UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

JUL 26 2012

To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE: Environmental Assessment for the Issuance of an Incidental Harassment Authorization to Take Marine Mammals by Harassment Incidental to Conducting High-Frequency Sonar Testing Activities in the Naval Surface Warfare Center Panama City Division

LOCATION: Gulf of Mexico

SUMMARY: The National Marine Fisheries Service proposes to issue an Incidental Harassment Authorization (IHA) to the U.S. Navy (Navy) for the taking, by Level B harassment, of marine mammals incidental to high-frequency sonar testing at the Naval Surface Warfare Center Panama City Division in the Gulf of Mexico. NMFS proposes to issue an IHA with mitigation measures, as described in Alternative 2 of the Environmental Assessment.

RESPONSIBLE OFFICIAL: Helen Golde, Acting Director, Office of Protected Resources NMFS/NOAA, 1315 East-West Highway, SSMC-3, Silver Spring, MD 20910

The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI) including the supporting environmental assessment (EA) is enclosed for your information. Although NOAA is not soliciting comments on this completed EA/FONSI we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the responsible official named above.

Sincerely,

for Patricia A. Montanio
NOAA NEPA Coordinator

Enclosure

# ENVIRONMENTAL ASSESSMENT

## FOR THE ISSUANCE OF AN INCIDENTAL HARASSMENT AUTHORIZATION TO TAKE MARINE MAMMALS BY HARASSMENT INCIDENTAL TO CONDUCTING HIGH-FREQUENCY SONAR TESTING ACTIVITIES IN THE NAVAL SURFACE WARFARE CENTER PANAMA CITY DIVISION

July 2012

| | |
|---|---|
| **LEAD AGENCY:** | USDOC, National Oceanic and Atmospheric Administration<br>National Marine Fisheries Service, Office of Protected Resources<br>1315 East West Highway<br>Silver Spring, MD 20910 |
| **RESPONSIBLE OFFICIAL:** | Helen Golde, Acting Director, Office of Protected Resources |
| **FOR INFORMATION CONTACT:** | Office of Protected Resources<br>National Marine Fisheries Service<br>1315 East West Highway<br>Silver Spring, MD 20910<br>(301) 427-8400 |
| **LOCATION:** | Gulf of Mexico |
| **ABSTRACT:** | The National Marine Fisheries Service proposes to issue an Incidental Harassment Authorization (IHA) to the U.S. Navy (Navy) for the taking, by Level B harassment, of marine mammals incidental to testing the AN/AQS-20A Mine Reconnaissance Sonar System (referred to as the Q-20) at the Naval Surface Warfare Center Panama City Division (NSWC PCD) Study Area in the Gulf of Mexico. |

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## List of Acronyms, Abbreviations, and Initialisms

| | |
|---|---|
| AAM | Active Acoustic Monitoring |
| ABR | auditory brainstem response |
| ADD | acoustic deterrence device |
| AHD | acoustic harassment device |
| ATOC | Acoustic Telemetry of Ocean Climate |
| AUTEC | Atlantic Undersea Training and Evaluation Complex |
| BOEM | Bureau of Ocean Energy Management, Regulation and Enforcement |
| BRS | Behavioral Response Studies |
| CAA | Clean Air Act |
| CASS/GRAB | Comprehensive Acoustic Simulation System/Gaussian Ray Bundle |
| CEE | Controlled Exposure Experiment |
| CFR | Code of Federal Regulations |
| CEQ | President's Council on Environmental Quality |
| CZMA | Coastal Zone Management Act |
| CZMP | Coastal Zone Management Plan |
| dB | decibel |
| DLS | Data Link Subsystem |
| EA | Environmental Assessment |
| EEZ | Exclusive Economic Zone |
| EFH | Essential Fish Habitat |
| EIS | Environmental Impact Statement |
| EOID | Electro-Optic Identification Device |
| ESA | Endangered Species Act |
| FEIS | Final Environmental Impact Statement |
| FLS | Forward-Looking Sonar |
| ft | foot/feet |
| FR | Federal Register |
| ETP | Eastern Tropical Pacific |
| GFS | Gap-Filler Sonar |
| GHG | greenhouse gas |
| GMFMC | Gulf of Mexico Fisheries Management Council |
| GOM | Gulf of Mexico |
| GOMEX | U.S. Navy Gulf of Mexico Range Complex |
| HFAS | high-frequency active sonar |
| HZ | hertz |
| IHA | Incidental Harassment Authorization |
| kHz | kilohertz |
| km | kilometer |
| $km^2$ | square kilometer |
| LCS | Littoral Combat Ship |
| LFAS | low-frequency active sonar |
| LIDAR | Light Detection and Ranging |
| m | meter |
| MBTA | Migratory Birds Treaty Act |
| MCM | mine countermeasure |
| MFAS | mid-frequency active sonar |
| mi | mile |

| | |
|---|---|
| MMPA | Marine Mammal Protection Act |
| MMS | Minerals Management Service, currently the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEM) |
| mph | miles per hour |
| MSFCMA | Magnuson-Stevens Fishery Conservation and Management Act |
| NAO | NOAA Administrative Order |
| NDAA | National Defense Authorization Act of 2004 |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| nmi | nautical mile |
| NOAA | National Oceanic and Atmospheric Administration |
| NRC | National Research Council |
| NSWC PCD | Naval Surface Warfare Center Panama City Division |
| OMB | Office of Management and Budget |
| OPR | Office of Protected Resources |
| PAM | Passive Acoustic Monitoring |
| PRN | pseudo-random noise |
| PTS | Permanent Threshold Shift |
| RDT&E | Research, Development, Test and Evaluation |
| RMMV | Remote Multi-Mission Vessel |
| rms | root-mean-square |
| s | second |
| SEL | Sound Exposure Level |
| SLS | Side-Looking Sonar |
| SWAMP | Sperm Whale Acoustic Monitoring Program |
| SWSS | Sperm Whale Seismic Study |
| TACSIT | Tactical Situation |
| TS | Threshold Shift |
| TTS | Temporary Threshold Shift |
| USFWS | United States Fish and Wildlife Service |
| VSS | Volumn Search Sonar |
| μPa | micro pascal |

# CHAPTER 1 PURPOSE AND NEED FOR ACTION

## 1.1 Description of Action

In response to receipt of requests from the U.S. Navy (Navy), the National Marine Fisheries Service (NMFS) proposes to issue an incidental harassment authorization (IHA) that authorizes takes[1] by level B harassment of marine mammals in the wild pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1631 *et seq.*), and the regulations governing the taking and importing of marine mammals (50 Code of Federal Regulations (CFR) Part 216).

This Environmental Assessment (EA), titled "*Environmental Assessment for the Issuance of an Incidental Harassment Authorization to Take Marine Mammals by Harassment Incidental to Conducting High-frequency Sonar Testing Activities in the Naval Surface Warfare Center Panama City Division,*" (hereinafter, the EA) addresses the impacts on the human environment that would result from the issuance of the IHA.

### 1.1.1 BACKGROUND

On December 28, 2011, NMFS received an application from the Navy requesting an authorization for the harassment of marine mammals incidental to conducting testing activities on the AN/AQS-20A Mine Reconnaissance Sonar System (referred to as the Q-20) at the Navy's Naval Surface Warfare Center Panama City Division (NSWC PCD) Study Area in the offshore waters of the Gulf of Mexico (GOM, or the Gulf).

To comply with the MMPA, the Navy has submitted an IHA application due to the presence of marine mammal species in the vicinity of its proposed Q-20 testing area. Marine mammals under NMFS' jurisdiction that could be adversely affected by the proposed sonar testing are:

- Atlantic bottlenose dolphin (*Tursiops truncatus*)
- Pantropical spotted dolphin (*Stenella attenuata*)
- Atlantic spotted dolphin (*S. frontalis*)
- Spinner dolphin (*S. longirostris*)
- Clymene dolphin (*S. clymene*)
- Striped dolphin (*S. coeruleoalba*)

### 1.1.2 PURPOSE AND NEED

The purpose and need of the proposed action is to ensure compliance with the MMPA and its implementing regulations in association with the Navy's proposed Q-20 testing at the NSWC PCD Study Area in the Gulf of Mexico. The MMPA prohibits takes of all marine mammals with certain exceptions.

[1] Take under the MMPA means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. 16 U.S.C. 1362(13).

In response to the receipt of the IHA application from the Navy, NMFS proposes to issue an IHA pursuant to the MMPA §101(a)(5)(D). The primary purpose of the IHA is to provide an exception from the take prohibitions under the MMPA to authorize "takes" by "level B harassment" of marine mammals, incidental to the proposed Q-20 testing activities at the NSWC PCD Study Area by the Navy. The need for the issuance of the IHA is related to NMFS' mandates under the MMPA. Specifically the MMPA prohibits takes of marine mammals, with specific exceptions, including the incidental, but not intentional, taking of marine mammals, for periods of not more than one year, by United States citizens who engage in a specified activity (other than commercial fishing).

IHA issuance criteria require that activities authorized by an IHA will have a negligible impact on the species or stock(s); and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses. In addition, the IHA must set forth the permissible methods of taking, other means of effecting the least practicable adverse impact on the species or stock and its habitat, and requirements for monitoring and reporting of such takings.

Issuance of an IHA is a federal agency action. For purposes of section 7 of the Endangered Species Act of 1973 (ESA; 16 U.S.C. 1531 et seq), NMFS must ensure that its action is not likely to jeopardize the continued existence of any federally-listed species or result in the destruction or adverse modification of critical habitat. In this instance, NMFS has determined that issuance of the IHA will not affect any listed species, and no take of listed species will be authorized by the IHA.

In addition, this EA is prepared in accordance with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.) for the analysis of the potential environmental impacts as the result of the NMFS proposed issuance of the IHA.

## 1.2 Scoping Summary

The purpose of scoping is to identify the issues to be addressed and the significant issues related to the proposed action, as well as identify and eliminate from detailed study the issues that are not significant or that have been covered by prior environmental review. An additional purpose of the scoping process is to identify the concerns of the affected public and Federal agencies, states, and Indian tribes.

The MMPA and its implementing regulations governing issuance of an IHA require that upon receipt of a valid and complete application for an IHA, NMFS publish a notice of receipt or a proposed IHA in the *Federal Register* (50 CFR § 216.104(b)(1)). The notice summarizes the purpose of the requested IHA, includes a statement about what type of NEPA analysis is under consideration, and invites interested parties to submit written comments concerning the application.

NOAA Administrative Order (NAO) 216-6, established agency procedures for complying with NEPA and the implementing regulations issued by the President's Council on Environmental Quality (CEQ). NAO 216-6 specifies that the issuance of an IHA under the MMPA is among a category of actions that require further environmental review and the preparation of NEPA documentation.

### 1.2.1 Comments on Application and EA

On February 28, 2012, NMFS published a notice of a proposed IHA for the Navy's Q-20 testing activities at the NSWC PCD Study in the *Federal Register* (77 FR 12010), which announced the availability of Navy's IHA application for public comment for 30 days. The public comment period for the proposed IHA afforded the public the opportunity to provide input on environmental impacts, many of which are highlighted in this EA. In addition, NMFS will post the final EA and Finding of No Significant Impact (assuming NMFS makes this finding) on http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications.

During the public comment period, NMFS received written comments on the proposed IHA from the following:

- Marine Mammal Commission
- One private citizen

All relevant comments will be addressed and included in the *Federal Register* notice if NMFS decides to issue the IHA.

### 1.2.2 Issues within the Scope of this EA

The EA addresses NMFS' proposal to issue an IHA under Section 101(a)(5)(D) of the MMPA, the alternatives to the proposed action, and the associated environmental impacts. The IHA, if issued, would authorize the harassment of six species of marine mammals incidental to the proposed Q-20 testing activities at the NSWC PCD Study Area in the GOM.

NMFS identified the following issues as relevant to the actions and appropriate for detailed evaluation: (1) disturbance of marine mammals from noises generated by sonar equipment; and (2) disturbance of marine mammals related to the presence of test operation vessels.

**Disturbance from Anthropogenic Noise:** The proposed sonar testing activity would introduce underwater noise from high-frequency sonar, as well as noise from vessels conducting the testing, into the marine ecosystem. These noises are likely to result in behavioral disturbance to marine mammals located in the vicinity of the Study Area.

**Disturbance from Vessel Presence:** The increased amount of vessel activities associated with the proposed Q-20 testing activity also has the potential to result in behavioral disturbance to marine mammals in the vicinity of the Study Area.

## 1.3 Applicable Laws and Necessary Federal Permits, Licenses, and Entitlements

This section summarizes Federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed actions, as well as who is responsible for obtaining them.

### 1.3.1 National Environmental Policy Act

Issuance of an IHA is subject to environmental review under NEPA. NMFS may prepare an EA, an EIS, or determine that the action is categorically excluded from further review. While NEPA does not dictate substantive requirements for an IHA, it requires consideration of environmental issues in Federal agency planning and decision making. The procedural provisions outlining federal agency responsibilities under NEPA are provided in the CEQ's implementing regulations (40 CFR Parts 1500-1508).

NOAA has, through NAO 216-6, established agency procedures for complying with NEPA and the implementing regulations issued by the CEQ. NAO 216-6 specifies that issuance of an IHA under the MMPA and ESA is among a category of actions that require further environmental review. When a proposed action has uncertain environmental impacts or unknown risks, establishes a precedent or decision in principle about future proposals, may result in cumulatively significant impacts, or may have an adverse effect upon endangered or threatened species or their habitats, preparation of an EA or EIS is required. The EA is prepared in accordance with NEPA, CEQ's implementing regulations and NAO 216-6.

### 1.3.2 Endangered Species Act

Section 7 of the ESA and implementing regulations at 50 CFR Part 402 require consultation with the appropriate Federal agency (either NMFS or the U.S. Fish and Wildlife Service, or USFWS) for Federal actions that "may affect" a listed species or critical habitat. NMFS' issuance of an IHA affecting ESA-listed species or designated critical habitat, directly or indirectly, is a Federal action subject to these section 7 consultation requirements. Accordingly, NMFS is required to ensure that its action is not likely to jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of critical habitat for such species.

Based on the analysis of the Navy Marine Resources Assessment (MRA) data on marine mammal distributions, there is near zero probability that ESA-listed sperm whales will occur in the vicinity of the proposed Q-20 test area. No other ESA-listed marine mammal is expected to occur in the vicinity of the test area. In addition, acoustic modeling analysis indicates that none of the ESA-listed marine mammal species would be exposed to levels of sound that would constitute a "take" under the MMPA, due to the low source level and high attenuation rates of the Q-20 sonar signal. Therefore, NMFS has determined that no ESA-listed species would be affected as a result of the proposed Q-20 testing activities.

### 1.3.3 Marine Mammal Protection Act

Section 101(a)(5)(D) of the MMPA (16 U.S.C. 1371(a)(5)(D)) directs the Secretary of Commerce (Secretary) to authorize, upon request, the incidental, but not intentional, taking by harassment of small numbers of marine mammals of a species or population stock, for periods of not more than one year, by United States citizens who engage in a specified activity (other than commercial fishing) within a specific geographic region if certain findings are made and notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such taking are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as: "…an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

The National Defense Authorization Act of 2004 (NDAA) (Public Law 108-136) removed the "small numbers" and "specified geographical region" limitations and amended the definition of "harassment" as it applies to a "military readiness activity" to read as follows (Section 3(18)(B) of the MMPA):

(i) 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

(ii) 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 [Level B Harassment].

Section 101(a)(5)(D) of the MMPA establishes a 45-day time limit for NMFS' review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of small numbers of marine mammals. Not later than 45 days after the close of the public comment period, if the Secretary makes the findings set forth in section 101(a)(5)(D)(i) of the MMPA, the Secretary shall issue the authorization with appropriate conditions to meet the requirements of section 101(a)(5)(D)(ii) of the MMPA.

NMFS has promulgated regulations to implement the permit provisions of the MMPA (50 CFR Part 216) and has produced Office of Management and Budget (OMB)-approved application instructions (OMB Number 0648-0151) that prescribe the procedures (including the form and manner) necessary to apply for permits. All applicants must comply with these regulations and application instructions in addition to the provisions of the MMPA. Applications for an IHA must be submitted according to regulations at 50 CFR §216.104.

### 1.3.4 Magnuson-Stevens Fishery Conservation and Management Act

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), Federal agencies are required to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency which may adversely affect essential fish habitat (EFH) identified under the MSFCMA.

For the proposed Q-20 testing activity at the NSWC PCD Study Area, NMFS and the Navy have determined that no consultation is required because neither issuance of the proposed IHA nor the underlying action would have an adverse effect on EFH.

### 1.3.5 Coastal Zone Management Act

The Federal Coastal Zone Management Act (CZMA) of 1972 authorizes states with approved Coastal Management Plans (CMPs) to review most federal activities and federally permitted activities within or affecting resources within the state's coastal zone to ensure that the activities will be conducted in a manner consistent with their approved CMP.

The proposed action would occur in the non-territorial waters of the Gulf of Mexico and would not have reasonably foreseeable effects on any land or water use or natural resource of the coastal zone; therefore, no consistency determination is necessary under the CZMA.

## 1.4 Description of the Specified Activities

### 1.4.1 Project Overview

**Figure 1-1. The AN/AQS-20A (Q-20)**

The Proposed Action is to test the Q-20 in non-territorial waters of the NSWC PCD Testing Range. The Q-20 uses high-frequency sonar and an Electro-Optic Identification Device (EOID) to locate and identify mines in littoral waters (Figure 1-1). The Q-20 would typically be towed by the Remote Multi-Mission Vehicle (RMMV), which is an autonomous, semi-submersible vehicle currently under development by the Navy. It could occasionally be towed by surrogate platforms such as small range craft or contractor boats, the littoral combat ship (LCS), or, on occasion, a Navy helicopter. Testing would occur from March 2012 through December 2014, with annual testing requirements amounting to approximately 42 mission tests.

### 1.4.2 Project Location

The Proposed Action would be located within a portion of the NSWC PCD Testing Range, identified in Figure 1-2 as the Tactical Situation (TACSIT) Channel, and in adjacent waters that include Target and Operational Test Fields located in Military Warning Area 151 (W-151). The northernmost portion of the TACSIT Channel is located approximately 32 nautical miles (nm; 37 mi) south of the city of Fort Walton Beach and continues for 37 nm (42 mi) in a generally southeastern direction. The test area is located in the northern Gulf of Mexico (GOM) between depths of 100 m and 250 m (330 ft to 820 ft). The Navy would deploy inert mine-like objects within this area to simulate a minefield. Mine shapes already in place for other test activities could also be used. Once an inert mine shape is detected, classified, and identified, the inert mine shape could then be neutralized with a simulated training neutralizer.

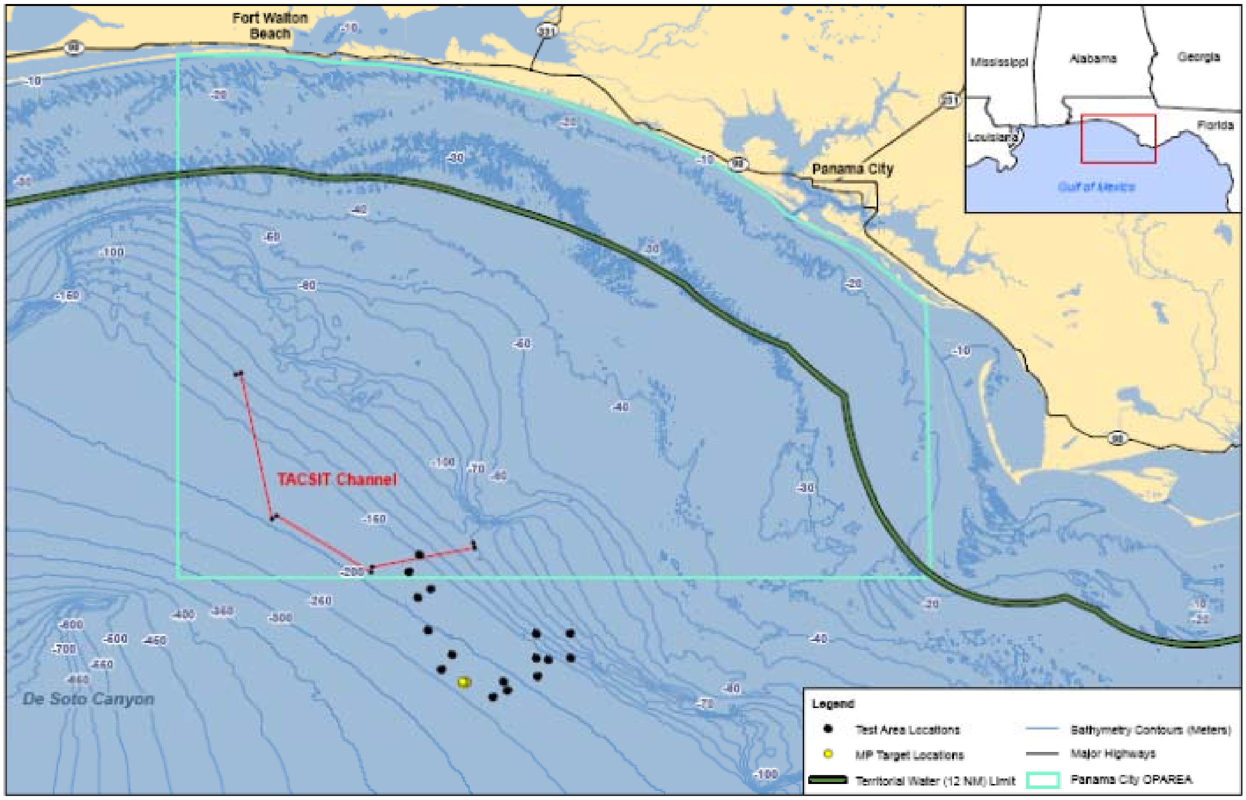


**Figure 1-2. Q-20 testing area.**

Notes:
-NM = Nautical Mile

### 1.4.3 Project Components

#### 1.4.3.1 AN/AQS-20A Mine Reconnaissance Sonar System (Q-20)

The Q-20 has an actively controlled tow body that provides a stable platform for four sonar, and one optical mine reconnaissance, sensors that are used for the detection, classification, localization, and identification of bottom, moored, and volume mines. Active sonars emit acoustic energy specifically to obtain information concerning objects that reflect sound energy.

**Q-20 Sonar Systems:** The Q-20 is equipped with four high frequency (>10 kilohertz [kHz]) sonar systems that are used for mine detection in the water column and along the ocean bottom, high-resolution bottom imaging for navigational purposes, and to minimize risk of collision with sub-surface objects. These sonars are the only active underwater acoustic sources that would be tested during the Proposed Action. The four Q-20 sonar sensors are: (1) Volume Search Sonar (VSS); (2) Side-Looking Sonar (SLS); (3) Forward-Looking Sonar (FLS); and (4) Gap-Filler Sonar (GFS). The VSS and the FLS sonars are the only acoustic sonars that require consideration under the MMPA; the SLS and GFS sonars operate at very high frequencies (greater than 200 kHz), well above the hearing sensitivities of marine mammals, sea turtles, and seabirds.

Specifications for the four sonar arrays are provided in Table 1-1. Sound source levels are in decibels referenced to 1 micro Pascal (dB re 1 μPa) at 1 m.

**Table 1-1. Q-20 Sonar Specifications**

| Sonar Array | Frequency (kHz) | Source Strength (dB re 1 μPa-m) | Directional Exposure |
|---|---|---|---|
| Volume Search Sonar (VSS) | 35 | 212 | Crosstrack beam width: 243° Squint Angle: 0° or 30° |
| Forward-Looking Sonar (FLS) | 85 | 207 | Azimuth: 60° Depression/Elevation: 60° |
| Side-Looking Sonar | > 200 | 216 | Azimuth: 5.6° Depression/Elevation: 14.9° |
| Gap-Filler Sonar (GFS) | > 200 | 190 | Azimuth: +/- 23o Depression/Elevation: 24.6° down |

Note: Source Strength is normalized to a duration of 1 second. Sources above 200 kHz are not required to be modeled for impacts to biological resources. Crosstrack beam width describes the area of the search; squint angle is the angle that the beam may be steered away from the track; azimuth and depression/elevation are parameters describing the angle of the search field and the width of the beam at a given distance from the source.

**Optical Sensor:** Optical testing of the Electro-Optic Identification Device (EOID) would be conducted during test events. The EOID module would be used on the Q-20 tow body to scan and create an image of a mine-like object. The EOID uses a doubled-pulsed laser source for illumination of objects on or above the seabed. Testing would assess the mechanical performance of the EOID, and its functional capability to identify mine-like objects or targets of opportunity in the test area.

#### 1.4.3.2 REMOTE MULTI-MISSION VEHICLE (RMMV)

The RMMV is a diesel-powered, remotely-operated, 7 m sub-surface vehicle that tows the Q-20. The RMMV would be visible at the surface by its snorkel/mast that extends vertically 5 m from the RMMV and 1.8 m above the surface, providing air intake and exhaust for the diesel engine, a platform for the radio frequency antennae, and an operator initiated real-time obstacle avoidance system.

Line-of-sight and over-the-horizon radio frequency telemetry systems (i.e., a Data Link Subsystem [DLS]) would provide command and control of the RMMV and transmit mine reconnaissance sensor data to and from command and control technicians. A team of four people would operate the RMMV and the Q-20 from either the LCS or a range craft: a supervisor would maintain overall responsibility for the test; a Remote Vehicle Operator would operate and monitor the RMMV; a Remote Sensor Operator would operate and monitor the Q-20; and a Mission Logger would capture all commands, results, and metrics for the test. The system could be pre-programmed to perform autonomously, or test operators could manually control and monitor the RMMV and Q-20 via real-time encrypted data communications modes, with response times of 5 – 15 seconds to effect changes in course and speed.

The RMMV would operate at speeds up to 12 knots (13.8 miles per hour [mph]) during testing. Collision avoidance maneuvers would be assessed during test events. Test observers on support vessels would possess the capability to immediately shutdown the RMMV with a kill switch transponder should the need arise to ensure public safety, avoid marine animals or object collisions, prevent entanglements, or prevent loss of the RMMV or the Q-20. The decision to halt operations using the kill switch for safety reasons would be by the authority of the Offshore Lead, the Safety Officer, or other designee, who would be present during the test mission. The RMMV and the Q-20 would be recovered at the conclusion of each mission run.

#### 1.4.3.3 Surface Vessels

Although the RMMV would be the primary vessel used to tow the Q-20 during test events, other range craft, contractor vessels, or a helicopter could potentially be used to tow the Q-20 if the RMMV were unavailable. Other surface vessels would provide field observation and safety support during test events.

### 1.4.4 Q-20 Test Activitiess

This section covers the general test strategy. Tests would include component, subsystem level, and full-scale testing in the operational environment. When the RMMV is used, the RMMV and the Q-20 would be operated by remote command and control systems, and field observation and safety would be provided by support vessels.

Q-20 test events would begin in March of 2012 and would continue through December of 2014. A test event consists of all activities needed to complete the test's objectives, which may or may not involve active Q-20 sonar use. In some instances, a test event may span several days. During such extended events, to conserve fuel and other resources, supporting vessels may remain at sea until the test event is concluded. Regardless of test event objectives, active Q-20 sonar use would not exceed 10 hours in one 24-hour day, and the total number of test days with active sonar use would not exceed 42 days in one year. As such, total active Q-20 sonar use would not exceed 420 hours per year. Light Detection and Ranging (LIDAR) use during a Q-20 mission test event is expected to be approximately 4 minutes.

Each test event would begin by towing or transporting the Q-20, as well as personnel and other equipment (such as the RMMV) as appropriate, to the TACSIT Channel testing site with a range support vessel. Once in place, the system would operate under its own propulsion (e.g., the RMMV's diesel engine) and begin the mission run. The test event would end with a return to the shore facility. Test events would be approximately equally divided between summer and winter months. If a helicopter were to be used to tow the Q-20 during the test, the helicopter would also transport the Q-20 to the test area. Tests at the TACSIT Channel would involve searching the channel for mine-like objects.

Each test event would have the following outline:

1. Transit to track.
    a. RMMV inertial navigation unit alignment (Q-20 not powered on)
    b. Q-20 in-water examination (may involve divers or onboard observers)
    c. Q-20 alignment maneuvering and self-tests (Q-20 powered on; sonar not in use)
2. Track execution (sonar in use)
    a. System follows track of waypoints specific to test mission, with changing parameters such as:

        i. RMMV speed and heading
        ii. Q-20 depth/altitude
        iii. Q-20 sonar mode
        iv. Deploy/retrieve Q-20
    b. Perform reacquisition maneuvers on contacts (mine shapes), if contained in test mission plan
3. Transit from track
    a. Q-20 powered off
    b. Prepare for collection

# CHAPTER 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

The NEPA implementing regulations (40 CFR § 1502.14) and NAO 216-6 provide guidance on the consideration of alternatives to a Federal proposed action and require rigorous exploration and objective evaluation of all reasonable alternatives. Alternatives must be consistent with the purpose and need of the action and be feasible. This chapter describes the range of potential actions (alternatives) determined reasonable with respect to achieving the stated objective, as well as alternatives eliminated from detailed study and also summarizes the expected outputs and any related mitigation of each alternative.

In light of NMFS' stated purpose and need, NMFS considered the following three alternatives for the issuance of an IHA to the Navy to conduct its Q-20 testing activities at the NSWC PCD test area in the non-territorial waters of the Gulf of Mexico.

## 2.1 Alternative 1—No Action Alternative

Under the No Action Alternative, NMFS would not issue an IHA to the Navy for the harassment of marine mammals incidental to conducting Q-20 testing activities at its NSWC PCD test area in the non-territorial waters of the Gulf of Mexico. The MMPA prohibits all takings of marine mammals unless authorized by a permit or exemption under the MMPA. The consequences of not authorizing incidental take are (1) the entity conducting the activity may be in violation of the MMPA if take occurs, (2) mitigation and monitoring measures cannot be required by NMFS, and (3) mitigation measures might not be performed voluntarily by the applicant. By undertaking measures to further protect marine mammals from incidental take through the authorization program, the impacts of these activities on the marine environment can potentially be lessened. While NMFS does not authorize the sonar testing activity itself, NMFS does authorize the incidental harassment of marine mammals in connection with the proposed Q-20 testing activities and prescribes the methods of taking and other means of effecting the least practicable adverse impact on the species and stocks and their habitats. If an IHA is not issued, the Navy could decide either to cancel its Q-20 testing or to continue the activities described in Section 1.4 of this EA. If the latter decision is made, the Navy could independently implement (presently unidentified) mitigation measures; however, it would be proceeding without authorization from NMFS pursuant to the MMPA. If the Navy did not implement mitigation measures during testing activities, takes of marine mammals by harassment (and potentially by injury or mortality) could occur if the activities were conducted when marine mammals were present. Although the No Action Alternative would not meet the purpose and need to allow incidental takings of marine mammals under certain conditions, CEQ regulations require consideration and analysis of a No Action Alternative for the purposes of presenting a comparative analysis to the action alternatives.

## 2.2 Alternative 2—Issuance of an IHA with Required Mitigation, Monitoring, and Reporting Measures (Preferred Alternative)

Under this alternative, NMFS would issue an IHA under section 101(a)(5)(D) of the MMPA to the Navy, allowing the take by Level B harassment of marine mammal species incidental to conducting Q-20 testing activities at the NSWC PCD test area in the non-territorial waters of the Gulf of Mexico. In order to reduce the incidental harassment of marine mammals to the lowest level practicable, the Navy would be required to implement the mitigation, monitoring, and reporting measures described in Chapters 5 and 6 of this EA. The impacts to marine mammals and their habitat that could be anticipated from implementing this alternative are addressed in Chapter 4 of this EA. Since the MMPA requires the holder of an IHA to reduce impacts on marine mammals to the lowest level practicable, implementation of this alternative would meet NMFS' purpose and need as described in this EA.

### 2.3 Alternative 3—Issuance of an IHA with Additional Mitigation and Monitoring Measures

Under Alternative 3, NMFS would issue an IHA under section 101(a)(5)(D) of the MMPA to the Navy, allowing the incidental take by Level B harassment only of marine mammal species incidental to conducting Q-20 testing activities at the NSWC PCD test area in the non-territorial waters of the Gulf of Mexico. While all of the mitigation, monitoring, and reporting measures that would be required under Alternative 2 would also be required under Alternative 3, the difference under this alternative is that additional mitigation and monitoring measures would be required. Additional measures that would be required by NMFS under this alternative include: near real-time passive acoustic monitoring (PAM), active acoustic monitoring (AAM), and the use of aerial monitoring during the Navy's Q-20 testing activities. The effects of implementing Alternative 3 are addressed in Chapter 4 of this EA.

### 2.4 Alternatives Considered but Eliminated from Further Consideration

NMFS considered whether other alternatives could meet the purpose and need and support the Navy's proposed activities. An alternative that would allow for the issuance of an IHA with no required mitigation or monitoring was considered but eliminated from consideration, as it would not be in compliance with the MMPA and therefore would not meet the purpose and need. For that reason, this alternative is not analyzed further in this document.

# CHAPTER 3 AFFECTED ENVIRONMENT

This chapter describes the affected environment relative to physical, biological, and socioeconomic resources found in the proposed action area of the Navy's Q-20 testing area in the Gulf of Mexico.

As stated earlier, the proposed action would be located within a portion of the NSWC PCD Testing Range, identified in Figure 1-2 as the TACSIT Channel, and in adjacent waters that include Targe and Operational Test Fields located in W-151. The northernmost portion of the TACSIT Channel is located approximately 32 nm south of the city of Fort Walton Beach and continues for 37 nm in a generally southeastern direction. The test area is located in the northern Gulf of Mexico between depths of 100 m and 250 m (330 ft to 820 ft).

## 3.1 Physical Environment

### 3.1.1 Geology and Oceanography

Sea floor depth in the non-territorial portion of the NSWC PCD Testing Range ranges from about 30 m to about 300 m. Depth in the immediate project area ranges from about 120 m to 190 m. Bathymetry is characterized by a steepening continental shelf that deepens beyond the boundary of the NSWC PCD Testing Range. Soft bottom areas are the most extensive type of bottom in the NSWC PCD Testing Range. Sand is the predominant substrate throughout the NSWC PCD Testing Range with silt at depths greater than about 100 m. Hard bottom areas are hard or rocky outcroppings or formations that support the growth of algae, sponges, and a few stony coral species. Within the non-territorial waters of the NSWC PCD Testing Range, known hard bottom areas are scattered coral reefs found between 60 m and 90 m that cover 77 $km^2$, less than 1% of the total area (NSWC PCD 2009). Hard bottom areas provide habitat for other animals such as crabs, lobsters, sea anemones, grouper, and snapper. Hard bottom areas are sensitive and can be negatively affected by direct contact or continuous silting from bottom disturbances. One hard bottom area is known to exist at the eastern end of the proposed test area.

No water quality criteria exist for the non-territorial waters, where all activities under the Proposed Action would take place (NSWC PCD 2009). Turbidity in the GOM generally decreases from nearshore to offshore, and bottom turbidities tend to be higher than turbidity levels at the surface. On average, the turbidity levels within the GOM range from 0.05-0.15 nephelometric turbidity units (NTUs) (NSWC PCD 2009). This would equate to a diver having an approximate 23 m (75 ft) of visibility. No water quality data are available for the amount of suspended or dissolved solids (turbidity) caused by current subsurface operations (NSWC PCD 2009).

### 3.1.2 Air Quality

Estimated emissions from a proposed federal action are typically compared with the relevant national and state standards to assess the potential for increases in pollutant concentrations. Impacts would occur if the action alternatives would directly or indirectly produce emissions that would be the primary cause of, or would significantly contribute to, a violation of state or federal ambient air quality standards. Emission thresholds associated with Clean Air Act (CAA) conformity requirements are another means of assessing the significance of air quality impacts. A formal conformity determination would be required for federal actions occurring in nonattainment or maintenance areas when the total direct and indirect stationary and mobile source emissions of nonattainment pollutants or their precursors exceed de minimis thresholds. Areas that violate ambient air quality standards are designated as nonattainment areas. Areas that comply with federal air quality standards are designated as attainment areas. This action would involve testing operations within non-territorial waters of the NSWC PCD Testing Range; therefore, de minimis thresholds and attainment status do not apply. Although the CAA does not apply, the standards provide a point of reference for estimating impacts.

Greenhouse gases (GHGs) are pollutants of concern for air quality and climate change. GHGs include water vapor, carbon dioxide ($CO_2$), methane ($CH_4$), oxides of nitrogen ($NO_x$), ozone ($O_3$), and several chlorofluorocarbons (CFCs). The largest source of manmade CO2 emissions globally is the combustion of fossil fuels such as coal, oil, and gas in power plants, automobiles, industrial facilities, and other sources. Total GHG emissions from a source are often expressed as a $CO_2$ equivalent ($CO_{2e}$).

GHG emissions for an action can be inventoried based on methods prescribed by state and federal agencies. However, the specific contributions of a particular project to global or regional climate change generally cannot be identified based on existing scientific knowledge because individual projects typically have a negligible effect. Also, climate processes are understood at only a general level. Estimates of annual GHG emissions under Alternative 1 are provided in this section (see Chapter 4).

### 3.1.3 Acoustic Environment

The need to understand the marine acoustic environment is critical when assessing the effects of military sonar operations on humans and wildlife. Sounds generated by the Navy sonar within the marine environment can affect its inhabitants' behavior (e.g., deflection from loud sounds) or ability to effectively live in the marine environment (e.g., masking of sounds that could otherwise be heard). Understanding of the existing environment is necessary to evaluate what the potential effects of the proposed activity may be.

This section summarizes the various sources of natural ocean sounds and anthropogenic sounds documented in the ocean and, where available, describes the sound characteristics of these sources and their relevance for the NSWC PCD's Q-20 testing activities.

Ambient sound levels are the result of numerous natural and anthropogenic sounds that can propagate over large distances and vary greatly on a seasonal and spatial scale (National Research Council [NRC] 2003a). Where natural forces dominate, there will be sounds at all frequencies and contributions in ocean sound from a few hundred Hz to 200 kHz (NRC 2003a).

In the offshore waters of the Gulf of Mexico, the main sources of underwater ambient sound would be associated with:

- Wind and wave action

- Precipitation
- Vessel and industrial transit
- Sonar and seismic-survey activities
- Biological sounds

The contribution of these sources to the background sound levels differs with their spectral components and local propagation characteristics (e.g., water depth, temperature, salinity, and ocean bottom conditions). In deep water, low-frequency ambient sound from 1–10 Hz mainly comprises turbulent pressure fluctuations from surface waves and the motion of water at the air-water interfaces. At these infrasonic frequencies, sound levels depend only slightly on wind speed. Between 20–300 Hz, distant anthropogenic sound (ship transiting, etc.) dominates wind-related sounds. Above 300 Hz, the ambient sound level depends on weather conditions, with wind- and wave-related effects mostly dominating sounds. Biological sounds arise from a variety of sources (e.g., marine mammals, fish, and shellfish) and range from approximately 12 Hz to over 100 kHz. The relative strength of biological sounds varies greatly; depending on the situation, biological sound can be nearly absent to dominant over narrow or even broad frequency ranges (Richardson *et al.* 1995).

Typical background sound levels within the ocean are shown as a function of frequency (Figure 3-1; Wenz 1962). The sound levels are given in underwater dB frequency bands written as dB re 1 $\mu Pa^2/Hz$. Sea State or wind speed is the dominant factor in calculating ambient noise levels above 500 Hz.

#### 3.1.3.1 Sources of Natural Ocean Sounds

Sources of natural ocean sounds in the offshore Gulf of Mexico that contribute to the ambient sound levels are from non-biological and biological origins. Examples of non-biological natural sound sources include wind and wave action, surface precipitation, and subsea earthquakes. Biological sources of sound production are fish, marine mammals, and sea birds.

**Non-biological Sound Sources**

Wind and waves are common and interrelated sources of ambient noise in all the world's oceans. Ambient noise levels, defined as the background noise levels from a collection of unidentified sources, tend to increase with increasing wind speed and wave height, other factors being equal (Richardson *et al.* 1995). Therefore, ambient noise is often described in relation to sea state. In 1948, Knudsen et al. summarized typical sound levels versus frequency for sea states 0 – 6, which shows an ambient noise spectrum level with a –5 dB per octave. Thus, for each doubling of frequency above 500 Hz, the ambient noise level in a 1-Hz band typically decreases by 5 dB. Wind speed at the sea surface seems to be directly related to noise production (Wille and Geyer 1984). Their data, from water 30 m deep, indicated that wave height is not as directly relevant to noise levels. Ross (1976) also developed generalized spectra relating spectrum level ambient noise in deep water to wind force and sea state. He indicates that, above 500 Hz, the Knudsen models tend to overestimate the ambient levels at each sea state by a few dB.

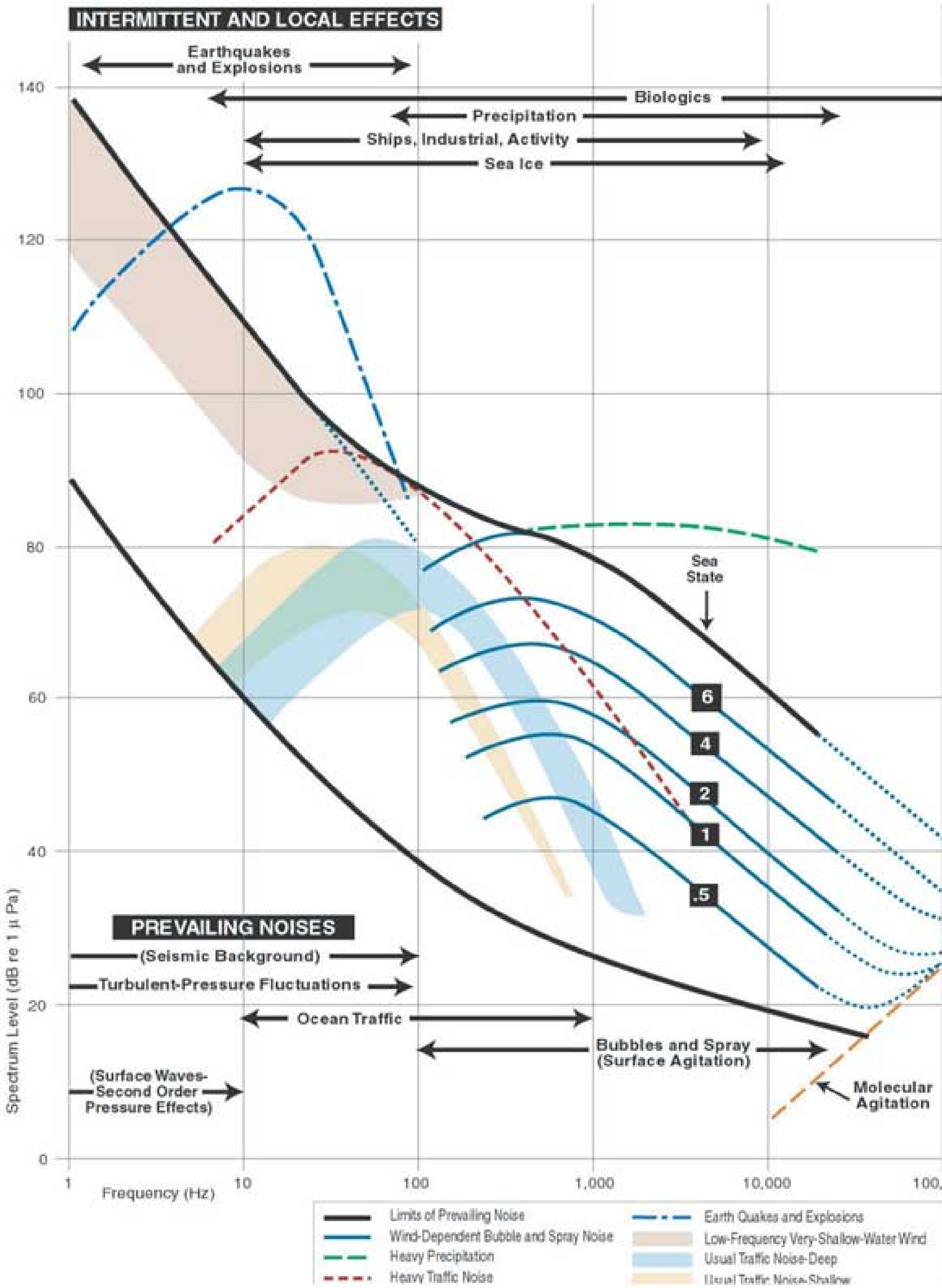


**Figure 3-1. Background sound levels within the ocean (Source: Wenz (1962); adopted from the National Research Council (NRC; 2003a). Ocean Noise and Marine Mammals. National Academy Press. Washington DC).**

Precipitation in the form of rain and snow would be another source of sound. These forms of precipitation can increase ambient sound levels by up to 35 dB across a broad band of frequencies, from 100 Hz to more than 20 kHz (Nystuen and Farmer 1987). In general, it is expected that precipitation in the form of rain would result in greater increases in ambient sound levels than snow. Thus, ocean sounds caused by precipitation are quite variable and transitory.

Seismic events such as earthquakes caused by a sudden shift of tectonic plates, or volcanic events where hydrothermal venting or eruptions occur, can produce a continual source of sound in some areas. This sound can be as much as 30 – 40 dB above background sound and can last from a few seconds to several minutes (Schreiner *et al.* 1995).

**Biological Sound Sources**

The sounds produced by marine life are many and varied. Marine mammals and many fish and marine invertebrates are known to produce sounds (Wenz 1962; Tavolga 1977; Zelick *et al.* 1999).

Fishes produce different types of sounds using different mechanisms and for different reasons. Sounds may be intentionally produced as signals to predators or competitors, to attract mates, or as a fright response. Sounds are also produced unintentionally including those made as a by-product of feeding or swimming. The three main ways fishes produce sounds are by using sonic muscles that are located on or near their swim bladder (drumming); striking or rubbing together skeletal components (stridulation); and by quickly changing speed and direction while swimming (hydrodynamics). The majority of sounds produced by fishes are of low frequency, typically less than 1,000 Hz.

Marine mammals can contribute significantly to the ambient sound levels in the acoustic environment of the ocean. Underwater sounds of baleen whales are primarily at frequencies below 1 kHz and have durations from approximately ½ s to over 1 s and sometimes longer. Some have fundamental frequencies as low as 20 Hz (e.g., fin whale). Many toothed whales produce both short clicks for echolocation and frequency modulated whistles for communication. However, calls by the sperm whales are only clicks, which function both as communication signals as well as echolocation, and can propagate well to long distances.

### 3.1.3.2 Sources of Anthropogenic Sounds

Human sources include noise from vessels (motor boats used for subsistence and local transportation, commercial shipping, research vessels, etc.); navigation and scientific research equipment; airplanes and helicopters; human settlements; military activities; and marine development. Table 3-1 provides a comparison of manmade sound levels from various sources associated with the marine environment.

**Vessel Activities and Traffic**

Shipping is the dominant source of sound in the world's oceans in the range from 5 to a few hundred Hz (National Academy of Sciences 2005). Commercial shipping is the major contributor to sound in the world's oceans and contributes to the 10 – 100 Hz frequency band (NRC 2003a). Some of the more intense anthropogenic sounds come from oceangoing vessels, especially larger ships such as supertankers. Shipping noise, often at source levels of 150 - 190 dB, dominates the low frequency regime of the spectrum. It is estimated that over the past few decades the shipping contribution to ambient noise has increased by as much as 12 dB (Hildebrand 2009).

The types of vessels that are commonly found in the Gulf of Mexico include container ships and oil tankers, cruise ships, fishing boats, recreational vessels such as skiffs with outboard motors or smaller pleasure boats, and vessels associated with oil and gas exploration and development, predominately seismic source vessels, support vessels, and drill ships.

**Table 3-1. A Comparison of Most Common Anthropogenic Sound Levels from Various Sources**

| Source | Activities | dB at source |
|---|---|---|
| ***Vessel Activity*** | | |
| | Tug Pulling Barge | 171 |
| | Fishing Boat | 151-158 |
| | Zodiac (outboard) | 156 |
| | Supply Ship | 181 |
| | Tankers | 169-180 |
| | Supertankers | 185-190 |
| | Freighter | 172 |
| ***Dredging*** | | |
| | Clamshell Dredge | 150-162 |
| | *Aquarius* (cutter suction dredge) | 185 |
| | *Beaver Mackenzie* Dredge | 172 |
| ***Seismic and Marine Surveys*** | | |
| | Airgun Arrays | 235-259 |
| | Single Airguns | 216-232 |
| | Water Guns | 217-245 |
| | Sparker | 221 |
| | Boomer | 212 |
| | Depth Sounder | 180 |
| | Sub-bottom Profiler | 200-230 |
| | Side-scan Sonar | 220-230 |
| | Military | 200-230 |

Sources: Richardson *et al.* 1995.

In shallow water, vessels more than 10 km away from a receiver generally contribute only to background noise (Richardson *et al.* 1995). In deep water, traffic noise up to 4,000 km away may contribute to background-noise levels (Richardson *et al.* 1995). Shipping traffic is most significant at frequencies from 20 - 300 Hz (Richardson *et al.* 1995). Fishing boats in coastal regions also contribute sound to the overall ambient noise. Sound produced by these smaller boats typically is at a higher frequency, around 300 Hz (Richardson *et al.* 1995).

**Industrial Activities**

Dredging and construction are common activities within the coastal waters of the GOM. Dredge vessels produce sounds that are continuous in duration and strongest at low frequencies and vary depending on the type of dredge (Greene 1985; 1987). Sounds derived from onshore construction activities are most likely present only within shallow waters, but depending on the specific activity may have the potential to propagate into coastal waters as well (Richardson *et al.* 1995).

Offshore drilling and oil production includes a variety of activities that emit underwater sound. Sounds generated by drilling activities from fixed, metal-legged platforms are not very intense and are typically at very low frequencies (Richardson *et at.* 1995). Similarly, sound associated with offshore oil and gas production also tends to be weak and at very low frequencies (Gales 1982).

Oil and gas operations also have the need for support activities such as supply/anchor handling and crew boats and helicopters. Sounds produced by these activities are the same as those for small vessels and aircraft as discussed above.

Seismic surveys are used to find oil and gas reservoirs below the surface of the seafloor (MMS 2007a). These activities utilize direct high-intensity, low-frequency sound waves through layers of rock, which are then reflected back and recorded and processed to give information about the structure and composition of the subsurface geological formations. Airguns typically perform these operations and are used in sets or arrays, and are therefore the most common source of seismic survey noise. Even though airgun pulses are directed downward towards the seafloor, the sound can propagate horizontally for over 100 km (54 nm) in deep waters (Richardson *et al.* 1995).

**Miscellaneous Sources**

Acoustical systems are associated with some research, military, commercial, or other vessel use of the Beaufort or Chukchi seas. Such systems include multibeam sonar, sub-bottom profilers, and acoustic Doppler current profilers. Active sonar is used for the detection of objects underwater. These range from depth-finding sonar, found on most ships and boats, to powerful and sophisticated units used by the military. Sonar emits transient, and often intense, sounds that vary widely in intensity and frequency. Acoustic pingers used for locating and positioning oceanographic and geophysical equipment also generate noise at high frequencies.

Underwater explosions are used for both military testing and non-military activities, such as offshore structure removals. They are the strongest point sources of anthropogenic sound in the GOM. Explosives produce initial shock waves that later become conventional acoustic pulses as they propagate.

## 3.2 Biological Environment

### 3.2.1 Plankton Community

A variety of plankton species are distributed throughout the GOM and in its adjacent bays. This community is composed of organisms moved about passively by drifting or floating with the ocean currents. In general, this group of organisms is very small or microscopic, although there are exceptions. Jellyfish and pelagic (open ocean) Sargassum, for example, are unable to move against the surrounding currents and therefore are considered plankton even though some jellyfish can grow to 3 m (9.8 ft) in diameter (DON 2007). Plankton include bacterioplankton (bacteria), zooplankton (animals) including ichthyoplankton (larval fish), phytoplankton (plant-like organisms), and virioplankton (viruses). Zooplankton are tiny, free-floating animals that provide an important link between phytoplankton and higher trophic levels, including fish and marine mammals (Steidinger 1973). Of these plankton species, virioplankton dominate the communities in most aquatic systems (Wommack and Colwell 2000).

### 3.2.2 Invertebrate

There are over 50,000 different species of marine invertebrates, including crustaceans, cephalopods, mollusks, sponges, and corals, among many others. They can range in size from less than a single millimeter to several meters long, or even bigger. Marine invertebrate habitats range from intertidal zones to the deep sea and everywhere in between (NSWC PCD 2009). Oceanic invertebrates include benthic fauna associated with the sediments as well as free-swimming animals that live on the ocean floor or float in the water column. Benthic invertebrates include the infauna, which are animals living in the substrate (such as burrowing worms and mollusks), and the epifauna, which are animals that live on the substrate (such as mollusks, crustaceans, hydroids, sponges, and echinoderms). Free swimming invertebrates include cephalopods (such as octopus and squid) and jellyfish.

The benthic fauna of the offshore NSWC PCD Study Area are characteristic of temperate species found in sandy substrates. Benthic habitats, or substrates, of the northeastern GOM differ from other GOM regions, mainly due to lack of deposits from the Mississippi River. The eastern GOM has a primary substrate of thin sand layers and hard-bottom over carbonate rock. This substrate supports a diverse collection of epifauna, which are derived from the more southern tropical areas. A greater array of hard-bottom epibiotic (relic, or a remnant of old living hard-bottom) substrate is found off the southwest Florida shelf due to a more tropical climate.

At least 1,497 species of invertebrate epibiota (organisms living on the substrate), including mollusks (20%), crustaceans (19%), cnidarians (10%), echinoderms (8%), sponges (6%), and others (11%) have been collected from live-bottom stations on the Florida shelf. Non-invertebrate groups, fish (15%), and algae (11%) account for the rest of epibiotic species. More than 90% of sponges and 53% of scleractinian coral have been identified (Phillips *et al.* 1990).

### 3.2.3 Fish, Fishery Resources, and Essential Fish Habitat

This section focuses on offshore marine fish/fishery resources and habitats occurring in the NSWC PCD Testing Range in the Gulf of Mexico. The proposed Q-20 testing activities would be conducted in non-territorial waters of the GOM and, therefore, would not impact freshwater habitats.

#### 3.2.3.1 Marine Fish

Over 550 species of fish are found in the GOM (NSWC PCD 2009). These fish are taxonomically and ecologically diverse. Marine fish occupy an important part of the marine food chain, and serve as prey for many other species including other fish, seabirds, and marine mammals. Some species are economically important and support recreational and commercial fisheries.

**Table 3-2. Typical Fish Assemblages in the NSWC PCD Testing Range**

| ***Habitat Type*** | ***Examples of Fish Supported*** |
|---|---|
| Reef | Triggerfish<br>Jacks<br>Wrasses<br>Snapper<br>Grouper<br>Surgeon fish<br>Parrotfish<br>Damselfish |
| Sea floor<br>(Areas of vertical relief) | Seabass<br>Damselfish<br>Porgis<br>Snapper |
| Open water of the GOM | Coastal migratory pelagic fish<br>Mackerel<br>Cobia<br>Cero<br>Little tunny<br>Dolphinfish (Mahi-mahi)<br>Bluefish<br>Pelagic offshore fish<br>Atlantic spadefish<br>Tomtate<br>Gray snapper<br>Blue angelfish<br>Belted sandfish<br>Cubbyu<br>White grunt |

Fish may be characterized by where they live in the water column (Table 3-2). Benthic and reef fish live at the bottom of waters and around artificial or natural reef systems. Pelagic fish spend most of their lives in the open waters of the GOM and make seasonal, latitudinal migrations along the west coast of Florida. These migrations are caused by seasonal changes in temperature, movement of their food resources, and spawning instincts. Predatory species such as jacks, bluefish, cobia, and King and Spanish mackerels leave their wintering areas in south Florida to move northward in the spring along the continental shelf possibly due to the presence of large congregations of prey species in those areas, such as herring and menhaden. These species spawn over the continental shelf from northwestern Florida to the northwestern GOM off of Texas (NSWC PCD 2009). Oceanic pelagic species are mainly found beyond the continental shelf off of the west coast of Florida but move through the Florida Straits into the Atlantic Ocean after spawning. Billfish, which include black marlin, white marlin, sailfish, and swordfish, spawn off northwestern Florida in areas beyond the continental shelf (NSWC PCD 2009). Table 3-2 summarizes the habitats and associated features and functions found within the NSWC PCD Testing Range and provides examples of fish assemblages that occur within each habitat type.

Two fish species in the GOM are protected under the ESA. No fish species in the GOM is presently a candidate under the ESA. The subadult and adult Gulf sturgeon (*Acipenser oxyrinchus desotoi*) are currently listed as a threatened species, and the smalltooth sawfish (*Pristis pectinata*) is currently listed as an endangered species.

Gulf sturgeon subadults and adults may be found in the nearshore marine waters within close proximity to the boundary of the eastern GOM, particularly along the northern GOM. The Gulf sturgeon in this area has been observed 1.9 km (1 nm) from shore (Ross *et al.* 2002). The Gulf sturgeon is not expected to be present in the testing areas since it is a coastal inhabitant. Critical habitat was designated for the Gulf sturgeon in March 2003 (Department of the Interior and Department of Commerce 2003). Critical habitat is delineated along the nearshore waters of Florida from St. Joseph Bay to Pensacola Bay and includes Panama City's coastal waters of the GOM and extends from the mean high water line to 1.6 km (0.9 mi) offshore. Critical habitat for the Gulf sturgeon is far inshore of non-territorial waters in the NSWC PCD Testing Range.

The smalltooth sawfish, once common throughout the GOM from Texas to Florida, currently ranges primarily throughout peninsular and southern Florida and is only likely to be found in the Everglades region. It is usually found in shallow waters close to shore in sheltered bays and in estuaries or river mouths. The smalltooth sawfish is not expected to be present within the proposed action area. NMFS designated critical habitat for the smalltooth sawfish in September 2009 (NMFS 2009) in the southern and southwest portions of peninsular Florida.

#### 3.2.3.2 Essential Fish Habitat (EFH)

NMFS and regional fishery councils are required to describe and identify EFH for all federally managed species under the Magnuson-Stevens Act (16 U.S.C. §§ 1801 et seq.). EFH has been designated for all 26 fish species managed by the Gulf of Mexico Fishery Management Council (GMFMC) and for 20 of the highly migratory fish species (tunas, sharks, swordfish, and billfish) managed by NMFS within the eastern GOM (NSWC PCD 2009). EFH for the brown shrimp also extends into the proposed test area. Finally, floating mats of Sargassum are also recognized as EFH and may occur in the test area.

### 3.2.4 Sea Turtles

Five species of sea turtles occur along the continental shelf of the eastern GOM: green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Kemp's ridley turtle (*Lepidochelys kempii*), leatherback turtle (*Dermochelys coriacea*), and loggerhead turtle (*Caretta caretta*). Loggerheads and leatherbacks also occur over the slope region of the eastern GOM. Sea turtles spend their lives at sea and only come ashore to nest. Cape San Blas, approximately 60 mi east of the project area, has been documented as supporting the highest density of nesting sea turtles in northwest Florida (DON 2009).

Of the five species protected by state and federal governments, all but the loggerhead are classified as endangered. The northwest Atlantic population of the loggerhead, including the Gulf of Mexico, is classified as a distinct population segment and listed as threatened under the ESA. The loggerhead is also classified as threatened by the State of Florida (DON 2009).

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 (DON 2009). *Sargassum*, a generally planktonic brown algae (seaweed), provides food and shelter to juvenile sea turtles. Sea turtle hatchlings are known to associate with pelagic *Sargassum* habitat during their "lost years" when they drift along with the planktonic mats. This nursery association is thought to play a vital role in the life of young turtles. The GOM is second to the Sargasso Sea in the quantity of *Sargassum* present in the area. Any *Sargassum* mats drifting at sea have the potential to host young sea turtles, since both are found with currents and can travel for long distances from their points of origin.

### 3.2.5 Marine Birds

Although NMFS does not expect marine birds would be directly affected by the proposed action (issuing an IHA to the Navy for Q-20 testing activities in the non-territorial waters of the GOM), they could be indirectly affected by the proposed activities. Therefore, as part of the environmental analysis, the baseline information on marine birds is provided here as part of the affected environment.

The GOM is populated by both resident and migratory coastal and marine birds. For discussion purposes, these species have been separated into four groups: diving birds, gulls/terns, shorebirds, and passerines. Many species of birds likely to occur in the GOM are pelagic (open ocean) species and therefore are rarely sighted nearshore (MMS 2007b). In addition, the Migratory Bird Treaty Act (MBTA) protects a total of 836 migratory bird species, 58 of which are currently legally hunted as game birds.

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**Diving Birds:** Diving birds are a diverse group. There are three main groups of diving birds: cormorants and anhingas, loons, and grebes. Diving birds prefer fish and are able to actively search for and capture their prey because their eyes have been adapted to see underwater. Nesting diving birds in the GOM include cormorants (MMS 2007b). These birds feed generally by pushing themselves underwater with their wings and/or feet. Loons and grebes closely resemble one another; however, loons are larger and have a thicker neck and longer bill. The five species of loons migrate to the GOM during the non-breeding winter season. Grebes that winter along the Gulf Coast of Florida include horned and eared grebes.

**Gulls/Terns:** Gulls, terns, noddies, jaegers, and black skimmers make up the gull/tern group. Most of these species eat exclusively small fish and feed by pushing themselves underwater with their wings and/or feet. Terns are streamlined and have substantial size bills relative to prey size for scooping, plunge diving, and underwater pursuit of fish. Exceptions to these feeding methods are the sooty tern (the only tropical species in the group) and gull-billed tern, which pluck food from the water's surface (MMS 2007b).

**Shorebirds:** Shorebirds are generally restricted to coastline and inland water margins (beaches, mudflats, etc.). An important characteristic of almost all shorebird species is their strongly developed migratory behavior, with some shorebirds migrating from nesting places in the high Arctic tundra to the southern part of South America. Along the central Gulf Coast, 44 species of shorebirds have been recorded; only 6 nest in the area, the remaining being wintering residents and/or staging migrants (MMS 2007b).

**Passerine Birds:** Passerine birds mostly migrate across the GOM each fall and spring and are protected along with other migrants under the MBTA. Trans-Gulf (flying straight over the GOM) migration peaks in late April and early May, coinciding with a southerly airflow (Moore *et al.* 1995). Fall migrations occur regularly between September and October. The majority of these neotropical migrants (or birds that winter in the tropics and breed in temperate climates) fly at night, usually beginning at sunset and ending by dawn or when they find suitable habitat (Moore *et al.* 1995). In addition, neotropical species can be expected to be found flying at altitudes ranging from 150 m (492 ft) to 4,000 m (13,123 ft) above the surface of the water.

### 3.2.6 Marine Mammals

Cetaceans (whales and dolphins) inhabiting the GOM may be grouped as mysticetes (baleen whales) or odontocetes (toothed whales, including dolphins). One baleen whale and 21 toothed whale species, including dolphins, could occur in the non-territorial waters of the NSWC PCD Study Area. Eight additional whale species (North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), fin whale (*B. Physalus*), blue whale (*B. musculus*), Minke whale (*B. acutorostrata*), Sowerby's beaked whale (*Mesoplodon bidens*), and True's beaked whale (Mesoplodon mirus), as well as the West Indian manatee (*Trichechus manatus*), occur in the GOM but are considered extralimital to the proposed action area and are not further assessed. All cetaceans are afforded Federal protection under the Marine Mammal Protection Act (MMPA).

Table 3-3 provides an overview of the best and minimum population estimates for marine mammal stocks by region in the Q-20 Study Area, based on NMFS most recent Stock Assessment Reports (Waring *et al.* 2010). This table addresses only the species that are potentially expected to be in the Q-20 Study Area and that were analyzed in this document. Stocks and regions are provided because some species, in this case the Atlantic bottlenose dolphin, have been divided into different stocks based on their anatomical, genetic, and/or behavioral characteristics.

**Table 3-3. Best and Minimum Population Estimates for Marine Mammals in the Q-20 Study Area (Waring *et al.* 2010)**

| ***Species*** | ***Stock*** | ***Best Population Estimate*** | ***Minimum Population Estimate*** |
|---|---|---|---|
| Bryde's whale | Northern GOM | 15 | 5 |
| Sperm whale | Northern GOM | 1,665 | 1,409 |
| *Kogia* sp. (Dwarf & pygmy sperm whale) | Northern GOM | 453 | 340 |
| *Mesoplodon* sp. (Blainville's & Gervais beaked whales) | Northern GOM | 57 | 24 |
| Cuvier's beaked whale | Northern GOM | 65 | 39 |
| Sowerby's beaked whale | Western North Atlantic | NA | NA |
| Rough-toothed dolphin | Northern GOM | 2,653 | 1,890 |
| Atlantic bottlenose dolphin | Coastal, Eastern GOM | 7,702 | 6,551 |
| Atlantic bottlenose dolphin | Continental shelf & slope | 17,777 | 13,667 |
| Atlantic bottlenose dolphin | GOM oceanic | 3,708 | 2,641 |
| Atlantic bottlenose dolphin | Northern GOM coastal | 2,473 | 2,004 |
| Pantropical spotted dolphin | Northern GOM | 34,067 | 29,311 |
| Atlantic spotted dolphin | Northern GOM | 37,611 | 29,844 |
| Spinner dolphin | Northern GOM | 1,989 | 1,356 |
| Clymene dolphin | Northern GOM | 6,575 | 4,901 |
| Striped dolphin | Northern GOM | 3,325 | 2,266 |
| Fraser's dolphin | Northern GOM | 726 | 427 |
| Risso's dolphin | Northern GOM | 1,589 | 1,271 |
| Melon headed whale | Western North Atlantic | 2,283 | 1,293 |
| Pygmy killer whale | Northern GOM | 323 | 203 |
| False killer whale | Northern GOM | 777 | 501 |
| Killer whale | Northern GOM | 49 | 28 |
| Short-finned pilot whale | Northern GOM | 716 | 542 |

### 3.2.6.1 Threatened and Endangered Marine Mammals

**Sperm Whale (*Physeter macrocephalus*)**

***Description:*** The sperm whale is the largest toothed whale species. Adult females can reach 12 m (39 ft) in length, while adult males measure as much as 18 m (59 ft) in length. Sperm whales prey on large mesopelagic squid and other cephalopods as well as demersal fish and occasionally benthic invertebrates.

***Status:*** Sperm whales are classified as endangered under the ESA. They are considered a strategic stock. The sperm whale population in the northern GOM as a stock is considered to be distinct from the U.S. Atlantic stock. Genetic analyses, coda vocalizations, and population structure support this. In the GOM, the best abundance estimate for sperm whales is 1,665, with a minimum population estimate of 1,409 (Waring *et al.* 2010). Abundance information, population dynamics, and trends are extremely limited for sperm whale populations in U.S. waters (Lowry *et al.* 2007).

***Distribution:*** Sperm whales are found from tropical to polar waters in all oceans of the world between approximately 70°N and 70°S. Females use a subset of the waters where males are regularly found. Females are normally restricted to areas with sea surface temperature (SST) greater than approximately 15°C, whereas males, and especially the largest males, can be found in waters as far pole-ward as the pack ice with temperatures close to 0°C. The thermal limits on female distribution correspond approximately to the 40° parallels (50°N in the North Pacific; Whitehead 2003). Photo-identification data analyzed by Jaquet *et al.* (2003) revealed that seven female sperm whales moved into the Gulf of California from the Galápagos Islands, traveling up to 3,803 km (2,052 nm); these are among the longest documented movements for female sperm whales.

Sperm whales show a strong preference for deep water (from the continental shelf break seaward). Sperm whale concentrations have been correlated with high productivity and steep bottom topography. In the GOM, the region of the Mississippi River Delta has been recognized for high densities of sperm whales and appears to represent an important calving and nursery area for these animals. Body sizes for most of the sperm whales seen off the mouth of the Mississippi River range from 7 to 10 m (23 to 33 ft), which is the typical size for females and younger animals. On the basis of photo-identification of sperm whale flukes and acoustic analyses, it is likely that some sperm whales are resident to the GOM. Tagging data demonstrated that some individuals spend several months at a time in the Mississippi River Delta and the Mississippi Canyon for several months, while other individuals move to other locations the rest of the year. Most tagged sperm whales in the GOM show a strong preference for the waters of the continental slope and canyon regions, while several individuals go offshore into waters with a bottom depth greater than 3,000 m (9,843 ft). Spatial segregation between the sexes was noted one year by Jochens *et al.* (2008); females and immatures showed high site fidelity to the region south of the Mississippi River Delta and Mississippi Canyon and in the western Gulf, while males were mainly found in the De Soto Canyon and along the Florida slope.

***Diving Behavior:*** Sperm whales forage during deep dives that routinely exceed a depth of 400 m (1,312 ft) and 30 min duration. Sperm whales are capable of diving to depths of over 2,000 m (6,56 ft) with durations of over 60 min. Male sperm whales spend up to 83% of daylight hours underwater. In contrast, females spend prolonged periods of time at the surface (1 to 5 hours daily) without foraging. An average dive cycle consists of about a 45 min dive with a 9 min surface interval. The average swimming speed is estimated to be 0.7 meters per second (m/sec) (1.6 miles per hour [mi/hr]). Dive descents are about 9 to 11 min at a rate of 1.2 to 1.52 m/sec (2.7 to 3.40 mi/hr), and ascents average 11.8 min at a rate of 1.4 m/sec (3.1 mi/hr).

***Acoustics and Hearing:*** Sperm whales typically produce short-duration (<30 ms), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges. When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours. Codas are shared between individuals of a social unit and are considered to be primarily for intra-group communication. Recent research in the South Pacific suggests that in breeding areas the majority of codas are produced by mature females. Coda repertoires have also been found to vary geographically and are categorized as dialects, similar to those of killer whales. For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean and those in the Pacific. Furthermore, the clicks of neonatal sperm whales are very different from those of adults. Neonatal clicks are of low-directionality, long-duration (2 to 12 ms), and low-frequency (dominant frequencies around 0.5 kHz) with estimated source levels between 140 and 162 dB re 1 μPa-m root mean square (rms) and are hypothesized to function in communication with adults. Source levels from adult sperm whale's highly directional (possible echolocation), short (100 μs) clicks have been estimated up to 236 dB re 1 μPa-m rms. Creaks (rapid sets of clicks) are heard most frequently when sperm whales are engaged in foraging behavior in the deepest portion of their dives with intervals between clicks and source levels being altered during these behaviors. It has been shown that sperm whales may produce clicks during 81% of their dive period; specifically, 64% of the time during their descent phases. In addition to producing clicks, sperm whales, in some regions like Sri Lanka and the Mediterranean Sea, have been recorded making what are called trumpets at the beginning of dives just before commencing click production.

The anatomy of the sperm whale's inner and middle ear indicates an ability to best hear high frequency to ultrasonic frequency sounds. They may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales. The auditory brainstem response (ABR) technique used on a stranded neonatal sperm whale indicated it could hear sounds from 2.5 to 60 kHz with best sensitivity to frequencies between 5 and 20 kHz (Ridgway and Carder 2001).

***Occurrence in Q-20 Study Area:*** Sperm whales in the GOM aggregate along the continental slope in or near the perimeter of cyclonic (cold-core) eddies. The area of the Mississippi River Delta might represent an important calving and nursery area for sperm whales. On the basis of photo-identification of sperm whale flukes and acoustic analyses, it is likely that some sperm whales are resident to the GOM.

The sperm whale is expected to occur from the continental shelf break to the 3,000 m (9,843 ft) isobath. There is a concentrated occurrence that encompasses the area off the Mississippi River Delta, and the influences of this river, between the continental shelf break and approximately the 1,000 m (3,281 ft) isobath. This is an area that has been recognized for high densities of sperm whales and represents a habitat where they can be predictably found. Sperm whales in this area appear to have affinity for cyclonic (cold-core) eddies. In fact, the largest numbers of encounters with sperm whales appeared to shift in response to shifts in distribution of eddies.

There is a low or unknown occurrence of sperm whales in waters with a bottom depth greater than 3,000 m (9,843 ft), which reflects the fact that there has been comparatively little survey effort in waters this deep, yet there have been confirmed sightings of sperm whales. Occurrence is assumed to be the same throughout the year. Body sizes for most of the sperm whales seen off the mouth of the Mississippi River range from 7 to 10 m (23 to 32.8 ft), which is a typical size for females and younger animals. The area of the

Mississippi River Delta might represent an important calving and nursery area for sperm whales. On the basis of photo-identification of sperm whale flukes and acoustic analyses, it is likely that some sperm whales are resident to the GOM.

There has also been recent extensive work on the movements and habitat use of sperm whales in the northern Gulf of Mexico, such as the studies conducted by the Sperm Whale Acoustic Monitoring Program (SWAMP) and the Sperm Whale Seismic Study (SWSS). These studies include habitat cruises, physical oceanographic analyses, and long term satellite tag deployments. Several satellite tags have operated for over 12 months and indicate movements generally along the shelf break (700-1,000 m depth) throughout the Gulf, with some animals (more frequently males) using deeper oceanic waters.

Based on the analysis of largely the same data set compiled in the GOM Marine Resources Assessment (DON 2007) and used to estimate "sightings per unit effort," sperm whales have a zero probability of being seen in the vicinity of the proposed test area except during spring (April-July). The low (non-zero) probability of occurrence during spring reflects a lone sighting as shown in the NMFS Stock Assessment Report (Waring *et al.* 2010).

#### 3.2.6.2 Non-ESA-Listed Marine Mammals

Marine mammal species that are not listed under the ESA that could occur in the proposed Q-20 testing area in the non-territorial waters of GOM include

- Bryde's whale (*Balaenoptera edeni*)
- Dwarf sperm whale (*Kogia sima*)
- Pygmy sperm whale (*K. breviceps*)
- Cuvier's beaked whale (*Ziphius cavirostris*)
- Sowerby's beaked whale (*Mesoplodon bidens*)
- Blainville's beaked whale (*M. densirostris*)
- Gervais beaked whale (*M. europaeus*)
- Rough-toothed dolphin (*Steno bredanensis*)
- Atlantic bottlenose dolphin (*Tursiops truncatus*)
- Pantropical spotted dolphin (*Stenella attenuata*)
- Atlantic spotted dolphin (*S. frontalis*)
- Spinner dolphin (*S. longirostris*)
- Clymene dolphin (*S. clymene*)
- Striped dolphin (*S. coeruleoalba*)
- Fraser's dolphin (*Lagenodelphis hosei*)
- Risso's dolphin (*Grampus griseus*)
- Melon-headed whale (*Peponocephala electra*)
- Pygmy killer whale (*Feresa attenuata*)
- False killer whale (*Pseudorca crassidens*)
- Killer whale (*Orcinus orca*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)

**Bryde's Whale (*Balaenoptera edeni*)**

***Description:*** The Bryde's whale is a medium-sized baleen whale. Adults can be up to 15.5 m (51 ft) in length, but there is a smaller "dwarf" species that rarely reaches over 10 m (33 ft) in length. Bryde's whales can be easily confused with sei whales; however, closer examination reveals them to have a number of distinctive characteristics. It is not clear how many species of Bryde's whales there are, but genetic analyses suggest the existence of at least two species. The taxonomy of the baleen whale group formerly known as sei and Bryde's whales is currently confused and highly controversial.

***Status:*** The best estimate of abundance for Bryde's whales within the Northern GOM Stock is 15, with a minimum population size estimate of 5 whales (Waring *et al.* 2010). It has been suggested that the Bryde's whales found in the GOM may represent a resident stock, but there is no information on stock differentiation (Waring *et al.* 2010). The NOAA Stock Assessment Report provisionally considers the GOM population a separate stock from the Atlantic Ocean stock(s).

***Distribution:*** The Bryde's whale is found in tropical and subtropical waters, generally not moving pole-ward of 40° in either hemisphere. Long migrations are not typical of Bryde's whales although limited shifts in distribution toward and away from the equator in winter and summer, respectively, have been observed. Most sightings in the GOM have been made in the De Soto Canyon region and off western Florida. Additional information on reproductive areas and seasons for this species is not available.

***Diving Behavior:*** Bryde's whales are lunge-feeders, feeding primarily on fish, but they also take small crustaceans. Bryde's whales might dive as long as 20 min.

***Acoustics and Hearing:*** Bryde's whales produce low frequency tonal and swept calls similar to those of other rorquals. Calls vary regionally, yet all but one of the call types have a fundamental frequency below 60 Hz. They last from 0.25 sec to several seconds; and they are produced in extended sequences. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing.

***Occurrence in Q-20 Study Area:*** Bryde's whales found in the GOM may represent a resident stock. Bryde's whales are not frequently sighted in the GOM, although they are observed more frequently than any other species of baleen whale in this region. Nothing is known of their movement patterns in this area, and strandings are scattered throughout the coast of the Gulf. Therefore, there is a low or unknown occurrence of Bryde's whale from the shelf break to the 2,000 m (6,562 ft) isobath throughout most of the Q-20 Study Area.

Bryde's whales are expected to occur year-round in an area encompassing the De Soto Canyon and an area off western Florida, from the shelf break to the 2,000 m (6,562 ft) isobath, based on the fact that most sightings were made in this region during dedicated cetacean surveys. Also considered was the likelihood that Bryde's whale movements are taking place in oceanic waters in this area.

**Pygmy (*Kogia breviceps*) and Dwarf Sperm Whales (*K. sima*)**

***Description:*** There are two species of *Kogia*: the pygmy sperm whale and the dwarf sperm whale. They are difficult to distinguish from one another in the field, and sightings of either species are often categorized as *Kogia* sp. The difficulty in identifying pygmy and dwarf sperm whales is exacerbated by their avoidance reaction toward ships and change in behavior toward approaching survey aircraft. Based on the cryptic behavior of these species and small group sizes (much like that of beaked whales), as well as similarity in appearance, it is difficult to identify these whales to species in sightings at sea. Pygmy and dwarf sperm whales reach body lengths of around 3 and 2.5 m (9.8 and 8.2 ft), respectively. *Kogia* feed on cephalopods and, less often, on deep-sea fish and shrimp. Zooplankton is likely part of the diet of one or more of the common prey species of *Kogia*.

***Status:*** *K. breviceps* and *K. sima* are difficult to differentiate in the field, therefore estimated abundances include both species of *Kogia*. The GOM population is provisionally being considered a separate stock for management purposes from the U.S. Atlantic stock, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s) (Waring *et al.* 2010). The best abundance estimate for pygmy and dwarf sperm whales in the Northern GOM is 453 animals with a minimum population of 340 (Waring *et al.* 2010).

***Distribution:*** Both *Kogia* species have a worldwide distribution in tropical and temperate waters. In the western Atlantic Ocean, *Kogia* sp. (specifically, the pygmy sperm whale) are documented as far north as the northern Gulf of St. Lawrence, as far south as Colombia (dwarf sperm whale), and as far west as Texas in the GOM. Worldwide, both species of *Kogia* generally occur in waters along the continental shelf break and over the continental slope. Data from the GOM suggest that *Kogia* may associate with frontal regions along the shelf break and upper continental slope, since these are areas with high epipelagic zooplankton biomass. A satellite-tagged, rehabilitated pygmy sperm whale released off the Atlantic coast of Florida remained along the continental slope and the western edge of the Gulf Stream during the time of the tag's operation. Dwarf sperm whales may have a more oceanic distribution than pygmy sperm whales and/or dive deeper during feeding bouts, based on hematological and stable isotope data. Information on the reproductive areas and seasons for these species is not available.

***Diving Behavior:*** Whales of the genus *Kogia* make dives of up to 25 min. Median dive times of around 11 min are documented for *Kogia*. A satellite-tagged pygmy sperm whale released off Florida was found to make long nighttime dives, presumably indicating foraging on squid in the deep scattering layer.

***Acoustics and Hearing:*** The only sound recordings for the pygmy sperm whale are from a stranded individual that produced echolocation clicks ranging from 60 to 200 kHz, with a dominant frequency of 120 to 130 kHz. Recently, a dwarf sperm whale was recorded producing clicks at 13 to 33 kHz with durations of 0.3 to 0.5 sec. A study completed on a stranded pygmy sperm whale indicated a hearing range of 90 to 150 kHz. No information on sound production or hearing is available for the dwarf sperm whale.

***Occurrence in Q-20 Study Area:*** As noted earlier, identification to species for this genus is difficult, particularly at sea. Based on the distribution of the available sighting records and the known preference of both *Kogia* sp. for deep waters, pygmy and dwarf sperm whales are expected to occur between the continental shelf break and the 3,000 m (9,843 ft) isobath. There is a low or unknown occurrence of pygmy and dwarf sperm whales in the very deep waters seaward of the 3,000 m (9,843 ft) isobath.

There is no evidence that *Kogia* sp. regularly occur in continental shelf waters of the GOM. However, there are some sighting records for these species in waters over the continental shelf. Therefore, there is also a low or unknown occurrence of *Kogia* sp. between the 50 m (164 ft) isobath and the continental shelf break. Occurrence is assumed to be the same for all four seasons.

**Beaked Whales (Various Species)**

***Description:*** Worldwide, there are 20 recognized beaked whale species in five genera (Mead 2002). In the GOM, four have documented occurrence, including Cuvier's beaked whale and three members of the genus *Mesoplodon* (Gervais', Blainville's, and Sowerby's beaked whales).

Identification of *Mesoplodon* to species is very difficult in the field, and in many cases, *Mesoplodon* and Cuvier's beaked whale (*Ziphius cavirostris*) cannot be distinguished at sea; therefore, sightings of beaked whales (Family Ziphiidae) are identified as *Mesoplodon* sp., Cuvier's beaked whale, or unidentified Ziphiidae. Of the beaked whale species, the Cuvier's beaked whale is the easiest to identify. With the exception of the Cuvier's beaked whale, the aforementioned beaked whale species are nearly indistinguishable at sea. Little is known about the habitat preferences of beaked whales. All species of beaked whales probably feed at or close to the bottom in deep oceanic waters, taking whatever suitable prey they encounter or feeding on whatever species are locally abundant.

*Mesoplodon* species have maximum reported adult lengths of 6.2 m (20 ft); Blainville's beaked whales are documented to reach a maximum length of around 4.7 m (15 ft); Gervais' beaked whale males reach lengths of at least 4.5 m (15 ft), while females reach at least 5.2 m (17 ft); and Sowerby's beaked whale males and females attain lengths of at least 5.5 and 5.1 m (18 and 17 ft), respectively. Cuvier's beaked whales are relatively robust compared to other beaked whale species. Male and female Cuvier's beaked whales may reach 7.5 and 7.0 m (24.6 and 23.0 ft) in length, respectively. Northern bottlenose whales are 7 to 9 m (23.0 to 29.5 ft) in length and have rotund bodies, large bulbous heads, and small, well-defined beaks.

***Status:*** The best abundance estimate for Cuvier's beaked whales in the northern GOM is 65 individuals, with a minimum population estimate for the northern GOM of 39 Cuvier's beaked whales (Waring *et al.* 2010). It is not possible to determine the minimum population estimate of only Cuvier's beaked whales. The best abundance estimate for *Mesoplodon* species in the northern GOM is 106 animals. The minimum population estimate for Mesoplodon species in the northern GOM is 76.

***Distribution:*** Little is known about beaked whale habitat preferences. World-wide, beaked whales normally inhabit continental slope and deep oceanic waters, normally inhabiting deep ocean waters (below 2,000 m [6,562 ft]) or continental slopes (200 to 2,000 m [656 to 6,562 ft]), and rarely straying over the continental shelf. In the GOM, beaked whales are seen in waters with a bottom depth ranging from 420 to 3,487 m (1,378 to 11,440 ft). In many locales, occurrence patterns have been linked to physical features, in particular, the continental slope, canyons, escarpments, and oceanic islands.

Cuvier's beaked whales are the most widely distributed of the beaked whales and are present in most regions of all major oceans. This species occupies almost all temperate, subtropical, and tropical waters, as well as subpolar and even polar waters in some areas. Cuvier's and Blainville's beaked whales are generally sighted in waters with a bottom depth greater than 200 m (656 ft) and are frequently recorded at bottom depths greater than 1,000 m (3,281 ft). At oceanic islands, Cuvier's beaked whales may be found in deeper waters than Blainville's beaked whales. Information on reproductive areas and seasons is not available for these species.

The ranges of most mesoplodonts are poorly known. The distributions of these species in the GOM are known almost entirely from strandings, and may relate to water temperature. Information on reproductive areas and seasons is not available for these species.

Sowerby's beaked whales and True's beaked whales are the most northerly species, occurring in northern, temperate waters of the North Atlantic; in the GOM they are currently considered extralimital. Information on reproductive areas and seasons is not available for these species.

Blainville's and Gervais' beaked whales generally occur in warmer, southern waters. The Blainville's beaked whale is thought to have a continuous distribution throughout the tropical, subtropical, and warm-temperate waters of the world's oceans, occurring occasionally in cold temperate areas. There are occurrence records for the Blainville's beaked whale from Nova Scotia south to Florida, the Bahamas, and the GOM. The Gervais' beaked whale is restricted to warm-temperate and tropical Atlantic waters with records throughout the Caribbean Sea. The Gervais' beaked whale is the most frequently-stranded beaked whale in the GOM. Information on reproductive areas and seasons is not available for these species.

***Diving Behavior:*** Dives range from those near the surface where the animals are still visible to long, deep dives. Tagged Cuvier's beaked whale dive durations as long as 87 minutes and dive depths of up to 1,990 m (6,529 ft) have been recorded. Dive durations for *Mesoplodon* sp. Are typically over 20 min. Tagged Blainville's beaked whale dives have been recorded to 1,408 m (4,619 ft) and lasting as long as 54 min. Several aspects of diving have been identified between Cuvier's and Blainville's beaked whales: (1) both may dive for 48 to 68 minutes to depths greater than 800 m (2,625 ft), with one long dive occurring on average every two hours; (2) ascent rates for long/deep dives are substantially slower than descent rates, while during shorter dives there is no consistent differences; and (3) both may spend prolonged periods of time (66 to 155 min) in the upper 50 m (164 ft) of the water column. Both species make a series of shallow dives after a deep foraging dive to recover from oxygen debt; average surface intervals between foraging dives have been recorded as 63 min for Cuvier's beaked whales and 92 min for Blainville's beaked whales.

***Acoustics and Hearing:*** Sounds recorded from beaked whales are divided into two categories: whistles and pulsed sounds (clicks); whistles likely serve a communicative function and pulsed sounds are important in foraging and/or navigation (Bioecomac, *et al.* 2011). Whistle frequencies are about 2 to 12 kHz, while pulsed sounds range in frequency from 300 Hz to 135 kHz; however, higher frequencies may not be recorded due to equipment limitations. Whistles recorded from free-ranging Cuvier's beaked whales off Greece ranged in frequency from 8 to 12 kHz, with an upsweep of about 1 sec, while pulsed sounds had a narrow peak frequency of 13 to 17 kHz, lasting 15 to 44 sec in duration. Short whistles and chirps from a stranded sub adult Blainville's beaked whale ranged in frequency from slightly <1 to almost 6 kHz. Recent studies incorporating digital acoustic recording tags (known commonly as DTAGs) attached to both Blainville's and Cuvier's beaked whales in the Ligurian Sea (arm of the Mediterranean Sea) recorded high-frequency echolocation clicks (duration: 175 μs for Blainville's and 200 to 250 μs for Cuvier's) with dominant frequency ranges from about 20 to over 40 kHz (limit of recording system was 48 kHz) and only at depths greater than 200 m. The source levels of the Blainville's beaked whales' clicks were estimated to range from 200 to 220 dB re 1 μPa-m, while they were 214 dB re 1 μPa-m for the Cuvier's beaked whale.

From anatomical examination of their ears, it is presumed that beaked whales are predominantly adapted to best hear ultrasonic frequencies. Beaked whales have well-developed semi-circular canals (typically for vestibular function but may function differently in beaked whales) compared to other cetacean species, and they may be more sensitive than other cetaceans to low frequency sounds. The only direct measure of beaked whale hearing is from using auditory evoked potential techniques on a stranded juvenile Gervais' beaked whale. The hearing range was 5 to 80 kHz, with greatest sensitivity at 40 and 80 kHz.

***Occurrence in Q-20 Study Area:*** Based on the known preference of beaked whales for deep waters and the distribution of available sighting records for the GOM, beaked whales may be expected to occur throughout the GOM in waters off the continental shelf break in the eastern GOM. Occurrence is assumed to be the same year-round.

**Rough-Toothed Dolphin (*Steno bredanensis*)**

***Description:*** The rough-toothed dolphin is a relatively robust dolphin that reaches 2.8 m (9.2 ft) in length. Cephalopods and fish, including large fish such as dorado, are prey.

***Status:*** The best estimate of abundance for rough-toothed dolphins is 2,653 in the northern GOM. The minimum population estimate for the same area is 1,890 rough-toothed dolphins (Waring *et al.* 2010). There is no information on stock differentiation for the western North Atlantic stock of this species.

***Distribution:*** Rough-toothed dolphins are found in tropical to warm-temperate waters globally, rarely ranging north of 40°N or south of 35°S. Rough-toothed dolphins occur in low densities throughout the Eastern Tropical Pacific (ETP) where surface water temperatures are generally above 25°C (77°F). This species is not a commonly-encountered species in the areas where it is known to occur. Not many records for this species exist from the western North Atlantic but they indicate that this species occurs from Virginia south to Florida, the GOM, the West Indies, and along the northeastern coast of South.

The rough-toothed dolphin is regarded as an offshore species that prefers deep waters; however, it can occur in waters with variable bottom depths. In the GOM, the rough-toothed dolphin occurs primarily in the deeper waters off the continental shelf. When stranded and rehabilitated individuals were released with tags off the Atlantic Coast of Florida in March 2005, they moved to waters as deep as 4,000 to 5,000 m (13,123 to 16,404 ft) in bottom depth. The rough-toothed dolphin may regularly frequent coastal waters and areas with shallow bottom depths. Sighting and tagging data indicate the use of continental shelf waters by this species in the northern GOM. Additionally, there are reports of rough-toothed dolphins over the continental shelf in shallow waters around La Gomera, Canary Islands, Puerto Rico and the Virgin Islands, the Bahamas, and in coastal waters off Brazil, including even in a lagoon system. All records for this species for Puerto Rico and the Virgin Islands are in waters on the continental shelf. Rough-toothed dolphins have been sighted on the continental shelf in Ilha Grande Bay (southeastern coast of Brazil), but there has not been much sighting effort in deep waters. Information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Rough-toothed dolphins may stay submerged for up to 15 min and are known to dive as deep as 150 m (492 ft).

***Acoustics and Hearing:*** The rough-toothed dolphin produces a variety of sounds, including broadband echolocation clicks and whistles. Echolocation clicks (duration <250 microseconds [μsec]) typically have a frequency range of 0.1 to 200 kHz, with a dominant frequency of 25 kHz. Whistles (duration <1 sec) have a wide frequency range of 0.3 to greater than 24 kHz but dominate in the 2 to 14 kHz range. There has been no data collected on rough-toothed dolphin hearing ability. However, odontocetes are generally adapted to hear high frequencies.

***Occurrence in Q-20 Study Area:*** The rough-toothed dolphin is expected to occur seaward of the continental shelf break to the 3,000 m (9,843 ft) isobath based on the known preference of this species for deep waters and the distribution of available sighting records. There is a low or unknown occurrence of this species in waters with a bottom depth greater than 3,000 m (9,843 ft), based on a very small number of sightings in those waters. There is additionally an area of low or unknown occurrence between the 50 m (164 ft) isobath and the shelf break. Two separate mass strandings of rough-toothed dolphins occurred in the Florida Panhandle during December 1997 and 1998. Four of the stranded dolphins were rehabilitated and released, three with satellite-linked transmitters. Water depth at tracking locations of these individuals averaged 195 m (640 ft). Since the tagged individuals were observed again with wild rough-toothed dolphins off the Florida Panhandle, this suggests a previously undocumented regular occurrence of this species in the northeastern GOM and the possibility of encountering rough-toothed dolphins on the continental shelf.

**Bottlenose Dolphin (*Tursiops truncatus*)**

Description: Bottlenose dolphins (genus *Tursiops*) are large, relatively robust dolphins with striking regional variation in body size; adult body length ranges from 1.9 to 3.8 m (6.2 to 12.5 ft). *Tursiops* are opportunistic feeders, taking a wide variety of fish, cephalopods, and shrimp. *Tursiops* use a wide variety of feeding strategies, including feeding in association with shrimp trawls.

Scientists recognize a near shore (coastal) and an offshore form of the bottlenose dolphin, which may be distinguished by external morphology, hematology, cranial morphology, diet, and parasite load. Both “coastal” and “offshore” forms of bottlenose dolphins occur in the GOM (Waring *et al.* 2010).

***Status:*** The stock structure of bottlenose dolphins in the GOM is uncertain and appears to be complex. The multi-disciplinary research programs conducted over the last 37 years have begun to shed light on the structure of some of the stocks of bottlenose dolphins, though additional analyses are needed before stock structures can be elaborated on in the GOM. As research is completed, it may be necessary to revise stocks of bottlenose dolphins in the GOM (Waring *et al.* 2010).

In the northern GOM, there are three coastal stocks; a continental shelf stock; an oceanic stock; and numerous bay, sound, and estuarine stocks. It is believed that many of these different stocks may overlap each other. The best estimate of abundance along the GOM continental shelf and slope is 17,777, with a minimum population estimate of 13,667 bottlenose dolphins (Waring *et al.* 2010).

***Distribution:*** The overall range of the common bottlenose dolphin is worldwide in tropical and temperate waters. This species occurs in all three major oceans and many seas. Dolphins of the genus Tursiops generally do not range pole-ward of 45°, except around the United Kingdom and northern Europe. Climate changes can contribute to range extensions as witnessed in association with the 1982/83 El Niño event when the range of some bottlenose dolphins known to the San Diego, California area was extended northward by 600 km (324 nm) to Monterey Bay.

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 GOM, the Caribbean, and southward to Venezuela and Brazil. Bottlenose dolphins may also be found in very deep waters. The range of the offshore bottlenose dolphin stock may include waters beyond the continental slope, and offshore bottlenose dolphins may move between the Atlantic and the GOM.

The bottlenose dolphin is by far the most widespread and common cetacean in coastal waters of the GOM. Bottlenose dolphins are frequently sighted near the Mississippi River Delta and have even been known to travel several kilometers up the Mississippi River. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Navy bottlenose dolphins have been trained to reach maximum diving depths of about 300 m (984 ft). The presence of deep-sea fish in the stomachs of some individual offshore bottlenose dolphins suggests that they dive to depths of more than 500 m (1,640 ft). A tagged individual near Bermuda had maximum recorded dives of 600 to 700 m (1,969 to 2,297 ft) and durations of 11 to 12 min. Dive durations up to 15 min have been recorded for trained individuals. Typical dives, however, are more shallow and of a much shorter duration. Data from a tagged individual off Bermuda indicated a possible diel dive cycle (i.e., a regular daily dive cycle) in search of mesopelagic (living at depths between 180 and 900 m [591 and 2,953 ft] prey in the deep scattering layer.

***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 kHz and a source level of 218 to 228 dB re 1 μPa-m and 3.4 to 14.5 kHz and 125 to 173 dB re 1 μPa-m, respectively. Whistles are primarily associated with communication and can serve to identify specific individuals (i.e., signature whistles). Up to 52% of whistles produced by bottlenose dolphin groups with mother-calf pairs can be classified as signature whistles. Sound production also is influenced by group type (single or multiple individuals), habitat, and behavior. Bray calls (low-frequency vocalizations; majority of energy below 4 kHz), for example, are used when capturing fish, specifically sea trout (*Salmo trutta*) and Atlantic salmon (*S. salar*), in some regions (i.e., Moray Firth, Scotland). Additionally, whistle production has been observed to increase while feeding. 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). For example, preliminary research indicates that characteristics of whistles from populations in the northern GOM significantly differ (i.e., in frequency and duration) from those in the western north Atlantic.

Bottlenose dolphins can typically hear within a broad frequency range of 0.04 to 160 kHz. 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. Scientists have reported a range of highest sensitivity between 25 and 70 kHz, with peaks in sensitivity at 25 and 50 kHz. Recent research, on the same individuals, indicates that auditory thresholds obtained by electrophysiological methods correlate well with those obtained in behavior studies, except at the some lower (10 kHz) and higher (80 and 100 kHz) frequencies. Temporary threshold shifts (TTS) in hearing have been experimentally induced in captive bottlenose dolphins using a variety of noises (i.e., broad-band, pulses). For example, TTS has been induced with exposure to a 3 kHz, one-second pulse with sound exposure level (SEL) of 195 dB re 1 μPa2-s, one-second pulses from 3 to 20 kHz at 192 to 201 dB re 1μPa-m, and octave band noise (4 to 11 kHz) for 50 minutes at 179 dB re 1 μPa-m. 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. Observed changes in behavior were induced with an exposure to a 75 kHz one-second pulse at 178 dB re 1 μPa-m. TTS has been measured to be between 8 and 16 kHz (negligible or absent at higher frequencies) after 30 min of noise exposure (4 to 11 kHz) at 160 dB re 1 μPa-m (Nachtigall *et al.* 2004).

***Occurrence in Q-20 Study Area:*** Based on the distribution of sighting records in the GOM, bottlenose dolphins are expected to occur from the shoreline to the 1,000 m (3,281 ft) isobath. There are concentrated occurrences of bottlenose dolphins from the shore to the 30 m (98 ft) isobath off west-central Florida and from the shore to just seaward of the continental shelf break from Cape San Blas, Florida to the western extent of the map area.

Additionally, bottlenose dolphin occurrence is concentrated in a swath encompassing the shelf break east of Cape San Blas, as well as the Florida Keys. There is a low or unknown occurrence of bottlenose dolphins in waters with a bottom depth greater than 1,000 m (3,281 ft), which takes into consideration that comparatively little survey effort has taken place in deeper waters and also that there is a small possibility of encountering this species in that area. Bottlenose dolphin occurrence in the Q-20 Study Area is assumed to be similar throughout the year.

**Pantropical (*Stenella attenuate*) and Atlantic Spotted Dolphins (*S. frontalis*)**

***Description:*** The pantropical spotted dolphin is a generally slender dolphin. Adults may reach up to 2.6 m (8.5 ft) in length. Pantropical spotted dolphins are born spotless and develop spots as they age although the degree of spotting varies geographically. Some populations may be virtually unspotted. Pantropical spotted dolphins prey on epipelagic fish, squid, and crustaceans, with some take of mesopelagic animals.

The Atlantic spotted dolphin tends to resemble the bottlenose dolphin more than it does the pantropical spotted dolphin. In body shape, it is somewhat intermediate between the two, with a moderately long but rather thick beak. Adults are up to 2.3 m (7.5 ft) long and 143 kilogram (kg) (315 pounds [lb]) in weight. Atlantic spotted dolphins are born spotless and develop spots as they age. Some Atlantic spotted dolphin individuals become so heavily spotted that the dark cape and spinal blaze are difficult to see. There is marked regional variation in adult body size of the Atlantic spotted dolphin. 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. The largest body size is exhibited by the coastal form, which occurs in waters over the continental shelf of North America (U.S. East Coast, GOM, and Central America). The smallest Atlantic spotted dolphins are those around oceanic islands, such as the Azores, and on the high seas in the western North Atlantic. Atlantic spotted dolphins feed on small cephalopods, fish, and benthic invertebrates, and in the GOM have been seen feeding cooperatively and are known to feed in association with shrimp trawls.

Where the Atlantic spotted dolphin and the pantropical spotted dolphin co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea (Waring *et al.* 2010).

***Status:*** The best estimate of abundance for Atlantic spotted dolphins in the northern GOM is 37,611, with a minimum population estimate of 29,894 dolphins (Waring *et al.* 2010).

The pantropical spotted dolphin is the most abundant and commonly-seen cetacean in deep waters of the northern GOM. The best estimate of abundance for pantropical spotted dolphins in the northern GOM is 34,067, with a minimum population of 29,311 dolphins (Waring *et al.* 2010).

***Distribution:*** The pantropical spotted dolphin is distributed in tropical and subtropical waters worldwide, generally occurring in oceanic waters beyond the shelf break. Stenellid dolphins have been sighted within the Gulf Stream, which is consistent with the oceanic distribution of pantropical spotted dolphins and their preference for warm waters. Pantropical spotted dolphins in the GOM have been sighted in waters with bottom depths ranging from 435 to 2,121 m (1,427 to 6,959 ft). Pantropical spotted dolphins in the GOM do not appear to have a preference for any one specific habitat type (i.e., within the Loop Current, inside cold-core eddies, or along the continental slope).

The Atlantic spotted dolphin, as its name suggests, is endemic to the tropical and warm-temperate Atlantic Ocean. In the western North Atlantic, this translates to waters from northern New England to the GOM and the Caribbean, and southward to the coast of Venezuela. Known densities of Atlantic spotted dolphins are highest in the eastern GOM, east of Mobile Bay. The large, heavily spotted coastal form of the Atlantic spotted dolphin typically occurs over the continental shelf inside or near the 185 m (607 ft) isobath, usually at least 8 to 20 km (4 to 11 NM) offshore. Sightings of offshore spotted dolphins have been made along the north wall of the Gulf Stream and warm-core ring features. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Pantropical spotted dolphins dives during the day are generally shorter and shallower than dives at night; rates of descent and ascent are higher at night than during the day. Similar mean dive durations and depths have been obtained for tagged pantropical spotted dolphins in the ETP and off Hawaii. The only information on dive depth for Atlantic spotted dolphins is based on a satellite-tagged individual from the GOM. This individual made short, shallow dives (over 76 percent of the time to depths less than 10 m [33 ft]) over the continental shelf, although some dives were as deep as 40 to 60 m (131 to 197 ft).

***Acoustics and Hearing:*** Pantropical spotted dolphin whistles have a frequency range of 3.1 to 21.4 kHz. Clicks typically have two frequency peaks (bimodal) at 40 to 60 kHz and 120 to 140 kHz with estimated source levels up to 220 dB re 1 μPa peak-to-peak. No direct measures of hearing ability are available for pantropical spotted dolphins, but ear anatomy has been studied and indicates that this species should be adapted to hear the lower range of ultrasonic frequencies (<100 kHz).

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. Other sounds, such as squawks, barks, growls, and chirps, typically range in frequency from 0.1 to 8 kHz. Recently recorded echolocation clicks have 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. Echolocation click source levels as high as 210 dB re 1 μPa-m peak-to-peak have been recorded. There are no empirical hearing data for Atlantic spotted dolphins.

***Occurrence in Q-20 Study Area:*** The Atlantic spotted dolphin is expected to occur in waters over the continental shelf in the GOM from the 10 m (33 ft) isobath to the shelf break. The majority of the sightings support this determination. Taking into consideration sightings recorded seaward of the continental shelf break and over the continental slope near the Mississippi River Delta and in the southern GOM, there is a low or unknown occurrence of this species between the shelf break and the 2,000 m (6,562 ft) isobath. Occurrence is assumed to be similar during all seasons.

The pantropical spotted dolphin is an oceanic species and is the most common cetacean in the oceanic northern GOM and is found in the deeper waters off the continental shelf. The pantropical spotted dolphin is expected to occur from the continental shelf break to the 3,000 m (9,843 ft) isobaths. There is a low or unknown occurrence of the pantropical spotted dolphin seaward of the 3,000 m (9,843 ft) isobaths based on the little survey effort in waters this deep compared to the waters off the shelf break and over the continental slope. Occurrence is assumed to be similar throughout the year.

**Spinner Dolphin (*S. longirostris*)**

***Description:*** This is a very slender dolphin that has a very long and slender beak and can reach lengths of 2.4 m (7.9 ft). This species has a three-part color pattern (dark gray cape, light gray sides, and white belly). There are four known subspecies of spinner dolphins and probably other undescribed ones. Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp, diving to at least 200 to 300 m (656 to 984 ft). Many of these organisms become available to spinner dolphins when the deep-scattering layer moves toward the surface at night.

***Status:*** The best estimate of abundance for spinner dolphins in the northern GOM is 1,989. The minimum population estimate for the northern GOM is 1,356 spinner dolphins (Waring *et al.* 2010).

***Distribution:*** The spinner dolphin is found in tropical and subtropical waters worldwide, occurring in both coastal and oceanic environments. Limits are near 40ºN and 40ºS. In the western North Atlantic, they are known from South Carolina to Florida, the Caribbean, the GOM, and the West Indies southward to Venezuela. Sightings of this species off the U.S. Atlantic coast and GOM have occurred primarily in deeper waters (bottom depth greater than 2,000 m [6,562 ft]). Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Spinner dolphins feed primarily on small mesopelagic fish, squid, and sergestid shrimp, and they dive to at least 199 to 300 m (653 to 984 ft). Foraging takes place primarily at night when the mesopelagic prey migrates vertically towards the surface and also horizontally towards the shore. Spinner dolphins are well known for their propensity to leap high into the air and spin before landing in the water; the purpose of this behavior is unknown.

***Acoustics and Hearing:*** Pulses, whistles, and clicks have been recorded from this species. Pulses and whistles have dominant frequency ranges of 5 to 60 kHz and 8 to 12 kHz, respectively. Spinner dolphins consistently produce whistles with frequencies as high as 16.9 to 17.9 kHz with a maximum frequency for the fundamental component at 24.9 kHz. Clicks have a dominant frequency of 60 kHz. The burst pulses are predominantly ultrasonic, often with little or no energy below 20 kHz. Source levels between 195 and 222 dB re 1 µPa-m have been recorded for spinner dolphin clicks. Other research indicates that this species produces whistles in the range of 1 to 22.5 kHz with the dominant frequency being 6.8 to 17.9 kHz, although their full range of hearing may extend down to 1 kHz or below as reported for other small odontocetes (Nedwell *et al.* 2004).

***Occurrence in Q-20 Study Area:*** As a species with a preference for deep waters, the spinner dolphin is expected to occur from the continental shelf break to the 2,000 m (6,562 ft) isobaths. There is a low or unknown occurrence of the spinner dolphin seaward of the 2,000 m (6,562 ft) isobaths. Occurrence is assumed to be similar throughout the year.

### Clymene Dolphin (*S. clymene*)

***Description:*** The Clymene dolphin is easily confused with the spinner dolphin (and the short-beaked common dolphin) due to its similar appearance. The Clymene dolphin, however, is smaller and more robust, with a much shorter and stockier beak. The Clymene dolphin can reach at least 2 m (7 ft) in length and weights of at least 85 kg (187 lb). Available information on feeding habits is limited to the stomach contents of two individuals and one observation of free ranging dolphins; Clymene dolphins feed on small fish and squid.

***Status:*** For animals in the GOM, the best estimate of abundance for Clymene's dolphins is 6,575, with a minimum population estimate of 4,901 dolphins (Warring *et al.* 2010).

***Distribution:*** Sightings of these animals in the northern GOM occur primarily over the deeper waters off the continental shelf and primarily west of the Mississippi River *(NMFS, 2009f)*. In a study of habitat preferences in the GOM, Clymene dolphins were found more often on the lower slope and deep water areas in regions of cyclonic or confluence circulation. Clymene dolphins are found in deep waters with a mean bottom depth of 1,870 m (6,135 ft). Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** There is no diving information available for this species.

***Acoustics and Hearing:*** The only data available for this species is a description of their whistles. Clymene dolphin whistle structure is similar to that of other stenellids, but it is generally higher in frequency (range of 6.3 to 19.2 kHz). There is no empirical data on the hearing ability of Clymene dolphins; however, the most sensitive hearing range for odontocetes generally includes high frequencies.

***Occurrence in Q-20 Study Area:*** Based on the distribution of sighting records, the Clymene dolphin is expected to occur from the continental shelf break to the 3,000 m (9,843 ft) isobaths.

There has not been much survey effort in waters deeper than 3,000 m (9,843 ft), yet there are documented sightings seaward of the 3,000 m (9,843 ft) isobaths. Therefore, there is a low or unknown occurrence of the Clymene dolphin seaward of the 3,000 m (9,843 ft) isobaths. Occurrence is assumed to be the same during all seasons.

**Striped Dolphin (*Stenella coeruleoalba*)**

***Description:*** The striped dolphin is a uniquely marked dolphin, which is relatively robust and reaches 2.6 m (8.5 ft) in length. Striped dolphins often feed in pelagic or benthopelagic zones along or seaward of the continental slope. Small, midwater fish (in particular, myctophids or lantern fish) and squid are the dominant prey.

***Status:*** The best abundance estimate for striped dolphins in the northern GOM is 3,325, with a minimum population estimate of 2,266 striped dolphins (Warring *et al.* 2010).

***Distribution:*** The striped dolphin has a worldwide distribution in cool-temperate to tropical waters. In the western North Atlantic, this species is known from Nova Scotia southward to the Caribbean, the GOM, and Brazil. Striped dolphins are usually found outside the continental shelf, typically over the continental slope out to oceanic waters, often associated with convergence zones and waters influenced by upwelling. This species appears to avoid waters with sea temperatures of less than 20°C (68°F). Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Striped dolphins often feed in pelagic or benthopelagic zones along the continental slope or just beyond it in oceanic waters. A majority of their prey possesses luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 200 to 700 m (656 to 2,297 ft) to reach potential prey. Striped dolphins may feed at night in order to take advantage of the deep scattering layer's diurnal vertical movements.

***Acoustics and Hearing:*** Striped dolphin whistles range from 6 to greater than 24 kHz, with dominant frequencies ranging from 8 to 12.5 kHz. A single striped dolphin's hearing range, determined by using standard psycho-acoustic techniques, was from 0.5 to 160 kHz with best sensitivity at 64 kHz.

***Occurrence in Q-20 Study Area:*** The striped dolphin is expected to occur from the continental shelf break to the 2,000 m (6,562 ft) isobaths. There are a few confirmed sightings of striped dolphins seaward of the 2,000 m (6,562 ft) isobaths; therefore, there is a low or unknown occurrence of striped dolphins in waters with a bottom depth greater than 2,000 m (6,562 ft). Occurrence is assumed to be the same throughout the year.

**Fraser's Dolphin (*Lagenodelphis hosei*)**
***Description:*** The Fraser's dolphin reaches a maximum length of 2.7 m (8.9 ft) and is generally more robust than other small delphinids. Fraser's dolphins feed on midwater fish, squid, and shrimp.

***Status:*** The best estimate of abundance for Fraser's dolphins in the northern GOM is 726, with a minimum population estimate of 427 animals (Warring *et al.* 2010).

***Distribution:*** Fraser's dolphin is found in tropical and subtropical waters around the world, typically between 30ºN and 30ºS. Strandings in temperate areas are considered extralimital and usually are associated with anomalously warm water temperatures. This is an oceanic species except in places where deep water approaches the coast. In the GOM, this species occurs mostly in very deep waters well beyond the continental shelf break. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** There is no information available on depths to which Fraser's dolphins may dive, but they are thought to be capable of deep diving.

***Acoustics and Hearing:*** Very little is known of the acoustic abilities of the Fraser's dolphin. Fraser's dolphin whistles have a frequency range of 7.6 to 13.4 kHz. There are no hearing data for this species.

***Occurrence in Q-20 Study Area:*** Fraser's dolphin occurrence is assumed to be the same for all four seasons in the eastern GOM, and is expected to occur from the continental shelf break to the 3,000 m (9,843 ft) isobaths. This determination was based on the distribution of sightings in the Q-20 Study Area and the known habitat preferences of this species. Fraser's dolphins have been sighted over the abyssal plain in the southern GOM.

There is a low or unknown occurrence of the Fraser's dolphin seaward of the 3,000 m (9,843 ft) isobaths.

**Risso's Dolphin (*Grampus griseus*)**
***Description:*** The Risso's dolphin is a moderately large, robust animal reaching at least 3.8 m (12.5 ft) in length. Adults range from dark gray to nearly white and are heavily covered with white scratches and splotches. Cephalopods are the primary prey.

***Status:*** The best abundance estimate for Risso's dolphins in the northern GOM is 1,589, with a minimum population estimate of 1,271 dolphins (Warring *et al.* 2010).

***Distribution:*** The Risso's dolphin is distributed worldwide in tropical and warm-temperate waters, roughly between 60ºN and 60ºS, where surface water temperature is usually greater than 10 degrees Celsius (ºC) (50 degrees Fahrenheit [°F]). In the western North Atlantic, this species is found from Newfoundland southward to the GOM, throughout the Caribbean, and around the equator. A number of studies have noted that the Risso's dolphin is found along the continental slope. The strong correlation between the Risso's dolphin distribution and the steeper portions of the upper continental slope in the GOM is most likely the result of cephalopod distribution in the same area. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Individuals may remain submerged on dives for up to 30 min and dive as deep as 600 m.

***Acoustics and Hearing:*** Risso's dolphin vocalizations include broadband clicks, barks, buzzes, grunts, chirps, whistles, and combined whistle and burst-pulse sounds that range in frequency from 0.4 to 22 kHz and in duration from less than a second to several seconds. The combined whistle and burst pulse sound (2 to 22 kHz, mean duration of 8 sec) appears to be unique to Risso's dolphin. Risso's dolphins also produce echolocation clicks (40 to 70 μs duration) with a dominant frequency range of 50 to 65 kHz and estimated source levels up to 222 dB re 1 μPa-m peak-to-peak.

Baseline research on the hearing ability of this species was conducted in a natural setting (included natural background noise) using behavioral methods on one older individual. This individual could hear frequencies ranging from 1.6 to 100 kHz and was most sensitive between 8 and 64 kHz. Hearing in a stranded infant has also been measured. This individual could hear frequencies ranging from 4 to 150 kHz, with best sensitivity at 90 kHz. This study demonstrated that this species can hear higher frequencies than previously reported.

***Occurrence in Q-20 Study Area:*** The Risso's dolphin is most commonly found in areas with steep bottom topography. Based on this known habitat preference and the distribution of sighting records in the northern GOM, Risso's dolphins are expected to occur between the continental shelf break and the 2,000 m (6,562 ft) isobaths throughout the year. There is a concentrated occurrence of the Risso's dolphin south of the Mississippi River Delta to approximately where the DeSoto Canyon begins, from the shelf break to the vicinity of the 1,000 m (3,281 ft) isobaths. This is based on sighting concentrations, as well as the oceanography of the area being favorable to prey concentrations for this species. There is a low or unknown occurrence of this species in waters beyond the 2,000 m (6,562 ft) isobaths.

**Melon-Headed Whale (*Peponocephala electra*)**

***Description:*** Melon-headed whales at sea closely resemble pygmy killer whales. Melon-headed whales reach a maximum length of 2.75 m (9 ft). Melon-headed whales prey on squid, pelagic fish, and occasionally crustaceans. Most of the fish and squid families eaten by this species consist of mesopelagic species found in waters up to 1,500 m (4,921 ft) deep, suggesting that feeding takes place deep in the water column.

***Status:*** The best estimate of abundance for melon-headed whales in the northern GOM is 2,283, with a minimum population estimate of 1,293 melon-headed whales (Warring *et al.* 2010).

***Distribution:*** Melon-headed whales are found worldwide in deep tropical and subtropical waters. Little information is available on habitat preferences for this species. Most melon-headed whale sightings in the GOM have been in deep waters, well beyond the edge of the continental shelf and waters out over the abyssal plain. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** There is no diving information available for this species. Melon-headed whales prey on squid, pelagic fish, and occasionally crustaceans. Most of the fish and squid families eaten by this species consist of mesopelagic species found in waters up to 1,500 m (4,921 ft) deep, suggesting that feeding takes place deep in the water column.

***Acoustics and Hearing:*** The only published acoustic information for melon-headed whales is from the southeastern Caribbean. Sounds recorded included whistles and click sequences. Whistles had dominant frequencies around 8 to 12 kHz; higher-level whistles were estimated at no more than 155 dB re 1 μPa-m. Clicks had dominant frequencies of 20 to 40 kHz; higher-level click bursts were judged to be about 165 dB re 1 μPa-m. No data on hearing ability for this species are available.

***Occurrence in Q-20 Study Area:*** Melon-headed whales and pygmy killer whales can be difficult to distinguish from one another, and on many occasions, only a determination of "pygmy killer whale/melon-headed whale" can be made. The occurrence of both species is considered similar and therefore appears combined. Based on known preferences of the melon-headed whale for deep waters and the confirmed sightings of this species in the GOM, melon-headed whales are expected to occur between the continental shelf break and the 3,000 m (9,843 ft) isobaths. There is a low or unknown occurrence of melon-headed whales in waters with a bottom depth greater than 3,000 m (9,843 ft) based on the few available sighting records.

Melon-headed whale occurrence patterns are expected to be the same year-round in the eastern GOM.

**Pygmy Killer Whale (*Feresa attenuata*)**

***Description:*** Pygmy killer whales and melon-headed whales can be difficult to distinguish from one another, and on many occasions, only a determination of "pygmy killer whale/melon-headed whale" can be made. The rounded flipper shape is the best distinguishing characteristic of a pygmy killer whale. Pygmy killer whales reach lengths of up to 2.6 m (8.5 ft). Pygmy killer whales eat mostly fish and squid, and sometimes attack other dolphins.

***Status:*** The best estimate of abundance for pygmy killer whales in the northern GOM is 323. The minimum population estimate for the northern GOM is 203 pygmy killer whales (Warring *et al.* 2010).

***Distribution:*** This species has a worldwide distribution in deep tropical, subtropical, and warm temperate oceans. Pygmy killer whales generally do not range north of 40ºN or south of 35ºS. The sparse number of pygmy killer whale sightings might be due to its somewhat cryptic behavior. The pygmy killer whale is a deepwater species, with a possible occurrence most likely in waters outside the continental shelf break. This species does not appear to be common in the GOM. In the northern GOM, the pygmy killer whale is found primarily in deeper waters beyond the continental shelf extending out to waters over the abyssal plain.

***Diving Behavior:*** There is no diving information available for this species.

***Acoustics and Hearing:*** The pygmy killer whale emits short duration, broadband signals similar to a large number of other delphinid species. Clicks produced by pygmy killer whales have centered frequencies between 70 and 85 kHz; there are bimodal peak frequencies between 45 and 117 kHz. The estimated source levels are between 197 and 223 dB re 1 μPa-m. These clicks possess characteristics of echolocation clicks. There are no hearing data available for this species.

***Occurrence in Q-20 Study Area:*** As stated previously, pygmy killer whales and melon-headed whales can be difficult to distinguish from one another, and on many occasions, only a determination of "pygmy killer whale/melon-headed whale" can be made. The occurrence of both species is considered similar and therefore appears combined. Based on confirmed sightings of the pygmy killer whale in the GOM and this species' propensity for deeper water, pygmy killer whales are expected to occur between the continental shelf break and the 3,000 m (9,843 ft) isobaths. There is a low or unknown occurrence of pygmy killer whales in waters with a bottom depth greater than 3,000 m (9,843 ft) based on the few available sighting records.

Pygmy killer whales are thought to occur year-round in the GOM in small numbers and occurrence patterns are expected to be the same year-round. Additional information on reproductive areas and seasons is not available for this species.

**False Killer Whale (*Pseudorca crassidens*)**

***Description:*** The false killer whale is a large, dark gray to black dolphin reaching lengths of 6.1 m (20.0 ft). The flippers have a characteristic hump on the leading edge; this is perhaps the best characteristic in distinguishing this species from the other "blackfish" (pygmy killer, melon-headed, and pilot whales).

***Status:*** The best estimate of abundance for false killer whales in the northern GOM is 777. The minimum population estimate for the northern GOM is 501 false killer whales (Warring *et al.* 2010).

***Distribution:*** False killer whales are found in tropical and temperate waters, generally between 50ºS and 50ºN with a few records north of 50ºN in the Pacific and the Atlantic. This species is found primarily in oceanic and offshore areas, though they do approach close to shore at oceanic islands. Inshore movements are occasionally associated with movements of prey and shoreward flooding of warm ocean currents. In the western North Atlantic, false killer whales have been reported off Maryland southward along the mainland coasts of North America, the GOM, and the southeastern Caribbean Sea. Although sample sizes are small, most false killer whale sightings in the GOM are east of the Mississippi River, and sightings of this species in the northern GOM occur in oceanic waters greater than 200 m (656 ft) deep. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** There is no diving information available for this species. However, it is known that false killer whales primarily eat deep-sea cephalopods and fish, and have been known to attack other toothed whales, including sperm whales and baleen whales. False killer whales in many different regions are known to take tuna from long-lines worldwide.

***Acoustics and Hearing:*** Dominant frequencies of false killer whale whistles are from 4 to 9.5 kHz, and those of their echolocation clicks are from either 20 to 60 kHz or 100 to 130 kHz depending on ambient noise and target distance. Click source levels typically range from 200 to 228 dB re 1 μPa-m. Recently, false killer whales recorded in the Indian Ocean produced echolocation clicks with dominant frequencies of about 40 kHz and estimated source levels of 201-225 dB re 1 μPa-m. False killer whales can hear frequencies ranging from approximately 2 to 115 kHz with best hearing sensitivity ranging from 16 to 64 kHz. Additional behavioral audiograms of false killer whales support a range of best hearing sensitivity between 16 and 24 kHz, with peak sensitivity at 20 kHz, peaking at 22.5 kHz.

***Occurrence in Q-20 Study Area:*** Most sightings of false killer whales in the GOM have been made in oceanic waters with a bottom depth greater than 200 m (656 ft); there also have been sightings from over the continental shelf. False killer whales are expected to occur between the continental shelf break and the 2,000 m (6,562 ft) isobaths throughout the GOM. There is a low or unknown occurrence of this species seaward of the 2,000 m (6,562 ft) isobaths, which is based on the sighting records. There is also a low or unknown occurrence of false killer whales between the 50 m (164 ft) isobaths and the shelf break in the Q-20Study Area. This was based on the fact that false killer whales sometimes make their way into shallower waters, such as off Hong Kong and in the GOM, as well as many sightings reported by sport fishermen in the mid-1960s of "blackfish" (most likely false killer whales based on the descriptions) in waters offshore of Pensacola and Panama City, Florida. There have been occasional reports of fish stealing by these animals (the false killer whale frequently has been implicated in such fishery interactions). False killer whale occurrence patterns in the eastern GOM are expected to be the same throughout the year.

***Killer Whale (Orcinus orca)***

***Description:*** The killer whale is the largest member of the dolphin family; females may reach 7.7 m (25.3 ft) in length and males 9.0 m (29.5 ft). The black-and-white color pattern of this species is striking as is the tall, erect dorsal fin of the adult male (1.0 to 1.8 m in height [3.3 to 5.9 ft]). Killer whales feed on bony fish, elasmobranches, cephalopods, seabirds, sea turtles, and other marine mammals.

***Status:*** The best estimate of abundance for killer whales in the northern GOM is 49, with a minimum population estimate of 28 (NMFS, 2010c).

***Distribution:*** This is a cosmopolitan species found throughout all oceans and contiguous seas, from equatorial regions to the polar pack ice zones. Although found in tropical waters and the open ocean, killer whales as a species are most numerous in coastal waters and at higher latitudes. Killer whales have the most ubiquitous distribution of any species of marine mammal, and they have been observed in virtually every marine habitat from the tropics to the poles and from shallow, inshore waters (and even rivers) to deep, oceanic regions. In coastal areas, killer whales often enter shallow bays, estuaries, and river mouths. In the western North Atlantic, killer whales are known from the polar pack ice southward to Florida, the Lesser Antilles, and the GOM. Killer whales are sighted year-round in the northern GOM. It is not known whether killer whales in the GOM stay within the confines of the GOM or range more widely into the Caribbean and adjacent North Atlantic Ocean. Little is known of the movement patterns of killer whales in this region. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** The maximum depth recorded for free-ranging killer whales diving off British Columbia is 264 m (866 ft). On average, however, for seven tagged individuals, less than 1% of all dives examined were to depths greater than 30 m (98 ft). A trained killer whale dove to a maximum of 260 m (853 ft). The longest duration of a recorded dive from a radio-tagged killer whale was 17 min.

***Acoustics and Hearing:*** Killer whales produce a wide-variety of clicks and whistles, but most of this species' social sounds are pulsed, with frequencies ranging from 0.5 to 25 kHz (dominant frequency range: 1 to 6 kHz). Echolocation clicks recorded for this species indicate source levels ranging from 195 to 224 dB re 1 μPa-m peak-to-peak, dominant frequencies ranging from 20 to 60 kHz, and durations of 80 to 120 μs. Source levels associated with social sounds have been calculated to range from 131 to 168 dB re 1 μPa-m and have been demonstrated to vary with vocalization type (e.g., whistles:

average source level of 140.2 dB re 1 μPa-m, variable calls: average source level of 146.6 dB re 1 μPa-m, and stereotyped calls: average source level 152.6 dB re 1 μPa-m). Additionally, killer whales modify their vocalizations depending on social context or ecological function (i.e., short-range vocalizations [<10 km, or 6.2 mile, range]) are typically associated with social and resting behaviors and long-range vocalizations [10 to 16 km, or 6.2 to 9.9 mile, range] associated with travel and foraging.

Acoustic studies of resident killer whales in British Columbia have found that they possess dialects, which are highly stereotyped, repetitive discrete calls that are group-specific and are shared by all group members. These dialects are likely used to maintain group identity and cohesion and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales. Dialects have been documented in northern Norway and southern Alaskan killer whales populations and likely occur in other regions as well. Both behavioral and ABR techniques indicate killer whales can hear a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz, which is one the lowest maximum-sensitivity frequency known among toothed whales.

***Occurrence in Q-20 Study Area:*** Killer whale sightings in the northern GOM are generally clumped in a broad region south of the Mississippi River Delta and in waters ranging in bottom depth from 256 to 2,652 m (840 to 8,701 ft). Based on this information, killer whales are expected to occur in an area south of the Mississippi River Delta from the shelf break into waters with an approximate bottom depth of 2,000 m (6,562 ft). Sightings have been made in waters over the continental shelf (including close to shore) as well as in waters past the 2,000 m (6,562 ft) isobaths. There is a low or unknown possibility of encountering killer whales anywhere in the GOM (besides the before-mentioned area of expected occurrence) shoreward of the 10 m (33 ft) isobaths. Occurrence patterns are assumed to be similar for all seasons.

**Short-Finned Pilot Whale (*Globicephala macrorhynchus*)**
***Description:*** Pilot whales are among the largest members of the dolphin family. The shortfinned pilot whale (*G. macrorhynchus*) may attain lengths of 5.5 m (18 ft) (females) and 6.1 m (20 ft) (males). The closely related long-finned pilot whale (*Globicephala melas*) is not known to occur in the GOM.

***Status:*** For short-finned pilot whales in the GOM, the best estimate of abundance is 716, with a minimum population estimate of 542 animals (NMFS, 2009k).

***Distribution:*** The short-finned pilot whale usually does not range north of 50ºN or south of 40ºS. Pilot whales are found in both near shore and offshore environments. Pilot whales are found over the continental shelf break, in slope waters, and in areas of high topographic relief. Pilot whales are sometimes seen in waters over the continental shelf. A number of studies have found the distribution and movements of pilot whales to coincide closely with the abundance of squid. The occurrence of pilot whales in the Southern California Bight was found to be associated with high relief topography, which has been related to the squid-feeding habits of pilot whales. This is likely the case in other geographic locations. Additional information on reproductive areas and seasons is not available for this species.

***Diving Behavior:*** Pilot whales are deep divers; foraging dives deeper than 600 m (1,969 ft) are recorded. Pilot whales are able to stay submerged for up to 40 min.

***Acoustics and Hearing:*** Short-finned pilot whale whistles and clicks have a dominant frequency range of 2 to 14 kHz and 30 to 60 kHz, respectively, at an estimated source level of 180 dB re 1 μPa-m. There are no hearing data available for either pilot whale species.

***Occurrence in Q-20 Study Area:*** The identifications of many pilot whale specimen records in the GOM, and most or all sightings, have not been unequivocally shown to be of the short-finned pilot whale. There are no confirmed records of long-finned pilot whales in the GOM. Based on known distribution and habitat preferences of pilot whales, it is assumed that all of the pilot whale records in the northern GOM are of the short-finned pilot whale. Based on sightings and the apparent preference of pilot whales for steep bottom topography, this species is expected to occur from the continental shelf break to the 2,000 m (6,562 ft) isobaths in the Q-20 Study Area. There is a low or unknown occurrence of pilot whales between the 10 m (33 ft) isobaths and the shelf break, east of Cape San Blas, Florida, past the Florida Keys. There is a low or unknown occurrence of pilot whales between the 2,000 and 3,000 m (6,562- and 9,843 ft) isobaths. Pilot whales do have an oceanic distribution, and the few shipboard surveys that have occurred past the 2,000 m (6,562 ft) isobaths have occasionally recorded pilot whales. There is a preponderance of pilot whale sightings in the historical records for the northern GOM. Pilot whales, however, are less often reported during recent surveys, such as GulfCet (DON 2007). The reason for this apparent decline is not known, but it has been suggested that abundance or distribution patterns might have changed over the past few decades, perhaps due to changes in available prey species. Occurrence patterns are assumed to be the same throughout the year.

## 3.3 Socioeconomic Environment

### 3.3.1 Tourism

The coastal zone of the northern GOM is one of the major tourist and recreational regions of the United States, especially for marine fishing and beach activities. Recreational resources include coastal beaches, barrier islands, coral reefs, estuarine bays and sounds, river deltas, and tidal marshes. Many of the areas used for recreational purposes are held in trust for the public under Federal, state, and local jurisdiction as parks and landmarks. Commercial facilities such as resorts and marinas are also primary areas for tourist activity. However, the proposed Q-20 testing area is located offshore of the northern GOM. Therefore it is outside the areas where regularly visited by tourists.

### 3.3.2 Recreational Fishing

The GOM waters are estimated to support almost 30% of the nation's marine recreational fishing, with 3.6 million anglers in 2006 who caught an estimated 191 million fish during more than 23 million individual fishing trips (DON 2009). Almost 109 million of the fish were caught from private/rental boats, nearly 8 million from charter boats, and almost 43 million from the shore.

In the GOM, recreational fishing activities typically occur within 5 km (2.7 nm) of the shoreline, with anglers fishing from shore or from private or charter boats. Recreational fishing activities also include fishing from charter boats that go into deep water. Party boats fish primarily over offshore hard-bottom areas, wrecks, or artificial reefs for amberjack, barracuda, groupers, snapper, grunts, porgies, and sea bass.

### 3.3.3 Recreational Boating

Recreational boating activities in the eastern GOM are primarily associated with sport fishing, charter boat fishing, sport diving, sailing, power cruising, and other recreational boating activities. Recreational fishing boats and other recreational boats range throughout coastal waters in the northeast GOM, depending on the season and weather conditions. Most recreational fishing and boating occur within a few miles of shore, with boats generally returning to the point of departure. Fishing charters and recreational fishing boats pursuing sport fishing opportunities in deeper water can be expected to traverse the eastern GOM. Fishing parties may also enter the eastern GOM to fish at artificial reefs. Numerous artificial reefs have been established along the coast of the northeastern GOM, many of them at considerable distances from shore.

The area within and adjacent to the GOM contains many sites popular with scuba divers and snorkelers. Many of the favored dive sites are wrecks and artificial reefs. There are close to 300 named dive sites off the Florida coast from the Florida Keys to Pensacola. The vast majority of these sites is located within 40 km (21.6 nm) of shore and thus is outside the Q-20 testing area.

### 3.3.4 Commercial Fishing

The GOM is one of the most important commercial fishing areas in the United States based on landings by volume and economic value. High concentrations of profitable fish are typically found along the eastern GOM, at the Florida Big Bend Seagrass beds, the Florida Middle Grounds, the mid-Outer Continental Shelf (OCS), and the DeSoto Canyon Protected Areas. Red drum, spotted seatrout, gulf menhaden, and striped mullet are important commercial species. Fishermen also target species like pinfish, croakers, flounders, sea robin, lizardfish, rays, and skates that are associated with bottom habitats.

### 3.3.5 Commercial Shipping

Seven of Florida's deepwater ports are located on the GOM: Port of Pensacola, Port of Panama City, Port St. Joe, Port of St. Petersburg, Port of Tampa, Port Manatee, and Port of Key West. It is estimated that approximately 45% of U.S. shipping tonnage passes through GOM ports (DON 2009). The GOM supports the second largest marine transport industry in the world.

### 3.3.6 Military Activities

The offshore areas of the northern GOM are also active sites for a variety of U.S. Navy activities. The Navy's Gulf of Mexico (GOMEX) Range Complex is located in the northern GOM. It includes 17,440 $nm^2$ of offshore surface and subsurface operation areas (OPAREA) and 12,072 $nm^2$ of shallow ocean area less than 100 fathoms (600 ft) deep. The Navy has been training in the GOMEX Range Complex for national defense purposes for over 70 years. The GOMEX Range Complex provides the infrastructure and proximity that allows for all levels of training which include mine warfare, surface warfare, air warfare, strike warfare, and amphibious warfare trainings (DON 2010).

In addition, the NSWC PCD, which includes W-151, W-155, W-470 areas, and St. Andrew Bay in the northern GOM, conducts new and increased mission operations for the Navy that support eight primary research, development, test and evaluation (RDT&E) capabilities: air, surface, and subsurface operations, sonar, laser, electromagnetic, live ordnance, and projectile firing operations. NSWC PCD's activities occur either on or over the waters within the northern GOM.

# CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

This chapter outlines the effects or impacts to the aforementioned resources in the Gulf of Mexico from the proposed action and alternatives. Significance of these effects is determined by considering the context in which the action will occur and the intensity of the action. The context in which the action will occur includes the specific resources, ecosystem, and the human environment affected. The intensity of the action includes the type of impact (beneficial versus adverse), duration of impact (short versus long term), magnitude of impact (minor versus major), and degree of risk (high versus low level of probability of an impact occurring).

The terms "effects" and "impacts" are used interchangeably in preparing these analyses. The CEQ's regulations for implementing the procedural provisions of NEPA, also state, "Effects and impacts as used in these regulations are synonymous" (40 CFR §1508.8). The terms "positive" and "beneficial", or "negative" and "adverse" are likewise used interchangeably in this analysis to indicate direction of intensity in significance determination.

## 4.1 Effects of Alternative 1 – No Action Alternative

Under the No Action Alternative, NMFS would not issue an IHA to the Navy for the harassment of marine mammals incidental to conducting Q-20 testing activities at its NSWC PCD test area in the non-territorial waters of the Gulf of Mexico. In this case, the Navy would decide whether or not they would want to continue with its proposed Q-20 testing activities. If the Navy choose not to conduct the activities, then there would be no effects to marine mammals. Conducting these activities without an MMPA authorization (i.e., an IHA) could result in a violation of Federal law. If the Navy decides to conduct some or all of the activities without implementing any mitigation measures, and if activities occur when marine mammals are present in the action areas, there is the potential for unauthorized harassment of marine mammals. The sounds produced by the Q-20 sonar could cause behavioral harassment of marine mammals in the action areas, while some marine mammals may avoid the area of ensonification or with testing activities altogether. Auditory impacts (i.e., temporary and permanent threshold shifts) could also occur if no mitigation or monitoring measures are implemented. As explained later in this document, monitoring of exclusion zone for the presence of marine mammals allows for the implementation of mitigation measures, such as shutdowns of sonar transmission when marine mammals occur within the zone. These measures are required to avoid the onset of shifts in hearing thresholds. However, if a marine mammal occurs within these high energy ensonified zones, it is possible that hearing impairments to marine mammals could occur. Additionally, although unlikely, based on its proximity to the Q-2 sonar system, permanent threshold shift (PTS) could also occur, but this possibility is thought to be unlikely if the exposure is of a few pulses. If the Navy were to decide to implement mitigation and monitoring measures similar to those described in Chapter 5 of this EA, then the impacts would most likely be similar to those described for Alternative 2 below.

## 4.2 Effects of Alternative 2 – Preferred Alternative

Under this alternative, NMFS would issue an IHA to the Navy for its proposed Q-20 testing with required mitigation, monitoring, and reporting requirements as discussed in Chapter 5 of this EA. As part of NMFS' action, the mitigation and monitoring described later in this EA would be undertaken as required by the MMPA, and, as a result, no serious injury or mortality of marine mammals is expected and correspondingly no impact on the reproductive or survival ability of affected species would occur. Potentially affected marine mammal species under NMFS' jurisdiction would be: bottlenose dolphin, pantropical spotted dolphin, Atlantic spotted dolphin, spinner dolphin, Clymene dolphin, and striped dolphin. None of these species is listed as endangered under the ESA.

### 4.2.1 Effects on Physical Environment

Although NMFS does not expect the physical environment would be directly affected from the proposed action, it could be indirectly affected by the Q-20 testing activities. Therefore, as part of the environmental analysis, the effects on the physical environment are analyzed as part of the environmental consequences analysis.

#### 4.2.1.1 Effects on Geology and Oceanography

The sonar testing activities of the proposed Navy's Q-20 testing in the non-territorial waters of GOM will have no effects on the geology and geomorphology and the physical oceanography of the project area. The proposed Navy's action is sonar testing, and the resultant activities will not affect the stratigraphy, seafloor sediments and geology, or sub-seafloor geology in any way. The proposed Q-20 testing will not affect the GOM circulation patterns, topography, bathymetry, or incoming water masses; atmospheric pressure systems; surface-water runoff; or density differences between water masses.

#### 4.2.1.2 Effects on Air Quality

The proposed Q-20 testing by the Navy in the GOM will have a minimal, temporary, and localized effect on air quality in the project area and no measurable effect on air quality on the GOM coastline. The sporadic activities and significant distance to shore will ensure that the potential effects from the vessels' emissions will not represent any threat to the project area or the GOM coastline air quality.

#### 4.2.1.3 Effects on Acoustic Environment

Potential effects on the marine acoustic environment within the Navy's Q-20 testing activities in the GOM include sound generated by the sonar system and other active acoustic sources for navigational purposes. As described in Section 1.4.3.1, all the Q-20 are high-frequency sonar systems which will have high absorption as their signals are transmitted through the water column. Therefore, these effects are expected to be localized to the project areas and temporary, occurring only during Q-20 testing.

### 4.2.2 Effects on Biological Environment

#### 4.2.2.1 Effects on Lower Trophical Organisms

Lower trophic-level organisms present in the prospect areas include phytoplankton, zooplankton, and invertebrates. The types of lower trophic organisms found in the proposed Q-20 testing areas by the Navy in the GOM are described in Sections 3.2.1 and 3.2.2. The potential effect of sound from the active acoustic sources (including Q-20 sonar and other active acoustic navigational equipment) and vessels on lower trophic-level organisms is discussed below.

Reactions of zooplankton to sound are, for the most part, not known. Their abilities to move significant distances are limited or nil, depending on the type of animal. Studies on euphausiids and copepods have documented the use of hearing receptors to maintain schooling structures (Wiese 1996) and detection of predators (Wong 1996); therefore, these organisms have some sensitivity to sound. However, the intensity of this type of high-frequency sonar is much lower than the intensity of sound energy required to negatively affect zooplankton. Pressure changes of sufficient magnitude to cause that type of reaction would probably occur only near the sonar source, which is expected to be a very small area. Impacts on zooplankton behavior are predicted to be negligible.

The physiology of many marine invertebrates is such that they are the same density as the surrounding water; therefore, sudden changes in pressure, such as that caused by a sudden loud sound, is unlikely to cause physical damage. There have been some studies evaluating potential effects of sound energy from seismic surveys on marine invertebrates (e.g., crabs and bivalves) and other marine organisms (e.g., sea sponges and polychaetes). Studies on brown shrimp in the Wadden Sea (Webb and Kempf 1998) have revealed no particular sensitivity to sounds generated by airguns used in seismic activities with sound levels of 190 dB at 1.0 m (3.3 ft) in water depths of 2.0 m (6.6 ft). According to reviews by Thomson and Davis (2001) and Moriyasu *et al.* (2004), seismic survey sound pulses have limited effect on benthic invertebrates, and observed effects are typically restricted to animals within a few meters of the sound source. Although no studies on the effects of sonar signal on invertebrates is available, it can be assumed that it is similar to that of seismic impulse. No appreciable, adverse effect on benthic populations would be expected, due in part to large reproductive capacities and naturally high levels of predation and mortality of these populations.

#### 4.2.2.2 Effects on Fish

Use of sonar and laser equipment has the potential to affect fish. The sonar frequencies proposed in the Navy's Q-20 testing activities are at or above 35 kHz, and fish hearing predominantly occurs below 1 kHz, although some fish, notably clupeids – which include sardines, herring, anchovies, menhaden – are able to detect and may react to mid- or high-frequency sounds (DON 2009). Fish within a few meters of the Q-20 could be affected due to the pressure differential associated with a high-energy sonar pulse (Popper 2008), but in the open ocean, the most likely response would be to avoid the source. There is no evidence of ecologically significant behavioral responses by fish to sonar (Popper 2008). Accordingly, sonar operations associated with the proposed Q-20 testing are expected to have only minor, localized, and temporary effects, if any, on fish populations.

Mitson and Knudsen (2003) examined the causes and effects of fisheries research-vessel noise on fish abundance estimation and noted that avoidance behavior by a herring school was shown due to a noisy vessel; by contrast, there is an example of no reaction of herring to a noise-reduced vessel. They note a study wherein the FRV Johan Hjort was using a propeller shaft speed of 125 revolutions per minute, giving a radiated noise level sufficient to cause fish avoidance behavior at 560 m distance when traveling at 9 knots, but it reduced to 355 m at 10 knots. They show that large changes in noise level occur for a small change in speed. Their data also suggest abnormal fish activity continues for some time as the vessel travels away from the recording buoy used in the study.

Vessel traffic may disturb some fish resources and their habitat during operations. However, vessel noise is expected to be chiefly transient; fishes in the immediate vicinity of such vessels are believed likely to avoid such noise perhaps by as much as several hundred meters. Vessel noise is likely to be of negligible impact to fish resources.

Therefore, in conclusion, NMFS finds that the issuance of an IHA to the Navy would not result in significant harm to fish.

#### 4.2.2.3 Effects on Sea Turtle

Maximum sensitivity of the five species to underwater sound occurs in the low-frequency spectrum. The Q-20 only operates in the high-frequency range. There is no evidence of potential high-frequency sonar effects on sea turtles. The best available scientific data, including low audiometric and behavioral sensitivity of sea turtles to low-frequency sound, and their navigation techniques through sensory systems other than hearing, were presented in the NSWC PCD EIS/OEIS (DON 2009), leading to the conclusion that sonar operations of all types, including the Q-20, would have no effect on sea turtles.

#### 4.2.2.4 Effects on Marine Birds

Little is known about the general hearing or underwater hearing capabilities of birds, but research suggests an in-air maximum auditory sensitivity between 1 and 5 kHz (DON 2009). No scientific evidence exists to show that birds can hear mid-frequency sounds underwater. Even if some diving bird species are able to hear at moderately high frequencies, effects from the proposed action are unlikely for the following reasons (DON 2009): there is no evidence that diving birds use underwater sound; they spend a small fraction of time submerged and could rapidly fly away from the area and disperse to other areas if disturbed; the minimum frequency used in the Proposed Action is 35 kHZ; and it is scientifically reasonable to extend these reasons to mid- and high-frequency active sonar. Furthermore, it is extremely unlikely that active sonar use will coincide with the dive of a bird, particularly because they spend a short period of time underwater (DON 2009).

#### 4.2.2.5 Effects on Marine Mammals

The proposed Q-20 sonar testing activities in the Q-20 Study Area could potentially result in harassment to marine mammals. Although surface operations related to sonar testing involve ship movement in the vicinity of the Q-20 test area, NMFS considers it unlikely that ship strike could occur as analyzed below.

#### 4.2.2.5a Surface Operations

Typical operations occurring at the surface include the deployment or towing of mine countermeasures (MCM) equipment, retrieval of equipment, and clearing and monitoring for non-participating vessels. As such, the potential exists for a ship to strike a marine mammal while conducting surface operations. In an effort to reduce the likelihood of a vessel strike, the mitigation and monitoring measures discussed below would be implemented.

Collisions with commercial and U.S. Navy vessels can cause major wounds and may occasionally cause fatalities to marine mammals. The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (e.g., the sperm whale). Laist *et al.* (2001) identified 11 species known to be hit by ships worldwide. Of these species, fin whales are struck most frequently; followed by right whales, humpback whales, sperm whales, and gray whales. More specifically, from 1975 through 1996, there were 31 dead whale strandings involving four large whales along the GOM coastline. Stranded animals included two sei whales, four minke whales, eight Bryde's whales, and 17 sperm whales. Only one of the stranded animals, a sperm whale with propeller wounds found in Louisiana on 9 March 1990, was identified as stranding as a result of a possible ship strike (Laist *et al.* 2001). In addition, from 1999 through 2003, there was only one stranding involving a false killer whale in the northern GOM (Alabama 1999) (Waring *et al.* 2007). According to the 2010 Stock Assessment Report (Waring *et al.* 2011), during 2009 there was one known Bryde's whale mortality as a result of a ship strike. Otherwise, no other marine mammal that is likely to occur in the northern GOM has been reported as either seriously or fatally injured as a result of a ship strike from 1999 through 2009 (Waring et al. 2007).

It is unlikely that activities in non-territorial waters will result in a ship strike because of the nature of the operations and size of the vessels. For example, the hours of surface operations take into consideration operation times for multiple vessels during each test event. These vessels range in size from small Rigid Hull Inflatable Boat (RHIB) to surface vessels of approximately 420 feet. The majority of these vessels are small RHIBs and medium-sized vessels. A large proportion of the timeframe for the Q-20 test events include periods when ships remain stationary within the test site.

The greatest time spent in transit for tests includes navigation to and from the sites. At these times, the Navy follows standard operating procedures (SOPs). The captain and other crew members keep watch during ship transits to avoid objects in the water. Furthermore, with the implementation of the proposed mitigation and monitoring measures described below, NMFS believes that it is unlikely vessel strikes would occur. Consequently, because of the nature of the surface operations and the size of the vessels, the proposed mitigation and monitoring measures, and the fact that cetaceans typically more vulnerable to ship strikes are not likely to be in the project area, the NMFS concludes that ship strikes are unlikely to occur in the Q-20 Study Area.

### 4.2.2.5b Acoustic Effects: Exposure to Sonar

For activities involving active tactical sonar, NMFS's analysis will identify the probability of lethal responses, physical trauma, sensory impairment (permanent and temporary threshold shifts and acoustic masking), physiological responses (particular stress responses), behavioral disturbance (that rises to the level of harassment), and social responses that would be classified as behavioral harassment or injury and/or would be likely to adversely affect the species or stock through effects on annual rates of recruitment or survival. In this section, we will focus qualitatively on the different ways that exposure to sonar signals may affect marine mammals. Then, in the Estimated Take of Marine Mammals section, NMFS will relate the potential effects on marine mammals from sonar exposure to the MMPA regulatory definitions of Level A and Level B Harassment and attempt to quantify those effects.

**Direct Physiological Effects**

Based on the literature, there are two basic ways that Navy sonar might directly result in physical trauma or damage: Noise-induced loss of hearing sensitivity (more commonly-called "threshold shift") and acoustically mediated bubble growth. Separately, an animal's behavioral reaction to an acoustic exposure might lead to physiological effects that might ultimately lead to injury or death, which is discussed later in the Stranding section.

***Threshold Shift (Noise-Induced Loss of Hearing)***

When animals exhibit reduced hearing sensitivity (i.e., sounds must be louder for an animal to recognize them) following exposure to a sufficiently intense sound, it is referred to as a noise-induced threshold shift (TS). An animal can experience temporary threshold shift (TTS) or permanent threshold shift (PTS). TTS can last from minutes or hours to days (i.e., there is recovery), occurs in specific frequency ranges (e.g., an animal might only have a temporary loss of hearing sensitivity between the frequencies of 1 and 10 kHz)), and can be of varying amounts (for example, an animal's hearing sensitivity might be reduced by only 6 dB or reduced by 30 dB). PTS is permanent (i.e., there is no recovery), but also occurs in a specific frequency range and amount as mentioned in the TTS description.

The following physiological mechanisms are thought to play a role in inducing auditory TSs: Effects on sensory hair cells in the inner ear that reduce their sensitivity, modification of the chemical environment within the sensory cells, residual muscular activity in the middle ear, displacement of certain inner ear membranes, increased blood flow, and post-stimulatory reduction in both efferent and sensory neural output (Southall *et al.* 2007). The amplitude, duration, frequency, temporal pattern, and energy distribution of sound exposure all affect the amount of associated TS and the frequency range in which it occurs. As amplitude and duration of sound exposure increase, so, generally, does the amount of TS. For continuous sounds, exposures of equal energy (the same SEL) will lead to approximately equal effects. For intermittent sounds, less TS will occur than from a continuous exposure with the same energy (some recovery will occur between exposures) (Kryter 1985; 1994; Ward 1997). For example, one short but loud (higher SPL) sound exposure may induce the same impairment as one longer but softer sound, which in turn may cause more impairment than a series of several intermittent softer sounds with the same total energy (Ward 1997). Additionally, though TTS is temporary, very prolonged exposure to sound strong enough to elicit TTS, or shorter-term exposure to sound levels well above the TTS threshold, can cause PTS, at least in terrestrial mammals (Kryter 1985) (although in the case of Navy sonar, animals are not expected to be exposed to levels high enough or durations long enough to result in PTS).

PTS is considered auditory injury (Southall et al. 2007). Irreparable damage to the inner or outer cochlear hair cells may cause PTS, however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.* 2007).

Although the published body of scientific literature contains numerous theoretical studies and discussion papers on hearing impairments that can occur with exposure to a loud sound, only a few studies provide empirical information on the levels at which noise-induced loss in hearing sensitivity occurs in nonhuman animals. For cetaceans, published data are limited to the captive bottlenose dolphin and beluga whale (Finneran *et al.* 2000; 2002; 2005; Schlundt *et al.* 2000; Nachtigall *et al.* 2003; 2004).

Marine mammal hearing plays a critical role in communication with conspecifics, and interpreting environmental cues for purposes such as predator avoidance and prey capture. Depending on the frequency range of TTS degree (dB), duration, and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious (similar to those discussed in auditory masking, below). For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animal is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present.

Alternatively, a larger amount and longer duration of TTS sustained during a time when communication is critical for successful mother/calf interactions could have more serious impacts. Also, depending on the degree and frequency range, the effects of PTS on an animal could range in severity, although it is considered generally more serious because it is a long term condition. Of note, reduced hearing sensitivity as a simple function of development and aging has been observed in marine mammals, as well as humans and other taxa (Southall *et al.* 2007), so we can infer that strategies exist for coping with this condition to some degree, though likely not without cost. There is no empirical evidence that exposure to Navy sonar can cause PTS in any marine mammals; instead the probability of PTS has been inferred from studies of TTS (see Richardson *et al.* 1995).

***Acoustically Mediated Bubble Growth***

One theoretical cause of injury to marine mammals is rectified diffusion (Crum and Mao 1996), the process of increasing the size of a bubble by exposing it to a sound field. This process could be facilitated if the environment in which the ensonified bubbles exist is supersaturated with gas. Repetitive diving by marine mammals can cause the blood and some tissues to accumulate gas to a greater degree than is supported by the surrounding environmental pressure (Ridgway and Howard 1979). The deeper and longer dives of some marine mammals (for example, beaked whales) are theoretically predicted to induce greater supersaturation (Houser *et al.* 2001). If rectified diffusion were possible in marine mammals exposed to high-level sound, conditions of tissue supersaturation could theoretically speed the rate and increase the size of bubble growth. Subsequent effects due to tissue trauma and emboli would presumably mirror those observed in humans suffering from decompression sickness.

It is unlikely that the short duration of sonar pings would be long enough to drive bubble growth to any substantial size, if such a phenomenon occurs. Recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at sound exposure levels and tissue saturation levels that are improbable to occur in a diving marine mammal. However, an alternative but related hypothesis has also been suggested: Stable bubbles could be destabilized by high-level sound exposures such that bubble growth then occurs through static diffusion of gas out of the tissues. In such a scenario the marine mammal would need to be in a gas-supersaturated state for a long enough period of time for bubbles to become of a problematic size. Yet another hypothesis (decompression sickness) has speculated that rapid ascent to the surface following exposure to a startling sound might produce tissue gas saturation sufficient for the evolution of nitrogen bubbles (Jepson *et al.* 2003; Fernandez *et al.* 2005). In this scenario, the rate of ascent would need to be sufficiently rapid to compromise behavioral or physiological protections against nitrogen bubble formation. Collectively, these hypotheses can be referred to as "hypotheses of acoustically mediated bubble growth."

Although theoretical predictions suggest the possibility for acoustically mediated bubble growth, there is considerable disagreement among scientists as to its likelihood (Piantadosi and Thalmann 2004; Evans and Miller 2003). Crum and Mao (1996) hypothesized that received levels would have to exceed 190 dB in order for there to be the possibility of significant bubble growth due to supersaturation of gases in the blood (i.e., rectified diffusion). More recent work conducted by Crum *et al.* (2005) demonstrated the possibility of rectified diffusion for short duration signals, but at SELs and tissue saturation levels that are highly improbable to occur in diving marine mammals. To date, Energy Levels (ELs) predicted to cause in vivo bubble formation within diving cetaceans have not been evaluated. Although it has been argued that traumas from some recent beaked whale strandings are consistent with gas emboli and bubble-induced tissue separations (Jepson *et al.* 2003), there is no conclusive evidence of this (Hooker *et al.* 2011). However, Jepson *et al.* (2003; 2005) and Fernandez *et al.* (2004; 2005) concluded that in vivo bubble formation, which may be exacerbated by deep, long duration, repetitive dives may explain why beaked whales appear to be particularly vulnerable to sonar exposures. A recent review of evidence for gas-bubble incidence in marine mammal tissues suggests that diving mammals vary their physiological responses according to multiple stressors, and that the perspective on marine mammal diving physiology should change from simply minimizing nitrogen loading to management of the nitrogen load (Hooker *et al.* 2011). This suggests several avenues for further study, ranging from the effects of gas bubbles at molecular, cellular and organ function levels, to comparative studies relating the presence/absence of gas bubbles to diving behavior. More information regarding hypotheses that attempt to explain how behavioral responses to Navy sonar can lead to strandings is included in the Behaviorally Mediated Bubble Growth section, after the summary of strandings.

**Acoustic Masking**

Marine mammals use acoustic signals for a variety of purposes, which differ among species, but include communication between individuals, navigation, foraging, reproduction, and learning about their environment (Erbe 2000; Clark *et al.* 2009a; 2009b). Masking, or auditory interference, generally occurs when sounds in the environment are louder than, and of a similar frequency to, auditory signals an animal is trying to receive. Masking is a phenomenon that affects animals that are trying to receive acoustic information about their environment, including sounds from other members of their species, predators, prey, and sounds that allow them to orient in their environment. Masking these acoustic signals can disturb the behavior of individual animals, groups of animals, or entire populations.

The extent of the masking interference depends on the spectral, temporal, and spatial relationships between the signals an animal is trying to receive and the masking noise, in addition to other factors. In humans, significant masking of tonal signals occurs as a result of exposure to noise in a narrow band of similar frequencies. As the sound level increases, though, the detection of frequencies above those of the masking stimulus also decreases. This principle is also expected to apply to marine mammals because of common biomechanical cochlear properties across taxa.

Richardson *et al.* (1995) argued that the maximum radius of influence of an industrial noise (including broadband low frequency sound transmission) on a marine mammal is the distance from the source to the point at which the noise can barely be heard. This range is determined by either the hearing sensitivity of the animal or the background noise level present. Industrial masking is most likely to affect some species' ability to detect communication calls and natural sounds (i.e., surf noise, prey noise, etc.; Richardson *et al.* 1995).

The echolocation calls of odontocetes (toothed whales) are subject to masking by high frequency sound. Human data indicate low-frequency sound can mask high-frequency sounds (i.e., upward masking). Studies on captive odontocetes by Au (1993) indicate that some species may use various processes to reduce masking effects (e.g., adjustments in echolocation call intensity or frequency as a function of background noise conditions). There is also evidence that the directional hearing abilities of odontocetes are useful in reducing masking at the high frequencies these cetaceans use to echolocate, but not at the low-to-moderate frequencies they use to communicate (Zaitseva *et al.* 1980).

As mentioned previously, the functional hearing ranges of mysticetes (baleen whales) and odontocetes (toothed whales) all encompass the frequencies of the sonar sources used in the Navy's Q-20 test activities. Additionally, almost all species' vocal repertoires span across the frequencies of the sonar sources used by the Navy. The closer the characteristics of the masking signal to the signal of interest, the more likely masking is to occur. However, because the pulse length and duty cycle of the Navy sonar signals are of short duration and would not be continuous, masking is unlikely to occur as a result of exposure to these signals during the Q-20 test activities in the designated Q-20 Study Area.

***Impaired Communication***

In addition to making it more difficult for animals to perceive acoustic cues in their environment, anthropogenic sound presents separate challenges for animals that are vocalizing. When they vocalize, animals are aware of environmental conditions that affect the "active space" of their vocalizations, which is the maximum area within which their vocalizations can be detected before it drops to the level of ambient noise (Brenowitz 1982; Brumm *et al.* 2004; Lohr *et al.* 2003). Animals are also aware of environmental conditions that affect whether listeners can discriminate and recognize their vocalizations from other sounds, which are more important than detecting a vocalization (Brenowitz 1982; Brumm *et al.* 2004; Dooling 2004; Marten and Marler 1977; Patricelli and Blickley 2006). Most animals that vocalize have evolved an ability to make vocal adjustments to their vocalizations to increase the signal-to-noise ratio, active space, and recognizability of their vocalizations in the face of temporary changes in background noise (Brumm *et al.* 2004; Patricelli and Blickley 2006). Vocalizing animals will make one or more of the following adjustments to their vocalizations: Adjust the frequency structure; adjust the amplitude; adjust temporal structure; or adjust temporal delivery.

Many animals will combine several of these strategies to compensate for high levels of background noise. Anthropogenic sounds that reduce the signal-to-noise ratio of animal vocalizations, increase the masked auditory thresholds of animals listening for such vocalizations, or reduce the active space of an animal's vocalizations impair communication between animals. Most animals that vocalize have evolved strategies to compensate for the effects of short-term or temporary increases in background or ambient noise on their songs or calls. Although the fitness consequences of these vocal adjustments remain unknown, like most other trade-offs animals must make, some of these strategies probably come at a cost (Patricelli and Blickley 2006). For example, vocalizing more loudly in noisy environments may have energetic costs that decrease the net benefits of vocal adjustment and alter a bird's energy budget (Brumm *et al.* 2004; Wood and Yezerinac 2006).

**Behavioral Disturbance**

Behavioral responses to sound are highly variable and context-specific. Exposure of marine mammals to sound sources can result in (but is not limited to) the following observable responses: Increased alertness; orientation or attraction to a sound source; vocal modifications; cessation of feeding; cessation of social interaction; alteration of movement or diving behavior; habitat abandonment (temporary or permanent); and, in severe cases, panic, flight, stampede, or stranding, potentially resulting in death (Southall *et al.* 2007).

Many different variables can influence an animal's perception of and response to (nature and magnitude) an acoustic event. An animal's prior experience with a sound type affects whether it is less likely (habituation) or more likely (sensitization) to respond to certain sounds in the future (animals can also be innately pre-disposed to respond to certain sounds in certain ways) (Southall *et al.* 2007). Related to the sound itself, the perceived nearness of the sound, bearing of the sound (approaching vs. retreating), similarity of a sound to biologically relevant sounds in the animal's environment (i.e., calls of predators, prey, or conspecifics), and familiarity of the sound may affect the way an animal responds to the sound (Southall *et al.* 2007). Individuals (of different age, gender, reproductive status, etc.) among most populations will have variable hearing capabilities, and differing behavioral sensitivities to sounds that will be affected by prior conditioning, experience, and current activities of those individuals. Often, specific acoustic features of the sound and contextual variables (i.e., proximity, duration, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone.

There are only few empirical studies of behavioral responses of free-living cetaceans to military sonar being conducted to date, due to the difficulties in implementing experimental protocols on wild marine mammals.

An opportunistic observation was made on a tagged Blainville's beaked whale (*Mesoplodon densirostris*) before, during, and after a multi-day naval exercises involving tactical mid-frequency sonars within the U.S. Navy's sonar testing range at the Atlantic Undersea Test and Evaluation Center (AUTEC), in the Tongue of the Ocean near Andros Island in the Bahamas (Tyack *et al.* 2011). The adult male whale was tagged with a satellite transmitter tag on May 7, 2009. During the 72 hrs before the sonar exercise started, the mean distance from whale to the center of the AUTEC range was approximately 37 km. During the 72 hrs sonar exercise, the whale moved several tens of km farther away (mean distance approximately 54 km). The received sound levels at the tagged whale during sonar exposure were estimated to be 146 dB re 1 μPa at the highest level. The tagged whale slowly returned for several days after the exercise stopped (mean distance approximately 29 km) from 0 – 72 hours after the exercise stopped (Tyack *et al.* 2011).

In the past several years, controlled exposure experiments (CEE) on marine mammal behavioral responses to military sonar signals using acoustic tags have been started in the Bahamas, the Mediterranean Sea, southern California, and Norway. These behavioral response studies (BRS), though still in their early stages, have provided some preliminary insights into cetacean behavioral disturbances when exposed to simulated and actual military sonar signals.

In 2007 and 2008, two Blainville's beaked whales were tagged in the AUTEC range and exposed to simulated mid-frequency sonar signals, killer whale (*Orcinus orca*) recordings (in 2007), and pseudo-random noise (PRN, in 2008) (Tyack *et al.* 2011). For the simulated mid-frequency exposure BRS, the tagged whale stopped clicking during its foraging dive after 9 minutes when the received level reached 138 dB SPL, or a cumulative SEL value of 142 dB re 1 $\mu Pa^2$-s. Once the whale stopped clicking, it ascended slowly, moving away from the sound source. The whale surfaced and remained in the area for approximately 2 hours before making another foraging dive (Tyack *et al.* 2011).

The same beaked whale was exposed to killer whale sound recording during its subsequent deep foraging dive. The whale stopped clicking about 1 minute after the received level of the killer whale sound reached 98 dB SPL, just above the ambient noise level at the whale. The whale then made a long and slow ascent. After surfacing, the whale continued to swim away from the playback location for 10 hours (Tyack *et al.* 2011).

In 2008, a Blainville's beaked was tagged and exposed with PRN that has the same frequency band as the simulated mid-frequency sonar signal. The received level at the whale ranged from inaudible to 142 dB SPL (144 dB cumulative SEL). The whale stopped clicking less than 2 minutes after exposure to the last transmission and ascended slowly to approximately 600 m. The whale appeared to stop at this depth, at which time the tag unexpectedly released from the whale (Tyack *et al.* 2011).

During CEEs of the BRS off Norway, social behavioral responses of pilot whales and killer whales to tagging and sonar exposure were investigated. Sonar exposure was sampled for 3 pilot whale (*Globicephala* spp.) groups and 1 group of killer whales. Results show that when exposed to sonar signals, pilot whales showed a preference for larger groups with medium-low surfacing synchrony, while starting logging, spyhopping and milling. Killer whales showed the opposite pattern, maintaining asynchronous patterns of surface behavior: decreased surfacing synchrony, increased spacing, decreased group size, tailslaps and loggings (Visser *et al.* 2011).

Although the small sample size of these CEEs reported here is too small to make firm conclusions about differential responses of cetaceans to military sonar exposure, none of the results showed that whales responded to sonar signals with panicked flight. Instead, the beaked whales exposed to simulated sonar signals and killer whale sound recording moved in a well oriented direction away from the source towards the deep water exit from the Tongue of the Ocean (Tyack *et al.* 2011). In addition, different species of cetaceans exhibited different social behavioral responses towards (close) vessel presence and sonar signals, which elicit different, potentially tailored and species-specific responses (Visser *et al.* 2011).

Much more qualitative information is available on the avoidance responses of free-living cetaceans to other acoustic sources, like seismic airguns and low-frequency active sonar, than mid-frequency active sonar. Richardson *et al.* (1995) noted that avoidance reactions are the most obvious manifestations of disturbance in marine mammals.

Southall *et al.* (2007) reports the results of the efforts of a panel of experts in acoustic research from behavioral, physiological, and physical disciplines that convened and reviewed the available literature on marine mammal hearing and physiological and behavioral responses to man-made sound with the goal of proposing exposure criteria for certain effects. This compilation of literature is very valuable, though Southall *et al.* (2007) note that not all data is equal, some have poor statistical power, insufficient controls, and/or limited information on received levels, background noise, and other potentially important contextual variables—such data were reviewed and sometimes used for qualitative illustration, but were not included in the quantitative analysis for the criteria recommendations.

In the Southall *et al.* (2007) report, for the purposes of analyzing responses of marine mammals to anthropogenic sound and developing criteria, the authors differentiate between single pulse sounds, multiple pulse sounds, and non-pulse sounds. HFAS/MFAS sonar is considered a non-pulse sound. Southall *et al.* (2007) summarize the reports associated with low-, mid-, and high-frequency cetacean responses to non-pulse sounds (there are no pinnipeds in the Gulf of Mexico (GOM)) in Appendix C of their report (incorporated by reference and summarized in the three paragraphs below).

The reports that address responses of low-frequency cetaceans to non-pulse sounds include data gathered in the field and related to several types of sound sources (of varying similarity to HFAS/MFAS) including: Vessel noise, drilling and machinery playback, low frequency M-sequences (sine wave with multiple phase reversals) playback, low frequency active sonar playback, drill vessels, Acoustic Thermometry of Ocean Climate (ATOC) source, and non-pulse playbacks. These reports generally indicate no (or very limited) responses to received levels in the 90 to 120 dB re 1 μPa range and an increasing likelihood of avoidance and other behavioral effects in the 120 to 160 dB range. As mentioned earlier, however, contextual variables play a very important role in the reported responses and the severity of effects are not linear when compared to received level. Also, few of the laboratory or field datasets had common conditions, behavioral contexts or sound sources, so it is not surprising that responses differ.

The reports that address responses of mid-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources (of varying similarity to HFAS/MFAS) including: Pingers, drilling playbacks, vessel and ice-breaking noise, vessel noise, Acoustic Harassment Devices (AHDs), Acoustic Deterrent Devices (ADDs), HFAS/MFAS, and non-pulse bands and tones. Southall et al. were unable to come to a clear conclusion regarding these reports. In some cases, animals in the field showed significant responses to received levels between 90 and 120 dB, while in other cases these responses were not seen in the 120 to 150 dB range. The disparity in results was likely due to contextual variation and the differences between the results in the field and laboratory data (animals responded at lower levels in the field).

The reports that address the responses of high-frequency cetaceans to non-pulse sounds include data gathered both in the field and the laboratory and related to several different sound sources (of varying similarity to HFAS/MFAS) including: acoustic harassment devices, Acoustical Telemetry of Ocean Climate (ATOC), wind turbine, vessel noise, and construction noise. However, no conclusive results are available from these reports. In some cases, high frequency cetaceans (harbor porpoises) are observed to be quite sensitive to a wide range of human sounds at very low exposure RLs (90 to 120 dB). All recorded exposures exceeding 140 dB produced profound and sustained avoidance behavior in wild harbor porpoises (Southall *et al.* 2007).

In addition to summarizing the available data, the authors of Southall *et al.* (2007) developed a severity scaling system with the intent of ultimately being able to assign some level of biological significance to a response. Following is a summary of their scoring system, a comprehensive list of the behaviors associated with each score may be found in the report:

- 0–3 (Minor and/or brief behaviors) includes, but is not limited to: No response; minor changes in speed or locomotion (but with no avoidance); individual alert behavior; minor cessation in vocal behavior; minor changes in response to trained behaviors (in laboratory).

- 4–6 (Behaviors with higher potential to affect foraging, reproduction, or survival) includes, but is not limited to: Moderate changes in speed, direction, or dive profile; brief shift in group distribution; prolonged cessation or modification of vocal behavior (duration > duration of sound); minor or moderate individual and/or group avoidance of sound; brief cessation of reproductive behavior; or refusal to initiate trained tasks (in laboratory).

- 7–9 (Behaviors considered likely to affect the aforementioned vital rates) includes, but are not limited to: Extensive of prolonged aggressive behavior; moderate, prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms; long-term avoidance of an area; outright panic, stampede, stranding; threatening or attacking sound source (in laboratory).

In Table 4-1 we have summarized the scores that Southall *et al.* (2007) assigned to the papers that reported behavioral responses of low-frequency cetaceans, mid-frequency cetaceans, and high-frequency cetaceans to non-pulse sounds.

**Stranding and Mortality**

When a live or dead marine mammal swims or floats onto shore and becomes “beached” or incapable of returning to sea, the event is termed a “stranding” (Geraci *et al.* 1999; Geraci and Lounsbury 2005). Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most stranding are unknown (Geraci and Lounsbury 2005; Odell 1980).

Table 4. Data compiled from three tables from Southall et al. (2007) indicating when marine mammals (low-frequency cetacean = L, mid-frequency cetacean = M, and high-frequency cetacean = H) were reported as having a behavioral response of the indicated severity to a non-pulse sound of the indicated received level. As discussed in the text, responses are highly variable and context specific.

| | Received RMS Sound Pressure Level (dB re 1 microPa) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Response Score | 80 to <90 | 90 to < 100 | 100 to < 110 | 110 to <120 | 120 to < 130 | 130 to < 140 | 140 to < 150 | 150 to < 160 | 160 to < 170 | 170 to < 180 | 180 to < 190 | 190 to < 200 |
| 9 | | | | | | | | | | | | |
| 8 | | M | M | | M | | M | | | | M | M |
| 7 | | | | | | L | L | | | | | |
| 6 | H | L/H | L/H | L/M/H | L/M/H | L | L/H | H | M/H | M | | |
| 5 | | | | | M | | | | | | | |
| 4 | | | H | L/M/H | L/M | | L | | | | | |
| 3 | | M | L/M | L/M | M | | | | | | | |
| 2 | | | L | L/M | L | L | L | | | | | |
| 1 | | | M | M | M | | | | | | | |
| 0 | L/H | L/H | L/M/H | L/M/H | L/M/H | L | M | | | | M | M |

Several sources have published lists of mass stranding events of cetaceans during attempts to identify relationships between those stranding events and military sonar (Hildebrand 2004; Taylor *et al.* 2004). For example, based on a review of stranding records between 1960 and 1995, the International Whaling Commission (IWC 2005) identified 10 mass stranding events of Cuvier's beaked whales that had been reported and one mass stranding of four Baird's beaked whales (*Berardius bairdii*). The IWC concluded that, out of eight stranding events reported from the mid-1980s to the summer of 2003, seven had been associated with the use of mid-frequency sonar, one of those seven had been associated with the use of low frequency sonar, and the remaining stranding event had been associated with the use of seismic airguns. None of the strandings has been associated with high frequency sonar such as the Q-20 sonar proposed to be tested in this action. Therefore, NMFS does not consider it likely that the proposed Q-20 testing activity would cause marine mammals to strand.

**Effects on Marine Mammal Habitat**

There are no areas within the NSWC PCD that are specifically considered as important physical habitat for marine mammals.

The prey of marine mammals are considered part of their habitat. The Navy's Final Environmental Impact Statement and Overseas Environmental Impact Statement (FEIS) on the research, development, test and evaluation activities in the NSWC PCD study area contains a detailed discussion of the potential effects to fish from HFAS/MFAS. These effects are the same as expected from the proposed Q-20 sonar testing activities within the same area.

The extent of data, and particularly scientifically peer-reviewed data, on the effects of high intensity sounds on fish is limited. In considering the available literature, the vast majority of fish species studied to date are hearing generalists and cannot hear sounds above 500 to 1,500 Hz (depending upon the species), and, therefore, behavioral effects on these species from higher frequency sounds are not likely. Moreover, even those fish species that may hear above 1.5 kHz, such as a few sciaenids and the clupeids (and relatives), have relatively poor hearing above 1.5 kHz as compared to their hearing sensitivity at lower frequencies. Therefore, even among the species that have hearing ranges that overlap with some mid- and high frequency sounds, it is likely that the fish will only actually hear the sounds if the fish and source are very close to one another. Finally, since the vast majority of sounds that are of biological relevance to fish are below 1 kHz, even if a fish detects a mid-or high frequency sound, these sounds will not mask detection of lower frequency biologically relevant sounds. Based on the above information, there will likely be few, if any, behavioral impacts on fish.

#### 4.2.2.5c Effects of Vessel Presence and Noise on Marine Mammals

Whales have been shown to alter their behavior around various vessels, including whale-watching and fishing boats (Williams *et al.* 2002). For example, in the presence of whale-watching and fishing boats in Johnstone Strait, British Columbia, killer whales increased their travel budgets by 12.5% and reduced the time they spent feeding. These lost feeding opportunities could have resulted in a substantial estimated decrease in energy intake. These observations suggest that, in order to lessen the potential impacts of human activities, avoiding impacts to important feeding areas would provide considerable benefits to cetaceans and other marine mammals that are sensitive to human disturbance.

Marine mammals may temporarily move away from areas of heavy vessel activity but re-inhabit the same area when traffic is reduced (Allen and Read 2000; Lusseau 2004), or they may abandon a once-preferred region for as long as disturbance persists (Gerrodette and Gilmartin 1990). For example, evidence exists that indicates that killer whales evade potentially harmful noise on annual and regional spatial scales (Morton and Symonds 2002). When animals switch from short-term evasive tactics to long-term site avoidance in response to increasing disturbance, the costs of tolerance have likely exceeded the benefits of remaining in previously preferred habitat. For example, in a long-term study in Shark Bay Western Australia, cumulative vessel activity was shown to result in a decline in abundance of bottlenose dolphins over a relatively short time (Bejder *et al.* 2006). The authors attributed this to the long-term displacement of dolphins away from the area of disturbance. For animals such as cetaceans that exhibit enduring, individually specific social relationships, disruption of social bonds through displacement of sensitive individuals may have far-reaching repercussions (Bejder *et al.* 2006). Given the scarcity of long-term studies to fully evaluate the potential impacts of human activities, a cumulative impact, like those detected in Shark Bay and Johnstone Strait, could go unnoticed for decades. Thus, management deliberations must draw strong inferences from well-documented sites, where long-term information can be taken into account (Bejder *et al.* 2006).

Noise, rather than the simple presence of vessels, seems the likeliest mechanism for vessels to alter whale behavior. It is perhaps unsurprising that cetaceans have been shown to shorten their feeding bouts and initiate fewer of them in the presence of ships and boats. For marine mammals, it is reasonable to assume that larger and noisier vessels, such as seismic and ice-breaking ships, would have greater and more dramatic impacts upon behavior than would smaller vessels.

Nevertheless, the proposed Q-20 testing activities by the Navy are of small scale. Operational and support vessels involved in the testing are fewer in number when compared to regular shipping. All vessels involved in the proposed Q-20 testing are small in tonnage compared to large container ships, therefore, their source levels are expected to be much lower than vessels used in commercial shipping.

### 4.2.3 Effects on Socioeconomic Environment

The proposed Q-20 testing area is in the non-territorial waters of the GOM. As discussed in Chapter 3 Affected Environment, the proposed action area is not frequently used by tourism, recreational fishing, and recreational boating activities. In addition, the Q-20 testing activities would occur for a maximum of about 42 days per year in a small area. Therefore, it is not anticipated that the proposed Q-20 testing activities will have effects on the socioeconomic environment in the vicinity of the action area as far as tourism, recreational fishing and boating, commercial fishing, and commercial shipping are concerned.

## 4.3 Effects of Alternative 3 – Additional Mitigation Requirements for Marine Mammals

### 4.3.1 Effects on Physical Environment

Effects to the physical environment would be the same under Alternative 3 as those described above for Alternative 2. No additional effects beyond those already described would be expected.

### 4.3.2 Effects on Biological Environment

#### 4.3.2.1 Effects on Lower Trophical Organisms

No additional effects beyond those described in Section 4.2.2.1 above would be expected under Alternative 3 on lower trophical organisms in the GOM.

#### 4.3.2.2 Effects on Fishes

No additional effects beyond those described in Section 4.2.2.2 above would be expected under Alternative 3 on fish species in the GOM.

#### 4.3.2.3 Effects on Sea Turtles

No additional effects beyond those described in Section 4.2.2.3 above would be expected under Alternative 3 on sea turtles in the GOM.

#### 4.3.2.4 Effects on Marine Birds

No additional effects beyond those described in Section 4.2.2.4 above would be expected under Alternative 3 on marine birds in the GOM.

#### 4.3.2.5 Effects on Marine Mammals

Marine mammals would still be expected to be harassed by the proposed Q-20 sonar testing activities in the GOM. As described in Alternative 2, anticipated impacts to marine mammals associated with the Navy's proposed activities (primarily resulting from noise propagation) are from vessel movements and Navy sonar operations. Potential impacts to marine mammals might include one or more of the following: masking of important natural signals, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects. These are the same types of reactions that would be anticipated under the Preferred Alternative (Alternative 2).

The primary difference under Alternative 3 is that additional mitigation and monitoring measures for detecting marine mammals would be required. These additional measures include near real-time PAM, active acoustic monitoring (AAM), and the implementation of aerial monitoring. While the technologies for acoustic monitoring methods are still being developed and refined, it is expected that they would allow for additional detection of marine mammals beyond visual observations from shipboard observers. These additional monitoring measures using PAM and AAM could allow for necessary mitigation measures (i.e., power-downs and shutdowns) to be implemented when visibility is not favorable for visual monitoring, such as at night, and could extend monitoring zones beyond visual limits. However, the Q-20 testing activities are only planed during daylight hours, and the exclusion zones are expected to be small due to the low source intensities. In addition, requiring regular aerial monitoring would significantly increase the operational cost with no significant increase in the degree of protection for marine mammals.

### 4.3.3 Effects on Socioeconomic Environment

Under Alternative 3, impacts to the socioeconomic environment are anticipated to be the same as those described for Alternative 2 in Section 4.2.3 above.

## 4.4 Estimation of Takes

For purposes of evaluating the potential significance of the takes by harassment, estimations of the number of potential takes are discussed in terms of the populations present. The specific number of takes considered for the authorizations is developed via the MMPA process, and the analysis in this EA provides a summary of the anticipated numbers that would be authorized to give a relative sense of the nature of impact of the proposed actions. The methods to estimate take by harassment and present estimates of the numbers of marine mammals that might be affected during the Navy's proposed Q-20 testing are described in detail in the Navy's IHA applications and the proposed IHA, which was published in the *Federal Register* on February 28, 2012 (77 FR 12010).

The quantitative analysis was based on conducting sonar operations in 13 different geographical regions, or provinces. Using combined marine mammal density and depth estimates, which are detailed later in this section, acoustical modeling was conducted to calculate the actual exposures. Refer to Appendix B, Geographic Description of Environmental Provinces of the Navy's IHA application, for additional information on provinces. Refer to Appendix C, Definitions and Metrics for Acoustic Quantities of the Navy's IHA application, for additional information regarding the acoustical analysis.

The approach for estimating potential acoustic effects from Q-20 test activities on cetacean species uses the methodology that the DON developed in cooperation with NMFS for the Navy's HRC Draft EIS (DON 2007). The exposure analysis for behavioral response to sound in the water uses energy flux density for Level A harassment and the methods for risk function for Level B harassment (behavioral). The methodology is provided here to determine the number and species of marine mammals for which incidental take authorization is requested.

To estimate acoustic effects from the Q-20 test activities, acoustic sources to be used were examined with regard to their operational characteristics as described in the previous section. Systems with an operating frequency greater than 200 kHz were not analyzed in the detailed modeling as these signals attenuate rapidly resulting in very short propagation distances. Based on the information above, the Navy modeled the Q-20 sonar parameters including source levels, ping length, the interval between pings, output frequencies, directivity (or angle), and other characteristics based on records from previous test scenarios and projected future testing. Additional information on sonar systems and their associated parameters is in Appendix A, Supplemental Information for Underwater Noise Analysis of the Navy's IHA application.

Based on the analysis, Q-20 sonar operations in non-territorial waters may expose up to six species to sound likely to result in Level B (behavioral) harassment (Table 4-2). They include the bottlenose dolphin (*Tursiops truncatus*), Atlantic spotted dolphin (*Stenella frontalis*), pantropical spotted dolphin (*S. attenuata*), striped dolphin (*S. coeruleoalba*), spinner dolphin (*S. longirostris*), and Clymene dolphin (*S. clymene*). No marine mammals would be exposed to levels of sound likely to result in TTS. The Navy requests that the take numbers of marine mammals for its IHA reflect the exposure numbers listed in Table 4-2.

Table 4-2. Estimates of Marine Mammal Exposures from Sonar in Non-territorial Waters per Year

| Marine Mammal Species | Level A | Level B (TTS) | Level B (Behavioral) |
|---|---|---|---|
| Bottlenose dolphin (GOM oceanic) | 0 | 0 | 399 |
| Pantropical spotted dolphin | 0 | 0 | 126 |
| Atlantic spotted dolphin | 0 | 0 | 315 |
| Spinner dolphin | 0 | 0 | 126 |
| Clymene dolphin | 0 | 0 | 42 |
| Striped dolphin | 0 | 0 | 42 |

### 4.4.1 Potential for Long-Term Effects

Q-20 test activities will be conducted in the same general areas, so marine mammal populations could be exposed to repeated activities over time. However, as described earlier, this analysis assumes that short-term non-injurious SELs predicted to cause temporary behavioral disruptions qualify as Level B harassment. It is highly unlikely that behavioral disruptions will result in any long-term significant effects.

#### 4.4.2 Potential for Effects on ESA-Listed Species

To further examine the possibility of whale exposures from the proposed testing, CASSGRAB sound modeling software was used to estimate transmission losses and received sound pressure levels (SPLs) from the Q-20 when operating in the test area. Specifically, four radials out towards DeSoto Canyon (which is considered an important habitat for the ESA-listed sperm whales) were calculated. The results indicate the relatively rapid attenuation of sound pressure levels with distance from the source, which is not surprising given the high frequency of the source. Below 120 dB, the risk of significant change in a biologically important behavior approaches zero. This threshold is reached at a distance of only 2.8 km (1.5 nm) from the source. With the density of sperm whales being near zero in this potential zone of influence, this calculation reinforces NMFS' conclusion that the proposed activity will not affect sperm whales. It should also be noted that DeSoto Canyon is well beyond the distance at which sound pressure levels from the Q-20 attenuate to zero.

### 4.5 Cumulative Effects

Cumulative effect is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions" (40 CFR §1508.7). Cumulative impacts may occur when there is a relationship between a proposed action and other actions expected to occur in a similar location or during a similar time period, or when past or future actions may result in impacts that would additively or synergistically affect a resource of concern. These relationships may or may not be obvious. Actions overlapping within close proximity to the proposed action can reasonably be expected to have more potential for cumulative effects on "shared resources" than actions that may be geographically separated. Similarly, actions that coincide temporally will tend to offer a higher potential for cumulative effects.

Actions that might permanently remove a resource would be expected to have a potential to act additively or synergistically if they affected the same population, even if the effects were separated geographically or temporally. Note that the proposed action considered here would not be expected to result in the removal of individual cetaceans from the population or to result in harassment levels that might cause animals to permanently abandon preferred feeding areas or other habitat locations, so concerns related to removal of viable members of the populations are not implicated by the proposed action. This cumulative effects analysis considers these potential impacts, but more appropriately focuses on those activities that may temporally or geographically overlap with the proposed activity such that repeat harassment effects warrant consideration for potential cumulative impacts to the affected six marine mammal species and their habitats.

Cumulative effects on affected resources that may result from the following activities—military activities, oil and gas exploration and development, fishing activities, maritime traffic, and scientific research—within the proposed action area are discussed in the following subsections.

### 4.5.1 Military Activities

The northern GOM is also the home to the Navy's Gulf of Mexico (GOMEX) Range Complex, in which the Navy conducts major training exercises. It also includes the NSWC Panama City Division (PCD) that the Navy uses to conduct RDT&T activities. The Navy has applied for marine mammal take authorizations under existing regulations to take marine mammals incidental to these training and RDT&E activities. Specifically, at the GOMEX Range Complex, the Navy conduct training operations and RDT&E operations by (1) maintaining baseline operations at current levels; (2) increasing training operations from current levels as necessary to support the Fleet Readiness Training Plan; (3) accommodating mission requirements associated with force structure change; and (4) implementing enhanced range complex capabilities. The LOAs for the Navy's GOMEX Range Complex training exercises and NSWC PCD's RDT&E activities were issued in 2011 and 2012. No training activity was conducted at the GOMEX Range Complex in the 2011 season, and RDT&E operations at the NSWC PCD during the 2011 season were much lower than analyzed for the regulations governing issuance of the LOA.

### 4.5.2 Oil and Gas Exploration and Development

The northern shelf in the GOM has large reservoirs of oil and natural gas. As of the late 1990's over 83% of the crude oil and 99% of the natural gas produced offshore in the U.S. came from the GOM (Davis *et al.* 2000). The oil and gas industry is characterized by production and pumping platforms, tanker traffic, seismic surveys, explosive removal of platforms from expired lease areas, and associated vessel and aircraft support (Würsig *et al.* 2000). As of 2003, there were 3,462 offshore production platforms active in the search for natural gas and oil on the GOM Outer Continental Shelf (OCS). There is also a deepwater crude-oil terminal offshore of Louisiana, known as the Louisiana Offshore Oil Port (LOOP). This facility is located 29 km (18 mi) south of Grand Isle, Louisiana (MMS 2000). LOOP provides facilities for offloading, temporary storage, and transport of crude oil; the use of this facility reduces vessel traffic in coastal and inland ports (MMS 2000). From 1981 to 1996, about 3,350 tankers used this facility (MMS 2000). Seismic surveys on behalf of the oil industry have been and remain very common in the northern GOM. From 1998 to 2002, an average of 370,149 line km (230,000 line mi) of seismic survey work has been conducted per year in that area, including over 342,790 km (213,000 mi) in 2002. Oil and natural gas production is believed to potentially result in acoustical harassment to marine mammals. Natural resources within state waters (3 nmi of the coast) are regulated by the state and U.S. Army Corps of Engineers, and beyond state waters are regulated by the Bureau of Ocean Energy Management, Regulation and Enforcement.

#### *Gulf Oil Spill of 2010*

On April 20, 2010, an explosion on the Deepwater Horizon MC252 drilling platform in the GOM caused the rig to sink and oil began to leak. Approximately five million barrels of oil were released into the GOM until the well was finally capped in mid-July, 2010. The spill caused significant impacts to wildlife and the fishing community in the GOM region, specifically along the coastal areas of Texas, Louisiana, Mississippi, Alabama, and Florida. Oil spills have been documented to have direct toxic impacts on a variety of species of fish and invertebrates (which includes commercially important aquatic life, e.g., blue crabs, squid, and shrimp), marine mammals, sea turtles, birds, and habitat. Toxins in the oil can kill these species or have other harmful effects such as genetic damage, liver disease, cancer, and reproductive, developmental, and immune system impairment. NMFS is working with other Federal, state, and tribal co-trustees to conduct short-term and long-term restoration projects of coastal and marine natural resources and their habitats impacted by oil to pre-spill conditions. To help determine the type and amount of restoration needed to compensate the public for harm to natural resources and lost public uses as a result of the oil spill, NOAA will study the effects of the spill by conducting a process known as Natural Resources Damage Assessment (NRDA). Past restoration projects have included: enhancing beach shoreline; creating and restoring wetlands; creating oyster reefs and other shellfish habitat; restoring coral and seagrass beds; acquiring, restoring, and protecting waterfowl habitat; conducting species recovery and monitoring programs; and provide recreational opportunities.

### 4.5.3 Commercial and Recreational Fishing Activities

The GOM is also a major area for commercial and recreational fishing; it provides almost 20% of the commercial fish catches in the U.S. annually (MMS 2000) and, together with recreational fishing, generates $2.8 billion annually. Along the Atlantic and GOM coast, almost 2.8 billion pounds of fish were commercially caught with a value of over $2.1 billion. In addition, over 12 million Americans participate in saltwater recreational fishing along the Atlantic and GOM coast. Nearshore and offshore waters east of the Mississippi River Delta have especially diverse fishery resources (MMS 2000). In addition, recreational and charter fishing vessel activities are highly popular on the shelf and offshore GOM. These activities could result in by-catch of marine mammals, entanglement in fishing gear, and reduce prey availability for marine mammals.

### 4.5.4 Maritime Traffic

Four of the United States' busiest ports are also located in the GOM; handling about 45% of U.S. shipped tonnage (Würsig *et al.* 2000). Thus, vessel traffic in the area is extensive. Tanker traffic in the northern Gulf is most intense between the Mississippi River and Sabine River, Texas; in 1998, there were 40,599 tanker trips between the Mississippi River and Sabine River (MMS 2000). Ship strikes are potential sources of serious injury or mortality to large whales; however, the occurrence of ship strikes to dolphins are rare. Effects to dolphins from large commercial vessels are believed to be limited to acoustical harassment which could decrease social communication, foraging success, and predator detection.

### 4.5.5 Scientific Research

Marine mammal and seismic survey research cruises operate within the GOM. While some marine mammal surveys introduce no more than increased vessel traffic impacts to the environment, seismic surveys use various methods (e.g., airgun arrays) to conduct research. In 2003 and 2007-2008, the Lamont-Doherty Earth Observatory of Columbia University was issued an IHA to conduct this type of seismic research in the northern GOM from the R/V *Maurice Ewing* and R/V *Marcus G. Langseth*, respectively. Monitoring reports from other seismic surveys suggest that impacts are no more severe than those anticipated in the IHAs. Furthermore, based on the number of marine mammal observations, it appears that fewer marine mammals were exposed than anticipated.

### 4.5.6 Marine Mammal Unusual Mortality Event

NMFS has declared an unusual mortality event (UME) (mostly bottlenose dolphins) in the GOM. As of February 5, 2012, the UME involves 647 cetacean strandings in the northern GOM (5% stranded alive and 95% stranded dead). Of these, 114 cetaceans stranded prior to the response phase for the oil spill, between February 1, 2010 and April 29, 2010. Between April 30 to November 2, 2010, 122 cetaceans stranded or were reported dead offshore during the initial response phase to the oil spill. After the initial response phase ended, 411 cetaceans stranded between November 3, 2010 and February 5, 2012. The number of cetaceans stranded after the initial response phase ended includes six dolphins that were killed incidental to fish related scientific data collection and one dolphin killed incidental to trawl relocation for a dredging project.

In addition to investigating all other potential causes, scientists are investigating the role *Brucella* bacterial infections may have in the UME. Scientists have sampled and tested 21 dolphins for *Brucella* so far, with five dead animals testing positive between June, 2010 and February, 2011. NMFS is working with a team of marine mammal health experts, including veterinarians, epidemiologists, biologists, and toxicologists, to investigate the cause of death for as many of the stranded dolphins as possible as well as to develop a multi-tiered approach. The findings of the investigations may take years to complete and will be made public when scientifically and legally appropriate. Given the decomposition of some of the carcasses, some analyses cannot be performed.

### 4.5.6 Conclusion

Given the small spatial scale and infrequent occurrence of the proposed activity and the required mitigation, NMFS anticipates there would be minimal synergistic adverse environmental impacts from the Q-20 testing activities under the IHA. Therefore, NMFS has determined that Q-20 testing activities would not produce any significant cumulative impacts to the human environment.

Despite the other activities going on in the area, NMFS does not believe that significant cumulative impacts are likely to occur at the Q-20 testing area in the northern GOM as a result of the issuance of this IHA for the take of marine mammals, by Level B harassment, incidental to the sonar testing activities. NMFS anticipates impacts to be limited to temporary behavioral disturbance of six species of dolphins, during the time of the sonar testing.

# CHAPTER 5 MITIGATION, MITIGATION, AND REPORTING MEASURES

As required under the MMPA, NMFS considered mitigation to effect the least practicable impact on marine mammals and has developed a series of mitigation measures, as well as monitoring and reporting procedures (Chapter 6), that would be required under the IHA issued for the proposed Q-20 testing activities described earlier in this EA. Mitigation measures have been proposed by the Navy for its Q-20 testing activities. Additional measures have also been considered by NMFS pursuant to its authority under the MMPA to ensure that the proposed activities will result in the least practicable impact on marine mammal species or stocks in the GOM. The mitigation requirements contained in the MMPA IHAs will help to ensure that potential impacts to marine mammals will be negligible. If issued, all mitigation measures contained in the IHA must be followed.

## 5.1 Required Mitigation, Monitoring, and Reporting Measures under Preferred Alternative

In order to issue an incidental take authorization (ITA) under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the "permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance." The National Defense Authorization Act (NDAA) of 2004 amended the MMPA as it relates to military-readiness activities and the ITA process such that "least practicable adverse impact" shall include consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the "military readiness activity." The Q-20 sonar testing activities described in the Navy's IHA application are considered military readiness activities.

Additionally, in order to issue an ITA for an activity, section 101(a)(5)(D) of the MMPA states that NMFS must set forth "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 CFR 216.104(a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present.

For the proposed Q-20 sonar testing activities in the GOM, NMFS worked with the Navy to develop mitigation, monitoring, and reporting measures.

### 5.1.1 Personnel Training

Marine mammal mitigation training for those who participate in the active sonar activities is a key element of the protective measures. The goal of this training is for key personnel onboard Navy platforms in the Q-20 Study Area to understand the protective measures and be competent to carry them out. The Marine Species Awareness Training (MSAT) is provided to all applicable participants, where appropriate. The program addresses environmental protection, laws governing the protection of marine species, Navy stewardship, and general observation information including more detailed information for spotting marine mammals. Marine mammal observer training will be provided before active sonar testing begins.

Marine observers would be aware of the specific actions to be taken based on the RDT&E platform if a marine mammal is observed. Specifically, the following requirements for personnel training would apply:

- All marine observers onboard platforms involved in the Q-20 sonar test activities will review the NMFS-approved MSAT material prior to use of active sonar.

- Marine Observers shall be trained in marine mammal recognition. Marine Observer training shall include completion of the Marine Species Awareness Training, instruction on governing laws and policies, and overview of the specific Gulf of Mexico species present, and observer roles and responsibilities.

- Marine observers will be trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of mitigation measures if marine species are spotted.

### 5.1.2 Range Operation Procedures

The following procedures would be implemented to maximize the ability of Navy personnel to recognize instances when marine mammals are in the vicinity.

***Observer Responsibilities***

- Marine observers will have at least one set of binoculars available for each person to aid in the detection of marine mammals.

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

- Observers will be responsible for informing the Test Director of any marine mammal that may need to be avoided, as warranted.

- These procedures would apply as much as possible during RMMV operations. When an RMMV is operating over the horizon, it is impossible to follow and observe it during the entire path. An observer will be located on the support vessel or platform to observe the area when the system is undergoing a small track close to the support platform.

*Operating Procedures*

- Test Directors will, as appropriate to the event, make use of marine species detection cues and information to limit interaction with marine species to the maximum extent possible, consistent with the safety of the ship.

- During Q-20 sonar activities, personnel will utilize all available sensor and optical system (such as Night Vision Goggles) to aid in the detection of marine mammals.

- Navy aircraft participating will conduct and maintain, when operationally feasible and safe, surveillance for marine species of concern as long as it does not violate safety constraints or interfere with the accomplishment of primary operational duties.

- Marine mammal detections by aircraft will be immediately reported to the Test Director. This action will occur when it is reasonable to conclude that the course of the ship will likely close the distance between the ship and the detected marine mammal.

- Exclusion Zones—The Navy will ensure that sonar transmissions are ceased if any detected marine mammals are within 200 yards (183 m) of the sonar source. Active sonar will not resume until the marine mammal has been seen to leave the area, has not been detected for 30 minutes, or the vessel has transited more than 2,000 yards (1,828 m) beyond the location of the last detection.

- Special conditions applicable for dolphins only: If, after conducting an initial maneuver to avoid close quarters with dolphins, the Test Director or the Test Director's designee concludes that dolphins are deliberately closing to ride the vessel's bow wave, no further mitigation actions are necessary while the dolphins or porpoises continue to exhibit bow wave riding behavior.

- Sonar levels (generally)—Navy will operate sonar at the lowest practicable level, except as required to meet testing objectives.

### 5.1.3 Clearance Procedures

When the test platform (surface vessel or aircraft) arrives at the test site, an initial evaluation of environmental suitability will be made. This evaluation will include an assessment of sea state and verification that the area is clear of visually detectable marine mammals and indicators of their presence. For example, large flocks of birds and large schools of fish are considered indicators of potential marine mammal presence.

If the initial evaluation indicates that the area is clear, visual surveying will begin. The area will be visually surveyed for the presence of protected species and protected species indicators. Visual surveys will be conducted from the test platform before test activities begin. When the platform is a surface vessel, no additional aerial surveys will be required. For surveys requiring only surface vessels, aerial surveys may be opportunistically conducted by aircraft participating in the test.

Shipboard monitoring will be staged from the highest point possible on the vessel. The observer(s) will be experienced in shipboard surveys, familiar with the marine life of the area, and equipped with binoculars of sufficient magnification. Each observer will be provided with a two-way radio that will be dedicated to the survey, and will have direct radio contact with the Test Director. The observers shall conduct monitoring for at least 15 minutes prior to the initiation of the Q-20 testing activities. Observers will report to the Test Director any sightings of marine mammals or indicators of these species, as described previously. Distance and bearing will be provided when available. Observers may recommend a "Go" / "No Go" decision, but the final decision will be the responsibility of the Test Director.

During the Q-20 testing activities, marine observers shall continue monitoring in the operation area for any marine mammals.

Post-mission surveys will be conducted from the surface vessel(s) and aircraft used for pre-test surveys. Marine observers shall conduct monitoring for at least 15 minutes after the cessation of Q-20 testing activities. Any affected marine species will be documented and reported to NMFS. The report will include the date, time, location, test activities, species (to the lowest taxonomic level possible), behavior, and number of animals.

NMFS has carefully evaluated the Navy's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another:

- the manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals

- the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and

- the practicability of the measure for applicant implementation, including consideration of personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

### 5.1.4 Monitoring for Q-20 Testing Activities

Systematic monitoring of the affected area for marine mammals will be conducted prior to, during, and after test events using aerial and/or ship-based visual surveys. Observers will record information during the test activity. Data recorded will include exercise information (time, date, and location) and marine mammal and/or indicator presence, species, number of animals, their behavior, and whether there are changes in the behavior. Personnel will immediately report observed stranded or injured marine mammals to NMFS stranding response network and NMFS Regional Office. Reporting requirements will be included in the Naval Surface Warfare Center Panama City Division (NSWC PCD) Mission Activities Final Environmental Impact Statement/Overseas Environmental Impact Statement Annual Activity report as required by its Final Rule (DON 2009).

### 5.1.5 Ongoing Monitoring

The Navy has an existing Monitoring Plan that provides for site-specific monitoring for MMPA and Endangered Species Act (ESA) listed species, primarily marine mammals within the Gulf of Mexico, including marine water areas of the Q-20 Study Area (DON 2009). This monitoring plan was initially developed in support of the NSWC PCD Mission Activities Final Environmental Impact Statement/Overseas Environmental Impact Statement and subsequent Final Rule by NMFS (DON 2009). The primary goals of monitoring are to evaluate trends in marine species distribution and abundance in order to assess potential population effects from Navy training and testing events and determine the effectiveness of the Navy's mitigation measures. The monitoring plan, adjusted annually in consultation with NMFS, includes aerial- and ship-based visual observations, acoustic monitoring, and other efforts such as oceanographic observations.

### 5.1.6 Monitoring Reports

The results of the Navy's Q-20 testing monitoring (i.e., vessel and aerial based visual monitoring), including estimates of "take" by harassment, shall be submitted in a report to NMFS within 90 days after the expiration of the IHA, if issued. The monitoring report shall include:

(a) summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through the study period, accounting for sea state and other factors affecting visibility and detectability of marine mammals);

(b) analyses of the effects of various factors influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);

(c) species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), and group sizes;

(d) sighting rates of marine mammals during periods with and without sonar testing activities (and other variables that could affect detectability).

## 5.2 Additional Mitigation Measures under Alternative 3

As discussed in Section 2.3, additional measures that would be required by NMFS under Alternative 3 would include using PAM and AAM for the presence of marine mammals and to use aerial monitoring. However, at this time, the existing technology for PAM has not yet been proven effective for monitoring or mitigation as would be required under an IHA, while AAM would require added anthropogenic noise to be introduced into the water column in addition to that from Q-20. Finally, aerial monitoring would require the Navy to invest tremendous resources to monitor a small area which could be more practically monitored by vessel. Nevertheless, the Navy agrees that it will use aircraft to monitor for marine mammals when operationally feasible and safe. Therefore, NMFS does not believe that the additional mitigation measure under Alternative 3 would provide any added benefits.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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# Finding of No Significant Impact for the Issuance of an Incidental Harassment Authorization to the U.S. Navy to Take Marine Mammals by Harassment Incidental to Conducting High-Frequency Sonar Testing at the Naval Surface Warfare Center Panama City Division in the Gulf of Mexico

## National Marine Fisheries Service

Background

The National Marine Fisheries Service (NMFS) received an application from the U.S. Navy (Navy), for an incidental harassment authorization (IHA) under the Marine Mammal Protection Act (MMPA) for the take of marine mammals incidental to activities related to testing the AN/AQS-20A Mine Reconnaissance Sonar System (Q-20) at the Naval Surface Warfare Center Panama City Division (NSWC PCD) in the non-territorial waters (beyond 12 nautical miles) of the Gulf of Mexico (GOM). Section 101(a)(5)(D) directs NMFS' to allow, upon request, the take of small numbers of marine mammals incidental to activities other than commercial fishing, provided that NMFS determines that the actions will have a negligible impact on the affected species or stocks of marine mammals, and will not have an unmitigable adverse impact on the availability of those species or stocks of marine mammals for taking for subsistence uses. The National Defense Authorization Act of 2004 (NDAA) (Public Law 108-136) removed the "small numbers" and "specified geographical region" limitations in section 101(a)(5) and amended the definition of "harassment" as it applies to a "military readiness activity" to read as follows (Section 3(18)(B) of the MMPA):

> (i) 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
>
> (ii) 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 [Level B Harassment].

In accordance with the National Environmental Policy Act (NEPA) and its implementing regulations and agency NEPA procedures, NMFS completed an *Environmental Assessment for the Issuance of an Incidental Harassment Authorization to Take Marine Mammals by Harassment Incidental to Conducting High-Frequency Sonar Testing Activities in the Naval Surface Warfare Center Panama City Division* (EA). This FONSI has been prepared to evaluate the significance of the impacts of NMFS' proposed actions and is specific to Alternative 2 in NMFS' EA as the preferred alternative. Alternative 2 is entitled "Issuance of an IHA with Required Mitigation, Monitoring, and Reporting

Measures." Based on NMFS' review of the Navy's proposed actions and the measures contained in Alternative 2, NMFS has determined that no significant impacts to the human environment would occur from implementing the Preferred Alternative.

Significance Review

National Oceanic and Atmospheric Administration Administrative Order (NAO) 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality (CEQ) regulations at 40 C.F.R. §1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with the others. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria, and NMFS NEPA policy. These include:

1) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat (EFH) as defined under the Magnuson-Stevens Fishery Conservation and Management Act and identified in fishery management plans?

Response: NMFS' proposed action (i.e., issuing an IHA to the Navy) would not cause substantial damage to the ocean and coastal habitats. The Navy's proposed Q-20 sonar testing activities would result in only short-term marine mammal exposure to high-frequency sonar signals (for a total of approximately 420 hours in a year) within a limited area. To date, there is no evidence that sonar signals can cause fish mortalities.

Although EFH has been designated in the area, NMFS and the Navy have determined that no EFH consultation is required because neither issuance of the proposed IHA nor the underlying action would have an adverse effect on EFH.

2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: The issuance of the IHA will not have a substantial impact on biodiversity or ecosystem function within the affected areas. The impacts of the high-frequency sonar testing itself on marine mammals are specifically related to the acoustic activities, and these are expected to be temporary in nature and not result in a substantial impact to marine mammals or to their role in the ecosystem. In accordance with the Preferred Alternative, NMFS will authorize the take, by Level B Harassment (temporary behavioral disturbance and displacement) only, of six species of marine mammal incidental to the Navy's activities. Neither injury nor mortality is anticipated and will not be authorized. Level B Harassment of marine mammals is not expected to affect biodiversity or ecosystem function.

During the Q-20 testing, only a small fraction of the available habitat would be ensonified at any given time. Disturbance to fish species, if it occurs, would be short-term (i.e., most likely only hours to days), and fish would return to their pre-disturbance behavior once the sonar testing activity in a specific area ceases. Thus, the proposed Q-20 testing would have little, if any, impact on the ability of marine mammals to feed in the area where high-frequency sonar operations are conducted.

No mortality to fish and/or invertebrates is anticipated. The Q-20 sonar testing is predicted to have little, if any, adverse physical effects on the various life stages of fish and invertebrates. Though these effects do not require authorization under the IHA, the effects on these features were considered with respect to consideration of effects to marine mammals and their habitats, and NMFS finds that these potential adverse effects from the Q-20 testing on fish and invertebrates are not anticipated to have a substantial effect on biodiversity and/or ecosystem function within the testing area.

3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Response: Issuance of the IHA associated with the Q-20 testing is not expected to have a substantial adverse impact on public health or safety. The constant monitoring for marine mammals during operations effectively eliminates the possibility of any humans being inadvertently exposed to levels of sound that might have adverse effects. Although the conduct of sonar testing may carry some risk to the personnel involved (i.e., boat or mechanical accidents during operations), those personnel would be required to be adequately trained or supervised in performance of the underlying activity (i.e., during naval training and operations) to minimize such risk to personnel.

4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: Based on the analysis of the Navy Marine Resources Assessment (MRA) data on marine mammal distributions, there is near zero probability that sperm whale will occur in the vicinity of the proposed Q-20 test area, and, even in the unlikely event a sperm whale did occur in the vicinity, acoustic modeling indicates the whale would not be exposed to levels of sound that would constitute a "take" under the MMPA, due to the low source level and high attenuation rates of the Q-20 sonar signal. Other species listed under the Endangered Species Act (ESA), such as green turtle, hawksbill turtle, Kemp's ridley turtle, leatherback turtle, and loggerhead turtles, are not expected to occur in the vicinity of the test area. Therefore, ESA-listed species will not be affected as the result of the Navy's proposed Q-20 testing activities. No critical habitat exists in the Q-20 testing area. The potential effects to other non-target species are discussed in (2) above.

5) Are significant social or economic impacts interrelated with natural or physical environmental effects?

Response: Neither issuance of the IHA nor the Navy's proposed action will have a significant social or economic impact on commercial fishing or other activities that could potentially be affected by the Q-20 testing activities. The testing area is in the offshore non-territorial waters of the GOM, and is rarely used for recreational fishing and boating activities. In addition, the proposed Q-20 sonar testing would occur for a maximum of 420 hours per year in a small area. NMFS believes this low level of activity would not have significant effects on socioeconomic activities such as commercial fishing, as commercial fishermen would potentially be displaced from a small area for only a short time.

6) Are the effects on the quality of the human environment likely to be highly controversial?

Response: Although there is some lack of agreement within the scientific and stakeholder communities about the potential effects of military sonar on marine mammals, there is not a substantial dispute about the size, nature or effect of the proposed action. The Q-20 is a low intensity, high-frequency (35 – 200 kHz) sonar system, and the signals would be greatly attenuated within a short distance compared to the Navy's mid-frequency tactical sonar. There is no historic marine mammal stranding associated with high-frequency sonar operations. Only one general comment was received from the public during the comment period on the proposed IHA that expressed concerns about the Navy injuring and killing thousands of marine mammals; however, injury and mortality are neither expected nor authorized by this IHA. Therefore, NMFS does not believe the effects of the proposed action (issuance of an IHA to the Navy) are highly controversial.

7) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?

Response: No substantial impacts to park land, prime farmlands, wetlands, or wild and scenic rivers are anticipated as a result of issuing an IHA to the Navy as none of these unique areas are found in the action area. Similarly, as described in the response to question (1) above, no substantial impacts to EFH are expected.

8) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: While NMFS' judgments on impact thresholds are based on somewhat limited data, enough is known for NMFS and the regulated entity (here the Navy) to develop precautionary monitoring and mitigation measures to minimize the potential for significant impacts on biological resources. The Navy has been operating sonar for many years, including systems similar to the Q-20 high-frequency sonar. In the past several years, NMFS has issued regulations and letters of authorization to the Navy for the harassment of marine mammals incidental to the conduct of sonar training and research, development, test and evaluation (RDT&E) activities in various parts of the ocean. Based on the Navy's marine mammal monitoring and mitigation reports from these training and RDT&E activities, NMFS concludes that the previous monitoring and mitigation measures prescribed in these marine mammal take authorizations were effective. In addition, actual take of marine mammals was generally lower than expected due to the implementation of monitoring and mitigation measures. Therefore, effects on the human environment are not highly uncertain and do not involve unique or unknown risks.

9) Is the proposed action related to other actions with individually insignificant but cumulatively significant impacts?

Response: Within the offshore GOM there are other Federal actions, such as oil-and-gas exploration and production and other types of Naval training exercises (GOMEX Range Complex) and RDT&E activities (NSWC PCD). However, these activities are temporally dispersed and use appropriate mitigation designed to reduce impacts on marine life to the lowest level practicable. The Navy's Q-20 sonar testing will only occur for a maximum of 420 hours in a year; will take only small numbers of each species by behavioral disturbance; and are not expected to result in injury or mortality. While it is possible that some animals may experience multiple behavioral disturbance incidents due to the planned conduct of other actions in the larger GOM, the potential for multiple, cumulative impacts to marine mammals is considered remote due to the distance between actions, the short term nature of anticipated behavioral effects, and the separation in time from any disturbance due to past activities. In addition, since mitigation and monitoring measures are in place or would be required for all actions that require MMPA take authorization, each action's effects would be managed to ensure the least practicable adverse impact to marine mammal species or stocks.

10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historic resources?

Response: The proposed activity will occur offshore in the GOM, therefore, it is not likely, directly or indirectly, to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places, as none are known to exist in the action area.

11) Can the proposed action reasonably be expected to result in the introduction or spread of a non-indigenous species?

Response: The proposed action (i.e., issuance of an IHA to the Navy) is not expected to result in the introduction or spread of a non-indigenous species. The Navy is responsible for ensuring that its ships are in compliance with all international and U.S. national ballast water requirements to prevent the spread of a non-indigenous species. Therefore, neither NMFS's issuance of the IHA nor the Navy's proposed Q-20 testing is expected to result in the introduction or spread of non-indigenous species, as all international and national preventive measures would be implemented.

12) Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?

Response: To ensure compliance with statutory and regulatory standards, NMFS' actions under section 101(a)(5)(D) of the MMPA must be considered individually and be based on the best available information, which is continuously evolving. Moreover, each action for which an incidental take authorization is sought must be considered in light of the specific circumstances surrounding the action, and mitigation and monitoring may vary depending on those circumstances. Therefore, a finding of no significant impact for this action may inform the environmental review for future projects but would not establish a precedent or represent a decision in principle about a future consideration.

13) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

Response: NMFS does not expect the action to violate any Federal law or requirements imposed for the protection of the environment, and the action itself would result in issuance of the IHA in compliance with all standards required in the MMPA.

14) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Response: There are other sonar testing activities around the world that may impact marine mammals, but most are dispersed both geographically and temporally, and are relatively short-term in nature. Although other activities such as oil and gas exploration and production and related seismic surveys, commercial fisheries, marine transportation, and other military activities (e.g., Navy's training at GOMEX Range Complex) occur at the Gulf of Mexico, given the small spatial scale and infrequent occurrence of the proposed activity and the required mitigation, NMFS anticipates there would be minimal synergistic adverse environmental impacts from the Q-20 testing activities under the IHA. In addition, the action will not target any marine species, but may affect certain non-target species, such as marine mammals in the area. However, due to the relatively low energy from the Q-20 system and the infrequent testing activities, NMFS does not believe there will be cumulative adverse effects that could have a substantial effect on any target or non-target species.

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**DETERMINATION**

In view of the information presented in this document and the analyses contained in the supporting *Environmental Assessment for the Issuance of an Incidental Harassment Authorization to Take Marine Mammals by Harassment Incidental to Conducting High-Frequency Sonar Testing Activities in the Naval Surface Warfare Center Panama City*

*Division*, prepared by NMFS, it is hereby determined that the issuance of an IHA to the Navy for the take, by Level B harassment only, of marine mammals incidental to conducting Q-20 sonar testing at the NSWC PCD in the Gulf of Mexico, in accordance with Alternative 2 in NMFS' EA, will not significantly impact the quality of the human environment, as described above and supported by NMFS' EA. In addition, all beneficial and adverse impacts of the proposed actions have been analyzed to reach the conclusion of no significant impacts. Accordingly, preparation of an Environmental Impact Statement for this action is not necessary.

JUL 2 4 2012

Helen Golde, Acting Director
Office of Protected Resources
National Marine Fisheries Service

Date