RCS 11-491

EGLIN AIR FORCE BASE
Florida

MARITIME STRIKE OPERATIONS TACTICS DEVELOPMENT AND EVALUATION

FINAL ENVIRONMENTAL ASSESSMENT

May 2013

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FINDING OF NO SIGNIFICANT IMPACT

FOR

MARITIME STRIKE OPERATIONS TACTICS DEVELOPMENT AND EVALUATION EGLIN AIR FORCE BASE, FLORIDA

Contract No. W91278-11-D-0040
Task Order No. 0013

RCS 11-491

This finding, and the analysis upon which it is based, was prepared pursuant to the President's Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of the National Environmental Policy Act (NEPA) and its implementing regulations as promulgated at 40 Code of Federal Regulations (CFR) Part 1500 (40 CFR 1500-1508), as well as the U.S. Air Force Environmental Impact Analysis Process as promulgated at 32 CFR Part 989.

The Department of the Air Force has conducted an Environmental Assessment (EA) of the potential environmental consequences associated with the conduct of live ordnance testing in the Gulf of Mexico (GOM) as part of the 53d Wing Maritime Strike Operations Tactics Development and Evaluation (TD&E) Program at Eglin Air Force Base (AFB). That EA (May 2013) is hereby incorporated by reference into this finding.

PURPOSE AND NEED (EA Section 1.4, page 1-1)

The purpose of the Proposed Action is to continue the development of tactics, techniques, and procedures (TTPs) for Air Force strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. The Proposed Action is needed because current weaponeering systems do not accurately model air-launched weapon detonations on or under water. Damage effects of these conditions must be known to generate TTPs to engage small moving boats.

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

Proposed Action, All Scenarios (Preferred Alternative) (EA Section 2.1, page 2-1)

The Proposed Action, which is the preferred alternative, is for the 96th Test Wing (96 TW) commander to authorize use of multiple types of live munitions in the Eglin Gulf Test and Training Range against small boat targets for all desired surface and water depth scenarios for the Maritime Strike Operations Tactics Development and Evaluation Program. Ordnance delivery under the Proposed Action involves the maximum deployment of all live munitions at depths of up to 10 feet under the surface. This level of testing would be expected to provide the intended level of tactics and weapons evaluation, including a number of replicate tests sufficient for an acceptable statistical confidence level regarding munitions capabilities.

Alternative 1: Reduced Number of Detonations (EA Section 2.2.1, page 2-5)

Under Alternative 1, the overall number of live munitions would be decreased, including the number of subsurface detonations.

Alternative 2: Reduced Number of Detonations and No Subsurface Detonations (EA Section 2.2.2, page 2-5)

Under Alternative 2, the total number of live munitions would decrease relative to the Proposed Action, although the number would be slightly higher than under Alternative 1. However, there would be no subsurface detonations.

No Action Alternative (EA Section 2.2.3, page 2-7)

Under the No Action Alternative, Maritime Strike testing would not occur at Eglin AFB. The program would not achieve objectives of developing effective methods to counter small boat threats from the air.

ENVIRONMENTAL IMPACTS

Analysis was conducted to determine the potential impacts to the human and natural environment resulting from the Proposed Action, All Scenarios; Alternative 1, Reduced Number of Detonations; Alternative 2, Reduced Number of Detonations and No Subsurface Detonations; and the No Action Alternative. No significant impacts to resources have been identified (EA Chapter 3, pages 3-1 to 3-51). In addition, no significant cumulative impacts caused by implementation of the Proposed Action when combined with other past, present, and reasonably foreseeable actions that could affect safety and GOM access, socioeconomics, physical resources, and biological resources have been identified (EA Chapter 4, pages 4-1 to 4-7).

Safety/Restricted Access (EA Section 3.1.3, pages 3-2 to 3-5) – There would be no significant impacts due to safety or restricted access under any of the alternatives. Nonparticipating vessels and persons would be kept from the mission area by use of safety boats and Notices to Mariners (NOTMARs). Clearance by the Eglin Air Force Explosive Ordnance Disposal (EOD) team would be required for military and civilian personnel to re-enter target areas. Closure of the mission area would be temporary and intermittent and would not significantly impact recreational or commercial fishing.

Socioeconomics (EA Section 3.2.3, pages 3-8 to 3-9) – There would be potential for impacts to socioeconomic activities, including fishing and boating, from restricted access; however implementation of best management practices (BMPs) and continued use of communication services would minimize adverse impacts. Therefore, no significant impacts to socioeconomic resources would be anticipated under the Proposed Action. Additionally, no disproportionate impacts to low-income communities, minorities, or children have been identified under the Proposed Action.

Physical Resources (EA Section 3.3.3, pages 3-11 to 3-13) – There would be no significant impacts to physical resources. Impacts to water column and substrate quality would be minor.

Detonations would not be of sufficient strength to cause seafloor cratering. Scouring of the seafloor by debris pieces would be minor and would not affect benthic communities. Known hardbottom habitats and artificial reefs would not be affected.

Biological Resources (EA Section 3.4.3, pages 3-37 to 3-51) – There would be no significant impacts to biological resources. Marine fish may be injured or killed by detonations, but the number is expected to be negligible relative to overall populations. Maritime Strike activities would occur outside the principal distribution range of fish species protected under the Endangered Species Act (ESA), and Gulf sturgeon critical habitat would not be affected. Essential fish habitat would not be significantly impacted. Significant impacts to marine birds, including ESA-listed and migratory species, are not expected. Marine mammals and sea turtles could be exposed to noise or pressure levels resulting in mortality, injury, or harassment. Mitigation measures would decrease the potential for impacts. Consultation with the National Marine Fisheries Service (NMFS) and issuance of an Incidental Harassment Authorization (IHA) would be obtained before activities commenced.

REGULATIONS, PLANS, AND PERMITS (EA Section 5.1, page 5-1)

- IHA
- Eglin AFB initiated consultation with NMFS pursuant to the ESA through preparation of a Biological Assessment; Subsequently, NMFS prepared a Biological Opinion regarding the effects of Maritime Strike test activities.
- Coastal Zone Management Act (CZMA) Consistency Determination (Appendix A, Coastal Zone Management Act Consistency Determination)

MANAGEMENT ACTIONS (EA Section 5.2, pages 5-1 to 5-9)

The proponent is responsible for implementation of the following management actions.

Safety/Restricted Access (EA Section 5.2.1, page 5-1)

- Establish and maintain human safety buffer zones
- EOD teams would deem safe boat targets and dispose of any unexploded ordnance (UXO).

Socioeconomics (EA Section 5.2.2, page 5-2)

- Avoid training activities during holidays and special events such as fishing tournaments.
- Continue to provide advanced notification to users through NOTMARs and other media sources to timely inform users of training times and dates so that their activities can be planned accordingly.
- Eglin Range Safety employs local fisherman to help establish the safety zone and would continue this practice for the proposed live Maritime Strike missions.

Physical Resources (EA Section 5.2.3, page 5-2)

- No management actions have been identified for physical resources.

Biological Resources (EA Section 5.2.4, page 5-2 to 5-9)

- Avoid known hardbottom and artificial reef locations

- In addition, a detailed plan has been developed to mitigate potential impacts to marine mammals and sea turtles, both of which are protected under federal law (Marine Mammal Protection Act [MMPA] and ESA). This plan is included in the associated Maritime Strike IHA request and Biological Assessment.

- Visual monitoring would be required during Maritime Strike missions from surface vessels and high-definition video cameras.

  - Trained marine species observers would be aboard at least two of these boats and would conduct species surveys before each test.

  - The area to be surveyed would encompass the largest applicable zone of influence, based on the particular ordnance involved in a given test.

  - Observers would be required to leave the test area 30 minutes in advance of live weapon deployment. Observers would continue to scan for protected marine species from the safety zone periphery, but effectiveness would be limited as the boat would remain at a designated safety station.

  - Mission-related personnel would be within the test area (on boats and the instrumentation barge) on each day of testing well in advance of weapon deployment, typically near sunrise. These personnel would perform a variety of tasks including target preparation, equipment checks, etc., and would opportunistically observe for protected marine species and indicators as feasible throughout test preparation.

  - In addition to vessel-based monitoring, one to three video cameras would be positioned on an instrumentation barge anchored on-site. In addition to monitoring the area for test-specific issues, the camera(s) would also be used to monitor for the presence of protected species. A marine species observer would be located in the Eglin control tower, along with mission personnel, to view the video feed before and during test activities.

- Weather that supports the ability to observe protected marine species is required to effectively implement the surveys.

  - Maritime Strike missions would be delayed or rescheduled if the sea state is greater than moderate breeze, winds 11 to 16 knots; wave height 3.5 to 6 feet; breaking crests, numerous whitecaps at the time of the test.

- The test event would occur no earlier than two hours after sunrise and no later than two hours prior to sunset to ensure adequate daylight for pre- and post-mission monitoring.

- The survey team would consist of a combination of Air Force and civil service/civilian personnel.
    - Vessel-based and video monitoring would be conducted during all test missions (maximum of two missions per day).
    - The Eglin Range Safety Officer, in cooperation with the Santa Rosa Island Tower Control, would coordinate and manage all species observation efforts.
    - Marine mammal sightings and other applicable information would be communicated to tower control.
    - The Safety Officer and tower control would also be in continual contact with the test director throughout the mission and would coordinate information regarding range clearing.
    - Final decisions regarding mission prosecution, including possible test delay or relocation based on marine species sightings, would be the responsibility of the safety officer, with concurrence from the test director.
    - Post-detonation monitoring surveys would be conducted by the same survey personnel that conducted pre-mission surveys and would commence as soon as EOD personnel declare the test area safe. Local coordinators may report stranding data to state and regional coordinators. Any observed dead or injured marine mammal or sea turtle would be reported to the appropriate coordinator.

PUBLIC NOTIFICATION

A public notice was published in the *Northwest Florida Daily News* on 19 April 2013, inviting the public to review and comment on the Draft EA and Draft Finding of No Significant Impact. The public comment period closed on 3 May 2013, and no public comments were received. State agency comments were received and have been addressed in Appendix C, *Public and Agency Outreach*, of the Final EA.

FINDING OF NO SIGNIFICANT IMPACT

Based on my review of the facts and the environmental analysis contained in the attached EA, and as summarized above, I find that the proposed decision of the Air Force to conduct live ordnance testing in the Gulf of Mexico (GOM) as part of the 53d Wing Maritime Strike Operations Tactics Development and Evaluation Program, will not have a significant impact on the human or natural environment; therefore, an environmental impact statement is not required. This analysis fulfills the requirements of the NEPA, the President's CEQ, and 32 CFR Part 989.

Anthony A. Higdon

ANTHONY A. HIGDON, Colonel, USAF
Commander, 96th Civil Engineer Group

30 May 13
Date

MARITIME STRIKE OPERATIONS TACTICS DEVELOPMENT AND EVALUATION
EGLIN AIR FORCE BASE, FLORIDA

FINAL
ENVIRONMENTAL ASSESSMENT

Submitted to:

AFMC 96 CEG/CEVSP
Eglin Air Force Base, Florida 32542-6808

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RCS 11-491

May 2013

EXECUTIVE SUMMARY

This Environmental Assessment (EA) analyzes and presents the potential environmental consequences associated with the conduct of live ordnance testing in the Gulf of Mexico (GOM) as part of the 53d Wing Maritime Strike Operations Tactics Development and Evaluation (TD&E) Program. The Air Force proposes to employ live munitions against operationally representative high-speed remotely controlled boat targets. The purpose of the Proposed Action is to continue the development of tactics, techniques and procedures (TTP) for Air Force strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. The Proposed Action is needed because current weaponeering systems do not accurately model air-launched weapon detonations on or under water.

A description of each alternative is provided below. The differences between the alternatives pertain to the number of live munitions used, and different depth scenarios. All other aspects of the alternatives (with the exception of the No Action Alternative) would be the same.

Analysis of Proposed Action: (Preferred Alternative)

The Proposed Action, which is the Preferred Alternative, is for the 96th Test Wing (96 TW) commander to authorize the use of multiple types of live munitions in the EGTTR against small boat targets for all desired surface and depth scenarios, to a maximum depth of 10 feet, for the Maritime Strike Operations TD&E Program. Primary environmental impacts would consist of noise and pressure effects to marine species resulting from detonations at and under the water surface. Acoustic analysis indicates the potential for mortality, injury, and harassment of protected dolphin and sea turtle species due to detonations, although mortality estimates are for less than one animal of any species. Impacts to other biological resources, safety/restricted access issues, socioeconomics, and physical resources would not be significant. Eglin AFB would employ management actions to decrease the potential for impacts to environmental resources as well as human safety, including the use of safety boats, aircraft, and high-definition video cameras to ensure the test area is clear. Eglin has consulted with the National Marine Fisheries Service (NMFS) regarding management actions that would decrease the potential for impacts to dolphins and turtles, and has obtained incidental take authorizations for these species. It is expected that mortalities to marine species would be avoided through implementation of these actions.

Analysis of Alternative 1: Reduced Number of Detonations

Under Alternative 1, the overall number of live munitions would be decreased, including the number of subsurface detonations. Environmental impacts would generally be similar in scope to those described for the Proposed Action. However, the likelihood of impacts to protected dolphin and sea turtle species, as well as the number of individuals possibly affected, would decrease due to the reduced number of detonations.

Analysis of Alternative 2: Reduced Number of and No Subsurface Detonations

Under Alternative 2, the total number of live munitions would decrease relative to the Proposed Action, although the number would be slightly higher than under Alternative 1. However, there would be no subsurface detonations. Environmental impacts would generally be similar to those described for the Proposed Action. However, the likelihood of impacts to protected marine species, as well as the number of individuals possibly affected, would decrease substantially due to the absence of underwater detonations.

Analysis of No Action Alternative:

Under this alternative, Maritime Strike testing with live ordnance would not occur at Eglin AFB.

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LIST OF ACRONYMS AND ABBREVIATIONS

46 OG/OGMTP	46th Test Wing Precision Strike Division
96 TW	96th Test Wing
96 CEG/CEVH	96th Civil Engineer Group/Cultural Resources Branch
AFB	Air Force Base
AFSOC	U.S. Air Force Special Operations Command
AGL	above ground level
AGM	air-to-ground missile
BA	Biological Assessment
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practices
BO	Biological Opinion
CAF	Combat Air Force
CATEXed	categorically excluded
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO	carbon monoxide
CO_2	carbon dioxide
CV	Coefficient of Variation
CZMA	Coastal Zone Management Act
EA	Environmental Assessment
EFD	Energy flux density
EFH	essential fish habitat
EGTTR	Eglin Gulf Test and Training Range
EO	Executive Order
EOD	Explosive Ordnance Disposal
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDEP	Florida Department of Environmental Protection
FMC	fishery management councils
FMP	Fishery Management Plan
FWS	Fighter Weapons Squadron
FY	fiscal year
GBU	Guided Bomb Unit
GIS	geographical information system
GIWW	Gulf Intracoastal Waterway
GMFMC	Gulf of Mexico Fishery Management Council
GOM	Gulf of Mexico
GSMFC	Gulf States Marine Fisheries Commission
HAPC	Habitat Areas of Particular Concern
Hz	hertz
IHA	Incidental Harassment Authorization
In-lb/in^2	inch-pounds per square inch
J/m^2	Joules per square meter
JASSM	Joint Air-to-Surface Stand-Off Missile
JUON	Joint Urgent Operational Need
kHz	kiloHertz
km	kilometers
MBTA	Migratory Bird Treaty Act
mm	millimeters
MMPA	Marine Mammal Protection Act
MTS	Maritime Transportation System
NAAQS	national ambient air quality standards

LIST OF ACRONYMS AND ABBREVIATIONS, CONT'D

NDAA	National Defense Authorization Act
NEODS	Naval Explosive Ordnance Disposal School
NEPA	National Environmental Policy Act
NEW	net explosive weight
NM	nautical miles
NM^2	square nautical miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOTMAR	Notice to Mariners
NSWC PCD	Naval Surface Warfare Center, Panama City Division
Pa-s	Pascal-second
PBR	Potential Biological Removal
psi	per square inch
psi-msec	per square inch per millisecond
psw	Precision Strike Weapon
pts	permanent threshold shift
RCRA	Resource Conservation and Recovery Act
RDX	Research Department Explosive
ROI	region of influence
SDB	Small-diameter bomb
SEFSC	Southeast Fisheries Science Center
SEL	Sound exposure level
SOPGM	Stand-off precision guided munition
SST	Sea Surface Temperature
TD&E	Tactics Development and Evaluation
TM	tympanic-membrane
TNT	trinitrotoluene
TTP	tactics, techniques and procedures
TTS	Temporary threshold shifts
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
W-	Warning Area
W-151	Warning Area 151
WSEP	Weapon Systems Evaluation Program
ZOI	Zone of Influence

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1. PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

This Environmental Assessment (EA) analyzes and presents the potential environmental consequences associated with the conduct of live ordnance testing in the Gulf of Mexico (GOM) as part of the 53d Wing Maritime Strike Operations Tactics Development and Evaluation (TD&E) Program. This EA is prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, the Council on Environmental Quality (CEQ) regulations implementing NEPA (40 Code of Federal Regulations [CFR] 1500–1508), and Air Force regulations implementing NEPA procedures (32 CFR 989). Figure 1-1 depicts the regional setting of this action.

1.2 BACKGROUND

There has been limited Air Force aircraft and munitions testing on engaging and defeating small boat threats, which have increased in recent years. Small boats can carry a variety of weapons, including anti-ship missiles, unguided rockets, guns and suicide charges. Because of their low cost, small boats can be employed in large or small numbers by any nation or group. They are difficult to locate and track, and successful engagement in the marine environment in all weather conditions presents unique challenges to the military.

1.3 PROPOSED ACTION

The Air Force proposes to employ live munitions against operationally representative stationary and high-speed remotely controlled boat targets. Figure 1-2 depicts the location of the Proposed and Alternative Actions. More detailed information regarding the Proposed and Alternative Actions is provided in Chapter 2, Description of Proposed Action and Alternatives.

1.4 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the Proposed Action is to continue the development of tactics, techniques and procedures (TTP) for U.S. Air Force strike aircraft to counter small maneuvering maritime targets in order to better protect U.S. and other vessels or assets from small boat threats. The Proposed Action is needed because current weaponeering systems do not accurately model air-launched weapon detonations on or under water. Damage effects of these conditions must be known to generate TTPs to engage small moving boats. The test objectives are to (1) generate useable weaponeering data against small boats; (2) develop TTPs to engage small boats in all weather; and (3) determine the impact of TTPs on Combat Air Force (CAF) training. The 53d Wing will use the results of the test to develop publishable TTPs for inclusion in Air Force TTP 3-1 series manuals. Maritime Strike testing is a high national defense priority, being the fourth-highest project within the Air Force (as of November 2012). In addition, the project is categorized as a Joint Urgent Operational Need (JUON). A JUON is defined as an urgent operation need identified by a combatant commander that, if not addressed immediately, will seriously endanger personnel or pose a major threat to ongoing operations.

Figure 1-1. Eglin Air Force Base and Surrounding Region

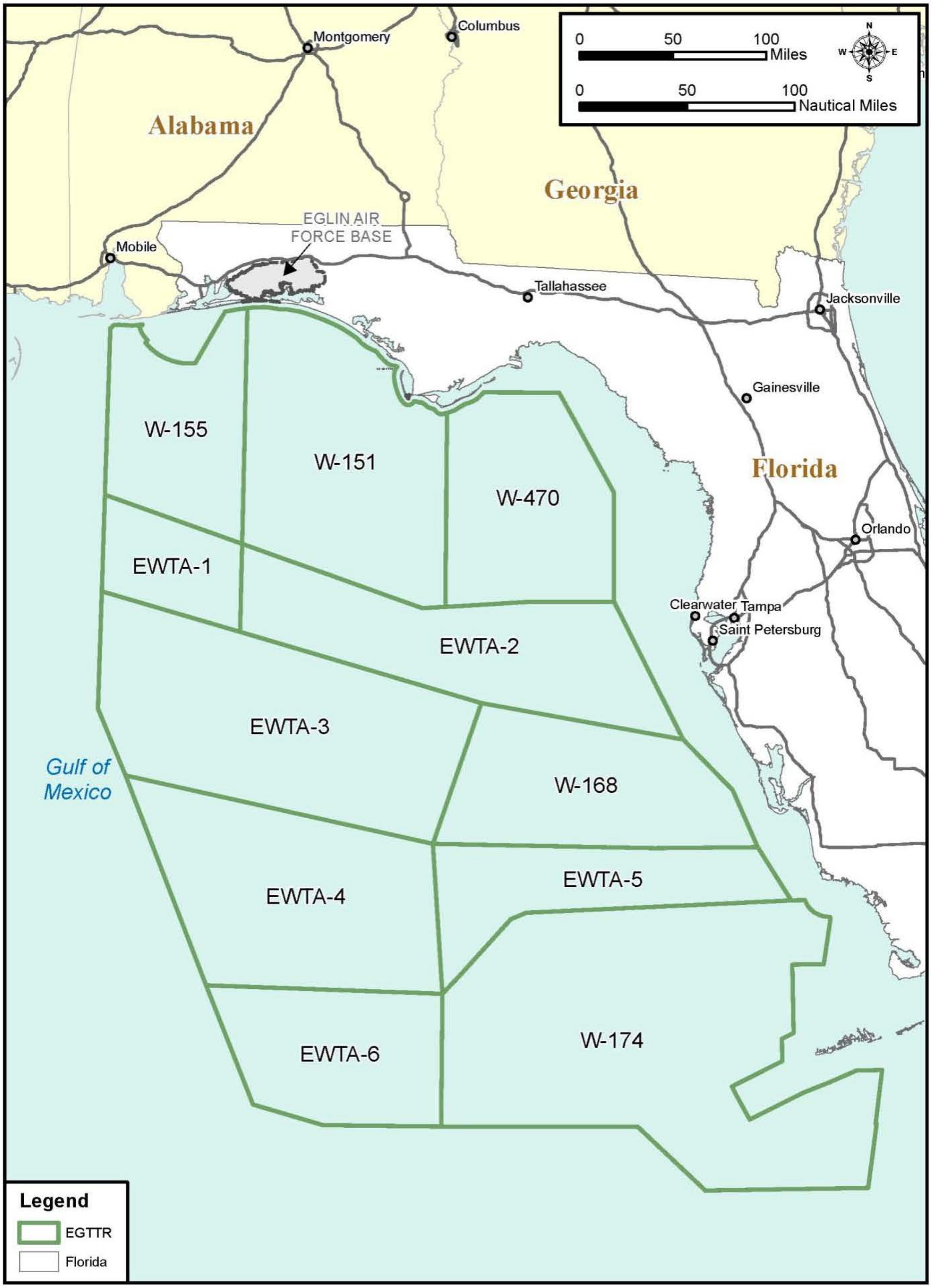

Figure 1-2. Eglin Gulf Test and Training Range (EGTTR)

1.5 SCOPE OF THE PROPOSED ACTION

The region of influence (ROI) for this analysis is Warning Area 151 (W-151) in the Eglin Gulf Test and Training Range (EGTTR) (Figure 1-2), which includes approximately 10,000 square nautical miles (NM^2) of GOM waters from 3 to 100 miles offshore of Santa Rosa Island. Maritime Strike operations include use of live munitions, aircraft operations, and restricted access to areas of W-151. Test missions would occur over an approximate two- to three-week period during the summer of 2013. This document encompasses only operations associated with Maritime Strike in the GOM; overland air operations and other activities over the GOM are addressed separately in other NEPA documents. Analysis addresses potential impacts due to Maritime Strike activities that could affect environmental resources located above, at, and below the GOM water surface. The military mission has been broadly identified as the effector of environmental impacts and the EGTTR environment has been identified as the receptor. Evaluation and quantification of this effector/receptor relationship is the scientific basis for the environmental analysis performed in this report.

1.6 DECISION DESCRIPTION

The Air Force desires to authorize Maritime Strike testing activities in the EGTTR. As described in Chapter 2, alternatives considered pertain to both the number of live detonations and the height/depth of live detonations; also included is a No Action Alternative. Therefore, a decision is to be made on the level of activity to be authorized.

1.7 ISSUES

An issue, as discussed in this document, is an effect of a mission activity that may directly or indirectly impact physical, biological, and/or cultural environment resources. A *direct* impact is a distinguishable, evident link between an action and the potential impact, whereas an *indirect* impact may occur later in time and/or may result from a direct impact.

Potential environmental impacts of alternative actions on GOM resource areas were identified through preliminary investigation. Resource areas eliminated from further analysis are discussed in Section 1.7.1. Resource areas identified for detailed analysis are described in Section 1.7.2, with narratives providing a summary of the preliminary screening for potential impacts.

1.7.1 Resource Areas Eliminated from Detailed Analysis

Air Quality

Air quality, with respect to those pollutants for which the U.S. Environmental Protection Agency (USEPA) has promulgated National Ambient Air Quality Standards (NAAQS) and/or the Florida Department of Environmental Protection (FDEP) has promulgated an ambient standard, was eliminated as a potential issue. Under existing conditions, the ambient air quality in Okaloosa and surrounding counties is classified as attainment for all NAAQS as promulgated by USEPA. Testing activities would release emissions from munitions use, surface craft, and aircraft. However, due to the comparatively small number of shots per year and the short duration of each test event, emissions are not anticipated to have any impact on ambient air quality in Okaloosa and surrounding counties.

Cultural Resources

Maritime Strike activities would occur over offshore waters of the GOM. The National Oceanic and Atmospheric Administration's (NOAA) Automated Wreck and Obstruction Information System was consulted to determine areas of avoidance to ensure testing would not impact cultural resources. No shipwrecks or other obstructions were found within the planned area of activity. Furthermore, in April 2013, Eglin Cultural Resources conducted a remote sensing survey of a 1-mile square region around the target area using side-scan sonar, a magnetometer, and a sub-bottom profiler to confirm the presence or absence of potential historic shipwrecks. Side-scan sonar provides high-quality images of the sea floor and objects on the floor, while the sub-bottom profiler detects objects on and below the sea floor. The magnetometer determines the magnetic signature of any detected objects, so that there is high confidence in discriminating underwater objects. Survey results revealed the target area to be sandy with no discernible structures or objects. Therefore, historic shipwrecks will be avoided and the issue of cultural resources was not carried forward for detailed analysis.

Airspace

Airspace was eliminated as a potential issue because the Proposed Action would occur in airspace designated as warning areas of the EGTTR and established for the purpose of military testing and training. The Proposed Action would be conducted in accordance with established Air Force procedures for air-to-surface testing in the EGTTR, and through coordination with the Federal Aviation Administration (FAA).

Noise Impacts to the Public

Noise impacts to the public were eliminated as a potential issue because the Air Force will establish a safety footprint around the target area that encompasses all potentially harmful in-air noise from detonations. Members of the public will not be allowed to enter the safety footprint. Additionally, mission support personnel will likewise maintain a safe distance from the target area.

Hazardous Waste

Generally, conventional explosive ordnance testing does not constitute hazardous waste as regulated by the Resource Conservation and Recovery Act (RCRA) (UXOINFO, 2013). Similarly, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) does not apply directly to unexploded ordnance (UXO) sites because, under most conditions, UXO are considered a solid waste and not a hazardous waste. However, the number and type of munitions expended on Eglin ranges, including munitions associated with Maritime Strike testing, must be recorded and reported each year pursuant to the Emergency Planning and Right-To-Know Act. In addition, the proponent is responsible for reporting and funding all costs associated with chemical and fuel spills during test events. All spills, regardless of quantity, are to be reported immediately to 96 CEG/CEVC at (850) 240-1828.

1.7.2 Resource Areas Identified for Detailed Analysis

Safety

The issue of safety pertains to hazards from the Proposed Action to military personnel and the public. Such hazards include the delivery of live ordnance, live detonations and the possibility of creating UXO from munitions that fail to detonate. In addition, floating debris could present a hazard to boat traffic. The analysis identifies the potential safety hazards and also discusses restricted access areas established by the Air Force to ensure the safety of the public.

Socioeconomics/Environmental Justice

Potential socioeconomic impacts are closely related to the restricted access issue described above, and environmental justice. Periodic closure of portions of the GOM could potentially impact the availability of these areas for commercial fishing or other economic activity.

Environmental justice addresses the potential for a proposed federal action to cause disproportionately high and adverse health effects on minority populations or low-income populations, including children. The analysis examines the demographics of potentially affected commercial and recreational users, and whether they comprise minority or low-income groups.

Physical Resources

Physical resources, which include water and sediments, would potentially be exposed to explosive by-products, target materials and residues, and petroleum products. Liquid, solid, and gaseous substances released into the environment from Maritime Strike missions would consist of organic and inorganic materials that may produce a chemical change or toxicological effect to the environment. Although some mission-related debris would float on the water surface, some percentage, such as destroyed targets, munitions fragments, and unexploded bombs, would be a source of debris that would be deposited into GOM waters and ultimately onto the seafloor.

Biological Resources

Noise from detonations is the primary issue with regard to potential effects to biological resources. Noise may produce stress reactions or behavioral changes (avoidance of the area) in wildlife species, and may cause hearing loss or damage. Analyses of potential noise impacts include discussions of two noise components: pressure waves and acoustic sound. Direct impact to a biological resource from a munition or moving target boat, while theoretically possible, is so unlikely as to be discountable.

1.8 REGULATORY COMPLIANCE

This EA has been prepared in accordance with NEPA, which requires a detailed environmental analysis for major federal actions with the potential to significantly affect the quality of the human and natural environments on land ranges and within U.S. territorial waters. As defined in this document, territorial waters extend from shoreline seaward to 22.2 kilometers (km) (12 nautical miles [NM]).

This document was also prepared in accordance with Executive Order (EO) 12114, *Environmental Effects Abroad of Major Federal Actions*, which requires environmental documentation for effects to resources seaward of U.S. territorial waters. As defined in this document, nonterritorial waters extend beyond 22.2 km (12 NM). The action affects resources that utilize both territorial and nonterritorial waters.

In addition to NEPA and EO 12114, this document complies with a variety of other environmental regulations. The following subsections provide a brief description of the environmental requirements most relevant to this EA.

1.8.1 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) established, with limited exceptions, a moratorium on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction. The act further regulates "takes" of marine mammals in the high seas by vessels or persons under U.S. jurisdiction. The term *take*, as defined in Section 3 (16 United States Code [USC] 1362) of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." *Harassment* was further defined in the 1994 amendments to the MMPA, which provided for two levels thereof, Level A (potential injury) and Level B (potential disturbance).

The National Defense Authorization Act (NDAA) of fiscal year (FY) 2004 (Public Law 108-136) amended the definition of harassment for military readiness activities. Military readiness activities, as defined in Public Law 107-314, Section 315(f), includes all training and operations related to combat, and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat. This definition, therefore, includes Maritime Strike activities occurring in the EGTTR Study Area. The amended definition of harassment for military readiness activities, as applied in this EA, is any act that:

- Injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment), or
- 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 behavioral patterns are abandoned or significantly altered (Level B harassment) (16 USC 1362 [18][B][i],[ii]).

Section 101(a)(5) of the MMPA directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing) within a specified geographic region. These incidental takes may be allowed if the National Marine Fisheries Service (NMFS) determines the taking will have a negligible impact on the species or stock and the taking will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses. Accordingly, Eglin has requested an Incidental Harassment Authorization (IHA) from NMFS to authorize takes of marine mammal species by harassment only. An IHA does not authorize takes by mortality.

1.8.2 Endangered Species Act

The Endangered Species Act (ESA) (16 USC 1531–1543) applies to federal actions in two separate respects. First, the ESA requires that federal agencies, in consultation with the responsible wildlife agency (i.e., NMFS), ensure that proposed actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of a critical habitat (16 USC 1536 [a][2]). Regulations implementing the ESA expand the consultation requirement to include those actions that "may affect" a listed species or adversely modify critical habitat.

Second, if an agency's proposed action would take a listed species, then the agency must obtain an incidental take statement from the responsible regulatory agency (i.e., NMFS). The ESA defines the term *take* to mean "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt any such conduct" (16 USC 1532[19]). The regulatory definitions of *harm* and *harass* are relevant to the Air Force's determination as to whether the proposed Maritime Strike activities would result in adverse effects on listed species.

- Harm is defined by regulation as "an act which actually kills or injures" fish or wildlife (50 CFR 222.102).
- Harass is defined by regulation to mean 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 behavioral patterns which include, but are not limited to, breeding, feeding or sheltering" (50 CFR 17.3).

As part of the environmental documentation for this EA, the Air Force entered into formal consultation with NMFS because certain actions under the Proposed Action would result in a "may affect" finding for listed species or designated critical habitat. Formal consultation began with the Air Force submitting a Biological Assessment (BA) to NMFS. Consultation ends once NMFS prepares a final Biological Opinion (BO) and issues an Incidental Take Statement, if required.

1.8.3 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 et seq.) was enacted to conserve and restore the nation's fisheries, and includes a requirement for NMFS and regional fishery councils to describe and identify essential fish habitat (EFH) for all species that are federally managed. EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Under the Act, federal agencies must consult with NMFS regarding any activity or proposed activity that is authorized, funded, or undertaken by the agency that may adversely affect EFH. An EFH assessment has been provided to NMFS' Southeast Fisheries Science Center in the Maritime Strike Biological Assessment. As described in Chapter 4, no adverse effects to EFH are anticipated from Maritime Strike mission activities.

1.8.4 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) provides assistance to states, in cooperation with federal and local agencies, for developing land and water use programs for their respective coastal zone. State territorial waters extend outward from the baseline (generally the shoreline) to a distance of 5.6 km (3 NM) on the east coast of Florida, and from the shoreline out to 16.7 km (9 NM) on the west coast of Florida.

The CZMA requires all federal agency activities that affect any land or water use, or natural resource of the coastal zone, be conducted in a manner consistent, to the maximum extent practicable, with the enforceable policies of the NOAA-approved state management program. This includes protecting natural resources and managing coastal development. In accordance with the CZMA, both direct and indirect effects are considered, and it is not required that the effects be adverse.

In accordance with 15 CFR 930.41, the state agencies have 60 days from receipt of this document to concur with or object to this Consistency Determination, or to request an extension, in writing, under 15 CFR 930.41(b). The federal agency may presume state agency concurrence if the state agency's response is not received within 60 days from receipt of the federal agency's consistency determination and supporting information.

The Air Force prepared a Consistency Determination for the State of Florida (Appendix A). The Air Force received a letter from the Florida State Clearinghouse which provided concurrence with this Consistency Determination.

1.8.5 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) was enacted to ensure the protection of shared migratory bird resources. The MBTA prohibits the intentional take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, any migratory bird or its egg, part, or nest, except as authorized under a valid permit. Current regulations authorize permits for the intentional taking of migratory birds for activities such as scientific research, education, and depredation control. However, these regulations do not expressly authorize the incidental taking of migratory birds resulting from actions where the take was not the intent of the action. The MBTA protects a total of 836 bird species, 58 of which are currently legally hunted as game birds.

Section 315 of the 2003 NDAA, "Incidental Taking of Migratory Birds during Military Readiness Activities," (Public Law 107-314, Section 315) required the Secretary of the Interior to promulgate regulations to exempt the Armed Forces for the incidental taking of migratory birds during military readiness activities. This task was delegated to the U.S. Fish and Wildlife Service (USFWS), who published a final rule in the *Federal Register* (effective March 30, 2007), which directly amended 50 CFR 21, *Migratory Bird Permits*, to authorize takes resulting from otherwise lawful military readiness activities (USFWS, 2007). This rule does not authorize takes under the ESA, and USFWS retains the authority to withdraw or suspend the authorization for incidental takes occurring during military readiness activities under certain circumstances.

Under this rule, the Air Force is still required under NEPA to consider the environmental effects of its actions and assess the adverse effects of military readiness activities on migratory birds. If it is determined that the Proposed Action may result in a significant adverse effect on a population of a migratory bird species, the Air Force will consult with USFWS to develop and implement appropriate conservation measures to minimize or mitigate these effects. Conservation measures, as defined in 50 CFR 21.3, include project designs or mitigation activities that are reasonable from a scientific, technological, and economic standpoint, and are necessary to avoid, minimize, or mitigate the take of migratory birds or other adverse impacts. Furthermore, a significant adverse effect on a population is defined as an effect that could, within a reasonable period of time, diminish the capacity of a population of a migratory bird species to sustain itself at a biologically viable level. Based on the analysis provided in Chapter 4, which shows that no adverse effects to migratory birds are anticipated, the Air Force is not planning consultations with USFWS under this act.

1.8.6 Clean Water Act

The Clean Water Act, as amended in 1972, regulates point and non-point source pollutant discharges into navigable waters of the United States. The USEPA controls pollutant discharges through the National Pollutant Discharge Elimination System permit program. As described in Section 3.3, there would be no significant impacts to water quality resulting from the Proposed Action. It is not anticipated that a permit would be required under the Clean Water Act.

2. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION (ALL SCENARIOS)

The Proposed Action, which is the preferred alternative, is for the 96th Test Wing (96 TW) commander to authorize use of multiple types of live munitions in the EGTTR against small boat targets, for all desired surface and water depth scenarios for the Maritime Strike Operations Tactics Development and Evaluation program.

The initial phases of the Maritime Strike program focused on detecting and tracking boats using various sensors, simulated weapons engagements, and testing with inert (containing no explosives) munitions. These actions were reviewed under the Eglin Environmental Impact Analysis Process and categorically excluded (CATEXed) off the *Eglin Gulf Test and Training Range Programmatic Environmental Assessment* (RCS 97-048). The Proposed Action represents the final phase of testing the effectiveness of live (containing explosive charges) munitions on small boat threats. Live munitions testing would include three fuzing options: detonation above the water surface, at the water surface, and below the water surface (two depths). The tests would occur on weekdays over a period of two to three weeks, with a maximum of two tests per day. Test events would be conducted in various sea states and weather conditions, up to a wave height of approximately 4 feet.

2.1.1 Test Methods and Procedures

All Maritime Strike missions would occur in the EGTTR in the northern GOM, at a location approximately 16.7 miles (14.5 nautical miles) offshore from Santa Rosa Island. The EGTTR is more accurately defined as the airspace over the GOM controlled by Eglin Air Force Base (AFB), beginning at a point 3 NM from shore. The EGTTR is subdivided into blocks consisting of Warning Areas W-155, W-151, W-470, W-168, and W-174, as well as Eglin Water Test Areas 1 through 6. Figure 2-1 shows the target location within W-151 and the surrounding notional composite safety footprint, developed to encompass the flight and impact characteristics of all Maritime Strike munitions. The actual safety footprint could be smaller or larger and shaped differently than the composite safety footprint, depending on the specific munitions and launch conditions.

Pre-Test Target Area Clearance Procedures for People and Protected Species

Non-mission personnel, such as recreational and commercial fishermen, would be advised to avoid the safety footprint while it is active, which is expected to be approximately four hours per test (a maximum of two tests per day could occur). Safety support vessels would be contracted by 96 RANSS to facilitate range clearance. If a non-participating vessel entered the hazard area, support vessel crews would attempt to contact the vessel and direct it to maneuver away from the hazard area. The Eglin Safety Office would monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. To inform the public, the Eglin Safety Office would request that the Coast Guard release a Notice to Mariners (NOTMAR) prior to the closure of the safety footprint around the target location. In addition, 96 RANSS personnel may also distribute flyers at the public docks explaining why the area would be closed.

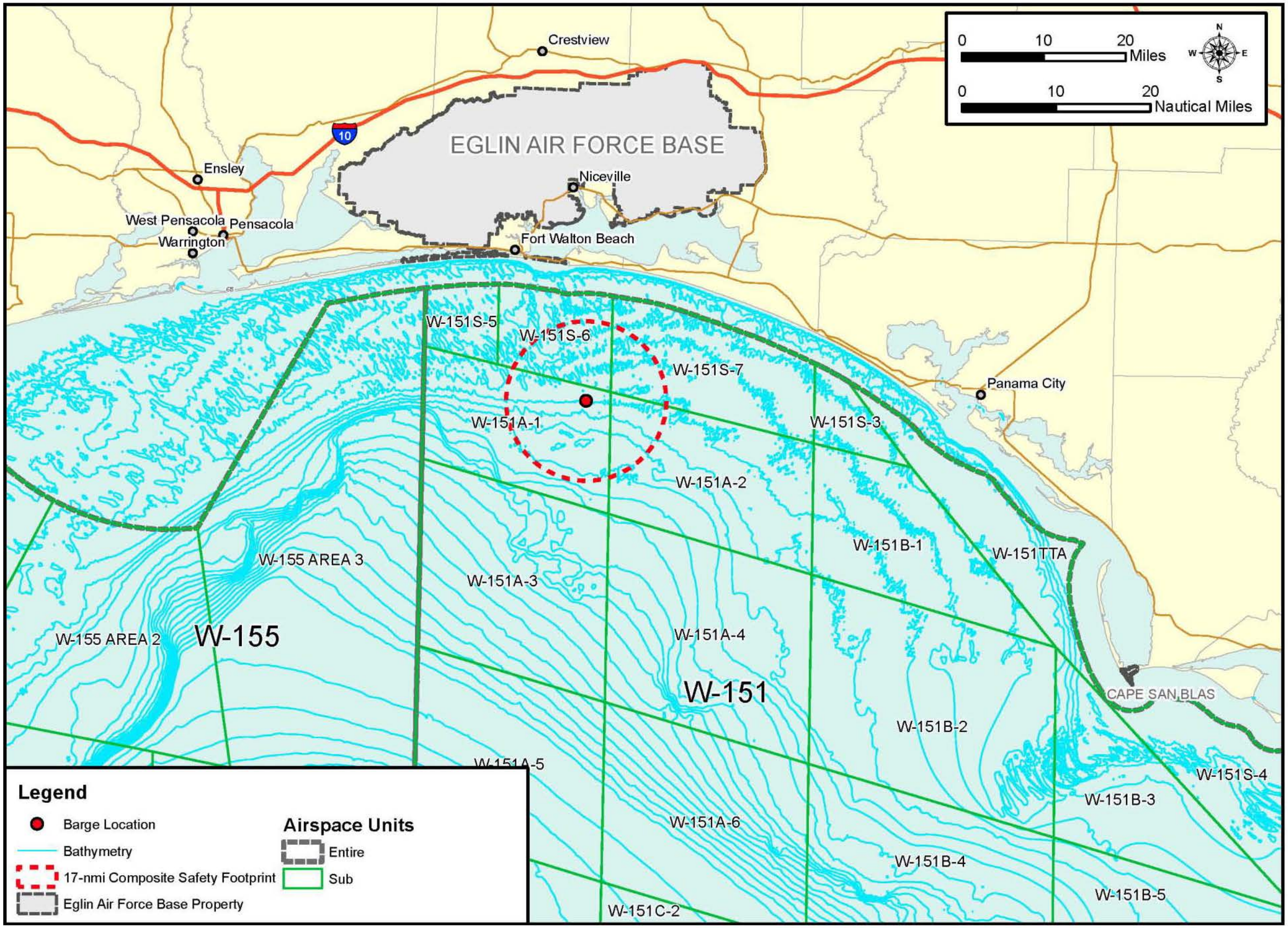

Figure 2-1. Proposed Location for Live Maritime Strike Tests

Before ordnance delivery, aircraft would make surveillance passes to ensure recreational and commercial vessels are clear of the danger area. The surveillance may consist of mission aircraft (weapon delivery or chase aircraft) making a dry run over the target area (at least two aircraft would participate in each test), although this action would not necessarily be performed for all tests. Alternatively, an E-9A surveillance aircraft would survey the target area for nonparticipating vessels and other objects on the water surface. A separate zone around the target would also be established for the protection of marine species, based on the results of acoustic impacts analysis for live ordnance detonations (approximate maximum radius of 2.2 miles). At least two of the support vessels would conduct marine species surveys of the target area. Missions would not proceed until the target area is determined to be clear of unauthorized personnel and protected species.

In addition to vessel-based monitoring, one to three video cameras would be positioned on an instrumentation barge anchored on-site. The camera configuration and actual number of cameras used would depend on the specific test being conducted. The camera(s) are typically used for situational awareness of the target area and surrounding area, and could also be used for monitoring the test site for the presence of marine species. Standard video frame resolution is 1024 x 800 pixels. A marine species observer would be located in the Eglin control tower, along with mission personnel, to view the video feed before and during test activities. The distance to which objects can be detected at the water surface by use of the cameras is generally comparable to that of the human eye.

Test Procedures and Scenarios

The Air Force proposes to employ multiple munitions and aircraft to meet the objectives of the Maritime Strike program (Table 2-1). Because the tests would focus on weapon/target interaction, no particular aircraft would be specified for a given test as long as it met the delivery parameters. The munitions would be deployed against static, towed, and remotely controlled boat targets. Static and controlled targets would consist of stripped boat hulls with plywood simulated crews and systems. Damaged boats may be recovered for data collection, but target boats may also be sunk. Test data collection and operation of remotely controlled boats would be conducted from the instrumentation barge anchored on-site, which would also provide a platform for cameras and weapon-tracking equipment. Target boats would be positioned 300 to 600 feet from the instrument barge, depending on the munitions.

Table 2-1. Proposed Live Munitions and Aircraft

Munitions	Aircraft
GBU-10 laser-guided Mk-84 bomb	F-16C fighter aircraft
GBU-24 laser-guided Mk-84 bomb	F-16C+ fighter aircraft
GBU-31 Joint Direct Attack Munition, global positioning system guided Mk-84 bomb	F-15E fighter aircraft
GBU-12 laser-guided Mk-82 bomb	A-10 fighter aircraft
GBU-38 Joint Direct Attack Munition, global positioning system guided Mk-82 bomb	B-1B bomber aircraft
GBU-54 Laser Joint Direct Attack Munition, laser-guided Mk-82 bomb	B-52H bomber aircraft
AGM-65E/L/K/G2 Maverick air-to-surface missile	
AGM-114 Hellfire air-to-surface missile	
M-117 bomb	
PGU-13 high explosive incendiary 30 mm rounds	
M56/PGU-28 high explosive incendiary 20 mm rounds	

AGM = air-to-ground missile; GBU = Guided Bomb Unit; PBU = Projectile Gun Unit; mm=millimeters

Proposed Action (All Scenarios)

Ordnance delivery under the Proposed Action involves the maximum deployment of all live munitions at depths of up to 10 feet under the surface. This level of testing would be expected to provide the intended level of tactics and weapons evaluation, including a number of replicate tests sufficient for an acceptable statistical confidence level regarding munitions capabilities. The number of each type of munition, height or depth of detonation, explosive material, and net explosive weight (NEW) of each munition is provided in Table 2-2.

Table 2-2. Proposed Action (Preferred Alternative)

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – explosive material	Net Explosive Weight per Munition
GBU-10	1	Water Surface: all	MK-84 - tritonal	945 lbs
GBU-24	1	Water Surface: all	MK-84 - tritonal	945 lbs
GBU-31 (JDAM)	13	Water Surface: 4 20 feet AGL: 3 5 feet underwater: 3 10 feet underwater: 3	MK-84 - tritonal	945 lbs (MK-84)
GBU-12	1	Water Surface: all	MK-82 - tritonal	192 lbs
GBU-38 (JDAM)	13	Water Surface: 4 20 feet AGL: 3 5 feet underwater: 3 10 feet underwater: 3	MK-82 – tritonal	192 lbs (MK-82)
GBU-54 (LJDAM)	1	Water Surface: all	MK-82 – tritonal	192 lbs (MK-82)
AGM-65E/L/K/G2 (Maverick)	2 each (8 total)	Water Surface: all	WDU-24/B penetrating blast-fragmentation warhead	86 lbs
AGM-114 (Hellfire)	4	Water Surface: all	High explosive anti-tank (HEAT) tandem anti-armor metal augmented charge	20 lbs
M-117	6	20 feet AGL: 3 Water Surface: 3	750 lb blast/fragmentation bomb, used the same way as MK-82 - tritonal	386 lbs (tritonal)
PGU-12 HEI 30 mm	1,000	Water Surface: all	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A Gun System	0.1 lbs
M56/PGU-28 HEI 20 mm	1,500	Water Surface: all	20 x 120 mm caliber with aluminized Comp A-4 HEI. Designed for M61 and M197 Gun System	0.02 lbs (Comp A-4 HEI)

AGL = above ground level; AGM = air-to-ground missile; GBU = Guided Bomb Unit; JDAM = Joint Direct Attack Munition; LJDAM = Laser Joint Direct Attack Munition; mm = millimeters; lbs = pounds; HEI = high explosive incendiary; PGU = Projectile Gun Unit

2.1.2 Post-Test

Post-test activities would consist of Air Force Explosive Ordnance Disposal (EOD) personnel detonating in place any remaining munitions components or items that would be considered

UXO, including fuzes or intact munitions. The EOD team would be on hand for each test and would give the all clear for mission personnel to re-enter the target area once it has been determined safe. UXO detonated in place could involve the sinking of target vessels. Once the area has been cleared for re-entry, test personnel would retrieve target debris and survey the area for any evidence of adverse impacts to protected marine species. Depending on the specific weapon system used and the location or position of the UXO, the test area could be closed for an extended period of time.

2.2 ALTERNATIVES CONSIDERED

This section introduces the alternatives that will be evaluated for potential environmental impacts in this EA for Maritime Strike activities. The Proposed Action and alternatives, which are analyzed in this document, are:

- **Proposed Action, All Scenarios** (Preferred Alternative): Authorize the total desired number of live munitions, including all desired subsurface detonations (Table 2-2).
- **Alternative 1, Reduced Number of Detonations**: Authorize a reduced number of detonations, including subsurface detonations (Table 2-3).
- **Alternative 2, Reduced Number of Detonations and No Subsurface Detonations**: Authorize a reduced number of detonations, with no subsurface detonations (Table 2-4).
- **No Action Alternative**: Under this alternative, Maritime Strike testing with live ordnance would not occur at Eglin AFB.

The general target location in the EGTTR is not very flexible due to instrumentation and operational constraints, particularly the need to anchor the instrumentation barge and the distance that radio communications are effective. Therefore, the basis of alternative development focused on decreasing potential environmental concerns. A description of each alternative is provided in the following sections. The differences between the alternatives pertain to the number of live munitions used, and different depth scenarios. All other aspects of the alternatives (with the exception of the No Action Alternative) would be the same.

2.2.1 Alternative 1: Reduced Number of Detonations

Under Alternative 1, the overall number of live munitions would be decreased, including the number of subsurface detonations. The number of each type of munition, height or depth of detonation, explosive material, and NEW of each munition is provided in Table 2-3.

2.2.2 Alternative 2: Reduced Number and No Subsurface Detonations

Under Alternative 2, the total number of live munitions would decrease relative to the Proposed Action, although the number would be slightly higher than under Alternative 1. However, there would be no subsurface detonations. The number of each type of munition, height or depth of detonation, explosive material, and NEW of each munition is provided in Table 2-4.

Table 2-3. Alternative 1, Reduced Number of Detonations

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – explosive material	Net Explosive Weight per Munition
GBU-10	1	Water Surface: all	MK-84 - tritonal	945 lbs
GBU-24	1	Water Surface: all	MK-84 – tritonal	945 lbs
GBU-31 (JDAM)	8	Water Surface: 3 20 feet AGL: 2 5 feet underwater: 2 10 feet underwater: 1	MK-84 – tritonal	945 lbs (MK-84)
GBU-12	1	Water Surface: all	MK-82 – tritonal	192 lbs
GBU-38 (JDAM)	8	Water Surface: 3 20 feet AGL: 2 5 feet underwater: 2 10 feet underwater: 1	MK-82 – tritonal	192 lbs (MK-82)
GBU-54 (LJDAM)	1	Water Surface: all	MK-82 – tritonal	192 lbs (MK-82)
AGM-65E/L/K/G2 (Maverick)	2 each (8 total)	Water Surface: all	WDU-24/B penetrating blast-fragmentation warhead	86 lbs
AGM-114 (Hellfire)	3	Water Surface: all	HEAT tandem anti-armor metal augmented charge	20 lbs
M-117	3	Water Surface: all	750 lb blast/fragmentation bomb, used the same way as MK-82 - tritonal	386 lbs (tritonal)
PGU-12 HEI 30 mm	1,000	Water Surface all	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A gun system.	0.1 lbs
M56/PGU-28 HEI 20 mm	1,500	Water Surface all	20 x 120 mm caliber with aluminized Comp A-4 HEI. Designed for M61 and M197 gun system.	0.02 lbs (Comp A-4 HEI)

AGL = above ground level; AGM = air-to-ground missile; mm = millimeters; lbs = pounds; HEI = high explosive incendiary; JDAM = Joint Direct Attack Munition; LJDAM = Laser Joint Direct Attack Munition; PGU – Projectile Gun Unit

Table 2-4. Alternative 2, Reduced Number and No Subsurface Detonations

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – explosive material	Net Explosive Weight per Munition
GBU-10	1	Water Surface: all	MK-84 – tritonal	945 lbs
GBU-24	1	Water Surface: all	MK-84 - tritonal	945 lbs
GBU-31 (JDAM)	7	Water Surface: 4 20 feet AGL: 3	MK-84 – tritonal	945 lbs (MK-84)
GBU-12	1	Water Surface: all	MK-82 – tritonal	192 lbs
GBU-38 (JDAM)	7	Water Surface: 4 20 feet AGL: 3	MK-82 – tritonal	192 lbs (MK-82)
GBU-54 (LJDAM)	1	Water Surface: all	MK-82 – tritonal	192 lbs (MK-82)
AGM-65E/L/K/G2 (Maverick)	2 each (8 total)	Water Surface: all	WDU-24/B penetrating blast-fragmentation warhead	86 lbs

Table 2-4. Alternative 2, Reduced Number and No Subsurface Detonations (Cont'd)

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – explosive material	Net Explosive Weight per Munition
AGM-114 (Hellfire)	4	Water Surface: all	High explosive anti-tank (HEAT) tandem anti-armor metal augmented charge	20 lbs
M-117	6	20 feet AGL: 3 Water Surface: 3	750 lb blast/fragmentation bomb, used the same way as MK-82 - tritonal	386 lbs (tritonal)
PGU-12 HEI 30 mm	1,000	Water Surface: all	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A gun system.	0.1 lbs
M56/PGU-28 HEI 20 mm	1,500	Water Surface: all	20 x 120 mm caliber with aluminized Comp A-4 HEI. Designed for M61 and M197 gun system.	0.02 lbs (Comp A-4 HEI)

AGL = Above Ground Level; GBU = Guided Bomb Unit; JDAM = Joint Direct Attack Munition; LJDAM = Laser Joint Direct Attack Munition; mm = millimeters; lbs = pounds; HEI = high explosive incendiary; PGU = Projectile Gun Unit

2.2.3 No Action Alternative

Under the No Action Alternative, Maritime Strike testing would not occur at Eglin AFB. The program would not achieve objectives of developing effective methods to counter small boat threats from the air.

2.3 COMPARISON OF ALTERNATIVES

The number of live detonations for each alternative is shown below in Table 2-5. Potential impacts under each alternative are summarized in Table 2-6.

Table 2-5. Number of Live Detonations for Each Alternative

Type of Munition	Number of Live Munitions, Proposed Action	Number of Live Munitions, Alternative 1 Reduced Number	Number of Live Munitions, Alternative 2 Reduced Number, No Subsurface
GBU-10	1	1	1
GBU-24	1	1	1
GBU-31 (JDAM)	13	8	7
GBU-12	1	1	1
GBU-38 (JDAM)	13	8	7
GBU-54 (LJDAM)	1	1	1
AGM-65E/L/K/G2 (Maverick)	2 each (8 total)	2 each (8 total)	2 each (8 total)
AGM-114 (Hellfire)	4	3	4
M-117	6	3	6
PGU-12 HEI 30 mm	1,000	1,000	1,000
M56/PGU-28 HEI 20 mm	1,500	1,500	1,500

AGL = above ground level; AGM = air-to-ground missile; GBU = guided bomb unit; JDAM = joint direct attack munition; LJDAM = laser joint direct attack munition; mm = millimeters; HEI = high explosive incendiary; PGU = projectile gun unit

Table 2-6. Summary of Potential Impacts Under All Alternatives

Resource	Proposed Action (Preferred Alternative)	Alternative 1, Reduced Number of Munitions	Alternative 2, Reduced Number, No Subsurface Detonations	No Action Alternative
Safety/Restricted Access	Non-participating vessels and persons would be kept from the mission area by use of safety boats and Notice To Mariners. The Eglin Air Force Base EOD team would resolve any UXO issues on surface targets. Clearance of the surface by the Eglin EOD team would be required for military and civilian personnel to re-enter target areas. Closure of the mission area would be temporary and intermittent and would not significantly impact recreational or commercial fishing.	Similar to the Proposed Action, nonparticipating personnel would be kept from the mission area, and Air Force EOD personnel would resolve unexploded ordnance issues on surface targets. Impacts to recreational and commercial fishing would be minor and insignificant. The number of live detonations would be less than the number under the Proposed Action.	Similar to the preceding alternatives, nonparticipating personnel would be kept from the mission area, and Air Force EOD personnel would resolve unexploded ordnance issues on surface targets. Impacts to recreational and commercial fishing would be minor and insignificant. The number of live detonations would decrease relative to the Proposed Action, and there would be no underwater detonations.	There would be no significant impacts due to safety or restricted access issues. Maritime Strike activities would not occur.

Table 2-6. Summary of Potential Impacts Under All Alternatives, Cont'd

Resource	Proposed Action (Preferred Alternative)	Alternative 1, Reduced Number of Munitions	Alternative 2, Reduced Number, No Subsurface Detonations	No Action Alternative
Socioeconomics	There would be potential for impacts to socioeconomic activities, including fishing and boating, from restricted access; however implementation of BMPs and continued use of communication services would minimize adverse impacts. Therefore, no significant impacts to socioeconomic resources would be anticipated under the Proposed Action. Additionally, no disproportionate impacts to low-income communities, minorities, or children have been identified under the Proposed Action.	Potential socioeconomic and environmental justice impacts would be similar to those described under the Proposed Action.	The potential socioeconomic and environmental justice impacts would be similar to those described under the Proposed Action.	There would be no potential impacts to socioeconomic and environmental justice resources from additional access restrictions under this alternative
Physical Resources	There would be no significant impacts to physical resources. Impacts to water column and substrate quality would be minor. Detonations would not be of sufficient strength to cause seafloor cratering. Scouring of the seafloor by debris pieces would be minor and would not affect benthic communities. Known hardbottom habitats and artificial reefs will not be affected.	There would be no significant impacts to physical resources. Potential effects would be similar to those described for the Proposed Action, but the number of detonations would decrease.	There would be no significant impacts to physical resources. Potential effects would be similar to those described for the Proposed Action, but the number of detonations would decrease and there would be no underwater detonations.	There would be no significant impacts to physical resources, as Maritime Strike testing would not occur.

Table 2-6. Summary of Potential Impacts Under All Alternatives, Cont'd

Resource	Proposed Action (Preferred Alternative)	Alternative 1, Reduced Number of Munitions	Alternative 2, Reduced Number, No Subsurface Detonations	No Action Alternative
Biological Resources	Marine fish may be injured or killed by detonations, but the number is expected to be negligible relative to overall populations. Maritime Strike activities would occur outside the principle distribution range of ESA-protected fish species, and Gulf sturgeon critical habitat would not be affected. Essential fish habitat would not be significantly impacted. Significant impacts to marine birds, including ESA-listed and migratory species, are not expected. Marine mammals and sea turtles could be exposed to noise or pressure levels resulting in mortality, injury, or harassment. Mitigation measures would decrease the potential for impacts. NMFS has issued a Biological Opinion (Appendix C) and issuance of an Incidental Harassment Authorization and would be obtained before activities commenced.	Impacts would be similar in scope to those described for the Proposed Action. However, the extent of impacts would be less because the number of detonations would decrease. The potential for mortality to marine mammals and sea turtles would be substantially less.	Impacts would be similar in scope to those described for the Proposed Action. However, the extent of impacts would be less because the overall number of detonations would decrease, and there would be no underwater detonations. There would be essentially no potential for mortality to marine mammals or sea turtles.	There would be no significant impacts to biological resources, as Maritime Strike testing would not occur.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 SAFETY/RESTRICTED ACCESS

3.1.1 Definition

Safety refers to the evaluation of risks to public health (both military and civilian) due to direct strikes by weapons, blast effects, UXO, and debris. Injury or death is possible without proper safety precautions. *Restricted access* refers to closure of the test area to recreational and commercial vessels for defined time periods.

3.1.2 Affected Environment

For actions occurring in the EGTTR with inherent safety risks, such as the Maritime Strike test mission, the Air Force implements measures to control the risk to the public. Such measures include the designation of areas as “restricted” or “closed” to the public. The closures are driven by the dimensions of the “safety footprint” of a particular action that may have potentially harmful noise, blast, or other effects. Safety footprints vary based on several factors, including weapon type, flight profile, altitude of delivery, speed, or flight system of the specified test activity.

When applying the individual weapon safety footprints to a test area in the EGTTR, it is generally the policy of the Eglin Range Safety Office to apply a safety buffer called the “impact limit line.” This line is the outermost impact boundary of items generated by the test. The safety buffer not only protects public users from areas potentially impacted by the test activity, but it also buffers the activity from adjacent Gulf uses (e.g., shipping, recreational boating, commercial activities), thereby ensuring public safety and compatible use of the Gulf. The buffer can also attenuate the noise from test area activities, mitigating the impact to adjacent/surrounding user groups.

Restricted access may affect the availability of discreet areas of ocean surface for uses including commercial fishing, recreational fishing, and other recreational activities, such as boating and scuba diving. The EGTTR is composed of several warning areas plus the Eglin Water Test Areas 1 through 6. There are generally no restrictions on public or commercial uses of the surface water under the warning areas unless DoD activities are planned, including activities that require airspace use. These activities must be scheduled through the controlling agency for that airspace. If there is an activity that could be hazardous to public or commercial use of the surface, a local NOTMAR may be issued through the U.S. Coast Guard Service stating the activity and potential hazards, although a NOTMAR is not necessarily requested for all hazardous tests. Even with these notices, it is the responsibility of the testing/training activity to ensure that there is no surface traffic in the area. If there is, aircrews must wait until the area is clear or find another location in the EGTTR that is clear of traffic. Due to the level of cooperation provided by local commercial and public users of the surface and the offshore nature of EGTTR waters, rescheduling of tests rarely occurs.

3.1.3 Environmental Consequences

3.1.3.1 Proposed Action (Preferred Alternative)

Safety

Maritime Strike missions include the detonation of live weapons, some of which have a large net explosive weight (up to 945 pounds). Therefore, to protect military and civilian personnel, several safety features would be implemented. Safety measures would generally be categorized as test area clearance and UXO disposition, as described below. In addition to on-site safety measures, the Eglin Safety Office Risk Management Board would review the specific test plan approximately one month in advance in order to discuss issues and identify risks. Test plans considered "high risk" would be elevated to the base commander for review

A NOTMAR would be issued in advance of each test and would include a description of the hazard, test area location, and time frame of closure. The NOTMAR would be broadcast on channel 16 through the U.S. Coast Guard. In addition, 96 RANSS personnel would distribute flyers at public docks explaining the closure, and diagramming the area to be closed.

The test area would be cleared of all commercial and recreational boats on the morning of the test. The cleared area would include a safety footprint around the target, the size of which would depend on the particular weapon being tested. The area would be cleared with the assistance of Air Force and contracted safety boats. Safety boats would include a number of local charter fishing boats with crews familiar with the test area, and possibly other commercial vessels operating in the vicinity. The use of local operators is expected to increase cooperation among other nonparticipating vessels. Safety boats would be positioned in a pattern such that unauthorized vessels would be seen if entering the cleared area. Some of the safety boats would be equipped with radar to detect nonparticipating vessels. Safety boat crews would attempt to contact any nonparticipating vessel and direct it to maneuver away from the hazard area. The Eglin Safety Office would monitor real-time activity of surface craft and use this information to make clear-to-arm and clear-to-fire calls as appropriate. Test area clearance would begin at daylight and continue throughout the mission. The safety footprint is expected to be closed for approximately four hours for each test (no more than two tests per day).

In addition to clearance by safety boats, the test area would be surveyed from aircraft prior to the test. Before ordnance delivery, aircraft would make surveillance passes to ensure recreational and commercial vessels are clear of the danger area. The surveillance may consist of mission aircraft (weapon delivery or chase aircraft) making a dry run over the target area (at least two aircraft would participate in each test), although this action would not necessarily be performed for all tests. Alternatively, an E-9A surveillance aircraft based at Tyndall AFB would survey the target area for nonparticipating vessels and other objects on the water surface. Observation effectiveness may vary among aircraft types, with jets and bombers possibly moving at high speed. However, propeller aircraft would be able to fly at slower speeds. The turboprop-driven E-9A aircraft is well suited to observe the GOM surface and is used regularly as a surveillance platform during Air Force missions (U.S. Air Force, 2009). It can be modified with the AN/APS-143(V)-1 Airborne Sea Surveillance Radar (also known as OceanEye™) to detect objects on the ocean surface. This radar allows E-9A operators to detect a person in a life raft up to 25 miles away. Location telemetry data can be transmitted to the range safety officer. Personnel in the E-9A would be able to adequately observe the ocean surface for nonparticipating vessels.

Finally, a limited degree of clearance effort may be conducted from the instrumentation barge. Mission-related personnel would be aboard the barge anchored on-site, up to a certain point prior to the test. A video link would be established between the barge and the target boat. Video controllers would, therefore, have a limited ability to observe the water surface near the target for unauthorized vessels.

There is potential for munitions to fail to detonate, resulting in UXO within the test area. Although the dud rate of the various munitions is not quantified, it is expected to be low (less than five percent), possibly resulting in a small number of unexploded gunnery rounds or larger ordnance remaining on intact target boats or on the sea floor. After the mission, targets still afloat would be inspected by the Eglin EOD team to identify any munitions components that would be considered UXO, including fuzes or intact munitions. UXO would be blown in-place, which could result in sinking of target vessels. Floating non-UXO debris that is not recovered could pose a strike hazard to vessels operating in the area. However, the amount of such material is expected to be small because the Air Force will remove debris to the extent feasible. The Eglin Marine Operations Team would collect as much floating debris from the mission site as possible. Large pieces of the targets, such as boat hulls or large fragments of plywood or other materials, would be towed back to Eglin AFB for analysis. Smaller debris would be collected with dip nets and transported to shore for analysis or disposal. Clearance of surface UXO by the Eglin EOD team would be required prior to military and civilian personnel reentering the target area.

UXO, if present, may also sink to the sea floor. Submerged UXO would pose a safety hazard because of the potential for recovery by members of the public. Once in the marine environment, UXO may be subject to a number of processes including transport, burial, exhumation, encasement, and corrosion/degradation. UXO may be buried upon impact with the sea floor (depending on velocity and sediment characteristics), or may become buried over time due to current-induced sediment movement. Shifting sediments may also cause exposure of previously buried ordnance, and a cycle of repeated burial/exhumation events can occur in some cases. Water currents may transport unburied UXO, potentially resulting in shoreward movement into shallower water. Such movement is more likely for smaller munitions such as gunnery rounds.

If UXO were to migrate out of the test area, it could be encountered by scuba divers or impacted by dredging operations. Dredging periodically occurs south of the Destin Pass and Eglin's Santa Rosa Island property. UXO could also be encountered during fishing operations (for example, bottom trawling during shrimp fishing). In extreme cases, ordnance could eventually reach the shoreline where it would potentially be accessible to a larger number of people, although this would not be likely for the larger munitions. Any of these scenarios would be considered a human safety hazard. The potential for UXO burial or migration is unknown for the specific Maritime Strike test location at this time.

Several factors could decrease the likelihood of impacts due to UXO. Submerged UXO would corrode and degrade over time in the saltwater environment. In some cases, unexploded munitions can become entombed long-term within the seabed. In addition, UXO may be subject to concretion, whereby the munition becomes encased by minerals, metals, or biogenic accretion. Concretion may stabilize the munition to some degree, possibly resulting in decreased likelihood of detonation from physical disturbance, although it may also result in preservation of the detonation mechanisms for some time. Recreational scuba divers would likely encounter UXO only if it migrated to an area containing natural or artificial reefs or other structures where marine life is concentrated.

In summary, a small number of UXO items could possibly be produced during Maritime Strike test activities. These items could be or become accessible to members of the public, thereby posing a human safety hazard. However, Eglin EOD personnel would be present for each test and would neutralize UXO to the extent possible. UXO deposited on the sea floor could be subject to long-term burial in the sediment, and would corrode and degrade over time. The likelihood of migration into areas of increased potential for human access is unquantified at this time; however, a modeling task will be performed and the results will be included in the final EA. Given these factors, there would not be a significant risk to safety resulting from Maritime Strike activities.

Restricted Access

An area of ocean surface would be closed to the public each time a live mission is conducted. The size of the closed area would vary, depending on the net explosive weight of the weapon being tested. The composite safety footprint shown in Figure 2-1 has an area of approximately 301 square miles, which represents about 2 percent of W-151 and 8 percent of W-151A. Closure would generally extend for about four hours per test, over the course of two to three weeks. However, if UXO are present after a test, and depending on the specific weapon system used and the location/configuration of the UXO, the test area could be closed for a longer time period. Compared with the overall area of nearshore Gulf waters available in the region, the closed area would be small and established on an intermittent, short-term basis.

A number of known artificial reefs would likely be inaccessible to recreational and commercial fishermen during test area closure, as well as an additional number of undisclosed reefs. However, commercial and recreational users of the Gulf would generally not be excluded from access to similar nearby resources. Boats would be required to move a moderate distance east or west when coming out of the Destin Pass (average safety zone radius would be less than five miles), which could cause public annoyance. It is unlikely that closure would require a vessel to return to port from limited fishing capability or require a charter fishing company to provide a refund to passengers. There would be no significant impacts to access of the Gulf of Mexico due to Maritime Strike activities.

3.1.3.2 Alternative 1, Reduced Number of Munitions

Impacts to safety and Gulf access under Alternative 1 would be similar to those described for the Proposed Action, with the exception that the overall number of detonations would decrease. Therefore, the resulting number of missions and times of test area closures would be somewhat less. Also, the likelihood of UXO in the test area would be decreased. There would be no significant impacts due to safety or restricted access.

3.1.3.3 Alternative 2, Reduced Number and No Subsurface Detonations

Impacts to safety and Gulf access under Alternative 2 would be similar to those described for the Proposed Action. The overall number of detonations would decrease, and there would be no subsurface detonations. Therefore, the resulting number of missions, times of test area closures, and the possibility of UXO would be somewhat less. There would be no significant impacts due to safety or restricted access.

3.1.3.4 No Action Alternative

Under the No Action Alternative, Maritime Strike activities would not occur. There would be no associated safety concerns or closure of safety footprints. There would be no significant impacts due to safety or restricted access.

3.2 SOCIOECONOMICS

3.2.1 Definition of the Resource

Socioeconomic activities associated with the alternatives are concentrated in the GOM, which is the ROI for this analysis. The major socioeconomic concerns are the potential impacts associated with restricted access to the marine environment. Many recreational and commercial activities take place in the GOM and are an important economic contributor to the coastal communities surrounding the GOM.

Environmental Justice and Special Risks to Children

In 1994, EO 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations (Environmental Justice)*, was issued to focus the attention of federal agencies on how their actions affect the human health and environmental conditions to which minority and low-income populations are exposed. This EO was also established to ensure that, if there were disproportionately high and adverse human health or environmental effects of federal actions on these populations, these effects would be identified and addressed. The environmental justice analysis addresses the characteristics of race, ethnicity, and poverty status for populations residing in areas potentially affected by implementation of the proposed action.

In 1997, EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks (Protection of Children)*, was issued to identify and address anticipated health or safety issues that affect children. The protection-of-children analysis addresses the distribution of population by age in areas potentially affected by implementation of the proposed action.

For the purpose of the environmental justice analysis, these populations are defined as follows:

> **Minority Populations**: All persons identified by the U.S. Census Bureau to be of Hispanic or Latino origin, regardless of race, plus non-Hispanic persons who are Black or

African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, or members of some other (i.e., nonwhite) race or two or more races.

Low-Income Populations: All persons who fall within the statistical poverty thresholds established by the U.S. Census Bureau. For the purposes of this analysis, low-income populations are defined as persons living below the poverty level. Starting with the 2010 decennial census, poverty data will be provided through the annual American Community Survey rather than as part of the decennial census.

Children: All persons identified by the census to be under the age of 18 years.

The affected area is the EGTTR in the northern GOM. The area is located entirely over the GOM and is approximately 17 miles to the shoreline of Santa Rosa Island in Okaloosa County. As such, a characterization of population groups living in the GOM is not applicable. However, impacts on human populations, for example, effects on commercial or recreational fishing, were considered in the analysis of environmental consequences to determine effects on users.

3.2.2 Affected Environment

Recreational Fishing

Recreational fishing effort in the GOM is a popular activity for residents in surrounding GOM communities and visitors. Recreational fishing participation in the Gulf has fluctuated over the past decade but is anticipated to increase over the next several years. In 2011, more than 22 million angler trips were made to the GOM (NMFS, 2012a).

Each state agency regulates the type and number of fish that can be caught and kept, which fish can be caught and released, and the maximum size of each type of fish caught. The species of fish caught also depend on the fishing location and the time of the year. In 2010, the majority of total catch in the Gulf were fished primarily from inland waters, (inshore saltwater and brackish water bodies), (73 percent), followed by state territorial seas, (approximately 10 statute miles from shore) (22 percent), and the federal economic exclusive zone, (State Territorial Seas to 200 nautical miles) (5 percent) (NMFS, 2012b). Certain types of species of fish are available year round.

There are typically two types of recreational fishing participants in the GOM that would have access to the area of influence: private/rental and charter participants. Private recreational participants include those who own a boat or have access to a private or rental boat. Based on a report by the Recreational Boating and Fishing Foundation, in 2008 nearly a third of all fishing participants surveyed for the report owned a boat. In addition, the median age bracket of recreational fishing participants was between 35 to 44 years of age, were male (67.5 percent), had 1 to 3 years of college education (26 percent) or higher, and classified themselves as Caucasian/White (82.4 percent) (RBFF, 2009). In 2010, there were approximately 12,684,737 recreational angler trips made by private/rental boat participates to the Gulf of Mexico with the majority of angler trips by private/rental boat were to inland waters (75 percent), followed by angler trips to state waters (less than 10 miles from shore) (18 percent) (NMFS, 2012c).

The second type of recreational fishing participant in the GOM include those individuals who do not have access to a private boat or choose to hire a charter boat for access to the fisheries. In 2010, the majority of angler trips by charter boat to the GOM were in the federal economic exclusive zone (greater than 10 miles from shore) followed by inland trips (NMFS, 2012c). Charter boats typically operate during the months of May through the month of October, each day beginning at 6:00 AM in the morning. Late morning and early afternoon trips are typically available for 8-, 10-, 12-hour and overnight trips. Rates vary depending on several factors including the length of the trip and the number of persons participating. Charter boat captain salaries are highly dependent on experience, employer, and geographic location. Based on the 2011 Occupational Employment Statistics Survey by the U.S. Bureau of Labor Statistics, “water vessel captains, mates, and pilots” had an annual mean wage of $59,510 in the state of Florida, which was lower than the national average of $71,760 (BLS, 2011).

Commercial Fishing

Commercial fishing refers to harvesting and selling fish to markets, seafood wholesalers, processors and retailers for a profit. Commercial fisheries are operated under strict guidelines established by the NMFS. In 2011, a total of approximately 2 billion pounds of fish were caught commercially within the five Gulf States (i.e., Alabama, Florida West Coast, Louisiana, Mississippi, and Texas), with the majority from Louisiana, for a total worth of $817 million (NMFS, 2012d). In 2010, the most commonly caught species in Louisiana between 3 and 200 miles from U.S. shore were menhaden followed by shrimp (NMFS, 2012e); off the Florida west coast, the most commonly caught species between 3 to 200 miles was shrimp, followed by grouper (NMFS, 2012f).

Tournaments and Events

A number of fishing tournaments, festivals, concerts, and other events are held annually in the Gulf of Mexico. The most popular events are center around boating and fishing and take place between March and October. Popular species sought during tournaments in the GOM includes cobia, kingfish, red snapper, blue marlin, sailfish, and king mackerel.

Maritime Transportation

The Maritime Transportation System (MTS) refers to the system of waterways, ports, and intermodal connections in which vessels traverse and transport people and goods on the water (DOT, 2012a). There are over 300 ports in the United States (DOT, 2012a). The closest ports to the Proposed Action are the Port of Pensacola and the Panama City Marina Wharf, located in Panama City, Florida. Both ports are within approximately 40 miles of the Proposed Action. The majority of maritime cargo in the area takes place in the Gulf Intracoastal Waterway (GIWW), the 1,300 miles inland waterway that links deep-water ports, tributaries, rivers, and bayous from Brownsville, Texas, along the entire coast of the Gulf of Mexico to Apalachicola, Florida (USACE, 2012).

The Office of Security issues maritime administration advisories to vessel masters, ship operators, and other U.S. maritime interests. Advisories are communicated through several mediums, including telex or message formats, Maritime Administration's web site, and the National Imaging and Mapping Agency's weekly NOTMARs (DOT, 2012b).

Artificial Reefs

Artificial reefs provide many opportunities for recreational anglers, divers, and other user groups which result in economic benefits to the coastal communities surrounding the Gulf of Mexico. There are approximately 2,700 artificial reef deployments located off 34 coastal counties in Florida, making it the state with the most permitted artificial reefs in the nation. The economic benefits, or expenditures, associated with artificial reefs in Northwest Florida, which is comprised of 5 counties, have been estimated at $414 million and support 8,136 jobs and contribute $84 million in wages and salaries. Of the total expenditures, $359 million were attributed to visitors and $56 million to residents. The annual recreational use value of artificial reefs was estimated to be $19.7 million. The majority of expenditures were distributed in Bay (36 percent), followed by Okaloosa (30 percent), Escambia (22 percent), Santa Rosa (7 percent), and Walton (5 percent) (Adams et al., 2012).

3.2.3 Environmental Consequences

3.2.3.1 Proposed Action (Preferred Alternative)

Under the Proposed Action, there would be a restriction in access within W-151 in the EGTTR, as shown in Figure 1-2, for up to four hours a day for the duration of up to 3 weeks. During this time, non-mission personnel, such as recreational and commercial fisherman, would be excluded from entering into the safety footprint while it is active. Recreational and commercial fishing participants, as well as other recreational seekers in the restricted area could potentially be affected during the closure and experience additional costs associated with time delays and re-routing. The continued use of NOTMARs and other modes of communication in advance of military training activities could minimize the potential impacts to recreational and commercial users by providing time for users to plan their activities accordingly. Additionally, since the majority of recreational activities in the GOM occur during the months of April through October, then implementation of a best management practice (BMP) that would restrict military training during holidays or special events during these months could minimize the potential impacts to recreational and commercial users.

Under the Proposed Alternative, there would be potential for impacts to socioeconomic activities including fishing and boating from restricted access; however implementation of BMPs and continued use of communication services would minimize adverse impacts; therefore, no significant impacts to socioeconomic resources would be anticipated under the Proposed Action.

The affected area is located entirely over the GOM. Human activity in this area consists primarily of military training exercises and commercial endeavors such as fishing and shipping. A characterization of population groups living in the GOM is not applicable; however based on demographic information of recreational fishing and boating participants reported by the Recreational Boating and Fishing Foundation (2009), there would not be disproportionate impacts to minority, low-income individuals, or children under the Proposed Action.

3.2.3.2 Alternative 1, Reduced Number of Munitions

Under Alternative 1, the number of live munitions used would be reduced; however, all other aspects of Alternative 1 would be the same as those described under the Proposed Action including the number and length of access restrictions. Therefore, potential socioeconomic and environmental justice impacts under Alternative 1 would be similar to those described under the Proposed Action.

3.2.3.3 Alternative 2, Reduced Number and No Subsurface Detonations

Under Alternative 2, the number of live munitions used and the depth would differ; however, all other aspects of Alternative 2 would be the same as those described under the Proposed Action, including the number and length of access restrictions. Therefore, potential socioeconomic and environmental justice impacts under Alternative 2 would be similar to those described under the Proposed Action.

3.2.3.4 No Action Alternative

Under this alternative, Maritime Strike testing with live ordnance would not occur at Eglin AFB and, thus, there are no potential impacts to socioeconomic and environmental justice resources from additional access restrictions.

3.3 PHYSICAL RESOURCES

3.3.1 Definition

Physical resources evaluated in this document include the Gulf of Mexico water column and underlying sediments.

3.3.2 Affected Environment

The physical marine environment potentially affected by the Proposed Action is within W-151 of the EGTTR. Specifically, the test site is located in subarea W-151A, southeast of the Destin Pass (Figure 1-2). This location is approximately 16.7 miles (14.5 nautical miles) offshore and is therefore outside of the 12-nautical mile state water boundary. The affected environment includes the water column and sediments, as described below.

Ocean water in the vicinity of the Maritime Strike test area typically has a salinity equal to or greater than 35 parts per thousand. Dissolved inorganic ions in Gulf waters over the continental shelf include sodium, chlorine, magnesium, potassium, calcium, and phosphate (SAIC, 1997). Tidal action in the Gulf of Mexico is less developed than that of the Atlantic Coast and may be diurnal (one high and one low), semidiurnal (two high and two low tides daily), or mixed (ESE, 1987 as cited in U.S. Air Force, 2002). Water depth in W-151A ranges from 30 to 350 meters, and the depth at the test site is about 35 meters. Turbidity, a measure of water clarity, in the GOM generally decreases from nearshore to offshore, and bottom turbidity measurements tend to be higher than turbidity levels at the surface. High turbidity measurements are caused by suspended solids or impurities in the water column.

The substrate (sediments) underlying W-151 is comparable to that found throughout the eastern half of the Gulf and consists primarily of quartz sand high in sulfur and phosphate content. There are locations of hardbottom substrate and artificial reefs in W-151, though not beneath the target area (Figure 3-2). However, a number of artificial reefs could occur inside the safety footprint and would be inaccessible for the duration of the test. The number of such structures affected would depend on the type of munition used, delivery parameters, etc. The geology of this area of the Gulf is characterized as a shallow, broad continental shelf, with steep slopes leading to two large deep water plains several miles from the target area and scattered regions where the bottom is somewhat higher.

Water quality within W151-A could be impacted by a number of effectors, including chemical materials, waste disposal, tides, and impacts from commercial activities, artificial reefs, and military activities (U. S. Air Force, 2005).Chemical pollutants from oil spills, leaks, discharges, and organotins (boat de-fouling reagents) may enter the nearshore coastal environment and flow outward to the open ocean by tidal action and eventually impact water quality. Chemical pollutants can have an effect through ingestion and long-term accumulation in the bodies of marine species. Pollutants have a tendency to bioaccumulate based on where the animal is situated within the food chain.

Vessels passing through the affected area may discharge food waste, oil and grease, cleaning products, detergents, oil, lubricants, fuel, and sewage. Untreated sewage in unregulated open ocean waters can cause eutrophication leading to excessive algal growth and depleted oxygen in the water column, resulting in harm to other organisms in the marine habitat. Certain algal species can produce biotoxins that can kill fish and marine mammal species.

Heavy metals and hydrocarbons have not been assessed specifically in the sediments of the W151-A test range. Elements such as nitrogen, iron, zinc, aluminum, manganese, and organic compounds are found naturally in Gulf waters, but some are also common byproducts of underwater explosives and ammunition firing.

Maritime Strike testing would result in deposition of target and munitions fragments, and potentially UXO, on the seafloor. Other types of past missions occurring in the EGTTR have resulted in deposition of similar items in the northeastern Gulf. The Military Munitions Rule, which addresses military munitions deposited on military ranges, is the result of a requirement for the USEPA, Department of Defense, and the states to issue a rule identifying when such munitions become hazardous waste under RCRA. A "military munition" is defined as all ammunition produced or used for national defense, and includes a number of items such as bombs, missiles, and small arms ammunition (40 CFR, Parts 260 – 270). A military munition is not considered solid waste under RCRA when it is used for its intended purpose on a military range, which includes testing and evaluation, among other uses. However, a munition is considered solid waste if it lands off-range and is not promptly rendered safe and/or retrieved. Generally, conventional explosive ordnance testing does not constitute hazardous waste under RCRA (UXOINFO, 2013). The rule's discussion of hazardous waste management includes reference to an "explosives or munitions emergency" involving UXO.

3.3.3 Environmental Consequences

3.3.3.1 Proposed Action (Preferred Alternative)

Physical resources (substrate and the water column) could be affected by metals and chemical materials introduced through spent munitions and explosive byproducts and by direct impacts.

Metals typically used to construct bombs, missiles, and gunnery rounds include copper, aluminum, steel, and lead. Aluminum is also present in some explosive materials such as tritonal and PBXN-109. Lead is present in batteries typically used in vessels such as the remotely controlled target boats. Metals would settle to the seafloor after munitions are detonated. Metal ions would slowly leach into the substrate and the water column, causing elevated concentrations in a small area around munitions fragments. Some of the metals, such as aluminum, occur naturally in the ocean at varying concentrations and would not necessarily impact the substrate or water column. Other metals, such as lead, could cause toxicity in microbial communities in the substrate. However, such effects would be localized and would not significantly affect the overall habitat quality of sediments in the northeastern Gulf. In addition, metal fragments would corrode, degrade, and become encrusted over time.

Chemical materials include explosive byproducts and fuel, oil, and other fluids (including battery acid) associated with remotely controlled target boats. Explosive byproducts would be introduced into the water column through detonation of live munitions. Explosive materials associated with Maritime Strike ordnance are listed in Table 2-2 and include tritonal and research department explosive (RDX), among others. Tritonal is primarily composed of 2,4,6-trinitrotoluene (TNT). RDX is sometimes referred to as cyclotrimethylenetrinitramine. Various byproducts are produced during and immediately after detonation of TNT and RDX. During the very brief time that a detonation is in progress, intermediate products may include carbon ions, nitrogen ions, oxygen ions, water, hydrogen cyanide, carbon monoxide, nitrogen gas, nitrous oxide, cyanic acid, and carbon dioxide (Becker, 1995). However, reactions quickly occur between the intermediates, and the final products consist mainly of water, carbon monoxide (CO), carbon dioxide (CO_2), and nitrogen gas, although small amounts of other compounds may be produced as well.

Chemicals introduced to the water column would be quickly dispersed by waves, currents, and tidal action and eventually become uniformly distributed throughout the northern GOM. A portion of the carbon compounds, such as CO and CO_2, would likely become integrated into the carbonate system (alkalinity and pH buffering capacity of seawater). Some of the nitrogen and carbon compounds, including petroleum products, would be metabolized or assimilated during protein synthesis by phytoplankton and bacteria. Most of the gas products that do not react with the water or become assimilated by organisms would be released to the atmosphere. Due to dilution, mixing, and transformation, none of these chemicals are expected to have significant impacts on the marine environment.

Explosive material that is not consumed in a detonation could sink to the substrate and bind to sediments. However, the quantity of such materials in expected to be inconsequential. Research has shown that if munitions function properly, nearly full combustion of the explosive materials will occur, and only extremely small amounts of raw material will remain. In addition, TNT decomposes when exposed to sunlight/ultraviolet radiation and is also degraded by microbial activity (Becker, 1995). Several types of microorganisms have been shown to metabolize TNT. Similarly, RDX is decomposed by hydrolysis, ultraviolet radiation exposure, and biodegradation.

Direct physical impacts to the seafloor could occur due to debris and detonation shock waves. Debris deposited on the seafloor would include spent munitions fragments and possibly pieces of the target boats (fiberglass, plywood, etc.). Debris would not appreciably affect the sandy seafloor. Debris moved by water currents could scour the bottom, but sediments would quickly refill any affected areas, and overall effects to benthic communities would be minor. Large pieces of debris would not be as prone to movement on the seafloor and could result in beneficial effects by providing habitat for encrusting organisms, fish, and other marine fauna. Target boats have foam-filled hulls and most of the pieces are designed to float in order to facilitate collection for a damage assessment. Overall, the quantity of material deposited on the seafloor would be small compared with other sources of debris in the GOM. Hardbottom habitats and artificial reefs are not located in the vicinity of the test site and would not be affected by debris. There is a potential for some debris to be carried by currents and interact with the substrate, but damage to natural or artificial reefs is not expected and the impacts would not be significant.

Detonations in the water column of sufficient strength to produce pressure waves reaching the seafloor would displace sediments and possibly cause cratering. Equations for determining the radius of a crater due to underwater explosions on the seafloor are provided by O'Keefe and Young (1984). However, the equations for seafloor detonations cannot be directly applied to detonations in the water column. In this case (and when the detonation occurs in relatively deep water), the radius of the explosive gas bubble may be considered a reasonable approximation of the radius of a crater if the detonation were to occur on the seafloor. Based on this association, the bubble radius of detonations in the water column is used to determine impacts to bottom sediments. If the radius extends to the seafloor, then impacts to the sediment would likely occur. If, however, the radius does not reach the bottom, then no impacts to sediment would be considered.

Swisdak (1978) provides the equation for the maximum radius of a gas bubble as:

$Amax = (J)\ (W^{.33}/[H+Ho]^{.33})$, where

Amax = maximum bubble radius (m)

J = bubble coefficient, which for TNT is 3.5 $m^{4/3}/kg^{1/3}$

W = charge weight (kilograms [kg])

H = depth of explosion (m)

Ho = atmospheric head, which equals 10 m

The largest NEW among the Maritime Strike weapons is 954 pounds (428.6 kg). The depth of underwater detonations is 5 or 10 feet (1.5 or 3 meters) beneath the surface. Because water pressure increases as the depth increases, the gas bubble caused by an explosion would be largest at shallower depths. For the purposes of analysis, a worst-case scenario is assumed of

945 pounds of NEW detonated 5 feet beneath the surface. Using these values in the equation above, the maximum bubble radius would be 11.5 meters (38 feet). Given the water depth at the target location to be approximately 35 meters, the explosive bubble radius would not extend to the seafloor. In addition, the bubble radius is larger than the detonation depth, which would result in a venting of explosive gas at the surface. Thus, sediment displacement from underwater detonations is not expected.

In summary, there would be no significant impacts to physical resources from the Proposed Action.

3.3.3.2 Alternative 1, Reduced Number of Munitions

Under Alternative 1, impacts to physical resources would be similar in nature to those described for the Proposed Action. Resources could be affected by metals and chemical materials introduced through spent munitions, explosive byproducts, and petroleum products, and by direct impacts. The number of detonations, including subsurface detonations, would decrease under this alternative. Therefore, the quantity of chemical compounds, metals, and debris generated would be smaller. Similar to the Proposed Action, the largest NEW would be 945 pounds, and the associated detonations would not cause sediment displacement on the seafloor. Any craters caused by UXO disposition would be refilled by water currents. Thus, there would be no significant impacts to physical resources under Alternative 1.

3.3.3.3 Alternative 2, Reduced Number and No Subsurface Detonations

Impacts under Alternative 2 would be similar in nature to those described for the Proposed Action. Resources could be affected by metals and chemical materials introduced through spent munitions, explosive byproducts, and petroleum products, and by direct impacts. The number of detonations would decrease relative to the Proposed Action. Therefore, the quantity of chemical compounds, metals, and debris generated would be smaller. There would be no underwater detonations under Alternative 2, and therefore no potential to affect substrates due to pressure waves. There would be no significant impacts to physical resources under Alternative 2.

3.3.3.4 No Action Alternative

Under the No Action Alternative, Maritime Strike test activities would not take place. No detonations would occur, and no materials would be introduced into the water. There would be no impacts to physical resources.

3.4 BIOLOGICAL RESOURCES

3.4.1 Definition

This section summarizes the biological resources that could be affected by Maritime Strike activities. Effects may potentially occur in the form of mortality, injury, harassment, or behavioral modifications. Resources include marine fish, marine birds, sea turtles, marine mammals, and select habitats. Threatened, endangered, and special status species are identified.

3.4.2 Affected Environment

Marine Fish

Over 550 species of fish, all taxonomically and ecologically diverse, are found in the GOM. Marine fish occupy an ecologically important aspect of the marine food chain. Fish feed on other marine species such as plants, plankton, and other smaller fish species. They also serve as prey to other organisms including other marine fish, seabirds, and marine mammals, and many species are economically important to humans (recreational and commercial fishing). The eastern GOM includes a variety of habitats that, in turn, support a wide diversity of fish. The abundance and distribution of fish occurring in the eastern GOM are affected not only by their physical environment but also by the habitat available to them. Key habitat features include coral reefs off southern Florida, a broad continental shelf off western Florida, DeSoto and Mississippi Canyons, the Mississippi River delta extending into the Gulf as part of Louisiana, and deepwater areas beyond the continental shelf.

In addition to habitat preference, the distribution of marine fish can also be affected by the species' life cycles, as well as position in the water column. Many marine fish spend part of their lives in saltwater and part of their lives in freshwater or brackish water. Different life cycles for marine fish include the following:

- Estuarine-dependent fish depend on bays and/or estuaries for part of their life cycle.
- Catadromous fish spawn in saltwater, then migrate into freshwater to grow to maturity.
- Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and return to fresh water to spawn.
- Some fish are totally marine species and spend their entire lives at sea.

Fish of the eastern GOM can be characterized by where they typically reside in the water column. Benthic and reef fish are found at the bottom of waters and around artificial or natural reef systems. Typical species include snapper, grouper, grunt, and triggerfish, among others. Pelagic fish, which occur mostly in the open waters of the Gulf, make seasonal, latitudinal migrations along the Florida coast. These migrations are caused by seasonal changes in temperature, movement of their food resources, and spawning instincts (MMS, 1990). Coastal pelagic families include jack, herring, mullet, bluefish, cobia, tuna, and mackerel. Oceanic pelagic species include dolphinfish, marlin, tuna, and swordfish.

Distribution, abundance, and diversity of fish in the GOM are further affected by physical and chemical characteristics such as salinity, temperature, depth, bottom type, primary productivity, oxygen content, turbidity, and currents. Table 3-1 depicts scientific families of the more common fish species occurring in the eastern GOM by temperature preference.

Threatened and Endangered Fish Species

Two species listed under the Endangered Species Act (ESA), the Gulf sturgeon (*Acipenser oxyrinchus*) and the smalltooth sawfish (*Prestis pectinata*), have reported occurrence in the eastern GOM. The Gulf sturgeon is listed as threatened, while the sawfish is listed as endangered. In addition, five species of concern have a reasonable potential for occurrence in the action area. A *species of concern* is a species about which NMFS has concerns regarding status and threats but for which insufficient information is available to indicate the need to list under the ESA. Table 3-1 includes all species with a listing status that could potentially occur in the project area. Individual species descriptions follow.

Table 3-1. Common Fish of the Eastern GOM Delineated by Temperature Preference

Temperature Preference	Scientific Family Name	Common Name
Temperate1	Acipenseridae	Sturgeons
	Atherinidae	Silversides
	Clupeidae	Herring, menhaden
	Cyprinodontidae	Mummichogs, killifish
	Engraulidae	Anchovies
	Exocoetidae	Flying fish
	Percichthyidae	Striped bass
	Pomatomidae	Bluefish
Subtropical2	Albulidae	Bonefish
	Carangidae	Jacks
	Ephippidae	Spadefish
	Holocentridae	Squirrelfish
	Istiophoridae	Marlins
	Labridae	Wrasses
Subtropical2 Cont'd	Lutjanidae	Snappers
	Mullidae	Goatfish
	Scaridae	Parrotfish
	Sciaenidae	Drums
	Scombridae	Mackerel, bonito, tunas
	Serranidae	Groupers
	Sparidae	Porgies
	Xiphiidae	Swordfish
Tropical3	Centropomidae	Snooks
	Chaetodontidae	Butterflyfish, angelfish
	Coryphaenidae	Dolphinfish
	Elopidae	Tarpon
	Gerreidae	Mojarras
	Lutjanidae	Snappers
	Pomacentridae	Damselfish
	Pomadasyidae	Grunts
	Rachycentridae	Cobia
	Sciaenidae	Drums
	Sphymidae	Hammerhead sharks
	Sphyraenidae	Barracudas

1. Species that prefer water temperatures of 10 degrees Celsius (ºC) or below, with a maximum temperature tolerance of 15ºC.
2. Species that tolerate a minimum water temperature between 10º to 20ºC.
3. Species that prefer waters greater than 20ºC or above.

Table 3-2. Fish Species with Federal Listing Status Potentially in the Project Area

Species Common Name	Species Scientific Name	Federal Status
Gulf sturgeon	Acipenser oxyrinchus desotoi	Threatened
Smalltooth sawfish	Pristis pectinata	Endangered
Alabama shad	Alosa alabamae	Species of concern
Dusky shark	Carcharhinus obscurus	Species of concern
Sand tiger shark	Carcharius taurus	Species of concern
Speckled hind	Epinephelus drummondhayi	Species of concern
Warsaw grouper	Epinephelus nigritus	Species of concern

The **Gulf sturgeon** is an anadromous fish occurring in riverine, estuarine, and nearshore marine environments of coastal states along the Gulf of Mexico. Adults range in length from 4 to 8 feet (1 to 2.5 meters). The species' freshwater range encompasses seven river systems from Lake Pontchartrain in Louisiana to the Suwannee River in Florida. Adult Gulf sturgeon occur in fresh water during the warm months, when spawning occurs, and migrate into estuarine and marine environments in the fall to forage and overwinter. Most subadult and adult Gulf sturgeon generally do not feed in the riverine habitats. Instead, feeding occurs on the bottom sediments of marine and estuarine habitats during fall and winter. Some individuals have been documented in estuarine waters, such as bays and sounds, for at least a portion of the fall and winter months, although the extent of this habitat use is not well studied. Juveniles may remain in the rivers for the first few years. Subadult and adult Gulf sturgeon may be found in the nearshore marine waters of the northern Gulf of Mexico from fall to spring. The Gulf sturgeon is generally considered to occur near the shoreline, although factors such as water depth or prey distribution may be more important factors than distance from land. Gulf sturgeon have been observed off the Suwannee River area as far as 16.7 km (9 NM) from shore (USFWS and NMFS, 2003).

The USFWS has designated critical habitat for the Gulf sturgeon in the Gulf of Mexico. This protected habitat encompasses coastal waters from the mean high water line and out to 1.9 km (1 NM) offshore. Critical habitat also includes several rivers and bays, including Choctawhatchee Bay near Eglin AFB.

Eglin AFB has studied sturgeon occurrence and distribution in areas potentially affected by military activities through funding provided by the Department of Defense Legacy Resource Management Program. Results show that the fish generally begin outmigration in October and have departed the river systems by November. After moving into the Gulf of Mexico, sturgeon may move east or west. A number of those moving east appear to remain in the vicinity of Eglin property, while most of those moving west continue to further locations outside the footprint of Eglin-scheduled activities. Movement back toward the river systems generally begins in March. The amount of sturgeon activity detected near Eglin's Santa Rosa Island property appears to be predominantly from sturgeon tagged in the Choctawhatchee River. Initial results indicated that sturgeon remain very close to shore off Santa Rosa Island (within 1,000 meters). However, a more offshore distribution was noted during the last year of study, when over 80 percent of sturgeon detections were recorded at a receiver 1,250 meters from shore. Given the commonly cited detection range of 500 meters, it is assumed that some number of sturgeon were at least 1,750 meters (approximately 1 mile) from shore. The extent of the offshore distribution could not be discerned because receivers were not placed farther out in the Gulf. However, the 1,750-meter distance does not approach the test area location 17 miles offshore, and sturgeon occurrence is not considered likely.

The **smalltooth sawfish** is one of two sawfish species occurring in U.S. waters. Once common throughout the GOM from Texas to Florida, the current distribution ranges primarily throughout peninsular and southern Florida. The species is only commonly found in the Everglades and in shallow areas with mangrove forests in Florida Bay and the Florida Keys, as well as off southern Florida. Sawfish reside typically within 1.9 km (1 NM) of the shore in estuaries, shallow banks, sheltered bays, and river mouths with sandy and muddy bottoms. Occasionally, they are found offshore on reefs or wrecks and over hard or mud bottoms. The smalltooth sawfish feeds on fish and crustaceans, using the long flat snout to stun and kill prey. Very little is known about their life history in Florida.

The **Alabama shad** is an anadromous species that spawns in large flowing rivers from the Mississippi River to the Suwannee River of Florida. Fish enter fresh water during January to April, where spawning occurs over sand, gravel, and rock substrates. Young individuals remain in fresh water for the first six to eight months. Adults leave the spawning area soon after spawning is complete. The current primary threats to Alabama shad include locks and dams blocking spawning migration, commercial and navigational dredging, and alteration of hydrology and river substrates (NMFS, 2008). Commercial fishing was previously a threat to this species.

The **dusky shark** has a wide-ranging, but patchy, distribution in warm-temperate and tropical waters, including the Atlantic Ocean. It is coastal and pelagic in its distribution, occurring from the surf zone to well offshore and from the surface to depths of 400 meters (NMFS, 2011). In the western Atlantic, this shark occurs from southern New England to the Caribbean and Gulf of Mexico to southern Brazil. The dusky shark undertakes long, temperature-related migrations, moving northward in summer as the waters warm and southward in fall as water temperatures drop.

The **sand tiger shark** is distributed in all warm and temperate seas except the eastern Pacific (NMFS, 2010). It is a species of concern in the western Atlantic and northern GOM. Sand tiger sharks range from the surf zone to depths up to 190 meters (626 feet). They are often found near the sea bottom but may occur at any point in the water column. This species is migratory, moving north during the summer and south during fall and winter.

The **speckled hind** inhabits warm, moderately deep waters from North Carolina to Cuba, including the GOM. The preferred habitat is hardbottom reefs in depths from 80 to 1,300 feet, although they generally prefer depths of 200 to 400 feet (NMFS, 2009).

The **Warsaw grouper** occurs on reefs in water depths of 55 to 525 meters (180 to 1,700 feet) (NMFS, 2009a). The species ranges from North Carolina to the Florida Keys, including the GOM. On September 28, 2010, the NMFS issued a finding that the petition to list the Warsaw grouper under the ESA did not present substantial information indicating listing was warranted. However, as of August 2012, this species remains listed as a species of concern list on the NMFS website.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act) (16 U.S.C. 1801 et seq.) established jurisdiction over marine fishery resources within the U.S. Exclusive Economic Zone. The Magnuson-Stevens Act mandated the formation of eight fishery management councils (FMCs), which function to conserve and manage certain fisheries within their geographic jurisdiction. The FMCs are required to prepare and maintain a Fishery Management Plan (FMP) for each fishery that requires management. The Gulf of Mexico Fishery Management Council (GMFMC) manages fisheries in the Maritime Strike study area. Amendments contained in the Sustainable Fisheries Act of 1996 (Public Law 104-267) require the councils to identify EFH for each fishery covered under a FMP. EFH is defined as the waters and substrate necessary for spawning, breeding, or growth to maturity (16 U.S.C. 1802[10]). The term “fish” is defined as “finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds.”

In addition to the GMFMC, the Gulf States Marine Fisheries Commission (GSMFC) and NMFS also have management responsibilities for certain fisheries. The GSMFC is an organization of five states from the Gulf coast of Florida to Texas that manages fishery resources in state waters. The GSMFC provides coordination and administration for a number of cooperative state/federal marine fishery resources. NMFS has jurisdiction over highly migratory species in federal waters of the GOM.

The GMFMC manages seven fishery resources in federal waters off the coasts of Texas, Louisiana, Mississippi, Alabama, and the west coast of Florida to Key West. The coral and coral reef FMP includes over 300 coral species. The reef fish FMP includes 31 species of snappers, groupers, tilefishes, jacks, triggerfishes, and wrasses. Fish in this FMP are generally demersal subtropical species that utilize similar habitats and are harvested by similar methods, both recreationally and commercially. Shrimp species include brown, white, pink, and royal red. The spiny lobster fishery is managed jointly by the GMFMC and the South Atlantic Fishery Management Council, with the GMFMC acting as the lead council. The Coastal Migratory Pelagics management unit consists of king mackerel, Spanish mackerel, cobia, dolphin, little tunny, cero mackerel, and bluefish. Managed species and associated EFH are shown in Table 3-3.

Table 3-3. Fish Species and Management Units for Which Essential Fish Habitat Has Been Identified

Species or Management Unit	Essential Fish Habitat
Coastal Migratory Pelagics (7 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council, from estuarine waters out to depths of 100 fathoms.
Coral and Coral Reefs (over 300 species)	The total distribution of coral species and life stages throughout the Gulf of Mexico including the East and West Flower Garden Banks, Florida Middle Grounds, southwest tip of the Florida reef tract, and predominant patchy hardbottom offshore of Florida from approximately Crystal River south to the Keys, and scattered along the pinnacles and banks from Texas to Mississippi, at the shelf edge.
Red Drum	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from Vermilion Bay, Louisiana to the eastern edge of Mobile Bay, Alabama out to depths of 25 fathoms; waters and substrates extending from Crystal River, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council between depths of 5 and 10 fathoms.
Reef Fish (31 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 100 fathoms.
Shrimp (4 species)	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Fort Walton Beach, Florida, from estuarine waters out to depths of 100 fathoms; waters and substrates extending from Grand Isle, Louisiana, to Pensacola Bay, Florida, between depths of 100 and 325 fathoms; waters and substrates extending from Pensacola Bay, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 35 fathoms, with the exception of waters extending from Crystal River, Florida, to Naples, Florida, between depths of 10 and 25 fathoms and in Florida Bay between depths of 5 and 10 fathoms.
Spiny Lobster	Gulf of Mexico waters and substrates extending from Tarpon Springs, Florida, to Naples, Florida, between depths of 5 and 10 fathoms; waters and substrates extending from Cape Sable, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council out to depths of 15 fathoms.
Stone Crab	All Gulf of Mexico estuaries; Gulf of Mexico waters and substrates extending from the U.S./Mexico border to Sanibel, Florida, from estuarine waters out to depths of 10 fathoms; waters and substrates extending from Sanibel, Florida, to the boundary between the areas covered by the Gulf of Mexico Fishery Management Council and the South Atlantic Fishery Management Council from estuarine waters out to depths of 15 fathoms.

Source: GMFMC, 2004

In addition to establishing EFH, the Magnuson-Stevens Act also directs NMFS and the FMCs to characterize habitat areas of particular concern (HAPCs). HAPCs are subsets of EFH that are rare, especially ecologically important, particularly susceptible to human-induced degradation, or located in environmentally stressed areas. HAPCs typically include high-value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish. HAPCs in the GOM include the Flower Garden Banks, Florida Middle Grounds, Tortugas North and South Ecological Reserves, Madison-Swanson Marine Reserve, Pulley Ridge, and the following reefs and banks: Stetson, McNeil, Bright Rezak, Geyer, McGrail Bouma, Sonnier, Alderice, and Jakkula (GMFMC, 2004). None of these areas are near the Maritime Strike test area and would not be affected by test activities.

Marine Birds

Marine birds are considered in this section to be those bird species 1) whose habitat and food source includes the sea, whether coastal, offshore, or pelagic waters, and/or 2) whose migratory routes at least partially traverse the sea. These species may be generally separated into six groups: diving birds, gulls/terns, shorebirds, passerines, wading birds, and waterfowl. Examples of birds that are characteristic of each group are provided in Table 3-4. While some marine bird species inhabit only pelagic habitats in the GOM, most inhabit waters of the continental shelf and adjacent coastal and inshore habitats.

Table 3-4. Bird Species in the Gulf of Mexico

Diving Birds	Gulls/Terns	Shorebirds	Passerines	Wading Birds	Waterfowl
Common loon Horned grebe Pied-billed grebe Anhinga Double-crested cormorant Gannets Boobies Petrels Shearwaters	Gulls Terns Noddies Jaegers Black skimmer	Jacana Oystercatcher Stilt Avocet Snipe Sandpipers Dunlin Plovers	Blue jay Red-winged blackbird Common grackle Northern cardinal Eastern towhee	Bitterns Herons Egrets White ibis	Scaups Blue-winged teal

Source: MMS, 2007; USGS, 2007

Most marine birds that use the sea as a food source are visual predators and forage during daylight hours (Shealer, 2002). Some species use tactile or olfactory perception (Furness and Monaghan, 1987). Most species feed at or near the surface (Furness and Monaghan, 1987). Others (e.g., many terns, pelicans) feed just below the surface using a method referred to as plunge diving, where the bird dives from the air into the water (Schreiber and Burger, 2002). When plunge diving, birds generally penetrate the water little further than their own body length (Furness and Monaghan, 1987) and remain underwater for only a few seconds. Another feeding method is pursuit diving, used by species such as cormorants and petrels, where a bird uses its wings and/or feet to swim underwater in pursuit of prey. A few species can dive to considerable depth and stay submerged for several minutes. Cormorants may forage to a depth of up to 130 meters (427 feet), gannets and boobies up to 25 meters (82 feet), and petrels and shearwaters up to 70 meters (230 feet), although foraging depths may be much shallower (Wilson et al., 2002).

The eastern GOM is a migratory route populated by both resident and migratory marine birds. A migratory bird is any species of family of birds that lives, reproduces, or migrates within or across international borders at some point during its annual life cycle. These species are protected under the MBTA. The MBTA prohibits the take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase or barter, and migratory bird, their eggs, parts, and nests, except as authorized under a valid permit. Current regulations authorize permits for certain actions, including military readiness activities.

Approximately two-thirds of the breeding bird species of the eastern United States migrate to Central and South America, Mexico, and the Caribbean. The states that border the eastern GOM lie within the Atlantic Flyway, a major migration route. Passerines (i.e., land birds or song birds) use an offshore route in the GOM. Most migratory land birds are nocturnal flyers (Moore et al., 1995). Migration generally peaks in late April to early May.

Some important resting areas for migratory birds include St. Andrew State Recreation Area, Gulf Islands National Seashore, St. Joseph Peninsula State Park, and St. George Island State Park (Duncan, 1994). Summer residents include Audubon's shearwaters, Wilson's storm-petrels, magnificent frigatebirds, sandwich terns (in the Florida Panhandle), least terns, and sooty terns. Winter residents include common loons, horned grebes, northern gannets, great cormorants, pomarine jaegers, parasitic jaegers, Bonaparte's gulls, and ringed-billed gulls. Permanent residents include pied-billed grebes, anhingas, double-crested cormorants, brown pelicans, laughing gulls, royal terns, and Caspian terns.

Threatened, Endangered, and Protected Bird Species in the Gulf of Mexico

Two bird species with potential occurrence in the project area are listed as threatened or endangered under the ESA: the piping plover (*Charadrius melodus*) and wood stork (*Mycteria Americana*). The bald eagle (*Haliaeetus leucocephalus*) has been removed from the federal ESA list, but remains protected under the Bald and Golden Eagle Protection Act (BGEPA). The BGEPA prohibits, among other things, the taking of bald eagles and their parts, nests, or eggs. Protected bird species are listed in Table 3-5.

Table 3-5. Endangered and Threatened Bird Species in the Gulf of Mexico

Species	Status	Areas of Occurrence
Piping plover Charadrius melodus	ESA: FT	Winters in the Florida Panhandle with highest numbers occurring in Franklin, Gulf, and Bay Counties. Critical habitat has been designated on Santa Rosa Island.
Wood stork Mycteria americana	ESA: FE	Inhabits tropical, subtropical zones with distinct wet and dry seasons.
Bald eagle Haliaeetus leucocephalus	BGEPA: Protected	Nests regularly in the Florida Panhandle.

ESA = Endangered Species Act; FT = federally threatened; FE = federally endangered; BGEPA = Bald and Gold Eagle Protection Act; SSC = species of special concern

Winter foraging critical habitat for the piping plover was designated in 2001 and includes some areas on the Eglin-controlled portion of Santa Rosa Island (the land mass nearest the Maritime Strike test location). Although only a small section of the island has been designated as critical habitat, piping plovers may be found anywhere that affords adequate foraging and sheltering resources. Piping plovers are known to forage in exposed wet sand areas such as wash zones, intertidal ocean beachfronts, wrack lines, washover passes, mud and sand flats, ephemeral ponds, and salt marshes. They are also known to use adjacent areas for sheltering in dunes, debris, and sparse vegetation.

Marine Mammals

Marine mammals that potentially occur within the northeastern GOM include numerous species of cetaceans and one sirenian, the Florida manatee (*Trichechus manatus latirostrus*). Manatees primarily inhabit coastal and inshore waters, and are rarely sighted offshore. Maritime Strike missions would be conducted approximately 17 miles offshore. Therefore, manatee occurrence is considered unlikely and further discussion of marine mammal species is limited to cetaceans.

Up to 28 cetacean species occur in the northern GOM. However, species with likely occurrence in the test area, and therefore included in this document, are limited to the bottlenose dolphin (*Tursiops truncatus*) and Atlantic spotted dolphin (*Stenella frontalis*). These species are frequently sighted in the northern Gulf over the continental shelf, in a water depth range that encompasses the Maritime Strike test location (Garrison, 2008; DON, 2007; Davis et al., 2000). Dwarf sperm whales (*Kogia sima*) and pygmy sperm whales (*Kogia breviceps*) are occasionally sighted over the shelf but are not considered regular inhabitants (Davis et al., 2000). The remaining cetacean species are primarily considered to occur at and beyond the shelf break (water depth of approximately 200 meters) and are, therefore, not included.

Information on each dolphin species, including general descriptions, status, and occurrence, is provided below. Descriptions include mention of "potential biological removal" (PBR). PBR is defined as the maximum number of animals that may be removed, not including natural mortalities, from a stock while allowing the stock to reach or maintain its optimal sustainable population.

Bottlenose dolphin (*Tursiops truncatus*)

Description – Bottlenose dolphins are large and robust, varying in color from light gray to charcoal. The genus *Tursiops* is named for its short, stocky snout that is distinct from the melon (Jefferson et al., 1993). The dorsal fin is tall and falcate. There are regional variations in body size, with adult lengths from 1.9 to 3.8 meters (6.2 to 12.5 feet) (Jefferson et al., 1993).

Scientists currently recognize a nearshore (coastal) and an offshore form of bottlenose dolphins, which are distinguished by external and cranial morphology, hematology, diet, and parasite load (Duffield et al., 1983; Hersh and Duffield, 1990; Mead and Potter, 1995; Curry and Smith, 1997). There is also a genetic distinction between nearshore and offshore bottlenose dolphins worldwide (Curry and Smith, 1997; Hoelzel et al., 1998). It has been suggested that the two forms should be considered different species (Curry and Smith, 1997; Kingston and Rosel, 2004), but no official taxonomic revisions have been made.

Status – In the northern GOM, there are coastal stocks; a continental shelf stock; an oceanic stock; and 32 bay, sound, and estuarine stocks (Waring et al., 2006). Sellas et al. (2005) reported the first evidence that the coastal stock off west central Florida is genetically separated from the adjacent inshore areas. Table 3-6 summarizes information on bottlenose dolphin stocks that occur in the north-central Gulf of Mexico, although not all these stocks have an equal probability of occurrence in the Maritime Strike test area. More detailed descriptions follow the table. Descriptions were obtained from stock assessment reports available on the NMFS website.

Table 3-6. Bottlenose Dolphin Stocks in the North-Central Gulf of Mexico

Stock	Distribution	Strategic Stock	Estimated Abundance	PBR
Bay, Sound, and Estuarine Stocks: Choctawhatchee Bay	Areas of contiguous, enclosed, or semi-enclosed water bodies	Yes	179 resident, 53 transient	1.7
Bay, Sound, and Estuarine Stocks: Pensacola/East Bay		Yes	33	U
Bay, Sound, and Estuarine Stocks: St. Andrew Bay		Yes	124	U
Gulf of Mexico Northern Coastal	Waters from shore to the 20-meter (66-foot) isobath, from the Mississippi River delta to the Florida Big Bend region	Yes	2,473	20
Northern Gulf of Mexico Continental Shelf	Waters between the 20- and 200-meter (66- and 656-foot) isobaths, from Texas to Key West	No	17,777	U
Northern Gulf of Mexico Oceanic	Waters from the 200-meter (656-foot) isobath to the seaward extent of the U.S. Exclusive Economic Zone	No	5,806	42

PBR = Potential Biological Removal; U = undetermined

Genetic, photo-identification, and tagging data support the concept of relatively discrete bay, sound, and estuarine stocks. NMFS has provisionally identified 32 such stocks that inhabit areas of contiguous, enclosed, or semi-enclosed water bodies adjacent to the northern GOM. The stocks are based on a description of dolphin communities in some areas of the Gulf coast. A *community* is generally defined as resident dolphins that regularly share a large portion of their range, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent than with dolphins in adjacent waters. Although the shoreward boundary of W-151 is beyond these environments, individuals from these stocks could potentially enter the study area. Movement between various communities has been documented (Waring et al., 2009), and Fazioli et al. (2006) reported that dolphins found within bays, sounds, and estuaries on the west central Florida coast move into the nearby Gulf waters used by coastal stocks.

Maritime Strike activities would occur seaward of the area considered to be occupied by the Choctawhatchee Bay stock. The best abundance estimate for this stock, as provided in the Draft 2012 Stock Assessment Report, is 179 resident dolphins, with an additional 53 transient dolphins. Stocks immediately to the west and east of Choctawhatchee Bay include Pensacola/East Bay and St. Andrew Bay stocks. PBR for the Choctawhatchee Bay stock is 1.7 individuals. NMFS considers all 32 stocks to be strategic.

Three coastal stocks have been identified in the northern GOM, occupying waters from the shore to the 20-meter (66-foot) isobath: eastern coastal, northern coastal, and western coastal stocks. The western coastal stock inhabits nearshore waters from the Texas/Mexico border to the Mississippi River delta. The northern coastal stock's range is considered to be from the Mississippi River delta to the Big Bend region of Florida (approximately 84°W). The eastern coastal stock is defined from 84°W to Key West, Florida.

Of the coastal stocks, the northern coastal is geographically most closely associated with the Maritime Strike mission area. PBR is 20 individuals. Prior to 2012, this stock was not considered strategic. However, the Draft 2012 Stock Assessment Report identifies an ongoing "unusual mortality event" of unprecedented size and duration (since February 2010) that has resulted in NMFS reclassifying this stock as strategic.

The northern GOM continental shelf stock is defined as bottlenose dolphins inhabiting the waters from the Texas/Mexico border to Key West, Florida, between the 20- and 200-meter (66- and 656-foot) isobaths. The continental shelf stock probably consists of a mixture of coastal and offshore ecotypes. PBR is undetermined, and the stock is not considered strategic.

The oceanic stock is provisionally defined as bottlenose dolphins inhabiting waters from the 200-meter (656-foot) isobath to the seaward extent of the U.S. Exclusive Economic Zone. This stock is believed to consist of the offshore form of bottlenose dolphins. The continental shelf stock may overlap with the oceanic stock in some areas and may be genetically indistinguishable. PBR is 42 individuals, and the stock is not considered strategic.

Diving Behavior – Dive durations as long as 15 minutes are recorded for trained individuals (Ridgway et al., 1969). Typical dives, however, are more shallow and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 seconds at shallow depths (Mate et al., 1995) and can last longer than 5 minutes during deep offshore dives (Klatsky et al., 2005). Offshore bottlenose dolphins regularly dive to 450 meters (1,476 feet) and possibly as deep as 700 meters (2,297 feet) (Klatsky et al., 2005).

Acoustics and Hearing – Sounds emitted by bottlenose dolphins have been classified into two broad categories: pulsed sounds (including clicks and burst-pulses) and narrow-band continuous sounds (whistles), which usually are frequency modulated. Clicks and whistles have a dominant frequency range of 110 to 130 kiloHertz (kHz) and a source level of 218 to 228 decibels referenced to 1 micropascal-meter (dB re 1 μPa-m peak-to-peak) (Au, 1993) and 3.4 to 14.5 kHz and 125 to 173 dB re 1 μPa-m peak-to-peak, respectively (Ketten, 1998). Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles) (Caldwell and Caldwell, 1965; Janik et al., 2006). Up to 52 percent of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles (Cook et al., 2004). Sound production is also influenced by group type (single or multiple individuals), habitat, and behavior (Nowacek, 2005). Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fish in some regions (Janik, 2000). Additionally, whistle production has been observed to increase while feeding (Acevedo-Gutiérrez and Stienessen, 2004; Cook et al., 2004). Furthermore, both whistles and clicks have been demonstrated to vary geographically in terms of overall vocal activity, group size, and specific context (e.g., feeding, milling, traveling, and socializing) (Jones and Sayigh, 2002; Zaretsky et al., 2005; Baron, 2006).

Bottlenose dolphins can hear within a broad frequency range of 0.04 to 160 kHz (Au, 1993; Turl, 1993). Electrophysiological experiments suggest that the bottlenose dolphin brain has a dual analysis system: one specialized for ultrasonic clicks and another for lower-frequency sounds, such as whistles (Ridgway, 2000). Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz (Nachtigall et al., 2000). Recent research on the same individuals indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at lower (10 kHz) and higher (80 and 100 kHz) frequencies (Finneran and Houser, 2006).

Temporary threshold shifts (TTSs) in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (i.e., broad-band, pulses) (Ridgway et al., 1997; Schlundt et al., 2000; Nachtigall et al., 2003; Finneran et al., 2005; Mooney et al., 2005; Mooney, 2006). For example, TTS has been induced with exposure to a 3-kHz, 1-second pulse with sound exposure level (SEL) of 195 decibels referenced to 1 squared micropascal per second (dB re 1 μPa^2-s) (Finneran et al., 2005), 1-second pulses from 3 to 20 kHz at 192 to 201 decibels referenced to 1 micropascal-meter (dB re 1 μPa-m) (Schlundt et al., 2000), and octave band noise (4 to 11 kHz) for 50 minutes at 179 dB re 1 μPa-m (Nachtigall et al., 2003). Preliminary research indicates that TTS and recovery after noise exposure are frequency dependent and that an inverse relationship exists between exposure time and sound pressure level associated with exposure (Mooney et al., 2005; Mooney, 2006). Observed changes in behavior were induced with an exposure to a 75-kHz 1-second pulse at 178 dB re 1 μPa-m (Ridgway et al., 1997; Schlundt et al., 2000). Finneran et al. (2005) concluded that an SEL of 195 dB re 1 μPa^{2-}s is a reasonable threshold for the onset of TTS in bottlenose dolphins exposed to mid-frequency tones.

Distribution **–** Bottlenose dolphins are distributed worldwide in tropical and temperate waters. The species occurs in all three major oceans and many seas. In the western North Atlantic, bottlenose dolphins occur as far north as Nova Scotia but are most common in coastal waters from New England to Florida, the Gulf of Mexico, the Caribbean, and southward to Venezuela and Brazil (Würsig et al., 2000). Bottlenose dolphins occur seasonally in estuaries and coastal embayments as far north as Delaware Bay (Kenney, 1990) and in waters over the outer continental shelf and inner slope, as far north as Georges Bank (CETAP, 1982; Kenney, 1990).

The bottlenose dolphin is by far the most widespread and common cetacean in coastal waters of the GOM (Würsig et al., 2000). Bottlenose dolphins are frequently sighted near the Mississippi River Delta (Baumgartner et al., 2001) and have even been known to travel several kilometers up the Mississippi River.

Gulf of Mexico

Bottlenose dolphins are abundant in continental shelf waters throughout the northern GOM (Fulling et al., 2003; Waring et al., 2006), including the outer continental shelf, upper slope, nearshore waters, the DeSoto Canyon region, the West Florida Shelf, and the Florida Escarpment. Mullin and Fulling (2004) noted that in oceanic waters, bottlenose dolphins are encountered primarily in upper continental slope waters (less than 1,000 meters in bottom depth) and that highest densities are in the northeastern Gulf. Significant occurrence is expected near all bays in the northern Gulf.

The results of a recent survey effort of nearshore and continental shelf waters of the eastern GOM (Garrison, 2008) identified four areas where bottlenose dolphins were clustered in winter: nearshore waters off Louisiana, the Florida Panhandle, north of Tampa Bay, and southwestern Florida. Dolphins were also common over the entire shelf. In summer, the number of group sightings was comparatively lower than in winter (162 versus 281), and bottlenose dolphins were more evenly distributed throughout coastal and shelf waters.

Atlantic spotted dolphin (*Stenella frontalis*)

Description – The Atlantic spotted dolphin has features that resemble the bottlenose dolphin. In body shape, it is typically somewhat larger than the inshore bottlenose dolphin ecotype, with a moderately long, thick beak. The dorsal fin is tall and falcate and there is generally a prominent spinal blaze. Adults are up to 2.3 meters (7.5 feet) long and can weigh as much as 143 kilograms (315 pounds) (Jefferson et al., 1993). Atlantic spotted dolphins are born spotless and develop spots as they age (Perrin et al., 1994; Herzing, 1997). Some individuals become so heavily spotted that the dark cape and spinal blaze are difficult to see (Herzing, 1997).

There is marked regional variation in adult body size of the Atlantic spotted dolphin (Perrin et al., 1987). In addition, there are two forms: a robust, heavily spotted form that inhabits the continental shelf, usually found within 250 to 350 km (135 to 189 NM) of the coast, and a smaller, less-spotted form that inhabits offshore waters (Perrin et al., 1994). The largest body size occurs in waters over the continental shelf of North America (east coast and GOM) and Central America (Perrin, 2002). The smaller, offshore form is not known to occur in the GOM.

Status – The most recent abundance estimate, as provided in the 2012 Draft Stock Assessment Report, is 37,611 individuals in the northern GOM (outer continental shelf and oceanic waters). The northern GOM population is considered genetically differentiated from the western North Atlantic populations. PBR for this species is undetermined. This is not considered a strategic stock

Diving Behavior – Information on diving depth for this species is available from a satellite-tagged individual in the Gulf of Mexico (Davis et al., 1996). This individual made short, shallow dives to less than 10 meters (33 feet) and as deep as 60 meters (197 feet), while in waters over the continental shelf on 76 percent of dives.

Acoustics and Hearing – A variety of sounds including whistles, echolocation clicks, squawks, barks, growls, and chirps have been recorded for the Atlantic spotted dolphin. Whistles have dominant frequencies below 20 kHz (range: 7.1 to 14.5 kHz) but multiple harmonics extend above 100 kHz, while burst pulses consist of frequencies above 20 kHz (dominant frequency of approximately 40 kHz) (Lammers et al., 2003). Other sounds, such as squawks, barks, growls, and chirps, typically range in frequency from 0.1 to 8 kHz. Recorded echolocation clicks had two dominant frequency ranges at 40 to 50 kHz and 110 to 130 kHz, depending on source level (i.e., lower source levels typically correspond to lower frequencies and higher frequencies to higher source levels (Au and Herzing, 2003). Echolocation click source levels as high as 210 dB re 1 μPa-m peak-to-peak have been recorded (Au and Herzing, 2003). Spotted dolphins in The Bahamas were frequently recorded during agonistic/aggressive interactions with bottlenose dolphins (and their own species) to produce squawks (0.2 to 12 kHz broadband burst pulses; males and females), screams (5.8 to 9.4 kHz whistles; males only), barks (0.2 to 20 kHz burst pulses; males only), and synchronized squawks (0.1- to 15-kHz burst pulses; males only in a coordinated group) (Herzing, 1996).

Hearing ability for the Atlantic spotted dolphin is unknown. However, odontocetes are generally adapted to hear high frequencies (Ketten, 1997).

Distribution – Atlantic spotted dolphins are distributed in warm-temperate and tropical Atlantic waters from northern New England to Venezuela, including the GOM and the Caribbean Sea (Perrin et al., 1987). Atlantic spotted dolphins may occur in both continental shelf and offshore waters (Perrin et al., 1994). In oceanic waters, this species usually occurs near the shelf break and upper continental slope waters (Davis et al., 1998; Mullin and Hansen, 1999).

Gulf of Mexico

Atlantic spotted dolphins in the northern GOM are abundant in continental shelf waters (Fulling et al., 2003; Waring et al., 2006). In the GOM, Atlantic spotted dolphins are most abundant east of Mobile Bay (Fulling et al., 2003). On the west Florida shelf, spotted dolphins are more common in deeper waters than bottlenose dolphins (Griffin and Griffin, 2003); Griffin and Griffin (2004) reported higher densities of spotted dolphins in this area during November through May.

In winter, spotted dolphins may occur in waters over the continental shelf and along the shelf break throughout the entire northern GOM. Stranding data suggest that this species may be more common than the survey data demonstrate.

Occurrence during spring is primarily in the vicinity of the shelf break from central Texas to southwestern Florida. Sighting data reflect high usage of the Florida Shelf by this species.

In summer, occurrence is primarily in waters over the continental shelf, along the shelf break throughout the entire northern GOM, and over the Florida Escarpment. Sighting data show increased usage of the Florida Shelf, as well as the Florida Panhandle and inshore of DeSoto Canyon. An additional area of increased occurrence is predicted in shelf waters off western Louisiana.

In fall, the sighting data demonstrate occurrence in waters over the continental shelf and along the shelf break throughout the entire northern GOM. There are numerous sightings in the Mississippi River delta region and Florida Panhandle. This is the season with the least amount of systematic survey effort, and inclement weather conditions can make sighting cetaceans difficult during this time of year.

Marine Mammal Density

Bottlenose and spotted dolphin density estimates were obtained from two sources. Bottlenose dolphin estimates were obtained from a habitat modeling project conducted for portions of the EGTTR, including the Maritime Strike project area, as described in Garrison (2008). As part of the modeling effort, personnel from NOAA’s Southeast Fisheries Science Center (SEFSC) conducted line transect aerial surveys of the continental shelf and coastal waters of the eastern GOM during winter (February 2007, water temperatures of 12° to 15° Celsius) and summer (July/August 2007, water temperatures greater than 26° Celsius). The surveys covered nearshore and continental shelf waters (to a maximum depth of 200 meters), with the majority of effort concentrated in waters from the shoreline to 20 meters depth. Marine species encounter rates during the surveys were corrected for sighting probability and the probability that animals were available on the surface to be seen. The survey data were combined with remotely sensed environmental data/habitat parameters (water depth, sea surface temperature [SST], and chlorophyll-*a* concentration) to develop habitat models. The technical approach, described as generalized regression and spatial prediction, spatially projects the species-habitat relationship based on distribution of environmental factors, resulting in predicted densities for unsampled locations and times. The spatial density model can therefore be used to predict relative density in unobserved areas and at different times of year based upon the monthly composite SST and chlorophyll datasets derived from satellite data. Similarly, the spatial density model can be used to predict relative density for any subregion within the surveyed area.

Garrison (2008) produced bottlenose dolphin density estimates at various spatial scales within the EGTTR. At the largest scale, density data were aggregated into four principal strata categories: north-inshore, north-offshore, south-inshore, and south-offshore. Densities for these strata were provided in the published survey report. Unpublished densities were also provided for smaller blocks (subareas) corresponding to airspace units, and a number of these subareas were combined to form larger zones. Densities in these smaller areas were provided to Eglin AFB in Excel© spreadsheets by the report author.

For both large areas and subareas, regions occurring entirely within waters deeper than 200 meters were excluded from predictions, and those straddling the 200-meter isobath were clipped to remove deep water areas. In addition, because of limited survey effort, density estimates beyond 150 meters water depth are considered invalid. The environmental conditions encountered during the survey periods (February and July/August) do not necessarily reflect the range of conditions potentially encountered throughout the year. In particular, the transition seasons of spring (April-May) and fall (October-November) have a very different range of water temperatures. Accordingly, for predictions outside of the survey period or spatial range, it is necessary to evaluate the statistical variance in predicted values when attempting to apply the model. The coefficient of variation (CV) of the predicted quantity is used to measure the validity of model predictions. According to Garrison (2008), the best predictions have CV values of approximately 0.2. When CVs approach 0.7, and particularly when they exceed 1.0, the resulting model predictions are extremely uncertain and are considered invalid.

Based on the preceding discussion, the bottlenose dolphin density estimate used in this document is the median density corresponding to subarea 137 (Figure 3-1) in the month of June. The planned Maritime Strike test location lies within this subarea. Within this block, Garrison (2008) provided densities based on one-year (2007) and five-year monthly averages for SST and chlorophyll. The five-year average is considered preferable. Only densities with a CV rounded to 0.7 or lower (i.e., 0.64 and below) were considered. The CV for June in this particular block is 0.62.

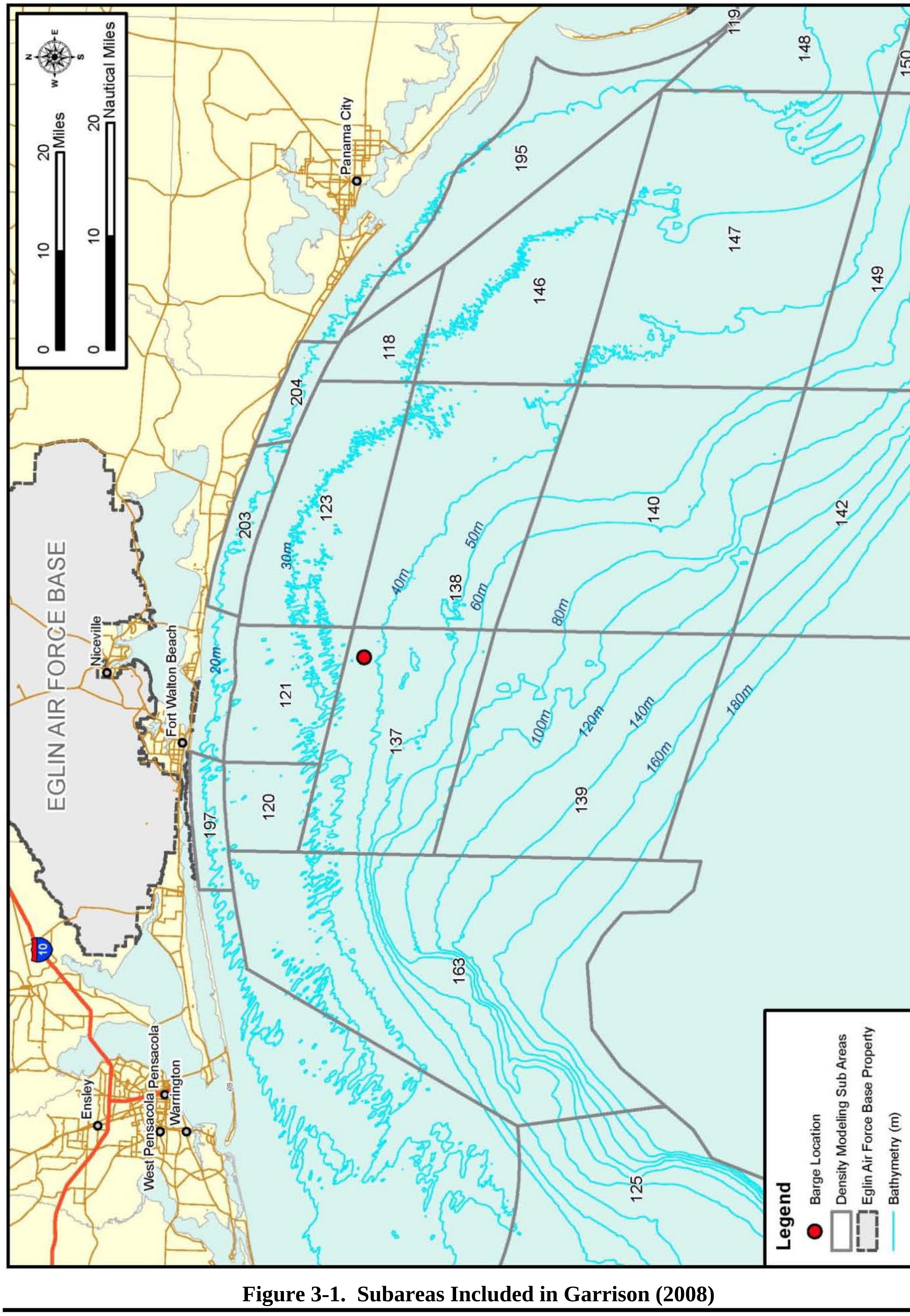

Figure 3-1. Subareas Included in Garrison (2008)

Atlantic spotted dolphin density was derived from Fulling et al. (2003), which describes the results of mammal surveys conducted in association with fall ichthyoplankton surveys from 1998 to 2001. The surveys were conducted by SEFSC personnel from the U.S.-Mexico border to southern Florida, in water depths of 20 to 200 meters. Using the software program DISTANCE©, density estimates were generated for east and west regions, with Mobile Bay as the dividing point. The east region is used in this document. Densities were provided for Atlantic spotted dolphins and unidentified *T. truncatus*/*S. frontalis* (among other species). The unidentified *T. truncatus*/*S. frontalis* category is treated as a separate species group with a unique density. Density estimates from Fulling et al. (2003) were not adjusted for sighting probability [g(0) = 1] (perception bias) or surface availability (availability bias) in the original survey report, likely resulting in underestimation of true density. Perception bias refers to the failure of observers to detect animals, although they are present in the survey area and available to be seen. Availability bias refers to animals that are in the survey area, but are not able to be seen because they are submerged when observers are present. Perception bias and availability bias result in the underestimation of abundance and density numbers (negative bias).

Fulling et al. (2003) did not collect data to correct density for perception and availability bias. However, in order to address this negative bias, Eglin AFB has adjusted density estimates based on information provided in available literature. There are no published g(0) correction factors for Atlantic spotted dolphins.

However, Barlow (2006) estimated g(0) for numerous marine mammal species near the Hawaiian Islands, including offshore pantropical spotted dolphins (*Stenella attenuata*). Separate estimates for this species were provided for group sizes of 1 to 20 animals (g(0) = 0.76), and greater than 20 animals (g(0) = 1.00). Although Fulling et al. (2003) sighted some spotted dolphin groups of more than 20 individuals, the 0.76 value is used as a more conservative approach. Barlow (2006) provides the following equation for calculating density:

Density (# animals/km^2) =

$$\frac{(n)\ (S)\ (f_0)}{(2L)\ (g_0)}$$

Where n = number of animal group sightings on effort

S = mean group size

f(0) = sighting probability density at zero perpendicular distance (influenced by species detectability and sighting cues such as body size, blows, and number of animals in a group)

L = transect length completed (km)

g(0) = probability of seeing a group directly on trackline (influenced by perception bias and availability bias)

Because (n), (S), and (f_0) cannot be directly incorporated as independent values due to lack of original information, we substitute the variable $X_{species}$ which incorporates all three values, such that $X_{species} = (n)(S)(f_0)$ for a given species. This changes the density equation to:

$$D_{Adjusted} = \frac{X_{species}}{(2L)(g_0)}$$

Using the minimum density estimates provided in Fulling et al. (2003) for Atlantic spotted dolphins and solving for $X_{SpottedDolphin}$:

$$0.201 = \frac{X_{Spotted\ Dolphin}}{(2)(816)(1.0)}$$

$X_{SpottedDolphin} = 328.032$.

Placing this value of n and the revised g(0) estimate in the original equation results in the following adjusted density estimate:

$$D_{Adjusted} = \frac{328.032}{(2)(816)(0.76)}$$

$D_{Adjusted} = 0.265$

Using the same method, adjusted density for the unidentified *T. truncatus*/*S. frontalis* species group is 0.009 animals/km^2. There are no variances attached to either of these recalculated density values, so overall confidence in these values is unknown. Table 3-7 shows the densities for each species and species group used in this document to calculate potential takes.

Table 3-7. Marine Mammal Density Estimates

Species	Density (animals/km^2)
Bottlenose dolphin[a]	0.455
Atlantic spotted dolphin[b]	0.265
Unidentified bottlenose dolphin/Atlantic spotted dolphin[b]	0.009

km^2 = square kilometers
a. Source: Garrison, 2008; adjusted for observer and availability bias by author
b. Source: Fulling et al., 2003; adjusted for negative bias based on information provided by Barlow (2003; 2006)

Sea Turtles

Four sea turtle species have reasonable likelihood of occurrence within the Maritime Strike test area: green, Kemp's ridley, leatherback, and loggerhead (Table 3-8). All species but the loggerhead are classified under the ESA as endangered. The loggerhead is classified as threatened. Sea turtles spend their lives at sea and rarely come ashore except to nest. It is theorized that young turtles, between the time they enter the sea as hatchlings and their appearance as subadults, spend their time drifting in ocean currents among seaweed and marine debris (Carr, 1986a, 1986b, 1987). The number of sea turtles has decreased during the 20th century. Factors contributing to this decline include habitat destruction from beach lighting, erosion-control practices, off-road vehicle use, predator activities, and illegal egg harvesting.

Table 3-8. Sea Turtle Species with Potential Occurrence in the Maritime Strike Test Area

Species	Status
Atlantic green sea turtle (*Chelonia mydas*)	ESA: FE
Kemp's ridley sea turtle (*Lepidochelys kempii*)	ESA: FE
Leatherback sea turtle (*Dermochelys coriacea*)	ESA: FE
Atlantic loggerhead sea turtle (*Caretta caretta*)	ESA: FT

ESA = Endangered Species Act; FE = federally endangered; FT = federally threatened

Nesting activity in Florida is documented by the Florida Fish and Wildlife Conservation Commission for the loggerhead, green, and leatherback sea turtle. Of these species, the loggerhead is the most prolific, with Florida accounting for over 90 percent of nesting in the U.S. (FWRI, 2012a). The majority of sea turtle nesting occurs along the southeastern Florida peninsula. For example, in 2011 there were 22,871 loggerhead nests in Brevard County, compared with 87 nests for Santa Rosa, Okaloosa, and Walton Counties combined (the three counties in which Eglin AFB lies). Sea turtle nesting data for these three counties are provided in Table 3-9. Although the state website does not list nesting activity for leatherback or Kemp's ridley sea turtles in the northern Gulf, Eglin AFB reports that these two species occasionally nest on military-controlled beaches of Santa Rosa Island.

Table 3-9. Sea Turtle Nesting Data, 2011

County	Survey Length in km (mi)	Loggerhead Sea Turtle Nests	Loggerhead Sea Turtle Nonnesting Emergences	Green Sea Turtle Nests	Green Sea Turtle Nonnesting Emergences	Leatherback Sea Turtle Nests	Leatherback Sea Turtle Nonnesting Emergences
Santa Rosa	11.2 (7.00)	12	7	1	0	0	0
Okaloosa	38.0 (23.6)	31	19	7	4	0	0
Walton	48.7 (30.3)	44	29	1	0	0	0

Source: FWRI, 2012b
km = kilometers; mi = miles

Atlantic green sea turtle (*Chelonia mydas*)

The green sea turtle is the largest hard-shelled sea turtle; adults commonly reach 1 meter (39.4 inches) in carapace (shell) length and 150 kilograms (331 pounds) in weight (NMFS and USFWS, 1991a). The species is considered to be a tropical herbivore. Green turtles are classified as threatened under the ESA, with the Florida and Mexican Pacific coast nesting populations listed as endangered. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

Green turtles are distributed worldwide in tropical and subtropical waters (NMFS and USFWS, 1991a). In the GOM, the species occurs from Texas to southern Florida. Adults are predominantly tropical and are only occasionally found north of southern Florida. Juveniles are frequently found in the GOM in areas where there is an abundance of seagrass (USFWS NFFO, 2009a). In the U.S, the species nests in small numbers in Georgia, South Carolina, Alabama, and the Carolinas and in larger numbers in Florida. The green turtle nesting aggregation in Florida is recognized as a regionally significant colony (USFWS NFFO, 2009a). The officially recognized nesting and hatching season for the green sea turtle extends from 01 May through 31 October in the Florida Panhandle. Eglin AFB property supports the highest number of green sea turtle nests in northwest Florida.

Post-hatchling green turtles are believed to reside in oceanic waters for a period of three to seven years. Once green turtles reach a carapace length of 20 to 25 centimeters (7.9 to 9.8 inches), they migrate to shallow nearshore areas (less than 50 meters [164 feet] in depth) where they spend the majority of their lives as late juveniles and adults (NMFS and USFWS, 1991a; Bjorndal and Bolten, 1988; Musick and Limpus, 1997). The optimal habitats for benthic-stage juveniles and adults are warm, shallow waters (3 to 5 meters [10 to 16 feet] in bottom depth) with abundant submerged vegetation (seagrass and/or algae), and in close proximity to nearshore reefs or rocky areas (Ernst et al., 1994).

Green turtles typically make dives shallower than 30 meters (98 feet); however, a maximum dive depth of 110 meters (361 feet) has been recorded in the Pacific Ocean. The maximum dive time recorded for a subadult green turtle is 66 minutes, with routine dives ranging from 9 to 23 minutes. Green sea turtles have been seen in the open ocean and can likely traverse an entire ocean basin during their life cycle. However, since the primary food source of these animals is often restricted to shallow water habitats, most individuals use nearshore, rather than offshore, migration routes on their way to the primary foraging grounds (Ernst et al., 1994).

Atlantic loggerhead sea turtle (*Caretta caretta*)

The loggerhead turtle is a large, hard-shelled sea turtle. The mean straight carapace length of adult loggerheads is approximately 92 centimeters (36 inches), and the average weight is 116 kilograms (256 pounds) (NMFS and USFWS, 1991b). This species is listed as threatened under the ESA. The NMFS and USFWS proposed listing of nine distinct population segments of loggerhead sea turtles as endangered or threatened in 2010. There is no available estimate of the size of the loggerhead population in the western north Atlantic Ocean. These turtles are the most commonly seen sea turtles in the southeastern United States and may be found near underwater structures and reefs (USFWS NFESO, 2010). The diet of loggerheads consists of gastropods, mollusks, coelenterates, and cephalopods.

From March through June, adult loggerheads congregate in the nearshore and offshore waters of the GOM to mate. Their nesting sites are on the numerous barrier islands and beaches between the Florida Keys and the northern GOM. Nesting females come ashore in the spring and summer to dig their nests between the high tide mark and the dune line and sometimes between dunes. Nest incubation averages 71 days. The Florida Panhandle, including beaches on Eglin AFB property, supports one of three demographically independent loggerhead nesting groups in the continental U.S. (TEWG, 2000; Epperly et al., 2001).

The loggerhead turtle occurs worldwide in habitats ranging from coastal estuaries to waters far beyond the continental shelf (Dodd, 1988). Loggerheads are primarily oceanic as post-hatchlings and early juveniles, often occurring in *Sargassum* drift lines where they are transported throughout the ocean by dominant currents (Bolten and Balazs, 1995). In the north Atlantic Ocean, it is hypothesized that early juvenile loggerheads inhabit the pelagic zone of the North Atlantic Gyre system (Bolten et al., 1998). Loggerheads apparently then shift to a different midwater feeding habitat; in the eastern north Atlantic Ocean, it is believed to be the waters surrounding the Azores and Madeira (islands off the southwest coast of Europe and the northwest coast of Africa). Other oceanic waters include the Grand Banks (Newfoundland, Canada) and the Mediterranean Sea. After reaching a certain size, early juvenile loggerheads then make a transoceanic crossing back towards the western Atlantic Ocean (Musick and Limpus, 1997). As later juveniles and adults, loggerheads most often occur on the continental shelf and shelf edge of the U.S. Atlantic and Gulf coasts; they are also known to inhabit coastal estuaries and bays along both coasts (CETAP, 1982; Shoop and Kenney, 1992).

On average, loggerhead turtles spend over 90 percent of their time underwater (DON, 2007). Routine dive depths of 9 to 22 meters (29.5 to 72 feet) have been recorded, and dives of up to 233 meters (764 feet) have been recorded for a post-nesting female loggerhead. Routine dives typically last from 4 to 172 minutes.

Loggerhead sea turtles are not as dependent on nearshore waters as some other species (greens and hawksbills). Thus, the expected distribution of loggerheads extends from the shoreline past the continental shelf break into waters of the continental slope as deep as 2,000 meters (6,562 feet). Beyond this depth, loggerhead occurrence is low/unknown due to potential associations of hatchlings with *Sargassum* and the possibility that adults are occupying mid-ocean habitats as they travel to and from nesting beaches and foraging grounds in the Atlantic Ocean and Caribbean Sea.

Leatherback sea turtle (*Dermochelys coriacea*)

The leatherback turtle is the largest living sea turtle. Adult carapace lengths range from 137 to 183 centimeters (54 to 72 inches), with a maximum of 256.5 centimeters (8.4 feet). Adult leatherbacks typically weigh between 200 and 700 kilograms (441 and 1,543 pounds) (NMFS and USFWS, 1992), although larger individuals have been documents (Eckert and Luginbuhl, 1988). Leatherback turtles are listed as endangered under the ESA.

This species commonly nests along the shorelines of the Atlantic, Pacific, and Indian Oceans (USFWS NFFO, 2009b). Only infrequent nesting activity has been documented for the leatherback in northwest Florida. The officially recognized nesting and hatching season for the leatherback extends from 01 March through 30 September, with nest incubation ranging from 60 to 75 days. Until the spring of 2000, the only confirmed leatherbacks nesting in northwest Florida were in Franklin and Gulf Counties. In May and June 2000, leatherback nesting activity was documented for the first time in Okaloosa County on Eglin's portion of Santa Rosa Island, and a nest was also documented in 2012. The leatherback feeds primarily on jellyfish but occasionally will eat sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed.

The leatherback turtle is distributed worldwide in tropical, subtropical, and warm-temperate waters throughout the year and into cooler temperate waters during warmer months (NMFS and USFWS, 1992; James et al., 2005). Leatherbacks in the western north Atlantic Ocean are broadly distributed from the Caribbean region to as far north as Nova Scotia, Newfoundland, Labrador, Iceland, the British Isles, and Norway. This species migrates further and moves into cold waters more than any other sea turtle species (Lazell, 1980; Shoop and Kenney, 1992). It is also the most oceanic and wide-ranging of sea turtles, undertaking extensive migrations along depth contours for hundreds, even thousands, of kilometers.

There is limited information about the entirely oceanic distribution of post-hatchling and early juvenile leatherbacks. What is known is that these life stages are restricted to waters with temperatures greater than 26° Celsius (79° Fahrenheit), and they are likely not associated with *Sargassum* in contrast to the other four sea turtle species found in U.S. waters (NMFS and USFWS, 1992; Eckert, 2002). Late juvenile and adult leatherback turtles are known to range from mid-ocean to the continental shelf and nearshore waters (Schroeder and Thompson, 1987; Shoop and Kenney, 1992). Juvenile and adult foraging habitats include both coastal feeding areas in temperate waters and offshore feeding areas in tropical waters. The distribution and movement of adult leatherbacks appear to be linked to the seasonal availability of their prey and the requirements of their reproductive cycle (Collard, 1990; Davenport and Balazs, 1991).

The leatherback is the deepest diving sea turtle. The average dive depths from tagging studies off the continental shelf of St. Croix are 35 to 122 meters (115 to 400 feet), with estimated maximum depths of over 1,000 meters (3,281 feet) (DON, 2007). Typical dive durations average 6.9 to 14.5 minutes per dive, with a maximum of 42 minutes. Routine dive lengths for leatherbacks around St. Croix can range from 4 to 14.5 minutes. The maximum known dive length is 7.7 minutes for a subadult leatherback.

Kemp's ridley sea turtle (*Lepidochelys kempi*)

The Kemp's ridley sea turtle is the smallest living sea turtle. The straight carapace length is approximately 65 centimeters (26 inches) and adults weigh less than 45 kilograms (99 pounds) (USFWS and NMFS, 1992) Adult Kemp's ridley shells are almost as wide as they are long. Kemp's ridley turtles are listed as endangered under the ESA and are considered the most imperiled of the world's sea turtles (USFWS and NMFS, 1992). Adults have the most restricted distribution of any sea turtle and are largely confined to the GOM, while post-pelagic turtles can be found over crab-rich sandy or muddy bottoms of the GOM or off the eastern U.S. coast. This species commonly nests from April to June along the Gulf coasts of Mexico and the U.S. and the Atlantic coast of North America (USFWS NFFO, 2009c). The Kemp's ridley is a rare nester on Eglin beaches and was documented for the first time in 2008 when three nests were deposited on Santa Rosa Island. Since the confirmed nesting in 2008, Kemp's ridleys have returned to Santa Rosa Island in 2010, 2011, and 2012.

Kemp's ridley turtles occur in open-ocean and *Sargassum* habitats of the North Atlantic Ocean as post-hatchlings and small juveniles (e.g., Manzella et al., 1991). They may be retained in the northern Gulf until migrating inshore to demersal habitat or may be carried south in the Loop Current, where they are swept into the Florida Current and Gulf Stream (Musick and Limpus, 1997). Once they reach a size of approximately 20 to 30 centimeters (8 to 12 inches), or 2 years of age, they actively migrate to neritic developmental habitats along the U.S. Atlantic and Gulf coasts, where they spend the majority of their lives as large juveniles and adults. The nearshore habitats in the continental United States that are frequently used by Kemp's ridleys include warm-temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and beachfront waters where their preferred food, the blue crab, is known to exist (Lutcavage and Musick, 1985; Landry and Costa, 1999). The highly suitable habitats identified for the Kemp's ridley turtle in the GOM include the western coast of Florida (particularly the Cedar Keys area), the eastern coast of Alabama (including Mobile Bay), the mouth of the Mississippi River, and the coastal waters off western Louisiana and eastern Texas. The movements of juveniles have been documented within and among preferred habitats along both the Atlantic and Gulf coasts.

Few data are available on the maximum dive duration. Satellite-tagged juvenile Kemp's ridley turtles show different mean surface intervals and dive depths depending on whether they are located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals) (DON, 2007). Dive times range from a few seconds to a maximum of 167 minutes; routine dives last between 16.7 and 33.7 minutes. Kemp's ridleys spend between 89 and 96 percent of their time submerged.

Juveniles/Hatchlings

In addition to adult turtles, hatchlings are present at certain times of the year. Loggerhead turtles nest every year on Santa Rosa Island. Green turtles nest every other year. Leatherback and Kemp's ridley turtles nest on the island infrequently. Nesting generally occurs between May and August, and the incubation period is approximately 60 days. Once hatchlings reach the GOM, at least some will be associated with floating mats of *Sargassum*. The mats provide a wide variety of food and provide cover.

Sea Turtle Density

Density estimates for three sea turtle species (loggerhead, Kemp's ridley, and leatherback) were obtained from the same habitat modeling project described for bottlenose dolphins in the preceding subsection (Garrison, 2008). Please refer to that discussion for a more detailed description of the modeling effort. Similar to the results for bottlenose dolphins, sea turtle density estimates were provided at various spatial scales within the EGTTR. At the largest scale, density data were aggregated into four principal strata categories: north-inshore, north-offshore, south-inshore, and south-offshore. Densities for these strata were provided in the published survey report. It should be noted that these aggregated densities were not corrected for the availability of turtles at the surface, and the resulting negative bias is likely large. Unpublished densities were also provided for smaller blocks (subareas) corresponding to airspace units, and a number of these subareas were combined to form larger zones. Densities in these smaller areas were provided to Eglin AFB in Excel© spreadsheets by the report author. Unlike the aggregated estimates, subarea densities were corrected for animal surface availability.

Due to difficulties in distinguishing green and hawksbill sea turtles from the air, and to the fact that they overlap in the southern portion of the survey range, these two species were combined into a one category ("green/hawksbill"). Habitat modeling resulted in prediction of relatively high densities of this species category in warm, offshore waters of the northern GOM. However, Garrison (2008) cautions that this prediction is highly suspect and should be treated with skepticism and that the results should only be applied from southwestern Florida to the Dry Tortugas. Therefore, habitat modeling results for these species are not used in this document. Model results for leatherback turtles are also less reliable due to overall low observation numbers, but Garrison (2008) does not suggest discounting leatherback density estimates in the northern Gulf.

Density estimates for green sea turtles are derived from Epperly et al. (2002). Although the publication focuses on sea turtle bycatch, aerial surveys were conducted in conjunction with the studies. The surveys were conducted by NMFS personnel each fall between 1992 and 1996. Results were stratified into inshore (0 to 10 fathoms) and offshore (10 to 40 fathoms) areas, as well as into western and eastern geographic zones. The eastern offshore stratum is most applicable to the Maritime Strike test location. Results were also presented for upper and lower 95 percent confidence intervals. The density corresponding to the upper confidence interval is used in this document. Density estimates were not adjusted for sighting or availability bias, likely resulting in underestimation of true density; therefore, the authors presented the values as minimum density estimates. To account for the potential for negative bias associated with sighting and availability bias, Eglin AFB adjusted the minimum density estimate for green sea turtles based on a 90 percent dive profile (i.e., sea turtles are assumed to spend an average of 90 percent of their time underwater and 10 percent at the surface).

Based on the preceding discussion, density estimates shown in Table 3-10 for loggerhead and Kemp's ridley sea turtles correspond to subarea 137 in the month of June, as presented by Garrison (2008). Within this block, densities were provided based on one-year (2007) and five-year monthly averages for SST and chlorophyll. The five-year average is considered preferable and is used in this document. CVs for this area and month are 0.41 for loggerhead and 0.43 for Kemp's ridley turtles and are, therefore, considered acceptable. The CV associated with leatherback turtle density is 31.1, which is unacceptably high. Therefore, the month nearest to June with a valid CV is used, which is July (CV of 0.37). The green sea turtle density estimate represents the minimum estimate provided by Epperly et al. (2002), adjusted by Eglin AFB according to the presumed dive profile.

Table 3-10. Sea Turtle Density Estimates

Species	Adjusted Density (animals/km^2)
Loggerhead sea turtle[a]	0.423
Kemp's ridley sea turtle[a]	0.052
Leatherback sea turtle[a]	0.409
Green sea turtle[b]	0.170

km^2 = square kilometers

a. Source: Garrison, 2008; adjusted for observer and availability bias by author.

b. Source: Epperly et al., 2002; not adjusted for sighting or availability bias by authors, but adjusted by Eglin AFB for this take analysis.

3.4.3 Environmental Consequences

3.4.3.1 Proposed Action (Preferred Alternative)

Marine Fish

Underwater detonations can create very high sound pressures in the form of shock waves that propagate in all directions and have the potential to seriously harm cartilaginous and bony fish. Shock waves created by the detonation velocity are faster than the speed of sound. Thus, shock waves from underwater detonations are the primary cause of mortality/injury to aquatic life at great distances from the shot point. In addition, ordnance in open water that is not contained completely by structure will produce higher amplitude and higher frequency shock waves (Keevin and Hempen, 1997).

Underwater shock waves can rupture swim bladders and blood vessels of fish, tear their tissues, and rupture and hemorrhage the spleen, kidney, liver, and gonads of fish (Wright, 1982; Lewis, 1996). In most cases, fish with swim bladders are more affected than fish without swim bladders (Lewis, 1996). Various factors can affect the extent of the effect of underwater detonations on fish. These factors include underwater topography and overall water depth, charge weight and type, position of munitions, animal size and position in the water column, as well as proximity to source. Fish feeding and/or swimming at the surface and/or in shallow water are generally more affected than fish at deeper depths within the water column (Lewis, 1996).

Marine fish species may be affected by detonation of live ordnance deployed during Maritime Strike activities. Fish that are located in proximity to a detonation could be killed, injured, or disturbed by the impulsive sound. There currently is no generally accepted threshold for determining effects to fish from explosives other than mortality models. In general, underwater explosions are lethal to most fish species near the detonation regardless of size, shape, or internal anatomy (CSA, 2004). At farther distances, species with gas-filled swim bladders are more susceptible than those without swim bladders. Larger fish are generally less susceptible to death or injury than small fish. Species with elongated body forms that are round in cross section may be less susceptible to injury than deep-bodied forms, and orientation of fish relative to the shock wave may affect the extent of injury. Open water pelagic fish (e.g., mackerel) seem to be less affected than reef fish. Variations in the fish population, including numbers, species, sizes, orientation, and range from the detonation point, make it very difficult to predict mortalities at any specific site of detonation. Most fish species experience large numbers of natural mortalities, especially during early life stages, and therefore any small level of mortality caused by Maritime Strike activities would most likely be negligible to the population as a whole.

Behavioral changes and masking could occur due to detonations. Although some fish in the vicinity of the exercises may react negatively to the sound of underwater detonations, the sounds are relatively short term and localized. Behavioral changes are not expected to have lasting effects on the survival, growth, or reproduction of fish populations. Given that the energy distribution of an explosion covers a broad frequency spectrum, sound from underwater explosions might overlap with some environmental cues significant to marine fish. However, the time scale of individual explosions is very limited, and test activities are dispersed in time. Thus, the likelihood of underwater detonations resulting in substantial masking is low.

It is not anticipated that fish protected under the ESA would be affected. Although the smalltooth sawfish historical range included the Florida Gulf coast, they are now only commonly found in southern Florida. This species typically resides within 1 mile of land in estuaries, shallow banks, sheltered bays, and river mouths. Occasionally, they are found offshore on reefs or wrecks and over hard or mud bottoms. Only a remote chance exists for this species to be in the test area. The Gulf sturgeon is generally considered to occur near the shoreline, although factors such as water depth or prey distribution may be more important factors than distance from land. Gulf sturgeons have been observed off the Suwannee River area as far as 16.7 km (10 miles) from shore (USFWS and NMFS, 2003). The USFWS has designated critical habitat for the Gulf sturgeon in the GOM (in addition to several rivers and bays). This protected Gulf habitat encompasses coastal waters from the mean high water line and out to 1.9 km (1 NM) offshore.

However, given the offshore distance of the Maritime Strike test area (17 miles) and the fact that activities are planned for summer, when sturgeon will generally be in riverine habitats, impacts to this species are considered unlikely. Maritime Strike activities would occur well beyond the offshore critical habitat boundary. There would be no significant impacts to marine fish resulting from Maritime Strike activities.

Essential Fish Habitat

The MSA requires federal agencies to assess potential impacts to EFH for managed commercial fisheries. Adverse impacts to EFH are defined as those that reduce quality and/or quantity of EFH. The EFH constituents identified in Table 3-3 (Section 3.4.3) include estuaries, coral/hardbottom, other substrate, and the water column. Maritime Strike test activities would not occur in estuaries, and no reef or other hardbottom habitat, including artificial reefs, is known to occur at the test site (Figure 3-2).

Impacts to substrate and the water column would be due to chemical materials, debris, and blast effects. Chemical materials would be introduced into bottom sediments and the water column. Such materials include metals from expended ordnance that could leach into the marine environment, detonation byproducts, and possibly fuel, oil, and other fluids associated with remotely controlled target boats. Typical metals associated with bombs, missiles, and gunnery rounds include copper, aluminum, steel, and lead, among others. Explosive byproducts include substances such as carbon and nitrogen oxides, which would be released into the water column after detonation. If a remotely controlled boat is sunk, or if the boat remains afloat but the fuel tank, engine, or other fluid-containing structure is struck by ordnance, the fluids could enter the water column.

Metal concentrations in the substrate could be elevated in a very small area around spent munitions. However, overall impacts to the Gulf floor are considered negligible. Metals, detonation byproducts, and other chemicals in the water column would be quickly dispersed through wave action, currents, tidal action, and by storm systems. In addition, the byproducts, fuel, and oil would also be degraded by microbial action and ultraviolet light exposure. Therefore, the introduction of chemicals into the marine environment will have minimal to no adverse impacts.

Debris deposited on the seafloor would include spent munitions, pieces of the target boats (plywood, fiberglass, plastics, etc.), and possibly entire target boats. Debris pieces would not appreciably affect the sandy seafloor. Debris moved by water currents could scour the bottom, but sediments would quickly refill any affected areas, and overall effects to benthic communities would be minor. Large pieces of debris, possibly including nearly intact boats, would not be as prone to movement on the seafloor and could result in beneficial effects by providing habitat for encrusting organisms, fish, and other marine fauna. Overall, the quantity of material deposited on the seafloor would be small compared to other sources of debris in the GOM. Mission avoidance of hardbottom habitats and artificial reefs provides the best assurance for habitat protection. The potential for some pieces to be carried by currents and cause some minimal habitat alteration before becoming embedded in the sediments exists but is considered low.

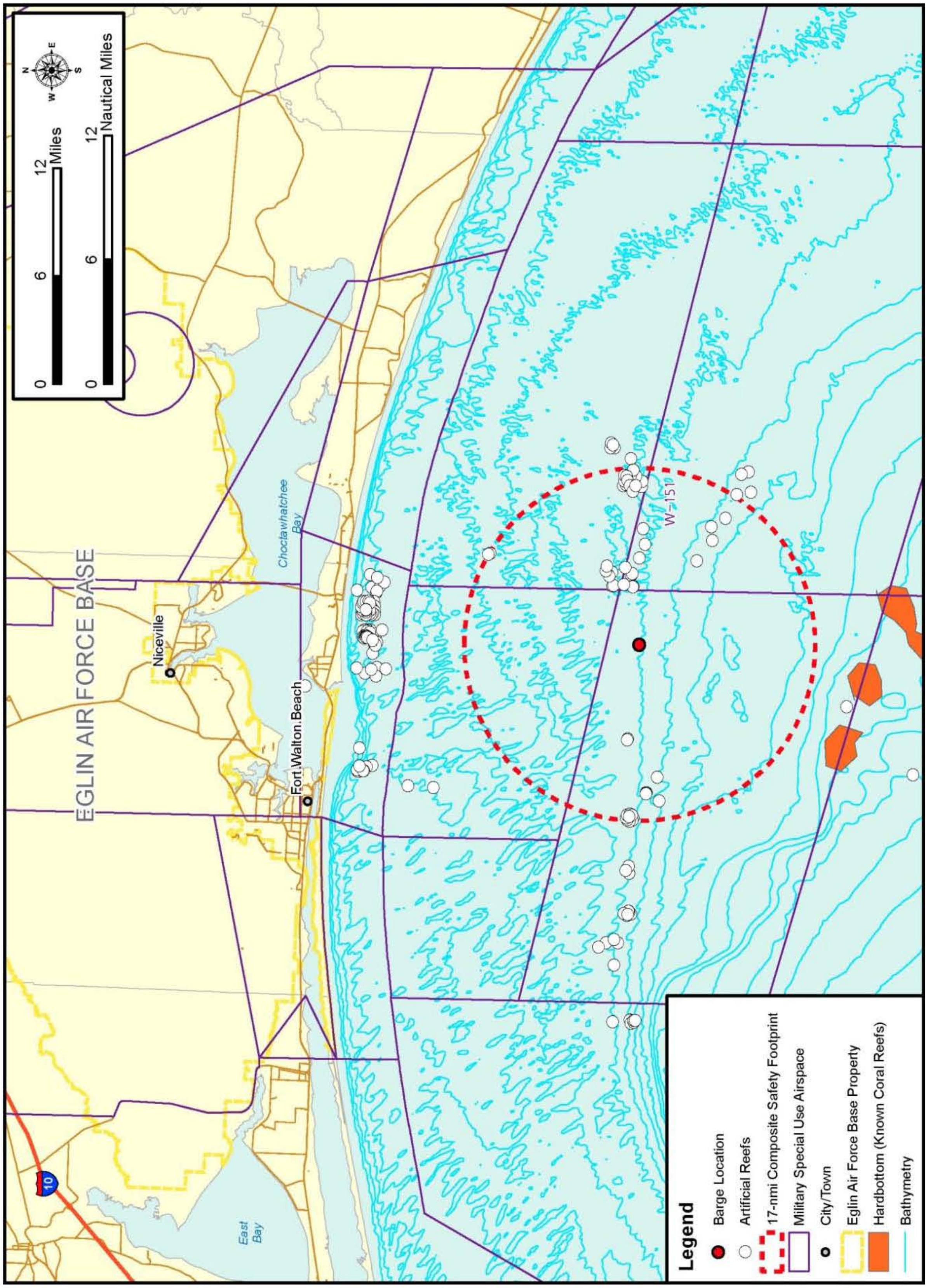

Figure 3-2. Hardbottom Habitat Near the Maritime Strike Test Area

Explosions would not occur on the seafloor and, therefore, ordnance expenditures would not result in impacts to the substrate. Underwater detonation using the larger NEW (945 pounds) would not result in substantial sediment displacement the seafloor, as discussed in Section 3.3.3. If minor displacement occurs, water currents would redistribute sediments so that habitat alteration would be short term. Blast effects would not be pronounced enough to cause seafloor cratering.

In summary, there would be no reduction in EFH quality and/or quantity due to Maritime Strike test activities.

Marine Birds

Ordnance operations during test activities have the potential to affect birds. Birds at rest on the water's surface and diving birds could be injured or killed if an underwater detonation occurred nearby. Marine birds generally spend a short period of time underwater, although those species that use pursuit diving to capture prey may be underwater for a more extended time. Overall, it is unlikely that a detonation will coincide with the dive of a marine bird. In addition, very little published literature exists on the effects of underwater detonations to diving birds. During studies conducted on seismic surveys, airguns were not found to have caused any harm to the seabirds being studied (Turnpenny and Nedwell, 1994; Lacroix et al., 2003). Injuries due to explosives have been reported, but only when the seabirds occurred near the detonation (Yelverton et al., 1973; Damon et al., 1974; Turnpenny and Nedwell, 1994). Few, if any, individual birds are likely to be affected by test activities.

Three bird species protected by federal law may occur in the test area, including the piping plover, wood stork, and bald eagle. Although the bald eagle has been removed from the federal list of endangered species, it remains protected under the Bald and Gold Eagle Protection Act. Critical habitat has been designated for the piping plover on Santa Rosa Island, the land mass nearest the Maritime Strike test location. None of these species would typically be found on the marine water surface or in association with the target boats, and none are diving birds. Direct impacts would be limited to encounters of birds flying through the test area at the same time a detonation occurred, at a height above the water that placed them in the blast radius, and to direct strikes by weapons in flight. The likelihood of such scenarios, while not quantified, is considered low. Piping plover critical habitat would not be affected by test activities.

There would be no significant impacts to marine birds due to Maritime Strike activities.

Marine Mammals

Potential causes of marine mammal impacts analyzed in this EA include debris and effects from noise and pressure waves produced by detonations. Due to the high mobility and hearing ability of dolphin species, vessel strikes are not considered to be an issue. Bottlenose and Atlantic spotted dolphins have the ability to move quickly through the water column and are often seen riding the bow wave of boats. The possibility of a direct strike by munitions is also considered low and is not discussed in this document.

Debris

Fragments of exploded bombs, missiles, and gunnery rounds, as well as pieces of damaged targets, could be suspended in the water column or sink to the bottom. Debris can negatively impact marine species. Plastics introduced into the marine environment may cause potential injury or death through ingestion or entanglement.

However, Maritime Strike tests would contribute only a comparatively small amount of debris within the region. Debris that sinks to the bottom will eventually become covered in the substrate, although cycles of covering/exposure may occur due to water current movement. The Maritime Strike mission team would recover surface debris to the extent practicable. There would be no significant impacts to marine mammals due to debris from Maritime Strike tests.

Detonations

Dolphins spend their entire lives in the water and are entirely submerged below the surface for much of the time (greater than 90 percent for most species). When at the surface, unless engaging in behaviors such as jumping, the body is almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This can make dolphins difficult to locate visually and also exposes them to underwater noise, both natural and anthropogenic, essentially 100 percent of the time because their ears are nearly always below the water's surface.

Dolphins may be potentially injured or harassed due to noise or pressure waves from detonation of live ordnance during Maritime Strike tests. The potential effects of exposure to pressure waves are similar to those described above for marine fish, and may include tissue damage to air-filled structures of the body, hemorrhaging, and eardrum rupture, among others. At some distance from an underwater detonation, the pressure waves become diminished and acoustic energy (noise) becomes the dominant impact parameter. Sound is a compressional wave that moves outward in all directions from a source. As a sound wave moves further from the source, the sound level decreases due to energy loss resulting from spreading, absorption, reflection, and refraction. At distances relatively near an explosion, noise exposure can result in temporary or permanent hearing threshold changes. At further distances, where sound level is decreased, effects may be limited to behavioral reactions such as startle effects or disruption of normal activities. A more complete description of the potential effects of pressure waves and noise, as well as the associated metrics, are provided in following subsections.

Three key sources of information are necessary for quantifying potential noise effects on marine mammals: 1) the zone of influence, which is the distance from the explosion to which a particular energy or pressure threshold extends; 2) the density of animals potentially occurring within the zone of influence; and 3) the number of events.

Zone of Influence

The zone of influence (ZOI) is defined as the area of ocean in which marine mammals could potentially be exposed to various noise thresholds associated with exploding ordnance. Marine mammals may be affected by certain energy and pressure levels resulting from the detonations. Generally accepted criteria and thresholds used for impact assessment were originally developed for the shock trials of the *USS SEAWOLF* and *USS Winston S. Churchill* (DDG-81). An exception is the modification of the Level B harassment pressure metric associated with temporary threshold shift from 12 pounds per square inch (psi) to 23 psi. These thresholds are currently accepted and used by NMFS for all similar underwater noise impact analyses.

Criteria for assessing potential impacts may include 1) mortality, 2) injury (hearing-related and non-hearing related), and 3) harassment (temporary loss of some hearing ability and behavioral reactions). The paragraphs below discuss in general the various metrics, criteria, and thresholds used for impact assessment.

Metrics

Standard impulsive and acoustic metrics were used for the analysis of underwater energy and pressure waves in this document. Four metrics are particularly important for this risk assessment.

- *Peak Pressure*: This is the maximum positive pressure, or peak amplitude of impulsive sources, for an arrival. Units are in pounds per square inch.
- *Positive Impulse*: This is the time integral of the pressure over the initial positive phase of an arrival. This metric represents a time-averaged pressure disturbance from an explosive source. Units are typically pascal-second (Pa-s) or pounds per square inch per millisecond (psi-msec). The latter is used in this document. There is no decibel analog for impulse.
- *Energy flux density (EFD)*: For plane waves, which is assumed for acoustic energy produced by the actions described in this document, EFD is the time integral of the squared pressure divided by the impedance. EFD levels have units of joules per square meter (J/m2), inch-pounds per square inch (in-lb/in2), or decibels referenced to 1 squared micropascal-second (dB re 1 μPa2-s) (with the usual convention that the reference impedance is the same as the impedance at the field point). The latter unit is used in this document.
- *1/3-Octave EFD*: This is the EFD in a 1/3-octave frequency band. A 1/3-octave band has upper and lower frequency limits with a ratio of 21/3. Therefore, the band width is approximately 25 percent above and below center frequency. The 1/3 octave selected is the hearing range at which the subject animals' hearing is believed to be most sensitive.

Criteria and Thresholds: Mortality

Lethal impacts are associated with exposure to a certain level of positive impulse pressure, expressed as psi-msec. The criterion for marine mammal mortality used in the *Churchill* document is "onset of severe lung injury." The threshold is stated in terms of the Goertner (1982) modified positive impulse with value indexed to 30.5 psi-msec. The Goertner approach depends on propagation, source/animal depths, and animal mass in a complex way. Because animals of greater mass can withstand greater pressure shock waves, this threshold was conservatively based on the mass of a dolphin calf. This threshold is further conservative in that, although it corresponds to only a 1 percent chance of mortality, any animal experiencing onset of severe lung injury is considered to be lethally taken.

Criteria and Thresholds: Injury (Level A Harassment)

Nonlethal injurious impacts are currently defined with dual criteria: 1) eardrum (i.e., tympanic membrane [TM]) rupture, and 2) the onset of slight lung injury. These criteria are considered indicative of the onset of injury. The more conservative (i.e., most impactive) of the two thresholds is used for impact analysis in this document. The threshold for TM rupture is considered to correspond to a 50 percent rupture rate (i.e., 50 percent of animals exposed to the threshold are expected to suffer TM rupture). This threshold is considered to be an EFD value of 1.17 in-lb/in^2, which corresponds to approximately 205 dB re 1 μPa^2-s (the term "sound exposure level" is increasingly used synonymously with EFD). TM rupture is not necessarily considered a life-threatening injury, but it is a useful index of possible injury that is well correlated with measures of permanent hearing impairment (e.g., Ketten [1998] indicates a 30 percent incidence of permanent threshold shift (PTS) at this threshold).

The onset of slight lung injury is the second criterion considered indicative of nonlethal injury. A cetacean would be expected to recover from this type of injury. The criterion is associated with a positive impulse level, which is given in terms of the Goertner (1982) modified positive impulse metric indexed to 13 psi-msec. The 13 psi-msec threshold corresponds to slight lung injury in a dolphin calf. The impact range for similar injury in an adult dolphin or larger cetacean would be less. However, as a conservative measure, the 13 psi-msec threshold is typically used to estimate impacts to all cetaceans.

Criteria and Thresholds: Noninjurious Impacts (Level B Harassment)

Public Law 108-136 (2004) amended the definition of Level B harassment under the MMPA for military readiness activities. For such activities, Level B harassment is defined as "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 behavioral patterns are abandoned or significantly altered." Thus, Level B harassment is limited to noninjurious impacts. Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects may be considered Level B harassment.

The physiological effect associated with noninjurious Level B harassment is TTS, which is defined as a temporary, recoverable loss of hearing sensitivity at a particular frequency or frequency range. Similar to Level A harassment, TTS is currently defined with dual criteria. The first criterion is an EFD of 182 dB re 1 μPa2-s in any 1/3-octave band at frequencies above 100 hertz (Hz) for toothed whales and above 10 Hz for baleen whales. The second criterion is stated in terms of peak pressure at 23 psi. The more conservative (i.e., larger) range of the two criteria is used to estimate impacts to marine mammals in this document.

Behavioral reactions may occur at noise levels below those considered to cause TTS in marine mammals, particularly in cases of multiple detonations. Behavioral effects may include decreased ability to feed, communicate, migrate, or reproduce, among others. Such effects are known as sub-TTS Level B harassment. Behavioral effects are currently considered to occur at an EFD level of 177 dB re 1 μPa2-s. Table 3-11 summarizes the thresholds and criteria discussed above and used in this document to estimate potential noise impacts to marine mammals.

Table 3-11. Criteria and Thresholds Used for Impact Analyses

Mortality	Level A Harassment		Level B Harassment		
30.5 psi-msec	**205 dB re 1 μPa^2-s EFD[a]**	**13 psi-msec**	**182 dB re 1 μPa^2-s EFD[a]**	**23 psi peak pressure**	**177 dB re 1 μPa^2-s EFD[a]**
Onset of severe lung injury	TM rupture in 50% of exposed animals	Onset of slight lung injury	TTS	TTS	Behavioral response

dB re 1 μPa^2-s EFD = decibels referenced to 1 squared micropascal-second energy flux density; psi-msec = parts per square inch per millisecond; TM = tympanic membrane

a. In greatest 1/3-octave band above 10 Hz or 100 Hz

Marine Mammal Density

Density estimates for bottlenose and Atlantic spotted dolphins are provided in Section 3.4.2. The densities were derived from the results of published documents authored by NMFS personnel. Density is nearly always reported for an area (e.g., animals per square kilometer). Analyses of survey results may include correction factors for negative bias, such as that provided by Garrison (2008) for bottlenose dolphins. Even though Fulling et al. (2003) did not provide a correction for Atlantic spotted dolphins or unidentified bottlenose/spotted dolphins, Eglin AFB adjusted those densities based on information provided in other published literature (Barlow 2003; 2006). Although the study area appears to represent only the surface of the water (two-dimensional), density actually implicitly includes animals anywhere within the water column under that surface area. Density estimates usually assume that animals are uniformly distributed within the prescribed area, even though this is likely rarely true. Marine mammals are often clumped in areas of greater importance, for example, in areas of high productivity, lower predation, safe calving, etc. Density can occasionally be calculated for smaller areas, but usually there are insufficient data to calculate density for such areas. Therefore, assuming an even distribution within the prescribed area remains the norm.

In addition, assuming that marine mammals are distributed evenly within the water column does not accurately reflect behavior. Databases of behavioral and physiological parameters obtained through tagging and other technologies have demonstrated that marine animals use the water column in various ways. Some species conduct regular deep dives while others engage in much shallower dives, regardless of bottom depth. Assuming that all species are evenly distributed from surface to bottom is almost never appropriate and can present a distorted view of marine mammal distribution in any region. Therefore, a depth distribution adjustment is applied to marine mammal densities in this document. By combining marine mammal density with depth distribution information, a three-dimensional density estimate is possible. These estimates allow more accurate modeling of potential marine mammal exposures from specific noise sources.

Number of Events

The number of events for Maritime Strike activities generally corresponds to the number of live weapons deployed, which is provided in Table 2-2. However, it should be noted that the 20-millimeter (mm) and 30-mm gunnery rounds were modeled as one burst each.

Detonation Effects

Table 3-12 provides the maximum estimated summer range, or radius, from the detonation point to which the various thresholds extend. This range is then used to calculate the total area of the ZOI. The calculated ZOIs are combined with density estimates (adjusted for depth distribution) and the number of live munitions to provide an estimate of the number of marine mammals potentially affected (Table 3-13). Final exposure estimates were obtained from the results of acoustic modeling. Appendix B contains a description of the acoustic model used to determine the numbers of marine species potentially impacted by Maritime Strike activities. For metrics with two criteria (e.g., 205 dB EFD and 13 psi-msec for Level A harassment), the larger number of the two are presented and used for impact calculations. The impact estimates shown do not account for required management actions, which are expected to reduce the likelihood and extent of impacts. These measures are described in Chapter 5.

Table 3-12. Summer Threshold Radii for Maritime Strike Ordnance (in meters)

Munition	Height/Depth of Detonation	Mortality	Level A Harassment		Level B Harassment		
		30.5 psi-msec	205 dB EFD[1]	13 psi-msec	182 dB EFD[1]	23 psi	177 dB EFD[1]
GBU-10	Water surface	202	275	362	1,023	1,280	1,361
GBU-24	Water surface	202	275	362	1,023	1,280	1,361
GBU-31 (JDAM)	Water surface	202	275	362	1,023	1,280	1,361
	20 feet AGL	0	0	0	0	0	0
	5 feet underwater	385	468	700	2,084	1,281	2,775
	10 feet underwater	457	591	836	2,428	1,280	3,526
GBU-12	Water surface	114	161	243	744	752	1,020
GBU-38 (JDAM)	Water surface	114	161	243	744	752	1,020
	20 feet AGL	0	0	0	0	0	0
	5 feet underwater	239	280	445	1,411	752	2,070
	10 feet underwater	279	345	532	1,545	752	2,336
GBU-54 (LJDAM)	Water surface	114	161	243	744	752	1,020
AGM-65E/L/K/G2 (Maverick)	Water surface	84	124	187	618	575	846
AGM-114 (Hellfire)	Water surface	46	70	105	425	353	618
M-117	20 feet AGL	0	0	0	0	0	0
	Water surface	147	203	293	847	950	1,125
PGU-13 HEI 30 mm	Water surface	0	6	7	31	60	55
M56/PGU-28 HEI 20 mm	Water surface	0	0	0	16	37	27

AGL = above ground level; AGM = air-to-ground missile; dB EFD = decibels energy flux density; GBU = guided bomb unit; JDAM = joint direct attack munition; LJDAM = laser joint direct attack munition; mm = millimeters; PGU = projectile gun unit; psi-msec = pounds per square inch per millisecond

1. In greatest 1/3-octave band above 10 or 100 hertz

Table 3-13. Number of Marine Mammals Potentially Affected by Maritime Strike Test Missions, Proposed Action

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Harassment (Behavioral)
Bottlenose dolphin	0.524	1.883	28.692	58.367
Atlantic spotted dolphin	0.145	0.982	15.889	30.076
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.010	0.037	0.568	1.155

TTS = temporary threshold shift

The table indicates the potential for lethality, injury, and non-injurious harassment (including behavioral harassment) to marine mammals in the absence of mitigation measures. The numbers represent total impacts for all detonations combined. Mortality was calculated as approximately one-half an animal for bottlenose dolphins and about 0.1 animals for spotted dolphins. It is expected that, with implementation of the management practices outlined in Chapter 5, potential impacts would be mitigated to the point that there would be no mortality takes. An application for an IHA under the MMPA has been submitted to NMFS for Maritime Strike activities. The permit would be required prior to the conduct of this action. An IHA authorizes take by Level A and B harassment only; mortality takes are not authorized.

Sea Turtles

Sea turtles could be impacted during Maritime Strike test activities by boat strikes, debris, and potential effects from noise and pressure waves produced by detonations. Due to sea turtles' generally dispersed distribution and relatively short surface intervals, the possibility of direct strikes by munitions is considered low and is not considered further.

Boat Strikes

In addition to target boats, a number of surface vessels would be at the Maritime Strike test area to secure the safety zone. Boat strikes could potentially affect sea turtles swimming or feeding at or just beneath the water surface. In addition, noise from surface vessel traffic may cause behavioral responses in sea turtles. However, the number of boats associated with the test would not appreciably change the typical background level of boat traffic in the area, where a large number of recreational and commercial fishing boats regularly operate in the area. In addition, surveys for marine species would be conducted before test activities take place. The likelihood of a boat strike is considered low. Therefore, there would be no significant impacts to sea turtles resulting from boat strikes associated with Maritime Strike test activities.

Debris

Fragments of exploded bombs, missiles, and gunnery rounds would likely pass through the boat targets and settle on the Gulf floor. In addition, pieces of damaged targets could also be suspended in the water column or sink to the bottom. Debris can negatively impact marine species. In particular, plastics introduced into the marine environment are well documented to cause potential injury or death to sea turtles through ingestion or entanglement. However, Maritime Strike tests would contribute only a comparatively small amount of debris within the region. Debris that sinks to the bottom will eventually become covered in the substrate, although cycles of covering/exposure may occur due to water current movement. The Maritime Strike mission team would recover surface debris to the extent practicable. There would be no significant impacts to sea turtles due to debris from Maritime Strike tests.

Noise and Pressure Effects

Sea turtles spend nearly their entire lives at sea, coming ashore only to nest and, in rare circumstances and locations, to bask. When at the water surface, sea turtle bodies are almost entirely below the water's surface, with only the head above water. This makes sea turtles difficult to locate visually and also exposes them to effects from underwater explosions essentially 100 percent of the time. Detonation of live ordnance produces noise and pressure waves in the water column that could injure or harass sea turtles. Compared to marine mammals, little is known about the role of sound and hearing in sea turtle survival, and only rudimentary information is available about responses to anthropogenic noise. However, sea turtles appear to be most sensitive to low frequencies. Greatest sensitivities have been found to be from 200 to 700 Hz for the green turtle (Ridgway et al., 1969) and around 250 Hz for juvenile loggerheads (Bartol et al., 1999, as cited in DON, 2008). The effective hearing range for marine turtles is generally considered to be between 100 and 1,000 Hz (Bartol et al., 1999, as cited in DON, 2008; Lenhardt, 1994; DON, 2008; Ridgway et al., 1969). Hearing thresholds below 100 Hz were found to increase rapidly (Lenhardt, 1994). Additionally, calculated in-water hearing thresholds at best frequencies (100 to 1,000 Hz) appear to be high—160 to 200 dB re 1μPa (Lenhardt, 1994; Moein et al., 1995, as cited in DON, 2008). A recent study on the effects of airguns on sea turtle behavior also suggests that they are most likely to respond to low-frequency sounds (McCauley et al., 2000). Green and loggerhead turtles noticeably increased their swimming speed, as well as swimming direction, when received levels reached 166 dB re 1 μPa, and their behavior became increasingly erratic at 175 dB re 1 μPa (McCauley et al., 2000).

The potential number of sea turtles affected by detonations are assessed in the following paragraphs. Similar to marine mammal analysis, three key sources of information are necessary for estimating potential effects: 1) the zone of influence; 2) the density of animals potentially occurring within the zone of influence; and 3) the number of events. There are currently no acoustic energy or pressure impact threshold ranges specifically for sea turtles that are endorsed by NMFS. In the absence of such information, criteria and thresholds used for marine mammal analyses are considered reasonably applicable to sea turtles (e.g., DON, 2008; DON, 2009). Specifically, thresholds are identified for mortality, injury, and harassment, as shown in Table 3-14. The Level B behavioral harassment criterion corresponding to 177 dB EFD is currently not used for turtle impacts analysis.

Table 3-14. Explosive Criteria Used for Estimating Sea Turtle Impacts

Effect	Criteria	Metric	Threshold
Mortality	Onset of extensive lung injury	Goertner modified positive impulse	30.5 psi-ms
Physiological	Onset slight lung injury	Goertner modified positive impulse	Indexed to 13 psi-ms
Behavioral	TTS	Greatest energy flux density level in any 1/3-octave band above 100 Hz - for total energy over all exposures	182 dB re 1 μPa^2-s
Behavioral	TTS	Peak pressure over all exposures	23 psi

dB 1 μPa^2-s = decibel referenced to 1 micropascal squared second; Hz = hertz; psi-ms = pounds per square inch-millisecond; PTS = permanent threshold shift; TTS= temporary threshold shift

Sea Turtle Density

Sea turtle density estimates are provided in Section 3.4.2. The densities were obtained from documents authored by NMFS personnel. Similar to the marine mammal density determination, turtle densities were adjusted for depth distribution, resulting in a three-dimensional estimate. This allows more accurate modeling of potential sea turtle exposures from explosive sources.

Number of Events

The number of events generally corresponds to the number of live weapons deployed, which is provided in Table 2-2. However, it should be noted that the 20-mm and 30-mm gunnery rounds were modeled as one burst each.

Detonation Effects

The summer ranges to which various thresholds extend for each Maritime Strike munition are shown in Table 3-12 in the preceding marine mammal analysis. These ranges are used to calculate the total area of the ZOI. The calculated ZOIs are combined with density estimates and the number of live munitions to provide an estimate of the number of sea turtles potentially affected (Table 3-15). Although there are dual criteria for behavioral impacts, the larger of the two is used for calculations. It should be noted that the impact estimates shown in the table do not account for required management actions, which are expected to reduce the likelihood and extent of impacts. These measures are described in Chapter 5.

Table 3-15. Number of Sea Turtles Potentially Affected by Maritime Strike Test Missions, Proposed Action

Species	Number of Impacts, Mortality	Number of Impacts, Injury	Number of Impacts, Harassment
Loggerhead sea turtle	0.198	0.441	20.542
Kemp's ridley sea turtle	0.024	0.054	2.525
Leatherback sea turtle	0.292	0.596	21.938
Green sea turtle	0.079	0.177	8.256

The table indicates the potential for lethality, injury, and noninjurious harassment to sea turtles in the absence of mitigation measures. The numbers represent total impacts for all detonations combined. Mortality is considered unlikely for Kemp's ridley and green turtles. Mortality was calculated as less than 0.3 animals each for loggerhead and leatherback turtles. It is expected that, with implementation of the management practices outlined in Chapter 5, potential impacts would be mitigated to the point that there would be no mortality takes. A consultation with NMFS pursuant to the ESA has been initiated through preparation of a Biological Assessment. A Biological Opinion, issued by NMFS and possibly containing reasonable and prudent measures and conservation recommendations, would be required before implementing the Proposed Action.

3.4.3.2 Alternative 1, Reduced Number of Munitions

Under Alternative 1, the overall number of detonations would be reduced, including the number of subsurface detonations. Potential impacts to biological resources would be similar in scope to those described for the Proposed Action. However, the likelihood of impacts, as well as the number of individual animals possibly affected, would decrease due to the reduced number of detonations.

Marine fish located near a detonation could be killed, injured, or disturbed by the impulsive sound. Underwater explosions are generally lethal to most fish species near a detonation regardless of size, shape, or internal anatomy. At farther distances, species with gas-filled swim bladders are more susceptible than those without swim bladders. Effects may be influenced by factors such as fish size, body shape, and orientation relative to the shock wave. Most fish species experience large numbers of natural mortalities and, therefore, any small level of mortality caused by Maritime Strike activities would most likely be negligible to the overall population. The likelihood of long-term behavioral changes or hearing masking is low. It is not anticipated that fish protected under the ESA (Gulf sturgeon and smalltooth sawfish) would be affected. Activities would not take place in Gulf sturgeon critical habitat. There would be no reduction in EFH quality and/or quantity. There would be no significant impacts to marine fish or fish habitat resulting from Maritime Strike activities.

Birds at rest on the water's surface, diving for prey, or flying through the test area could be injured or killed if these behaviors coincided with a detonation. However, such an occurrence is considered unlikely. Few, if any, individual birds (including protected species) are expected to be affected by test activities. There would be no significant impacts to marine birds due to Maritime Strike activities.

Similar to the Proposed Action, the potential for marine mammals to be affected by debris is low. Marine mammals could be affected by noise and pressure waves caused by detonations, although the number is lower than that of the Proposed Action. Table 3-16 presents an estimate of the number of marine mammals potentially affected under Alternative 1.

Table 3-16. Number of Marine Mammals Potentially Affected by Maritime Strike Test Missions, Alternative 1

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Harassment (Behavioral)
Bottlenose dolphin	0.272	1.065	16.312	32.520
Atlantic spotted dolphin	0.073	0.563	8.848	17.232
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.005	0.021	0.323	0.643

TTS = temporary threshold shift

The table indicates the potential for lethality, injury, and noninjurious harassment (including behavioral harassment) to marine mammals in the absence of mitigation measures. Similar to the Proposed Action, the numbers represent total impacts for all detonations combined. Mortality was calculated as approximately 0.3 animals for bottlenose dolphins and is negligible for other species/species groups. It is expected that implementation of the management practices outlined in Chapter 5 would mitigate potential impacts so that there would be no mortality takes.

An application for an incidental take permit under the MMPA has been submitted to NMFS for Maritime Strike activities. The permit would be required prior to the conduct of this action.

Potential impacts to sea turtles resulting from boat strikes and debris are similar to those described for the Proposed Action and are not significant. However, turtles may be killed, injured, or harassed due to detonations. Table 3-17 shows the number potentially affected.

Table 3-17. Number of Sea Turtles Potentially Affected by Maritime Strike Test Missions, Alternative 1

Species	Number of Impacts, Mortality	Number of Impacts, Injury	Number of Impacts, Harassment
Loggerhead sea turtle	0.101	0.236	11.644
Kemp's ridley sea turtle	0.012	0.029	1.431
Leatherback sea turtle	0.151	0.311	12.276
Green sea turtle	0.041	0.095	4.680

The table indicates the potential for lethality, injury, and noninjurious harassment to sea turtles in the absence of mitigation measures. Mortality is considered unlikely for any species, particularly with implementation of mitigation measures. A consultation with NMFS pursuant to the ESA was completed through preparation of a Biological Assessment. NMFS issued a Biological Opinion (Appendix C) for this action in May 2013. NMFS concluded that the Proposed Action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of a critical habitat.

3.4.3.3 Alternative 2, Reduced Number and No Subsurface Detonations

Under Alternative 2, the overall number of detonations would be reduced, and there would be no subsurface detonations. Potential impacts to biological resources would be somewhat similar in scope to those described for the previous alternatives. However, the likelihood of impacts, as well as the number of individual animals possibly affected, would decrease substantially due to the absence of underwater detonations.

The number of marine mammals and sea turtles potentially affected by detonations in the air and at the water surface is shown in Table 3-18 and Table 3-19. The number of animals potentially affected is considerably lower than those of the previous two alternatives due to the lack of underwater detonations. Consultation with NMFS would be required, as well obtaining applicable take permits.

Table 3-18. Number of Marine Mammals Potentially Affected by Maritime Strike Test Missions, Alternative 2

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Harassment (Behavioral)
Bottlenose dolphin	0.084	0.502	12.164	14.034
Atlantic spotted dolphin	0.020	0.264	4.668	7.882
Unidentified bottlenose dolphin/Atlantic spotted dolphin	0.002	0.010	0.241	0.278

TTS = temporary threshold shift

Table 3-19. Number of Sea Turtles Potentially Affected by Maritime Strike Test Missions, Alternative 2

Species	Number of Impacts, Mortality	Number of Impacts, Injury	Number of Impacts, Harassment
Loggerhead sea turtle	0.029	0.086	5.922
Kemp's ridley sea turtle	0.004	0.011	0.728
Leatherback sea turtle	0.046	0.103	8.302
Green sea turtle	0.012	0.035	2.380

3.4.3.4 No Action Alternative

Under the No Action Alternative, Maritime Strike test activities would not take place. There would be no impacts to marine species due to detonations and other support activities.

4. CUMULATIVE IMPACTS

Cumulative impacts to environmental resources result from incremental effects of proposed actions when combined with other past, present, and reasonably foreseeable future projects in the ROI. Cumulative impacts can result from individually minor but collectively substantial actions undertaken over a period of time by various agencies (federal, state, and local) or individuals. In accordance with NEPA, a discussion of cumulative impacts resulting from projects that are proposed, or anticipated over the foreseeable future, is required.

4.1 PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS IN THE ROI

This section discusses the potential for cumulative impacts caused by implementation of the Proposed Action when combined with other past, present, and reasonably foreseeable actions occurring in the ROI. The ROI is defined in Chapter 1 as Warning Area W-151. However, activities occurring in the other adjacent northern warning areas (W-155 and W-470, shown on Figure 1-2) could also impact some of the same resources due to similarity of depth, topography, and benthic and water column habitat. Past, present, and reasonably foreseeable actions that could affect safety and GOM access, socioeconomics, physical resources, and biological resources in the vicinity are included.

4.1.1 Past and Present Actions

U.S. Air Force Special Operations Command Air-To-Surface Gunnery Testing and Training

The U.S. Air Force Special Operations Command (AFSOC) conducts air-to-surface gunnery testing and training missions within the EGTTR. All activities take place within W-151. Missions involve live fire of 25-mm, 40-mm, and 105-mm gunnery rounds at targets on the water surface (flares or towed boats). A maximum total of 70 missions with about 46,000 associated rounds may be conducted annually, although the actual number of missions has typically been smaller in the past. All munitions are fired from AC-130 gunship aircraft. Gunnery missions may occur in any month, during daytime or nighttime hours.

Marine mammals and sea turtles may be potentially harassed due to noise or pressure from gunnery operations. Through consultations with NMFS and USFWS, Eglin has estimated the number of dolphins and sea turtles that could be affected (Table 4-1). Other cetacean species were evaluated also but are not included in the table because these species would not be affected by Maritime Strike activities.

Table 4-1. Marine Species Potentially Affected by Air-To-Surface Gunnery

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Behavioral Harassment
Bottlenose dolphin	0.03	1.67	96.01	316.67
Atlantic spotted dolphin	0.02	1.33	76.49	252.08
Sea turtles (all species)	0	0.01	1.26	Not applicable

TTS = temporary threshold shift

The number of animals potentially affected in the above table does not account for mitigation measures required during gunnery missions. These measures consist of visual observation and operational practices. Target areas are monitored for the presence of protected species before, during, and after the mission using visual scans and the aircraft's instrumentation (infrared and low-light television). If a protected species is sighted, the mission is delayed or relocated to avoid impact. In order to facilitate visual monitoring, daytime missions are conducted only in sea states of 4 or less on the Beaufort scale. Eglin has implemented three operational mitigation measures. The first is development of a 105-mm training round that has only about 7 percent of the explosive material of that contained in regular rounds. Ramp-up procedures are also implemented, where missions begin with the smallest round and proceed to the largest round. Finally, as a conservation measure to avoid impacts to the federally listed sperm whale, AFSOC has agreed to conduct only 1 of the 70 potential missions beyond the 200-meter isobath.

Precision Strike Weapon

The U.S. Air Force Air Armament Center and U.S. Navy, in cooperation with the 96th Test Wing Precision Strike Division (46 OG/OGMTP), conducts precision strike weapon (PSW) test missions within two sites in W-151 of the EGTTR. The weapons involved in the testing include the Joint Air-to-Surface Stand-Off Missile (JASSM) AGM-158 A and B and the small-diameter bomb (SDB) GBU-39/B. The JASSM is a precision cruise missile containing approximately 300 pounds of TNT-equivalent NEW, while the SDB is a guided bomb with approximately 48 pounds of TNT-equivalent NEW. Up to two live and four inert JASSM missiles per year may be launched from an aircraft at a target located on the GOM water surface approximately 15 to 24 NM offshore. Detonation occurs either upon contact with the target or 120 milliseconds after contact, corresponding a depth of 70 to 80 feet. Up to 6 live and 12 inert SDBs per year may also be deployed against a target in the GOM. Detonation occurs either 10 to 25 feet above the target or upon contact with the target.

Eglin has estimated the maximum number of dolphins and sea turtles that could be affected by PSW missions (Table 4-2), although the numbers are derived from worst-case scenarios and in reality could be much smaller. Two other cetacean species were evaluated also but are not included in the table because these species would not be affected by Maritime Strike activities.

Table 4-2. Marine Species Potentially Affected by PSW Missions

Species	Mortality	Level A Harassment	Level B Harassment (TTS)
Bottlenose dolphin	0.28	3.34	30.97
Atlantic spotted dolphin	0.23	2.66	24.65
Sea turtles (all species)[1]	0	1.00	27.00

PSW = precision strike weapon
1. The NMFS estimated 15 lethal or nonlethal takes for all sea turtle species combined over a five-year period

The number of animals potentially affected in the above table does not account for mitigation measures required during gunnery missions. These measures consist of visual monitoring from surface vessels and aircraft. Monitoring is conducted up to one hour before the mission and also after the mission is completed.

Patriot Missile Launches

Patriot missile testing consists of launching missiles from land sites on either the Eglin Reservation (no effects to marine resources) or Santa Rosa Island. Missiles launched from the island are intended to intercept drone or towed targets over the GOM. The intercept point is approximately 9 miles (15 km) from shore, depending on the specifications of the test scenario. After impact, debris from the Patriot missile and target fall into the Gulf and are not recovered. However, drones that are used to tow other targets will generally fall into the water intact and may be recovered. Up to 12 Patriot missile launches may occur on Santa Rosa Island per year.

Stand-Off Precision Guided Munition Testing

Stand-off precision guided munition (SOPGM) testing has occurred once at Eglin AFB, in 2009. During the test, three Griffin missiles with a NEW of 7.5 pounds TNT equivalent each were fired at boat targets in the GOM. The missiles were deployed over a two-day period. The test location was the same as the western site used for PSW testing described above, which was about 24 NM offshore in W-151. The visual observation requirements specified for PSW testing were also required for SOPGM events. NMFS concurred with Eglin's assessment that impacts to marine mammals would be within the scope of impacts evaluated for PSW missions. There are currently no further SOPGM tests planned.

Naval Explosive Ordnance Disposal School Training

Naval Explosive Ordnance Disposal School (NEODS) training activities are conducted 3 NM offshore of Eglin property, in approximately 60 feet of water in W-151. During a typical training scenario, five charges packed with C-4 explosive material (either 5-lb NEW or 10-lb NEW) are detonated adjacent to inert mines located on the seafloor. Training events occur up to eight times per year, resulting in up to 40 detonations annually. Eglin has estimated the maximum number of dolphins and sea turtles that could be affected by NEODS missions (Table 4-3), in the absence of mitigation measures.

Table 4-3. Marine Species Potentially Affected by NEODS Activities

Species	Mortality	Level A Harassment	Level B Harassment (TTS)	Level B Behavioral Harassment
Bottlenose dolphin	0	3.80	10.18	51.20
Sea turtles (all species)[1]	0	0.42	9.84	Not applicable

TTS = temporary threshold shift
1. NMFS estimated six lethal or nonlethal takes for all sea turtle species combined over a five-year period

Mitigation measures consist of visual monitoring before, during, and after the mission. Detonations are postponed if protected species or species indicators are sighted within the applicable survey radius. In addition, hardbottom habitats and artificial reefs are avoided to alleviate any potential impacts to protected habitats. As of the date of this EA, no NEODS missions have been conducted.

Naval Surface Warfare Center, Panama City Division Mission Activities

Naval Surface Warfare Center, Panama City Division (NSWC PCD) is the U.S. Navy's premier research and development organization focused on littoral (coastal region) warfare and expeditionary (designed for military operations abroad) maneuver warfare. NSWC PCD provides in-water research, development, test, and evaluation in support of a wide variety of operations. These activities may be generally categorized as air operations, surface operations, subsurface operations, sonar operations, electromagnetic operations, laser operations, ordnance operations, and projectile firing. The activities occur in W-151, W-155, and W-470. The NSWC PCD activities that primarily affect the resources described in this EA include 1) aerial delivery of inert shapes, rockets, and mines; 2) robotic "crawler" vehicle operation; 3) mooring and burying of mines; 4) sonar operation; and 5) ordnance operations (line charges and other detonations from 2 to 600 pounds NEW). In addition to impacts to the water column and seafloor, the Navy estimated bottlenose dolphin, Atlantic spotted dolphin, and sea turtle takes resulting from sonar and ordnance operations, as shown in Table 4-4. Other marine mammals were specified but are not included here because they would not be affected by Maritime Strike activities.

Table 4-4. Marine Species Potentially Affected by NSWC PCD Sonar and Ordnance Operations

Species	Level A Harassment	Level B Harassment	Level B Harassment (behavioral)
Bottlenose dolphin	3	47	567
Atlantic spotted dolphin	3	24	447
Sea turtles (all species)	0	8	Not applicable

An extensive suite of mitigation measures are available for NSWC PCD activities, depending on the particular mission. Mitigation measures are identified specifically for each operations category, including safety, sonar use, and detonations. These measures are expected to decrease the potential for impacts to marine resources.

Atlantic Fleet Active Sonar Training

The U.S. Navy Atlantic Fleet conducts periodic training exercises using mid- and high-frequency active sonar technology and the improved/advanced extended echo ranging system. Training occurs in the Atlantic Ocean and GOM. Activities overlapping the geographic location of Maritime Strike missions in the Gulf occur within the Pensacola/Panama City OPAREA, in W-151 and W-155 of the EGTTR. Training activities include the use of passive and active sonar, as well as small explosives (explosive source sonobuoy). Potential impacts to the water column, substrate, and marine species were analyzed. In the GOM (which includes other training areas in addition to the Pensacola/Panama City area), hundreds of bottlenose and Atlantic spotted dolphins were projected to be exposed to Level B harassment (TTS), while many thousands were estimated to be behaviorally harassed. A substantially smaller number was projected to be exposed to Level A harassment. Extensive mitigation measures are associated with the training, including personnel training, lookout requirements, and operating procedures.

4.1.2 Reasonably Foreseeable Future Actions

86 Fighter Weapons Squadron Combat Hammer Maritime Weapon Systems Evaluation Program

The 86 Fighter Weapons Squadron (FWS) has indicated an interest in establishing a 5- to 10-year program, the Combat Hammer Maritime Weapon Systems Evaluation Program (WSEP). The activities would consist of deploying live bombs and missiles against approximately 30 small boats in nearshore GOM waters off Eglin AFB. Thus, the action would be similar to Maritime Strike testing. A combination of towed and remotely controlled target boats would likely be used. A number of possible weapon delivery aircraft could be used. Proposed live munitions are shown in Table 4-5.

Table 4-5. Proposed Live Munitions for Combat Hammer Maritime WSEP

Munition	Number Proposed
GBU-10 bomb	24
GBU-12 bomb	32
GBU-24 bomb	16
GBU-31 bomb	28
GBU-38 bomb	12
AGM-65D missile	8
AGM-65K2 missile	8
AIM 9X missile	3

AGM = air-to-ground missile; AIM = air intercept missile; GBU = guided bomb unit

4.2 POTENTIAL IMPACTS RESULTING FROM CUMULATIVE ACTIONS IN THE ROI

Safety/Restricted Access

Similar to Maritime Strike activities, the actions listed above involve detonation of live ordnance, and most include dropping or firing ordnance from aircraft. Therefore, there is potential for human exposure to blast effects and debris strikes (intact weapons and target debris). All of the activities require the testing/training area to be clear of nonparticipating personnel and vessels. Delineated human safety zones are established for some of the actions. Mission areas may also be surveyed from aircraft and/or on-site cameras. With these measures in place, there would be no cumulative significant risk to the safety of military personnel or civilian populations.

Restricted access associated with past, present, and foreseeable actions would result in additional instances of closure of portions of the GOM. However, the closures occur in discreet areas for specified time periods. Compared to the overall area of nearshore Gulf waters available in the region, the closed areas are small, and commercial and recreational users of the Gulf have access to similar nearby resources. Maritime Strike testing is expected to be completed in less than a month. There would likely be some temporary public annoyance due to mission area closures, but economic and quality-of-life impacts would be minor. There would be no significant cumulative impact to Gulf access due to Maritime Strike activities.

Socioeconomics

Restricted access, as described above, would most likely result in additional costs to local recreational and commercial fisherman due to delays and rerouting during testing activities. In addition, increased military activities along with potential increases in fishing limits and reduced seasons for certain fish species could result in more difficulty in planning fishing activities, which could affect commercial fishing income. However, any access restrictions would be temporary and minor, lasting only the duration of the testing activities. Continued coordination between the Air Force and fishermen, and advanced notification of testing times and dates through the use of NOTMARs and other media sources, would allow time for recreational and commercial fisherman to plan accordingly which could help minimize costs. Also, the U.S. Air Force would continue to employ commercial fishing boats to help maintain the safety zone, which could alleviate the potential loss of income for some during testing activities. Through continued implementation of management actions and BMPs the potential for significant cumulative impacts to socioeconomic resources are anticipated to be minimal.

Physical Resources

The actions described above involve incidental expenditure of chemical materials and debris into the water column and onto the seafloor. Chemical materials include metals associated with weapons and targets, explosive byproducts and, in some cases, petroleum products. Past and previous actions have been analyzed through NEPA documentation for effects to physical resources, and results indicate that the quantity of explosive byproducts and petroleum products cumulatively expended is small and results in overall insignificant effects to water or sediment quality. Chemical materials are quickly dispersed by waves and currents and are transformed by various processes such as assimilation into the carbonate system, metabolism and assimilation by microbial organisms, release in gaseous form to the atmosphere, and by photic and microbial degradation. Metal fragments from weapons and targets that sink to the seafloor may result in an elevated concentration of metal ions near the fragments. However, the contribution of metals resulting from the actions described above are not expected to affect a significant portion of Gulf habitat, and the metal fragments corrode and degrade over time. The quantity of debris is not considered sufficient to significantly affect the seafloor by scouring. Known hardbottom habitat is avoided. There would be no significant cumulative impact to physical resources due to Maritime Strike activities.

Biological Resources

Localized loss or degradation of habitat, noise impacts, or direct physical impacts to species can have a cumulative impact when viewed on a regional scale if that loss or impact is compounded by other events with the same end results. The actions described above have the potential to impact fish, EFH, and protected marine species. Fish occurrence is difficult to predict in discreet GOM locations. However, given the spatial and temporal variations in fish populations and distribution along with intermittent timing of missions, cumulative impacts to fish species are not considered significant. Water column and benthic habitats are not likely to be significantly affected. Protected species (sea turtles and marine mammals) are potentially subjected to noise and pressure levels due to several of the cumulative actions. In particular, a large number of cetaceans are potentially affected. Mitigation measures (visual monitoring and other measures) that are required for all actions are expected to decrease the potential for impacts, particularly when monitoring in the affected area can continue until detonations occur. The actions have been analyzed individually and found to cause no significant effects. The action with the greatest potential for impact is the Atlantic Fleet active sonar training. For this action, most dolphin effects pertain to behavioral harassment, and the Navy concluded that testing would generally result in only short-term effects to individuals and would likely not affect annual rates of recruitment or survival.

4.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

NEPA requires that EAs include identification of any irreversible and irretrievable commitment of resources that would be involved in the implementation of the Proposed Action. Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the uses of these resources have on future generations. Irreversible effects primarily result from the use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the Proposed Action (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site).

Environmental consequences as a result of this project are considered short term and temporary. Resources irreversibly committed would be limited to aircraft fuel and test munitions and targets, although the quantity of these resources would be small in relation to similar testing routinely conducted at Eglin AFB. Maritime Strike activities would not result in destruction of or impacts to environmental resources, including physical, biological, and cultural resources, to the degree that future use would be limited.

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5. MANAGEMENT PRACTICES

The following is a list of regulations, plans, permits, and management actions associated with the Proposed Action as described in Section 1.3. The environmental impact analysis process for this EA identified the need for these requirements, and the proponent and interested parties involved in the Proposed Action cooperated to develop them. These requirements are, therefore, to be considered as part of the Proposed Action and would be implemented through the Proposed Action's initiation. The proponent is responsible for adherence to and coordination with the listed entities to complete the plans, permits, and management actions.

5.1 REGULATIONS, PLANS, AND PERMITS

Eglin AFB has obtained an Incidental Harassment Authorization from NMFS pursuant to the MMPA for the incidental harassment of marine mammal species. NMFS and Eglin AFB have concluded that Maritime Strike test activities would have a negligible impact on marine mammal species and stocks, and that take would not have an unmitigable adverse impact on the availability of such species or stock for subsistence uses. However, the proponent would adhere to all mitigation and management requirements associated with the authorization.

Eglin AFB initiated consultation with NMFS pursuant to the ESA through preparation of a Biological Assessment. Subsequently, NMFS prepared a Biological Opinion regarding the effects of Maritime Strike test activities. NMFS and Eglin AFB have concluded that the Proposed Action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of a critical habitat. The proponent will adhere to all reasonable and prudent measure requirements, as well as conservation recommendations, provided by NMFS. The Biological Assessment also included an evaluation of potential impacts to EFH. NMFS and Eglin AFB have concluded that the Proposed Action will not adversely affect EFH.

The CZMA requires all federal agency activities that affect land or water use or natural resource of the coastal zone be conducted in a manner consistent with the state management program. Eglin AFB prepared a Consistency Determination pursuant to the CZMA for the State of Florida (Appendix A). Eglin has received a letter from the Florida State Clearinghouse that provides concurrence with this Consistency Determination.

5.2 MANAGEMENT ACTIONS

The proponent is responsible for implementation of the following management actions.

5.2.1 Safety/Restricted Access

- Establish and maintain human safety buffer zones.
- Explosive Ordnance Disposal teams would deem safe boat targets and dispose of any surface UXO.

5.2.2 Socioeconomics

- Avoid testing activities during holidays and special events such as fishing tournaments.
- Continue to provide advanced notification to users through NOTMARs and other media sources to timely inform users of testing times and dates so that their activities can be planned accordingly.
- Eglin Range Safety employs local fisherman to help establish the safety zone and would continue this practice for the proposed live Maritime Strike missions.

5.2.3 Physical Resources

- None

5.2.4 Biological Resources

The following management action pertains to protection of EFH.

- Avoid known hardbottom and artificial reef locations.

In addition, a detailed plan has been developed to mitigate potential impacts to marine mammals and sea turtles, both of which are protected under federal law (MMPA and ESA). The complete mitigation plan is included below. This plan is also included in the associated Maritime Strike IHA request and Biological Assessment.

The potential marine mammal and sea turtle takes discussed in Chapter 3 represent the maximum expected number of animals that could be exposed to particular noise and pressure thresholds. The impact estimates do not take into account measures that would be employed to minimize impacts to marine species (these measures will help ensure human safety of test participants and nonparticipants as well). Mitigation measures consist of visual monitoring to detect the presence of protected marine species and possible indicators of these species (large schools of fish, flocks of birds, jellyfish aggregations, and *Sargassum* mats). Monitoring procedures are described in the following subsections.

Visual Monitoring

Visual monitoring would be required during Maritime Strike missions from surface vessels and high-definition video cameras. Marine species observation would primarily be conducted from safety support vessels. A large number of safety boats (20 to 25) would be stationed around the test site to clear nonparticipating vessels from the area. Based on the composite footprint, safety boats would be located approximately 15,829 meters (9.5 miles) from the detonation point. Actual distance would vary based on the size of the munition being deployed, but as a comparison point, this distance is used for the mitigation plan. Trained marine species observers would be aboard at least two of these boats and would conduct species surveys before each test. The area to be surveyed would encompass the largest applicable ZOI, based on the particular ordnance involved in a given test. Based on acoustic modeling results for the summer season, the largest possible distance from the target to be surveyed is 3,526 meters (2.2 miles). This distance corresponds to the 177 dB EFD marine mammal behavioral harassment threshold for 945-pound NEW munitions detonated at 10 feet underwater. The smallest behavioral harassment range is 27 meters (0.02 miles) and is associated with 20-mm gunnery rounds. The survey pattern would depend on the size of the ZOI and may include line transects or circular routes. Because of human safety issues, observers would be required to leave the test area 30 minutes in advance of live weapon deployment and move to a position on the safety zone periphery, approximately 9.5 miles from the detonation point. Observers would continue to scan for protected marine species from the safety zone periphery, but effectiveness would be limited as the boat would remain at a designated safety station.

Mission-related personnel would be within the test area (on boats and the instrumentation barge) on each day of testing well in advance of weapon deployment, typically near sunrise. Target strikes are planned to occur within 300 to 600 feet of the barge. These personnel would perform a variety of tasks including target preparation, equipment checks, etc., and would opportunistically observe for protected marine species and indicators as feasible throughout test preparation. However, such observations would be considered incidental and would only occur as time and schedule permits. Testing would continue regardless of whether these incidental efforts take place. Any sightings would be relayed to the control tower, as described in the detailed mitigation procedures below.

In addition to vessel-based monitoring, one to three video cameras would be positioned on an instrumentation barge anchored on-site, as described in Section 2.1.1, to allow for real-time monitoring for the duration of the mission. The camera configuration and actual number of cameras used would depend on the specific test being conducted. In addition to monitoring the area for test-specific issues, the camera(s) would also be used to monitor for the presence of protected species. A marine species observer would be located in the Eglin control tower, along with mission personnel, to view the video feed before and during test activities. The species observer would be proficient in identification of marine life and indicators in the region, as required by Eglin's Marine Species Observer Training course. This course has been approved by NMFS. Due to the relatively short duration of observation time (one and one-half hours for one or two missions per day), visual fatigue is not anticipated and only one observer would be present. The distance to which objects can be detected at the water surface by use of the cameras is considered generally comparable to that of the human eye. The barge would be located about 100 to 200 meters from the target. The marine mammal mortality threshold distance extends from 0 to 457 meters (depending on ordnance), and the Level A distance extends from 0 to 836 meters. Given these distances, observers could reasonably be expected to view a substantial portion of the mortality zone in front of the camera, although a small portion would be behind or to the side of the camera view. Some portion of the Level A harassment zone could also be viewed, although it would be less than that of the mortality zone (a large percentage would be behind or to the side of the camera view). Representative screen shots from three different cameras are shown in Figure 5-1, Figure 5-2, and Figure 5-3.

At least two ordnance delivery aircraft would participate in each live weapon release mission, in addition to an E-9A surveillance plane. Prior to the test, Air Force pilots aboard mission aircraft may make a dry run over the target area to ensure it is clear of nonparticipating vessels before ordnance is deployed, although this action would not necessarily be performed during every test. Jets would fly at a minimum speed of 300 knots indicated air speed (approximately 345 miles per hour, depending on atmospheric conditions) and at a minimum altitude of 1,000 feet (305 meters). Due to the limited flyover duration and potentially high speed and altitude, observation for marine species would probably be only marginally effective at best, and pilots would, therefore, not participate in species surveys. The turboprop-driven E-9A aircraft is well suited to locating vessels on the ocean surface through use of radar. However, the radar is not effective for detecting small marine species, and the aircraft configuration is not conducive to visually searching the ocean surface. Therefore, the E-9A would not participate in marine species surveys.

Figure 5-1. Representative Screen Shot, Camera 1

Figure 5-2. Representative Screen Shot, Camera 2

Figure 5-3. Representative Screen Shot, Camera 3

Environmental Considerations

Weather that supports the ability to observe protected marine species is required to effectively implement the surveys. Wind speed and the resulting surface conditions of the GOM are critical factors affecting observation effectiveness. Higher winds typically increase wave height and create "white cap" conditions, both of which limit an observer's ability to locate marine species at or near the surface. Maritime Strike missions would be delayed or rescheduled if the sea state is greater than number 4 of Table 5-1 at the time of the test. This would maximize detection of marine species. The lead scientist at the test site would make the final determination of whether conditions are conducive for sighting protected species or not. In addition, the test event would occur no earlier than two hours after sunrise and no later than two hours prior to sunset to ensure adequate daylight for pre- and post-mission monitoring.

Table 5-1. Sea State Scale for Maritime Strike Surveys

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

Survey Team

The survey team will consist of a combination of Air Force and civil service/civilian personnel. Vessel-based and video monitoring would be conducted during all test missions (maximum of two missions per day). The Eglin Range Safety Officer, in cooperation with the Santa Rosa

Island Tower Control, would coordinate and manage all species observation efforts. Marine species sightings and other applicable information would be communicated to tower control. The safety officer and tower control would also be in continual contact with the test director throughout the mission and would coordinate information regarding range clearing. Final decisions regarding mission prosecution, including possible test delay or relocation based on marine species sightings, would be the responsibility of the safety officer, with concurrence from the test director. Lines of communication for marine species surveys are shown in Figure 5-4. Responsibilities of each survey component are described in the following paragraphs.

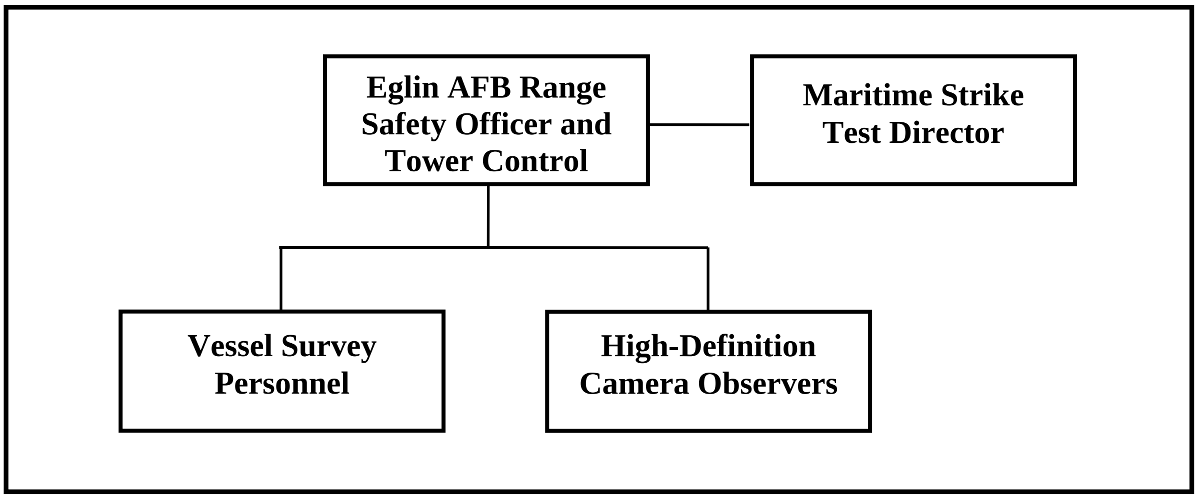

Figure 5-4. Marine Species Observer Lines of Communication

Surface Vessel Survey Team

Marine species and species indicator monitoring would be conducted from at least two surface vessels. Marine mammal indicators include large schools of fish (which could indicate the potential for marine mammals to enter the ZOI) and large, active groups of birds (which could indicate a large school of fish is present). Sea turtle indicators include large jellyfish aggregations (prey items for some turtle species) and large *Sargassum* mats (potential habitat for young turtles). Monitoring activities would be conducted from the highest point feasible on the vessels. Vessel-based observers would be familiar with marine life in the area and would be equipped with binoculars. If the entire ZOI cannot be adequately observed from a stationary point, the surface vessels would conduct line transects or move in other applicable patterns to provide sufficient coverage.

High-Definition Video Camera Controller

Maritime Strike test missions would be monitored from the instrumentation barge via live high-definition video feed. Video monitoring would, in addition to facilitating assessment of the test mission, make possible remote viewing of the area for determination of environmental conditions and the presence of marine species. Although not part of the surface vessel survey team, the video controller would report any marine mammal sightings to the Range Safety Officer/tower control. The entire ZOI would not be visible through the video feed for all tests.

Lines of Communication

The vessel monitoring teams and the video camera controller would have open lines of communication to facilitate real-time reporting of marine species and other relevant information, such as safety concerns. Direct radio communication between all surface vessel and barge personnel and the Range Safety Officer/tower control would be maintained throughout the test. Survey results from the surface vessels and video feed would be relayed to the safety officer. The safety officer and test director would collaborate regarding range clearance, with the safety officer having final authority for mission go/no-go decisions.

Detailed Mitigation Plan

The applicable ZOI would be monitored for the presence of protected marine species and species indicators. Maritime Strike mitigations would be regulated by Air Force safety parameters. Although unexpected, any mission may be delayed or cancelled due to technical issues. Should a technical delay occur, all mitigation procedures would continue until either the test takes place or is canceled. To ensure the safety of vessel-based survey personnel, the team would depart the test area approximately 30 minutes before live ordnance delivery. In some cases, two missions could occur in one day. If there is more than 1 hour between missions, pre-mission surveys would be reinitiated until 30 minutes prior to the second event. Stepwise mitigation procedures for the Maritime Strike mission are outlined below.

<u>Pre-mission Monitoring</u>: The purposes of pre-mission monitoring are to 1) evaluate the test site for environmental suitability of the mission and 2) verify that the ZOI is free of visually detectable protected marine species, as well as potential indictors of these species. On the morning of the test, the test director and safety officer would confirm that there are no issues that would preclude mission prosecution and that weather is adequate to support mitigation measures.

(a) Two Hours Prior to Mission

Mission-related surface vessels would be on-site at least two hours prior to the test mission. Observers on board at least one vessel would assess the overall suitability of the test site based on environmental conditions (sea state) and presence/absence of marine species indicators. This information would be relayed to the safety officer.

(b) One and One-Half Hours Prior to Mission

Vessel-based surveys and video camera surveillance would begin one and one-half hours prior to live weapon deployment. Surface vessel observers would survey the ZOI and relay all marine species and indicator sightings, including the time of sighting and direction of travel, if known, to the safety officer. Surveys would continue for approximately one hour. During this time, test personnel in the area would also observe for marine species as feasible. If protected marine species or indicators are observed within the ZOI, the test range would be declared “fouled,” a term that signifies to mission personnel that conditions are such that a live ordnance drop cannot occur (e.g., protected species or civilian vessels are in the test area). If no protected species or indicators are observed, the range would be declared “green.”

(c) One-Half Hour Prior to Mission

At approximately 30 minutes prior to live weapon deployment, surface vessel observers would be instructed to leave the test site and remain outside the safety zone, which on average would be 9.5 miles from the detonation point (the actual size is determined by weapon NEW and method of delivery) during conduct of the mission. The survey team would continue to monitor for protected species while leaving the area. Once the survey vessels have arrived at the perimeter of the safety zone (approximately 30 minutes after being instructed to leave, depending on actual travel time), the mission would be allowed to proceed. Protected species monitoring would continue from the periphery of the safety zone while the mission is in progress. The other safety boat crews would also be instructed to observe for marine species. Challenges from monitoring at this point include the potentially far distance from the target (on average 9.5 miles) and the requirement for the safety boats to remain on-station. These observations are therefore considered supplemental to the dedicated protected species surveys and would not be relied upon as the primary monitoring method. After the survey vessels leave the area, marine species monitoring of the immediate test site would continue on the tower through the video feed received from the high definition cameras on the instrumentation barge.

(d) Execution of Mission

Immediately prior to live weapon drop, the test director and safety officer would communicate to confirm the results of protected species surveys and the appropriateness of proceeding with the mission. The safety officer would have final authority to proceed with, postpone, move, or cancel the mission. The mission would be postponed or moved if:

- Any marine mammal or sea turtle is visually detected within the ZOI. Postponement would continue until the animal(s) that caused the postponement is confirmed to be outside of the ZOI due to the animal swimming out of the range.
- Large schools of fish, large flocks of active birds, large jellyfish aggregations, or large *Sargassum* mats are observed within the ZOI. Postponement would continue until these potential indicators are confirmed to be outside the ZOI.

In the event of a postponement, pre-mission monitoring would continue as long as weather and daylight hours allow.

Post-mission monitoring: Post-mission monitoring is designed to determine the effectiveness of pre-mission mitigation by reporting sightings of any dead or injured marine species. Post-detonation monitoring surveys would be conducted by the same observers that conducted pre-mission surveys and would commence as soon as EOD personnel declare the test area safe. Vessels would move into the ZOI from outside the safety zone and monitor for at least 30 minutes, concentrating on the area down-current of the test site. The monitoring team would document any protected marine species that were killed or injured as a result of the test and, if practicable, recover and examine any dead animals. The species, number, location, and behavior of any animals observed would be documented and reported to the Eglin Natural Resources Section representative. If a second mission is conducted on the same day, the post-mission monitoring would also be considered part of pre-mission monitoring for the second event. In this case, pre-mission monitoring would continue until 30 minutes prior to weapon delivery.

NMFS maintains stranding networks along U.S. coasts to collect and circulate information about marine species standings. Local coordinators may report stranding data to state and regional coordinators. Any observed dead or injured marine mammal or sea turtle would be reported to the appropriate coordinator.

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7. REFERENCES

Acevedo-Gutiérrez, A. and S. C. Stienessen, 2004. Bottlenose dolphins (*Tursiops truncatus*) increase number of whistles when feeding. *Aquatic Mammals* 30(3):357-362.

Adams, Chuck, Bill Lindberg, and John Stevely, 2009. "The Economic Benefits Associated with Florida's Artificial Reefs." University of Florida.

Au, W. W. L. 1993. The sonar of dolphins. New York, New York: Springer-Verlag.

Au, W. W. L. and D. L. Herzing. 2003, Echolocation signals of wild Atlantic spotted dolphin (*Stenella frontalis*). *Journal of the Acoustical Society of America 113*(1):598-604.

Baron, S. 2006. Personal communication via email between Dr. Susan Baron, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida, and Dr. Amy R. Schlock, Geo-Marine, Inc., Hampton, Virginia, 31 August.

Bartol, S. M., J. A. Musick, and M. L. Lenhardt, 1999. "Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta*)," Copeia, 3:836-840.

Baumgartner, M. F., K. D. Mullin, L. N. May, and T. D. Lemming, 2001. Cetacean habitats in the northern Gulf of Mexico. Fishery Bulletin 99:219-239.

Becker, Naomi M. 1995. Fate of Selected High Explosives in the Environment: A Literature Review. Los Alamos National Laboratory. LAUR-95-1018. March 1995.

Bjorndal, K. A., and A. B. Bolten, 1988. Growth rates of immature green turtles, *Chelonia mydas*, on feeding grounds in the southern Bahamas. *Copeia,* Vol 1988, pp 555–564.

Bolten, A. B., and G. H. Balazs, 1995. Biology of the early pelagic stage–the "lost year." in *Biology and Conservation of Sea Turtles*, K.A. Bjorndal, ed., rev. ed. Smithsonian Institution Press: Washington, D.C. pp 579–581.

Bolten, A. B., K. A. Bjorndal, H. R. Martins, T. Dellinger, M. J. Biscoito, S. E. Encalada, and B. W. Bowen, 1998. Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. *Ecological Applications*, Vol 8, pp 1–7.

Bureau of Labor Statistics (BLS), 2011. May 2011 State Occupational Employment and Wage Estimates, Florida.

Caldwell, M. C. and D. K. Caldwell, 1965. Individualized whistle contours in bottlenosed dolphins (*Tursiops truncatus)*. *Nature* 207:434-435.

Carr, A. F., 1986a. Rips, FADS and little loggerheads. Bioscience, Vol 36, pp 92–100.

Carr, A. F., 1986b. New perspectives on the pelagic stage of sea turtle development. National Oceanic and Atmospheric Administration Technical Memo. NMFS-SEFC-190. 36 pp.

Carr, A. F., 1987. Impact of nondegradable marine debris on the ecology and survival outlook of sea turtles. Marine Pollution Bulletin, Vol 18 (6B), pp 352–356.

Cetacean and Turtle Assessment Program (CETAP), 1982. Characterization of marine mammals and turtles in the Mid- and North Atlantic areas of the U.S. Outer Continental Shelf. Contract AA551-CT8-48. Prepared for U.S.

References

Collard, S. B., 1990. Leatherback Turtles Feeding Near a Warmwater Mass Boundary in the Eastern Gulf of Mexico. *Marine Turtle Newsletter*, Vol 50, pp 12–14.

Continental Shelf Associates, Inc. (CSA), 2004. Explosive Removal of Offshore Structures. Information Synthesis Report. OCS Study MMS 2002-070.

Cook, M. L. H., L. S. Sayigh, J. E. Blum, and R. S. Wells, 2004. Signature-whistle production in undisturbed free-ranging bottlenose dolphins (*Tursiops truncatus*). *Proceedings of the Royal Society B: Biological Sciences* 271:1043-1049.

Curry, B. E. and J. Smith. 1997. Phylogeographic structure of the bottlenose dolphin (*Tursiops truncatus*): Stock identification and implications for management. Pages 227-247 in Dizon, A.E., S.J. Chivers, and W.F. Perrin, eds. *Molecular genetics of marine mammals*. Lawrence, Kansas: Society for Marine Mammalogy.

Damon, Edward G., and others (Lovelace Foundation for Medical Education and Research). The Tolerance of Birds to Airblast. National Technical Information Services, U.S. Department of Commerce. Prepared for Defense Nuclear Agency. AD-785 259. 23 July 1974.

Davenport, J. and G. H. Balazs, 1991. 'Fiery Bodies'—are Pyrosomas an Important Component of the Diet of Leatherback Turtles*?" British Herpetological Society Bulletin, Vol* 31, pp 33–38.

Davis, R. W., W. E. Evans, and B. Würsig, eds., 2000. Cetaceans, Sea Turtles and Seabirds in the Northern Gulf of Mexico: Distribution, Abundance and Habitat Associations. Volume II: Technical Report. Prepared by Texas A&M University at Galveston and the National Marine Fisheries Service. U.S. Department of the Interior, Geological Survey, Biological Resources Division, USGS/BRD/CR-1999-0006 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans LA. OCS Study MMS 2000-003. 346 pp.

Davis, R. W., B. Würsig, G. S. Fargion, T. A. Jefferson, and C. C. Schroeder, 1996. Overview of the Gulf of Mexico. Pages 9-54 in Davis, R. W. and G. S. Fargion, eds. Distribution and abundance of cetaceans in the north-central and western Gulf of Mexico, final report. Volume 2: Technical report. OCS Study MMS 96-0027. New Orleans: Minerals Management Service.

Davis, R. W., G. S. Fargion, N. May, T. D. Leming, M. Baumgartner, W. E. Evans, L. J. Hansen, and K. Mullin, 1998. Physical habitat of cetaceans along the continental slope in the north-central and western Gulf of Mexico. *Marine Mammal Science* 14(3):490-507.

Department of the Navy (DON), 2007. Marine Resource Assessment for the Gulf of Mexico. Department of the Navy, U.S. Fleet Forces Command, Norfolk, VA. Final Report. Contract # N62470-02-D-9997, CTO 0030. Prepared by Geo Marine, Inc., Hampton, VA.

Department of the Navy (DON), U.S. Fleet Forces Command, 2007. Marine Resources Assessment for the Gulf of Mexico. Final Report. February 2007.

Department of the Navy (DON). 2008. United States Fleet Forces Command. Final Atlantic Fleet Active Sonar Training Environmental Impact Statement/Overseas Environmental Impact Statement. December 12, 2008.

Department of the Navy (DON). 2009. Final Environmental Impact Statement/Overseas Environmental Impact Statement, NSWC PCD Mission Activities. September 2009.

Department of Transportation (DOT), 2012a. Maritime Transportation System. Available online at: http://www.marad.dot.gov/ports_landing_page/marine_transportation_system/MTS.htm. Accessed on August 17, 2012.

References

Department of Transportation (DOT), 2012b. Maritime Administration Advisories. Available online at: http://www.marad.dot.gov/news_room_landing_page/maritime_advisories/advisory_summary.htm. Accessed on August 17, 2012.

Dodd, C. K., 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). *U.S. Fish and Wildlife Service Biological Report*, Vol 88, No 14, pp 1–110.

Duncan, R. A., 1994. Bird Migration, Weather, and Fallout. pp 1–95. Independently published: Gulf Breeze, Florida.

Duffield, D. A., S. H. Ridgway, and L. H. Cornell, 1983. Hematology distinguishes coastal and offshore forms of dolphins (*Tursiops*). *Canadian Journal of Zoology*, Vol 61, pp 930–933.

Eckert, K. L., and C. Luginbuhl, 1988. Death of a giant. *Marine Turtle Newsletters*, Vol 43, pp 2–3.

Eckert, S. A., 2002. Distribution of juvenile leatherback sea turtle *Dermochelys coriacea* sightings. *Marine Ecology Progress Series*, Vol 230, pp 289–293.

Environmental Science and Engineering (ESE), Inc., LGL Ecological Research Associates, Inc., and Continental Shelf Associates, Inc., 1987. *Southwest Florida Shelf Ecosystems Study*. Prepared for the Minerals Management Service, Gulf of Mexico OCS Region, Contract No. 14-12-0001-30276.

Epperly, S., L. Avens, L. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast U.S. waters and the Gulf of Mexico. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SEFSC-490, 88 pp.

Epperly, S. P., M. L. Snover, J. Braun-McNeill, W. N. Witzell, C. A. Brown, L. A. Csuzdi, W. G. Teas, L. B. Crowder, and R. A. Myers, 2001. Stock assessment of loggerhead sea turtles of the western north Atlantic. NOAA Technical Memorandum NMFS-SEFSC-455:3–66.

Ernst, C. H., R. W. Barbour, and J. E. Lovich, 1994. *Turtles of the United States and Canada*. Smithsonian Institution Press, Washington, D.C.

Fazioli, K. L., S. Hofmann, and R. S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus)*. *Aquatic Mammals* 32(2):212-222.

Finneran, J. J., D. A. Carder, and S. H. Ridgway, 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*), belugas, (*Delphinapterus leucas*), and California sea lions (*Zalophus californianus*). Environmental Consequences of Underwater Sound (ECOUS) Symposium, San Antonio, Texas. 12-16 May 2003.

Finneran, J. J. and D. S. Houser. 2006. Comparison of in-air evoked potential and underwater behavioral hearing thresholds in four bottlenose dolphins (*Tursiops truncatus*). *Journal of the Acoustical Society of America* 119(5): 3181-3192.

Fish and Wildlife Research Institute (FWRI), Florida Fish and Wildlife Conservation Commission. 2012a. *Trends in Nesting by Florida Loggerheads*. Information accessed on the internet at http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/. Information accessed on September 20, 2012.

Fish and Wildlife Research Institute (FWRI), Florida Fish and Wildlife Conservation Commission. 2012b. *2011 Statewide Nesting Totals*. Information accessed on the internet at http://myfwc.com/research/wildlife/sea-turtles/nesting/statewide/. Information accessed on September 21, 2012.

References

Fulling, G. L., K. D. Mullin, and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. *Fishery Bulletin* 101:923-932

Furness, R. W., and P. Monaghan, 1987. Seabird Ecology. Chapman and Hall: New York.

Garrison, L. 2008. Protected Species Habitat Modeling in the Eglin Gulf Test and Training Range. Department of Defense Legacy Resource management Program, Project Number 05-270. Prepared by Dr. Lance Garrison, Southeast Fisheries Science Center, National Marine Fisheries Service.

Goertner, J. F., 1982. *Prediction of Underwater Explosion Safe Ranges for Sea Mammals*. Research and Technology Department, Naval Surface Weapons Center, Dahlgren, VA and Silver Spring, Maryland. NSWC TR 82-188.

Govoni, J. J., L. R. Settle, and M. A. West, 2003. Trauma to juvenile pinfish and spot inflicted by submarine detonations. *Journal of Aquatic Animal Health*, Vol 15, pp 111–119.

Griffin, R. B. and N. J. Griffin. 2003. Distribution, habitat partitioning, and abundance of Atlantic spotted dolphins, bottlenose dolphins, and loggerhead sea turtles on the eastern Gulf of Mexico continental shelf. *Gulf of Mexico Science* 21(1):23-34.

Griffin, R. B. and N. J. Griffin. 2004. Temporal variation in Atlantic spotted dolphin (*Stenella frontalis*) and bottlenose dolphin (*Tursiops truncatus*) densities on the west Florida continental shelf. *Aquatic Mammals* 30(3):380-390.

Gulf of Mexico Fishery Management Council (GMFMC). 2004. Final Environmental Impact Statement for the Generic Essential Fish Habitat Amendment to the Following Fishery Management Plans in the Gulf of Mexico (GOM): Shrimp Fishery of the Gulf of Mexico; Red Drum Fishery of the Gulf of Mexico; Reef Fish Fishery of the Gulf of Mexico; Stone Crab Fishery of the Gulf of Mexico; Coral and Coral Reef Fishery of the Gulf of Mexico; Spiny Lobster Fishery of the Gulf of Mexico and South Atlantic; Coastal Migratory Pelagic Resources of the Gulf of Mexico and South Atlantic. Volume 1: Text. March 2004.

Gulf of Mexico Program (GPM), 1993. *Marine Debris Action Agenda for the Gulf of Mexico.* Stennis Space Center, MS. United States Environmental Protection Agency, Office of Water.

Hersh, S. L. and D. A. Duffield. 1990. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. Pages 129-139 in Leatherwood, S. and R.R. Reeves, eds. The bottlenose dolphin. San Diego, California: Academic Press.

Herzing, D. L. 1996. Vocalizations and associated underwater behavior of free-ranging Atlantic spotted dolphins, *Stenella frontalis* and bottlenose dolphins, *Tursiops truncatus*. *Aquatic Mammals* 22(2):61-79.

Herzing, D. L. 1997. The life history of free-ranging Atlantic spotted dolphins (*Stenella frontalis*): Age classes, color phases, and female reproduction. *Marine Mammal Science* 13(4):576-595.

Hoelzel, A. R., C. W. Potter, and P. B. Best, 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' populations of the bottlenose dolphin. *Proceedings of the Royal Society B: Biological Sciences* 265:1177-1183.

James, M. C., R. A. Myers, and C. A. Ottensmeyer. 2005. Behaviour of leatherback sea turtles, Dermochelys coriacea, during the migratory cycle. *Proceedings of the Royal Society B: Biological Sciences*, Vol 272, pp 1547–1555.

Janik, V. M. 2000. Food-related bray calls in wild bottlenose dolphins *(Tursiops truncatus)*. *Proceedings of the Royal Society B: Biological Sciences* 267:923-927.

References

Janik, V. M., L. S. Sayigh, and R. S. Wells. 2006. Signature whistle shape conveys identity information to bottlenose dolphins. *Proceedings of the National Academy of Sciences of the United States of America* 103(21):8293-8297.

Jefferson, T. A., S. Leatherwood, and M. A. Webber, 1993. FAO species identification guide. Marine mammals of the world. Rome, Italy: Food and Agriculture Organization of the United Nations.

Jones, G. J. and L. S. Sayigh. 2002. Geographic variation in rates of vocal production of free-ranging bottlenose dolphins. *Marine Mammal Science* 18(2):374-393.

Keevin, Thomas N. and Gregory L. Hempen. 1997. The Environmental Effects of Underwater Explosions with Methods to Mitigate Impacts. U.S. Army Corps of Engineers, St. Louis District. August 1997.

Kenney, R. D. 1990. Bottlenose dolphins off the northeastern United States. Pages 369-386 in S. Leatherwood and R.R. Reeves, eds. The bottlenose dolphin. San Diego: Academic Press.

Ketten, D. R., 1997. Structure and Function in Whale Ears. *Bioacoustics* vol. 8, no. 1, pp. 103-136.

Ketten, D. R. 1998. Marine mammal auditory systems: *A summary of audiometric and anatomical data and its implications for underwater acoustic impacts.* NOAA-TM-NMFSSWFSC-256, Department of Commerce.

Kingston, S. E. and P. E. Rosel, 2004. Genetic differentiation among recently diverged *delphinid* taxa determined using AFLP markers. *Journal of Heredity* 95(1):1-10.

Klatsky, L., R. Wells, and J. Sweeney, 2005. Bermuda's deep diving dolphins - Movements and dive behavior of offshore bottlenose dolphins in the Northwest Atlantic Ocean near Bermuda. Page 152 in Abstracts, Sixteenth Biennial Conference on the Biology of Marine Mammals. 12-16 December 2005. San Diego, California.

Lacroix, D., R. B. Lanctot, J. R. Reed, and T. L. McDonald, 2003. Effect of underwater seismic surveys on molting male long-tailed ducks in the Beaufort Sea, Alaska. *Canadian Journal of Zoology*, Vol 81, pp 1862–1875.

Lammers, M. O., W. W. L. Au, and D. L. Herzing, 2003. The broadband social acoustic signaling behavior of spinner and spotted dolphins. *Journal of the Acoustical Society of America* 114(3):1629-1639.

Landry, A. M., Jr., and D. Costa, 1999. Status of sea turtle stocks in the Gulf of Mexico with emphasis on the Kemp's ridley, in *Gulf of Mexico Large Marine Ecosystem Blackwell Science*, H. Kumpf, K. Steidinger, and K. Sherman, eds. Malden, MA. pp 248–268.

Lazell, J. D., 1980. New England waters: Critical habitat for marine turtles. *Copeia*, Vol 1980, pp 290–295.

Lenhardt, M. L., 1994. "Seismic and Very Low frequency sound induced behaviors in captive loggerhead marine turtles (*Caretta caretta*)," Proceedings, Fourteenth Annual Symposium on Sea Turtle Biology and Conservation, *National Oceanic and Atmospheric Administration Technical Memorandum NMFS-SEFSC-351*, Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida, pp. 238-241, 32.

Lewis, John A. Effects of Underwater Explosions on Life in the Sea. Department of Defence, Defence Science and Technology Organisation, Commonwealth of Australia. August 1996.

Lutcavage, M., and J. A. Musick, 1985. Aspects of the Biology of Sea Turtles in Virginia. *Copeia*, Vol 1985, pp 449–456.

Manzella, S., K. Bjornddal, and C. Lagueux, 1991. Head-started Kemp's ridley recaptured in Caribbean. *Marine Turtle Newsletter*, Vol 54, pp 13–14.

Mate, B. R., K. A. Rossbach, S. L. Nieukirk, R. S. Wells, A. B. Irvine, M. D. Scott, and A. J. Read, 1995. Satellite-monitored movements and dive behavior of a bottlenose dolphin (*Tursiops truncatus*) in Tampa Bay, Florida. *Marine Mammal Science*, Vol 11, No 4, pp 452–463.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M. N. Jenner, J. D. Penrose, R. I. T. Prince, A. Adhitya, J. Murdock, and K. McCabe, 2000. Marine seismic surveys: analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. Report R99-15 prepared for Australian Petroleum Production Exploration Association.

Mead, J. G. and C. W. Potter. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic Coast of North America: Morphologic and ecologic considerations. IBI Reports 5:31-44.

Minerals Management Service (MMS), 1990. Gulf of Mexico Sales 131, 135, and 137: Central, Western and Eastern Planning Areas Final Environmental Impact Statement, Volume I: Sections I through IV.C. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. MMS 90-0042.

Minerals Management Service (MMS), 2007. Final Environmental Impact Statement for Proposed Western Gulf of Mexico OCS Oil and Gas Lease Sales 204, 207, 210, 215, and 218, and Proposed Central Gulf of Mexico OCS Oil and Gas Lease Sales 205, 206, 208, 213, 216, and 222. November.

Mooney, T. A. 2006. Personal communication via email between Dr. Aran Mooney, University of Hawaii, Marine Mammal Research Program, Kane'ohe, Hawaii, and Dr. Amy R. Scholik, Geo-Marine., Inc., Hampton, Virginia, 29 August.

Mooney, T. A., P. E. Nachtigall, W. W. L. Au, M. Breese, and S. Vlachos. 2005. Bottlenose dolphin: Effects of noise duration, intensity, and frequency. Page 197 in Abstracts, Sixteenth Biennial Conference on the Biology of Marine Mammals. 12-16 December 2005. San Diego, California.

Moore, F. R., S. A. Gauthreaux, P. Kerlinger, and T. R. Simons, 1995. Habitat requirements during migration: important link in conservation. In: Ecology and Management of Neotropical Migratory Birds, pp 121–144, T. E. Martin and D. M. Finch, eds. Oxford University Press Inc.: New York.

Morreale, S. J., A. B. Meylan, and B. Baumann, 1989. Sea turtles in Long Island Sound, New York: an historical perspective, in *Proceedings of the Ninth Annual Workshop on Sea Turtle Conservation and Biology*, S. A.

Mullin, K. D. and G. L. Fulling, 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. *Marine Mammal Science* 20(4): 787-807.

Mullin, K. D. and L. J. Hansen. 1999. Marine mammals of the northern Gulf of Mexico. Pages 269-277 in Kumpf, H., K. Steidinger, and K. Sherman, eds. The Gulf of Mexico large marine ecosystem: Assessment, sustainability, and management. Cambridge, England: Blackwell Science.

Musick, J. A., and C. J. Limpus, 1997. Habitat utilization and migration of juvenile sea turtles, in *The Biology of Sea Turtles*, P.L. Lutz and J.A. Musick, eds. CRC Press: Boca Raton, Florida. pp 137–163.

Nachtigall, P. E., D. W. Lemonds, and H. L. Roiblat, 2000. Psychoacoustic studies of dolphin and whale hearing, in *Hearing by Whales and Dolphins*, Au, W.W.L., A.N. Popper, and R.R. Fay, eds. Springer-Verlag: New York. pp 330-363.

Nachtigall, P. E., J. L. Pawloski, and W. W. L. Au, 2003. Temporary threshold shift and recovery following noise exposure in the Atlantic bottlenose dolphin (*Tursiops truncatus*). *Journal of the Acoustical Society of America* 113:3425-3429.

References

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), 1991a. *Recovery plan for U.S. population of Atlantic green turtle (*Chelonia mydas*)*. St. Petersburg, Florida: National Marine Fisheries Service.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), 1991b. *Recovery plan for Northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*)*. Second revision.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), 1992. *Recovery plan for leatherback turtles* (Dermochelys coriacea) in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, Washington, DC.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS), 1993. *Recovery plan for hawksbill turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico*. National Marine Fisheries Service, St. Petersburg, Florida.

National Marine Fisheries Service (NMFS), 2012a. MRIP Effort Time Series Query. Personal Communication from the National Marine Fisheries Service, Fisheries Statistics Division. September 10, 2012.

National Marine Fisheries Service (NMFS), 2012b. Personal Communication from the National Marine Fisheries Service, Fisheries Statistics Division. September 10, 2012.

National Marine Fisheries Service (NMFS), 2012c. MRIP Effort Time Series Query. Personal Communication from the National Marine Fisheries Service, Fisheries Statistics Division. September 10, 2012.

National Marine Fisheries Service (NMFS), 2012d. NMFS Landings Query Results.

National Marine Fisheries Service (NMFS), 2012e. Landings by Distance from U.S. Shores, 2010, State of Louisiana.

National Marine Fisheries Service (NMFS), 2012f. Landings by Distance from U.S. Shores, 2010, State of Florida West Coast.

NOAA National Marine Fisheries Service (NMFS), 2008. Fact Sheet. Species of Concern. Alabama Shad (Alosa alabamae). September 22, 2008.

NOAA National Marine Fisheries Service (NMFS), 2009. Fact Sheet. Species of Concern. Speckled Hind (Epinephelus drummondhayi). June 10, 2009.

NOAA National Marine Fisheries Service (NMFS), 2009a. Fact Sheet. Species of Concern. Warsaw Grouper (Epinephelus nigritus). June 10, 2009.

NOAA National Marine Fisheries Service (NMFS), 2010. Fact Sheet. Species of Concern. Sand Tiger Shark (Carcharius taurus). December 22, 2010.

NOAA National Marine Fisheries Service (NMFS), 2011. Fact Sheet. Species of Concern. Dusky Shark (Carcharhinus obscurus). January 24, 2011.

Nowacek, D. P. 2005. Acoustic ecology of foraging bottlenose dolphins (*Tursiops truncatus*), habitat specific use of three sound types. *Marine Mammal Science* 21(4):587-602.

O'Keefe, D. J. and G. A. Young, 1984. Handbook on the Environmental Effects of Underwater Explosions. Naval Surface Weapons Center, Dahlgren, Virginia, September 13, 1984.

Perrin, W. F. 2002. *Stenella frontalis*. *Mammalian Species* 702:1-6.

Perrin, W. F., D. K. Caldwell, and M. C. Caldwell. 1994. Atlantic spotted dolphin-*Stenella frontalis* (G. Cuvier, 1829). Pages 173-190 in Ridgway, S.H. and R. Harrison, eds. Handbook of marine mammals. Volume 5: The first book of dolphins. San Diego, California: Academic Press.

Perrin, W. F., E. D. Mitchell, J. G. Mead, D. K. Caldwell, M. C. Caldwell, P. J. H. van Bree, and W.H. Dawbin. 1987. Revision of the spotted dolphins, *Stenella* spp. *Marine Mammal Science* 3(2):99-170.

Plotkin, P. T., ed., 1995. *National Marine Fisheries Service and U.S. Fish and Wildlife Service status reviews for sea turtles listed under the Endangered Species Act of 1973.* National Marine Fisheries Service: Silver Spring, Maryland.

Recreational Boating & Fishing Foundation (RBFF), 2009. "A Special Report on Fishing and Boating."

Rester, J., and R. Condrey, 1996. The occurrence of the hawksbill turtle, *Eretmochelys imbricata*, along the Louisiana coast. *Gulf of Mexico Science*, Vol 2, pp 112–114.

Ridgway, S. H., B. L. Scronce, and J. Kanwisher, 1969. Respiration and deep diving in the bottlenose porpoise. *Science*, Vol 166, pp 1651–1654.

Ridgway, S. H. 2000. The auditory central nervous system. Pages 273-293 in Au, W.W.L., A.N. Popper, and R.R. Fay, eds. Hearing by whales and dolphins. New York, New York: Springer-Verlag.

Ridgway, S. H., D. A. Carder, R. R. Smith, T. Kamolnick, C. E. Schlundt, and W. R. Elsberry, 1997. Behavioral responses and temporary shift in masked hearing threshold of bottlenose dolphins, *Tursiops truncatus*, to 1-second tones of 141 to 201 dB re 1 μPa. Technical Report 1751, Revision 1. San Diego: Naval Sea Systems Command.

Schlundt C. E., J. J. Finneran, D. A. Carder, and S. H. Ridgway, 2000. Temporary threshold shift in masked hearing threshold of bottlenose dolphins, *Tursiops truncatus*, and white whales, *Delphinapterus leucas*, after exposure to intense tones. *Journal of Acoustical Society of America* 107:3496-3508.

Schreiber, E. A. and J. Burger, 2002. Biology of Marine Birds. CRC Press Ltd.

Schroeder, B. A., and N. B. Thompson. 1987. Distribution of the loggerhead turtle, *Caretta caretta*, and the leatherback turtle, *Dermochelys coriacea*, in the Cape Canaveral, Florida area: results of aerial surveys, *Ecology of East Florida Sea Turtles*, W. N. Witzell, ed. NOAA Technical Report NMFS 53. National Marine Fisheries Service; Miami, Florida. pp 45–53.

Science Applications International Corporation (SAIC), 1997. Northeastern Gulf of Mexico Coastal and Marine Ecosystem Program; Data Search and Synthesis; Synthesis Report. U.S. Dept. of the Interior, U.S. Geological Survey, Biological Resources Division, USGS/BRD/CR—1997-0005 and Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA, OCS Study MMS 96-0014. 313 pp.

Sellas, A. B., R. S. Wells, and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. *Conservation Genetics* 6:715-728.

Shealer, D. A., 2002. Foraging Behavior and Food of Seabirds. Biology of Marine Birds. CRC Press.

Shoop, C. R., and R. D. Kenney, 1992. Seasonal Distributions and Abundances of Loggerhead and Leatherback Sea Turtles in Waters of the Northeastern United States. *Herpetological Monographs*, Vol 6, pp 43–67.

Swisdak, Jr., M. M., 1978. Explosion effects and properties: Part II - Explosion effects in water. Naval Surface Weapons Center, Silver Spring, MD. NSWC/WOL TR 76-116.

Turl, C. W. 1993. Low-frequency sound detection by a bottlenose dolphin. *Journal of the Acoustical Society of America* 94(5): 3006-3008.

Turnpenny, A. W. H., and J. R. Nedwell, 1994. The effects on marine fish, diving mammals and birds of underwater sound generated by seismic surveys. FARL Report Reference: FCR 089/94, October 1994. Accessed online at: http://www.subacoustech.com/downloads/reports/FCR089_94.pdf.

Turtle Expert Working Group (TEWG), 2000. *Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic*. NOAA Technical Memorandum NMFS-SEFSC-444, pp 1–115.

USA Today, 2012. "Fishing in Destin, Florida; Travel Tips." Available online at: http://traveltips.usatoday.com/fishing-destin-florida-17481.html. Accessed on September 10, 2012.

U.S. Air Force. 2009. Fact Sheet, E-9A. November 20, 2009. Information accessed on the internet at http://www.af.mil/information/factsheets/factsheet.asp?id=13080. Information accessed on October 4, 2012.

U.S. Air Force. 2002. Eglin Gulf Test and Training Range Final Programmatic Environmental Assessment. Eglin Air Force Base, Florida. November 2002.

U.S. Air Force. 2005. Final Environmental Assessment, Eglin Gulf Test and Training Range (EGTTR) Precision Strike Weapons (PSW) test (Five Year Plan). Eglin Air Force Base, Florida. November 2005.

United States Army Corps of Engineers (USACE), 2012. "*The Gulf Intracoastal Waterway Project*." Brochure. New Orleans District.

U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), 1992. Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). National Marine Fisheries Service, St. Petersburg, Florida. p 40.

U.S. Fish and Wildlife Service and National Marine Fisheries Service (USFWS and NMFS). 2003. 50 CFR Part 226. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Gulf Sturgeon. Federal Register Volume 68, Number 53. March 19, 2003.

USFWS, 2007. Final rule in the *Federal Register* (effective March 30, 2007), amending Title 50 Code of Federal Regulations (CFR) Part 21, *Migratory Bird Permits.*

USFWS North Florida Field Office (NFFO), 2009a. Green Sea Turtle (*Chelonia mydas*). Accessed at http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/green-sea-turtle.htm. Last updated on 16 January 2009.

USFWS North Florida Field Office (NFFO), 2009b. Leatherback Sea Turtle (*Dermochelys coriacea*). Accessed at http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/leatherback-sea-turtle.htm. Last updated on 16 January 2009.

USFWS North Florida Field Office (NFFO), 2009c. Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/kemps-ridley-sea-turtle.htm. Accessed on 20 July 2009.

USFWS North Florida Ecological Services Office (NFESO), 2010. Loggerhead Sea Turtle (*Caretta caretta*). Accessed on 18 March 2010. http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/loggerhead-sea-turtle.htm.

U.S. Geological Survey (USGS), 2007. Bird Checklists of the United States-Florida. Retrieved from http://www.npwrc.usgs.gov/resource/birds/chekbird/r4/12.htm, on 15 March 2007.

References

UXOINFO, 2013. UXOINFO Policies, Regulations, and Laws. Information accessed on the internet at http://www.uxoinfo.com/uxoinfo/policy2.cfm. Information accessed on January 8, 2013.

Waring, G. T., E. Josephson, C. P. Fairfield-Walsh, and K. Maze-Foley, eds., 2006. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2005.* NOAA Technical Memorandum NMFS-NE-194:1-346.

Waring, G. T., E. Josephson, K. Maze-Foley, and P. E. Rosel, eds., 2009. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2009. NOAA Technical Memorandum NMFS-NE-213. U.S. Department Of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Woods Hole, MA. December.

Wilson, R. P., D. Gremiller, J. Syder, M. Kierspel, S. Garthe, H. Weimerskirch, C. Schafer-Neth, A. J. A. Scolaro, C-A. Bost, J. Plots, and D. Nel, 2002. Remote-sensing Systems and Seabirds: Their Use, Abuse and Potential for Measuring Marine Environmental Variables. Marine Ecology Progress Series. Vol 228: 241-261.

Witzell, W. N., 1983. *Synopsis of the Biological Data on the Hawksbill Turtle* Eretmochelys imbricata *(Linnaeus 1766*). Food and Agriculture Organization Fisheries Synopsis Number 137. Food and Agriculture Organization, Rome. p 78.

Wright, D. G., 1982. A Discussion Paper on the Effects of Explosives on Fish and Marine Mammals in the Waters of the Northwest Territories. *Canadian Technical Report of Fisheries and Aquatic Sciences*, No. 1052.

Würsig, B., T. A. Jefferson, and D. J. Schmidly, 2000. The marine mammals of the Gulf of Mexico. College Station, Texas: Texas A&M University Press.

Yelverton, John T., Donald R. Richmond, E. Royce Fletcher, and Robert K. Jones. Safe Distances from Underwater Explosions for Mammals and Birds. Lovelace Foundation for Medical Education and Research. National technical information Service, U.S. Department of Commerce. Prepared for Defense Nuclear Agency. Contract Numbers DASA 01-70C-0075 and DASA 01-71C-0013. September 26, 1973.

Zaretsky, S. C., A. Martinez, L. P. Garrison, and E. O. Keith. 2005. Differences in acoustic signals from marine mammals in the western North Atlantic and northern Gulf of Mexico. Page 314 in Abstracts, Sixteenth Biennial Conference on the Biology of Marine Mammals. 12–16 December 2005. San Diego, California.

APPENDIX A

COASTAL ZONE MANAGEMENT ACT CONSISTENCY DETERMINATION

FEDERAL AGENCY COASTAL ZONE MANAGEMENT ACT (CZMA) CONSISTENCY DETERMINATION

Introduction

This document provides the State of Florida with the U.S. Air Force's Consistency Determination under CZMA Section 307 and 15 CFR Part 930 sub-part C. The information in this Consistency Determination is provided pursuant to 15 CFR Section 930.39 and Section 307 of CZMA, 16 U.S.C. § 1456, as amended, and its implementing regulations at 15 CFR Part 930.

This federal consistency determination addresses the Proposed Action for Maritime Strike Operations Tactics Development and Evaluation testing offshore of Eglin Air Force Base (AFB), Florida (Figure A-1 and Figure A-2).

Proposed Federal Agency Action

The Proposed Action is for the 96th Test Wing (96 TW) commander to authorize the use of multiple types of live munitions in the Eglin Gulf Test and Training Range against small boat targets for various surface and depth scenarios, to a maximum depth of 10 feet, for the Maritime Strike Operations Tactics Development and Evaluation Program. The munitions would be deployed against static, towed, and remotely controlled boat targets. Targets would consist of stripped boat hulls with plywood simulated crews and systems. Damaged boats would be recovered for data collection. The number of each type of munition, height or depth of detonation, explosive material, and explosive weight of each munition is provided in Table A-1.

The tests would occur on weekdays over a period of two to three weeks, with a maximum of two tests per day. Tests are planned to occur during June 2013. The Maritime Strike test site is located approximately 17 nautical miles offshore, in a water depth of 35 meters (115 feet). A safety footprint would be designated around the targets for each test, and would incorporate the flight and impact characteristics of all Maritime Strike munitions. A notional composite safety footprint is shown in Figure A-2. However, the actual safety footprint of any given test could be smaller or larger and shaped differently than the composite safety footprint, depending on the specific munition and launch conditions.

Non-mission personnel, such as recreational and commercial fishermen, would be advised to avoid the safety footprint while it is active, which is expected to be approximately four hours per test. Safety support vessels would be contracted to facilitate range clearance. If a non-participating vessel entered the hazard area, support vessel crews would attempt contact the vessel and direct it to maneuver away from the hazard area. Post-test activities would consist of "safing" the targets if they are still afloat by identifying and rendering safe munitions components that would be considered unexploded ordnance (UXO).

Table A-1. Maritime Strike Munitions

Type of Munition	Total # of Live Munitions	# of Detonations by Height/Depth	Warhead – explosive material	Net Explosive Weight per Munition
GBU-10	1	Water Surface: all	MK-84 - tritonal	945 lbs
GBU-24	1	Water Surface: all	MK-84 - tritonal	945 lbs
GBU-31 (JDAM)	13	Water Surface: 4 20 feet AGL: 3 5 feet underwater: 3 10 feet underwater: 3	MK-84 - tritonal	945 lbs (MK-84)
GBU-12	1	Water Surface: all	MK-82 - tritonal	192 lbs
GBU-38 (JDAM)	13	Water Surface: 4 20 feet AGL: 3 5 feet underwater: 3 10 feet underwater: 3	MK-82 – tritonal	192 lbs (MK-82)
GBU-54 (LJDAM)	1	Water Surface: all	MK-82 – tritonal	192 lbs (MK-82)
AGM-65E/L/K/G2 (Maverick)	2 each (8 total)	Water Surface: all	WDU-24/B penetrating blast-fragmentation warhead	86 lbs
AGM-114 (Hellfire)	4	Water Surface: all	High explosive anti-tank (HEAT) tandem anti-armor metal augmented charge	20 lbs
M-117	6	20 feet AGL: 3 Water Surface: 3	750 lb blast/fragmentation bomb, used the same way as MK-82 - tritonal	386 lbs (tritonal)
PGU-12 HEI 30 mm	1,000	Water Surface: all	30 x 173 mm caliber with aluminized RDX explosive. Designed for GAU-8/A Gun System	0.1 lbs
M56/PGU-28 HEI 20 mm	1,500	Water Surface: all	20 x 120 mm caliber with aluminized Comp A-4 HEI. Designed for M61 and M197 Gun System	0.02 lbs (Comp A-4 HEI)

Primary environmental impacts would consist of noise and pressure effects to marine species, including dolphins, sea turtles, and marine fish, among others, resulting from detonations at and under the water surface. Eglin AFB would employ management actions to decrease the potential for impacts to environmental resources as well as human safety, including the use of safety boats, aircraft, and high-definition video cameras to ensure the test area is clear. Eglin is consulting with the National Marine Fisheries Service regarding management actions that would decrease the potential for impacts to dolphins and turtles.

FEDERAL CONSISTENCY REVIEW

Statutes addressed as part of the Florida Coastal Zone Management Program consistency review, and considered in the analysis of the Proposed Action, are discussed in Table A-2. After review of the Florida Coastal Management Program and its enforceable policies, the U.S. Air Force has made a determination that this activity would not have an effect on the state of Florida coastal zone or its resources. Pursuant to 15 CFR § 930.41, the Florida State Clearinghouse has 60 days from receipt of this document in which to concur with or object to this Consistency Determination, or to request an extension, in writing, under 15 CFR § 930.41(b). Florida's concurrence will be presumed if Eglin AFB does not receive its response by the 60th day from receipt of this determination.

Table A-2. Florida Coastal Management Program Consistency Review

Statute	Consistency	Scope
Chapter 161 *Beach and Shore Preservation*	The Proposed Action would not affect beach and shore management, specifically as it pertains to: • The Coastal Construction Permit Program. • The Coastal Construction Control Line (CCCL) Permit Program. • The Coastal Zone Protection Program. All activities would occur beyond the 9-nautical mile state water boundary.	This statute provides policy for the regulation of construction, reconstruction, and other physical activities related to the beaches and shores of the state. Additionally, this statute requires the restoration and maintenance of critically eroding beaches.
Chapter 163, Part II *Growth Policy; County and Municipal Planning; Land Development Regulation*	The Proposed Action would not affect local government comprehensive plans.	Requires local governments to prepare, adopt, and implement comprehensive plans that encourage the most appropriate use of land and natural resources in a manner consistent with the public interest.
Chapter 186 *State and Regional Planning*	The Proposed Action would not affect state plans for water use, land development, or transportation.	Details state-level planning efforts. Requires the development of special statewide plans governing water use, land development, and transportation.
Chapter 252 *Emergency Management*	The Proposed Action would not affect the state's vulnerability to natural disasters. The Proposed Action would not affect emergency response and evacuation procedures.	Provides for planning and implementation of the state's response to, efforts to recover from, and the mitigation of natural and manmade disasters.
Chapter 253 *State Lands*	All actions would take place beyond the 9-nautical mile state water boundary. Chemical materials and debris that could potentially be transported into state waters would have no significant adverse effects on water quality or sediments, as discussed in the Maritime Strike EA. Therefore, the Proposed Action would not negatively affect state lands.	Addresses the state's administration of public lands and property of this state and provides direction regarding the acquisition, disposal, and management of all state lands.
Chapter 258 *State Parks and Preserves*	The Proposed Action would not affect state parks, recreational areas, and aquatic preserves.	Addresses administration and management of state parks and preserves.

Statute	Consistency	Scope
Chapter 259 *Land Acquisition for Conservation or Recreation*	The Proposed Action would result in intermittent, temporary closure (about four hours per test) of ocean surface over the course of two to three weeks. The composite safety footprint shown in Figure A-2 has a radius of about 8.5 nautical miles, which would place part of the cleared area in state waters. However, avoidance of this area would not be significantly burdensome for tourists or recreational users of the Gulf, as large areas of similar resources are available nearby.	Authorizes acquisition of environmentally endangered lands and outdoor recreation lands.
Chapter 260 *Florida Greenways and Trails Act*	The Proposed Action would not affect the Greenways and Trails Program.	Established in order to conserve, develop, and use the natural resources of Florida for healthful and recreational purposes.
Chapter 267 *Historical Resources*	All actions would take place beyond the 9-nautical mile state water boundary, although there is potential for chemicals or debris to subsequently move into state waters. The National Oceanic and Atmospheric Administration’s Automated Wreck and Obstruction Information System was consulted to determine areas of avoidance to ensure testing would not impact cultural resources. No shipwrecks or obstructions were found within the planned area of activity. Analysis in the Maritime Strike EA concludes that the potential for chemical or physical impacts to the sea floor would be remote. This implies that impacts to unknown archaeological resources positioned within the sediments or deeper portion of the water column would be unlikely. Section 1.7.1 of the EA summarizes the potential for impacts to historical resources and concludes that the possibility is so low that detailed analysis is not carried forward in the document.	Addresses management and preservation of the state’s archaeological and historical resources.
Chapter 288 *Commercial Development and Capital Improvements*	The Proposed Action would not affect future business opportunities on state lands, or the promotion of tourism in the region.	Promotes and develops general business, trade, and tourism components of the state economy
Chapter 334 *Transportation Administration*	The Proposed Action would not affect the planning needs of the state’s transportation administration.	Addresses the state’s policy concerning transportation administration.
Chapter 339 *Transportation Finance and Planning*	The Proposed Action would not affect the finance and planning needs of the state’s transportation system.	Addresses the finance and planning needs of the state’s transportation system.

Statute	Consistency	Scope
Chapter 373 *Water Resources*	The proposed testing location would occur in marine waters approximately 14.5 nautical miles from shore. Although this location is outside of the 9-nautical mile state water boundary, there is potential for chemicals or debris to subsequently move into state waters, including estuarine waters and wetlands. However, analysis in Section 3.3.3 of the Maritime Strike EA concludes that impacts to water quality would be negligible. There would be no adverse impacts to fish or other wildlife due to water quality degradation. Surface waters and subsurface waters would not be affected.	Addresses sustainable water management; the conservation of surface and ground waters for full beneficial use; the preservation of natural resources, fish, and wildlife; protecting public land; and promoting the health and general welfare of Floridians.
Chapter 375 *Outdoor Recreation and Conservation Lands*	The Proposed Action would not affect opportunities for recreation on state lands.	Develops comprehensive multipurpose outdoor recreation plan to document recreational supply and demand, describe current recreational opportunities, estimate need for additional recreational opportunities, and propose means to meet the identified needs.
Chapter 376 *Pollutant Discharge Prevention and Removal*	The Proposed Action would not affect the transfer, storage, or transportation of pollutants.	Regulates transfer, storage, and transportation of pollutants, and cleanup of pollutant discharges.
Chapter 377 *Energy Resources*	The Proposed Action would not affect energy resource production, including oil and gas, and/or the transportation of oil and gas.	Addresses regulation, planning, and development of oil and gas resources of the state.
Chapter 379 *Fish and Wildlife Conservation*	Eglin AFB Natural Resources Section is currently conducting formal consultations with the National Marine Fisheries Service pursuant to the Endangered Species Act and Marine Mammal Protection Act regarding protected marine species (dolphins and sea turtles). All terms and conditions resulting from these consultations would be followed. Further potential impacts to biological resources are addressed in Section 3.4.3 of the Maritime Strike EA. Therefore, the Proposed Action would be consistent with the state's protection of fish and wildlife resources.	Addresses the management and protection of the state of Florida's wide diversity of fish and wildlife resources.
Chapter 380 *Land and Water Management*	The Proposed Action would not affect development of state lands with regional (i.e., more than one county) impacts. The Proposed Action would not include changes to coastal infrastructure such as capacity increases of existing coastal infrastructure, or use state funds for infrastructure planning, designing or construction.	Establishes land and water management policies to guide and coordinate local decisions relating to growth and development.
Chapter 381 *Public Health, General Provisions*	The Proposed Action would not affect the state's policy concerning the public health system.	Establishes public policy concerning the state's public health system.

Statute	Consistency	Scope
Chapter 388 *Mosquito Control*	The Proposed Action would not affect mosquito control efforts.	Addresses mosquito control effort in the state.
Chapter 403 *Environmental Control*	Although the proposed testing location is outside of the 9-nautical mile state water boundary, there is potential for chemicals or debris to move into state waters. Water quality and sediments are analyzed in Section 3.3.3 of the Maritime Strike EA, and a determination is made that there would be no significant impacts to water or sediments due to the introduction of metals, explosive byproducts, or petroleum products. In addition, sediment displacement resulting from detonations in the water column would is not expected. Air quality and waste is addressed in Section 1.7.1 of the EA. Air emissions resulting from munitions use, surface craft, and aircraft are not expected to impact air quality of the region. The amount of solid waste produced by testing would be small and would potentially consist of weapons, weapon fragments, and target fragments. Explosive ordnance testing generally does not constitute hazardous waste. Any unexploded ordnance issues would be addressed by Eglin AFB. The Proposed Action would not affect water quality, air quality, pollution control, solid waste management, or other environmental control efforts of the state.	Establishes public policy concerning environmental control in the state.
Chapter 582 *Soil and Water Conservation*	The Proposed Action would not affect soil erosion or water conservation efforts.	Provides for the control and prevention of soil erosion.

Figure A-1. Eglin Air Force Base and Surrounding Region

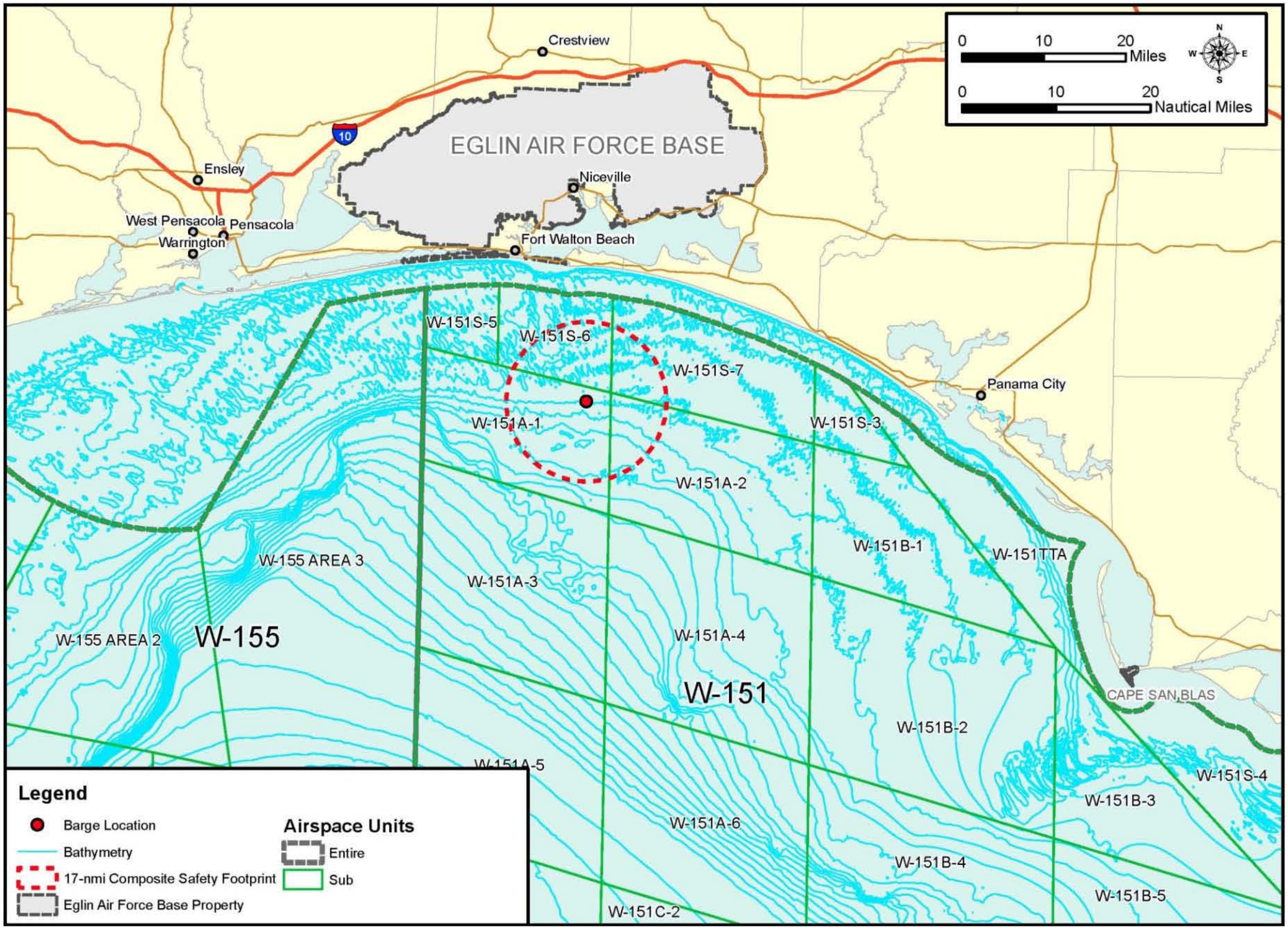

Figure A-2. Proposed Location for Live Maritime Strike Tests

APPENDIX B

ACOUSTIC MODELING METHODOLOGY

B.1 INTRODUCTION

Marine species exposure estimates are derived from the results of acoustic modeling performed by a contracted company with expertise in underwater acoustics. The modeling process and methodology are discussed in the following sections, which include a description of the acoustic sources being modeled, characterization and descriptions of important environmental components incorporated into the model, methodologies and calculations used to model impacts to marine animals, and a description of harassment estimate determination and model results.

B.2 EXPLOSIVE ACOUSTIC SOURCES

B.2.1 Acoustic Characteristics of Explosive Sources

The acoustic sources employed for Maritime Strike Operations are categorized as broadband explosives. Broadband explosives produce significant acoustic energy across several frequency decades of bandwidth. Propagation loss is sufficiently sensitive to frequency as to require model estimates at several frequencies over such a wide band.

Explosives are impulsive sources that produce a shock wave that dictates additional pressure-related metrics (peak pressure and positive impulse). A list of the proposed munitions to be used in Maritime Strike Operations is provided in Section 2.1.1.

Explosives detonated underwater introduce loud, impulsive, broadband sounds into the marine environment. Three source parameters influence the effect of an explosive: the weight of the explosive material, the type of explosive material, and the detonation depth. The net explosive weight (NEW) accounts for the first two parameters. The NEW of an explosive is the weight of TNT required to produce an equivalent explosive power.

The detonation depth of an explosive is particularly important due to a propagation effect known as surface-image interference. For sources located near the sea surface, a distinct interference pattern arises from the coherent sum of the two paths that differ only by a single reflection from the pressure-release surface. As the source depth and/or the source frequency decreases, these two paths increasingly, destructively interfere with each other, reaching total cancellation at the surface (barring surface-reflection scattering loss).

B.2.2 Animal Harassment Effects of Explosive Sources

The harassments expected to result from these sources are computed on a per in-water explosive basis; to estimate the number of harassments for multiple explosives, consider the following: Let A represent the impact area (that is, the area in which the chosen metric exceeds the threshold) for a single explosive. The cumulative effect of a series of explosives is then dictated by the spacing of the explosives relative to the movement of the marine wildlife. If the detonations are spaced widely in time or space, allowing for sufficient animal movements as to ensure a different population of animals is considered for each detonation, and N corresponds to the number of explosives being detonated, calculating the cumulative impact area ($A_{Cumulative}$) of N explosives can be represented as $A_{Cumulative} = N \times A$, regardless of the metric. This leads to a worst case estimate of harassments and is the method used in this analysis.

At the other extreme is the case where the detonations occur at essentially the same time and location (but not close enough to require the source emissions to be coherently summed). In this case, the pressure metrics (peak pressure and positive impulse) are constant regardless of the number of detonations spaced closely in time, while the energy metrics increase at a rate of $N^{½}$ (under spherical spreading loss only) or less.

The firing sequence for some of the proposed munitions (gunnery) consists of a number of rapid bursts, often lasting a second or less. Due to the tight spacing in time, each burst can be treated as a single detonation. For the energy metrics, the impact area of a burst is computed using a source energy spectrum that is the source spectrum for a single detonation scaled by the number of rounds in a burst. For the pressure metrics, the impact area for a burst is the same as the impact area of a single round. For all metrics, the cumulative impact area of an event consisting of N bursts is merely the product of the impact area of a single burst and the number of bursts, as would be the case if the bursts are sufficiently spaced in time or location as to ensure that each burst is affecting a different set of marine wildlife.

Explosives are modeled as detonating at depths ranging from the water surface to 10 feet below the surface, as provided by Government-furnished information. Impacts from above-surface detonations were considered negligible and not modeled.

For sources that are detonated at shallow depths, it is frequently the case that the explosion may breach the surface with some of the acoustic energy escaping the water column. The source levels have not been adjusted for possible venting, nor does the subsequent analysis attempt to take this into account.

B.3 ENVIRONMENTAL CHARACTERIZATION

B.3.1 Important Environmental Parameters for Estimating Animal Harassment

Propagation loss ultimately determines the extent of the Zone of Influence (ZOI) for a particular source activity. In turn, propagation loss as a function of range depends on a number of environmental parameters, including:

- water depth,
- sound speed variability throughout the water column,
- bottom geo-acoustic properties, and
- surface roughness, as determined by wind speed.

Due to extensive operations in the marine environment, such as anti-submarine warfare training, and the importance of sound propagation loss to many such activities, the U.S. Navy has invested heavily in measuring and modeling these environmental parameters over the last four to five decades. The result of this effort is the following collection of global databases containing these environmental parameters, which are accepted as standards for Navy and other Department of Defense modeling efforts. Table B-1 contains the version of the databases used in the modeling for this analysis.

Table B-1. Navy Standard Databases Used in Modeling

Parameter	Database	Version
Water Depth	Digital Bathymetry Data Base Variable Resolution	DBDBV 6.0
Ocean Sediment	Re-packed Bottom Sediment Type	BST 2.0
Wind Speed	Surface Marine Gridded Climatology Database	SMGC 2.0
Temperature/Salinity Profiles	Generalized Digital Environment Model	GDEM 3.0

The sound speed profile directs the sound propagation in the water column. The spatial variability of the sound speed field is generally small over operating areas of typical size. The presence of a strong oceanographic front is a noteworthy exception to this rule. To a lesser extent, variability in the depth and strength of a surface duct can be of some importance. If the sound speed minimum occurs within the water column, more sound energy can travel further without suffering as much loss (ducted propagation). But if the sound speed minimum occurs at the surface or bottom, the propagating sound interacts more with these boundaries and may become attenuated more quickly. In the mid-latitudes, seasonal variation often provides the most significant variation in the sound speed field. For this reason, both summer and winter profiles are modeled to demonstrate the extent of the difference.

Losses of propagating sound energy occur at the boundaries. The water-sediment boundary defined by the bathymetry can vary by a large amount. In a deep water environment, the interaction with the bottom may matter very little. In a shallow water environment the opposite is true and the properties of the sediment become very important. The sound propagates through the sediment, as well as being reflected by the interface. Soft (low density) sediment behaves more like water for lower frequencies and the sound has relatively more transmission and relatively less reflection than a hard (high density) bottom or thin sediment.

The roughness of the boundary at the water surface depends on the wind speed. Average wind speed can vary seasonally, but could also be the result of local weather. A rough surface scatters the sound energy and increases the transmission loss. Boundary losses affect higher frequency sound energy much more than lower frequencies.

B.3.2 Characterizing the Acoustic Marine Environment

The environment for modeling impact value is characterized by a frequency-dependent bottom definition, range-dependent bathymetry and sound velocity profiles (SVP), and seasonally varying wind speeds and SVPs. The bathymetry database is on a grid of variable resolution.

The sound velocity profile database has a fixed spatial resolution, storing temperature and salinity as a function of time and location. The low frequency bottom loss is characterized by standard definition of geo-acoustic parameters for the given sediment type of sand. The high frequency bottom loss class is fixed to match expected loss for the sediment type. The area of interest can be characterized by the appropriate sound speed profiles, set of low frequency bottom loss parameters, high frequency bottom loss class, and High Frequency Environmental Acoustics (HFEVA) very-high frequency sediment type for modeled frequencies in excess of 10 kilohertz (kHz).

Generally, seasonal variation is sampled by looking at summer and winter cases. However, given current plans to conduct Maritime Strike activities in the June 2013 timeframe, ordnance usage was assigned to the summer season only rather than equally divided between summer and winter seasons.

Impact volumes in the operating area were then computed using propagation loss estimates and the explosives model derived for the representative environment.

B.3.3 Description of the Eglin AFB Maritime Strike Exercise Area Environment

The Maritime Strike Operations Study Area is located off the coast of Florida in the Gulf of Mexico. It is an area that slopes from shallow waters near the coast to deeper waters offshore. The bottom is characterized as sandy sediment according to the Bottom Sediments Type Database. Environmental values were extracted from unclassified Navy standard databases in a radius of 50 kilometers (km) around the center point at

N 30° 08.5' W 86° 28'

The Navy standard database for bathymetry has a resolution of 0.05 minutes in the Gulf of Mexico; see Figure B-1. Mean and median depths from DBDBV in the extracted area are 47 and 112 meters, respectively.

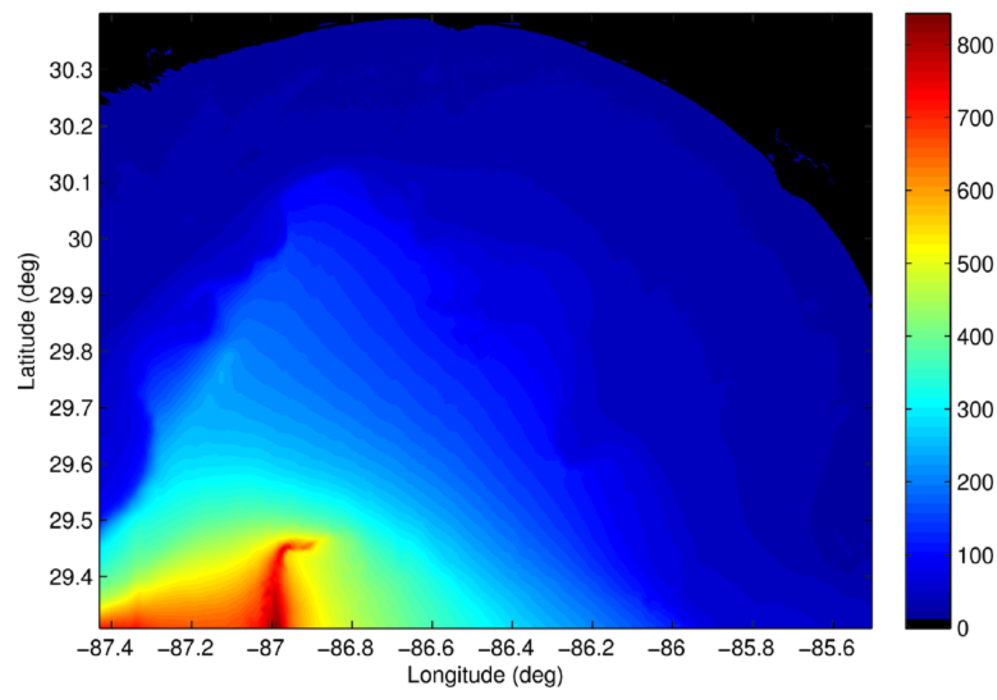

Figure B-1. Bathymetry (in meters) for the Maritime Strike Operations Study Area Representative Environment

The seasonal variability in wind speed was modeled as 8.6 knots in the summer and 13.02 knots in the winter.

Example input of range-dependent bathymetry is depicted in Figure B-2 for the due-north bearing.

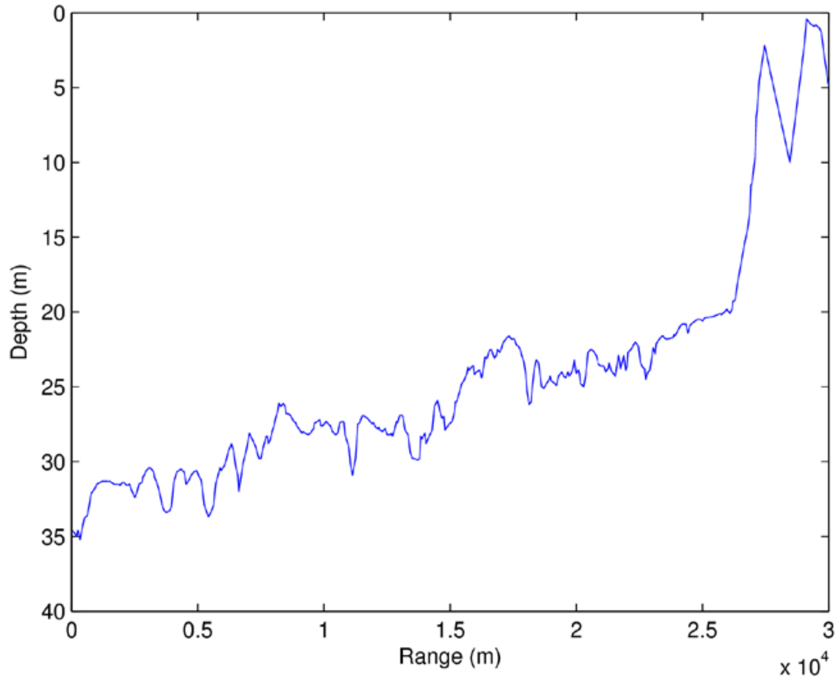

Figure B-2. Bathymetry Due North of Maritime Strike Operations Study Area Center Point

B.4 MODELING IMPACT ON MARINE ANIMALS

Many underwater actions include the potential to injure or harass marine animals in the neighboring waters through noise emissions. The number of animals exposed to potential harassment in any such action is dictated by the propagation field and the characteristics of the noise source.

Estimating the number of animals that may be injured or otherwise harassed in a particular environment entails the following steps.

- For the relevant environmental acoustic parameters, transmission loss (TL) estimates are computed, sampling the water column over the appropriate depth and range intervals. TL calculations are also made over disjoint one-third octave bands for a wide range of frequencies with dependence in range, depth, and azimuth for bathymetry and sound speed. TL computations were sampled with 20 degree spacing in azimuth.

- The accumulated energy within the waters where the source detonates is sampled over a volumetric grid. At each grid point, the received energy from each source emission is modeled as the effective energy source level reduced by the appropriate propagation loss from the location of the source at the time of the emission to that grid point and summed. For the peak pressure or positive impulse, the appropriate metric is similarly modeled for each emission. The maximum value of that metric over all frequencies and emissions is stored at each grid point.

- The impact volume for a given threshold is estimated by summing the incremental volumes represented by each grid point sampled in range and depth for which the appropriate metric exceeds that threshold, and accumulated over all modeled bearings. Histograms representing impact volumes as a function of (possibly depth-dependent) thresholds are stored in a spreadsheet for dynamic changes of thresholds.

- Finally, the number of harassments is estimated as the inner-product of the animal density depth profile and the impact volume and scaled by user-specifiable surface animal densities.

The following section describes in detail the process of computing impact volumes.

B.4.1 Calculating Transmission Loss

TL was pre-computed for both seasons for thirty non-overlapping frequency bands. The bands had one-third octave spacing around center frequencies from 50 Hz to approximately 40.637 kHz. The TL was then modeled using the Navy Standard GRAB V3 propagation loss model (Keenan, 2000) with CASS v4.3, and the results were interpolated onto a variable range grid with logarithmic spacing. The increased spatial resolution near the source provided greater fidelity for estimates.

TL was calculated from the source depth to an array of output depths. The output depths were the mid-points of depth intervals matching GDEM's depth sampling. For water depths from surface to 10 meters (m) depth, the depth interval was 2 m. Between 10 m and 100 m water depth, the depth interval was 5 m. For waters greater than 100 m, the depth interval was 10 m. For the Maritime Strike study area environment, there were thirty depths (1, 3, 5, 7, 9, 12.5, 17.5, 22.5, 27.5, 32.5, 37.5, 42.5, 47.5, 52.5, 57.5, 62.5, 67.5, 72.5, 77.5, 82.5, 87.5, 92.5, 97.5, 105, 115, 125, 135, 145, 155, 160, all in meters) representing depth-interval midpoints. The output depths represent possible locations of the animals and are used with the animal depth distribution to better estimate animal impact. The depth grid is used to make the surface-image interference correction and to capture the depth-dependence of the positive impulse threshold.

An important propagation consideration at low frequencies is the effect of surface-image interference. As either source or target approach the surface, pairs of paths that differ by a single surface reflection set up an interference pattern that ultimately causes the two paths to cancel each other when the source or target is at the surface. A fully coherent summation of the eigenrays produces such a result but also introduces extreme fluctuations that would have to be highly sampled in range and depth, and then smoothed to give meaningful results, and would be inappropriate in representing a broad one-third octave band of the spectrum. An alternative approach is to implement what is sometimes called a semi-coherent summation. A semi-coherent sum attempts to capture significant effects of surface-image interference (namely the reduction of the field due to destructive interference of reflected paths as the source or target approach the surface) without having to deal with the more rapid fluctuations associated with a fully coherent sum. The semi-coherent sum is formed by a random phase addition of paths that have already been multiplied by the expression:

$$\sin^2\left(\frac{4\pi f z_s z_a}{c^2 t}\right)$$

where f is the frequency, z_s is the source depth, z_a is the animal depth, c is the sound speed and t is the travel time from source to animal along the propagation path. For small arguments of the sine function this expression varies directly as the frequency and the two depths. It is this relationship that causes the propagation field to go to zero as the depths approach the surface or the frequency approaches zero.

B.4.2 Computing Impact Volumes

The next two sections provide a detailed description of the approach taken to compute impact volumes for explosives. The impact volume associated with a particular activity is defined as the volume of water in which some acoustic metric exceeds a specified threshold. The product of this impact volume with a volumetric animal density yields the expected value of the number of animals exposed to that acoustic metric at a level that exceeds the threshold. The acoustic metric can either be an energy term (energy flux density, either in a limited frequency band or across the full band) or a pressure term (such as peak pressure or positive impulse). The thresholds associated with each of these metrics define the levels at which half of the animals exposed will experience some degree of harassment (ranging from behavioral change to mortality).

Impact volume is particularly relevant when trying to estimate the effect of repeated source emissions separated in either time or space. Impact range, which is defined as the maximum range at which a particular threshold is exceeded for a single source emission, defines the range to which marine mammal activity is monitored in order to meet mitigation requirements.

The effective energy source level is modeled directly for the sources to be used for Maritime Strike activities at a specific location in the Gulf. The energy source level is comparable to the model used for other explosives (Arons [1954], Weston [1960], McGrath [1971], Urick [1983], Christian and Gaspin [1974]). The energy source level over a one-third octave band with a center frequency of f for a source with a net explosive weight of w pounds is given by:

$$\mathrm{ESL} = 10 \log_{10} (0.26 f) + 10 \log_{10} (2 p_{max}^2 / [1/\theta^2 + 4 \pi^2 f^2]) + 197 \text{ dB}$$

where the peak pressure for the shock wave at one meter is defined as

$$p_{max} = 21600 (w^{1/3} / 3.28)^{1.13} \text{ psi} \qquad \text{(A-1)}$$

and the time constant is defined as:

$$\theta = [(0.058)\ (w^{1/3})\ (3.28 / w^{1/3})^{\ 0.22}\ ] / 1000 \text{ sec} \qquad \text{(A-2)}$$

For each season and explosive source, the amount of energy in the water column is calculated. The propagation loss for each frequency, expressed as a pressure term, modulates the sound energy found at each point on the grid of depth (uniform spacing) and range (logarithmic spacing). If a threshold is exceeded at a point, the impact volume at an annular sector is added to the total impact volume. The impact volume at a point is calculated exactly using the depth interval, the range interval of the point, and the slice of a sphere centered where the range is zero.

B.4.3 Effects of Metrics on Impact Volumes

The impact of explosive sources on marine wildlife is measured by three different metrics, each with its own thresholds. The energy metric, the peak pressure metric, and the “modified” positive impulse metric are discussed in this section. The energy metric, using the peak one-third-octave level, is accumulated after the explosive detonation. The other two metrics, peak pressure and positive impulse, are not accumulated but rather the maximum levels are taken.

Energy Metric

The energy flux density is sampled at several frequencies in one-third-octave bands and only the peak one-third-octave level is accumulated over time. In the case of Level A calculations, the Total Energy is considered.

Peak Pressure Metric

The peak pressure metric is a simple, straightforward calculation at each range/animal depth combination. First, the transmission pressure ratio, modified by the source level in a one-third-octave band, is summed across frequency. This averaged transmission ratio is normalized by the total broadband source level. Peak pressure at that range/animal depth combination is then simply the product of:

- the square root of the normalized transmission ratio of the peak arrival,
- the peak pressure at a range of one meter (given by equation A-1), and
- the similitude correction (given by $r^{-0.13}$, where r is the slant range).

If the peak pressure for a given grid point is greater than the specified threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

"Modified" Positive Impulse Metric

The modeling of positive impulse follows the work of Goertner (Goertner, 1982). The Goertner model defines a "partial" impulse as

$$\int_0^{T_{min}} p(t)\, dt$$

where $p(t)$ is the pressure wave from the explosive as a function of time t, defined so that $p(t) = 0$ for $t < 0$. This similitude pressure wave is modeled as

$$p(t) = p_{max}\, e^{-t/\theta}$$

where p_{max} is the peak pressure at one meter (see equation A-1), and θ is the time constant defined in equation A-2.

The upper limit of the "partial" impulse integral is

$$T_{min} = \min \{T_{cut}, T_{osc}\}$$

where T_{cut} is the time to cutoff and T_{osc} is a function of the animal lung oscillation period. When the upper limit is T_{cut}, the integral is the definition of positive impulse. When the upper limit is defined by T_{osc}, the integral is smaller than the positive impulse and thus is just a "partial" impulse. Switching the integral limit from T_{cut} to T_{osc} accounts for the diminished impact of the positive impulse upon the animals lungs that compress with increasing depth and leads to what is sometimes call a "modified" positive impulse metric.

The time to cutoff is modeled as the difference in travel time between the direct path and the surface-reflected path in an isovelocity environment. At a range of r, the time to cutoff for a source depth z_s and an animal depth z_a is

$$T_{cut} = 1/c \; \{ [r^2 + (z_a + z_s)^2]^{1/2} - [r^2 + (z_a - z_s)^2]^{1/2} \}$$

where c is the speed of sound.

The animal lung oscillation period is a function of animal mass M and depth z_a and is modeled as

$$T_{osc} = 1.17\, M^{1/3}\, (1 + z_a/33)^{-5/6}$$

where M is the animal mass (in kg) and z_a is the animal depth (in feet).

The modified positive impulse threshold is unique among the various injury and harassment metrics in that it is a function of depth and the animal weight. So instead of the user specifying the threshold, it is computed as $K\,(M/42)^{1/3}\,(1 + z_a/33)^{1/2}$. The coefficient K depends upon the level of exposure. For the onset of slight lung injury, K is 19.7; for the onset of extensive lung hemorrhaging (1% mortality), K is 47.

Although the thresholds are a function of depth and animal weight, sometimes they are summarized as their value at the sea surface for a typical dolphin calf (with an average mass of 12.2 kg). For the onset of slight lung injury, the threshold at the surface is approximately 13 psi-msec; for the onset of extensive lung hemorrhaging (1% mortality), the threshold at the surface is approximately 31 psi-msec.

As with peak pressure, the “modified” positive impulse at each grid point is compared to the derived threshold. If the impulse is greater than that threshold, then the incremental volume for the grid point is added to the impact volume for that depth layer.

B.5 ESTIMATING ANIMAL HARASSMENT

B.5.1 Distribution of Animals in the Environment

Species densities are usually reported by marine biologists as animals per square kilometer. This gives an estimate of the number of animals below the surface in a certain area, but does not provide any information about their distribution in depth. The impact volume vector specifies the volume of water ensonified above the specified threshold in each depth interval. A corresponding animal density for each of those depth intervals is required to compute the expected value of the number of exposures. The two-dimensional area densities do not contain this information, so three-dimensional densities must be constructed by using animal depth distributions to extrapolate the density at each depth.

The following bottlenose dolphin (summer profile) example demonstrates the method used to account for three-dimensional analysis by merging the depth distributions with user-specifiable surface densities. Bottlenose dolphins are distributed with:

- 19.2% in 0-10 m,
- 76.8% in 10-50 m,
- 1.7% in 50-100 m, and
- 2.3% in 100-165 m.

The impact volume vector is sampled at 30 depths over the maximally 165-m water column. Since this is a finer resolution than the depth distribution, densities are apportioned uniformly over depth intervals. For example, 19.2% of bottlenose dolphins are in the 0-10 meter interval, so approximately

- 3.84% are in 0-2 meters,
- 3.84% are in 2-4 meters,
- 3.84% are in 4-6 meters,
- 3.84% are in 6-8 meters, and
- 3.84% are in 8-10 meters.

Similarly, 76.8% are in the 10-50 m interval, so approximately

- 9.60% are in 10 - 15 meters,
- 9.60% are in 15 - 20 meters,
- 9.60% are in 20 - 25 meters,
- etc.

B.5.2 Harassment Estimates

Impact volumes for all depth intervals are scaled by their respective depth densities, divided by their depth interval widths, summed over the entire water column and finally converted to square kilometers to create impact areas. The spreadsheet allows a user-specifiable surface density in animals per square kilometer, so the product of these quantities yields expected number of animals in ensonified water where they could experience harassment.

Since the impact volume vector is the volume of water at or above a given threshold per unit operation (e.g. per detonation, or clusters of munitions explosions), the final harassment count for each animal is the unit operation harassment count multiplied by the number of units deployed.

The detonations of explosive sources are generally widely spaced in time and/or space. This implies that the impact volume for multiple firings can be easily derived by scaling the impact volume for a single detonation. Thus the typical impact volume vector for an explosive source is presented on a per-detonation basis.

B.6 REFERENCES

Arons, A.B. (1954). “Underwater Explosion Shock Wave Parameters at Large Distances from the Charge,” J. Acoust. Soc. Am. 26, 343.

Bartberger, C.L. (1965). “Lecture Notes on Underwater Acoustics,” NADC Report NADC=WR-6509, Naval Air Development Center Technical Report, Johnsville, PA, 17 May (AD 468 869) (UNCLASSIFIED).

Christian, E.A. and J.B. Gaspin, (1974). Swimmer Safe Standoffs from Underwater Explosions,” NSAP Project PHP-11-73, Naval Ordnance Laboratory, Report NOLX-89, 1 July (UNCLASSIFIED).

Department of the Navy (1998), “Final Environmental Impact Statement, Shock Testing the SEAWOLF Submarine,” U.S. Department of the Navy, Southern Division, Naval Facilities Engineering Command, North Charleston, SC, 637 p.

Department of the Navy (2001), “Final Environmental Impact Statement, Shock Trial of the WINSTON S. CHURCHILL (DDG 81),” U.S. Department of the Navy, NAVSEA, 597 p.

Finneran, J.J., R. Dear, D.A. Carder, and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. Journal of the Acoustical Society of America. 111:2929-2940.

Finneran, J.J., and C.E. Schlundt. 2004. Effects of intense pure tones on the behavior of trained odontocetes. Space and Naval Warfare Systems Center, San Diego, Technical Document. September.

Finneran, J.J., D.A. Carder, C.E. Schlundt and S.H. Ridgway. 2005. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. Journal of Acoustical Society of America. 118:2696-2705.

Goertner, J.F. (1982), "Prediction of Underwater Explosion Safe Ranges for Sea Mammals," NSWC TR 82-188, Naval Surface Weapons Center, Dahlgren, VA.

Keenan, R.E., Denise Brown, Emily McCarthy, Henry Weinberg, and Frank Aidala (2000). "Software Design Description for the Comprehensive Acoustic System Simulation (CASS Version 3.0) with the Gaussian Ray Bundle Model (GRAB Version 2.0)", NUWC-NPT Technical Document 11,231, Naval Undersea Warfare Center Division, Newport, RI, 1 June (UNCLASSIFIED).

Ketten, D.R. 1998. Marine mammal auditory systems: A summary of audiometric and anatomical data and its implications for underwater acoustic impacts. NOAA-TM-NMFS-SWFSC-256, Department of Commerce.

Kryter, K.D. W.D. Ward, J.D. Miller, and D.H. Eldredge. 1966. Hazardous exposure to intermittent and steady-state noise. Journal of the Acoustical Society of America. 48:513-523.

McGrath, J.R. (1971). "Scaling Laws for Underwater Exploding Wires," J. Acoust. Soc. Am. 50, 1030-1033 (UNCLASSIFIED).

Miller, J.D. 1974. Effects of noise on people. Journal of the Acoustical Society of America. 56:729–764.

Nachtigall, P.E., J.L. Pawloski, and W.W.L. Au. 2003. Temporary threshold shift and recovery following noise exposure in the Atlantic bottlenose dolphin (Tursiops truncatus). Journal of the Acoustical Society of America. 113:3425-3429.

Schlundt, C.E., J.J. Finneran, D.A. Carder, and S.H. Ridgway. 2000. Temporary shift in masked hearing thresholds of bottlenose dolphins, *Tursiops truncatus*, and white whales, *Delphinapterous leucas*, after exposure to intense tones. Journal of the Acoustical Society of America. 107:3496-3508.

Urick, R.J. (1983). Principles of Underwater Sound for Engineers, McGraw-Hill, NY (first edition: 1967, second edition: 1975, third edition: 1983) (UNCLASSIFIED).

Ward, W.D. 1997. Effects of high-intensity sound. In Encyclopedia of Acoustics, ed. M.J. Crocker, 1497-1507. New York: Wiley.

Weston, D.E. (1960). "Underwater Explosions as Acoustic Sources," Proc. Phys. Soc. 76, 233 (UNCLASSIFIED).

Yelverton, J.T. 1981, Underwater Explosion Damage Risk Criteria for Fish, Birds, and

Mammals, Manuscript, presented at 102nd Meeting of the Acoustical Society of America, Miami Beach, FL, December, 1982. 32pp

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APPENDIX C

PUBLIC AND AGENCY REVIEW

Public Notification

2093574

In compliance with the National Environmental Policy Act, Eglin Air Force Base announces the availability of the Draft Environmental Assessment for Maritime Strike Operations Tactics Development and Evaluation, and Draft Finding of No Significant Impact (FONSI), for public review.

The Proposed Action is for the Air Force to test the use of multiple types of live weapons against small boat targets in the Eglin Gulf Test and Training Range, at a location approximately 17 miles offshore from Santa Rosa Island. The weapons would be deployed from aircraft and would include various types of bombs, missiles, and 20-mm and 30-mm gunnery rounds. Detonations would occur above, at, and below the water surface. Testing would occur over a period of two to three weeks, with a maximum of two tests per day. A cleared zone would be established around the targets during each test to maintain the safety of recreational and commercial users of the Gulf. In addition, protection measures for marine species would be included in the action.

Your comments on this Draft Environmental Assessment (EA) are requested. Letters or other written or oral comments provided may be published in the Final EA. As required by law, comments will be addressed in the Final EA and made available to the public. Any personal information provided will be used only to identify your desire to make a statement during the public comment period or to fulfill requests for copies of the Final EA or associated documents. Private addresses will be compiled to develop a mailing list for those requesting copies of the Final EA. However, only the names and respective comments of respondent individuals will be disclosed. Personal home addresses and phone numbers will not be published in the Final EA.

Copies of the Draft EA and Draft FONSI may be reviewed online at www.eglin.af.mil/eglindocuments.asp from Apr. 19 until May 3rd. Local libraries have Internet access, and librarians can assist in accessing this document. Comments must be received by May 6th to be included in the Final EA.

For more information or to comment on these proposed actions, contact: Mike Spaits, 96 TW Public Affairs, 101 West D Ave., Ste. 238, Eglin AFB, Florida 32542 or email: mike.spaits@eglin.af.mil. Tel: (850) 882-2836; Fax: (850) 882-4894.

McKee, Walter J. (Jamie)

From:	Spaits, Mike GS12 USAF AFMC 96 TW/PA <mike.spaits@eglin.af.mil>
Sent:	Thursday, May 09, 2013 8:36 AM
To:	Lawrence, April Civ USAF AFMC 96 CEG/CEVSP; McKee, Walter J. (Jamie)
Subject:	FW: NOA_Maritime Strike_DEA Public Notification_April 2013
Attachments:	2093574[1].pdf
Signed By:	michael.spaits@us.af.mil

All,
Heres the ad that ran on April 19th. We did not receive any comments.

Thanks,
Mike Spaits
Eglin Environmental Public Affairs
O - (850) 882-2836
C - (850) 621-3391

-----Original Message-----
From: Wiltse, Maureen [mailto:MWiltse@nwfdailynews.com]
Sent: Wednesday, April 17, 2013 3:01 PM
To: Spaits, Mike GS12 USAF AFMC 96 TW/PA
Subject: RE: NOA_Maritime Strike_DEA Public Notification_April 2013

Mike,
Attached is the proof of the display ad. Please send approval and/or changes to run the ad.

Thanks,
Maureen Wiltse
NW FL Daily News
2 Eglin Parkway NE (32548)
PO Box 2949
Fort Walton Beach, FL 32549
Phone (850) 315-4353
Fax (850) 862-5230
email: mwiltse@nwfdailynews.com

From: Spaits, Mike GS12 USAF AFMC 96 TW/PA [mike.spaits@eglin.af.mil]
Sent: Tuesday, April 16, 2013 1:47 PM
To: Wiltse, Maureen
Subject: NOA_Maritime Strike_DEA Public Notification_April 2013

Maureen,
Here's that Legal Display we talked about earlier.

Thanks,
Mike Spaits

1

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

MARJORY STONEMAN DOUGLAS BUILDING
3900 COMMONWEALTH BOULEVARD
TALLAHASSEE, FLORIDA 32399-3000

RICK SCOTT
GOVERNOR

HERSCHEL T. VINYARD JR.
SECRETARY

April 26, 2013

Mr. W. Jamie McKee, Environmental Scientist
Science Applications International Corporation
1140 North Eglin Parkway
Shalimar, FL 32579

RE: Department of the Air Force – Draft Environmental Assessment
Maritime Strike Operations Tactics Development and Evaluation, Eglin Air Force Base
Gulf of Mexico Offshore Okaloosa and Walton Counties, Florida.
SAI # FL201303286556C

Dear Jamie:

The Florida State Clearinghouse has coordinated a review of the subject Draft Environmental Assessment (EA) under the following authorities: Presidential Executive Order 12372; Section 403.061(42), *Florida Statutes*; the Coastal Zone Management Act, 16 U.S.C. §§ 1451-1464, as amended; and the National Environmental Policy Act, 42 U.S.C. §§ 4321-4347, as amended.

The Florida Department of State's (DOS) Division of Historical Resources notes that the testing area for this project is free of recorded shipwrecks or other recorded cultural resources. Prior to testing, the project area will be surveyed for any historical resources that might be present on the sea floor. Provided that no evidence of historical resources is located during the survey, DOS staff concurs with the Finding of No Significant Impact. If evidence of historical resources is discovered, however, the agency requests that the testing area be relocated to avoid these resources. Further investigation and consultation with DOS staff would be necessary if the testing area cannot be relocated. Following the completion of the survey, DOS requests that a survey report and log be submitted for inclusion in the Florida Master Site File. Please refer to the enclosed DOS letter.

Based on the information contained in the Draft EA and enclosed state agency comments, the state has determined that the proposed federal action is consistent with the Florida Coastal Management Program (FCMP). To ensure the project's continued consistency with the FCMP, the concerns identified by the DOS must be addressed prior to project implementation. The state's continued concurrence will be based on the activity's compliance with FCMP authorities, including federal and state monitoring of the activity to ensure its continued conformance, and the adequate resolution of any issues identified during this and subsequent reviews.

www.dep.state.fl.us

Mr. W. Jamie McKee
Page 2 of 2
April 26, 2013

Thank you for the opportunity to review this proposal. Should you have any questions regarding this letter, please contact Ms. Lauren P. Milligan at (850) 245-2170.

Yours sincerely,

Sally B. Mann

Sally B. Mann, Director
Office of Intergovernmental Programs

SBM/lm
Enclosures

cc: Timothy Parsons, DOS

Florida
Department of Environmental Protection

"More Protection, Less Process"

Categories

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Project Information	
Project:	FL201303286556C
Comments Due:	04/18/2013
Letter Due:	05/03/2013
Description:	DEPARTMENT OF THE AIR FORCE - DRAFT ENVIRONMENTAL ASSESSMENT - MARITIME STRIKE OPERATIONS TACTICS DEVELOPMENT AND EVALUATION, EGLIN AIR FORCE BASE - GULF OF MEXICO OFFSHORE OKALOOSA AND WALTON COUNTIES, FLORIDA.
Keywords:	USAF - MARITIME STRIKE OPERATIONS TACTICS DEV./EVAL., EGLIN AFB - GULF OF MEXICO
CFDA #:	12.200

Agency Comments:
ENVIRONMENTAL PROTECTION - FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
The Department's Beaches, Mines and ERP Support Program indicated that staff wishes to reiterate the state's concerns regarding unexploded ordnance ending up in future beach sand borrow areas, but acknowledged that the Air Force is doing what it can to minimize this issue.
STATE - FLORIDA DEPARTMENT OF STATE
The DOS notes that the testing area for this project is free of recorded shipwrecks or other recorded cultural resources. Prior to testing, the project area will be surveyed for any historical resources that might be present on the sea floor. Provided that no evidence of historical resources is located during the survey, DOS concurs with the Finding of No Significant Impact. If evidence of historical resources is discovered, however, staff requests that the testing area be relocated to avoid these resources. Further investigation and consultation with DOS staff would be necessary if the testing area cannot be relocated. Following the completion of the survey, DOS requests that a survey report and log be submitted for inclusion in the Florida Master Site File.
FISH and WILDLIFE COMMISSION - FLORIDA FISH AND WILDLIFE CONSERVATION COMMISSION
NO COMMENT BY MARY DUNCAN ON 4/10/13.

For more information or to submit comments, please contact the Clearinghouse Office at:

3900 COMMONWEALTH BOULEVARD, M.S. 47
TALLAHASSEE, FLORIDA 32399-3000
TELEPHONE: (850) 245-2161
FAX: (850) 245-2190

Visit the Clearinghouse Home Page to query other projects.

FLORIDA DEPARTMENT *of* STATE

RICK SCOTT
Governor

KEN DETZNER
Secretary of State

Lauren Milligan
Florida State Clearinghouse
Florida Department of Environmental Protection
3900 Commonwealth Blvd., Mail Station 47
Tallahassee, FL 32399

April 26, 2013

Re: SHPO/DHR Project File No.: 2013-1620
Agency: US Air Force
Project Number: FL201303286556C
Project Name: Draft EA: Maritime Strike Operations Tactics, Eglin AFB

Dear Ms. Milligan:

This office reviewed the referenced project for possible impact to historic properties listed, or eligible for listing, on the *National Register of Historic Places.* The review was conducted in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, *36 CFR Part 800: Protection of Historic Properties,* and the *National Environmental Policy Act of 1970.*

We note that the testing area for this project is free of recorded shipwrecks or other recorded cultural resources. We also note that prior to testing, the project area will be surveyed for any historical resources that might be present on the sea floor. Provided that no evidence of historical resources is located during this survey, this office concurs with the finding of No Significant Impact. However, if evidence of historical resources is discovered during the survey, we request that the testing area be relocated to avoid these resources. Further investigation and consultation with this office will be necessary if the testing area cannot be relocated. Following the completion of the survey, we request that a survey report and a survey log be submitted to this office for inclusion in the Florida Master Site File.

If you have any questions concerning our comments, please contact Tim Parsons, Deputy State Historic Preservation Officer, at timothy.parsons@dos.myflorida.com, or at 850-245-6333. Thank you for your interest in protecting Florida's archaeological and historical resources.

Sincerely,

Timothy A. Parsons, DSHPO for

Robert F. Bendus, Director
Division of Historical Resources
and State Historic Preservation Officer

VIVA FLORIDA 500.

DIVISION OF HISTORICAL RESOURCES
R. A. Gray Building • 500 South Bronough Street • Tallahassee, Florida 32399-0250
Telephone: 850.245.6300 • www.flheritage.com
Commemorating 500 years of Florida history **www.fla500.com**

VIVA FLORIDA 500.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

MAY - 6 2013

F/SER31:AB
SER-2012-9587

Mr. Thomas Chavers
Chief, Eglin Natural Resources
Department of the Air Force, 96th Test Wing
501 De Leon Street, Suite 101
Eglin Air Force Base, Florida 32542

Ref.: Eglin Air Force Base Maritime Strike Operations Tactics Development and Evaluation

Dear Mr. Chavers:

This is the National Marine Fisheries Service's (NMFS) biological opinion issued in accordance with Section 7 of the Endangered Species Act (ESA) of 1973. The Department of the Air Force proposes to conduct maritime strike operations within the Eglin Gulf Test and Training Range located in the Gulf of Mexico. These strike operations will continue the development of tactics, techniques, and procedures for Air Force aircraft to counter small maneuvering maritime targets.

The biological opinion analyzes the project's effects on five species of sea turtles, Gulf sturgeon, smalltooth sawfish, sperm whales, and Gulf sturgeon critical habitat. The biological opinion is based on project-specific information provided by the Air Force and their consultants, as well as NMFS's review of published literature. It is our opinion that the action, as proposed, may adversely affect four species of sea turtles (loggerhead, Kemp's ridley, green, and leatherback). It is also NMFS's opinion that the project may affect but is not likely to adversely affect hawksbill sea turtles, smalltooth sawfish, Gulf sturgeon, sperm whales, and Gulf sturgeon critical habitat.

We look forward to further cooperation with you on other Department of the Air Force projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Adam Brame, consultation biologist, at (727) 209-5958, or by e-mail at Adam.Brame@noaa.gov.

Sincerely,

Miles M. Croom
for Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: 1. Biological opinion
2. *PCTS Access and Additional Considerations for ESA Section 7 Consultations* (Revised July 15, 2009)

File: 1514-22.S

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	Department of the Air Force, Eglin Air Force Base
Activity:	Maritime Strike Operations in the Eglin Gulf Test and Training Range, Florida (Consultation Number SER-2012-9587)
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida
Approved by:	Miles M Croom for Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	MAY - 6 2013

TABLE OF CONTENTS

Background

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), requires that each federal agency 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; Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. NMFS and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA: if the subject species is cited in 50 CFR 222.23(a) or 227.4 the federal agency shall contact NMFS, otherwise the federal agency shall contact USFWS (50 CFR 402.01).

Formal consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation is concluded after NMFS issues a biological opinion (opinion) that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures) to reduce the effect of take, and recommends conservation measures to further conserve the species. Notably, no incidental destruction or adverse modification of critical habitat can be authorized, and thus there are no reasonable and prudent measures, only reasonable and prudent alternatives that must avoid destruction and adverse modification.

This document represents NMFS's opinion based on our review of impacts associated with proposed maritime strike operations to be conducted in the Eglin Gulf Test and Training Range, offshore of Florida. The Department of the Air Force is both the applicant and action agency for this particular project. This opinion analyzes project effects on sea turtles, Gulf sturgeon, smalltooth sawfish, and sperm whales in accordance with Section 7 of the ESA. This opinion is based on project information provided by the Eglin Natural Resources Section (NRS) and other sources of information including published literature and summary reports provided by the Eglin NRS.

1 CONSULTATION HISTORY

NMFS received a request from the Eglin Air Force Base (EAFB) on December 10, 2012, for ESA Section 7 consultation on the project. This original request contained a Biological Assessment (BA) that analyzed impacts to five species of sea turtles, Gulf sturgeon, smalltooth sawfish, and marine mammals. The Air Force provided a revised BA January 22, 2013. The Air Force determined that the project (1) may affect four species of sea turtles; (2) may affect, but is not likely to adversely affect Gulf sturgeon, smalltooth sawfish, and Gulf sturgeon critical habitat; and (3) will have no effect on sperm whales. NMFS initiated formal consultation January 22, 2013.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

The U.S. Air Force (USAF) proposes to conduct maritime strike missions in the Gulf of Mexico involving the use of multiple types of live munitions (Table 1) against small boat targets in the Eglin Gulf Test and Training Range. Ordnance will be delivered by multiple types of aircraft and targets will include stationary, towed, and remotely controlled boats. Ordnance detonations will occur above (approximately 20 ft), at, or below (5-10 ft) the water surface. In total, the USAF will deploy 48 live bombs/missiles and 2,500 live gunnery rounds. The USAF will conduct one to two missions per day over a two- to three-week period in June 2013. Missions will only occur on weekdays and during daytime hours. The USAF will request that the Coast Guard release a *Notice to Mariners* approximately a week prior to the missions, informing boaters of the closure of a safety zone. Approximately 20-25 boats will be used to establish the safety zone around the test area prior to each live mission. This safety zone will be approximately 283 square miles (181,366 acres) and will be closed to recreational and commercial vessels for up to four hours per mission. The USAF will also use an instrumentation barge anchored 300-600 ft from target boats as a base of operations to collect data, remotely control the target boats, and observe for protected species. Live video feeds from this barge will be viewed by a trained marine species observer located in the Eglin control tower before and during test activities. In addition to the safety zone, the USAF will also establish a marine species protection zone based on the distance to which energy- and pressure-related impact zones could extend. Trained marine species observers will be aboard at least two of the safety boats and will survey the species protection zone up to 30 minutes prior to each test. Crews of the other safety boats will also opportunistically scan for protected species, though this will not be their primary task.

Table 1. Types, amounts, and detonation locations of munitions proposed for use.

Type of Munition	Total # of Munitions	# of Detonations by Height/Depth	Net Explosive Weight per Munition
GBU-10	1	Water surface	945 lb
GBU-24	1	Water surface	945 lb
GBU-31 (JDAM)	13	Water surface: 4 20 feet above water: 3 5 feet underwater: 3 10 feet underwater: 3	945 lb
GBU-12	1	Water surface	192 lb
GBU-38 (JDAM)	13	Water surface: 4 20 feet above water: 3 5 feet underwater: 3 10 feet underwater: 3	192 lb
GBU-54 (LJDAM)	1	Water surface	192 lb
AGM-65E/L/K/G2 (Maverick)	2 each (8 total)	Water surface	86 lb
AGM-114 (Hellfire)	4	Water surface	20 lb
M-117	6	Water surface: 3 20 feet above water: 3	386 lb
PGU-12 HEI 30 mm	1,000	Water surface	0.1 lb
M56/PGU-28 HEI 20 mm	1,500	Water surface	0.2 lb

3

2.2 Action Area

The Eglin Gulf Test and Training Range comprises 102,000 square nautical miles of Gulf of Mexico surface waters, beginning three nautical miles from shore. The training range is subdivided into blocks consisting of Warning Areas, and all activities under this project will take place in Warning Area W-151A. More specifically, the strike missions will be conducted in the northern inshore portion of the Warning Area, approximately 17 miles offshore of Santa Rosa Island (Figure 1). Water depth in the mission area is approximately 115 feet. The action area will include the portion of Warning Area W-151A where the munitions testing will occur as well as the waters between the Warning Area and EAFB where boats will transit.

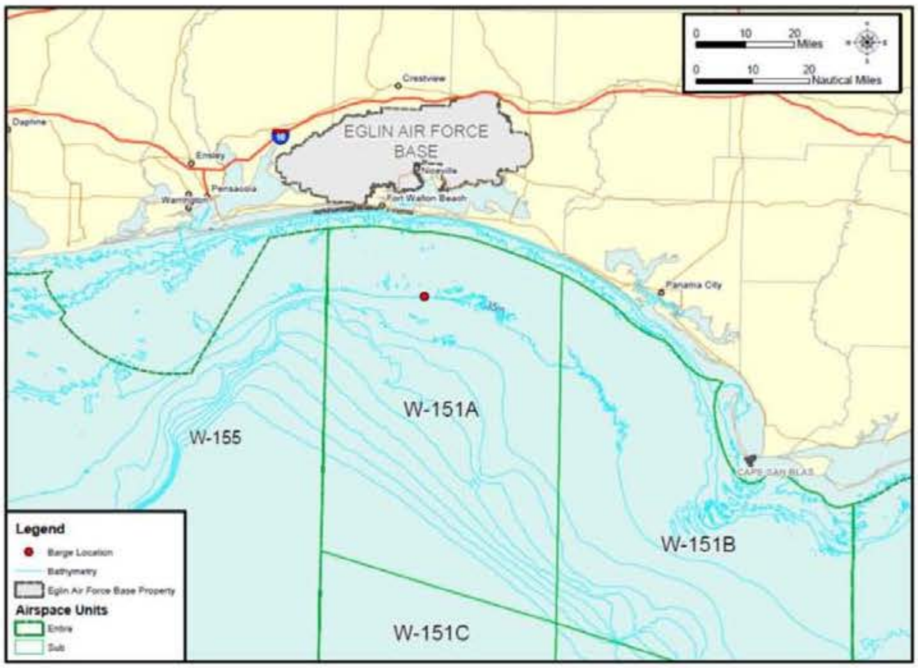

Figure 1. Map of the EAFB Warning Areas, including W-151A. The red point indicates the approximate position of the strike missions.

4

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

The following endangered (E) and threatened (T) sea turtle and fish species, and designated critical habitat under the jurisdiction of NMFS, may occur in or near the action area:

Common Name	Scientific Name	ESA Listed Status
Sea Turtles		
Loggerhead sea turtle	*Caretta caretta*[1]	T
Hawksbill sea turtle	*Eretmochelys imbricata*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Green sea turtle	*Chelonia mydas*[2]	E/T
Fish		
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T
Smalltooth sawfish	*Pristis pectinata*[3]	E
Whales		
Sperm whale	*Physeter macrocephalus*	E
Critical Habitat		
Gulf sturgeon Unit 11		

3.1 Analysis of Species and Critical Habitats Not Likely to be Adversely Affected

There are five species of sea turtles (green, hawksbill, Kemp's ridley, leatherback, and loggerhead) which may be found in or near the action area. However, according to the NOAA Sea Turtle Stranding and Salvage Network (http://www.sefsc.noaa.gov/species/turtles/strandings.htm) hawksbill sea turtle strandings in the action area during the ten-year period of 2003 – 2012 were rare, with only five reported strandings over the ten-year period. By comparison, 543 loggerhead, 345 green, 320 Kemp's ridley, and 30 leatherback sea turtles stranded in the area during the same ten-year period. Due to the rarity of hawksbills in the action area NMFS believes any effects to this species are discountable.

Smalltooth sawfish, Gulf sturgeon, and sperm whales also use portions of the Gulf of Mexico and may be found in or near the action area. However, each of these species is unlikely to be found in the area of the munitions testing (approximately 17 miles offshore of Santa Rosa Island). Smalltooth sawfish are rare to the northern Gulf coast as their population is generally restricted to the southern half of peninsular Florida (NMFS 2000). Gulf sturgeon use the nearshore waters of the northern Gulf coast including bays, estuaries, and barrier island passes

[1] Northwest Atlantic Ocean (NWA) distinct population segment (DPS). On September 16, 2011, NMFS and USFWS issued a final rule changing the listing of loggerhead sea turtles from a single, threatened species to nine DPSs listed as either threatened or endangered. The NWA DPS was listed as threatened.
[2] Green turtles are listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are listed as endangered.
[3] U.S. distinct population segment

(NMFS 2009), but are unlikely to found on the outer continental shelf where munitions will be tested. Conversely, sperm whales are found in the Gulf of Mexico but are more typically associated with the deeper waters off the continental slope (Baumgartner et al. 2001). Therefore, any effects to these species are discountable.

Unit 11 of Gulf sturgeon critical habitat is located within the action area, but is unlikely to be affected by the proposed action. Unit 11 extends from the high tide line out one mile from shore. Since the munitions will occur approximately 17 miles offshore, critical habitat will not be affected by the munitions testing. However, vessels associated with the training will have to pass through critical habitat en route to the testing area. Boats traveling through the critical habitat unit are not expected to cause any adverse effects to the essential features of Gulf sturgeon critical habitat (abundant prey items, water quality, sediment quality, and safe, unobstructed migratory pathways). Boats will operate in marked channels or waters sufficiently deep enough to avoid contact with the bottom so there will be no effect to Gulf sturgeon prey that live within the sediments or sediment quality. Similarly, vessel traffic associated with the project will have no effect on migratory pathways. While vessels could affect water quality in the area, NMFS believes any effects will be insignificant, as any pollution of the water from outboard motors will be minute in relation to the large volume of water in the Gulf.

In summary, NMFS concludes hawksbill turtles, smalltooth sawfish, Gulf sturgeon, sperm whales, and Gulf sturgeon critical habitat may be affected, but are not likely to be adversely affected by the proposed action covered in this opinion. These species and the critical habitat will not be discussed further.

3.2 Species Likely to be Adversely Affected

Green, Kemp's ridley, leatherback, and loggerhead sea turtles are all likely to be adversely affected by the proposed action. These sea turtles area all highly migratory, travel widely throughout the Gulf and South Atlantic, and are known to occur in the test area. The remaining sections of this opinion will focus solely on these species.

The following subsections are synopses of the best available information on the status of the species that are likely to be adversely affected by one or more components of the proposed action, including information on the distribution, population structure, life history, abundance, population trends, and threats to each species. The biology and ecology of these species as well as their status and trends inform the effects analysis for this opinion. Additional background information on the status of sea turtle species can be found in a number of published documents, including: recovery plans for the Atlantic green sea turtle (NMFS and USFWS 1991), Kemp's ridley sea turtle (NMFS and USFWS 1992a), leatherback sea turtle (NMFS and USFWS 1992b), and loggerhead sea turtle (NMFS and USFWS 2008); Pacific sea turtle recovery plans (NMFS and USFWS 1998a; NMFS and USFWS 1998b; NMFS and USFWS 1998c; NMFS and USFWS 1998d); and sea turtle status reviews, stock assessments, and biological reports (NMFS and USFWS 1995; TEWG 1998; TEWG 2000; NMFS-SEFSC 2001; TEWG 2007; NMFS and USFWS 2007a; NMFS and USFWS 2007b; NMFS and USFWS 2007c; NMFS and USFWS 2007d; Conant et al. 2009; TEWG 2009; NMFS-SEFSC 2009d).

3.2.1 Loggerhead Sea Turtle – NW Atlantic DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a final rule designating nine DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011; effective October 24, 2011). The DPSs established by this rule are (1) Northwest Atlantic Ocean (threatened); (2) Northeast Atlantic Ocean (endangered); (3) South Atlantic Ocean (threatened); (4) Mediterranean Sea (endangered); (5) North Pacific Ocean (endangered); (6) South Pacific Ocean (endangered); (7) North Indian Ocean (endangered); (8) Southeast Indo-Pacific Ocean (endangered); and (9) Southwest Indian Ocean (threatened). The Northwest Atlantic DPS (NWA DPS) is the only one that occurs within the action area and therefore is the only one considered in this opinion.

Species Description, Distribution, and Population Structure
Loggerheads are large sea turtles with the mean straight carapace length (SCL) of adults in the southeast U.S. being approximately 92 cm. The corresponding mass is approximately 116 kg (Ehrhart and Yoder 1978). Adult and subadult loggerhead sea turtles typically have a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 11 or 12 pairs of marginal scutes, five pairs of costals, five vertebrals, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes (Dodd 1988).

The loggerhead sea turtle inhabits continental shelf and estuarine environments and occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd 1988). The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990).

In the western North Atlantic, the majority of loggerhead nesting is concentrated along the coasts of the United States from southern Virginia to Alabama. Additional nesting beaches are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison and Morford 1996; Addison 1997), off the southwestern coast of Cuba (Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches. Aerial surveys suggest that loggerheads in U.S. waters are distributed as a whole in the following proportions: 54 percent in the southeast U.S. Atlantic, 29 percent in the northeast U.S. Atlantic, 12 percent in the eastern Gulf of Mexico, and 5 percent in the western Gulf of Mexico (TEWG 1998). Shallow water habitats with large expanses of open ocean access, such as Florida Bay, provide year-round resident foraging areas for significant numbers of male and female adult loggerheads while juveniles are also found in enclosed, shallow water estuarine environments not frequented by adults (Epperly et al. 1995c). Further offshore, adults primarily inhabit continental shelf waters, from New England south to Florida, the Caribbean, and Gulf of Mexico (Schroeder et al. 2003). Benthic, immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool and then migrate back northward in spring (Shoop and Kenney 1992; Keinath 1993; Epperly et al. 1995c; Morreale and Standora 1998).

Within the NWA DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. Previous Section 7 analyses have recognized at least five Western Atlantic subpopulations, divided geographically as follows: (1) a northern nesting subpopulation, occurring from North Carolina to Northeast Florida at about 29ºN; (2) a South Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the Eastern Yucatán Peninsula, Mexico (Márquez M 1990; TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS-SEFSC 2001). The recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded, based on recent advances in genetic analyses, that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula and that specific boundaries for subpopulations could not be designated based on genetic differences alone. Thus, the plan uses a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to identify recovery units. The recovery units are (1) the Northern Recovery Unit (Florida/Georgia border north through southern Virginia); (2) the Peninsular Florida Recovery Unit (Florida/Georgia border through Pinellas County, Florida); (3) the Dry Tortugas Recovery Unit (islands located west of Key West, Florida); (4) the Northern Gulf of Mexico Recovery Unit (Franklin County, Florida, through Texas); and (5) the Greater Caribbean Recovery Unit (Mexico through French Guiana, the Bahamas, Lesser Antilles, and Greater Antilles) (NMFS and USFWS 2008). The recovery plan concluded that all recovery units are essential to the recovery of the species. Although the recovery plan was written prior to the listing of the NWA DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the NWA DPS.

Life History Information

Loggerhead sea turtles reach sexual maturity between 20 and 38 years of age, although this varies widely among populations (Frazer and Ehrhart 1985; NMFS and SEFSC 2001). The annual mating season for loggerhead sea turtles occurs from late March to early June, and eggs are laid throughout the summer months. Female loggerheads deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984) and have an average remigration interval of 3.7 years (Tucker 2010). Mean clutch size varies from 100 to 126 eggs for nests occurring along the southeastern U.S. coast (Dodd 1988).

Loggerheads originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for a period as long as 7-12 years (Bolten et al. 1998). Stranding records indicate that when immature loggerheads reach 40-60 centimeters straight carapace length, they begin to occur in coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell 2002). Recent studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Laurent et al. 1998; Bolten and Witherington 2003). These studies suggest some turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or move back and forth between pelagic and coastal habitats interchangeably (Witzell 2002).

As post-hatchlings, loggerheads hatched on U.S. beaches migrate offshore and become associated with sargassum habitats, driftlines, and other convergence zones (Carr 1986) (Witherington 2002). Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd 1988). Sub-adult and adult loggerheads are primarily found in coastal waters and prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Abundance and Trends

A number of stock assessments and similar reviews (TEWG 1998; TEWG 2000; NMFS and SEFSC 2001; Heppell et al. 2003; NMFS and USFWS 2008; Conant et al. 2009; TEWG 2009; NMFS-SEFSC 2009d) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size.

Numbers of nests and nesting females can vary widely from year to year. However, nesting beach surveys can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of females turtles, as long as such studies are sufficiently long and effort and methods are standardized [see e.g., NMFS and USFWS (2008)]. NMFS and USFWS (2008) concluded that the lack of change in two important demographic parameters of loggerheads, remigration interval and clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population. Analysis of available data for the Peninsular Florida Recovery Unit (PFRU) up through 2008 led to the conclusion that the observed decline in nesting for that unit could best be explained by an actual decline in the number of adult female loggerheads in the population (Witherington et al. 2009).

Annual nest totals from beaches within the Northern Recovery Unit (NRU) averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (Georgia Department of Natural Resources (GDNR) unpublished data, North Carolina Wildlife Resources Commission unpublished data, South Carolina Department of Natural Resources (SCDNR) unpublished data), and represent approximately 1,272 nesting females per year [4.1 nests per female (Murphy and Hopkins 1984)]. The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3 percent annually. Nest totals from aerial surveys conducted by SCDNR showed a 1.9 percent annual decline in nesting in South Carolina from 1980 through 2008. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline. Data in 2008 showed improved nesting numbers. In 2008, 841 loggerhead nests were observed compared to the ten-year average of 715 nests in North Carolina. The number dropped to 276 in 2009, but rose again in 2010 (846 nests) and 2011 (948 nests). In South Carolina, 2008 was the seventh highest nesting year on record since 1980, with 4,500 nests, but this did not change the long-term trend line indicating a decline on South Carolina beaches. Nesting dropped in 2009 to 2,183, with an increase to 3,141 in 2010. Georgia beach surveys located a total of 1,648 nests in 2008. This number surpassed the previous statewide record of 1,504 nests in 2003. In 2009, the number of nests declined to 998, and in 2010, a new statewide record was established with 1,760 loggerhead nests. (GDNR, NCWRC, and SCDNR nesting data located at www.seaturtle.org).

Another consideration that may add to the importance and vulnerability of the NRU is the sex ratio of this subpopulation and its potential importance for genetic diversity. Research conducted over a limited time frame but across multiple years found that while the small Northern subpopulation can produce a larger proportion of male hatchlings than the large Peninsular Florida subpopulation, the sex ratio is female biased. In most years, the extent of the female bias is likely to be less extreme based upon current information. However, because their absolute numbers are small, their contribution to overall hatchling sex ratios is small (Wyneken et al. 2004; Wyneken et al. 2012). Since nesting female loggerhead sea turtles exhibit nest fidelity, the continued existence of the Northern subpopulation is related to the number of female hatchlings that are produced. Fewer females will limit the number of subsequent offspring produced by the subpopulation.

The PFRU is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed a mean of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008). The statewide estimated total for 2010 was 73,702 (FWRI nesting database). An analysis of index nesting beach data shows a 26 percent decline in nesting by the PFRU between 1989 and 2008, and a mean annual rate of decline of 1.6 percent despite a large increase in nesting for 2008, to 38,643 nests [Figure 2, (NMFS and USFWS 2008; Witherington et al. 2009, FWRI nesting database)]. With the addition of data through 2010, the nesting trend for the proposed NWA DPS of loggerheads became only slightly negative and not statistically different from zero [no trend (NMFS and USFWS 2010)]. Nesting at the index nesting beaches declined in 2011 but increased to near record levels (58,172 nests) in 2012 (FWRI nesting database).

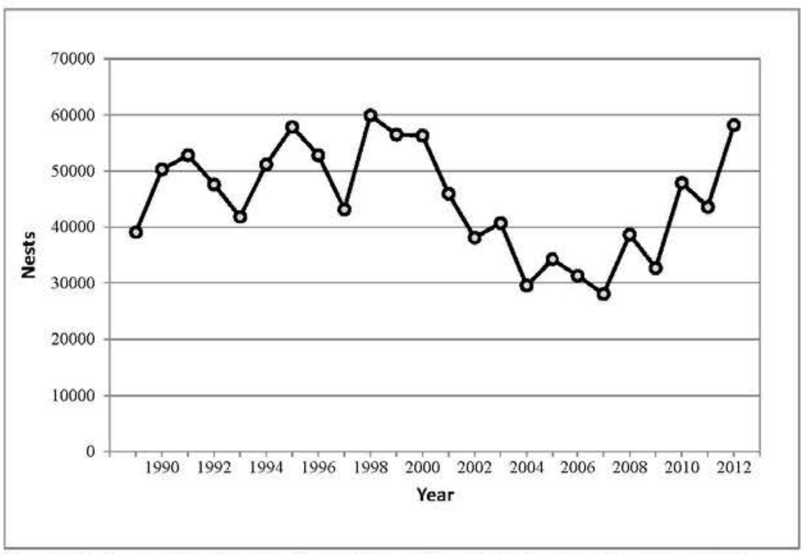

Figure 2. Loggerhead sea turtle nesting at Florida index beaches since 1989.

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The remaining three recovery units—Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (GCRU)—are much smaller nesting assemblages but still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida's statewide survey program. Survey effort was relatively stable during the 9-year period from 1995-2004 (although the 2002 year was missed). Nest counts ranged from 168-270, with a mean of 246, but with no detectable trend during this period (NMFS and USFWS 2008). Nest counts for the NGMRU are focused on index beaches rather than all beaches where nesting occurs. Analysis of the 12-year dataset (1997-2008) of index nesting beaches in the area shows a significant declining trend of 4.7 percent annually (NMFS and USFWS 2008). Nesting on the Florida Panhandle index beaches, which represents the majority of NGMRU nesting, had shown a large increase in 2008, but then declined again in 2009 and 2010 before rising back to a level similar to the 2003-2007 average in 2011. Similarly, nesting survey effort has been inconsistent among the GCRU nesting beaches and no trend can be determined for this subpopulation. Zurita et al. (2003) found a statistically significant increase in the number of nests on seven of the beaches on Quintana Roo, Mexico, from 1987-2001, where survey effort was consistent during the period. However, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008).

Determining the meaning of the long-term nesting decline data is confounded by various in-water research that suggests the abundance of neritic juvenile loggerheads is steady or increasing. Although Ehrhart et al. (2007) found no significant regression-line trend in a long-term dataset, researchers have observed notable increases in catch per unit effort (CPUE) over the past several years (Ehrhart et al. 2007, Epperly et al. 2007, Arendt et al. 2009). Epperly et al.(2007) determined the trends of increasing loggerhead catch rates from previous studies provide evidence there has been an increase in neritic juvenile loggerhead abundance in the southeastern United States in the recent past. A study led by the South Carolina Department of Natural Resources found that standardized trawl survey CPUEs for loggerheads from South Carolina to North Florida was 1.5 times higher in summer 2008 than summer 2000. However, even though there were persistent inter-annual increases from 2000-2008, the difference was not statistically significant, likely due to the relatively short time series. Comparison to other datasets from the 1950s through 1990s showed much higher CPUEs in recent years regionally and in the South Atlantic Bight, leading SCDNR to conclude that it is highly improbable that CPUE increases of such magnitude could occur without a real and substantial increase in actual abundance (Arendt et al. 2009). Whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence is not clear. NMFS and USFWS (2008), citing (Bjorndal et al. 2005), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest Stage III individuals (oceanic/neritic juveniles, historically referred to as small benthic juveniles), which could indicate a relatively large cohort that will recruit to maturity in the near future (TEWG 2009). However, in-water studies throughout the eastern United States also indicate a substantial decrease in the abundance of the smallest Stage III loggerheads, a pattern also corroborated by stranding data (TEWG 2009).

The Southeast Fisheries Science Center (SEFSC) has developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS-SEFSC 2009d). This model does not incorporate existing trends in the data (such as nesting trends) but instead relies on utilizing the available information on the relevant life-history parameters for sea turtles and then predicts future population trajectories based upon model runs using those parameters. Therefore, the model results do not build upon, but instead are complementary to, the trend data obtained through nest counts and other observations. The model uses the range of published information for the various parameters including mortality by stage, stage duration (years in a stage), and fecundity parameters such as eggs per nest, nests per nesting female, hatchling emergence success, sex ratio, and remigration interval. Model runs were done for each individual recovery unit as well as the western North Atlantic population as a whole, and the resulting trajectories were found to be very similar. One of the most robust results from the model was an estimate of the adult female population size for the western North Atlantic in the 2004-2008 time frame. The distribution resulting from the model runs suggest the adult female population size to be likely between approximately 20,000 to 40,000 individuals, with a low likelihood of being up to 70,000 (NMFS-SEFSC 2009d). A much less robust estimate for total benthic females in the western North Atlantic was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1 million (NMFS-SEFSC 2009d).

Threats

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

The Loggerhead Biological Review Team determined that the greatest threats to the Northwest Atlantic DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009). Domestic fishery operations often capture, injure, and kill sea turtles at various life stages. Loggerheads in the pelagic environment are exposed to U.S. Atlantic pelagic longline fisheries. Although loggerhead sea turtles are most vulnerable to pelagic longlines during their immature life history stage, there is some evidence that benthic juveniles may also be captured, injured, or killed by pelagic fisheries as well (Lewison et al. 2004). Southeast U.S. shrimp fisheries have historically been the largest fishery threat to benthic sea turtles in the southeastern United States, and continue to interact with and kill large numbers of turtles each year. Loggerheads in the benthic environment in waters off the coastal United States are exposed to a suite of other fisheries in federal and state waters including trawl, gillnet, purse seine, hook-and-line, including bottom longline and vertical line (e.g., bandit gear, handline, and rod-reel), pound net, and trap fisheries (refer to the Environmental Baseline section of this opinion for more specific information regarding federal and state managed fisheries affecting sea turtles within the action area). As an example, in the spring of 2000 a total of 275 loggerhead carcasses were found on North Carolina beaches and the deaths were suspected to have been from a large-mesh gillnest fishery operating offshore in the preceding weeks.

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

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

Coastal development can deter or interfere with nesting, affect nesting success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage et al. 1997; Bouchard et al. 1998). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to females and may change the natural behaviors of both adults and hatchlings (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). In addition, coastal development is usually accompanied by artificial lighting which has been known to alter the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal 1991).

Predation by various land predators is a threat to developing nests and emerging hatchlings. Additionally, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout portions of their ranges (NMFS and USFWS 2008).

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

Acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges may directly injure individuals through skin contact with oils (Geraci 1990), inhalation at the water's surface and ingesting compounds while feeding (Matkin and Saulitis 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area. In 2010, there was a massive oil spill in the Gulf of Mexico at British Petroleum's Deep Water Horizon (DWH) well. Official estimates are that millions of barrels of oil were released into the Gulf. Additionally, almost 2 million gallons of chemical dispersant were subsequently released to combat the oil. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts to sea turtles as a result of habitat impacts, prey loss, and subsurface oil particles and oil components broken down through physical, chemical, and biological processes are not known. More detailed information on the effects of oil spills affecting populations in the action area, including the potential impacts of the 2010 DWH oil spill are described in the Environmental Baseline section of this document.

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov).

Climate change impacts on sea turtles currently cannot, for the most part, be predicted with any degree of certainty; however significant impacts to the hatchling sex ratios of loggerhead turtles may result (NMFS and USFWS 2007b). In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25°-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007b). Modeling suggests an increase of 2°C in air temperature would result in a sex ratio of over 80 percent female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100 percent female offspring. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most clutches, leading to death (Hawkes et al. 2007). Warmer sea surface temperatures have been correlated with an earlier onset of loggerhead nesting in the spring (Weishampel et al. 2004; Hawkes et al. 2007), as well as short inter-nesting intervals (Hays et al. 2002) and shorter nesting season (Pike et al. 2006).

The effects from increased temperatures may be exacerbated on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990). These impacts will be exacerbated by sea level rise. If females nest on the seaward side of the erosion control structures, nests may be exposed to repeated tidal overwash (NMFS and USFWS 2007b). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993; Fish et al. 2005; Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc., which could ultimately affect the primary foraging areas of sea turtles.

Actions have been taken to reduce anthropogenic impacts to loggerhead sea turtles from various sources, particularly since the early 1990s. These include lighting ordinances, predation control, and nest relocations to help increase hatchling survival, as well as measures to reduce the mortality of pelagic immatures, benthic immatures, and sexually mature age classes from various fisheries and other marine activities. Recent actions have taken significant steps towards reducing the recurring sources of mortality of sea turtles in the environmental baseline and improving the status of all loggerhead subpopulations. For example, the Turtle Excluder Device (TED) regulation published on February 21, 2003 (68 FR 8456), represents a significant improvement in the baseline effects of trawl fisheries on loggerhead sea turtles, though shrimp trawling is still considered to be one of the largest source of anthropogenic mortality on loggerheads (NMFS-SEFSC 2009d).

3.2.2 Green Sea Turtle

The green sea turtle was listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations which were listed as endangered.

Species Description, Distribution, and Population Structure
Green sea turtles have a smooth carapace with four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They typically have a black dorsal surface and a white ventral surface although the carapace of green sea turtles in the Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, brown and black in starburst or irregular patterns (Lagueux 2001).

Green sea turtles are distributed circumglobally, mainly in waters between the northern and southern 20°C isotherms (Hirth 1971) and nesting occurs in more than 80 countries worldwide

(Hirth and USFWS 1997). The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica, and Raine Island, on the Great Barrier Reef in Australia. The complete nesting range of green sea turtles within the southeastern United States includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina as well as the USVI and Puerto Rico (NMFS and USFWS 1991; Dow et al. 2007). However, the vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward Counties. For more information on green sea turtle nesting in other ocean basins, refer to the 1991 Recovery Plan for the Atlantic Green Turtle (NMFS and USFWS 1991) or the 2007 Green Sea Turtle 5-Year Status Review (NMFS and USFWS 2007a).

In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts. Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Hildebrand 1982; Doughty 1984; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon system in Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward Counties (Guseman and Ehrhart 1992; Wershoven and Wershoven 1992). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Miskito coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatán Peninsula.

Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs (Hays et al. 2001) and, like loggerheads, are known to migrate from northern areas in the summer back to warmer southern waters to the south in the fall and winter to avoid seasonally cold seawater temperatures. In terms of genetic structure, regional subpopulations show distinctive mitochondrial DNA properties for each nesting rookery (Bowen et al. 1992; Fitzsimmons et al. 2006). Despite the genetic differences, turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. However, such mixing occurs at extremely low levels in Hawaiian foraging areas, perhaps making this central Pacific population the most isolated of all green turtle populations occurring worldwide (Dutton et al. 2008).

Life History Information

Green sea turtles exhibit particularly slow growth rates [about 1-5 centimeters per year (Green 1993; McDonald-Dutton and Dutton 1998)] and also have one of the longest ages to maturity of any sea turtle species [i.e., 20-50 years (Chaloupka and Musick 1997; Hirth and USFWS 1997)]. The slow growth rates are believed to be a consequence of their largely herbivorous, low-net energy diet (Bjorndal 1982). Upon reaching sexual maturity, females begin returning to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982; Frazer and Ehrhart 1985) and are capable of migrating significant distances (hundreds to thousands of kilometers) between foraging and nesting areas. While females lay eggs every 2-4 years, males are known to reproduce every year (Balazs 1983).

Green sea turtle mating occurs in the waters off nesting beaches. In the southeastern United States, females generally nest between June and September, and peak nesting occurs in June and July (Witherington and Ehrhart 1989). During the nesting season, females nest at approximately two-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart 1996). Clutch size often varies among subpopulations, but mean clutch size is around 110-115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart 1989), which will incubate for approximately two months before hatching. Survivorship at any particular nesting site is greatly influenced by the level of anthropogenic stressors, with the more pristine and less disturbed nesting sites (e.g., Great Barrier Reef in Australia) showing higher survivorship values than nesting sites known to be highly disturbed (e.g., Nicarauga) (Campbell and Lagueux 2005; Chaloupka and Limpus 2005). After emerging from the nest, hatchlings swim to offshore areas and go through a posthatchling pelagic stage where they are believed to live for several years, feeding close to the surface on a variety of marine algae and other life associated with drift lines and other debris. This early oceanic phase remains one of the most poorly understood aspects of green turtle life history (NMFS and USFWS 2007b). However, at approximately 20- to 25-cm caprapace length, juveniles leave pelagic habitats and enter benthic foraging habitats. Growth studies using skeletochronology indicate that for green sea turtles in the Western Atlantic shift from the oceanic phase to nearshore development habitats (protected lagoons and open coastal areas rich in sea grass and marine algae) after approximately 5-6 years (Zug and Glor 1998; Bresette et al. 2006). As adults, they feed almost exclusively on sea grasses and algae in shallow bays, lagoons, and reefs (Rebel and Ingle 1974) although some populations are known to also feed heavily on invertebrates (Carballo et al. 2002). While in coastal habitats, green sea turtles exhibit site fidelity to specific foraging and nesting grounds and it is clear they are capable of "homing in" on these sites if displaced (McMichael et al. 2003). Reproductive migrations of Florida green turtles have been identified through flipper tagging and/or satellite telemetry. Based on these studies, the majority of adult female Florida green turtles are believed to reside in nearshore foraging areas throughout the Florida Keys from Key Largo to the Dry Tortugas and in the waters southwest of Cape Sable, Florida, with some post-nesting turtles also residing in Bahamian waters as well (NMFS and USFWS 2007a).

Abundance and Trends

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

The Atlantic regions were among the best performing in terms of abundance in the entire review. The 5-year status review for the species identified eight geographic areas considered to be primary sites for green sea turtle nesting in the Atlantic/Caribbean and reviewed the trend in nest count data for each (NMFS and USFWS 2007a). These sites are (1) Yucatán Peninsula, Mexico; (2) Tortuguero, Costa Rica; (3) Aves Island, Venezuela; (4) Galibi Reserve, Suriname; (5) Isla Trindade, Brazil; (6) Ascension Island, United Kingdom; (7) Bioko Island, Equatorial Guinea; and (8) Bijagos Achipelago, Guinea-Bissau. Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precluded a meaningful trend assessment for either site (NMFS and USFWS 2007a). Seminoff (2004) likewise reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic, including all of the above with the exception that nesting in Florida was reviewed in place of Isla Trindade, Brazil. Seminoff (2004) concluded that all sites in the central and western Atlantic showed increased nesting, with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007a). More information about site specific trends for the other major ocean regions can be found in the most recent five-year status review for the species (see NMFS and USFWS (2007a)).

By far, the largest known nesting assemblage in the Atlantic occurs at Tortuguero, Costa Rica. According to monitoring data on nest counts as well as documented emergences (both nesting and non-nesting events), there appears to be an increasing trend in this nesting assemblage since monitoring began in the early 1970s. For instance, from 1971-1975 there were approximately 41,250 average emergences documented per year and this number increased to an average of 72,200 emergences documented per year from 1992-1996 (Bjorndal et al. 1999). Troëng and Rankin (2005) collected nest counts from 1999-2003 and also reported increasing trends in the population consistent with the earlier studies, with nest count data suggesting 17,402-37,290 females per year (NMFS and USFWS 2007a). Modeling by (Chaloupka et al. 2008) using data sets of 25 years or more resulted in an estimate of the Tortuguero, Costa Rica, population growing at 4.9 percent annually. The number of females nesting per year on beaches in the Yucatán, Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007a).
In the continental United States, green turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida where an estimated 200-1,100 females nest each year (Meylan et al. 1994; Weishampel et al. 2003). Occasional nesting has also been documented along the Gulf coast of Florida as well as the beaches on the Florida Panhandle (Meylan et al. 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina; just east of the mouth of the Cape Fear River; on Onslow Island; and on Cape Hatteras National Seashore. In 2010, a total of 18 nests were found in North Carolina, six nests in South Carolina, and six nests in Georgia (nesting databases maintained on www.seaturtle.org). Increased nesting has also been observed along the Atlantic coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997).

In Florida, index beaches were established to standardize data collection methods and effort on key nesting beaches. Since establishment of the index beaches in 1989 up until recently, the pattern of green turtle nesting has shown biennial peaks in abundance with a generally positive trend during the ten years of regular monitoring (Figure 3). According to data collected from Florida's index nesting beach survey from 1989-2012, green turtle nest counts across Florida have increased approximately tenfold from a low of 267 in the early 1990s to a high of 10,701 in 2011. Modeling by Chaloupka et al. (2008) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9 percent.

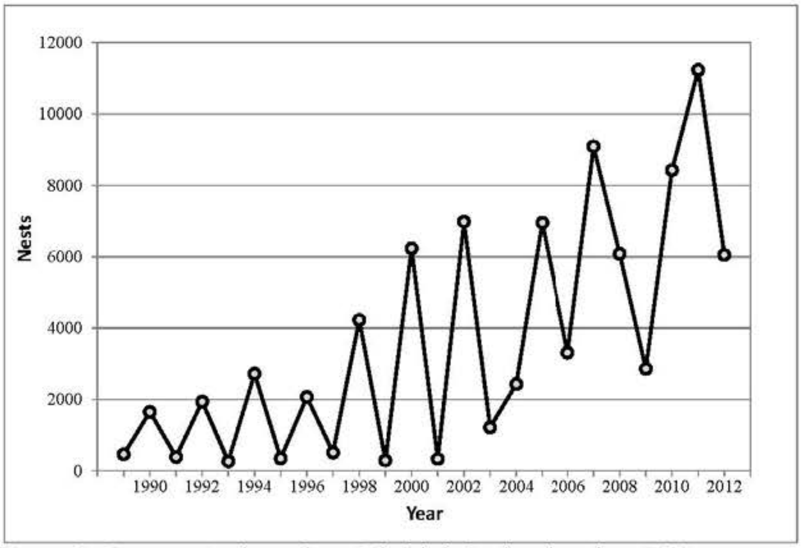

Figure 3. Green sea turtle nesting at Florida index beaches since 1989.

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas of the southeastern United States, where they come to forage. Ehrhart et al. (2007) have documented a significant increase in in-water abundance of green turtles in the Indian River Lagoon area. It is likely that immature green sea turtles foraging in the southeastern United States come from multiple genetic stocks; therefore, the status of immature green sea turtles in the southeastern United States might also be assessed from trends at all of the main regional nesting beaches, principally Florida, Yucatán, and Tortuguero.

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the overexploitation of green sea turtles for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. There are also significant and ongoing threats to green sea turtles from human-related causes in the United States. Similar to that described in more detail above for loggerhead sea turtles, these threats include beach armoring, erosion control, artificial lighting, beach disturbance (e.g., driving on the beach), pollution, foraging habitat loss as a result of direct destruction by dredging, siltation, boat damage, interactions with fishing gear, and oils spills. For all sea turtle species, the potential impacts of the 2010 oil well release are described in the Environmental Baseline section of this document.

Fibropapillomatosis disease is an increasing threat to green sea turtles. Presently, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Jacobson 1990; Jacobson et al. 1991; Herbst 1994). Other sources of natural mortality include cold-stunning and biotoxin exposure. Cold-stunning is not considered a major source of mortality in most cases. As temperatures fall below 8°-10°C, turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989). During January 2010, an unusually large cold-stunning event in the southeastern United States resulted in around 4,600 sea turtles, mostly greens, found cold-stunned, with hundreds found dead or dying. A large cold-stunning event occurred in the western Gulf of Mexico in February 2011, resulting in approximately 1650 green turtles being found cold-stunned in Texas. Of these, approximately 620 were found dead or died after stranding and approximately 1030 were rehabilitated and released. Additionally, during this same time frame, approximately 340 green turtles were found cold-stunned in Mexico, with approximately 300 of those reported as being subsequently released.

The likely effects of global climate change discussed previously for loggerheads also apply to green turtles. Additionally, green sea turtle hatchling size also appears to be influenced by incubation temperatures, with smaller hatchlings produced at higher temperatures (Glen et al. 2003).

3.2.3 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its entire range on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act of 1969, a precursor to the ESA.

Species Description, Distribution, and Population Structure
The leatherback is the largest sea turtle in the world. Mature males and females can reach lengths of over 2 m and weigh close to 900 kg (or 2000 lbs). The leatherback is the only sea turtle that lacks a hard, bony shell. A leatherback's carapace is approximately 4 cm thick and consists of a leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The ridged carapace and large flippers are characteristics that make the leatherback uniquely equipped for long distance foraging migrations. Leatherbacks lack the crushing chewing plates characteristic of sea turtles that feed on hard-bodied prey (Pritchard 1971). Instead, they have pointed toothlike cusps and sharp edged jaws that are perfectly adapted for a

diet of soft-bodied pelagic (open ocean) prey, such as jellyfish and salps. A leatherback's mouth and throat also have backward-pointing spines that help retain gelatinous prey.

The leatherback sea turtle ranges farther than any other sea turtle species, exhibiting broad thermal tolerances (NMFS and USFWS 1995). They forage in temperate and subpolar regions between latitudes 71ºN and 47ºS in all oceans and undergo extensive migrations to and from their tropical nesting beaches. In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS-SEFSC 2001). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are located in French Guiana and Suriname (NMFS-SEFSC 2001).

Previous genetic analyses of leatherbacks using only mitochondrial DNA (mtDNA) suggested that within the Atlantic basin there were at least three genetically distinct nesting populations: the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1998). Further genetic analyses using microsatellite markers along with the mtDNA data and tagging data has resulted in Atlantic Ocean leatherbacks now being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007). General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages, although data to support this is limited in most cases.

Life History Information

Leatherbacks are a long-lived sea turtle species, with some individuals reaching 30 years of age or older. Past estimates showed that they reached sexual maturity faster than most other sea turtle species as Rhodin (1985) reported maturity for leatherbacks occurring at 3-6 years of age while Zug and Parham (1996) reported maturity occurring at 13-14 years of age. More recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the western North Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe 2007). Female leatherbacks lay up to 10 nests during the nesting season (March through July in the U.S.) at 2-3 year intervals. They produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. After 60-65 days, leatherback hatchlings with white striping along the ridges of their backs and on the margins of the flippers emerge from the nest. Leatherback hatchlings are approximately 50-77 cm in length, with fore flippers as long as their bodies, and weigh approximately 40-50 g. Although leatherbacks forage in coastal waters, they appear to remain primarily pelagic through all life stages (Heppell et al. 2003). Eckert (1999) found that leatherback juveniles remain in waters warmer than 26ºC until they exceed 100 cm in length. The location and abundance of prey, including medusae, siphonophores, and salpae, in temperate and boreal latitudes likely has a strong influence on leatherback distribution in these areas (Plotkin 1995). Leatherbacks are known to be deep divers, with recorded depths in excess of a half mile (Eckert et al. 1989), but may also come into shallow waters to locate prey items.

Abundance and Trends

The status of the Atlantic leatherback population has been less clear than the Pacific population, which has shown dramatic declines at many nesting sites (Spotila et al. 2000; Sarti Martínez et al. 2007). This uncertainty has been a result of inconsistent beach and aerial surveys, cycles of erosion and reformation of nesting beaches in the Guianas (representing the largest nesting area), a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species, and inconsistencies in the availability and analyses of data. However, coordinated efforts at data collection and analyses by the Leatherback Turtle Expert Working Group have helped to clarify the understanding of the Atlantic population status (TEWG 2007).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with the vast majority of the nesting occurring in the Guianas and Trinidad. Past analyses had shown that the nesting aggregation in French Guiana had been declining at about 15 percent per year since 1987 (NMFS-SEFSC 2001). However, from 1979-1986, the number of nests was increasing at about 15 percent annually, which could mean that the observed decline could be part of a nesting cycle that coincides with the erosion cycle of Guiana beaches described by Schultz (1975). It is thought that the cycle of erosion and reformation of beaches has resulted in shifting nesting beaches throughout this region. This was supported by the increased nesting seen in Suriname, where leatherback nest numbers had shown large increases concurrent with declines elsewhere (with more than 10,000 nests per year since 1999 and a peak of 30,000 nests in 2001), and the long-term trend for the overall Suriname and French Guiana population was thought to possibly show an increase [(Girondot et al. 2002) in (Hilterman and Goverse 2003)]. In the past, many sea turtle scientists have agreed that the Guianas (and some would include Trinidad) should be viewed as one population and that a synoptic evaluation of nesting at all beaches in the region is necessary to develop a true picture of population status (Reichart et al. 2001). Genetics studies have added support to this notion and have resulted in the designation of the Southern Caribbean/Guianas stock. Using both Bayesian modeling and regression analyses, the TEWG (TEWG 2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate (using nesting females as a proxy for population). This positive growth was seen within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007).

The Western Caribbean stock includes nesting beaches from Honduras to Colombia. The most intense nesting in that area occurs in Costa Rica, Panama, and the Gulf of Uraba in Colombia (Duque et al. 2000). The Caribbean coast of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troëng et al. 2004). Examination of data from three index nesting beaches in the region (Tortuguero, Gandoca, and Pacuare in Costa Rica) using various Bayesian and regression analyses indicated that the nesting population likely was not growing over the 1995-2005 time series of available data (TEWG 2007). Other modeling of the nesting data for Tortuguero indicates a possible 67.8 percent decline between 1995 and 2006 (Troëng and Chaloupka 2007).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, the U.S. Virgin Islands (St. Croix), and the British Virgin Islands (Tortola). In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 percent (TEWG 2007). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1 percent from 1986-2004 (TEWG 2007). Nesting in Tortola is limited, but has been increasing from 0-6 nests per year in the late 1980s to 35-65 per year in the 2000s, with an annual growth rate of approximately 1.2 percent between 1994 and 2004 (TEWG 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the index nesting beach surveys, the TEWG (TEWG 2007) estimated a significant annual nesting growth rate of 1.17 percent between 1989 and 2005. In 2007, a record 517 leatherback nests were observed on the index beaches in Florida, followed by 265 nests in 2008, a record 615 nests in 2009, a slight decline to 552 nests in 2010, and then a new record of 625 nests in 2011 [Figure 4, (FWC Index Nesting Beach Survey Database)]. This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting, but overall the trend shows rapid growth on Florida's east coast beaches.

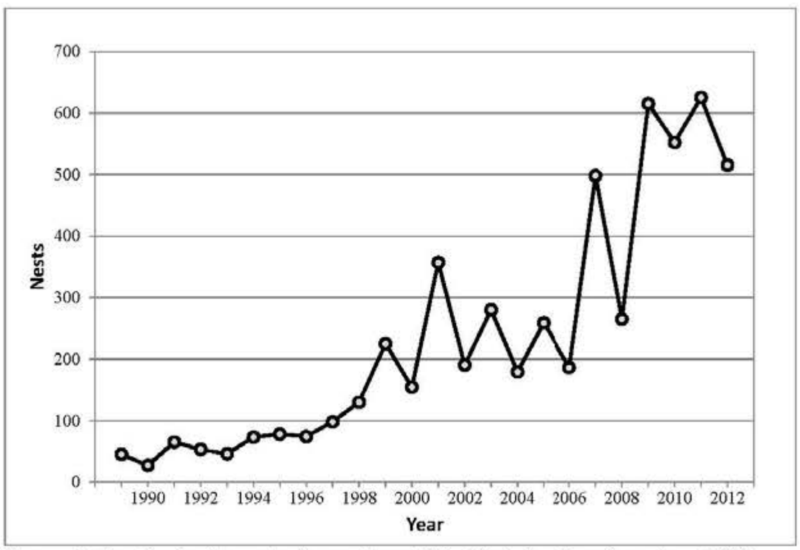

Figure 4. Leatherback sea turtle nesting at Florida index beaches since 1989.

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The West African nesting stock of leatherbacks is a large, important, but mostly unstudied aggregation. Nesting occurs in various countries along Africa's Atlantic coast, but much of the nesting is undocumented and the data are inconsistent. However, it is known that Gabon has a very large amount of leatherback nesting, with at least 30,000 nests laid along its coast in one season (Fretey et al. 2007). Fretey et al. (2007) also provide detailed information about other known nesting beaches and survey efforts along the Atlantic coast of African. Because of the lack of consistent effort and minimal available data, trend analyses were not possible for this stock (TEWG 2007).

Two other small but growing nesting stocks utilize the beaches of Brazil and South Africa. For the Brazilian stock, the TEWG (TEWG 2007) analyzed the available data and determined that between 1988 and 2003 there was a positive annual average growth rate of 1.07 percent using regression analyses and 1.08 percent using Bayesian modeling. The South African stock has an annual average growth rate of 1.06 based on regression modeling and 1.04 percent using the Bayesian approach (TEWG 2007).

Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1996, the entire Western Atlantic population was characterized as stable at best (Spotila et al. 1996), with numbers of nesting females reported to be on the order of 18,800. Spotila et al. (1996) estimated that the leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, totaled approximately 27,600 adult females (considering both nesting and interesting females), with an estimated range of 20,082-35,133. This is consistent with the estimate of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) determined by the TEWG (TEWG 2007).

Threats

Anthropogenic impacts to the leatherback population are similar to those facing other sea turtle species including interactions with fishery gear, marine pollution, destruction of foraging habitat, and threats to nesting beaches (see loggerhead status and trends section for more information on these threats). Of all the extant sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, especially gillnet and pot/trap lines used in various fisheries around the world. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, their method of locomotion, and/or perhaps their attraction to the lightsticks used to attract target species in longline fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine and many other stranded individuals exhibited evidence of prior entanglement (Dwyer et al. 2002). For many years, the use of TEDs required for use in many U.S. fisheries were less effective at excluding the larger leatherback sea turtles compared to the smaller, hard-shelled turtle species. However, modifications to the design of TEDs have been required since 2003 that are expected to have reduced the amount of leatherback deaths that result from net capture. 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 from intense egg harvesting in some areas has caused a sharp decline in leatherback sea turtle populations and represents a significant threat to survival and recovery of the species worldwide. Leatherback sea turtles may also be more susceptible to marine debris ingestion than other sea turtle species due to their predominantly pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding and migratory purposes (Shoop and Kenney 1992; Lutcavage et al. 1997).

Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained some form of plastic debris (Mrosovsky 1981). The presence of plastic in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and forms of debris such a plastic bags (Mrosovsky et al. 2009). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks. Just as with other sea turtles, nesting and foraging leatherback sea turtles are subjected to the effects from past and present oil spills occurring in the Gulf of Mexico and other regions (see loggerhead sea turtle status section for more information). At the time of this consultation, no confirmed deaths of leatherbacks have been recorded in the vicinity of the DWH spill site, although this does not mean that no mortality has occurred (NMFS et al. 2011). In addition to direct contact, ingestion of oil-contaminated prey items represents a particular threat to leatherbacks emanating from the DWH spill in the Gulf of Mexico and this may continue to be a threat to recovery in the years ahead.

As discussed in more detail in the loggerhead section above, global climate change can be expected to have various impacts on all sea turtles, including leatherbacks. Global climate change is likely to also influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007c). Several studies have shown leatherback distribution is influenced by jellyfish abundance [e.g., (Houghton et al. 2006; Witt et al. 2006; Witt et al. 2007)]; however, more studies need to be done to monitor how changes to prey items affect distribution and foraging success of leatherbacks so that population-level effects can be determined.

3.2.4 Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was listed as endangered throughout its entire range on December 2, 1970 under the Endangered Species Conservation Act of 1969, a precursor to the ESA. No critical habitat has been designated for the species.

Species Description, Distribution, and Population Structure
The Kemp's ridley sea turtle is the smallest of all extant sea turtles with adults generally weighing less than 45 kilograms and having a carapace length of around 65 centimeters. Adults have an almost circular carapace with a grayish green color while the plastron is often pale yellow. There are two pairs of prefrontal scales on the head, five vertebral scutes, and five pairs of costal scutes. In the bridge adjoining the plastron to the carapace, there are four scutes, each of which is perforated by a pore. Hatchlings are usually grayish-black in color and weigh between 15-20 grams. This species has a very restricted range relative to other sea turtle species with most adults occurring in the Gulf of Mexico in shallow near shore waters, although adult-sized individuals sometimes are found on the eastern seaboard of the United States as well. Nesting is essentially limited to the beaches of the western Gulf of Mexico, primarily in the Mexican state of Tamaulipas, although few nests have also been recorded in Florida and the

Carolinas (Meylan et al. 1995). Kemp's ridleys nest in daytime aggregations known as "arribadas," primarily at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nests in this single locality (Pritchard 1969).

Life History Information

Kemp's ridley sea turtles reach sexual maturity at 7-15 years of age. While some turtles nest annually, the weighted mean remigration rate is approximately two years. Nesting generally occurs from April to July and females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M 1994). Studies have shown that the time spent in the post-hatchling pelagic stage can vary from 1-4 years time, while the benthic immature stage typically lasts approximately 7-9 years (Schmid and Witzell 1997). Little is known of the movements of the post-hatching, planktonic stage within the Gulf of Mexico although the turtles during this stage are assumed to associate with floating seaweed (e.g., *Sargassum* spp.) where they would presumably feed on the available sargassum and associated infauna or other epipelagic species found in the Gulf of Mexico. Atlantic juveniles/subadults travel northward with vernal warming to feed in the productive, coastal waters of Georgia through New England, returning southward with the onset of winter to escape the cold (Lutcavage and Musick 1985; Henwood and Ogren 1987; Ogren 1989). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Epperly et al. 1995a; Epperly et al. 1995b; Musick and Limpus 1997). Adult Kemp's ridleys primarily occupy neritic habitats, typically containing muddy or sandy bottoms where prey can be found. In the post-pelagic stages, Kemp's ridley sea turtles are largely cancrivorous (crab eating), with a preference for portunid crabs (Bjorndal 1997). Stomach contents of Kemp's ridleys along the lower Texas coast consisted of a predominance of nearshore crabs and mollusks, as well as fish, shrimp and other foods considered to be scavenged discards from the shrimping industry (Shaver 1991).

Abundance and Trends

Of the seven extant species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the Rancho Nuevo beaches (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s, nesting numbers were below 1,000 (with a low of 702 nests in 1985). However, observations of increased nesting in the 1990s suggested that the decline in the Kemp's ridley population has stopped and the population is now increasing (USFWS 2000). The number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 percent per year from 1985 to 1999 (TEWG 2000). These trends are further supported by 2004-2012 nesting data from Mexico (Figure 5). The number of nests over that period has increased yearly from 7,147 in 2004, to 21,797 in 2012, though an unexplained decline in nesting was observed in 2010 (Gladys Porter Zoo nesting database 2013). A small nesting population is also emerging in the United States, primarily in Texas, rising annually from six nests in 1996 to 197 in 2009. Texas nesting then experienced a decline similar to that seen in Mexico for 2010, with 140 nests (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm), but nesting rebounded as 199 nests were recorded in 2011 and 209 nests in 2012 (National Park Service data, http://www.nps.gov/pais/naturescience/nesting2012).

Heppell et al. (2005) predicted in a population model that the population is expected to increase at least 12-16 percent per year and that the population could attain at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011) contained an updated model which predicts that the population is expected to increase 19 percent per year and that the population could attain at least 10,000 females nesting on Mexico beaches by 2011. Approximately 25,000 nests would be needed for an estimate of 10,000 nesters on the beach, based on an average 2.5 nests/nesting female. In 2009 the population was on track with 21,144 nests, but an unexpected and as yet unexplained drop in nesting occurred in 2010 (13,302), deviating from the NMFS et al. (2011) model prediction. A subsequent increases to 20,570 nests in 2011 and 21,797 in 2012 occurred, but we will not know if the population is continuing the trajectory predicted by the model until future nesting data is available. Of course, this updated model assumes that current survival rates within each life stage remain constant. The recent increases in Kemp's ridley sea turtle nesting seen in the last two decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998; TEWG 2000). While these results are encouraging, the species limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental stochasticity all of which are often difficult to predict with any certainty.

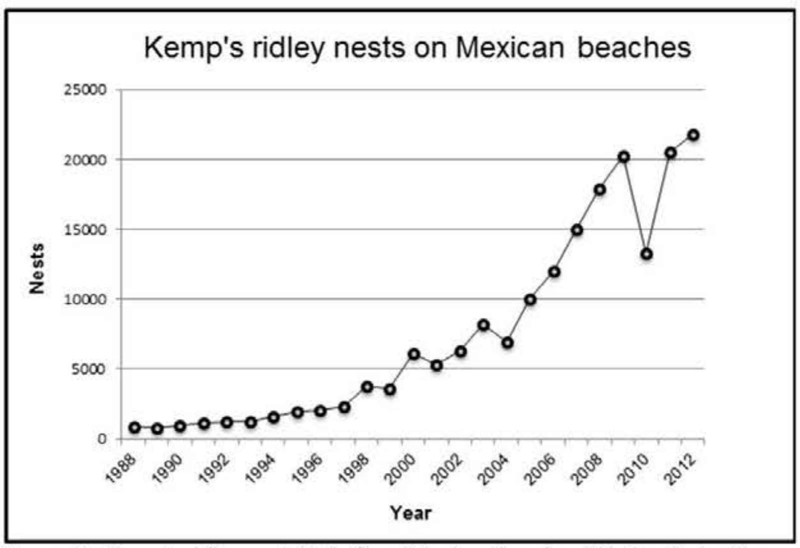

Figure 5. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2013).

Threats

Kemp's ridleys face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999-2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and five green sea turtles were found on Cape Cod beaches (R. Prescott, NMFS, pers. comm. 2001). Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stun events may be associated with numbers of sea turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned sea turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality. A complete list of other indirect factors can be found in NMFS SEFSC (NMFS-SEFSC 2001).

Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed in previous sections. For example, in the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the sea turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The five Kemp's ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction because it is unlikely that all of the carcasses washed ashore.

The impacts of pollution on Kemp's ridley sea turtles, as with all sea turtles, are still poorly understood. There is little data to provide an understanding of how water quality impacts sea turtles. For all sea turtle species, the potential impacts of the 2010 DWH oil spill are described in the Environmental Baseline section of this document. It is expected that the acute and chronic impacts of the DWH oil spill, along with other oil spills in the Gulf of Mexico, will continue to have an impact on sea turtles, especially Kemp's ridley sea turtles, for years to come. The potential impacts of the 2010 DWH oil spill are described in greater detail in the Environmental Baseline section of this document.

Global climate change impacts as described in the section for loggerhead sea turtles above are also expected. Other changes in the marine ecosystem caused by global climate change (e.g., salinity, oceanic currents, dissolved oxygen levels, nutrient distribution, etc.) could influence the distribution and abundance of phytoplankton, zooplankton, submerged aquatic vegetation, forage fish, etc., which could ultimately affect the primary foraging areas of Kemp's ridley sea turtles.

4 ENVIRONMENTAL BASELINE

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of green, Kemp's ridley, leatherback, and loggerhead turtles within the action area. The environmental baseline is a "snapshot" of the action area at a specified point in time and includes state, tribal, local, and private actions already affecting the critical habitat that will occur contemporaneously with the consultation in progress. Unrelated federal actions affecting the species and its critical habitat that have completed formal or informal consultation are also part of the environmental baseline, as are federal and other actions within the action area that may benefit the species and its critical habitat.

4.1 Status of Species in the Action Area

Sea Turtles
The four species of sea turtles that occur in the action area are all highly migratory. Therefore, the status of these species (or DPS where applicable) of sea turtles in the action area, as well as the threats to these species, are best reflected in their range-wide statuses and supported by the species accounts in Section 3 (Status of Species).

4.2 Factors Affecting Sea Turtles in the Action Area

As stated in Section 2.2 (Action Area), the action area includes the waters between Eglin Air Force Base and Warning Area W-151A, as well as the portion of Warning Area W-151A where the munitions testing will occur. The following analysis examines the impacts of past and on-going actions that may affect these species' environment specifically within this defined action area. The environmental baseline for this opinion includes the effects of several activities affecting the survival and recovery of ESA-listed sea turtle species in the action area. The activities that shape the environmental baseline in the action area of this consultation are federal fisheries, effects of vessel operations, additional military activities, dredging, and marine pollution.

4.2.1 Federal Actions

NMFS has undertaken a number of Section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered sea turtle species, and when appropriate, has authorized the incidental taking of these species. Each of those consultations sought to minimize the adverse effects of the action on sea turtles. The summary below of federal actions and the effects these actions have had on sea turtles includes only those federal actions in the action areas which have already concluded or are currently undergoing formal Section 7 consultation.

Fisheries
Threatened and endangered sea turtles are adversely affected by fishing gears used throughout the continental shelf of the action area. Gillnet, pelagic and bottom longline, other types of hook-and-line gear, trawl, and pot fisheries have all been documented as interacting with sea turtles.

For all fisheries for which there is an FMP, impacts have been evaluated under Section 7. Formal Section 7 consultations have been conducted on the following fisheries, occurring at least in part within the action area, found likely to adversely affect threatened and endangered sea turtles: Southeastern shrimp trawl fisheries, reef fish, and coastal migratory pelagic resources fisheries. Anticipated take levels associated with these and other fisheries in the Gulf of Mexico are presented in Appendix 1; the take levels reflect the impact on sea turtles and other listed species of each activity anticipated from the date of the incidental take statement (ITS) forward in time.

Southeastern Shrimp Trawl Fisheries
Various types of gear are used to capture shrimp including otter trawls, wing nets (butterfly nets), skimmer trawls, pusherhead trawls (chopstick rigs), stationary butterfly nets, beam trawls, roller-frame trawls, cast nets, channel nets, haul seines, traps, and dip nets. The otter trawl, with various modifications, is the dominant gear used in offshore waters and essentially the sole gear used in the federal fisheries. However, authorized gear types listed for the Gulf of Mexico FMP are trawl, butterfly net, skimmer, and cast net for commercial use and trawl only for the recreational use.

Shrimp trawling is believed to have had the greatest adverse effect on sea turtles in the action area in the past. By the late 1970s, there was evidence thousands of sea turtles were being killed annually in the Southeast (Henwood and Stuntz 1987). In 1990, the National Research Council (NRC) concluded the Southeast shrimp trawl fishery affected more sea turtles than all other activities combined and was the most significant anthropogenic source of sea turtle mortality in the U.S. waters, in part due to the high reproductive value of turtles taken in this fishery (NRC 1990). The level of annual mortality described in NRC (1990) is believed to have continued until 1992-1994, when U.S. law required all shrimp trawlers in the Atlantic and Gulf of Mexico to use TEDs, which allowed some turtles to escape nets before drowning (NMFS 2002). Despite the apparent success of TEDs for some species of sea turtles (e.g., Kemp's ridleys), it was later discovered that TEDs were not adequately protecting all species and size classes of sea turtles. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimension in TEDs in use at that time were too small for some sea turtles and that as many as 47 percent of the loggerheads stranding annually along the Atlantic and Gulf of Mexico were too large to fit the existing openings. In February 2003, NMFS implemented revisions to the TED regulations addressing that problem (68 FR 8456, February 21, 2003). The revised TED regulations were expected to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks.

NMFS has completed several consultations on Southeastern shrimp fisheries including regulations governing the use of TEDs. The most recent opinion titled "*Reinitiation of Endangered Species Act (ESA) Section 7 Consultation on the Continued Implementation of the Sea Turtle Conservation Regulations, as Proposed to Be Amended, and the Continued Authorization of the Southeast U.S. Shrimp Fisheries in Federal Waters under the Magnuson-Stevens Act*" was completed May 8, 2012. This opinion was the culmination of several requests for reinitiation of consultation on different shrimp fisheries and listed species as the various triggers for reinitiation were met. With each reinitiation request and determination made, the scope of the proposed action and the species subject to reinitiation of Section 7 consultation were expanded. The scope of the action and species subject to reinitiation of Section 7 consultation were also expanded as triggered by a proposed change to the sea turtle conservation regulations and the listing of the two DPS of Atlantic sturgeon. This new opinion now covers NMFS's Section 7 consultation responsibilities on both its implementation of sea turtle conservation regulations under the ESA as proposed to be amended, and its authorization of federal shrimp trawling under the MSA for all listed species. This opinion supersedes all previous determinations and opinions on southeastern shrimp trawl fisheries. The opinion concluded that operation of the fishery would not jeopardize the continued existence of any sea turtle species. Since the completion of this biop, NMFS has reinitiated consultation due to the withdrawal of the proposed rule to require TEDs in the skimmer trawl fishery.

Gulf of Mexico Reef Fish Fishery
The Gulf of Mexico reef fish fishery uses two basic types of gear: spear or powerhead, and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod-and-reel).

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

In response, NMFS published an emergency rule prohibiting the use of bottom longline gear in the reef fish fishery shoreward of a line approximating the 50-fathom depth contour in the eastern Gulf of Mexico, essentially closing the bottom longline sector of the reef fish fishery in the eastern Gulf of Mexico for six months pending the implementation of a long-term management strategy. The Gulf of Mexico Fishery Management Council (GMFMC) developed a long-term management strategy via a new amendment (Amendment 31 to the Reef Fish FMP). The amendment included a prohibition on the use of bottom longline gear in the Gulf of Mexico reef fish fishery shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida, from June through August; a reduction in the number of bottom longline vessels operating in the fishery via an endorsement program and a restriction on the total number of hooks that may be possessed onboard each Gulf of Mexico reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing. Amendment 31 was implemented on May 26, 2010.

On October 13, 2009, SERO completed an opinion that analyzed the expected effects of the continued operation of the Gulf of Mexico reef fish fishery under the changes proposed in Amendment 31 (NMFS-SEFSC 2009b). The opinion concluded that sea turtle takes would be substantially reduced compared to the fishery as it was previously prosecuted, and that operation of the fishery would not jeopardize the continued existence of any sea turtle species. In August 2011, consultation was reinitiated to address the DWH oil release event and potential changes to the environmental baseline. Reinitiation of consultation was not related to any material change in the fishery itself, violations of any terms and conditions of the 2009 opinion, or an exceedance of the incidental take statement. The resulting September 11, 2011, opinion concluded the continued operation of the Gulf reef fish fishery is not likely to jeopardize the continued existence of any listed sea turtles.

Coastal Migratory Pelagic Resources Fisheries

In 2007, NMFS completed a Section 7 consultation on the continued authorization of the coastal migratory pelagic resources fishery in the Gulf of Mexico and South Atlantic (NMFS 2007). Commercial fishermen target king and Spanish mackerel with hook-and-line (i.e., handline, rod-and-reel, and bandit), gillnet, and cast net gears. Recreational fishermen use only rod-and-reel. Trolling is the most common hook-and-line fishing technique used by both commercial and recreational fishermen. A winter troll fishery operates along the east and south Gulf coast. Although run-around gillnets accounted for the majority of the king mackerel catch from the late 1950s through 1982, in 1986, and in 1993, handline gear has been the predominant gear used in the commercial king mackerel fishery since 1993 (NMFS 2007a). The gillnet fishery for king mackerel is restricted to the use of "run-around" gillnets in Gulf to Monroe and Collier Counties in January. Run-around gillnets are still the primary gear used to harvest Spanish mackerel, but the fishery is relatively small because Spanish mackerel are typically more concentrated in state waters where gillnet gear is prohibited. The 2007 opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected only by the gillnet component of the fishery. The continued authorization of the fishery was not expected to jeopardize the continued existence of any of these species and an ITS was provided.

Federal Vessel Activity and Military Operations

Watercraft are the greatest contributors to overall noise in the sea and have the potential to interact with sea turtles though direct impacts or propellers. Sound levels and tones produced are generally related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and vessels underway with a full load, or those pushing or towing a load, are noisier than unladen vessels. Vessels operating at high speeds have the potential to strike sea turtles. Potential sources of adverse effects from federal vessel operations in the action area include operations of the U.S. Department of Defense (DoD), Bureau of Ocean Energy Management (BOEM), Bureau of Safety and Environmental Enforcement (BSEE), Federal Energy Regulatory Commission (FERC), United States Coast Guard (USCG), NOAA, and USACE.

Military

Formal consultations on overall U.S. Navy activities in the southeastern United States have been completed, including: U.S. Navy Atlantic Fleet Sonar Training Activities (AFAST) (January 20, 2011); Navy AFAST LOA 2012-2014: U.S. Navy active sonar training along the Atlantic Coast and Gulf of Mexico (December 19, 2011); and Activities in the Gulf of Mexico Range Complex from November 2010 to November 2015 (March 17 2011). These opinions concluded that although there is a potential from some USN activities to effect sea turtles, those effects were not expected to impact any species on a population level. Therefore, the activities were determined to be not likely to jeopardize the continued existence of any ESA-listed sea turtle species.

Military testing and training may also affect listed species of sea turtles. The air space over the Gulf of Mexico is used extensively by the DoD for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf of Mexico. The western Gulf has four warning areas that are used for military operations.

The areas total approximately 21 million acres (ac) or 58 percent of the area. In addition, six blocks in the western Gulf are used by the Navy for mine warfare testing and training. The central Gulf has five designated military warning areas that are used for military operations. These areas total approximately 11.3 million ac. Portions of the Eglin Water Test Areas (EWTA) comprise an additional 0.5 million ac in the Central Planning Area (CPA). The total 11.8 million ac is about 25 percent of the area of the CPA.

A consultation evaluating the impacts from USAF search-and-rescue training operations in the Gulf of Mexico was completed in 1999 (NMFS 1999). NMFS more recently completed four consultations on Eglin Air Force Base testing and training activities in the GOM. These consultations concluded that the incidental take of sea turtles is likely to occur. These opinions have issued incidental take for these actions: Eglin Gulf Test and Training Range (NMFS 2004a), the Precision Strike Weapons Tests (NMFS 2005b), the Santa Rosa Island Mission Utilization Plan (NMFS 2005c) and Naval Explosive Ordnance Disposal School (NMFS 2004b). These consultations determined the training operations would adversely affect sea turtles but would not jeopardize their continued existence.

Offshore Energy
NMFS has also conducted Section 7 consultations related to energy projects in the Gulf of Mexico [Mineral Management Service (MMS), FERC, and the Maritime Administration] to implement conservation measures for vessel operations. Through the Section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. However, at the present time they present the potential for some level of interaction.

Dredging
Marine dredging vessels are common within U.S. coastal waters. Although the underwater noises from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites ("borrow areas") have been identified as sources of sea turtle mortality. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speeds and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes resting or swimming turtles. Entrained sea turtles rarely survive. NMFS completed a regional opinion on the impacts of USACE's hopper-dredging operation in 2003 for operations in the Gulf of Mexico (NMFS 2007b). In the Gulf of Mexico regional biological opinion (GRBO), NMFS determined that (1) Gulf of Mexico hopper dredging would adversely affect Gulf sturgeon and four sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads) but would not jeopardize their continued existence and (2) dredging in the Gulf of Mexico would not adversely affect leatherback sea turtles, smalltooth sawfish, or ESA-listed large whales. An ITS for those species adversely affected was issued.

The above-listed regional opinion considers maintenance dredging and sand mining operations. Numerous other "free-standing" opinions have been produced that analyzed hopper dredging projects that did not fall (partially or entirely) under the scope of actions contemplated by this regional opinion. Examples include: the dredging of Ship Shoal in the Gulf of Mexico Central

Planning Area for coastal restoration projects [opinion issued to MMS, now Bureau of Ocean Energy Management (BOEM), in 2005 (NMFS 2005d)], East Pass dredging, Destin, Florida [to USACE in 2009 (NMFS 2009)], and dredging of City of Mexico beach canal inlet [to USACE in 2012 (NMFS 2012)]. Each of the above free-standing opinions had its own ITS and determined that hopper dredging during the proposed actions would not jeopardize the continued existence of any species of sea turtles or other listed species, or destroy or adversely modify critical habitat of any listed species.

Oil and Gas Exploration and Extraction
Although oil and gas exploration, production, and development do not occur within the action area, oil and gas activities may indirectly impact protected sea turtles located there. Oil spills and marine debris from nearby oil and gas activities could affect protected turtles within the action area. Many Section 7 consultations have been completed on MMS (now BOEM) oil and gas lease activities. Opinions issued on July 11, 2002 (NMFS 2002b), November 29, 2002 (NMFS 2002c), August 30, 2003 [Lease Sales 189 and 197, (NMFS 2003)], and June 29, 2007 [2007-2012 Five-Year Lease Plan, (NMFS 2007c)] have concluded that sea turtle takes may result from vessel strikes, marine debris, and oil spills.

NMFS's June 29, 2007, opinion issued to MMS concluded that the five-year leasing program for oil and gas development in the coastal and the Western Planning Areas of the Gulf of Mexico. and its associated actions were not likely to jeopardize the continued existence of threatened or endangered species or destroy or adversely modify designated critical habitat. NMFS estimated the number of listed species that could potentially experience adverse effects as the result of exposure to an oil spill over the lifetime of the action. However, as discussed below, on April 20, 2010, a massive oil well explosion, and then subsequent release of oil at DWH MC252 well occurred. Given the effects of the spill, on July 30, 2010, BOEM requested reinitiation of interagency consultation under Section 7 of the ESA on the June 29, 2007, opinion on the Five-Year Outer Continental Shelf Oil and Gas Leasing Program (2007-2012) in the Central and Western Planning Areas of the Gulf of Mexico.

NMFS has begun synthesizing data from the spill, and it is clear that BOEM underestimated the size, frequency, and impacts associated with a catastrophic spill under the 2007-2012 lease sale program. The size and duration of the DWH oil spill were greater than anticipated, and the effects on listed species have exceeded NMFS's projections. However, NMFS has not yet issued an opinion concluding the reinitiated consultation.

The DWH Oil Spill and Recent Increase in Sea Turtle Strandings in the Northern Gulf
On April 20, 2010, while working on an exploratory well approximately 50 miles offshore Louisiana, the semi-submersible drilling rig DWH experienced an explosion and fire. The rig subsequently sank and oil and natural gas began leaking into the Gulf of Mexico. Oil flowed for 86 days, until finally being capped on July 15, 2010. Millions of barrels of oil were released into the Gulf. Additionally, approximately 1.84 million gallons of chemical dispersant was applied both subsurface and on the surface to attempt to break down the oil. There is no question that the unprecedented DWH spill and associated response activities (e.g., skimming, burning, and application of dispersants) have resulted in adverse effects on listed sea turtles.

At this time, the total effects of the oil spill on species found throughout the Gulf of Mexico, including sea turtles, are not known. Potential DWH-related impacts to all sea turtle species include direct oiling or contact with dispersants from surface and subsurface oil and dispersants, inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, loss of foraging resources which could lead to compromised growth and/or reproductive potential, harm to foraging, resting and/or nesting habitats, and disruption of nesting turtles and nests. There is currently an ongoing investigation and analysis being conducted under the Oil Pollution Act (33 U.S.C. 2701 et seq.) to assess natural resource damages and to develop and implement a plan for the restoration, rehabilitation, replacement or acquisition of the equivalent of the injured natural resources. The final outcome of that investigation may not be known for many months to years from the time of this opinion. Consequently, other than some emergency restoration efforts, most restoration efforts that occur pursuant to the Oil Pollution Act have yet to be determined and implemented, and so the ultimate restoration impacts on the species are unknowable at this time.

During the response phase to the DWH oil spill (April 26 – October 20, 2010) a total of 1,146 sea turtles were recovered, either as strandings (dead or debilitated generally onshore or nearshore) or were collected offshore during sea turtle search and rescue operations (Table 2). Subsequent to the response phase a few sea turtles with visible evidence of oiling have been recovered as strandings. The available data on sea turtle strandings and response collections during the time of the spill are expected to represent a fraction (currently unknown) of the actual losses to the species, as most individuals likely were not recovered. The number of strandings does not provide insights into potential sub-lethal impacts that could reduce long-term survival or fecundity of individuals affected. However, it does provide some insight into the potential relative scope of the impact among the sea turtle species in the area.

Table 2. Sea Turtles Recovered in the DWH Spill Response Area (April 26 – October 20, 2010).

Turtle Species	Alive	Dead	Total
Green turtle (*Chelonia mydas*)	172	29	201
Hawksbill turtle (*Eretmochelys imbricata*)	16	0	16
Kemp's ridley turtle (*Lepidochelys kempii*)	328	481	809
Loggerhead turtle (*Caretta caretta*)	21	67	88
Unknown turtle species	0	32	32
Total	537	609	1146

(http://www.nmfs.noaa.gov/pr/health/oilspill/turtles.htm)

Another period of high stranding levels occurred in 2011, similar to that in 2010. Investigations, including necropsies, were undertaken by NMFS to attempt to determine the cause of those strandings. Based on the findings, the two primary considerations for the cause of death of the turtles that were necropsied are forced submergence or acute toxicosis. With regard to acute toxicosis, sea turtle tissue samples were tested for biotoxins of concern in the northern Gulf of

Mexico. Environmental information did not indicate a harmful algal bloom of threat to marine animal health was present in the area. With regard to forced submergence, the only known plausible cause of forced submergence that could explain this event is incidental capture in fishing gear. NMFS has assembled information regarding fisheries operating in the area during and just prior to these strandings. While there is some indication that lack of compliance with existing TED regulations and the operations of other trawl fisheries that do not require TEDs may have occurred in the area at the time of the strandings, direct evidence that those events caused the unusual level of strandings is not available. More information on the stranding event, including number of strandings, locations, and species affected, can be found at http://www.nmfs.noaa.gov/pr/species/turtles/gulfofmexico.htm.

In addition to effects on subadult and adult sea turtles, the 2010 May through September sea turtle nesting season in the northern Gulf may also have been adversely affected by the DWH oil spill. Setting booms to protect beaches, cleanup activities, lights, people, and equipment all may have had unintended effects, such as preventing females from reaching nesting beaches and thereby reducing nesting in the northern Gulf. The spill could have also affected the emergence success of hatchlings from nests along the Gulf coast. In an attempt to reduce the loss of the 2010 northern Gulf cohort, many of nests were relocated to the east coast of Florida to reduce the risk to hatchlings. The survivorship and future nesting success of individuals from one nesting beach being transported to and released at another nesting beach is unknown.

ESA Research Permits

Sea turtles are the focus of research activities authorized by Section 10 permits under the ESA. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, to blood sampling, tissue sampling (biopsy), and performing laparoscopy on intentionally captured sea turtles. The number of authorized takes varies widely depending on the research and species involved, but may involve the taking of hundreds of sea turtles annually. Most takes authorized under these permits are expected to be (and are) nonlethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations. In addition, since issuance of the permit is a federal activity, issuance of the permit by NMFS must also be reviewed for compliance with Section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species or adverse modification of its critical habitat.

4.2.2 State or Private Actions

A number of activities that may indirectly affect protected species within the action area include discharges from wastewater systems, dredging, ocean pumping and disposal, and state fisheries. The impacts from these activities are difficult to measure. However, where possible, conservation actions through the ESA Section 7 process, ESA Section 10 permitting, and state permitting programs are being implemented to monitor or study impacts from these sources.

State Fisheries

Various fishing methods used in state commercial and recreational fisheries, including gillnets, fly nets, trawling, pot fisheries, pound nets, and vertical line are all known to incidentally take sea turtles, but information on these fisheries is sparse (NMFS-SEFSC 2001). Most of the state data are based on extremely low observer coverage, or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem.

Stone Crab Fishery
The commercial component of the fishery is traps; recreational fishers use traps or wade/dive for stone crabs. Of the gears used, only commercial traps are expected to result in adverse effects on ESA-listed species. The number of commercial traps actually in the water is very difficult to estimate, and the number of traps used recreationally is unquantifiable with any degree of accuracy. NMFS completed a Section 7 consultation on the Gulf of Mexico Stone Crab FMP on September 28, 2009 (NMFS 2009) and determined the continued authorization of the fishery would not adversely affect ESA-listed marine mammals, Gulf sturgeon, or adversely affect critical habitat. However, it did conclude the action was likely to adversely affect sea turtles and smalltooth sawfish, but would not jeopardize their continued existence; an ITS was issued for takes in the commercial trap sector of the fishery. On October 28, 2011, NMFS repealed the federal FMP for this fishery, and the fishery is now managed exclusively by the State of Florida.

Recreational Boat Traffic
Data show that vessel traffic is one cause of sea turtle mortality (Lutcavage et al. 1997), Sea Turtle Stranding Database). Stranding data for the U.S. Gulf of Mexico show that vessel-related injuries are noted in stranded sea turtles. Data indicate that live- and dead-stranded sea turtles showing signs of vessel-related injuries continue in a high percentage of stranded sea turtles in coastal regions of the southeastern United States.

4.2.3 Marine Pollution and Environmental Contamination

Sources of pollutants along the action area include atmospheric loading of pollutants such as PCBs, stormwater runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean (e.g., Mississippi River into the Gulf of Mexico), and groundwater and other discharges. Nutrient loading from land-based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo et al. 1986), the impacts of many other anthropogenic toxins have not been investigated.

Coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise and boat traffic can degrade marine habitats used by sea turtles (Colburn et al. 1996). The development of marinas and docks in inshore waters can negatively impact nearshore habitats. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations do not likely affect the more pelagic waters, the species of turtles analyzed in this opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

The Gulf of Mexico is an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (such as the recent DWH oil spill, Ixtoc I oil well blowout and fire in the Bay of Campeche in 1979, and the explosion and destruction of a loaded supertanker, the Mega Borg, near Galveston in 1990). Oil spills can impact wildlife directly through three primary pathways: ingestion – when animals swallow oil particles directly or consume prey items that have been exposed to oil, absorption – when animals come into direct contact with oil, and inhalation – when animals breath volatile organics released from oil or from "dispersants" applied by response teams in an effort to increase the rate of degradation of the oil in seawater. Several aspects of sea turtle biology and behavior place them at particular risk, including the lack of avoidance behavior, indiscriminate feeding in convergence zones, and large pre dive inhalations (Milton et al. 2003). When large quantities of oil enter a body of water, chronic effects such as cancer, and direct mortality of wildlife becomes more likely (Lutcavage et al. 1997). Oil spills in the vicinity of nesting beaches just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts et al. 1982; Lutcavage et al. 1997; Witherington 1999). Continuous low-level exposure to oil in the form of tar balls, slicks, or elevated background concentrations also challenge animals facing other natural and anthropogenic stresses. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease (Keller et al. 2004; Keller et al. 2006). Chronic exposure may not be lethal by itself, but it may impair a turtle's overall fitness so that it is less able to withstand other stressors (Milton et al. 2003).

The earlier life stages of living marine resources are usually at greater risk from an oil spill than adults. This is especially true for hatchlings, since they spend a greater portion of their time at the sea surface than adults; thus, their risk of exposure to floating oil slicks is increased (Lutcavage et al. 1995). One of the reasons might be the simple effects of scale: for example, a given amount of oil may overwhelm a smaller immature organism relative to the larger adult. The metabolic machinery an animal uses to detoxify or cleanse itself of a contaminant may not be fully developed in younger life stages. Also, in early life stages, animals may contain proportionally higher concentrations of lipids, to which many contaminants such as petroleum hydrocarbons bind. Most reports of oiled hatchlings originate from convergence zones, ocean areas where currents meet to form collections of contaminants. These zones aggregate oil slicks where surface currents collide before pushing down and around, and represents a virtually closed system where a smaller weaker sea turtle can easily become trapped (Carr 1987; Witherington 2002). Lutz and Lutcavage (1989) reported that hatchlings have been found apparently starved to death, their beaks and esophagi blocked with tarballs.

Frazier (1980) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell apparently plays an important role in navigation and orientation. A related problem is the possibility that an oil spill impacting nesting beaches may affect the locational imprinting of hatchlings, and thus impair their ability to return to their natal beaches to breed and nest (Milton et al. 2003). Whether hatchlings, juveniles, or adults, tar balls in a turtle's gut are likely to have a variety of effects – starvation from gut blockage, decreased absorption efficiency, absorption of toxins, effects of general intestinal blockage (such as local necrosis or ulceration), interference with fat metabolism, and buoyancy problems caused by the buildup of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats), among others. Also, trapped oil can kill the seagrass beds that turtles feed upon.

Unfortunately, little is known about the effects of dispersants on sea turtles, and such impacts are difficult to predict in the absence of direct testing. While inhaling petroleum vapors can irritate turtles' lungs, dispersants can interfere with lung function through their surfactant (detergent) effect. Dispersant components absorbed through the lungs or gut may affect multiple organ systems, interfering with digestion, respiration, excretion occurring in loggerhead turtle organs and eggs.

Nutrient loading from land-based sources, such as coastal communities and agricultural operations, are known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. An example is the large area of the Louisiana continental shelf with seasonally-depleted oxygen levels (< 2 mg/Liter) is caused by eutrophication from both point and non-point sources. Most aquatic species cannot survive at such low oxygen levels and these areas are known as "dead zones." The oxygen depletion, referred to as hypoxia, begins in late spring, reaches a maximum in mid-summer, and disappears in the fall. Since 1993, the average extent of mid-summer, bottom-water hypoxia in the northern Gulf of Mexico has been approximately 16,000 km^2, approximately twice the average size measured between 1985 and 1992. The hypoxic zone attained a maximum measured extent in 2002, when it was about 22,000 km^2 which is larger than the state of Massachusetts (USGS 2005). The hypoxic zone has impacts on the animals found there, including sea turtles, and the ecosystem-level impacts continue to be investigated.

4.2.4 Conservation and Recovery Actions Shaping the Environmental Baseline

Outreach and Education, Sea Turtle Entanglements, and Rehabilitation
NMFS and cooperating states (including Florida) have established an extensive network of sea turtle stranding participants along the Atlantic and Gulf of Mexico coasts that not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

Sea Turtle Handling and Resuscitation Techniques
NMFS published a final rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear.

A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the U.S. Coast Guard, or any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA [50 CFR 223.206(b)].

5 EFFECTS OF THE ACTION ON SEA TURTLES

In this section of the opinion we assess the effects of the proposed action on the four species of sea turtles identified in Section 3 (green, and Kemp's ridley, leatherback, and loggerhead) as likely to be adversely affected. Potential routes of effects of the proposed action on these species include contact with expendables (ordnance), ordnance detonation, noise disturbance, vessel interactions, and the release of marine debris.

5.1 Vessel interactions

A number of boats (20-25) will be involved with the proposed munitions testing, which could lead to interactions with sea turtles. Vessel traffic, particularly high-speed boats such as enforcement/patrol crafts, can strike sea turtles leading to injury or death; therefore, sea turtles may be affected by the project. However, NMFS believes the risk of vessel strike impacts to listed turtles resulting from the proposed action is low. The operation of 20-25 boats in an area approximately 283 square miles in size will not increase typical boat traffic in the area and will not lead to a higher risk of interactions between turtles and vessels. Munitions testing will occur in a variety of sea states up to wave heights of four feet, but vessel operators are expected to adjust their speed and vigilance based on conditions. Fair weather patterns and calm sea states will allow boaters to observe and avoid any protected species in their paths. Conversely, increased sea states will generally compel vessel operators to decrease speed, which would reduce the risk of an interaction. NMFS believes sea turtles may be affected but are not likely to be adversely affected by vessel strike as the risk of any effect is discountable.

5.2 Contact with expendables

Direct physical contact with expendables or shrapnel can result in physical harm to protected species. Direct physical impacts could result from bombs, gunnery ammunition, and shrapnel from live missiles impacting with animals at or near the surface of the water. Gunnery rounds will comprise the majority of all ordnance in this training (see Table 1). Some ordnance contains high explosives (bombs and missiles), but are analyzed separately in this document (Section 5.4) so all projectiles in this section are considered inert. NMFS believes it is unlikely that sea turtles will be directly impacted by ordnance or shrapnel because (1) the zone of influence (zone where turtles could be exposed to noise or pressure influences) will be surveyed by trained marine species observers prior to each mission, (2) the area in which impacts from falling debris would occur is very small (meters across) and can be monitored for species presence through the camera aboard the instrument barge, and (3) the relatively low densities of marine turtles in the test area (Table 3). Therefore, NMFS believes any effects will be discountable.

5.3 Marine debris

Munitions testing will be conducted on vessel targets which may result in fragments from both munitions and targets being dispersed into the water. These fragments could remain on the surface, enter the water column, or settle to the bottom. Surface debris will be collected by USAF personnel to the extent practicable, but no efforts will be made to collect debris below the surface. Marine debris can be ingested by sea turtles and cause gastrointestinal blockages or damage to internal organs. Sea turtles, especially leatherbacks, may be more susceptible to marine debris ingestion than other species due to the tendency of floating debris to concentrate in convergence zones which adults and juveniles use for feeding areas and migratory routes (Lutcavage et al. 1997, Shoop and Kenney 1992). Floating plastics such as plastic bags are known to be ingested by turtles thus causing injury or death (Mrosovsky et al. 2009). Debris can also result in entrapment or entanglement of sea turtles, though this is more commonly associated with derelict fishing gears. NMFS believes the proposed action may affect, but is not likely to adversely affect turtles through the release of marine debris because (1) the amount of debris will be minimal (relative to other sources of debris and the amount of water in the Gulf) and (2) surface debris will be collected and removed from the water. Therefore, any effects will be insignificant.

Table 3. Adjusted sea turtle densities in the action area as derived from published literature.

Sea Turtle Species	Adjusted Density (turtles/km^2)
Loggerhead[1]	0.423
Kemp's ridley[1]	0.052
Leatherback[1]	0.409
Green[2]	0.17

[1] Garrison 2008. Adjusted for observer and availability bias by author.

[2] Epperly et al. 2002. Not adjusted for sighting or availability bias by author but adjusted by Eglin AFB for this project.

5.4 Ordnance detonation and noise

The detonation of ordnances during the proposed action will result in noise and pressure waves in the water column that can affect marine turtles. Effects can include injury, death, or harassment (behavioral changes). How and to what degree sea turtles are affected depends on the source of the sound/pressure wave, the proximity of sea turtles to the source, and the number of disturbances over time. Animals in close proximity to detonations could be injured or killed as a result of tissue destruction caused by very intense pressure waves. Damage to tissue is most likely to occur where substantial impedance differences occur (e.g., across air/tissue interfaces in the middle ear, sinuses, lungs, and intestines).

Noise from mission activities may elicit a startle reaction from sea turtles and produce temporary, sublethal stress (NRC 1990). Startle reactions may result in increased surfacing, rapid swimming, or diving reactions to an acoustic stimulus (McCauley 2000, Lenhardt 1994). The ambient noise in habitats near mission activities may affect habitat quality such that important biological behaviors may be disrupted (e.g., feeding, mating, and resting), and mission areas may be avoided due to the noise generated. The magnitude of those effects may depend on several factors including the frequency, periodicity, duration, and intensity of the sounds, and the behavior of the animals during the exposure. Lenhardt et al. (1983) suggested that sea turtles use acoustic signals from their environment as guideposts during migration and as a cue to identify their natal beaches. Although there is some evidence that environmental sound may have a functional role in sea turtle behavior, relatively few studies have investigated the functional role of hearing in these species' life history and behavior. There is no information regarding the consequences that these disturbances may have on sea turtles in the long term, but short-term disruption to normal behaviors and temporary abandonment of habitat is likely in response to some noises produced by munitions testing.

While studies have addressed the effects of sound and pressure waves on marine mammals, far less is known about how these effects impact marine turtles. The ear structure of sea turtles (both an aerial and aquatic receptor, Lenhardt 1996) is different from that of cetaceans, and differences in the effects from detonation energy on marine mammals and marine reptiles may be expected. Marine turtles are sensitive to low frequencies, with an effective hearing range between 100 and 1000 Hz (Ridgeway 1969, Lenhardt 1994, Moein 1994, Bartol et al. 1999, Ketten and Bartol 2006). In-water hearing thresholds at frequencies ranging from 100-1000 Hz are 160 to 200 dB re 1μPa (Lenhardt 1994). McCauley et al. (2000) have shown that green and loggerhead turtles noticeably change swimming patterns at sound levels of 166 dB re 1μPa and behavior patterns at 175 dB re 1μPa. However due the general lack of information regarding thresholds for sea turtles, NMFS typically relies upon the thresholds for marine mammals when conducting noise analyses for sea turtles.

The USAF conducted an analysis to determine the effects of ordnance detonation on marine turtles by incorporating three sources of information: (1) zone of influence (ZOI), (2) density of sea turtles in the ZOI, and (3) the number of detonations (Table 1). They defined the ZOI as "the area of ocean in which sea turtles could potentially be exposed to various noise or pressure thresholds associated with exploding ordnances." Turtles in the ZOI may be affected through mortality, injury, or harassment (temporary threshold shifts), each of which is defined by different criteria. To determine the threshold for mortality of sea turtles, the USAF used criteria established by Goertner (1982) for the onset of severe lung injury to marine mammals (30.5 psi-ms). This criterion is dependent on animal mass, so to be conservative the USAF based this threshold on the mass of a dolphin calf. For non-lethal injury, the USAF based the threshold on the onset of slight lung injury associated with a positive impulse level (indexed to 13 psi-ms) from Goetner (1982). The final threshold, non-injurious harassment, was defined as "a temporary, recoverable loss of hearing sensitivity at a particular frequency or frequency range. This threshold is defined by two criteria: (1) an energy flux density of 182 dB re 1 μPa2/sec, and (2) a peak pressure of 23 psi. The USAF calculated the ZOI for behavioral effects using both criteria and then used the more conservative value (182 dB re 1 μPa^2/sec) to estimate the impacts to sea turtles for this project.

The USAF estimated sea turtle densities in the area based on past scientific literature (Table 3). While these studies only account for larger turtles that could be effectively observed, NMFS doesn't expect post-hatchlings or pelagic juveniles to be in the action area. These age classes of sea turtles generally use oceanic gyres and tidal fronts that are located farther offshore (pers. comm. B. Witherington, FWC, to A. Brame, NMFS, via phone 4-4-13). Further, NMFS does not expect post-hatchlings to be transiting through the action area as the hatching of sea turtles in this area occurs later in summer. Loggerhead, Kemp's ridley and leatherback sea turtle densities were estimated from a habitat modeling project conducted within portions of the Eglin Test Training Range (Garrison 2008). This model incorporated aerial survey data and environmental data to predict densities in different portions of the test range and during different months of the year. The USAF used the model to calculate the density of loggerhead and Kemp's ridley's in the month of June when the munitions testing is scheduled. Results of the model for leatherback turtle density in June were outside the acceptable range for the model so results from July were used instead.

The model developed by Garrison (2008) was not successful in predicting green sea turtle densities. Therefore, the USAF used offshore aerial survey data collected by Epperly et al. (2002) to estimate green turtle density for the purpose of this project. This data did not account for sighting or availability bias and may likely represent an underestimation of the true density of green sea turtles in the area. To account for this the USAF adjusted densities provided by Epperly et al. based on a 90 percent dive profile, thereby providing a more likely estimate of their true density in the area.

Table 4 shows the calculated distances from the detonation point to which the impact thresholds will extend. The USAF used these distances to calculate the ZOIs, which they in turn used along with the density estimates and the number of detonations to calculate the number of turtles that could potentially be impacted by the project (Table 5). The potential effects do not consider the mitigation efforts the USAF proposed as part of the project.

Table 4. Distances (radii) to which pressure waves and sound could propagate from the detonation of each proposed ordnance. Values were calculated using the threshold criteria outlined above and reported in meters.

Munition	Height/Depth of Detonation	Mortality Threshold	Injury Threshold	Behavioral Thresholds	
		30.5 psi-msec	13 psi-msec	182 dB EFD	23 psi
GBU-10	Water surface	202	352	1023	1280
GBU-24	Water surface	202	352	1023	1280
GBU-31	Water surface	202	362	1023	1280
(JDAM)	20 feet above water	0	0	0	0
	5 feet underwater	385	700	2084	1281
	10 feet underwater	457	836	2428	1280
GBU-12	Water surface	114	243	744	752
GBU-38	Water surface	114	243	744	752
(JDAM)	20 feet above water	0	0	0	0
	5 feet underwater	239	445	1411	752
	10 feet underwater	279	532	1545	752
GBU-54 (LJDAM)	Water surface	114	243	744	752
AGM-65E/L/K/G2 (Maverick)	Water surface	84	187	618	575
AGM-114 (Hellfire)	Water surface	46	105	425	353
M-117	Water surface	0	0	0	0
	20 feet above water	147	293	847	950
PGU-12 HEI 30 mm	Water surface	0	7	31	60
M56/PGU-28 HEI 20 mm	Water surface	0	0	16	37

Based on the above analysis conducted by the USAF and verified by NMFS, the project could result in the death of one turtle, the injury to two turtles, and the harassment of up to 54 turtles. NMFS believes that either one loggerhead or one leatherback sea turtle may be lethally taken while, up to 21 loggerhead, 23 leatherback, 3 Kemp's ridley, and 8 green sea turtles may be nonlethally taken (by injury or behavioral impacts). However, the risk of damage from ordnance testing can be reduced when observations indicate that there are no sea turtles within the area. The USAF will monitor the area for sea turtles prior to strike missions to reduce the potential for impacts (see Section 2.1).

Table 5. The estimated number of sea turtles that may potentially be affected by the proposed project.

Species	Mortality impacts	Injury impacts	Behavioral impacts
Loggerhead	0.198	0.441	20.542
Kemp's ridley	0.024	0.054	2.525
Leatherback	0.292	0.596	21.938
Green	0.080	0.178	8.255
Total	**0.594**	**1.269**	**53.260**

6 CUMULATIVE EFFECTS

ESA Section 7 regulations require NMFS to consider cumulative effects in formulating their biological opinions (50 CFR 402.14). Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this opinion.

Within the action area, major future changes are not anticipated in the ongoing human activities described in the environmental baseline. The present, major human uses of the action area such as commercial fishing, recreational boating and fishing, and the transport of mineral resources and other waterborne commerce throughout the Gulf of Mexico are expected to continue at the present levels of intensity in the near future as are their associated risks of injury or mortality to listed species posed by incidental capture by fishermen, accidental oil spills, vessel collisions, marine debris, chemical discharges, and anthropogenic noise.

The fisheries described as occurring within the action area (see Section 4, Environmental Baseline) are expected to continue as described into the foreseeable future, concurrent with the proposed action. Numerous fisheries in state waters of the Gulf of Mexico regions have also been known to adversely affect sea turtles. The past and present impacts of these activates have been discussed in the Environmental Baseline section of this opinion. NMFS is not aware of any proposed or anticipated changes in these fisheries (except perhaps the southeastern shrimp fisheries) that would substantially change the impacts each fishery has on sea turtles covered by this opinion.

Oil spills from tankers transporting foreign oil, as well as the illegal discharge of oil and tar from vessels discharging bilge water, will continue to affect water quality in the Gulf of Mexico. Cumulatively, these sources and natural oil seepage contribute most of the oil discharged into the

Gulf of Mexico. Floating tar sampled during the 1970s, when bilge discharge was still legal, concluded that up to 60 percent of the pelagic tars sampled did not originate from the northern Gulf of Mexico coast. In 2010, there was a massive oil well release in the Gulf of Mexico at British Petroleum's DWH well. Official estimates are that million barrels of oil were released into the Gulf. At this time the assessment of total direct impact to sea turtles has not been determined. Additionally, the long-term impacts as a result of habitat impacts, prey loss, and subsurface oil particles and oil components broken down through physical, chemical, and biological processes are not known.

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 many sites with high contaminant concentrations due to the large number of waste discharge point sources. A variety of diseases occur in marine turtles from different pathogens, harmful algal blooms, and increased contaminant loads. Diseases in turtles appear to occur more frequently in turtles that reside in poorly circulating, nearshore waters close to large human populations. The listed species analyzed in this opinion may be exposed to these contaminants, accumulate them (directly or indirectly), and be at an increased risk of disease and mortality during their life cycles.

The level of authorized incidental take in the Gulf of Mexico is expected to continue to increase in the future. Increased pressures from coastal development, pollution, noise, recreational and commercial fisheries, marine transportation, and mineral resource exploration and development is expected to result in increased risks to listed species and the ecosystems on which they depend. Although some unavoidable take is anticipated from future actions, harm avoidance measures are expected to reduce or eliminate many of the takes that may be associated with these actions.

7 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this opinion provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of any ESA-listed sea turtles. In Section 5, we outlined how the proposed action would affect these species at the individual level and the extent of those effects in terms of the number of associated interactions, captures, and mortalities of each species to the extent possible with the best available data. Now we assess each of these species' response to this impact, in terms of overall population effects, and whether those effects of the proposed action, in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize their continued existence.

"To jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly to reduce appreciably the likelihood of both the survival and the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). Thus, in making this conclusion for each species, we typically first look at whether there will be a reduction in the reproduction, numbers, or distribution. Then, if there is a reduction in one or more of these elements, we explore whether it will cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

The NMFS and USFWS' ESA Section 7 Handbook (USFWS and NMFS 1998) defines *survival* and *recovery*, as they apply to the ESA's jeopardy standard. *Survival* means "the species' persistence… beyond the conditions leading to its endangerment, with sufficient resilience to allow recovery from endangerment." Survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a sufficiently large population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter. *Recovery* means "improvement in the status of a listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Recovery is the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities.

NMFS believes that the effects of the proposed action (the lethal take of either one loggerhead or one leatherback and the nonlethal take (by injury or behavioral impacts) of up to 21 loggerhead, 23 leatherback, 3 Kemp's ridley, and 8 green sea turtles by pressure waves associated with the action) are not likely to appreciably reduce either the survival or recovery of these species in the wild. NMFS does not expect the activities associated with the proposed action, when added to ongoing activities affecting these species in the action area and the cumulative effects (Section 6.0), to affect sea turtles in a way that reduces the number of animals born in a particular year (i.e., a specific age-class), the reproductive success of adult sea turtles, or the number of hatchlings that annually recruit into the adult breeding population.

Sea turtles may be taken by the proposed action. The proposed action is not expected to affect foraging habitat, nesting beaches, or introduce any large amounts of substances or debris that may adversely affect sea turtles. The lethal take of one loggerhead or one leatherback is expected to reduce numbers, but this individual is expected to be replaced by recruitment from younger age classes and new individuals into the population nesting beaches. Although a few individuals may be removed each year, the population is believed to be large enough to maintain a viable reproductive population. All life stages are important to the survival and recovery of the species; however, it is important to note that individuals of one life stage are not equivalent to those of other life stages. For example, the take of male juveniles may affect survivorship and recruitment rates into the reproductive population in any given year, and yet not significantly reduce the reproductive potential of the population. However, the death of mature breeding females can have an immediate effect on the reproductive rate of the species. Sub-lethal effects on adult females may also reduce reproduction by hindering foraging success, as sufficient energy reserves are probably necessary for producing multiple clutches of eggs in a breeding year. Different age classes may be subject to relative rates of mortality, resilience, and overall effects of population dynamics.

In the absence of information on absolute numbers and sex ratio of the various age classes, it is difficult to predict the anticipated annual mortality of different age classes from the proposed action. However, the relatively low numbers of takes (lethal take of one loggerhead or one leatherback and the nonlethal take of up to 21 loggerhead, 21 leatherback, 3 Kemp's ridley, and

8 green sea turtles) are not expected to appreciably reduce the numbers found in any given age class, and not all of the expected takes will affect reproduction or recruitment into the population. Because of the expected low number of interactions with the species under consideration, we believe that the effects of the proposed action are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival and recovery of loggerhead, leatherback, Kemp's ridley, or green sea turtles in the wild.

8 CONCLUSION

After reviewing the current status of each species, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is NMFS's biological opinion that the proposed munitions testing may adversely affect sea turtles, but is not likely to jeopardize the continued existence of these species in the wild.

9 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and protective regulations issued pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with RPMs and terms and conditions of the ITS. Take that occurs while not in compliance with the requirements of the proposed action does not constitute authorized incidental take because it is not incidental to an otherwise lawful activity. Accordingly, such take is not covered by the ITS and constitutes unlawful take.

This opinion establishes an ITS with RPMs and terms and conditions for incidental take coverage for sea turtle takes throughout the action area during the proposed munitions testing. However, if new information indicates effects are greater than those anticipated in Section 5.4 that were the basis for our jeopardy analysis in Section 7, consultation must be reinitiated.

9.1 Anticipated Amount or Extent of Incidental Take

NMFS has determined that there is an expected impact to sea turtles in the action area as a result of the pressure waves and noise associated with detonating munitions from test mission activities. The proposed harm avoidance measures (pre- and post-site monitoring) will help reduce the numbers of sea turtle takes during missions. However, the available information still indicates that sea turtles may be harassed, injured, or killed as a result of pressure waves from exploding ordnance associated with the proposed action. Therefore, pursuant to Section 7(b)(4) of the ESA, NMFS anticipates the incidental take of turtles as shown in Table 6. If the actual incidental take exceeds this level at any time during the proposed project, the USAF must immediately reinitiate formal consultation.

9.2 Effect of the Take

NMFS has determined the level of anticipated take associated with the proposed action and exempted from ESA Section 9 take prohibitions in this ITS is not likely to jeopardize the continued existence of green, Kemp's ridley, leatherback, or loggerhead (NWA DPS) sea turtles.

Table 6. Anticipated take associated with the proposed project.

Species	Lethal take	Nonlethal take
Loggerhead	1	21
Kemp's ridley	0	3
Leatherback	1	23
Green	0	8
Total	1*	55

* indicates either one loggerhead or one leatherback

9.3 Reasonable and Prudent Measures

NMFS believes the following RPMs are necessary and appropriate to minimize impacts of incidental take of Kemp's ridley, green, loggerhead, and leatherback sea turtles:

1. The USAF shall avoid areas of sargassum when conducting training missions as sea turtles, especially juveniles, are known to use these habitats.

2. The USAF shall implement monitoring and reporting measures to validate the effectiveness of the measures to reduce impacts to sea turtles resulting from the training missions in the Eglin Gulf Test and Training Range.

9.4 Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the USAF must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting and monitoring requirements. These terms and conditions are nondiscretionary.

1. In conducting pre-mission surveys the USAF shall identify and avoid areas containing sargassum.
2. The USAF shall submit a report to NMFS Southeast Regional Office containing the following information:
   a. The date, time, and description of each mission activity.
   b. The coordinates and water depth of each mission location.
   c. The time pre-mission clearance of the area began and ended, and identification (to species level if possible) and number of any protected species sighted.
   d. Any incidental takes of protected species and their condition at time of sighting/collection. Incidental takes should be immediately reported to NMFS by transmitting take reports to takereport.nmfsser@noaa.gov and referencing the present biop by date, title, and PCTS number. Any takes should also be reported to the STSSN state coordinator, Dr. Alan Foley (904) 696-5904, and the FWC Wildlife Alert Hotline: 1-888-404-FWCC.

3. The USAF shall provide endangered species training and certification to train crew members.

10 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species to help implement recovery plans or to develop information. NMFS believes Department of the Air Force should implement the following conservation recommendations.

1. EAFB should conduct a study of noise and pressure wave propagation for small explosive charges at and just beneath the surface of the water (e.g., live munitions and gunnery rounds). Measurements should be taken that can be used to predict effects to marine life (eggs and larvae, fish, sea turtles, and cetaceans). EAFB should take measurements to characterize pressure, frequency, and sound levels at various distances and depths from the target areas (real or simulated) to document the propagation of pressure waves and sound from project activities, and to develop appropriate parameters to predict effects to marine life.
2. EAFB should develop an observer training program in coordination with NOAA Fisheries to assist pilots and vessel operators with methods to survey, observe, and identify protected species to avoid harm to species protected under the ESA and MMPA during routine missions in the EGTTR.

NMFS requests to be notified if the conservation measures are implemented. This will assist us to evaluate future project effects on sea turtles in the northern Gulf of Mexico.

11 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed munitions testing described and coordinated by the USAF. 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 taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the action may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

12 LITERATURE CITED

Ackerman, R. A. (1997). The nest environment and embryonic development of sea turtles. . The Biology of Sea Turtles. P. L. Lutz and J. A. Musick. New York, CRC Press: 432.

Addison, D. S. (1997). "Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996." Bahamas Journal of Science **5**: 34-35.

Addison, D. S. and B. Morford (1996). "Sea turtle nesting activity on the Cay Sal Bank, Bahamas." Bahamas Journal of Science **3**: 31-36.

Aguilar, R., J. Mas and X. Pastor (1995). Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, Caretta caretta, population in the western Mediterranean. 12th Annual Workshop on Sea Turtle Biology and Conservation, Jekyll Island, Georgia.

Antonelis, G. A., J. D. Baker, T. C. Johanos, R. C. Braun and A. L. Harting (2006). "Hawaiian monk seal (Monachus schauinslandi): status and conservation issues." Atoll Research Bulletin **543**: 75-101.

Arendt, M., J. Byrd, A. Segars, P. Maier, J. Schwenter, D. Burgess, B. Boynton, J. D. Whitaker, L. Ligouri, L. Parker, D. Owens and G. Blanvillain (2009). Examination of local movement and migratory behavior of sea turtles during spring and summer along the Atlantic Coast off the Southeastern United States. South Carolina Department of Natural Resources: 164.

Avens, L. and L. R. Goshe (2007). Skeletochronological analysis of age and growth for leatherback sea turtles in the western North Atlantic. Twenty-seventh Annual Symposium on Sea Turtle Biology and Conservation. , Myrtle Beach, South Carolina, USA. , International Sea Turtle Society.

Baker, J. D., C. L. Littnan and D. W. Johnston (2006). "Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna on the Northwestern Hawaiian Islands. ." Endangered Species Research **2:21-30**.

Balazs, G. (1982). Growth rates of immature green turtles in the Hawaiian Archipelago. Biology and Conservation of Sea Turtles. K. A. Bjorndal. Washington D.C., Smithsonian Institution Press: 117-125.

Balazs, G. H. (1983). Recovery records of adult green turtles observed or originally tagged at French Frigate Shoals, northwestern Hawaiian Islands. Washington, D.C.; Springfield, VA, NMFS.

Balazs, G. H. (1985). Impact of ocean debris on marine turtles: entanglement and ingestion. Proceedings of the workshop on the fate and impact of marine debris, Honolulu, HI, NOAA-NMFS.

Bartol, S.M., J.A. Musick, and M.L. Lenhardt (1999). Auditory evoked potentials of the loggerhead sea turtle (*Caretta caretta)*. Copeia 1999: 836-840.

Baumgartner, M.F., K.D. Mullin, L.N. May, and T.D. Leming. 2001. Cetacean habitats in the northern Gulf of Mexico. Fishery Bulletin **99**:219-239.

Bjorndal, K. A. (1982). "The consequences of herbivory for the life history pattern of the Caribbean green turtle, Chelonia mydas. Pages 111-116 In: Bjorndal, K.A. (editor). Biology and Conservation of Sea Turtles." Smithsonian Institution Press. Washington, D.C.

Bjorndal, K. A., A. B. Bolten and M. Y. Chaloupka (2005). "Evaluating trends in abundance of immature green turtles, Chelonia mydas, in the Greater Caribbean." Ecological Applications **15**(1): 304-314.

Bjorndal, K. A., A. B. Bolten and Southeast Fisheries Science Center (U.S.) (2000). Proceedings of a workshop on Assessing Abundance and Trends for In-Water Sea Turtle Populations : held at the Archie Carr Center for Sea Turtle Research University of Florida, Gainesville, Florida, 24-26 March 2000. Miami, Fla., U.S. Department of commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.

Bjorndal, K. A., J. A. Wetherall, A. B. Bolten and J. A. Mortimer (1999). "Twenty-Six Years of Green Turtle Nesting at Tortuguero, Costa Rica: An Encouraging Trend." Conservation Biology **13**(1): 126-134.

Bolten, A. B., K. A. Bjorndal and H. R. Martins (1994). Life history model for the loggerhead sea turtle (Caretta caretta) populations in the Atlantic: Potential impacts of a longline fishery. NOAA Technical Memo, U.S. Department of Commerce.

Bolten, A. B., K. A. Bjorndal, H. R. Martins, T. Dellinger, M. J. Biscoito, S. E. Encalada and B. W. Bowen (1998). "Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis." Ecological Applications **8**: 1-7.

Bolten, A. B. and B. E. Witherington (2003). Loggerhead sea turtles. Washington, D.C., Smithsonian Books.

Bouchard, S., K. Moran, M. Tiwari, D. Wood, A. Bolten, P. Eliazar and K. Bjorndal (1998). "Effects of Exposed Pilings on Sea Turtle Nesting Activity at Melbourne Beach, Florida." Journal of Coastal Research **14**: 1343-1347.

Bowen, B. W., A. B. Meylan, J. P. Ross, C. J. Limpus, G. H. Balazs and J. C. Avise (1992). "Global Population Structure and Natural History of the Green Turtle (Chelonia mydas) in Terms of Matriarchal Phylogeny." Evolution **46**: 865-881.

Bresette, M. J., D. Singewald and E. D. Maye (2006). Recruitment of post-pelagic green turtles (Chelonia mydas) to nearshore reefs on Florida's east coast. Page 288 In: Frick, M., A. Panagopoulou, A.F. Rees, and K. Williams (compilers). Book of Abstracts. Twenty-sixth annual symposium on sea turtle biology and conservation. International Sea Turtle Society. Athens, Greece.

Caldwell, D. K. and A. Carr (1957). Status of the sea turtle fishery in Florida. Transactions of the 22nd North American Wildlife Conference.

Campbell, C. L. and C. J. Lagueux (2005). "Survival probability estimates for large juvenile and adult green turtles (Chelonia mydas) exposed to an artisanal marine turtle fishery in the western Caribbean." Herpetologica **61**(2).

Carballo, A. Y., C. Olabarria and T. Garza Osuna (2002). "Analysis of four macroalgal assemblages along the Pacific Mexican coast during and after the 1997-98 El Niño." Ecosystems **5**(8): 749-760.

Carr, A. (1984). So Excellent a Fishe. New York, Charles Scribner's Sons.

Carr, A. (1986). New perspectives on the pelagic stage of sea turtle development. NOAA technical memorandum NMFS-SEFC;. Panama City, Fla., National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Panama City Laboratory: 36.

Carr, A. (1987). "Impact of nondegradable marine debris on the ecology and survival outlook of sea turtles." Marine Pollution Bulletin **18**(6, Supplement 2): 352-356.

Chaloupka, M. and G. Balazs (2007). "Using Bayesian state-space modelling to assess the recovery and harvest potential of the Hawaiian green sea turtle stock." Ecological Modelling **205**(1-2): 93-109.

Chaloupka, M. and C. Limpus (2005). "Estimates of sex- and age-class-specific survival probabilities for a southern Great Barrier Reef green sea turtle population." Marine Biology **146**(6): 1251-1261.

Chaloupka, M., K. A. Bjorndal, G. H. Balazs, A. B. Bolten, L. M. Ehrhart, C. J. Limpus, H. Suganuma, S. Troëng, and M. Yamaguchi. (2008). "Encouraging outlook for recovery of a once severely exploited marine megaherbivore." Global Ecology and Biogeography **17**(2): 297-304.

Chaloupka, M., T. M. Work, G. H. Balazs, S. K. K. Murakawa and R. Morris (2008). "Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982-2003)." Marine Biology **154**: 887-898.

Chaloupka, M. Y. and J. A. Musick (1997). Age, growth, and population dynamics. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick. Boca Raton, CRC Press: 233-276.

Colburn, T., D. Dumanoski and J. P. Myers (1996). Our stolen future. New York, Dutton/ Penguin Books.

Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possardt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite and B. E. Witherington (2009). Loggerhead sea turtle (Caretta caretta) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service: 222.

Crouse, D. T. (1999). "Population modeling implications for Caribbean hawksbill sea turtle management. ." Chelonian Conservation and Biology **3**(2): 185-188.

Crowder, L. and S. Heppell (2011). "The Decline and Rise of a Sea Turtle: How Kemp's Ridleys Are Recovering in the Gulf of Mexico." Solutions **2**(1): 67-73.

Daniels, R., T. White and K. Chapman (1993). "Sea-level rise: Destruction of threatened and endangered species habitat in South Carolina." Environmental Management **17**(3): 373-385.

Dellinger, T. and H. Encarnaçâo (2000). Accidental capture of sea turtles by the fishing fleet based at Madeira Island, Portugal. Proceedings of the Nineteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-443.

Dodd, C. K. (1988). Synopsis of the biological data on the loggerhead sea turtle: Caretta caretta (Linnaeus, 1758). Washington, D.C., Fish and Wildlife Service, U.S. Dept. of the Interior.

Doughty, R. W. (1984). "Sea turtles in Texas: a forgotten commerce." Southwestern Historical Quarterly **88**: 43-70.

Dow, W., K. Eckert, M. Palmer and P. Kramer (2007). An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region. Beaufort, North Carolina, The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy: 267.

Duque, V. M., V. M. Paez and J. A. Patino (2000). "Ecología de anidación y conservación de la tortuga cana, Dermochelys coriacea, en la Playona, Golfo de Uraba Chocoano (Colombia), en 1998 " Actualidades Biologicas Medellín **22**(72): 37-53.

Dutton, P. H., G. H. Balazs, R. A. LeRoux, S. K. K. Murakawa, P. Zarate and L. S. Martínez (2008). "Composition of Hawaiian green turtle foraging aggregations: mtDNA evidence for a distinct regional population." Endangered Species Research **5**: 37-44.

Dutton, P. H., E. Bixby and S. K. Davis (1998). Tendency towards single paternity in leatherbacks detected with microsatellites. Proceedings of the 18th International Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-436, Miami, FL, National Marine Fisheries Service.

Dwyer, K. L., C. E. Ryder and R. Prescott (2002). Anthropogenic mortality of leatherback sea turtles in Massachusetts waters. 2002 Northeast Stranding Network Symposium.

Eckert, S. A. (1999). Global distribution of juvenile leatherback turtles, Hubbs Sea World Research Institute Technical Report.

Eckert, S. A., K. L. Eckert, P. Ponganis and G. L. Kooyman (1989). "Diving and foraging behavior of leatherback sea turtles (Dermochelys coriacea)." Can. J. Zool **67**: 2834-2840.

Ehrhart, L. M. (1983). "Marine Turtles of the Indian River Lagoon System." Florida Sci. **46**: 334-346.

Ehrhart, L. M., W. E. Redfoot and D. Bagley (2007). "Marine turtles of the central region of the Indian River Lagoon system." Florida Sci. **70**(4): 415-434.

Ehrhart, L. M. and R. G. Yoder (1978). Marine turtles of Merritt Island National Wildlife Refuge, Kennedy Space Center, Florida. Proceedings of the Florida and Interregional Conference on Sea Turtles, Florida Marine Research Publications.

Epperly, S. P., L. Avens, L. P. Garrison, T. Henwood, W. Hoggard, J. Mitchel, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton and C. Yeung (2002). Analysis of Sea Turtle Bycatch in the Commercial Shrimp Fisheries of the Southeast U.S. Waters and the Gulf of Mexico, U.S. Department of Commerce, NOAA Technical Memorandum: 88.

Epperly, S. P., J. Braun-McNeill and P. M. Richards (2007). "Trends in the catch rates of sea turtles in North Carolina, U.S.A." Endangered Species Research **3**: 283-293.

Epperly, S. P., J. Braun and A. Veishlow (1995a). "Sea Turtles in North Carolina Waters." Conservation Biology **9**(2): 384-394.

Epperly, S. P., J. Braun, A. Chester, F. Cross, J. Merriner and P. Tester (1995b). "Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery." Bulletin of Marine Science **56**(2): 519-540.

Epperly, S. P. and W. Teas (2002). "Turtle excluder devices- are the escape openings large enough? ." Fishery Bulliten **100**(3): 466-474.

Fish, M. R., I. M. Cote, J. A. Gill, A. P. Jones, S. Renshoff and A. R. Watkinson (2005). "Predicting the Impact of Sea-Level Rise on Caribbean Sea Turtle Nesting Habitat." Conservation Biology **19**(2): 482-491.

Fitzsimmons, N. N., L. W. Farrington, M. J. McCann, C. J. Limpus and C. Moritz (2006). Green turtle populations in the Indo-Pacific: a (genetic) view from microsatellites. Proceedings of the Twenty-Third Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-536.

Frazer, N. B. and L. M. Ehrhart (1985). "Preliminary Growth Models for Green, Chelonia mydas, and Loggerhead, Caretta caretta, Turtles in the Wild." Copeia **1985**(1): 73-79.

Frazier, J. G. (1980). Marine turtles and problems in coastal management. Coastal Zone '80: Second Symposium on Coastal and Ocean Management 3, Washington, D.C., American Society of Civil Engineers.

Fretey, J., A. Billes and M. Tiwari (2007). "Leatherback, Dermochelys coriacea, Nesting Along the Atlantic Coast of Africa." Chelonian Conservation and Biology **6**(1): 126-129.

Fritts, T. H., M. A. McGehee, Coastal Ecosystems Project., U.S. Fish and Wildlife Service. Office of Biological Services. and United States. Minerals Management Service. Gulf of Mexico OCS Region. (1982). Effects of petroleum on the development and survival of marine turtle embryos. Washington, D.C., U.S. Dept. of the Interior/Minerals Management Service, Gulf of Mexico Outer Continental Shelf Regional Office.

Garrett, C. (2004). Priority Substances of Interest in the Georgia Basin - Profiles and background information on current toxics issues. Technical Supporting Document. Canadian Toxics Work Group Puget Sound/Georgia Basin International Task Force: 402.

Garrison, L. (2008). Protected Species Habitat Modeling in the Eglin Gulf Test and Training Range. Department of Defense Legacy Resource management Program, Project Number 05-270. Prepared by Dr. Lance Garrison, Southeast Fisheries Science Center, National Marine Fisheries Service.

Gavilan, F. M. (2001). Status and distribution of the loggerhead turtle, (Caretta caretta), in the wider Caribbean region. Marine turtle conservation in the wider Caribbean region: a dialogue for effective regional management. K. L. Eckert and F. A. Abreu Grobois. St. Croix, U.S. Virgin Islands: 36-40.

Geraci, J. R. (1990). Physiological and toxic effects on cetaceans. Sea Mammals and Oil: Confronting the Risks J. R. Geraci and D. J. St. Aubin, Academic Press, Inc.: 167-197.

Girondot, M., A. D. Tucker, P. Rivalan, M. H. Godfrey and J. Chevalier (2002). "Density-dependent nest destruction and population fluctuations of Guianan leatherback turtles." Animal Conservation **5**(1): 75-84.

Gladys Porter Zoo (2008). Final Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, Lepidochelys kempii, on the Coasts of Tamaulipas, Mexico. Brownsville, Texas.

Gladys Porter Zoo (2010). Summary Final Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, Lepidochelys kempii, on the Coasts of Tamaulipas, Mexico. Brownsville, Texas.

Gladys Porter Zoo (2011). Summary Final Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, Lepidochelys kempii, on the Coasts of Tamaulipas, Mexico. Brownsville, Texas.

Glen, F., A. C. Broderick, B. J. Godley and G. C. Hays (2003). "Incubation environment affects phenotype of naturally incubated green turtle hatchlings." Journal of the Marine Biological Association of the UK **83**(05): 1183-1186.

Grant, S. C. H. and P. S. Ross (2002). Southern Resident killer whales at risk: toxic chemicals in the British Columbia and Washington environment. . Fisheries and Oceans Canada. Sidney, B.C., Canadian Technical Report of Fisheries and Aquatic Sciences. **2412:** 124.

Green, D. (1993). "Growth rates of wild immature green turtles in the Galapagos Islands, Ecuador." Journal of Herpetology **27**(3): 338-341.

Guseman, J. L. and L. M. Ehrhart (1992). Ecological geography of Western Atlantic loggerheads and green turtles: evidence from remote tag recoveries. 11th Annual Workshop on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS.

Hartwell, S. I. (2004). "Distribution of DDT in sediments off the central California coast." Marine Pollution Bulletin **49**: 299-305.

Hawkes, L. A., A. C. Broderick, M. H. Godfrey and B. J. Godley (2007). "Investigating the potential impacts of climate change on a marine turtle population." Global Change Biology **13**(5): 923-932.

Hays, G. C., S. Akesson, A. C. Broderick, F. Glen, B. J. Godley, P. Luschi, C. Martin, J. D. Metcalfe and F. Papi (2001). "The diving behaviour of green turtles undertaking oceanic migration to and from Ascension Island: dive durations, dive profiles and depth distribution." Journal of Experimental Biology **204**: 4093-4098.

Hays, G. C., A. C. Broderick, F. Glen, B. J. Godley, J. D. R. Houghton and J. D. Metcalfe (2002). "Water temperature and internesting intervals for loggerhead (Caretta caretta) and green (Chelonia mydas) sea turtles." Journal of Thermal Biology **27**(5): 429-432.

Henwood, T. A. and L. H. Ogren (1987). "Distribution and migrations of immature Kemp's ridley turtles (Lepidochelys kempii) and green turtles (Chelonia mydas) off Florida, Georgia, and South Carolina." Northeast Gulf Science **9**(2): 153-160.

Henwood, T. A. and W. E. Stuntz (1987). "Analysis of sea turtle captures and mortalities during commercial shrimp trawling. ." Fishery Bulliten **85**(4): 813-817.

Heppell, S. S., L. B. Crowder, D. T. Crouse, S. P. Epperly and N. B. Frazer (2003). Population models for Atlantic loggerheads: past, present, and future. Loggerhead Sea Turtles. A. B. Bolten and B. E. Witherington. Washington, Smithsonian Books: 255-273.

Heppell, S. S., D.T. Crouse, L.B. Crowder, S.P. Epperly, W. Gabriel, T. Henwood, R. Marquez and N. B. Thompson (2005). "A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles." Chelonian Conservation and Biology **4**(4): 767-773.

Herbst, L. H. (1994). "Fibropapillomatosis of marine turtles." Annual Review of Fish Diseases **4**: 389-425.

Hildebrand, H. (1982). A historical review of the status of sea turtle populations in the Western Gulf of Mexico. Biology and Conservation of Sea Turtles. K. A. Bjorndal. Washington D.C., Smithsonian Institution Press: 447-453.

Hilterman, M. L. and E. Goverse (2003). Aspects of Nesting and Nest Success of the Leatherback Turtle (Dermochelys coriacea) in Suriname, 2002. Guianas Forests and Environmental Conservation Project (GFECP). Amsterdam, Wildlife Fund Guianas/Biotopic Foundation: 31.

Hirth, H. F. (1971). Synopsis of biological data on the green turtle Chelonia mydas (Linnaeus) 1758. Rome, Food and Agriculture Organization of the United Nations.

Hirth, H. F. and USFWS (1997). Synopsis of the biological data on the green turtle Chelonia mydas (Linnaeus 1758). Washington, D.C., U.S. Fish and Wildlife Service, U.S. Dept. of the Interior.

Houghton, J. D. R., T. K. Doyle, M. W. Wilson, J. Davenport and G. C. Hays (2006). "Jellyfish Aggregations and Leatherback Turtle Foraging Patterns in a Temperate Coastal Environment." Ecology **87**(8): 1967-1972.

Iwata, H., S. Tanabe, N. Sakai and R. Tatsukawa (1993). "Distribution of persistent organochlorines in the oceanic air and surface seawater and the role of ocean on their global transport and fate " Environmental Science and Technology **27**: 1080- 1098.

Jacobson, E. R. (1990). "An update on green turtle fibropapilloma." Marine Turtle Newsletter **49**: 7-8.

Jacobson, E. R., S. B. Simpson and J. P. Sundberg (1991). Fibropapillomas in green turtles. Research Plan for Marine Turtle Fibropapilloma. G. H. Balazs and S. G. Pooley, NOAA: 99-100.

Johnson, S. A. and L. M. Ehrhart (1994). Nest-site fidelity of the Florida green turtle. Proceedings of the 13th Annual Symposium on Sea Turtle Biology and Conservation.

Johnson, S. A. and L. M. Ehrhart (1996). "Reproductive Ecology of the Florida Green Turtle: Clutch Frequency." Journal of Herpetology **30**: 407-410.

Keinath, J. A. (1993). Movements and behavior of wild head-stated sea turtles. Ph.D. Dissertation, College of William and Mary.

Keller, J. M., J. R. Kucklick, M. A. Stamper, C. A. Harms and P. D. McClellan-Green (2004). "Associations between Organochlorine Contaminant Concentrations and Clinical Health Parameters in Loggerhead Sea Turtles from North Carolina, USA." Environmental Health Perspectives **112**: 1074-1079.

Keller, J. M., P. D. McClellan-Green, J. R. Kucklick, D. E. Keil and M. M. Peden-Adams (2006). " Effects of Organochlorine Contaminants on Loggerhead Sea Turtle Immunity: Comparison of a Correlative Field Study and In Vitro Exposure Experiments." Environmental Health Perspect **114**.

Ketten, D. R. and S. M. Bartol (2006). Functional measures of sea turtle hearing. Arlington, VA, Office of Naval Research.

Lagueux, C. (2001). Status and distribution of the green turtle, Chelonia mydas, in the Wider Caribbean Region, pp. 32-35. In: K. L. Eckert and F. A. Abreu Grobois (eds.). 2001 Proceedings of the Regional Meeting: Marine Turtle Conservation in the Wider

Caribbean Region: A Dialogue for Effective Regional Management. Santo Domingo, 16-18 November 1999., WIDECAST, IUCN-MTSG, WWF, UNEP-CEP.

Laurent, L., P. Casale, M. N. Bradai, B. J. Godley, G. Gerosa, A. C. Broderick, W. Schroth, B. Schierwater, A. M. Levy and D. Freggi (1998). "Molecular resolution of marine turtle stock composition in fishery bycatch: a case study in the Mediterranean." Molecular Ecology 7: 1529-1542.

Law, R. J., C.F. Fileman, A.D. Hopkins, J.R. Baker, J. Harwood, D.B. Jackson, S. Kennedy, A.R. Martin and R. J. Morris (1991). "Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles." Marine Pollution Bulletin **22**: 183-191.

Lenhardt, M.L. (1994). Seismic and Very Low frequency sound induced behaviors in captive loggerhead marine turtles (*Caretta caretta*), in *Proceedings, Fourteenth Annual Symposium on Sea Turtle Biology and Conservation,* NOAA Technical Memorandum NMFS-SEFSC-351, Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida, pp 238–241, 32.

Lenhardt, M. L., Bellmund, S., Byles, R. A., Harkins, S. W., and J.A. Musick (1983). "Marine turtle reception of bone-conducted sound." Journal of Auditory Research 23:119-125.

Lewison, R. L., S. A. Freeman and L. B. Crowder (2004). "Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles." Ecology Letters 7: 221-231.

Lutcavage, M. and J. A. Musick (1985). "Aspects of the Biology of Sea Turtles in Virginia." Copeia **1985**(2): 449-456.

Lutcavage, M. E. and P. L. Lutz (1997). Diving Physiology. Biology and conservation of sea turtles. P. L. Lutz and J. A. Musick. Boca Raton, CRC Press: 387-410.

Lutcavage, M. E., P. L. Lutz, G. D. Bossart and D. M. Hudson (1995). "Physiologic and clinicopathologic effects of crude oil on loggerhead sea turtles." Archives of Environmental Contamination and Toxicology **28**(4): 417-422.

Lutcavage, M. E., P. Plotkin, B. Witherington and P. L. Lutz. (1997). Human impacts on sea turtle survival. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick, CRC Press: 432.

Lutz, P. L. and M. Lutcavage (1989). The effects of petroleum on sea turtles: applicability to Kemp's ridley. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. J. C.W. Caillouet and J. A.M. Landry. **105:** 52-54.

Márquez M, R. (1990). Sea turtles of the world : an annotated and illustrated catalogue of sea turtle species known to date. Rome, Food and Agriculture Organization of the United Nations.

Márquez M, R. (1994). Synopsis of biological data on the Kemp's ridley turtle, Lepidochelys kempi (Garman, 1880). Miami, Fla., U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.

Matkin, C. O. and E. Saulitis (1997). Restoration notebook: killer whale (Orcinus orca). Anchorage, Alaska, Exxon Valdez Oil Spill Trustee Council.

McCauley, R. D., J. Fewtrell, A. J. Duncan, C. Jenner, M.-N. Jenner, J. D. Penrose, R. I. T. Prince, A. Adhitya, J. Murdoch, and K. McCabe (2000). Marine seismic surveys: analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid. CMST 163, Report R99-15, prepared for the Australian Petroleum Production Exploration Association from the Centre for Marine Science and Technology, Curtin University, Perth, Western Australia.

McDonald-Dutton, D. and P. H. Dutton (1998). Accelerated growth in San Diego Bay green turtles? Proceedings of the seventeenth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-415., Orlando, FL, National Marine Fisheries Service, Southeast Fisheries Science Center.

McMichael, E., R. R. Carthy and J. A. Seminoff (2003). Evidence of Homing Behavior in Juvenile Green Turtles in the Northeastern Gulf of Mexico. Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFSSEFSC-503., Miami, Fl, National Marine Fisheries Service, Southeast Fisheries Science Center.

Mearns, A. J. (2001). Long-term contaminant trends and patterns in Puget Sound, the Straits of Juan de Fuca, and the Pacific Coast. Puget Sound Research Conference, Olympia, Washington, Puget Sound Action Team.

Meylan, A. B., B. A. Schroeder and A. Mosier (1995). Sea Turtle Nesting Activity in the State of Florida, 1979-1992. St. Petersburg, FL, Florida Dept. of Environmental Protection, Florida Marine Research Institute.

Meylan, A. M., B. Schroeder and A. Mosier (1994). Marine Turtle Nesting Activity in the State of Florida, 1979-1992. Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-351, Hilton Head, SC, National Marine Fisheries Service, Southeast Fisheries Science Center.

Milton, S., P. Lutz and G. Shigenaka (2003). Oil toxicity and impacts on sea turtles. Oil and Sea Turtles: Biology, Planning, and Response. G. Shigenaka, NOAA National Ocean Service: 35-47.

Milton, S. L. and P. L. Lutz (2003). Physiological and Genetic Responses to Environmental Stress. The Biology of Sea Turtles. P. L. Lutz, J. A. Musick and J. Wyneken. Boca Raton, Florida, CRC Press. **2:** 163-197.

Moein, S.E., J.A. Musik, and M.L. Lenhardt (1994). Auditory behavior of the loggerhead sea turtle (*Caretta caretta*). Proceedings of the fourteenth annual symposium on sea turtle biology and conservation. NOAA Tech. Mem. NMFS-351, p. 89.

Morreale, S. J. and E. A. Standora (1998). Early life stage ecology of sea turtles in northeastern U.S. waters. NOAA Technical Memorandum NMFS-SEFSC-413: 49.

Mrosovsky, N. (1981). "Plastic Jellyfish." Marine Turtle Newsletter (17): 5-6.

Mrosovsky, N., G. D. Ryan and M. C. James (2009). "Leatherback turtles: The menace of plastic." Marine Pollution Bulletin **58**: 287-289.

Murphy, T. M. and S. R. Hopkins (1984). Aerial and ground surveys of marine turtle nesting beaches in the southeast region, NMFS-SEFSC.

Musick, J. A. and C. J. Limpus (1997). Habitat utilization and migration in juvenile sea turtles. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick, CRC Press: 432.

NMFS-SEFSC (2001). Stock assessments of loggerhead and leatherback sea turtles: and, an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the western North Atlantic. NOAA technical memorandum NMFS-SEFSC;. Miami, FL, U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center: v, 343 p.

NMFS-SEFSC (2009b). Estimated takes of loggerhead sea turtles in the vertical line component of the Gulf of Mexico reef fish fishery July 2006 through December 2008 based on observer and logbook data. , NMFS Southeast Fisheries Science Center 19.

NMFS-SEFSC (2009d). An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics, NMFS Southeast Fisheries Science Center: 46.

NMFS (1997). ESA Section 7 consultation on the continued hopper dredging of channels and borrow areas in the southeastern United States. Biological Opinion.

NMFS (1999). ESA Section 7 consultation on Moody Air Force Base Search and Rescue Training in the Gulf of Mexico. Biological Opinion.

NMFS (2000). Smalltooth Sawfish Status Review, NMFS, SERO: 73.

NMFS (2002a). ESA Section 7 consultation on Shrimp Trawling in the Southeastern United States, under the Sea Turtle Conservation Regulations and as managed by the Fishery Management Plans for Shrimp in the South Atlantic and Gulf of Mexico. Biological Opinion.

NMFS (2002b). ESA Section 7 consultation on the Proposed Gulf of Mexico Outer Continental Shelf Lease Sale184. Biological Opinion.

NMFS (2002c). ESA Section 7 consultation on Proposed Gulf of Mexico Outer Continental Shelf Multi-Lease Sales (185, 187, 190, 192, 194, 196, 198, 200, 201). Biological Opinion.

NMFS (2003). ESA Section 7 consultation on Gulf of Mexico Outer Continental Shelf oil and gas lease sales 189 and 197. Biological Opinion.

NMFS (2004a). ESA Section 7 consultation on the Eglin Gulf test and training range. Biological Opinion.

NMFS (2004b). ESA Section 7 consultation on Naval Explosive Ordnance Disposal School (NEODS) training, 5-year plan, Eglin AFB, Florida. Biological Opinion.

NMFS (2005a). ESA Section 7 consultation on the continued authorization of reef fish fishing under the Gulf of Mexico Reef Fish Fishery Management Plan and Proposed Amendment 23. Biological Opinion.

NMFS (2005b). ESA Section 7 consultation on Eglin Gulf Test and Training Range, Precision Strike Weapons (PSW) Test (5-Year Plan). Biological Opinion.

NMFS (2005c). ESA Section 7 consultation on the Santa Rosa Island mission utilization plan. Biological opinion.

NMFS (2005d). ESA Section 7 consultation on Dredging (sand mining) of Ship Shoal in the Gulf of Mexico Central Planning Area, South Pelto Blocks 12, 13, 19, and Ship Shoal Block 88 for coastal restoration projects. Biological Opinion.

NMFS (2007a). ESA Section 7 consultation on the Continued Authorization of Fishing under the Fishery Management Plan (FMP) for Coastal Migratory Pelagic Resources in Atlantic and Gulf of Mexico. Biological Opinion

NMFS (2007b). ESA Section 7 consultation on the dredging of Gulf of Mexico navigation channels and sand mining ("borrow") areas using hopper dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts. Second Revised Biological Opinion (November 19, 2003).

NMFS (2007c). ESA Section 7 consultation on Gulf of Mexico Oil and Gas Activities: Five-Year Leasing Plan for Western and Central Planning Areas 2007-2012. Biological Opinion.

NMFS (2009). ESA Section 7 consultation on Operations and Maintenance Dredging of East Pass Navigation Project in Destin, Okaloosa County, Florida. Biological Opinion.

NMFS (2012). ESA Section 7 consultation on City of Mexico Beach Maintenance Dredging of the Mexico Beach Canal Inlet, City of Meixco Beach, St. Andrew Bay Watershed, Bay County, Florida. Biological Opinion.

NMFS and SEFSC (2001). Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic Miami, FL, U.S. Department of Commerce, National Marine Fisheries Service: 46.

NMFS and USFWS (1991). Recovery plan for U.S. population of Atlantic green turtle (Chelonia mydas).

NMFS and USFWS (1992a). Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). U.S. Department of Interior and U.S. Department of Commerce, U.S. Fish and Wildlife Service, National Marine Fisheries Service: 47.

NMFS and USFWS (1992b). Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico. . Washington DC, National Marine Fisheries Service.

NMFS and USFWS (1995). Status reviews for sea turtles listed under the Endangered Species Act of 1973. Silver Spring, MD, National Marine Fisheries Service.

NMFS and USFWS (1998a). Recovery plan for U.S. Pacific populations of the green turtle (Chelonia mydas). Pacific Sea Turtle Recovery Team (U.S.), United States. National Marine Fisheries Service. and U.S. Fish and Wildlife Service. Region 1. Silver Spring, MD, National Marine Fisheries Service: vii, 84 p.

NMFS and USFWS (1998b). Recovery plan for U.S. Pacific populations of the hawksbill turtle (Eretmochelys imbricata). Pacific Sea Turtle Recovery Team (U.S.), United States. National Marine Fisheries Service. and U.S. Fish and Wildlife Service. Region 1. Silver Spring, MD, National Marine Fisheries Service: vii, 82 p.

NMFS and USFWS (1998c). Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle. Prepared by the Pacific Sea Turtle Recovery Team.

NMFS and USFWS (1998d). Recovery plan for U.S. Pacific populations of the loggerhead turtle (Caretta caretta). Pacific Sea Turtle Recovery Team (U.S.), United States. National Marine Fisheries Service. and U.S. Fish and Wildlife Service. Region 1. Silver Spring, MD, National Marine Fisheries Service: vii, 59 p.

NMFS and USFWS (2007a). Green sea turtle (Chelonia mydas) 5-year review: Summary and evaluation. Silver Spring, MD, National Marine Fisheries Service: 102.

NMFS and USFWS (2007b). Kemp's ridley sea turtle (Lepidochelys kempii) 5-year review: Summary and evaluation. Silver Spring, MD, National Marine Fisheries Service: 50.

NMFS and USFWS (2007c). Leatherback sea turtle (Dermochelys coriacea) 5-year review: Summary and evaluation. Silver Spring, MD, National Marine Fisheries Service: 79.

NMFS and USFWS (2007d). Loggerhead sea turtle (Caretta caretta) 5-year review: Summary and evaluation. Silver Spring, MD, National Marine Fisheries Service: 65.

NMFS and USFWS (2008). Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta), Second Revision Silver Spring, MD, National Marine Fisheries Service.

NMFS and USFWS (2010). Unpublished Final Draft Report. Summary Report of a Meeting of the NMFS/USFWS Cross-Agency Working Group on Joint Listing of North Pacific and Northwest Atlantic Loggerhead Turtle Distinct Population Segments. Washington, D.C.

NMFS, USFWS and SEMARNAT (2011). BiNational Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys kempii), Second Revision. Silver Spring, Maryland, National Marine Fisheries Service**:** 156 + appendices.

NRC (1990). Decline of the sea turtles: causes and prevention. Washington DC, National Research Council**:** 274.

Ogren, L. H. (1989). Distribution of juvenile and sub-adult Kemp's ridley sea turtle: Preliminary results from 1984-1987 surveys. First Intl. Symp. on Kemp's Ridley Sea Turtle Biol, Conserv. and Management, Galvaston, TX.

Pike, D. A., R. L. Antworth and J. C. Stiner (2006). "Earlier Nesting Contributes to Shorter Nesting Seasons for the Loggerhead Seaturtle, Caretta caretta." Journal of Herpetology **40**(1): 91-94.

Plotkin, P. (1995). Adult Migrations and Habitat Use. The Biology of Sea Turtles. P. L. Lutz, J. A. Musick and J. Wyneken, CRC Press. **2:** 472.

Pritchard, P. C. H. (1969). "The survival status of Ridley sea-turtles in American waters." Biological Conservation **2**(1): 13-17.

Pritchard, P. C. H. (1971). "The leatherback or leathery turtle, Dermochelys coriacea." IUCN Monogr **1**: 1-39.

Pritchard, P. C. H. (1997). Evolution, Phyolgeny and current status. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick. New York., CRC Press**:** 432.

Rebel, T. P. and R. M. Ingle (1974). Sea turtles and the turtle industry of the West Indies, Florida, and the Gulf of Mexico. Coral Gables, Fla., University of Miami Press.

Reichart, H. A., L. Kelle, L. Laurent, H. L. van de Lande, R. Archer, R. Charels and R. Lieveld (2001). Regional Sea Turtle Conservation Program and Action Plan for the Guiana. Paramaribo, World Wildlife Fund - Guianas Forests and Environmental Conservation Project

Rhodin, A. G. J. (1985). "Comparative Chondro-Osseous Development and Growth of Marine Turtles." Copeia **1985**(3): 752-771.

Ridgway, S. H., E. G. Wever, J. G. McCormick, J. Palin, and J. H. Anderson, 1969. Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Sciences*, Vol 64, pp 884–890.

Sarti Martínez, L., A. R. Barragán, D. García Muñoz, N. García, P. Huerta and F. Vargas (2007). "Conservation and Biology of the Leatherback Turtle in the Mexican Pacific." Chelonian Conservation and Biology **6**(1): 70-78.

Schmid, J. R. and W. N. Witzell (1997). "Age and growth of wild Kemp's ridley turtles (Lepidochelys kempii): cumulative results of tagging studies in Florida." Chelonian Conservation and Biology(2): 532-537.

Schroeder, B. A. and A. M. Foley (1995). Population studies of marine turtles in Florida Bay. Proceedings of the Twelfth Annual Workshop on Sea Turtle Biology and Conservation, NOAA.

Schroeder, B. A., A. M. Foley and D. A. Bagley (2003). Nesting patterns, reproductive migrations, and adult foraging areas of loggerhead turtles. Loggerhead Sea Turtles. A. B. Bolten and B. E. Witherington. Washington, DC. , Smithsonian Institution: 114-124.

Schultz, J. P. (1975). "Sea turtles nesting in Surinam." Zool. Verhand. Leiden(143): 172.

Seminoff, J. A. (2004). Chelonia mydas. 2004 IUCN Red List of Threatened Species.

Shaver, D. J. (1991). "Feeding Ecology of Wild and Head-Started Kemp's Ridley Sea Turtles in South Texas Waters." Journal of Herpetology **25**(3): 327-334.

Shaver, D. J. (1994). "Relative Abundance, Temporal Patterns, and Growth of Sea Turtles at the Mansfield Channel, Texas." Journal of Herpetology **28**(4): 491-497.

Shoop, C. R. and R. D. Kenney (1992). "Seasonal distributions and abundance of loggerhead and leatherback sea turtles in waters of the northeastern United States." Herpetological Monographs **6**: 43-67.

Spotila, J. R., A. E. Dunham, A. J. Leslie, A. C. Steyermark, P. Plotkin and F. V. Paladino (1996). "Worldwide population decline of Dermochelys coriacea: are leatherback turtles going extinct? ." Chelonian Conservation and Biology **2**(2): 209-222.

Spotila, J. R., R. D. Reina, A. C. Steyermark, P. T. Plotkin and F. V. Paladino (2000). "Pacific leatherback turtles face extinction." Nature **405**(6786): 529-530.

Storelli, M. M., G. Barone, A. Storelli and G. O. Marcotrigiano (2008). "Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (Chelonia mydas) from the Mediterranean Sea." Chemosphere **70**: 908-913.

TEWG (1998). An assessment of the Kemp's ridley (Lepidochelys kempii) and loggerhead (Caretta caretta) sea turtle populations in the western North Atlantic, U.S. Dept. Commerce: 115.

TEWG (2000). Assessment update for the kemp's ridley and loggerhead sea turtle populations in the western North Atlantic : a report of the Turtle Expert Working Group. NOAA technical memorandum NMFS-SEFSC ;. Miami, Fla., U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center: xvi, 115 p.

TEWG (2007). An Assessment of the Leatherback Turtle Population in the Atlantic Ocean, NOAA: 116.

TEWG (2009). An Assessment of the Loggerhead Turtle Population in the Western North Atlantic Ocean, NOAA: 131.

Troëng, S., D. Chacón and B. Dick (2004). "Possible decline in leatherback turtle Dermochelys coriacea nesting along the coast of Caribbean Central America " Oryx **38**: 395-403.

Troëng, S. and M. Chaloupka (2007). "Variation in adult annual survival probability and remigration intervals of sea turtles." Marine Biology **151**(5): 1721-1730.

Tucker, A. D. (2010). "Nest site fidelity and clutch frequency of loggerhead turtles are better elucidated by satellite telemetry than by nocturnal tagging efforts: Implications for stock estimation." Journal of Experimental Marine Biology and Ecology **383**(1): 48-55.

USFWS (2000). Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, Lepidochelys kempii, on the Coasts of Tamaulipas and Veracruz, Mexico.

USFWS and NMFS (1998). Endangered Species Consultation Handbook. Procedures for Conducting Section 7 Consultations and Conferences, U.S. Fish and Wildlife Service and National Marine Fisheries Service, March 1998.

USFWS and NMFS (2009). Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) – 5-yr Status Review: 42.

USGS. (2005). "The Gulf of Mexico Hypoxic Zone." from http://toxics.usgs.gov/hypoxia/hypoxic_zone.html.

Vargo, S., P. Lutz, D. Odell, E. V. Vleet and G. Bossart (1986). Effects of oil on marine turtles. Florida Institute of Oceanography. **Volume 2: Technical report:** 180.

Weishampel, J. F., D. A. Bagley and L. M. Ehrhart (2004). "Earlier nesting by loggerhead sea turtles following sea surface warming." Global Change Biology **10**: 1424-1427.

Weishampel, J. F., D. A. Bagley, L. M. Ehrhart and B. L. Rodenbeck (2003). "Spatiotemporal patterns of annual sea turtle nesting behaviors along an East Central Florida beach." Biological Conservation **110**(2): 295-303.

Wershoven, J. L. and R. W. Wershoven (1992). Juvenile green turtles in their nearshore habitat of Broward County, Florida: A five year review. 11th Annual Workshop on Sea Turtle Biology and Conservation, NOAA Technical Memorandum NMFS.

Witherington, B. and L. M. Ehrhart (1989). "Hypothermic stunning and mortality of marine turtles in the Indian River Lagoon system, Florida." Copeia **1989**: 696-703.

Witherington, B., S. Hirama and A. Mosier (2003). Effects of beach armoring structures on marine turtle nesting. Florida Fish and Wildlife Conservation Commission final project report to the U.S. Fish and Wildlife Service, Florida Fish and Wildlife Conservation Commission: 26.

Witherington, B., S. Hirama and A. Mosier (2007). Changes to armoring and other barriers to sea turtle nesting following severe hurricanes striking Florida beaches. Florida Fish and Wildlife Conservation Commission final project report to the U.S. Fish and Wildlife Services, Florida Fish and Wildlife Conservation Commission: 11.

Witherington, B., P. Kubilis, B. Brost and A. Meylan (2009). "Decreasing annual nest counts in a globally important loggerhead sea turtle population." Ecological Applications **19**(1): 30-54.

Witherington, B. E. (1992). "Behavioral responses of nesting sea turtles to artificial lighting." Herpetologica **48**(1): 31-39.

Witherington, B. E. (1999). "Reducing threats to nesting habitat." Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly (editors). Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication **4**: 179-183.

Witherington, B. E. and K. A. Bjorndal (1991). "Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles, Caretta caretta." Biological Conservation **55**(2): 139-149.

Witherington, B. W. (2002). "Ecology of neonate loggerhead turtles inhabiting lines of downwelling near a Gulf Stream front." Marine Biology **140**(4): 843-853.

Witt, M., B. Godley, A. Broderick, R. Penrose and C. S. Martin (2006). Leatherback turtles, jellyfish and climate change in the northwest Atlantic: current situation and possible future scenarios. Twenty-sixth Annual Symposium on Sea Turtle Biology and Conservation.

Witt, M. J., A. Broderick, D. J. Johns, C. S. Martin, R. Penrose, M. S. Hoogmoed and B. Godley (2007). "Prey landscapes help identify foraging habitats for leatherback turtles in the NE Atlantic." Marine Ecology Progress Series(337): 231-243.

Witzell, W. N. (2002). "Immature Atlantic loggerhead turtles (Caretta caretta): suggested changes to the life history model." Herpetological Review **33**(4): 266-269.

Wyneken, J., K. Blair, S. Epperly, J. Vaughn and L. B. Crowder (2004). Surprising sex ratios in west Atlantic loggerhead hatchlings- an unexpected pattern. Poster presentation at the 2004 International Sea Turtle Symposium in San Jose, Costa Rica: 166.

Wyneken, J., S. Eperly, S. Heppell, M. Rogers and L. Crowder (2012). Variable Loggerhead Hatchlings Sex Rations: Are Males Disappering? (Presented 2 Feb 2012, Abstract Number: 4523). Southeast Regional Sea Turtle Meeting Jekyll Island, Georgia.

Zug, G. R. and R. E. Glor (1998). "Estimates of age and growth in a population of green sea turtles (Chelonia mydas) in the Indian River Lagoon system, Florida: a skeletochronological analysis " Canadian Journal of Zoology **76**: 1497-1506.

Zug, G. R. and J. F. Parham (1996). "Age and growth in leatherback turtles, Dermochelys coriacea (Testudines: Dermochelyidae): a skeletochronological analysis." Chelonian Conservation and Biology **2**(2): 244-249.

Zurita, J. C., R. Herrera, A. Arenas, M. E. Torres, C. Calderon, L. Gomez, J. C. Alvarado and R. Villavicencio (2003). Nesting loggerhead and green sea turtles in Quintana Roo, Mexico, Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation, NOAA Tech. Memo. .

13 APPENDIX 1: ANTICIPATED INCIDENTAL TAKE OF ESA-LISTED SPECIES IN NMFS-AUTHORIZED FEDERAL FISHERIES IN THE SOUTHEAST REGION

Table A.1. Fishery Incidental Take Authorized in the Southeast Region

Fishery	ITS Authorization Period	Listed Species					
		Loggerhead	**Leatherback**	**Kemp's Ridley**	**Green**	**Hawksbill**	**Smalltooth Sawfish**
Coastal Migratory Pelagics	3-Year	33-All lethal	2 lethal takes for Leatherbacks, Hawksbill, and Kemp's Ridley-both lethal take		14-All Lethal	See leatherback entry	2 Non-lethal Takes
Gulf of Mexico Reef Fish	3-Year	1,044-No more than 572 lethal	11-All lethal	108-No more than 41 lethal	116-No more than 75 lethal	9-No more than 8 lethal	8 Non-lethal Takes
HMS-Pelagic Longline	3-Year	1,905-No more than 339 lethal	1,764-No more than 252 lethal	105-No more than 18 lethal for these species in combination			None
HMS-Shark	3-Year	679-No more than 346 lethal	74-No more than 47 lethal	2 – No more than 1 lethal	2 – No more than 1 lethal	2 – No more than 1 lethal	51–No more than 1 lethal take
Gulf of Mexico and South Atlantic Spiny Lobster	3-Year	3-Lethal or Non-Lethal Take	1 –Lethal or Non-Lethal take for Leatherbacks, Hawksbill, and Kemp's Ridley		3-Lethal or Non-Lethal Take	1 –Lethal or Non-Lethal take for Leatherbacks, Hawksbill, and Kemp's Ridley	2 Non-lethal Takes

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