Assessment* section of this Opinion, direct or indirect exposure to a stressor is required to cause an effect to endangered and threatened individuals. If endangered or threatened individuals are not likely to be exposed to a potential stressor, then we would conclude that the "potential stressor" is not likely to be an actual stressor and we would drop it from further discussion. As discussed in the *Description of the Proposed Actions* section of this Opinion, U.S. Navy's training exercises and RDT&E activities occur over land, water and the air space above land and water within the Range Complex. Activities that are not likely to expose listed species to the stressors associated with those activities are listed here.

BOMBEX Air-to-Ground activities consist of fixed-wing aircraft dropping unguided non-explosive practice munitions (bombs and rockets) on land targets to destroy enemy vehicles, infrastructure and personnel. This training exercise is conducted within the SEARAY Target Range and the Dixie and Yankee Target Ranges (see Figure 1 for locations of exercises).

[10] An intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3)

GUNEX air- to-ground activities consists of strike fighter aircraft and helicopter crews including Naval Special Warfare personnel attacking ground targets with 20 mm cannons to destroy or disable enemy vehicles, structures or personnel. This exercise occurs at the Yankee Target Range within the McMullen Range Complex (see Figure 1 for locations of exercises).

Basic flight instruction that occurs over inland areas R-4404, Meridian, Pine Hill, Pensacola and Kingsville MOAs and R-6312 and flight maneuver training that occurs within the Brownwood MOAs are used to train entry-level students in the fundamentals of flying so that pilots are prepared for exercises under the primary warfare areas. Training includes air combat maneuvers, air intercept control, aerial refueling, student pilot training and reconnaissance (see Figure 1 for locations of exercises).

These exercises are conducted inland and are not likely to directly or indirectly produce stressors that would reach the coastal or marine areas where endangered or threatened species under NMFS' jurisdiction might be exposed to those stressors. Listed species are not likely to be exposed to any stressors associated with these activities, and as a result these activities will not be considered further in these Opinions.

Training at the Demolition Pond consists of salvage diver training, explosive ordnance disposal tech training, security force training and diver training all detonating underwater explosive charges less than 5 lbs each and provides personnel with experience in placing and detonating underwater explosives. The demolition pond is a semi-enclosed shallow body of water 0-3.4 m (0-11 feet deep), 86 m in diameter (282 ft) and located in a small bayou in the southern portion of St. Andrew Bay near Panama City, Florida. The Demolition Pond's opening to St. Andrew Bay is approximately 13.7 m wide at high tide and much smaller at low tide. The distance from the center of the Demolition Pond to St. Andrew Bay is roughly 53.3 m (174.9 feet).

In shallow water sound wave propagation is much more influenced by surface and subsurface boundaries. Energy from detonations at the surface will dissipate through surface blowout and detonations closer to the bottom may have considerable energy absorbed by the seafloor. As pressure waves propagate laterally through the very shallow water column, the waves reflect off surface and bottom boundaries more often than they would over the same distance in deeper waters and thus, very shallow water boundaries exert their influence relatively more frequently over that distance. In the case of the Demolition Pond, pressure waves would also reflect off the shoreline, which encloses most of this training. Because of the physical features of the Demolition Pond we expect sound from underwater detonations in the Demolition Pond would be contained within the pond and not propagate outside into St. Andrew Bay.

Commonly used materials include detonation 3 chords, timers, fuses, blasting caps, marine markers, smoke flares, TNT, and C-4. Residual amounts of TNT are rapidly broken down into other chemical compounds by sunlight while microorganisms in water and sediment break down TNT more slowly. C-4 is made up of explosives, plastic binder, plasticizer, and usually, a marker or chemicals. Used ordnance will be removed from the Pond immediately after training as feasible which will lessen the amount of expended ordnance and chemicals associated with explosives.

No listed species have been documented within the Demolition Pond. Sperm whales occur in more offshore waters of the Gulf of Mexico and do not occur in areas within or adjacent to the pond. There are also no known nesting sites within St. Andrew Bay, although low survey effort within the area may account for the absence of nesting reports. In any case the pressure waves and chemicals associated with explosives are expected to be contained within the pond.

Mitigation measures employed by the U.S. Navy include visual monitoring for marine mammals and sea turtles prior to and during the training exercises and detonation activities will be halted if these listed species are likely to enter the Pond. As a result, listed species are not likely to be exposed to any stressors associated with these activities, and as a result, these activities will not be considered further in this Opinion.

Potential Stressors Associated with the Proposed Actions

We identified several potential stressors associated with the activities the U.S. Navy proposes to conduct in waters within and adjacent to the GOMEX Range Complex. Based on a review of available information, we then determined which of these possible stressors would likely occur and which would be negligible. As stated earlier the U.S. Navy has been conducting these same types of activities in the Action Area for the last 70 years. We expect that the stressors associated with these activities are currently active in the Action Area and that they will continue to be active over the next five years—the duration of the proposed actions.

The potential stressors associated with the activities the U.S. Navy proposes to conduct in waters within and adjacent to the GOMEX Range Complex are:

- Disturbance from surface vessel movements and the risk of vessel collisions from transiting and other vessels involved in training exercises;
- Disturbance from aircraft overflights during training exercises;
- pressure waves and sound fields associated with underwater explosions during training exercises;
- Military expended materials (chemical components of used ordnance, targets, chaff, flares and marine markers); and
- Military expended materials (ingestion risk of used ordnance and targets associated with training exercises to endangered and threatened species).

The following sections more fully describe these stressors and the probability of listed species being exposed to these stressors. Once we identify the probable stressors we describe the probable responses of listed species, given exposure, based on the best scientific and commercial information available.

Surface Vessels

Vessel movements within the GOMEX Range Complex include those related to transits to and from port destined for specific areas designated for training (e.g., HSGMGA, UNDET E3, Hotbox OPAREAs), vessel maneuvers during training and RDT&E and transit within and between those areas within the Range Complex during other types of activities such as storm evasion, deployment transits, and to rearrange for repairs/berthing/loading/off-loading from designated piers. The U.S. Navy proposes to

continue to conduct about 180 total vessel days[11] within the Action Area per year over the 5-year duration of the proposed action. Vessel movements unrelated to training activities — for example, for storm evasion, deployment transits, and movements in basins to rearrange ships for repairs, berthing, loading, and off-loading from designated piers — would increase these estimates. The number of Navy vessels operating in the GOMEX Range Complex varies based on training schedules and can range from 0 to about 10 vessels at any given time.

Vessel movements occur intermittently and are variable in duration, ranging from a few hours up to 2 weeks. Most vessel movements occur in the offshore OPAREAs, but vessel movements associated with MESG training in UNDET Area E3 and Commander Naval Installations Command (CNIC) harbor security group training (HSGMGA) in the Panama City OPAREA occur between shore and 12 nm, including the nearshore zone (<3 nm).

Vessel sizes range from small boats (<35 ft, 10.7 m) for a harbor security boat to 1,092 ft (332.8 m) for a nuclear aircraft carrier (CVN). The U.S. Navy also employs a variety of smaller craft, such as service vessels for routine operations and opposition forces used during training events. During training speeds generally range from 10 to 14 knots; however, ships/craft can and will, on occasion, operate within the entire spectrum of their specific operational capabilities during specific events, such as pursuing and overtaking hostile vessels and evasive maneuvers. The Naval Special Warfare rigid hull inflatable boat (RHIB) is 35 feet in length and has a speed of 40+ knots. Other small craft, such as those used in maritime security training events, are of similar length and speed to the RHIB and often resemble, and often are, recreational fishing boats (i.e., a 30 - 35 foot center console boat with twin outboard engines). Other surface vessels are used as targets during exercises such as GUNEX surface-to-surface ship where high speed maneuvering towed or remotely controlled targets include the QST-35 Seaborne Powered Target, High Speed Maneuverable Surface Target and remote controlled Jet Ski.

Disturbance from Surface Vessels

A number of studies indicate surface vessels represent sources of acute and chronic disturbance for marine mammals (Au and Green 1990, Au and Perryman 1982, Bain *et al.* 2006, Bauer 1986, Bejder 1999, 2006a, 2006b; Bryant *et al.* 1984, Corkeron 1995, Erbé 2000, Félix 2001, Goodwin and Cotton 2004, Hewitt 1985, Lemon *et al.* 2006, Lusseau 2003, 2006; Lusseau and Bejder 2007, Magalhães *et al.* 2002, Ng and Leung 2003, Nowacek *et al.* 2001, Richter *et al.* 2003, 2006; Scheidat *et al.* 2004, Simmonds 2005, Watkins 1986, Williams and Ashe 2007, Würsig *et al.* 1998). In some circumstances, marine mammals respond to vessels with the same suite of behaviors and tactics used when they encounter predators. It is not clear what environmental cue or cues marine animals might respond to: the sounds of waters being displaced by the ships, the sounds of the ships' engines, or a combination of environmental cues surface vessels produce while they transit.

These studies establish that free-ranging cetaceans 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 (Goodwin and Green 2004; Lusseau 2006). Several, authors, however, suggest that the noise generated by the

[11] Vessel movements within the GOMEX Range Complex is calculated as the number of steaming days per year by summing the number of steaming hours proposed, dividing by 24 hours/day and rounding to the nearest 10 days.

vessels is probably an important contributing factor to the responses of cetaceans to the vessels (Blane and Jackson 1994, Evans et al. 1992, 1994).

For surface vessels, the set of variables that help determine whether marine mammals are likely to be disturbed include: (1) the number of vessels in a marine mammal's perceptual field and the animal's assessment of the risks associated with those vessels; (2) the distance between vessel and marine mammals; (3) the vessel's speed and path; (4) the predictability of the vessel's path; (5) noise associated with the vessel and the rate at which the engine noise increases; and (7) the type of vessel. Because of the number of vessels involved in U.S. Navy training exercises, their speed, their use of course changes as a tactical measure, and associated sounds, the available evidence leads us to expect marine mammals to treat Navy vessels as potential stressors.

Sea turtles would be expected to detect approaching vessels via auditory and/or visual cues based on knowledge of their sensory biology (Bartol and Ketten 2006, Bartol and Musick 2003, Ketten and Bartol 2006, Lewenson et al. 2004). Little information is available on how turtles respond to vessel approaches. Hazel *et al* (2007) reported sea turtle reaction time was greatly dependent on the speed of the vessel; sea turtles were able to react faster to slower moving vessels than to faster moving vessels. Also, sea turtle reactions to vessels elicited short-term responses. Sea turtle hearing sensitivity is not well studied. Several studies using green, loggerhead, and Kemp's ridley turtles suggest that sea turtles are most sensitive to low-frequency sounds, although this sensitivity varies slightly by species and age class (Bartol *et al*. 1999, Ketten and Bartol 2006, Lenhardt 1994, Ridgway *et al*. 1969).

Probability of Collisions

Given the speeds at which some vessels move during training exercises, there is some risk of collisions between these vessels and marine mammals or sea turtles (although the risks of striking sea turtles is smaller than the risks of striking endangered marine mammals). The probability of a collision seems small given the number of steaming days (180) the U.S. Navy has historically conducted and proposes to continue to conduct. The Gulf of Mexico has the lowest reported incidences of marine mammal/vessel collisions of any other region of the U.S. (Jensen and Silber, 2003). However, between 1972 and 1999, eight confirmed or possible large whale ship strikes were recorded in the Gulf of Mexico, including two that collided with Navy vessels. Four of these collisions resulted in mortality of the animal (Jensen and Silber, 2003) and one resulted in extensive damage to a Navy vessel (Laist *et al.*, 2001). It is not known whether the ship strikes involving Navy vessels resulted in the mortality of the animal (Laist *et al.*, 2001; Jensen and Silber, 2003).

We do not have the information necessary to estimate the probability of collisions between marine mammals or sea turtles and U.S. Navy vessels, particularly the information involved in the calculation to estimate marine mammal and sea turtle encounter rates with U.S. Navy vessels. Ship collision records for the Gulf of Mexico report two whales struck by U.S. Navy vessels in the 27-year period between 1972 and 1999. The Navy's operational orders for ships that are underway are designed to prevent collisions between surface vessels participating in naval exercises and any endangered whales that might occur in the Action Area. These measures include marine observers on the bridge of ships, requirements for course and speed adjustments to maintain safe distances from whales, and having any ship that observes whales alert other ships in the area. Although there remains a possibility that a U.S. Navy vessel may

collide with a whale, the U.S. Navy's measures for avoiding collisions between surface vessels and whales, particularly since 1999, have been effective. Given this, we do not expect marine mammals and sea turtles to collide with U.S. Navy vessels during training and RDT&E activities within the GOMEX Range Complex. As a result, we do not consider this category of potential stressors further in our analyses.

Aircraft

U.S. Navy training requires the use of helicopters, maritime patrols and fighter jets. Approximately 5,318 fixed-wing aircraft sorties are proposed for flight over Gulf of Mexico waters per year over the 5-year duration of the proposed action. The U.S. Navy proposes to decrease the number of helicopter sorties flown over Gulf of Mexico waters from 38 per year to 18 per year for a total of 95 sorties over the 5-year duration of the proposed action.

Disturbance from Aircraft

Low-flying aircraft produce sounds that marine mammals can hear when they occur at or near the ocean's surface. Helicopters generally tend to produce sounds that can be heard at or below the ocean's surface more than fixed-wing aircraft of similar size and larger aircraft tend to be louder than smaller aircraft. 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 but represent acoustic stimuli (primarily low-frequency sounds from engines and rotors) that have been reported to affect the behavior of some marine mammals.

There are few studies of the responses of marine animals to air traffic and the few that are available have produced mixed results. Some investigators report some responses while others report no responses. Richardson *et al*. (1995) reported that there is no evidence that single or occasional aircraft flying above large whales and pinnipeds in-water cause long-term displacement of these mammals. Several authors have reported that sperm whales did not react to fixed-wing aircraft or helicopters in some circumstances (Au and Perryman 1982, Clarke 1956, Gambell 1968, Green et al. 1992) and reacted in others (Clarke 1956, Fritts *et al*. 1983, Mullin et al. 1991, Patenaude *et al*. 2006, Richter *et al*. 2003, 2006, Smultea *et al*. 2008, Würsig et al. 1998).

Based on sea turtle sensory biology (Ridgway et al., 1969; Lenhardt et al., 1994; Bartol, 1999; Bartol and Musick, 2003; Ketten and Bartol, 2006), sound from low flying aircraft could be heard by a sea turtle 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 sea 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.

Although we recognize sounds produced by aircraft as a potential stressor, we do not have sufficient information to estimate the probability of marine animals or sea turtles being exposed to aircraft noise associated with the training exercises and other activities the U.S. Navy plans to conduct in the GOMEX Range Complex.

Pressure Waves and Sound Fields Produced by Underwater Detonations

The U.S. Navy is proposing to continue detonation of underwater explosives although at reduced levels within the Action Area. Underwater explosions occur during only two training events. BOMBEX (air-to-surface) occurs in the BOMBEX Hotbox within the Pensacola OPAREA and GUNEX (surface-to-surface boat) occurs in UNDET Area E3 within the Corpus Christie OPAREA. Training using underwater detonations will last approximately 13 hours per year.

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the water column as well as produce a pressure wave. Three source parameters influence the effect of an explosive: the net effective weight of the explosive, the type of explosive material, and the detonation depth. The net explosive weight (the weight of only the explosive material in a given round, referenced to the explosive power of TNT) accounts for the first two parameters.

The U.S. Navy uses several thresholds and criteria to estimate the number of listed species that might be exposed to explosions from multiple high explosive ordnance detonations and single explosions from grenades. To be consistent the U.S. Navy used the thresholds and criteria established for single explosions for the Seawolf Submarine Shock Test and USS Winston S. Churchill Ship Shock to determine exposures for listed species from single explosions. The U.S. Navy then made additional assumptions to the single explosions thresholds and criteria to represent the multiple explosions and small arms training thresholds and criteria. In addition, the U.S. Navy revised the acoustic criterion for small underwater explosions (< 1500 net weight) from 12 pounds per square inch (psi) for peak pressure over all exposures to 23 psi to reflect an IHA issued to the Air Force (NOAA, 2006).

To calculate the number of endangered or threatened species that might be exposed to explosions associated with this ordnance we treat each in-water explosion as an independent event. The cumulative effect of a series of explosives can often be estimated by addition if the detonations are spaced widely in time and space which would provide marine animals sufficient time to move out of an area affected by an explosion. As a result, the populations of animals that are exposed to in-water explosions are assumed to consist of different animals each time.

Military Expended Materials

U.S. Navy training exercises in the GOMEX Range Complex include firing a variety of weapons and with a variety of non-explosive practice munitions including bombs, medium caliber cannon and small arms ammunition, targets, flares and marine markers.

Bombs

The U.S. Navy proposes to deploy 335 non-explosive bombs annually, 4 high explosive bombs annually, and up to 20 grenades annually. Non-explosive practice bombs are not equipped with explosive warheads. Practice bombs entering the water would consist of materials like concrete, steel, and iron, and would not contain the combustion chemicals found in the warheads of explosive bombs. These components are consistent with the primary building blocks of artificial reef structures. The steel and iron, although durable, would corrode over time, with no noticeable environmental impacts. The concrete is also durable and would offer a beneficial substrate for benthic organisms. After sinking to the bottom,

the bombs would be incorporated into the marine environment by natural encrustation and/or sedimentation (DoN, United States Fleet Forces, January 2009).

High explosive bombs would be fused to detonate on contact with the water. It is estimated that 99 percent of these bombs would explode within 5 feet of the ocean surface (DoN, 2005b). Anti-swimmer grenades detonate at a depth of no more than 3 m from the water's surface. Upon detonation anti-swimmer grenades will explode into small metallic pieces. Bomb bodies are steel and the bomb fins are either steel or aluminum. The steel may contain small percentages (typically less than 1%) of any of the following: carbon, manganese, phosphorus, sulfur, copper, nickel, chromium, molybdenum, vanadium, columbium, or titanium. The aluminum fins, in addition to the aluminum, may also contain: zinc, magnesium, copper, chromium, manganese, silicon, or titanium. Small and mostly metallic pieces of the bombs and grenades will quickly come to rest on the seafloor with each detonation. All these materials will slowly corrode over time.

Chemical products of underwater explosions are initially confined to a thin, circular area called "the surface pool". It is estimated that 100% of the solid explosion products and 10% of the gases remain in the pool (DoN, 2001 *in* DoN, United States Fleet Forces, January 2009). After the turbulence of the explosion has dispersed, the pool stabilizes and the chemical products are diluted and become undetectable. Initial concentrations of the chemical by-products of ordnance detonations are not hazardous to marine life and are rapidly dispersed in the ocean and because of continued dispersion and mixing, no buildup of explosion products in the water column would occur. Chemical effects to the marine environment and water quality are considered to be negligible from a BOMBEX (DoN, 2005b *in* DoN, United States Fleet Forces, January 2009). Initial concentrations of the chemical by-products of ordnance detonations are not hazardous to marine life and are rapidly dispersed in the ocean.

The concentrations of chemicals associated with bomb bodies and grenades and the explosive materials that are contained within high explosives are not hazardous to marine mammals, sea turtles, their prey, competitors, or predators. At the concentrations associated with explosive ordnance the U.S. Navy proposes to use in its training exercises, bombs and the chemicals associated with these bombs are not likely to adversely affect the endangered or threatened species that are likely to occur on the GOMEX Range Complex, either through direct action on the organisms themselves, through their food, or as a result of their action on competitors, predators, or pathogens. As a result, we do not consider this category of potential stressors further in our analyses.

Targets

The number of at-sea targets used by the U.S. Navy will vary over the 5-year duration of the proposed action. At-sea targets are usually remotely operated surface, traveling units, most of which are designed to be recovered for reuse. Aerial and surface targets would be deployed annually within the GOMEX Range Complex. Surface targets would include Integrated Maritime Portable Acoustic Scoring and Simulator Systems (IMPASS), Surface Tow Targets, QST-35 Seaborne Powered Targets, and expendable marine markers (smoke floats). Expended surface targets commonly used in addition to marine markers include cardboard boxes, 55-gallon steel drums, and a 10-foot-diameter red balloon tethered by a sea anchor (also known as a "killer tomato"). Floating debris, such as Styrofoam, may be lost from target boats.

Most target fragments would sink quickly in the sea. Expended material that sinks to the sea floor would gradually degrade, be overgrown by marine life, and/or be incorporated into the sediments. Floating non-hazardous expended material may be lost from target boats and would either degrade over time or wash ashore as flotsam. Non-hazardous expended materials are defined as the parts of a device made of non-reactive material. Typical non-reactive material includes metals such as steel and aluminum; polymers, including nylon, rubber, vinyl, and plastics; glass; fiber; and concrete. While these items represent persistent seabed litter, their strong resistance to degradation and their chemical composition mean they do not chemically contaminate the surrounding environment by leaching heavy metals or organic compounds. As a result, we do not consider this category of potential stressors further in our analyses.

Marine Markers and Flares

Marine markers and flares are pyrotechnic devices dropped on the water's surface to mark a surface position. The U.S. Navy is proposing to increase the number of marine markers from 34 to 124 per year. Markers are used within the GOMEX Range Complex during bombing, gunnery, and Security Force Training. Approximately 1840 flares are expected to be deployed per year.

The chemicals contained within markers and flares not only burn but also produce smoke. The smoke is expected to rapidly diffuse by air movement. The marker itself would eventually sink to the bottom and become encrusted and/or incorporated into the sediments. Phosphorus contained in the marker settles to the sea floor where it reacts with the water to produce phosphoric acid, until all phosphorus is consumed by the reaction. Combustion of red phosphorus produces phosphorus oxides, which have a low toxicity to aquatic organisms (DoN, United States Fleet Forces, January 2009).

Flares may contain magnesium or aluminum casings. Flares are designed to burn completely in air with only ash and a small plastic end cap entering the water. Flare end caps would eventually sink to the bottom and become encrusted and/or incorporated into the sediments. Solid flare and pyrotechnic residues may contain aluminum, magnesium, zinc, strontium, barium, cadmium, and nickel, as well as perchlorates. Hazardous constituents in pyrotechnic residues are typically present in small amounts or low concentrations, and are bound in relatively insoluble compounds. The chemicals associated with marine markers and flares are not likely to adversely affect the endangered or threatened species that are likely to occur within the GOMEX Range Complex, either through direct action on the organisms themselves, through their food, or as a result of their action on competitors, predators, or pathogens. As a result, we do not consider this category of potential stressors further in our analyses.

Naval Gunfire

Naval gunfire within the GOMEX Range Complex consists of non-explosive 5 in, 76-mm, 25 mm cannon, .50 cal or 7.62 mm rounds.

Shell fragments from gunfire would rapidly decelerate through contact with the surrounding water and settle to the sea floor. Un-recovered ordnance would sink to the ocean bottom. Metal shells and fragments would be corroded by seawater at slow rates, with comparable slow release rates. Over time, natural encrustation of exposed surfaces would occur, reducing the rate at which subsequent corrosion occurs. The rates of deterioration would vary, depending on the material and conditions in the immediate marine and benthic environment (DoN, United States Fleet Forces, 2009), but explosive residues are

expected to become covered by ocean sediments or diluted by ocean water; therefore the release of contaminants from unexploded ordnance, non-explosive ordnance, and fragments are not expected to result in degradation of marine water quality. As such, the degradation of expended ordnance the U.S. Navy proposes to use in its training exercises is not likely to adversely affect the endangered or threatened species that are likely to occur within the GOMEX Range Complex, either through direct action on the organisms themselves, through their food, or as a result of their action on competitors, predators, or pathogens. As a result, we do not consider this category of potential stressors further in our analyses.

Chaff

Radio frequency chaff (chaff) is an electronic countermeasure designed to reflect radar waves and obscure aircraft, ships, and other equipment from radar-tracking sources. Chaff is non-hazardous and consists of aluminum coated glass fibers (about 60% silica and 40% aluminum by weight) ranging in lengths from 0.3 to 3 inches with a diameter of about 40 micrometers. Chaff is released or dispensed from military vehicles in cartridges or projectiles that contain millions of chaff fibers. When deployed, a diffuse cloud of fibers undetectable to the human eye is formed. Chaff is a very light material that can remain suspended in air anywhere from 10 minutes to 10 hours. It can travel considerable distances from its release point, depending on prevailing atmospheric conditions (Arfsten *et al*.2002).

For each chaff cartridge used, a plastic end-cap and Plexiglas piston is released into the environment in addition to the chaff fibers. The end-cap and piston are both round and are 1.3 inches in diameter and 0.13 inches thick (Spargo, 2007). The fine, neutrally buoyant chaff streamers act like particulates in the water, temporarily increasing the turbidity of the ocean‘s surface. However, they are quickly dispersed and turbidity readings return to normal.

Based on the dispersion characteristics of chaff, large areas of open water on the GOMEX Range Complex would be exposed to chaff, but the chaff concentrations would be low. For example, Hullar et al. (1999) calculated that a 4.97-mile by 7.46-mile area (37.1 square miles or 28 square nautical miles) would be affected by deployment of a single cartridge containing 150 grams of chaff. The resulting chaff concentration would be about 5.4 grams per square nautical mile. This corresponds to fewer than 179,000 fibers per square nautical mile or fewer than 0.005 fibers per square foot, assuming that each canister contains five million fibers. The probability of individual animals being struck by this ordnance or encountering chaff particles is sufficiently small to be treated as discountable, even after considering the amount of ordnance the U.S. Navy would expend during the training activities it plans to conduct on the GOMEX Range Complex, As a result, we do not consider this category of potential stressors further in our analyses.

<u>Availability of Expended Materials to Endangered and Threatened Species</u>

Due to U.S. Navy training exercises and RDT&E activities expended ordnance and remnants from chaff, flares and targets will settle on the sea floor. The U.S. Navy expects that 76,062 training items will settle onto the sea floor within the GOMEX Range Complex (see Table 7). No ordnance is expended within the New Orleans OPAREA. The majority of training materials are expended in the deeper waters of the Panama City and Pensacola OPAREAs .

Table 7: Number of training items per Area/OPAREA within the GOMEX Range Complex (Source U.S. Navy 2009)	
Training Area/OPAREA	Number of Training Items Expended per nm^2 of sea bottom surface
W-151/Panama City OPAREA (3,084 nm^2)	16,000
Number of Items per nm^2 per year	5.2
20 Year Aggregate Density per nm^2	104
Corpus Christie OPAREA (6,878 nm^2)	24,100
Number of Items per nm^2 per year	3.5
20 Year Aggregate Density per nm^2	70
W-155A (Hotbox)/Pensacola OPAREA (1,459 nm^2)	24,107
Number of Items per nm^2 per year	16.5
20 Year Aggregate Density per nm^2	330
W-151 A/B or W-155A/Pensacola and Panama City OPAREAs (7,312 nm^2)	11,820
Number of Items per nm^2 per year	1.6
20 Year Aggregate Density per nm^2	32
Total Items Deposited	76,062

Expended ordnance and remnants from chaff and flares (end caps and pistons) may be available to endangered and threatened species and accidentally ingested. However, ingestion of expended ordnance is not expected to occur in the water column because ordnance quickly sinks. Of, the 76,062 items, approximately 97 percent are medium caliber cannon and small arms ammunition. The cartridges range in size from approximately 2 ¼ in (5.56 mm) to almost 9 in (25 mm). Expended materials would not settle in the same location each time because of different points of release and because of the small sizes of most ammunition which are subject to varying strengths of Gulf currents. These materials will tend to

settle out into the benthic environment over relatively large distances and become covered with bottom sediments over time.

The vast majority of training materials is expended in offshore training areas and their availability is limited in nearshore environments. Leatherback sea turtles feed throughout the epipelagic and into the mesopelagic zones of the water column on predominantly gelatinous zooplankton such as cnidarians and tunicates. They are not expected to feed in the benthic environment and would not mistake expended materials for their prey (gelatinous zooplankton such as jellyfish and salps). The majority of benthic foraging by green, hawksbill, Kemp's ridley and loggerhead sea turtles occurs in nearshore areas (Lutcavage et al, 1997) where expended materials are limited.

Due to the small size of expended materials, the low density of materials on the sea floor of training activities and the benthic foraging habitats of sea turtles, the probability of individual animals ingesting expended ordnance is sufficiently small to be treated as discountable, even after considering the amount of ordnance the U.S. Navy would expend during the training activities it plans to conduct in the GOMEC Range Complex. As a result, we do not consider this category of potential stressors further in our analyses.

Although sperm whales feed predominantly on mesopelagic cephalopods, they also frequently feed at or near the bottom in the benthic environment (Whitehead *et al*. 1992). As such, sperm whales can and do ingest non-prey items (Walker and Coe 1990). Although sperm whales can ingest expended training materials, given the small size of expended materials and the low density of materials on the sea floor the probability of individual animals ingesting expended ordnance is sufficiently small to be treated as discountable, even after considering the amount of ordnance the U.S. Navy would expend during the training activities it plans to conduct in the GOMEX Range Complex. As a result, we do not consider this category of potential stressors further in our analyses.

A variety of at-sea targets may be used in the OPAREA, ranging from high-tech remotely operated airborne and surface targets (e.g., airborne drones and Seaborne Powered Targets) to low-tech floating at-sea targets (e.g., inflatable targets, 55-gallon metal drums) and towed banners. Many of the targets are designed to be recovered for reuse and are not destroyed during training because ordnance is set to detonate before impacting the target. The only expendable airborne targets used in the OPAREA are Tactical Air-Launched Decoys, which are non-powered, constructed of extruded aluminum, weigh about 400 pounds, and are about 7 feet long. Expendable targets such as floating at-sea inflatable targets are recovered after use and properly disposed of onshore. Some targets such as 55-gallon metal drums and marine markers cannot be recovered and sink to the sea floor after use. Unrecoverable floating materials generated by target use are expected to be minimal. Given the expected low availability of target remnants the probability of individual animals ingesting these remnants is sufficiently small to be treated as discountable. As a result, we do not consider this category of potential stressors further in our analyses.

Exposure Analysis

As discussed in the Approach to the Assessment section of this opinion, our exposure analyses are designed to determine whether listed resources are likely to co-occur with the direct and indirect

beneficial and adverse effects of actions and the nature of that co-occurrence. In this section of this Opinion, we present the results of our exposure analyses, which are designed to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to one or more of the stressors produced by or associated with an Action and the populations or subpopulations those individuals represent.

Exposure to Vessel Traffic: Disturbance

The U.S. Navy proposes to continue to conduct about 180 total vessel days within the Action Area per year over the 5-year duration of the proposed action. Vessel movements unrelated to training activities for storm evasion, deployment transits, and movements in basins to rearrange ships for repairs, berthing, loading, and off-loading from designated piers also occur with the Action Area. Vessel movement can occur anywhere within the Range Complex; however movements due to training activities will predominately occur on the continental shelf as well as more offshore waters within the Panama City, Pensacola and Corpus Christi OPAREAS.

Military vessels underway or involved in naval operations or exercises introduce anthropogenic noise into the marine environment. Smaller vessels (boats 55 m or less) and personal watercraft such as jet skies that may be employed by the U.S. Navy during training exercises are powered by outboard motors or jet thrusters. These vessels all produce continuous, tonal sounds although the smaller the vessel the higher the frequency ranges of the sounds associated with the vessel (NRC 2003, Richardson *et al.* 1995). Large vessels produce low-frequency, continuous, tonal sounds, and sound pressure levels will vary according to speed, burden, capacity and length (Richardson et al. 1995). Vessels ranging from 135 to 337 meters (Nimitz-class aircraft carriers, for example, have lengths of about 332 m) generate peak source sound levels from 169-200 dB between 8 Hz and 430 Hz. Given the sound propagation of low frequency sounds, a vessel in this sound range can be heard more than 100 kilometers away (Ross 1976 in Polefka 2004).

The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Sea turtle hearing sensitivity is not well studied. Several studies using green, loggerhead, and Kemp's ridley turtles suggest that sea turtles are most sensitive to low-frequency sounds, although this sensitivity varies slightly by species and age class (Bartol *et al*. 1999, Ketten and Bartol 2006, Lenhardt 1994, Ridgway *et al*. 1969). Based on the hearing capabilities of sperm whales and sea turtles larger U.S. Navy vessels are expected to be audible at more than 100 kilometers away. Other smaller vessels would be heard at distances less than 100 kilometers depending on the frequencies emitted by the vessels and the distances between sperm whales, sea turtles and the vessels themselves. We expect that sperm whales and sea turtles could be exposed to acoustic stimuli from surface vessels, although we do not have sufficient information to estimate the probability of marine animals being exposed within the GOMEX Range Complex from November 2010 through November 2015.

The sperm whales that are likely to be exposed to these stressors would be individuals from the Gulf of Mexico population, which appears to be a grouping that is geographically and ecologically distinct from the sperm whales that occur in the North Atlantic Ocean. Exposed sperm whales might represent any age or gender. The sea turtles that are likely to be exposed to these stressors would be individuals of the

North Atlantic populations of green, Kemp's ridley, hawksbill and leatherback sea turtles. Loggerhead sea turtles exposed would be members of the North Atlantic populations or the proposed Northwest Atlantic population of loggerhead sea turtles. Exposed sea turtles might represent any age or gender.

Exposure to Aircraft: Disturbance

Training activities the U.S. Navy proposes to conduct include fixed-wing aircraft and helicopters. Low-flying aircraft produce sounds that marine mammals can hear when they occur at or near the ocean's surface. Helicopters generally tend to produce sounds that can be heard at or below the ocean's surface more than fixed-wing aircraft of similar size and larger aircraft tend to be louder than smaller aircraft. 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 but represent acoustic stimuli (primarily low-frequency sounds from engines and rotors) that have been reported to affect the behavior of some marine mammals. Sea turtles might detect low flying aircraft via visual cues such as the aircraft's shadow, however, it has been suggested that they might not respond to aircraft overflights based on acoustic stimuli alone.

The sperm whales that are likely to be exposed to these stressors would be individuals from the Gulf of Mexico population, which appears to be a grouping that is geographically and ecologically distinct from the sperm whales that occur in the North Atlantic Ocean. Exposed sperm whales might represent any age or gender. The sea turtles that are likely to be exposed to these stressors would be individuals of the North Atlantic populations of green, Kemp's ridley, hawksbill and leatherback sea turtles. Loggerhead sea turtles exposed would be members of the North Atlantic populations or the proposed Northwest Atlantic population of loggerhead sea turtles. Exposed sea turtles might represent any age or gender.

Although we recognize sounds produced by aircraft as a potential stressor, we do not have sufficient information to estimate the probability of marine animals being exposed to aircraft noise associated with the training exercises and other activities the U.S. Navy plans to conduct in the GOMEX Range Complex from November 2010 through November 2015.

Exposure to Underwater Detonations

We cannot estimate the number of marine mammals and sea turtles that might be exposed to the U.S. Navy's training and RDT&E activities within the Action Area because of the limited empirical information available regarding the number, age (or life stage), and gender of individual marine mammals and sea turtles that are likely to be exposed to the stressors associated with the U.S. Navy's training and RDT&E activities from November 2010 through November 2015. As a result, the U.S. Navy, NMFS, and most other entities (for example, oil and gas industries for drilling platforms, geophysics organizations that conduct seismic surveys, etc.) rely on computer models, simulations, or some kind of mathematical algorithm to estimate the number of animals that might be exposed to a sound source. Like all models, these approaches are based on assumptions and are sensitive to those assumptions.

Based on our evaluation of assumptions the U.S. Navy incorporates in its models, those models would tend to over-estimate the number of marine mammals that might be exposed to U.S. Navy activities in waters on and adjacent to the GOMEX Range Complex because (1) those models assume that marine mammals and sea turtles would not try to avoid being exposed to the shock waves or sound fields

associated with underwater detonations or would not try to avoid continued exposure to shock waves or sound fields; (2) those models assume that mean densities of marine mammals and sea turtles within any square kilometer area of the Range Complex would be constant over time (that is, the models assume that the probability of marine mammals occurring in any square kilometer area over any time interval is 1.0, when, in fact, the probability would be much smaller than 1.0; this difference would tend to overestimate the number of animals in the action area during shorter time intervals). For underwater detonations, we relied entirely on the U.S. Navy's and the Permit's Division's exposure estimates. For more information regarding the U.S. Navy's models and exposure estimates please refer to Appendix J of the Gulf of Mexico Range Complex Draft Environmental Impact Statement/Overseas Environmental Impact Statement (DoN, United States Fleet Forces, January 2009). For more information regarding the Permit Division's exposure estimates please refer to the April 28, 2009, proposed rule (74 *Federal Register* 19205).

Underwater Detonations Exposure Estimates

The U.S. Navy uses several thresholds and criteria based on the marine mammal received levels from sound and shock waves to estimate the numbers of listed species that might be exposed to underwater detonations and may be harassed or injured (as those terms are define for the purposes of the MMPA) because of that exposure. Underwater detonations at received levels greater than or equal to 177 dB re 1 Pa^2-s sound exposure level (SEL) and at received levels greater than or equal to 182 dB re 1 Pa^2-s SEL or 23 psi-ms are considered thresholds for behavioral harassment (Level B "take") by the Permits Division. Underwater detonations where received levels would be expected to cause 50 percent tympanic membrane rupture, or at received levels that would be expected to produce slight lung injury as a result of their exposure are considered thresholds for injury (Level A "take") by the Permits Division.

This approach to estimating the number of listed species that might be "taken" as a result of being exposed to underwater detonations the U.S. Navy proposes to conduct within the GOMEX Range Complex produced the following results:

Sperm Whales

The U.S. Navy models estimated that no individual sperm whales would be exposed to the sound fields or pressure waves associated with underwater detonations. However, because of the sperm whale's abundance in the Gulf of Mexico, the Permits Division determined that the incidental "take" of sperm whales by Level B harassment is likely due to the U.S. Navy's training exercises involving underwater detonations. Based on the Permit Division's estimates we would expect five instances each year in which sperm whales might be exposed to underwater detonations and experience behavioral changes that would be sufficient to constitute "take" (as that term is defined for the purposes of the MMPA) as a result of that exposure. We would expect sperm whales to be exposed to underwater detonations at received levels greater than or equal to 177 dB re 1 Pa^2-s SEL and at received levels greater than or equal to 182 dB re 1 Pa^2-s SEL or 23 psi-ms. As a result sperm whales would experience behavioral harassment or noise-induced loss of hearing sensitivity.

We would not expect sperm whales to be exposed to underwater detonations where received levels would be expected to cause them to experience 50 percent tympanic membrane rupture, or at received levels that would be expected to produce slight lung injury as a result of their exposure.

The sperm whales that are likely to be exposed to these stressors would be individuals from the Gulf of Mexico population, which appears to be a grouping that is geographically and ecologically distinct from the sperm whales that occur in the North Atlantic Ocean. Exposed sperm whales might represent any age or gender.

Sea Turtles

Because of the limited duration of training exercises involving underwater detonations (13 hours per year) and the estimated densities of sea turtles within the GOMEX range Complex the U.S. Navy's models estimated that no individual sea turtles of any species would be exposed to sound fields or pressure waves associated with underwater detonations. Further, the U.S. Navy proposes site-selection procedures, exclusion zones, and monitoring protocols to further reduce the probability that sea turtles would be exposed to the stressors associated with detonation exercises. Based on this information we would not expect sea turtles to co-occur or be exposed to sound fields or pressure waves associated with underwater detonations.

Response Analyses

As discussed in the Approach to the Assessment section of this biological opinion, response analyses determine how listed resources are likely to respond after being exposed to an Action's effects on the environment or directly on listed species themselves. This section of the Opinion will first determine the potential responses to each of the stressors identified thus far, then discuss the probable responses given probable exposure.

Potential Responses to Disturbance from Surface Vessels

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 (Goodwin and Green 2004; Lusseau 2006). However, several authors suggest that the noise generated during motion is probably an important factor (Blane and Jackson 1994, Evans et al. 1992, 1994). These studies suggest that marine mammals' behavioral responses to surface vessels are similar to their behavioral responses to predators.

As we discussed earlier, vessel traffic represents an acute or chronic source of disturbance to marine animals (Au and Green 1990, Au and Perryman 1982, Bain *et al.* 2006, Bauer 1986, Bejder 1999, 2006a, 2006b; Bryant *et al.* 1984, Corkeron 1995, Erbé 2000, Félix 2001, Goodwin and Cotton 2004, Hewitt 1985, Lemon *et al.* 2006, Lusseau 2003, 2006; Lusseau and Bejder 2007, Magalhães *et al.* 2002, Ng and Leung 2003, Nowacek *et al.* 2001, Richter *et al.* 2003, 2006; Scheidat *et al.* 2004, Simmonds 2005, Watkins 1986, Williams and Ashe 2007, Würsig *et al.* 1998). In some circumstances, marine mammals respond to vessels with the same suite of behaviors and tactics used when they encounter predators. It is not clear what environmental cue or cues marine animals might respond to: the sounds of waters being

displaced by the ships, the sounds of the ships' engines, or a combination of environmental cues surface vessels produce while they transit.

For surface vessels, the set of variables that help determine whether marine mammals are likely to be disturbed include:

1. 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).

   Below a threshold number of vessels (which probably varies from one species to another, although groups of marine mammals probably shared 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;
2. The distance between vessel and marine mammals when the animal perceives that an approach has started and during the course of the interaction;
3. The vessel's speed and vector;
4. The predictability of the vessel's path. That is, whether the vessel stays on a single path or makes continuous course changes;
5. 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);
6. The type of vessel (displacement versus planing), which marine mammals may interpret as evidence of a vessel's maneuverability.

Most of the investigations cited earlier 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, Lusseau 2003, Lusseau 2005; Notarbartolo di Sciara *et al.* 1996, Nowacek *et al.* 2001, Van Parijs and Corkeron 2001, Williams *et al.* 2002). 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 (Edds and Macfarlane 1987, Baker and Herman 1989, Kruse 1991, Polacheck and Thorpe 1990, Evans *et al. 1*992, Lütkebohle 1996, Nowacek *et al. 1*999). 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 (Stewart *et al.* 1982, Kruse 1991). We assume that this movement would give them greater opportunities to avoid or evade vessels as conditions warranted.

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, Notarbartolo di Sciara *et al.* 1996, 2002). Baker *et al.* (1983) reported that humpbacks in Hawai'i responded to vessels at distances of 2 to 4 km. Richardson *et al.* (1985) reported that bowhead whales (*Balaena mysticetus*) swam in the opposite

direction of approaching seismic vessels at distances between 1 and 4 km and engage in evasive behavior at distances under 1 km. Fin whales also responded to vessels at a distances of about 1 km (Edds and Macfarlane 1987).

Some cetaceans detect the approach of vessels at substantial distances. Finley *et al.* (1990) reported that beluga whales seemed aware of approaching vessels at distances of 85 km and began to avoid the approach at distances of 45-60 km. Au and Perryman (1982) studied the behavioral responses of eight schools of spotted and spinner dolphins (*Stenella attenuata* and *S. longirostris*) to an approaching ship (the NOAA vessel *Surveyor*: 91.4 meters, steam-powered, moving at speeds between 11 and 13 knots) in the eastern Pacific Ocean (10°15 N lat., 109°10 W long.). They monitored the response of the dolphin schools to the vessel from a Bell 204 helicopter flying a track line ahead of the ship at an altitude of 366 – 549 meters (they also monitored the effect of the helicopter on dolphin movements and concluded that it had no observable effect on the behavior of the dolphin schools). All of the schools continuously adjusted their direction of swimming by small increments to continuously increase the distance between the school and the ship over time. The animals in the eight schools began to flee from the ship at distances ranging from 0.9 to 6.9 nm. When the ship turned toward a school, the individuals in the school increased their swimming speeds (for example, from 2.8 to 8.4 knots) and engaged in sharp changes in direction.

Hewitt (1985) reported that five of 15 schools of dolphin responded to the approach of one of two ships used in his study and none of four schools of dolphin responded to the approach of the second ship (the first ship was the NOAA vessel *David Jordan Starr*; the second ship was the *Surveyor*). Spotted dolphin and spinner dolphins responded at distances between 0.5 to 2.5 nm and maintained distances of 0.5 to 2.0 nm from the ship while striped dolphins allowed much closer approaches. Lemon *et al.*(2006) reported that bottlenose dolphin began to avoid approaching vessels at distances of about 100 m.

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 *Kogia* species and beaked whales (ziphiids) showed the strongest avoidance reactions to approaching ships (avoidance reactions in 11 of 13 approaches) while spinner dolphins, Atlantic spotted dolphins, bottlenose dolphins, false killer whales, and 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.

Because of the number of vessels involved in U.S. Navy training exercises, their speed, their use of course changes as a tactical measure, and sounds associated with their engines and displacement of water along their bowline, the available evidence leads us to expect marine mammals to treat Navy vessels as potential stressors. Animals that perceive an approaching potential predator, predatory stimulus, or disturbance stimulus have four behavioral options (see Blumstein 2003 and Nonacs and Dill 1990):

a. ignore the disturbance stimulus entirely and continue behaving as if a risk of predation did not exist;
b. alter their behavior in ways that minimize their perceived risk of predation, which generally involves fleeing immediately;
c. change their behavior proportional to increases in their perceived risk of predation which requires them to monitor the behavior of the predator or predatory stimulus while they continue their current activity, or

d. take proportionally greater risks of predation in situations in which they perceive a high gain and proportionally lower risks where gain is lower, which also requires them to monitor the behavior of the predator or disturbance stimulus while they continue their current activity.

The latter two options are energetically costly and reduce benefits associated with the animal's current behavioral state. As a result, animals that detect a predator or predatory stimulus at a greater distance are more likely to flee at a greater distance (see Holmes *et al.* 1993, Lord *et al.* 2001). Some investigators have argued that short-term avoidance reactions can lead to longer term impacts such as causing marine mammals to avoid an area (Salden 1988, Lusseau 2005) or alter a population's behavioral budget (Lusseau 2004) which could have biologically significant consequences on the energetic budget and reproductive output of individuals and their populations.

Of the endangered and threatened species that occur in the Gulf of Mexico, the endangered and threatened sea turtles are most likely to ignore U.S. Navy vessels entirely and continue behaving as if the vessels and any risks associated with those vessels did not exist. Sperm whales might engage in any one of these options.

Potential Responses to Disturbance Associated with Aircraft

There are few studies of the responses of marine animals to air traffic (there are no studies of the responses of sea turtles to this traffic) and the few that are available have produced mixed results. Some investigators report some responses while others report no responses. Richardson et al. (1995) reported that there is no evidence that single or occasional aircraft flying above large whales and pinnipeds in-water cause long-term displacement of these mammals.

Several authors have reported that sperm whales did not react to fixed-wing aircraft or helicopters in some circumstances (Au and Perryman 1982, Clarke 1956, Gambell 1968, Green et al. 1992) and reacted in others (Clarke 1956, Fritts et al. 1983, Mullin et al. 1991, Patenaude et al. 2006, Richter et al. 2003, 2006, Smultea et al. 2008, Würsig et al. 1998). Richardson et al. (1985) reported that bowhead whales (Balaena mysticetus) responded behaviorally to fixed-wing aircraft that were used in their surveys and research studies when the aircraft were less than 457 meters above sea level; their reactions were uncommon at 457 meters, and were undetectable above 610 meters. They also reported that bowhead whales did not respond behaviorally to helicopter overflights at about 153 meters above sea level.

Smultea *et al*. (2008) studied the response of sperm whales to low-altitude (233-269 m) flights by a small fixed-wing airplane Kauai and reviewed data available from either 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 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 and *et al*. (2008) reported that the sperm whales formed a semi-circular "fan" formation that was similar to defensive formations reported by other investigators.

In a review of aircraft noise effects on marine mammals, Luksenburg and Parsons (2009) 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 (2009).

Probable Responses to Disturbance Associated with Aircraft

The U.S. Navy proposes to conduct 5,318 fixed-wing aircraft sorties (14 sorties per day) over Gulf of Mexico waters per year over the 5-year duration of the proposed action. The U.S. Navy also proposes to conduct 18 helicopter sorties per year over Gulf of Mexico waters over the 5-year duration of the proposed action. Aircraft sorties would be flown no lower than 3,000 ft (914 m) above the sea surface. Helicopter sorties would be flown lower, but would only last 1.5 hours per training event. Available evidence indicates that marine mammals respond to air traffic in some circumstances but not in others. Luksenburg and Parsons (2009) 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 (2009). Richardson *et al*. (1995) reported that there is no evidence that single or occasional aircraft flying above large whales and pinnipeds in-water cause long-term displacement of these mammals while Luksenburg and Parsons (2009) concluded that turtles exposed to aircraft overflights may exhibit no response or behavioral reactions such as quick diving. Any behavioral avoidance reaction would be short-term and would not permanently displace animals or result in physical harm. Given this, we conclude that any responses of marine mammals and sea turtles to disturbance associated with aircraft is likely to be short-lived and will not rise to the level of harassment. As such we will not consider aircraft disturbance further in this Opinion.

Potential Responses to Underwater Detonations

For marine mammal species, pressure waves from an explosion can impact air cavities, such as lungs and intestines, causing instantaneous or proximate mortality. Extensive hemorrhaging of the lungs due to underwater shock waves may cause death to a marine mammal through suffocation (Hill 1978). Other common injuries which may result in mortality include circulatory failure, broncho-pneumonia in damaged lungs, or peritonitis resulting from perforations of an animal's intestinal wall (Hill 1978). The degree of injury associated with impulse is believed to be directly proportional to mammal mass (Yelverton, et al. 1973), therefore, conservative criteria for the impulse effect are based on the lowest possible affected mammalian weight (e.g. dolphin calves, DoN 1998 in DoN, U.S. Fleet Forces 2009).

Non-lethal injuries include slight lung hemorrhage and tympanic membrane rupture from which the mammal is expected to recover (Yelverton et al. 1973; Richmond, et al. 1973). Eardrum damage criteria are based upon a limited number of small charge tests (Yelverton et al. 1973; Richmond et al. 1973). Ranges for the percentage by which tympanic membranes rupture in response to underwater explosions can be calculated by a conservative tympanic membrane damage model (DoN 1996 in DoN, U.S. Fleet Forces 2009). General criteria for damage to marine mammal tympanic membranes have been reported to

occur at impulse levels down to 20 psi-msec (Yelverton, et al. 1973). Behavioral and physiological harassment (TTS) may also occur which is recoverable.

Probable Responses to Underwater Detonations

The U.S. Navy proposes to employ measures to prevent endangered marine mammals from being exposed to underwater detonations during training activities within the GOMEX Range Complex. These measures involve site-selection procedures, exclusion zones, and monitoring protocols to reduce the probability that marine mammals would be exposed to sound fields and shock waves associated with underwater detonations. Despite these protective measures, the U.S. Navy identified five instances in which endangered sperm whales might be exposed to underwater detonations at received levels that would cause behaviors that would be considered behavioral harassment or temporarily cause noise-induced hearing loss.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

We expect the natural phenomena in the action area (e.g., storms, natural mortality) will continue to influence listed species as described in the Environmental Baseline. We also expect anthropogenic effects described in the Environmental Baseline will continue, including those related to habitat degradation due to pollution, ocean noise, coastal development and vessel traffic. Increases in vessel traffic would further increase collision risks for sea turtles and whales. Economic forces may lead to changes in shipping fleet vessels, which in turn could significantly change vessel noise characteristics (NRC 2003); however, it is unknown what future impact this will have on listed species. Private actions in the future also include the use of commercial sonars, which is expected to continue increasing in the ocean environment, as is the research, development, and use of new sonar devices (NRC 2003). However, no long-term acoustics data set is available that would allow an assessment of noise trends in the action area, and a projection of anticipated future impacts on these species would be speculation.

Integration and Synthesis of Effects

Thus far, we have described the endangered or threatened species that are likely to be exposed to the activities the U.S. Navy proposes to conduct within the GOMEX Range Complex and the probable responses of those endangered or threatened species given that exposure. In this section of our Opinion, we describe the probable consequences of those responses for endangered or threatened individuals, the population(s) those individuals represent, and the species those populations comprise to determine whether the proposed military readiness activities are likely to jeopardize the continued existence of those species by appreciably reducing the reproduction, numbers, or distribution of those species in the wild. As we discussed in the Approach to the Assessment section of this Opinion, we begin our risk analyses by asking whether the probable physical, physiological, behavioral, or social responses of endangered or threatened species are likely to reduce the fitness of endangered or threatened individuals or the growth, annual survival or reproductive success, or lifetime reproductive success of those individuals. If we

would not expect listed plants or animals exposed to an action's effects to experience reductions in their current or expected future reproductive success (that is, their fitness), we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise (Anderson 2000; Mills and Beatty 1979; Brandon 1978; Stearns 1977, 1992). Therefore, if we conclude that listed animals are not likely to experience reductions in their fitness, we would conclude our assessment because we would not expect the effects of the action to affect the performance of the populations those individuals represent or the species those population comprise. If, however, we conclude that listed animals are likely to experience reductions in their fitness as a result of their exposure to an action, we then determine whether those reductions would reduce the viability of the population or populations the individuals represent and the species those populations comprise (in section 7 consultations, the species represent the listed entities, which might represent species, subspecies, or distinct populations segments of vertebrate taxa).

As part of our risk analyses, we consider the consequences of exposing endangered or threatened species to the stressors associated with the proposed actions, individually and cumulatively, given that the individuals in the action areas for this consultation are also exposed to other stressors in the action area and elsewhere in their geographic range. These stressors or the response of individual animals to those stressors can produce consequences or cumulative impacts (in the NEPA sense of the term) that would not occur if animals were only exposed to a single stressor.

As we discuss in the narratives that follow, our analyses led us to conclude that endangered or threatened individuals that are likely to be exposed to the training exercises and RTD&E activities the U.S. Navy proposes to conduct on the GOMEX Range Complex are likely to experience disruptions in their normal behavioral patterns, but they are not likely to be killed, injured, or experience measurable reductions in their current or expected future reproductive success as a result of that exposure.

Sperm Whales

Based on the results of our exposure analyses, each year over the five-year period between November 2010 and November 2015, we would expect sperm whales to be exposed to vessel traffic associated with U.S. Navy training exercises and pressure waves and sound fields associated with underwater detonations within the GOMEX Range Complex. As sperm whales are considered a grouping, resident to the Gulf of Mexico, and training activities including underwater detonation can occur year round, sperm whales could be exposed to vessel traffic associated with U.S. Navy training exercises and pressure waves and sound fields year round. Because of the low number of collisions within the Range Complex and the protective measures the U.S. Navy proposes to employ, we do not expect a sperm to be struck by a Navy vessel within the GOMEX Range Complex over the five-year duration of the proposed actions. Because of the protective measures the U.S. Navy plans to employ before engaging in underwater detonations, we would not expect sperm whales to be exposed to underwater detonations at received levels that would be expected to cause them to experience 50 percent tympanic membrane rupture or at received levels that would be expected to produce slight lung injury as a result of their exposure (these two received levels are considered thresholds for Level A "take" or injury by the Permits Division). However, we would expect five sperm whales to be exposed to underwater detonations within the GOMEX Range Complex at received levels greater than or equal to 182 dB SEL or 23 psi-ms, which the Permits Division considers as a threshold for Level B "take" or behavioral harassment. This level of take amounts to approximately 0.6

percent of the sperm whale population within the Gulf of Mexico harassed each year by U.S. Navy activities in the GOMEX Range Complex.

As we discussed, we assume that the sperm whales that might be exposed to stressors associated with U.S. Navy activities on the GOMEX Range Complex are individuals from the Gulf of Mexico population, which appears to be a grouping that is geographically and ecologically distinct from the sperm whales that occur in the North Atlantic Ocean. Exposed sperm whales might represent any age or gender. These sperm whales would also be exposed to activities associated with the Atlantic Fleet Active Sonar (mid- and low frequency) training within the Gulf of Mexico and major range exercises (COMPTUEX and JTFEX) involving anti-submarine warfare and strike warfare exercises. The sperm whales that are exposed to the training activities within the GOMEX Range Complex might not respond to the acoustic cues generated by Navy vessels, while in other circumstances, they are likely to change their surface times, swimming speed, swimming angle or direction, respiration rates, dive times, and social interactions (Amaral and Carlson 2005; Au and Green 2000, Cockeron 1995, Erbe 2002, Félix 2001, Magalhães et al. 2002, Richter et al. 2003, Scheidat et al. 2004, Simmonds 2005, Watkins 1986, Williams et al. 2002). Some sperm whales may be less likely to engage in these responses within the GOMEX Range Complex if they are engaged in courtship or reproductive behavior because they are less sensitive to sounds associated with U.S. Navy training activities while engaged in those behavioral acts. The sperm whales that are likely to be exposed to vessel traffic within the GOMEX Range Complex would have had prior experience with similar stressors resulting from their exposure to commercial and recreational vessel traffic; that experience will make some sperm whales more likely to avoid activities associated with the training while others would be less likely to engage in avoidance behavior. However, these responses are not likely to reduce the fitness of the sperm whales that occur in the GOMEX Range Complex. Therefore, we would not expect the training and RTD&E activities the U.S. Navy proposes to conduct within the GOMEX Range Complex to affect the performance of the populations those sperm whales represent or the species those population comprise. As a result, we would not expect these training and RTD&E activities to appreciably reduce the sperm whales' likelihood of surviving and recovering in the wild.

Sea Turtles

As we discussed, we assume that the sea turtles that might be exposed to stressors associated with U.S. Navy activities on the GOMEX Range Complex would be individuals of the North Atlantic populations of green, Kemp's ridley, hawksbill and leatherback sea turtles. Loggerhead sea turtles exposed would be members of the North Atlantic population or the proposed Northwest Atlantic population of loggerhead sea turtles. Exposed sea turtles might represent any age or gender.

Based on the results of our exposure analyses, each year over the five-year period between November 2010 and November 2015, we would expect sea turtles to be exposed to vessel traffic associated with U.S. Navy training exercises and RDT&E activities. As sea turtles inhabit the Gulf of Mexico year round and training activities involving surface vessels can occur year round, sea turtles could be exposed to vessel traffic associated with U.S. Navy training exercises. The sea turtles that are exposed to the training activities within the GOMEX Range Complex might not respond to the acoustic cues generated by Navy vessels. Of the endangered and threatened species that occur in the Gulf of Mexico, the endangered and threatened sea turtles are most likely to ignore U.S. Navy vessels entirely and continue behaving as if the

vessels and any risks associated with those vessels did not exist. Because of the low number of collisions within the Range Complex and the protective measures the U.S. Navy proposes to employ, we do not expect a sea turtle to be struck by a Navy vessel within the GOMEX Range Complex over the five-year duration of the proposed actions. Because of the low densities of sea turtles, the low amount of training time associated with activities using underwater detonations (13 hours per year) and the protective measures the U.S. Navy plans to employ before engaging in underwater detonations, no sea turtles are expected to be exposed to the pressure waves and sound fields associated with underwater detonations within the GOMEX Range Complex. Therefore, we would not expect the training and RTD&E activities the U.S. Navy proposes to conduct within the GOMEX Range Complex to affect the survival and recovery of the populations those sea turtles represent or the species those populations comprise. As a result, we would not expect these training and RTD&E activities to appreciably reduce the green, kemp's ridley, hawksbill, loggerhead (individuals of the currently listed north Atlantic population or the proposed Northwest Atlantic DPS) or leatherback sea turtles' likelihood of surviving and recovering in the wild.

Conclusion for Listed Resources

After reviewing the current status of sperm whales, green sea turtles, kemp's ridley sea turtles, hawksbill sea turtles, leatherback sea turtles and loggerhead sea turtles, the environmental baseline for the action area, the effects training exercises and research, development, testing, and evaluation activities the U.S. Navy plans to conduct within the GOMEX Range Complex that are likely to occur over the five-year period between November 2010 and November 2015, and the cumulative effects, it is NMFS' biological opinion that the Navy's proposed training exercises and research, development, testing, and evaluation activities within the GOMEX Range Complex are not likely to jeopardize the continued existence of these threatened and endangered species under NMFS' jurisdiction.

The Opinion also concluded that training exercises and research, development, testing, and evaluation activities the U.S. Navy plans to conduct within the GOMEX Range Complex, are not likely to affect critical habitat that has been designated for endangered or threatened species in the action area. Therefore, those activities are not likely to result in the destruction or adverse modification of that critical habitat.

Conclusion for Proposed Resources

After reviewing the current status of the proposed Northwest Atlantic distinct population segment of loggerhead sea turtles, the environmental baseline for the action area, the effects training exercises and research, development, testing, and evaluation activities the U.S. Navy plans to conduct within the GOMEX Range Complex that are likely to occur over the 5-year period between November 2010 and November 2015, and the cumulative effects, it is NMFS' conference opinion that the U.S. Navy's proposal to conduct training exercises and research, development, testing, and evaluation activities within the GOMEX Range Complex are not likely to jeopardize the continued existence of this species.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation 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 listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The National Marine Fisheries Service (NMFS) is not including an incidental take authorization for marine mammals at this time because the incidental take of marine mammals has not been authorized under section 101(a)(5) of the Marine Mammal Protection Act of 1972, as amended. If and when such regulations or authorizations are issued, the National Marine Fisheries Service will prepare a new biological opinion to include an incidental take statement for the endangered and threatened species that have been considered in this Opinion, as appropriate.

CONSERVATION RECOMMENDATIONS

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

The following conservation recommendations would provide information for future consultations involving the issuance of marine mammal permits that may affect endangered whales as well as reduce harassment related to research activities:

1. Cumulative Impact Analysis. The U.S. Navy should work with NMFS' Endangered Species Division and other relevant stakeholders (the Marine Mammal Commission, International Whaling Commission, and the marine mammal research community) to develop a method for assessing the cumulative impacts of anthropogenic noise on cetaceans, pinnipeds, sea turtles, and other marine animals. This includes the cumulative impacts on the distribution, abundance, and the physiological, behavioral and social ecology of these species.

In order to keep NMFS' Endangered Species Division informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Permits, Conservation and Education Division of the Office of Protected Resources should notify the Endangered Species Division of any conservation recommendations they implement in their final action.

REINITIATION NOTICE

This concludes formal consultation and conference on the U.S. Navy's conduct of training operations and research, development, testing and evaluation activities within the Gulf of Mexico Range Complex from November 2010 to November 2015 and promulgation of regulations to authorize the U.S. Navy to "take" marine mammals incidental to the conduct of those activities. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, Action Agencies are normally required to reinitiate section 7 consultation immediately.

The U.S. Navy and NMFS' Permits, Education, and Conservation Division may ask NMFS' Endangered Species Division to confirm the conference opinion as a biological opinion issued through formal consultation if the Northwest Atlantic distinct population segment of loggerhead sea turtles is listed. The request must be in writing. If NMFS' Endangered Species Division reviews the proposed action and finds that there have been no significant changes in the action as planned or in the information used during the conference, NMFS' Endangered Species Division will confirm the conference opinion as the biological opinion for GOMEX activities and no further section 7 consultation will be necessary.

If the Northwest Atlantic distinct population segment of loggerhead sea turtles is listed and this conference opinion is subsequently adopted, the U.S. Navy and the Permits, Education, and Conservation Division shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this conference opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this conference opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

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