PROPOSED ACTION:	Issuance of an Incidental Harassment Authorization to Lamont Doherty Earth Observatory to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Northwest Atlantic Ocean, June – August, 2014.
TYPE OF STATEMENT:	Environmental Assessment
LEAD AGENCY:	U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service
RESPONSIBLE OFFICIAL:	Donna S. Wieting, Director Office of Protected Resources, National Marine Fisheries Service
FOR FURTHER INFORMATION:	Jeannine Cody National Marine Fisheries Service Office of Protected Resources Permits and Conservation Division 1315 East West Highway Silver Spring, MD 20910 301-427-8401
LOCATION:	The Northwest Atlantic Ocean, approximately 25 to 85 kilometers (15.5 to 52.8 miles) off the coast of New Jersey.
ABSTRACT:	This Environmental Assessment analyzes the environmental impacts of the National Marine Fisheries Service, Office of Protected Resources proposal to issue an Incidental Harassment Authorization to Lamont Doherty Earth Observatory, for the taking, by Level B harassment, of small numbers of marine mammals, incidental to a marine geophysical survey in the Atlantic Ocean, June - August, 2014.
DATE:	June 2014

CONTENTS

LIST OF ABBREVIATIONS OR ACRONYMS

ACRC	U.S. Navy's Atlantic City Range Complex
ADCP	acoustic Doppler current profiler
Authorization	Incidental Harassment Authorization
CFR	Code of Federal Regulations
Commission	Marine Mammal Commission
CZMA	Coastal Zone Management Act (16 U.S.C. §§ 1451 *et seq*.)
dB	decibel
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.)
EZ	exclusion zone
FONSI	Finding of No Significant Impact
FR	*Federal Register*
ft	feet
Hz	hertz
IHA	Incidental Harassment Authorization
ITA	Incidental Take Authorization
ITS	Incidental Take Statement
kHz	kilohertz
km	kilometer
km^2	square kilometer
m	meter
mi	mile
mi^2	square mile
MMPA	Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1631 *et seq*.)
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
µPa	micropascal
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq*.)
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NSF	National Science Foundation
OMB	Office of Management and Budget
Opinion	Biological Opinion
UME	Unusual Mortality Event
USFWS	U.S. Fish and Wildlife Service

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

1.1 DESCRIPTION OF PROPOSED ACTION

The Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1631 *et seq*.) prohibits the incidental taking of marine mammals. The incidental take of a marine mammal falls under four categories: mortality, serious injury, injury, or harassment. The MMPA defines harassment as any act of pursuit, torment, or annoyance which: (1) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

There are exceptions, however, to the MMPA's prohibition on take. The National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division (NMFS, hereinafter, we) may authorize the incidental taking of small numbers of marine mammals by harassment upon the request of a U.S. citizen provided we follow certain statutory and regulatory procedures and make determinations. We discuss this exception in more detail in section 1.2.

In response to the Observatory's request, we propose to issue an Incidental Harassment Authorization (Authorization) to Lamont-Doherty Earth Observatory of Columbia University (the Observatory) under Section 101(a)(5)(D) of the MMPA, which would allow the Observatory to take small numbers of marine mammals, incidental to the conduct of a marine geophysical (seismic) survey in federal waters in the northwest Atlantic Ocean approximately 25 to 85 kilometers (km) (15.5 to 52.8 miles (mi)) offshore New Jersey, June through August, 2014. We do not have the authority to permit, authorize, or prohibit the Observatory's research seismic activities under Section 101(a)(5)(D) of the MMPA, as that authority lies with a different Federal agency.

Our issuance of an Authorization to the Observatory is a major federal action under the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq*.), the Council on Environmental Quality (CEQ) regulations in 40 CFR §§ 1500-1508, and NOAA Administrative Order (NAO) 216-6. Thus, we are required to analyze the effects of our proposed action on the human environment.

This Environmental Assessment (EA)addresses the potential environmental impacts of three choices available to us under section 101(a)(5)(D) of the MMPA, namely:

- Issue the Authorization to the Observatory for take, by Level B harassment, of marine mammals during the seismic survey, taking into account the prescribed means of take, mitigation measures, and monitoring requirements;
- Not issue an Authorization to the Observatory in which case, for the purposes of NEPA analysis only, we assume that the activities would proceed and cause incidental take without the mitigation and monitoring measures prescribed in the Authorization[1]; or
- Issue the Authorization to the Observatory for take, by Level B harassment, of marine mammals during the seismic survey by incorporating additional required mitigation measures in addition to the Observatory's proposed measures.

[1] The Foundation's EA states that the Observatory would not conduct the proposed survey without an Incidental Harassment Authorization.

1.1.1 Background on the Observatory's MMPA Application

The Observatory proposes to use the R/V *Marcus G. Langseth* (*Langseth*)– a research vessel owned by the National Science Foundation (Foundation) and operated under a cooperative agreement with the Observatory– to collect and analyze data on the arrangement of sediments deposited during times of changing global sea level from roughly 60 million years ago to present. The three-dimensional (3-D) seismic reflection survey would investigate features such as river valleys cut into coastal plain sediments now buried under a kilometer of younger sediment and flooded by today's ocean.

The Foundation supports basic scientific research in the mathematical, physical, medical, biological, social, and other sciences pursuant to the National Science Foundation Act of 1950, as amended (NSF Act; 42 U.S.C. 1861-75). The Foundation considers proposals submitted by organizations and makes contracts and/or other arrangements (*i.e.*, grants, loans, and other forms of assistance) to support research activities. In 2014, a Foundation-expert panel recommended a research proposal titled, *Collaborative Research: Community-Based 3D Imaging That Ties Clinoform Geometry to Facies Successions and Neogene Sea-Level Change* (Award #1260237) for funding and ship time on the *Langseth*. As the federal action agency for this award, the Foundation has funded the proposed seismic survey in the Atlantic Ocean, June through August, 2014 as a part of the NSF Act of 1950.

Acoustic stimuli generated by the seismic airgun array have the potential to cause behavioral disturbances to marine mammals in the proposed project area. We describe the Foundation-supported seismic survey in more detail in section 2.2.

1.1.2 Marine Mammals in the Action Area

There are 34 marine mammal species with confirmed or potential occurrence off the coast of New Jersey (Tables 1a, b, and c). Of the 34 species listed in Tables 1a, b, and c, 27 species would most likely to be harassed incidental to conducting the seismic survey. (See Table 6 - 3.2.1 Affected Environment, Marine Mammals).

Table 1(a) – Mysticetes with possible/confirmed occurrence in the proposed activity area.

Mysticetes		
1	**North Atlantic right whale***	*Eubalaena glacialis*
2	**Humpback whale***	*Megaptera novaeangliae*
3	Common minke whale	*Balaenoptera acutorostrata*
4	**Sei whale***	*Balaenoptera borealis*
5	**Fin whale***	*Balaenoptera physalus*
6	**Blue whale***	*Balaenoptera musculus*

Table 1(b) – Odontocetes with possible/confirmed occurrence in the proposed activity area.

Odontocetes		
1	**Sperm whale***	*Physeter macrocephalus*
2	Dwarf sperm whale	*Kogia sima*
3	Pygmy sperm whale	*K. breviceps*
4	Blainville's beaked whale	*Mesoplodon densirostris*
5	Cuvier's beaked whale	*Ziphius cavirostris*
6	Gervais' beaked whale	*M. europaeus*
7	Sowerby's beaked whale	*M. bidens*

8	True's beaked whale	*M. mirus*
9	Northern bottlenose whale	*Hyperoodon ampullatus*
10	Rough-toothed dolphin	*Steno bredanensis*
11	Bottlenose dolphin	*Tursiops truncatus*
12	Pantropical spotted dolphin	*Stenella attenuate*
13	Atlantic spotted dolphin	*S. frontalis*
14	Spinner dolphin	*S. longirostris*
15	Striped dolphin	*S. coeruleoalba*
16	Short-beaked common dolphin	*Delphinus delphis*
17	White-beaked dolphin	*Lagenorhynchus albirostris*
18	Atlantic white-sided-dolphin	*L. acutus*
19	Risso's dolphin	*Grampus griseus*
20	False killer whale	*Pseudorca crassidens*
21	Pygmy killer whale	*Feresa attenuate*
22	Killer whale	*Orcinus orca*
23	Long-finned pilot whale	*Globicephala melas*
24	Short-finned pilot whale	*G. macrorhynchus*
25	Harbor porpoise	*Phocoena phocoena*

Table 1(c) – Pinnipeds with possible/confirmed occurrence in the proposed activity area.

Pinnipeds		
1	Gray seal	*Halichoerus grypus*
2	Harbor seal	*Phoca vitulina*
3	Harp seal	*Pagophilus groenlandicus*

[*] Listed as threatened or endangered under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.).

1.1.3 Species Not Considered Due to Rarity in the Action Area

We do not consider the following species in this EA because their range does not overlap with the survey area or the species are so rarely sighted that their presence in the proposed survey area, and therefore take, is unlikely (LGL, 2013; NSF, 2014).

Table 2 – Species with rare occurrence in the proposed activity area.

Species Not Considered Further in this EA		
1	**Beluga whale**	*Delphinapterus leucas*
2	Hooded seal	*Cystophora cristata*
3	Clymene dolphin	*Stenella clymene*
4	Fraser's dolphin	*Lagenodelphis hosei*
5	Melon-headed whale	*Peponocephala electra*
6	Bryde's whale	*Balaenoptera brydei*
7	West Indian manatee[1]	*Trichechus manatus*

[1] This species is under the jurisdiction of the U.S. Fish and Wildlife Service.

1.2 Purpose and Need

The MMPA prohibits "takes" of marine mammals with only a few specific exceptions. The applicable exception in this case is an exemption for incidental take of marine mammals in section 101(a)(5)(D) of the MMPA.

Section 101(a)(5)(D) of the MMPA directs the Secretary of Commerce (Secretary) to authorize, upon request, the incidental, but not intentional, taking of small numbers of marine mammals of a species or population stock, by United States citizens who engage in a specified activity (other than

commercial fishing) within a specified geographical region if we make certain findings and provide a notice of a proposed authorization to the public for review.

We have issued regulations to implement the Incidental Take Authorization provisions of the MMPA (50 CFR § 216) and have produced Office of Management and Budget (OMB)-approved application instructions (OMB Number 0648-0151) that prescribe the procedures necessary to apply for authorizations. All applicants must comply with the regulations at 50 CFR § 216.104 and submit applications requesting incidental take according to the provisions of the MMPA.

Purpose: The primary purpose of our proposed action is to authorize the take of marine mammals incidental to the Observatory's proposed seismic survey. The Authorization would exempt the Observatory from the take prohibitions contained in the MMPA.

To authorize the take of small numbers of marine mammals, we must evaluate the best available information to determine whether the take would have a negligible impact on marine mammals or stocks and have an unmitigable impact on the availability of affected marine mammal species for certain subsistence uses.

In addition, we must prescribe, where applicable, the permissible methods of taking and other means of effecting the least practicable impact on the species or stocks of marine mammals and their habitat (*i.e.*, mitigation), paying particular attention to rookeries, mating grounds, and other areas of similar significance. If appropriate, we must also prescribe the means of effecting the least practicable impact on the availability of the species or stocks of marine mammals for subsistence uses. Authorizations must also include requirements or conditions pertaining to the monitoring and reporting of such taking—in large part to better understand the effects of such taking on the species.

Need: On December 17, 2013, the Observatory submitted an adequate and complete application demonstrating both the need and potential eligibility for issuance of an Authorization in connection with the activities described in section 1.1.1. We now have a corresponding duty to determine whether and how we can authorize take by Level B harassment incidental to the activities described in the Observatory's application. Our responsibilities under section 101(a)(5)(D) of the MMPA and its implementing regulations establish and frame the need for this proposed action.

Any alternatives considered under NEPA must meet the agency's statutory and regulatory requirements. Our described purpose and need guide us in developing reasonable alternatives for consideration, including alternative means of mitigating potential adverse effects.

1.3 THE ENVIRONMENTAL REVIEW PROCESS

NEPA compliance is necessary for all "major" federal actions with the potential to significantly affect the quality of the human environment. Major federal actions include activities fully or partially funded, regulated, conducted, authorized, or approved by a federal agency. Because our issuance of an Authorization would allow for the taking of marine mammals consistent with provisions under the MMPA, we consider this as a major federal action subject to NEPA.

Under the requirements of NAO 216-6 section 6.03(f)(2)(b) for incidental harassment authorizations, we prepared this EA to determine whether the direct, indirect and cumulative impacts related to the

issuance of an Authorization for incidental take of marine mammals during the conduct of the Observatory's seismic survey activities in the Atlantic Ocean could be significant. If we deem the potential impacts to be not significant, this analysis, in combination with other analyses incorporated by reference—may support the issuance of a Finding of No Significant Impact (FONSI) for the proposed Authorization.

1.3.1 Laws, Regulations, or Other NEPA Analyses Influencing the EA's Scope

We have based the scope of the proposed action and nature of the three alternatives considered in this EA on the relevant requirements in section 101(a)(5)(D) of the MMPA. Thus, our authority under the MMPA bounds the scope of our alternatives. We conclude that this analysis—when combined with the analyses in the following documents—fully describes the potential impacts associated with the proposed seismic survey program, including any required mitigation and monitoring measures. After conducting an independent review of the information and analyses for sufficiency and adequacy, we incorporate by reference the relevant analyses on the Observatory's proposed action as well as a discussion of the affected environment and environmental consequences within the following documents per 40 CFR 1502.21 and NAO 216-6 § 5.09(d):

- our notice of the proposed Authorization in the *Federal Register* (79 FR 14779, March 17, 2014);
- *Request for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, June–July 2014* (LGL, 2013);
- *Draft Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, June–July 2014* (NSF, 2014); and
- *Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey* (NSF, 2011).

MMPA Application and Notice of the Proposed IHA

The CEQ regulations (40 CFR § 1502.25) encourage federal agencies to integrate NEPA's environmental review process with other environmental review laws. We rely substantially on the public process for developing proposed Authorizations and evaluating relevant environmental information and provide a meaningful opportunity for public participation as we develop corresponding EAs. We fully consider public comments received in response to our publication of the notice of proposed Authorization during the corresponding NEPA review process.

On March 17, 2014, we published a notice of a proposed Authorization in the *Federal Register* (79 FR 14779) which included the following:

- A detailed description of the proposed action and an assessment of the potential impacts on marine mammals and their habitat;
- Plans for the Observatory's mitigation and monitoring measures to avoid and minimize potential adverse impacts to marine mammals and their habitat and proposed reporting requirements; and

- Our preliminary findings under the MMPA.

We considered the Observatory's proposed seismic survey and associated mitigation and monitoring measures and preliminarily determined that the proposed 3-D seismic survey in the Atlantic Ocean, from June through August 2014, would result, at worst, in a modification in behavior and/or low-level physiological effects (Level B harassment) of certain species of marine mammals. In addition, we determined that the activity would not have an unmitigable adverse impact on the availability of marine mammals for subsistence uses. The notice afforded the public a 30-day comment period on our proposed MMPA Authorization. In response to a request by several environmental organizations and others, we extended the comment period for an additional 30 days. (79 FR 19580, April 9, 2014).

1.3.2 Scope of Environmental Analysis

Given the limited scope of the decision for which we are responsible, this EA intends to provide more focused information on the primary issues and impacts of environmental concern related specifically to our issuance of the Authorization. This EA does not further evaluate effects to the elements of the human environment listed in Table 3 because previous environmental reviews for similar seismic activities, incorporated by reference (NSF, 2011, 2014), have (1) already evaluated the effects of these activities on other elements of the human environment (as noted in Table 3); and (2) we have determined that the issuance of our Authorization would not affect those components of the human environment.

Table 3 – Components of the human environment not affected by our issuance of an Authorization.

Biological	Physical	Socioeconomic / Cultural
Amphibians	Air Quality	Commercial Fishing
Humans	Essential Fish Habitat	Military Activities
Non-Indigenous Species	Geography	Oil and Gas Activities
Seabirds	Land Use	Recreational Fishing
	Oceanography	Shipping and Boating
	State Marine Protected Areas	Recreational Diving
	Federal Marine Protected Areas	National Historic Preservation Sites
	National Estuarine Research Reserves	National Trails and Nationwide Inventory of Rivers
	National Marine Sanctuaries	Low Income Populations
	Park Land	Minority Populations
	Prime Farmlands	Indigenous Cultural Resources
	Wetlands	Public Health and Safety
	Wild and Scenic Rivers	Historic and Cultural Resources
	Ecologically Critical Areas	

1.3.3 NEPA Public Scoping Summary

NAO 216-6 established agency procedures for complying with NEPA and the implementing NEPA regulations issued by the CEQ. Consistent with the intent of NEPA and the clear direction in NAO 216-6 to involve the public in NEPA decision-making, we requested comments on the potential environmental impacts described in the Observatory's MMPA application and in the *Federal Register* notice of the proposed Authorization (79 FR 14779, March 17, 2014). The CEQ regulations further encourage agencies to integrate the NEPA review process with review

under the environmental statutes. Consistent with agency practice we integrated our NEPA review and preparation of this EA with the public process required by the MMPA for the proposed issuance of an Authorization.

The *Federal Register* notice of the proposed Authorization, combined with our preliminary determinations, supporting analyses, and corresponding public comment periods are instrumental in providing the public with information on relevant environmental issues and offering the public a meaningful opportunity to provide comments to us for consideration in both the MMPA and NEPA decision-making processes.

The *Federal Register* notice of the proposed Authorization summarized our proposed action; included a statement that we would evaluate the Foundation's draft EA (NSF, 2014) and determine whether or not to adopt it or prepare a separate NEPA analysis and incorporate relevant portions of the Foundation's draft EA by reference. We invited interested parties to submit written comments concerning the application and our preliminary analyses and findings including those relevant to consideration in the EA. The notice of the proposed Authorization was available for public review and comment from March 17 through May 16, 2014.

We posted the Observatory's application on our website concurrently with the release of the *Federal Register* notice of the proposed Authorization. We base this EA on the information included in our *Federal Register* notice, the documents it references, and the public comments provided in response. At the conclusion of this process, we will post the final EA, and, if appropriate, FONSI, on the same website.

1.3.4 Relevant Comments on our *Federal Register* Notice

During the 60-day public comment period on the notice of the proposed Authorization, we received comment letters from the following:

Table 4a – Members of the U.S. Congress who submitted comments on our proposed action.

Congressional	
Sen. Cory Booker, (D-NJ)	Rep. Frank Pallone, (D-NJ)
Rep. Frank A. LoBiondo, (R-NJ)	Rep. Chris Smith, (R-NJ)

Table 4b – Federal or state agencies who submitted comments on our proposed action.

Federal / State Agencies	
U.S. Marine Mammal Commission	State of New Jersey Department of Environmental Protection

Table 4c – Organizations and individuals who submitted comments on our proposed action.

Organizations and Private Citizens	
Alaska Inter-Tribal Council	Lincoln S. Hollister, private citizen
American Littoral Society	Natural Resources Defense Council
Asbury Park Fishing Club	New Jersey Beach Buggy Association
Association of NJ Environmental Commissions	Marine Trades Association of New Jersey
Center for Biological Diversity	Marcus Langseth Science Oversight Committee
Cetacean Society International	Oceana
Clean Ocean Action	Paddleout.org
Clean Water Action	reEarth

CWA Local 1075	SandyHook SeaLife Foundation
Drew Martin, private citizen	Save Barnegat Bay
Fisherman's Dock Cooperative	Surfers' Environmental Alliance
Hands Across the Sand	Surfrider Foundation
International Game Fish Association	WATERSPIRIT
League of Women Voters of New Jersey	Whale and Dolphin Action League
Lenape Nation PA	

The public comments related to the potential environmental impacts associated with our action of issuing an Authorization for the Observatory's action include:

- Ensuring that the Authorization complies with the MMPA;
- Re-evaluating our preliminary determinations for negligible impact on marine mammals;
- Providing justification that our determination that Level A harassment would not occur during the conduct of the seismic survey is based on the best available science;
- Considering and incorporating the latest information on species present in the area;
- Consideration of additional mitigation measures such as establishing larger exclusion zones; lowering the acoustic thresholds for take estimates; suspending activities at night; conducting the survey at an alternative time; and using additional methods to detect marine mammals;
- Ensuring consideration of cumulative effects of other anthropogenic sound producing activities in the action area, including future seismic exploration activities and the use of active acoustic sources; and
- Evaluating the impacts to North Atlantic right whales and bottlenose dolphins.

The Marine Mammal Commission (Commission) provides comments on all proposed incidental take authorizations as part of their established role under the MMPA (§ 202 (a)(2))The Commission submitted the following recommendations:

- Require the Observatory to take in-situ measurements at the survey location to verify, refine, and if needed, recalculate exclusion zone estimates;
- Require the Observatory to revise their take estimates; and
- Consult with the Foundation and the Observatory to develop, validate, and implement a monitoring program that provides a scientifically sound, reasonably accurate assessment of the types of marine mammal takes and the actual numbers of marine mammals taken.

We fully considered all of the public comments in preparing the final Authorization and this EA by reviewing the pertinent comments and information provided to us. We address any comments specific to the Observatory's application that address the statutory and regulatory requirements or findings that we must make in order to issue an Authorization. We will provide responses to the public comments in the *Federal Register* notice announcing the issuance of the Authorization

1.4 Other Permits, Licenses, or Consultation Requirements

This section summarizes federal, state, and local permits, licenses, approvals, and consultation requirements necessary to implement the proposed action. We incorporate those descriptions by reference in this EA and briefly summarize them in this section.

1.4.1 ENDANGERED SPECIES ACT

Section 7 of the ESA and implementing regulations at 50 CFR § 402 require consultation with the appropriate federal agency (either NMFS or the U.S. Fish and Wildlife Service) for federal actions that "may affect" a listed species or critical habitat. Our issuance of an Authorization is a federal action subject to the section 7 consultation requirements. Accordingly, we are required to ensure that our 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.

There are six marine mammal species under our jurisdiction listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area: blue, fin, humpback, North Atlantic right, sei, and sperm whales. There is no designated critical habitat for any of the ESA-listed species within the action area; thus, our Authorization will not affect any of these species' critical habitats.

On December 17, 2013, the Foundation requested authorization for the incidental take of three marine mammals listed as endangered under the ESA under our jurisdiction: fin, sei, and sperm whales. Under section 7 of the ESA, the Foundation, the lead Federal agency which owns and operates the *Langseth*, initiated formal consultation on their action with the National Marine Fisheries Service, Office of Protected Resources, Endangered Species Act Interagency Cooperation Division.

On February 3, 2014, we also initiated formal consultation on our proposed action with the National Marine Fisheries Service, Office of Protected Resources, Endangered Species Act Interagency Cooperation Division. For the proposed Authorization, NMFS reviewed the Observatory's take estimates for listed species under the ESA presented in Table 3 of their application (LGL, 2013). Based on the best available information, we requested consultation on the issuance of incidental take for two additional species (i.e., blue and North Atlantic right whales) in addition to the Foundation's original incidental take request for fin, humpback, sei, and sperm whales.

The formal consultation under section 7 of the ESA will conclude with a single Biological Opinion for the National Science Foundation's Division of Ocean Sciences and to the National Marine Fisheries Service's Office of Protected Resources, Permits and Conservation Division for the seismic survey and associated Authorization under the MMPA.

1.4.2 MARINE MAMMAL PROTECTION ACT

We discuss the MMPA and its provisions that pertain to the proposed action described within section 1.2.

1.4.3 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; 16 U.S.C. 1801 *et seq*.), 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.

Table 4 (page 29) of the Foundation's EA (NSF, 2014) identifies 39 marine species with EFH overlapping the proposed survey area. As the federal action agency funding the Observatory's activities, the Foundation will consult with the NMFS Greater Atlantic Regional Office on EFH.

On February 26, 2014, we determined that mitigation and monitoring measures required by the Authorization for the action would not result in adverse effects to EFH. Thus, the issuance of an Authorization for the taking of marine mammals incidental to the Observatory's seismic survey would not impact EFH and would not require an EFH consultation .

1.4.4 COASTAL ZONE MANAGEMENT ACT

Congress enacted the Coastal Zone Management Act (CZMA) (16 U.S.C. §§ 1451 *et seq*.) to encourage states to manage land and water uses that may affect coastal uses and resources. Once state coastal management programs and the policies within them receive federal approval from NOAA, federal agency activities that may have reasonably foreseeable effects on coastal uses or resources are required to be consistent with those enforceable policies.

On May 20, 2014, NOAA's Office of Ocean and Coastal Resource Management (OCRM) received from the State of New Jersey (State) a request for approval to review under CZMA § 307(d), 15 CFR 930, subpart F the Foundation's funding to Rutgers State University as an unlisted activity that occurs outside of the state's coastal zone. On June 18, 2014, OCRM denied the State of New Jersey's request to review Rutgers' application as an unlisted activity because the State's request for approval to review the activity was not made in a timely manner as required under 15 C.F.R. § 930.98. The State has not requested OCRM approval to review the Authorization as an unlisted activity.

CHAPTER 2 – ALTERNATIVES

2.1 INTRODUCTION

The NEPA and the implementing CEQ regulations (40 CFR §§ 1500-1508) require consideration of alternatives to proposed major federal actions and NAO 216-6 provides agency policy and guidance on the consideration of alternatives to our proposed action. An EA must consider all reasonable alternatives, including the No Action Alternative. This provides a baseline analysis against which we can compare the other alternatives.

To warrant detailed evaluation as a reasonable alternative, an alternative must meet our purpose and need. In this case, and as we previously explained, an alternative meets the purpose and need if it satisfies the requirements under section 101(a)(5)(D) the MMPA. We evaluated each potential alternative against these criteria; identified two action alternatives along with the No Action Alternative; and carried these forward for evaluation in this EA.

Alternatives 1 and 3 include a suite of mitigation measures intended to minimize any potential adverse effects to marine mammals. This chapter describes both alternatives and compares them in terms of their environmental impacts and their achievement of objectives.

2.2 DESCRIPTION OF THE OBSERVATORY'S PROPOSED ACTIVITIES

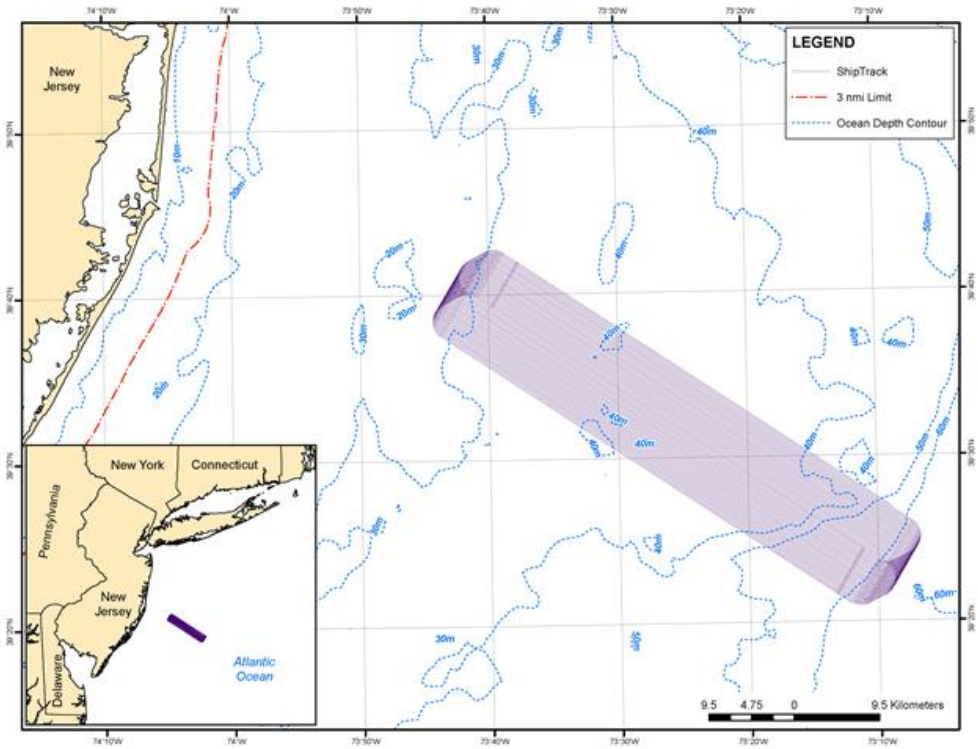
We presented a general overview of the Observatory's proposed 3-D seismic survey operations in our *Federal Register* notice of the proposed Authorization (79 FR 14779, March 17, 2014). Also, the Observatory's application (LGL, 2013) and the Foundation's draft EA (NSF, 2014), describe the survey protocols in detail. We incorporate those descriptions by reference in this EA and briefly summarize them here.

2.2.1 SPECIFIED TIME AND SPECIFIED AREA

The Observatory proposes to conduct the seismic survey from the period of June 3 through July 9, 2014. The proposed study (e.g., equipment testing, startup, line changes, repeat coverage of any areas, and equipment recovery) would include approximately 720 hours of airgun operations (i.e., 30 days over 24 hours). Some minor deviation from the Observatory's requested dates of June through July, 2014, is possible, depending on logistics, weather conditions, and the need to repeat some lines if data quality is substandard. However, because of the extension of the public comment period, the Observatory has agreed to delay the proposed start date of the survey. Therefore, we propose to issue an Authorization that is effective from June 30, 2014 to August 17, 2014. The revised date range falls within the effective date range that we proposed within the *Federal Register* notice of the proposed Authorization (79 FR 14779, March 17, 2014) and the Observatory would still be able to conduct the 30-day survey within the effective date range.

The Observatory proposes to conduct the seismic survey in the Atlantic Ocean, approximately 25 to 85 km (15.5 to 52.8 mi) off the coast of New Jersey between approximately 39.3–39.7° N and approximately 73.2–73.8° W (Figure 1). Water depths in the survey area are approximately 30 to 75 m (98.4 to 246 ft). They would conduct the proposed survey outside of New Jersey state waters and within the U.S. Exclusive Economic Zone.

Figure 1 – Proposed location of the seismic survey in the Atlantic Ocean off the coast of New Jersey during June through August, 2014.



2.2.2 3-D Seismic Survey Operations

Source Vessel: The *Langseth* is 71.5 m (235 ft) long vessel with a gross tonnage of 3,834 pounds. The vessel's speed during operations would be approximately 4.5 knots (kt) (8.3 km/hour (hr); 5.1 miles per hour (mph)). It has an observation tower that is 21.5 m (71 ft) above sea level providing protected species observers an unobstructed view around the entire vessel.

Transit: The *Langseth* would depart from New York and transit for approximately eight hours to the proposed survey area. Setup, deployment, and streamer ballasting would occur over approximately three days. At the end of the survey, the *Langseth* would return to New Jersey**.**

Transects: The proposed survey would cover approximately 4,900 km (3,045 mi) of transect lines within a 12 by 50 km (7.5 by 31 mi) area. Each transect line would have a spacing interval of 150 m (492 ft) in two 6-m (19.7-ft) wide race-track patterns.

Seismic Airguns: During the survey, the *Langseth* would deploy two pairs of subarrays of four or eight airguns as an energy source. The airguns are a mixture of Bolt 1500LL and Bolt 1900LLX airguns ranging in size from 40 to 220 cubic inches (in^3), with a firing pressure of 1,950 pounds per square inch. The dominant frequency components range from zero to 188 Hertz (Hz). The nominal source levels of the airgun subarrays on the *Langseth* range from 246 to 253 dB re: 1 µPa (peak-to-peak). The subarrays would fire alternately, with a total volume of either approximately 700 cubic inches (in^3) or 1,400 in^3. In either configuration, the source volume would not exceed 700 in^3 (i.e., the four-string subarray) or 1,400 in^3 (i.e., the eight-string subarray) at any time during acquisition. The *Langseth* would tow each subarray at a depth of either 4.5 or 6 m (14.8 or 19.7 ft) resulting in a shot interval of approximately 5.4 seconds (12.5 m; 41 ft). During acquisition the airguns will emit a brief (approximately 0.1 second) pulse of sound. During the intervening periods of operations, the airguns are silent.

Hydrophones: The receiving system would consist of four 3,000-m (1.9-mi) hydrophone streamers with a spacing interval of 75 m (246 ft) between each streamer. As the *Langseth* tows the airgun subarrays along the survey lines, the hydrophone streamers would receive the returning acoustic signals and transfer the data to the on-board processing system.

Multibeam Echosounder: The *Langseth* will operate a Kongsberg EM 122 multibeam echosounder concurrently during airgun operations to map characteristics of the ocean floor. The hull-mounted echosounder emits brief pulses of sound (also called a ping) (10.5 to 13.0 kilohertz (kHz) in a fan-shaped beam that extends downward and to the sides of the ship. The nominal source level for the multibeam echosounder is 242 dB re: 1 μPa.

Sub-bottom Profiler: The *Langseth* will also operate a Knudsen Chirp 3260 sub-bottom profiler concurrently during airgun and echosounder operations to provide information about the sedimentary features and bottom topography. The hull-mounted profiler emits a ping with a dominant frequency component at 3.5 kHz. The nominal source level for the profiler is 204 dB re: 1 μPa.

Acoustic Doppler Current Profiler: The Observatory would measure currents using a Teledyne OS75 75-kilohertz (kHz) acoustic Doppler current profiler (ADCP). The ADCP's configuration consists of a 4-beam phased array with a beam angle of 30°. The source level is proprietary information but has a maximum acoustic source level of 224 dB re: 1 μPa.

Support Vessel: The Observatory would use a support vessel to prevent the *Langseth's* streamer entangling with fixed fishing gear. The vessel would be a multi-purpose offshore utility vessel similar to the *Northstar Commander*, which is 28 m (91.9 ft) long with a beam of 8 m (26.2 ft) and a draft of 2.6 m (8.5 ft).

2.2.2 APPROACH TO DEVELOPING MITIGATION EXCLUSION ZONES

The Observatory's application (LGL, 2013) and Appendix A in the Foundation's draft EA (NSF, 2014), describe the approach to establishing mitigation exclusion zones in detail. We incorporate those descriptions by reference in this EA and briefly summarize them here.

In summary, the Observatory acquired sound propagation measurements for several array configurations at shallow- and deep-water depths during acoustic verification studies conducted in the northern Gulf of Mexico in 2003 (Tolstoy et al., 2004) and in 2007 and 2008 (Tolstoy et al., 2009). Based on the empirical data from those studies, the Observatory developed a sound propagation modeling approach[2] that conservatively predicts received sound levels as a function of distance from a particular airgun array configuration in deep water (Diebold et al., 2010).

In 2010, the Observatory assessed the accuracy of their modeling approach by comparing the sound levels of the field measurements in the Gulf of Mexico study to their model predictions (Diebold, et al., 2010). They reported that the observed sound levels from the field measurements fell almost entirely below the predicted mitigation radii curve for deep water (Diebold, et al., 2010). Based on this information, the Observatory has shown that their model can reliably estimate mitigation radii in deep water. We acknowledge that the Observatory based their

[2] The modeling approach uses ray tracing (*i.e.*, a graphical representation of the effects of refracting sound waves) for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer, unbounded by a seafloor).

modeling approach on the environmental variability present in the Gulf of Mexico, but the model has limited ability to capture the variability resulting from site-specific factors present in the marine environment offshore New Jersey.

The Observatory used a similar process to develop mitigation radii (i.e., exclusion and buffer zones) for a shallow-water seismic survey in the northeast Pacific Ocean offshore Washington in 2012. The Observatory conducted the shallow-water survey using an airgun configuration that was approximately 78 or 89 percent larger than the total discharge volumes proposed for this shallow-water survey (i.e., 6,600 in^3) compared to 700 in^3 or 1,400 in^3) and recorded the received sound levels on the shelf and slope off Washington using the Langseth's 8-km hydrophone streamer. Crone et al. (2013) analyzed those received sound levels from the 2012 survey and reported that the actual distances for the exclusion and buffer zones were two to three times smaller than what the Observatory's modeling approach predicted. While the results confirm bathymetry's role in sound propagation, Crone et al. (2013) were able to confirm that the empirical measurements from the Gulf of Mexico calibration survey (the same measurements used to inform the Observatory's modeling approach for this survey in shallow water) overestimated the size of the exclusion and buffer zones for the shallow-water 2012 survey off Washington and were thus precautionary, in that particular case, for effecting the least practicable impact marine mammals.

Following is a brief summary of the process used to predict the mitigation exclusion zones (Tables 5a and 5b) for the proposed study.

1. For an 18-gun, 3,300-in^3 array towed at a depth of 6 m (19.6 ft), the model predicted that the 160-, 180-, and 190-dB isopleths would result in radii (*i.e*., exclusion zones) of 4,500, 450, and 142 m (2.8, 0.3, and 0.1 mi) respectively, in deep water (Figure A3 in Appendix A of the Foundation's EA). The empirical data for the airgun configurations indicated that, for deep water, the Observatory's modeling approach overestimates the received sound levels at a given distance and is thus precautionary (Diebold, et al., 2010; Tolstoy, et al., 2009).
2. Using the modeling approach, the Observatory modeled the exclusion zones for the proposed suite of array configurations for this study in deep water (Figures A4-A8 in Appendix A of the Foundation's EA).
3. The Gulf of Mexico calibration study did not obtain measurements for the smaller array (i.e., 700 or 1,400 in^3) proposed for use in this survey. To account for this difference, the Observatory developed a scaling factor to extrapolate exclusion zones for the proposed study (NSF, 2014).
4. The Observatory calculated the ratios (*i.e*., scaling factors) between the model's deep-water exclusion zones for the 18-gun, 3,300-in^3 array and the model's deep-water exclusion zones for the study's various airgun configurations. This is an appropriate comparison of the sound exposure level outputs between two different types of airgun configurations.
5. To calculate the exclusion zones for the study's various array configurations in shallow water, the Observatory multiplied the scaling factors by the empirically-derived shallow water exclusion zones reported for an 18-gun, 3,300-in^3 array in the Gulf of Mexico (Diebold, et al., 2010). These empirically-derived exclusion zones from the Gulf of Mexico are approximately three times larger than the exclusion zones modeled for the 18-gun 3,300-in^3 array in deep water.

In summary, the Observatory used the ratio of the size of safety zones of a large airgun in deep water compared to this airgun array in deep water to determine the size of the safety zone for this airgun in shallow water, given the known zone for the same large airgun in shallow water. We believe that this is a rational method for best using the available information to estimate the safety zones.

The comparisons of the Observatory's model results and the field data collected in the Gulf of Mexico and Washington illustrate a degree of conservativeness built into the Observatory's model for deep water, which would be expected to offset some of the limited ability of the model to capture the variability resulting from site-specific factors, especially in shallow water. However, in the interest of additional protection, we have required more conservative and precautionary mitigation and monitoring measures within this Authorization. Following our consideration of those conservative factors, we have included an additional layer of conservativeness by increasing the 180-dB and 190-dB exclusion zones for this survey by a factor of 50 percent (approximately a 3-dB difference) to be precautionary and to account for sound levels falling well below the estimated radii. Thus, enlarging the exclusion zone should be able to account for any environmental variability within the study area in addition to the other conservative factors that we have considered in estimating the exclusion zones.

Table 5a in this EA shows the original predicted distances and Table 5b shows the revised distances.

Table 5a – Original modeled exclusion zones (EZ) for marine mammals in the survey area.

Source and Volume (in^3)	**Tow Depth (m)**	**Water Depth (m)**	**Predicted RMS Distances[1] (m)**		
			190 dB	180 dB	160 dB
Single Bolt airgun (40 in^3)	6	< 100	21	100	995
4-Airgun subarray (700 in^3)	4.5	< 100	101	378	5,240
4-Airgun subarray (700 in^3)	6	< 100	118	439	6,100
8-Airgun subarray (1,400 in^3)	4.5	< 100	128	478	6,670
8-Airgun subarray (1,400 in^3)	6	< 100	157	585	8,150

[1] Predicted distances based on Table 1 of the Foundation's EA (NSF, 2014).

Table 5b – Revised modeled exclusion zones (EZ) for marine mammals in the survey area.

Source and Volume (in^3)	**Tow Depth (m)**	**Water Depth (m)**	**Predicted RMS Distances[1] (m)**		
			187 dB	177 dB	160 dB
Single Bolt airgun (40 in^3)	6	< 100	31	109	995
4-Airgun subarray (700 in^3)	4.5	< 100	151	561	5,240
4-Airgun subarray (700 in^3)	6	< 100	175	651	6,100
8-Airgun subarray (1,400 in^3)	4.5	< 100	190	709	6,670
8-Airgun subarray (1,400 in^3)	6	< 100	234	886	8,150

[1] Predicted distances based on information submitted by the Observatory on June 27, 2014.

2.3 DESCRIPTION OF ALTERNATIVES

2.3.1 ALTERNATIVE 1 – ISSUANCE OF AN AUTHORIZATION WITH MITIGATION MEASURES

The Proposed Action constitutes Alternative 1 and is the Preferred Alternative. Under this alternative, we would issue an Authorization (valid from June through August 2014) to the Observatory allowing the incidental take, by Level B harassment, of 27 species of marine mammals subject to the mandatory mitigation and monitoring measures and reporting requirements set forth in the proposed Authorization, along with any additions based on consideration of public comments.

MITIGATION MEASURES

As described in Section 1.2.1, we must prescribe the means of effecting the least practicable adverse impact on the species or stocks of marine mammals and their habitat. In order to do so, we must consider the Observatory's proposed mitigation measures, as well as other potential measures, and assess how such measures could benefit the affected species or stocks and their habitat. Our evaluation of potential measures includes consideration of the following factors in relation to one another: (1) the manner in which, and the degree to which, we expect the successful implementation of the measure to minimize adverse impacts to marine mammals; (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Any additional mitigation measure proposed by us beyond what the applicant proposes should be able to or have a reasonable likelihood of accomplishing or contributing to the accomplishment of one or more of the following goals:

- Avoidance or minimization of marine mammal injury, serious injury, or death wherever possible;
- A reduction in the numbers of marine mammals taken (total number or number at biologically important time or location);
- A reduction in the number of times the activity takes individual marine mammals (total number or number at biologically important time or location);
- A reduction in the intensity of the anticipated takes (either total number or number at biologically important time or location);
- Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base; activities that block or limit passage to or from biologically important areas; permanent destruction of habitat; or temporary destruction/disturbance of habitat during a biologically important time; and
- For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

To reduce the potential for disturbance from acoustic stimuli associated with the activities, the Observatory has agreed to implement the following monitoring and mitigation measures for marine mammals. These include:

1) Utilize NMFS-qualified, vessel-based Protected Species Observers (PSOs) to visually watch for and monitor marine mammals near the seismic source vessel during daytime operations (from nautical twilight-dawn to nautical twilight-dusk) and before and during start-ups of sound sources day or night. Two PSOs would observe the exclusion and disturbance zones.

When practicable, as an additional means of visual observation, the *Langseth's* vessel crew may also assist in detecting marine mammals.

2) Establish a 177 dB re: 1 µPa and 187 dB re: 1 µPa exclusion zone (EZ) for marine mammals before the full array (either 700 or 1,400 in^3) or a single airgun (40 in^3) is in operation (Table 4).

3) Visually observe the entire extent of the EZ (177 dB re: 1 µPa for cetaceans and 187 dB re: 1 µPa for pinnipeds) using NMFS-qualified PSOs, for at least 30 minutes (min) prior to starting the airgun array (day or night).

4) Implement a ramp-up procedure when initiating the seismic operations or any time after the entire array has been shut down for more than 8 minutes, which means start the smallest sound source first and add sound sources in a sequence such that the source level of the array shall increase in steps not exceeding approximately 6 dB per 5-minute period. During ramp-up, the PSOs shall monitor the EZ, and if they sight marine mammals, they shall implement a power-down or shutdown as though the full array were operational. Therefore, initiation of ramp-up procedures from shutdown requires that the PSOs be able to visually observe the full EZ described in Measures 2 and 3.

5) Power-down or shutdown the sound source(s) if a PSO detects a marine mammal that is within, approaches, or enters the applicable EZ. A shutdown means that the crew shuts down all operating sound sources (i.e., turned off). A power-down means reducing the number of operating sound sources to a single operating 40 in^3 airgun, which reduces the EZ to the degree that the animal(s) is no longer within or about to enter it.

6) The shot interval for the single operating 40 in^3 airgun should be set to one shot per minute.

7) Following a power-down, the *Langseth* crew would not resume full airgun activity until the marine mammal has cleared the 177- or 187-dB exclusion zone. The observers would consider the animal to have cleared the exclusion zone if:
   a. the observer has visually observed the animal leave the exclusion zone; or
   b. an observer has not sighted the animal within the exclusion zone for 15 minutes for species with shorter dive durations (*i.e.*, small odontocetes or pinnipeds), or 30 minutes for species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales).

8) Following a power-down, the *Langseth* crew would resume operating the airguns at full power after 15 minutes of sighting any species with short dive durations (*i.e.*, small odontocetes or pinnipeds). Likewise, the crew would resume airgun operations at full power after 30 minutes of sighting any species with longer dive durations (*i.e.*, mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales).

9) Considering the conservation status of North Atlantic right whales, the *Langseth* crew will be required to shut down the airgun(s) immediately in the unlikely event that observers detect this species, regardless of the distance from the vessel. The *Langseth* would only begin ramp-up if observers have not seen a North Atlantic right whale for 30 minutes.

10) Following a shutdown for more than 8 minutes and subsequent animal departure, survey operations may resume following ramp-up procedures described in Measure 4.

11) The seismic survey may continue into night and low-light hours if such segment(s) of the survey is initiated when the entire applicable EZs can be effectively monitored visually (*i.e.*, PSO(s) must be able to see the extent of the entire applicable EZ).

12) No initiation of survey operations involving the use of sound sources is permitted from a shutdown position at night or during low-light hours (such as in dense fog or heavy rain) unless at least one airgun (40-in^3 or similar) has been operating during the interruption of seismic survey operations. Given these provisions, it is likely that the vessel's crew would not ramp up the airgun array from a complete shutdown at night or in thick fog, because the outer part of the EZ would not be visible during those conditions.

13) Alter speed or course during seismic operations if a marine mammal, based on its position and relative motion, appears likely to enter the relevant EZ. If speed or course alteration is not safe or practicable, or if after implementing an alteration the marine mammal still appears likely to enter the EZ, further mitigation measures, such as a power-down or shutdown, shall be taken.

MONITORING MEASURES

The Observatory proposes to sponsor marine mammal monitoring during the present project, in order to implement the mitigation measures that require real-time monitoring and to satisfy the monitoring requirements of the Authorization. The Observatory understands that we would review the monitoring plan and may require refinements to the plan.

The Authorization would require the Observatory to use a passive acoustic monitoring (PAM) system, to the maximum extent practicable, to detect, and allow some localization of marine mammals around the *Langseth* during all airgun operations and during most periods when airguns are not operating. When the PAM operator detects an animal, he/she must notify the PSO immediately of a vocalizing marine mammal so the *Langseth* crew can initiate a power-down or shut-down, if required.

REPORTING MEASURES

The Observatory would submit a report to us and the Foundation within 90 days after the end of the cruise. The report would describe the operations conducted and sightings of marine mammals near the operations. The report would provide full documentation of methods, results, and interpretation pertaining to all monitoring. The report must contain and summarize the following information:

1) Dates, times, locations, heading, speed, weather, sea conditions (including Beaufort sea state and wind force), and associated activities during all seismic operations and marine mammal sightings;

2) Species, number, location, distance from the vessel, and behavior of any marine mammals, as well as associated seismic activity (number of power-downs and shutdowns), observed throughout all monitoring activities;

3) An estimate of the number (by species) of: (A) pinnipeds that have been exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 µPa and/or 187 dB re: 1 µPa with a discussion of any specific behaviors those individuals exhibited; and (B) cetaceans that have been exposed to the seismic activity (based on visual observation) at received levels greater than or equal to 160 dB re: 1 µPa and/or 177 dB re: 1 µPa with a discussion of any specific behaviors those individuals exhibited.

4) A description of the implementation and effectiveness of the: (A) terms and conditions of the Biological Opinion's Incidental Take Statement (ITS); and (B) mitigation measures required by our Authorization. For the Biological Opinion, the report shall confirm implementation of each Term and Condition, as well as any conservation recommendations, and describe their

effectiveness, for minimizing the adverse effects of the action on ESA-listed marine mammals.

In the unanticipated event that the specified activity clearly causes the take of a marine mammal in a manner prohibited by the Authorization, such as an injury (Level A harassment), serious injury, or mortality (*e.g*., ship-strike, gear interaction, and/or entanglement), the Observatory shall immediately cease the specified activities and immediately report the incident to the Chief of the Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the Northeast Regional Stranding Coordinator. The Observatory may not resume activities until we are able to review the circumstances of the prohibited take. The report must include the following information:

1) Time, date, and location (latitude/longitude) of the incident;
2) The *Langseth's* speed during and leading up to the incident;
3) Description of the incident;
4) Status of all sound source use in the 24 hours preceding the incident;
5) Water depth;
6) Environmental conditions (e.g., wind speed and direction, Beaufort sea state, cloud cover, and visibility);
7) A description of marine mammal observations in the 24 hours preceding the incident;
8) Species identification or description of the animal(s) involved;
9) The fate of the animal(s); and
10) Photographs or video footage of the animal (if equipment is available).

In the event that the Observatory discovers an injured or dead marine mammal, and the PSO determines that the cause of the injury or death is unknown and the death is relatively recent (*i.e*., in less than a moderate state of decomposition as we describe in the next paragraph), the Observatory will immediately report the incident to the Incidental Take Program Supervisor, Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the Northeast Regional Stranding Coordinator. The report must include the same information identified in the paragraph above this section. Activities may continue while we review the circumstances of the incident. We would work with the Observatory to determine whether modifications in the activities are appropriate.

In the event that the Observatory discovers an injured or dead marine mammal, and the lead visual observer determines that the injury or death is not associated with or related to the authorized activities (e.g., previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), the Observatory would report the incident to the Incidental Take Program Supervisor, Permits and Conservation Division, Office of Protected Resources, NMFS, her designees, and the and the Northeast Regional Stranding Coordinator within 24 hours of the discovery. The Observatory would provide photographs or video footage (if available) or other documentation of the stranded animal sighting to NMFS. Activities may continue while we review the circumstances of the incident.

TAKE ESTIMATES

The Observatory modeled the number of different individuals that could be exposed to airgun sounds with received levels greater than or equal to 160 dB re: 1 µPa on one or more occasions

by multiplying the total marine area that would be within the 160-dB radius around the operating seismic source on at least one occasion (2,502 km^2 which includes a 25 percent contingency factor to account for repeated tracklines), along with the expected density of animals in the area. NSF acknowledged in their application that this approach does not allow for turnover in the mammal populations in the area during the course of the survey as the actual number of individuals exposed may be underestimated because it does not account for new animals entering or passing through the ensonification area (LGL, 2013; NSF, 2014), however, the Observatory suggested that the 25% contingency factor would cover any potential underestimate of individuals.

Based on public comments received on the *Federal Register* notice of proposed Authorization, we re-evaluated the mitigation and monitoring proposed for incorporation in the Authorization. NMFS determined—based on the best available information—that the revised mitigation measures (which include larger exclusion zones) and revised take estimates are presently the most feasible and effective measures for implementation (Wright, 2014). Thus, this Preferred Alternative would satisfy the purpose and need of our proposed action under the MMPA–issuance of an Authorization, along with required mitigation measures and monitoring that meets the standards set forth in section 101(a)(5)(D) of the MMPA and the implementing regulations.

2.3.2 ALTERNATIVE 2 – NO ACTION ALTERNATIVE

Under the No Action Alternative, the Observatory could choose not to proceed with their proposed activities or to proceed without an Authorization. If they choose the latter, the Observatory would not be exempt from the MMPA take prohibitions and would be in violation of the MMPA if take of marine mammals occurs.

For purposes of this EA, we characterize the No Action Alternative as the Observatory not receiving an Authorization and the Observatory conducting the 3-D seismic survey program without the protective measures and reporting requirements required by an Authorization under the MMPA. We take this approach to meaningfully evaluate the primary environmental issues—the impact on marine mammals from these activities in the absence of protective measures.

2.3.3 ALTERNATIVE 3 – ISSUANCE OF AUTHORIZATION WITH ADDITIONAL MITIGATION MEASURES

Under Alternative 3, we would issue an Authorization to the Observatory, allowing the incidental take by Level B harassment only of small numbers of marine mammal species incidental to conducting seismic survey activities in the Atlantic Ocean during the effective period of the Authorization. Alternative 3 would consist of all of the mitigation, monitoring, and reporting measures contained in Alternative 1, including the following additional measures derived from the public comment process on our notice of the proposed Authorization.

(1) **Alternate Survey Timing:** This measure would require the Observatory to postpone their research after the summer season to minimize interactions with marine life.

(2) **Operational Restrictions**: This measure would require the Observatory to suspend their activities in low-light/nighttime conditions and minimize the number of repeated tracklines for the survey.

(3) **Augmented Monitoring**: This measure would require the use of alternative technologies (e.g., night vision devices) to detect marine mammals beyond the proposed visual and acoustic monitoring.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER CONSIDERATION

We considered whether other alternatives could meet the purpose and need and support the Observatory's activities. We considered an alternative that would allow for the issuance of an Authorization with no required mitigation or monitoring but eliminated that Alternative from consideration, as it would not be in compliance with the MMPA and therefore would not meet the purpose and need. For that reason, we do not analyze this alternative further in this document.

CHAPTER 3 – AFFECTED ENVIRONMENT

This chapter describes existing conditions in proposed survey area. Descriptions of the physical and biological environment of the action area are contained in the documents incorporated by reference (see section 1.3.1) and summarized here.

3.1 PHYSICAL ENVIRONMENT

As discussed in Chapter 1, our proposed action and alternatives relate only to the proposed issuance of our Authorization of incidental take of marine mammals and not to the physical environment. Certain aspects of the physical environment are not relevant to our proposed action (see section 1.3.2 - Scope of Environmental Analysis). Because of the requirements of NAO 216.6, however, we briefly summarize the physical components of the environment here.

In summary, the New Jersey shelf lies between the Hudson and the Delaware shelf valleys from 38°40’ to 40°30’N and 72°30’ to 74°40’W and covers a 25,000-square kilometer (km^2) (9,653-square mile (mi^2)) area. The shelf ranges from 120 to 150 km (75 to 93 mi) in width, sloping to the east and becomes steeper where the shelf break begins at the 120- and 160-m (394- to 525-ft) isobath (Carey et al., 1998). The bottom type of the shelf is categorized as soft, consisting of sandy to muddy-sandy bottom substrate (Navy, 2013).

3.1.1 MARINE MAMMAL HABITAT

We presented information on marine mammal habitat and the potential impacts to marine mammal habitat in our notice of the proposed Authorization. Also, the Foundation presented more detailed information on the physical and oceanographic aspects of the New Jersey environment in their draft EA (NSF, 2014). In summary, the marine mammals in the survey area use the nearshore, shelf, shelf break, and continental slope waters, but may have differing habitat preferences based on their life history functions (NJDEP, 2010).

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 MARINE MAMMALS

We provide information on the occurrence of marine mammals with possible or confirmed occurrence in the survey area in section 1.1.2 of this EA (Tables 1a, b, and c). The marine mammals most likely to be present in the action area are in Table 6. This includes 6 mysticetes, 18 odontocetes, and 3 pinniped species under our jurisdiction.

The *Federal Register* notice on the proposed Authorization provided information on the stock, regulatory status, abundance, occurrence, seasonality, and hearing ability of the marine mammals in the action area. The Observatory’s application and the Foundation’s EA also provided distribution, life history, and population size information for marine mammals within the action area. We incorporate those descriptions by reference and briefly summarize the information in Tables 6 and 7.

Table 6 – Marine mammals most likely to be harassed incidental to the Observatory's survey.

Species	Stock Name	Regulatory Status[1, 2]	Abundance[3]	Occurrence and Range	Season
North Atlantic right whale	Western Atlantic	MMPA - D ESA – EN	455	common coastal/shelf	year-round[4]
Humpback whale	Gulf of Maine	MMPA - D ESA – EN	823	common coastal	spring - fall
Common minke whale	Canadian East Coast	MMPA - D ESA – NL	20,741	rare coastal/shelf	spring - summer
Sei whale	Nova Scotia	MMPA - D ESA – EN	357	uncommon shelf edge	spring
Fin whale	Western North Atlantic	MMPA - D ESA – EN	3,522	common pelagic	year-round
Blue whale	Western North Atlantic	MMPA - D ESA – EN	440	uncommon coastal/pelagic	occasional
Sperm whale	Nova Scotia	MMPA - D ESA – EN	2,288	common pelagic	year-round
Dwarf sperm whale	Western North Atlantic	MMPA - NC ESA – NL	1,783	uncommon shelf	year-round
Pygmy sperm whale	Western North Atlantic	MMPA - NC ESA – NL	1,783	uncommon shelf	year-round
Blainville's beaked whale	Western North Atlantic	MMPA - NC ESA – NL	7,092	uncommon shelf/pelagic	spring - summer
Cuvier's beaked whale	Western North Atlantic	MMPA - NC ESA – NL	6,532	uncommon shelf/pelagic	spring - summer
Gervais' beaked whale	Western North Atlantic	MMPA - NC ESA – NL	7,092	uncommon shelf/pelagic	spring - summer
Sowerby's beaked whale	Western North Atlantic	MMPA - NC ESA – NL	7,092	uncommon shelf/pelagic	spring - summer
True's beaked whale	Western North Atlantic	MMPA - NC ESA – NL	7,092	uncommon shelf/pelagic	spring - summer
Northern bottlenose whale	Western North Atlantic	MMPA - NC ESA – NL	unknown	rare pelagic	unknown
Bottlenose dolphin	Western North Atlantic Offshore	MMPA - NC ESA – NL	77,532	common pelagic	spring - summer
	Western North Atlantic Northern Migratory Coastal	MMPA - D ESA – NL	11,548	common coastal	summer
Atlantic spotted dolphin	Western North Atlantic	MMPA - NC ESA – NL	44,715	common coastal	summer - fall
Striped dolphin	Western North Atlantic	MMPA - NC ESA – NL	54,807	uncommon shelf	summer
Short-beaked common dolphin	Western North Atlantic	MMPA - NC ESA – NL	173,486	common shelf/pelagic	summer - fall
Atlantic white-sided-dolphin	Western North Atlantic	MMPA - NC ESA – NL	48,819	uncommon shelf/slope	summer - winter
Risso's dolphin	Western North Atlantic	MMPA - NC ESA – NL	18,250	common shelf/slope	year-round
Long-finned pilot whale	Western North Atlantic	MMPA - NC ESA – NL	26,535	uncommon shelf/pelagic	summer
Short-finned pilot whale	Western North Atlantic	MMPA - NC ESA – NL	21,515	uncommon shelf/pelagic	summer

Table 6 (cont.) – Marine mammals most likely to be harassed incidental to the Observatory's survey.

Species	Stock Name	Regulatory Status[1, 2]	Abundance[3]	Occurrence and Range	Season
Harbor porpoise	Gulf of Maine/Bay of Fundy	MMPA - NC ESA – NL	79,833	common coastal	year-round
Gray seal	Western North Atlantic	MMPA - NC ESA – NL	331,000	common coastal	fall - spring
Harbor seal	Western North Atlantic	MMPA - NC ESA – NL	70,142	common coastal	fall - spring
Harp seal	Western North Atlantic	MMPA - NC ESA – NL	7,100,000	rare, pack ice	Jan - May

[1] MMPA: D = Depleted, S = Strategic, NC = Not Classified.
[2] ESA: EN = Endangered, T = Threatened, DL = Delisted, NL = Not listed.
[3] 2013 NMFS Stock Assessment Report (Waring et al., 2014).
[4] Seasonality based on Whitt et al., 2013.

Table 7 – Classification of marine mammals that could potentially occur in the proposed activity area in May through August, 2014 by functional hearing group (Southall et. al., 2007).

Low Frequency Hearing Range	North Atlantic right, humpback, common minke, sei, fin, and blue whale
Mid-Frequency Hearing Range	Sperm whale, Blainville's beaked whale, Cuvier's beaked whale, Gervais' beaked whale, Sowerby's beaked whale, True's beaked whale, northern bottlenose whale, bottlenose dolphin, Atlantic spotted dolphin, spinner dolphin, striped dolphin, short-beaked common dolphin, Atlantic white-sided-dolphin, Risso's dolphin, long-finned pilot whale, short-finned pilot whale
High Frequency Hearing Range	Dwarf sperm whale, pygmy sperm whale, harbor porpoise
Pinnipeds in Water Hearing Range	Gray seal, harbor seal, harp seal

Pinnipeds: For the proposed Authorization, we considered authorizing take for pinnipeds based upon the best available density information (Navy, 2007) and other anecdotal sources (MMSC, 2014). This section includes a brief summary on life history information for gray, harp, and harbor seals.

Harbor Seals: Harbor seals are part of the "true seal" family, *Phocidae*. True seals lack external ear flaps and have short forelimbs that result in limited locomotion on land. Harbor seals typically inhabit temperate coastal habitats and use rocks, reefs, beaches, and drifting glacial ice as haul outs and pupping sites (Waring et al., 2014). On the east coast, they range from the Canadian Arctic to southern New England, New York, and occasionally the Carolinas (Waring et al., 2010). There are three well known, long-term haul out sites in New Jersey: Sandy Hook, Barnegat Inlet, and Great Bay (NJDEP, 2010). The best estimate of abundance for harbor seals is 70,142 (CV=0.29) with a minimum population estimate of 55,409 based on corrected available counts along the Maine coast in 2012 (Waring, et al., 2014). Harbor seals eat a variety of prey consisting mainly of fish, shellfish, and crustaceans. Researchers have found that seals complete both shallow and deep dives during hunting depending on the availability of prey (Tollit et al., 1997).

Gray Seals: Gray seals, also from the Phocid family, inhabit coastal waters and typically haul out on rocky coasts and islands, sandbars, ice shelves, and icebergs. The best abundance estimate for the Western North Atlantic stock is 331,000 (Hammill et al., 2012, in prep.). Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown (Waring, et al., 2014). Gray seals are

opportunistic feeders that consume between 4-6% of their body weight per day. Food sources include fish, crustaceans, squid, octopus, and even seabirds on occasion.

Harp Seals: The harp seal has a widespread distribution in the Arctic and in cold waters of the North Atlantic (Jefferson et al. 2008). It is the most abundant seal in the North Atlantic, with most seals aggregating off the east coast of Newfoundland and Labrador to pup and breed; the remainder congregates in the Gulf of St. Lawrence (Lavigne & Kovacs, 1988). These seals are highly migratory (Stenson & Sjare, 1997) and the southern limit of their habitat extends into the U.S. Atlantic Exclusive Economic Zone during winter and spring (Waring, et al., 2014). The best estimate of abundance for harp seals is 7.1 million (Hammill et al., 2012, in prep.). Jefferson et al. (2008) indicate that vagrant harp seals reach as far south as New York. Sightings of harp seals off the U.S. east coast, from Maine to New Jersey, are rare but have been increasing in recent years, particularly from January to May (Harris & Gupta, 2006). Harp seals are modest divers by pinniped standards. The average maximum dive is to about 1,200 feet (370 m), lasting approximately 16 minutes. They eat a variety of fish and invertebrates, but mainly focus on smaller fish such as capelin, arctic and polar cod, and invertebrates including krill.

CHAPTER 4 – ENVIRONMENTAL CONSEQUENCES

This chapter of the EA includes a discussion of the impacts of the three alternatives on the human environment. The Observatory's application, our notice of a proposed Authorization, and other related environmental analyses identified previously, inform our analysis of the direct, indirect, and cumulative effects of our proposed issuance of an Authorization.

Under the MMPA, we have evaluated the potential impacts of the Observatory's seismic survey activities in order to determine whether to authorize incidental take of marine mammals. Under NEPA, we have determined that an EA is appropriate to evaluate the potential significance of environmental impacts resulting from the issuance of our Authorization.

4.1 EFFECTS OF ALTERNATIVE 1 – ISSUANCE OF AN AUTHORIZATION WITH MITIGATION MEASURES

Alternative 1 is the Preferred Alternative where we would issue an Authorization to the Observatory allowing the incidental take, by Level B harassment, of 27 species of marine mammals from June through August 2014, subject to the mandatory mitigation and monitoring measures and reporting requirements set forth in the Authorization, if issued.

4.1.1 IMPACTS TO MARINE MAMMAL HABITAT

Our proposed action would have no additive or incremental effect on the physical environment beyond those resulting from the proposed activities. The Observatory's proposed seismic survey is not located within a marine sanctuary, wildlife refuge, a National Park, or other conservation area. The proposed activity— which uses one seismic source vessel—would minimally add to vessel traffic in the region and would not result in substantial damage to ocean and coastal habitats that might constitute marine mammal habitats. Finally, the Authorization would not impact physical habitat features, such as substrates and/or water quality.

Prey: In examining impacts to fish as prey species for marine mammals, we expect fish to exhibit a range of behaviors including no reaction or habituation (Peña et al., 2013) to startle responses and/or avoidance (Fewtrell & McCauley, 2012). We expect that the seismic survey would have no more than a temporary and minimal adverse effect on any fish or invertebrate species. Although there is a potential for injury to fish or marine life in close proximity to the vessel, we expect that the impacts of the seismic survey on fish and other marine life specifically related to acoustic activities would be temporary in nature, negligible, and would not result in substantial impact to these species or to their role in the ecosystem.

4.1.2 IMPACTS TO MARINE MAMMALS

We expect that the Observatory's 3-D seismic survey has the potential to take marine mammals by Level B harassment, as defined by the MMPA. Acoustic stimuli generated by the airgun arrays (and to a lesser extent the multibeam echosounder, sub-bottom profiler, and acoustic Doppler current profiler) may affect marine mammals in one or more of the following ways: behavioral disturbance, tolerance, masking of natural sounds, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al., 1995).

Our *Federal Register* notice of proposed Authorization, the Observatory's application (LGL, 2013), and the Foundation's EA on this action (NSF, 2014) provide detailed descriptions of these potential effects of seismic surveys on marine mammals. We incorporate those discussions by

reference here and summarize our consideration of additional studies submitted during the public comment period in the following sections.

The effects of noise on marine mammals are highly variable, ranging from minor and negligible to potentially significant, depending on the intensity of the source, the distances between the animal and the source, and the overlap of the source frequency with the animals' audible frequency. Nevertheless, monitoring and mitigation measures required by us for the Observatory's proposed activities will effectively reduce any significant adverse effects of these sound sources on marine mammals.

Behavioral Disturbance: The studies discussed in the *Federal Register* notice for the proposed Authorization note that there is variability in the behavioral responses of marine mammals to noise exposure. However, it is important to consider the context in predicting and observing the level and type of behavioral response to anthropogenic signals (Ellison et al., 2012).

Marine mammals may react to sound when exposed to anthropogenic noise. These behavioral reactions are often shown as: changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where noise sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haul-outs or rookeries). The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography) and is also difficult to predict (Richardson, et al., 1995; Southall et al., 2007).

Studies have shown that underwater sounds from seismic activities are often readily detectable by marine mammals in the water at distances of many kilometers (Castellote et al., 2012). Many studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response when exposed to seismic activities (e.g., Akamatsu et al., 1993; Harris et al., 2001; Madsen & Møhl, 2000; Malme et al., 1983, 1984; Richardson et al., 1986; Weir, 2008). Other studies have shown that marine mammals continue important behaviors in the presence of seismic pulses (e.g., Dunn & Hernandez, 2009; Greene Jr. et al., 1999; Holst & Beland, 2010; Holst & Smultea, 2008; Holst et al., 2005; Nieukirk et al., 2004; Richardson, et al., 1986; Smultea et al., 2004).

In a passive acoustic research program that mapped the soundscape in the North Atlantic Ocean, Clark and Gagnon (2006) reported that some fin whales stopped singing for an extended period starting soon after the onset of a seismic survey in the area. The study did not provide information on received levels or distance from the sound source. The authors could not determine whether or not the whales left the area ensonified by the survey, but the evidence suggests that most if not all singers remained in the area (Clark & Gagnon, 2006). Support for this statement comes from the fact that when the survey stopped temporarily, the whales resumed singing within a few hours and the number of singers increased with time (Clark and Gagnon, 2006). Also, they observed that one whale continued to sing while the seismic survey was actively operating (Figure 4, Clark & Gagnon, 2006). The authors conclude that there is not enough scientific knowledge to adequately evaluate whether or not these effects on singing or mating behaviors are significant or would alter survivorship or reproductive success. It is important to note that the Observatory's study area is well away from any known breeding or

calving grounds for low frequency cetaceans and approximately 20 km (12 mi) away from the identified habitats for coastal bottlenose dolphins and their calves in Toth et al. (2011, 2012) thereby reducing further the likelihood of causing an effect on marine mammals.

MacLeod et al. (2006) discussed the possible displacement of fin and sei whales related to distribution patterns of the species during a large-scale seismic survey offshore the west coast of Scotland in 1998. The authors hypothesized about the relationship between the whale's absence and the concurrent seismic activity, but could not rule out other contributing factors (Macleod, et al., 2006; Parsons et al., 2009). We would expect that marine mammals may briefly respond to underwater sound produced by the Observatory's seismic survey by slightly changing their behavior or relocating a short distance. Based on the best available information, we expect short-term disturbance reactions that are confined to relatively small distances and durations (Thompson et al., 1998; Thompson et al., 2013), with no long-term effects on recruitment or survival.

McDonald et al. (1995) tracked blue whales relative to a seismic survey with a 1,600 in^3 airgun array (slightly higher than the Observatory's largest proposed airgun array [1,400 in^3]). The whale started its call sequence within 15 km (9.3 mi) from the source, then followed a pursuit track that decreased its distance to the vessel where it stopped calling at a range of 10 km (6.2 mi) (estimated received level at 143 dB re: 1 μPa (peak-to-peak)). After that point, the ship increased its distance from the whale which continued a new call sequence after approximately one hour and 10 km (6.2 mi) from the ship. The authors suggested that the whale had taken a track paralleling the ship during the cessation phase but observed the whale moving diagonally away from the ship after approximately 30 minutes continuing to vocalize (McDonald, et al., 1995). The authors also suggest that the whale may have approached the ship intentionally or perhaps was unaffected by the airguns. They concluded that there was insufficient data to infer conclusions from their study related to blue whale responses (McDonald, et al., 1995).

McCauley et al. (2000; 1998) studied the responses of migrating humpback whales off western Australia to a full-scale seismic survey with a 16-airgun array (2,678 cubic inches (in^3)) and to a single, 20-in^3airgun. Both studies point to a contextual variability in the behavioral responses of marine mammals to sound exposure. The mean received level for initial avoidance of an approaching airgun was 140 dB re: 1 μPa for humpback whale pods containing females. In contrast, some individual humpback whales, mainly males, approached within distances of 100 to 400 m (328 to 1,312 ft), where sound levels were 179 dB re: 1 μPa (McCauley, et al., 2000). The authors hypothesized that the males gravitated towards the single operating air gun possibly due to its similarity to the sound produced by humpback whales breaching. Despite the evidence that some humpback whales exhibited localized avoidance reactions at received levels below 160 dB re: 1 μPa, the authors found no evidence of any gross changes in migration routes, such as inshore/offshore displacement during seismic operations (McCauley, et al., 2000; McCauley, et al., 1998).

DeRuiter et al. (2013) recently observed that beaked whales (considered a particularly sensitive species) exposed to playbacks (*i.e.*, simulated) of U.S. tactical mid-frequency sonar from 89 to 127 dB re: 1 μPa at close distances responded notably by altering their dive patterns . In contrast, individuals showed no behavioral responses when exposed to similar received levels from *actual* U.S. tactical mid-frequency sonar operated at much further distances (DeRuiter, et al., 2013). As noted earlier, one must consider the importance of context (*e.g.*, the distance of a sound source from the animal) in predicting behavioral responses.

Tolerance: With repeated exposure to sound, many marine mammals may habituate to the sound at least partially (Richardson & Wursig, 1997). Bain and Williams (2006) examined the effects of a large airgun array (maximum total discharge volume of 1,100 in^3) on six species in shallow waters off British Columbia and Washington: harbor seal, California sea lion (*Zalophus californianus*), Steller sea lion (*Eumetopias jubatus*), gray whale (*Eschrichtius robustus*), Dall's porpoise (*Phocoenoides dalli*), and the harbor porpoise. Harbor porpoises showed "apparent avoidance response" at received levels less than 145 dB re: 1 μPa at a distance of greater than 70 km (43 miles) from the seismic source (Bain & Williams, 2006). However, the tendency for greater responsiveness by harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson, et al., 1995; Southall, et al., 2007). In contrast, the authors reported that gray whales seemed to tolerate exposures to sound up to approximately 170 dB re: 1 μPa (Bain & Williams, 2006) and Dall's porpoises occupied and tolerated areas receiving exposures of 170–180 dB re: 1 μPa (Bain & Williams, 2006; Parsons, et al., 2009). The authors observed several gray whales that moved away from the airguns toward deeper water where sound levels were higher due to propagation effects resulting in higher noise exposures (Bain & Williams, 2006). However, it is unclear whether their movements reflected a response to the sounds (Bain & Williams, 2006). Thus, the authors surmised that the gray whale data (i.e., voluntarily moving to areas where they are exposed to higher sound levels) are ambiguous at best because one expects the species to be the most sensitive to the low-frequency sound emanating from the airguns (Bain & Williams, 2006).

Pirotta et al. (2014) observed short-term responses of harbor porpoises to a 2-D seismic survey in an enclosed bay in northeast Scotland which did not result in broad-scale displacement. The harbor porpoises that remained in the enclosed bay area reduced their buzzing activity by 15% during the seismic survey (Pirotta, et al., 2014). Thus, animals exposed to anthropogenic disturbance may make trade-offs between perceived risks and the cost of leaving disturbed areas (Pirotta, et al., 2014). However, unlike the semi-enclosed environment described in the Scottish study area, the Observatory's seismic study occurs in the open ocean. Because the Observatory would conduct the survey in an open ocean area, we do not anticipate that the seismic survey would entrap marine mammals between the sound source and the shore as marine mammals can temporarily leave the offshore survey area during the operation of the airgun(s) to avoid acoustic harassment.

Masking: Studies have shown that marine mammals are able to compensate for masking by adjusting their acoustic behavior such as shifting call frequencies and increasing call volume and vocalization rates. For example, blue whales increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio & Clark, 2010). North Atlantic right whales exposed to high shipping noise increased call frequency (Parks et al., 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller et al., 2000).

Risch et al. (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 kilometers (km) from the source. The recorded OAWRS produced series of frequency modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 μPa (Risch, et al., 2012). The authors hypothesize that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales)

were similar to those of natural humpback whale song components used during mating (Risch, et al., 2012). Thus, the novelty of the sound to humpback whales in the study area provided a compelling contextual probability for the observed effects (Risch, et al., 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch, et al., 2012), nor did they necessarily rise to the level of an MMPA take. The Observatory's study area is well away from any known breeding/calving grounds for low frequency cetaceans and approximately 20 km (12 mi) away from the identified habitats for bottlenose dolphins and their calves in Toth et al. (2011, 2012) thereby reducing further the likelihood of causing an effect on marine mammals

We expect that masking effects of seismic pulses would be limited in the case of smaller odontocetes given the intermittent nature of seismic pulses (5.4 seconds) plus the fact that sounds important to them are predominantly at much higher frequencies than are the dominant components of airgun sounds. Pinnipeds have best hearing sensitivity and/or produce most of their sounds at frequencies higher than the dominant components of airgun sounds, but there is some overlap in the frequencies of the airgun pulses and the calls. However, the intermittent nature of airgun pulses presumably reduces the potential for masking.

Hearing Impairment: Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Finneran et al., 2005; Finneran & Schlundt, 2013; Finneran et al., 2000; Kastak & Schusterman, 1998; Kastak et al., 1999; Schlundt et al., 2013; Schlundt et al., 2000). However, there has been no specific documentation of temporary threshold shift (TTS) or permanent hearing damage, *i.e*., permanent threshold shift (PTS) in free-ranging marine mammals exposed to sequences of airgun pulses during realistic field conditions (NSF, 2014).

Regarding the Lucke et al. (2009) study, the authors found a threshold shift (TS) of a harbor porpoise after exposing it to airgun noise (single pulse) with a received sound pressure level (SPL) at 200.2 dB (peak –to-peak) re: 1 μPa, which corresponds to a sound exposure level of 164.5 dB re: 1 μPa2 s after integrating exposure. We currently use the root-mean-square (rms) of received SPL at 180 dB and 190 dB re: 1 μPa as the threshold above which permanent threshold shift (PTS) could occur for cetaceans and pinnipeds, respectively. Because the airgun noise is a broadband impulse, one cannot directly extrapolate the equivalent of rms SPL from the reported peak-to-peak SPLs reported in Lucke et al. (2009). However, applying a conservative conversion factor of 16 dB for broadband signals from seismic surveys (Harris, et al., 2001; McCauley, et al., 2000) to correct for the difference between peak-to-peak levels reported in Lucke et al. (2009) and rms SPLs; the rms SPL for TTS would be approximately 184 dB re: 1 μPa, and the received levels associated with PTS (Level A harassment) would be higher. This is still above the current 180 dB rms re: 1 μPa threshold for injury. Yet, we recognize that the temporary threshold shift (TTS) of harbor porpoise is lower than other cetacean species empirically tested (Finneran & Schlundt, 2010; Finneran et al., 2002; Kastelein & Jennings, 2012).

Recent studies by Kujawa and Liberman (2009) and Lin et al. (2011) found that despite completely reversible threshold shifts that leave cochlear sensory cells intact, large threshold shifts could cause synaptic level changes and delayed cochlear nerve degeneration in mice and guinea pigs, respectively. We note that the high level of TTS that led to the synaptic changes shown in these studies is in the range of the high degree of TTS that Southall et al. (2007) used to calculate PTS levels. It is unknown whether smaller levels of TTS would lead to similar

changes. We, however, acknowledge the complexity of noise exposure on the nervous system, and will re-examine this issue as more data become available.

A recent study on bottlenose dolphins (Schlundt, et al., 2013) measured hearing thresholds at multiple frequencies to determine the amount of TTS induced before and after exposure to a sequence of impulses produced by a seismic air gun. The air gun volume and operating pressure varied from 40-150 in^3 and 1000-2000 psi, respectively. After three years and 180 sessions, the authors observed no significant TTS at any test frequency, for any combinations of air gun volume, pressure, or proximity to the dolphin during behavioral tests (Schlundt, et al., 2013). Schlundt et al. (2013) suggest that the potential for airguns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of air gun impulses compared to the high-frequency hearing ability of dolphins.

The predicted distances at which sound levels could result in Level A harassment are relatively small (886 m for cetaceans, and 234 m for pinnipeds). The avoidance behaviors discussed in the notice of proposed authorization (79 FR 14779, March 17, 2014) supports our expectations that individuals will avoid exposure at higher levels. Also, it is unlikely that animals would encounter repeated exposures at very close distances to the sound source because the Observatory would implement the required shutdown and power down mitigation measures to ensure that marine mammals do not approach the applicable exclusion zones for Level A harassment. We also expect that Level A harassment will be prevented through the required vessel-based visual monitoring of the exclusion zones and implementation of mitigation measures.

Strandings: In 2013, an International Scientific Review Panel (ISRP) investigated a 2008 mass stranding of approximately 100 melon-headed whales in a Madagascar lagoon system (Southall et al., 2013) associated with the use of a high-frequency mapping system. The report indicated that the use of a 12-kHz multibeam echosounder was the most plausible and likely initial behavioral trigger of the mass stranding event. This was the first time that a relatively high-frequency mapping sonar system had been associated with a stranding event. However, the report also notes that there were several site- and situation-specific secondary factors that may have contributed to the avoidance responses that lead to the eventual entrapment and mortality of the whales within the Loza Lagoon system (*e.g.*, the survey vessel transiting in a north-south direction on the shelf break parallel to the shore may have trapped the animals between the sound source and the shore driving them towards the Loza Lagoon). They concluded that for odontocete cetaceans that hear well in the 10-50 kHz range, where ambient noise is typically quite low, high-power active sonars operating in this range may be more easily audible and have potential effects over larger areas than low frequency systems that have more typically been considered in terms of anthropogenic noise impacts (Southall, et al., 2013). However, the risk may be very low given the extensive use of these systems worldwide on a daily basis and the lack of direct evidence of such responses previously (Southall, et al., 2013).

We have considered the potential for behavioral responses and indirect injury or mortality from the Observatory's use of the multibeam echosounder. Given that the Observatory proposes to conduct the survey offshore and the *Langseth* is not conducting the survey parallel to any coastline, we do not anticipate that the use of the source during the seismic survey would entrap marine mammals between the vessel's sound sources and the New Jersey coastline. In addition the Authorization outlines reporting measures and response protocols intended to minimize the impacts of, and enhance the analysis of, any potential stranding in the survey area.

NOAA has declared an Unusual Mortality Event (UME) for bottlenose dolphins along the Atlantic coast from early July 2013 through the present. Elevated strandings of bottlenose dolphins have occurred in New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia and Florida (through Brevard County). All age classes of bottlenose dolphins are involved and strandings range from a few live animals to mostly dead animals with many very decomposed. Many dolphins have presented with lesions on their skin, mouth, joints, or lungs (NMFS, 2014a). Based upon preliminary diagnostic testing and discussion with disease experts the tentative cause of this UME could be cetacean morbillivirus (NMFS, 2014b). However the investigation is still ongoing and additional contributory factors to the UME are under investigation including other pathogens, biotoxins, range expansion, etc. (NMFS, 2014b).

In two studies on habitat preferences of bottlenose dolphins inhabiting coastal waters of New Jersey, Toth et al. (2011, 2012) identified two groups that displayed site fidelity within a 70 linear km 2-km wide strip of coastal waters from the northern tip of Long Beach Island to southern Longport, New Jersey. In the 2011 study, the authors note that bottlenose dolphins were more prevalent closer to shore within the 2-km width (Toth, et al., 2011). In the 2012 study, the authors sighted and characterized two groups: one that occurred within 2 km of shore, and another that occurred within 1.9–6 km offshore (Toth, et al., 2012).

We expect that the survey's activities would result, at worst, in a temporary modification in behavior, temporary changes in animal distribution, and/or low-level physiological effects (Level B harassment) of bottlenose dolphins. We expect these impacts to be minor because we do not anticipate measurable changes to the population or impacts to rookeries, mating grounds, and other areas of similar significance.

The Authorization outlines reporting measures and response protocols with the Northeast Regional Stranding Coordinator intended to minimize the impacts of, and enhance the analysis of, any potential stranding in the survey area. The Observatory's activities are approximately 20 km (12 mi) away from the habitat in which the coastal bottlenose dolphins the commenter expressed concern are expected to occur (Toth, et al., 2011, 2012), which means that the area is not expected to be ensonified above 160 dB and that take of calves of this stock is not anticipated. Additionally, airgun pulses are outside of the range of frequencies in which dolphin hearing is most sensitive, and Schlundt et al.'s (2013) study suggests that the low-frequency content of air gun impulses may have fewer predicted impacts on bottlenose dolphins. Based on the fact that the acoustic effects are expected to be limited to behavioral harassment, and the survey is constantly moving (predominantly far offshore and well away from coastal species and the associated calving areas), we do not anticipate any focused adverse effects to animals involved in the UME.

No studies are available that would inform our analysis of whether seismic surveys have any additional impacts on marine mammal species subject to a UME. As discussed above, we have evaluated the potential effects of seismic surveys on a number of marine mammal species, including bottlenose dolphins, and have concluded that the Observatory's proposed seismic survey would, at most, result in a temporary modification in behavior, temporary changes in animal distribution, and/or low-level physiological effects. We base this conclusion on the following factors: (1) the available literature supports our conclusion that the low-frequency content of air gun impulses may have fewer predicted impacts on bottlenose dolphins; (2) the proposed project will occur approximately 20 km away from identified coastal habitats for

bottlenose dolphins thereby reducing significantly the probability of coastal bottlenose dolphin exposure; (3) the mitigation and monitoring measures are expected to limit the occurrence and intensity of any exposure; and (4) any effect on the human environment due to the project's impacts on dolphins is not expected to be significant.

In sum, we interpret these effects on all marine mammals as falling within the MMPA definition of Level B (behavioral) harassment. We expect these impacts to be minor because we do not anticipate measurable changes to the population or impacts to rookeries, mating grounds, and other areas of similar significance.

Under the Preferred Alternative, we would authorize incidental take, by Level B harassment only, of 27 species of marine mammals. Based on our best professional judgment and our evaluation of all of the available data, we expect no long-term or substantial adverse effects on marine mammals, their habitats, or their role in the environment.

The Observatory proposed a number of monitoring and mitigation measures for marine mammals as part of our evaluation for the Preferred Alternative. In consideration of the potential effects of the proposed seismic survey, we determined that the mitigation and monitoring measures described in section 2.3.1 of this EA would be appropriate for the preferred alternative to meet the Purpose and Need.

Injury: The Observatory did not request authorization to take marine mammals by injury (Level A harassment), serious injury, or mortality. Based on the results of our analyses, the Observatory's environmental analyses, and previous monitoring reports for the same activities, we do not expect the Observatory's planned activities to result in injury, serious injury, or mortality within the action area. The required mitigation and monitoring measures would minimize any potential risk for marine mammals.

Vessel Strikes: The potential for striking marine mammals is a concern with vessel traffic. Studies have associated ship speed with the probability of a ship strike resulting in an injury or mortality of an animal. However, it is highly unlikely that the Observatory would strike a marine mammal given the *Langseth's* slow survey speed (8 to 12 km/hr; 4 to 6 kt). Moreover, mitigation measures would be required of the Observatory to reduce speed or alter course if a collision with a marine mammal appears likely.

Estimated Take of Marine Mammals by Level B Incidental Harassment: The Observatory has requested take by Level B harassment as a result of the acoustic stimuli generated by their proposed seismic survey. We expect that the survey would cause a short-term behavioral disturbance for marine mammals in the proposed area.

As mentioned previously, we estimate that the activities could potentially affect, by Level B harassment only, 27 species of marine mammals under our jurisdiction. For each species, these estimates are small numbers (less than three percent for each species, except blue whales for which estimated takes are 3.86 percent) relative to the population sizes. Table 8 outlines, the regional density estimates for marine mammals in the action area, the number of Level B harassment takes that we propose to authorize in this Authorization, the percentage of each population or stock proposed for take as a result of the Observatory's activities, and the population trend for each species.

Table 8 –Level B harassment take levels, species or stock abundance, and percentage of population proposed for take.

Species	Density Estimate[1]	Modeled Number of Individuals Exposed to Sound Levels ≥ 160 dB	Proposed Take Authorization[2]	Percent of Species or Stock[3]	Population Trend[3]
North Atlantic right whale	0.283[4]	1	3	0.66	Increasing
Humpback whale	0.044[5]	1	2[2]	0.24	Increasing
Common minke whale	0	0	2[2]	0.01	No data
Sei whale	0.161	1	2[2]	0.56	No data
Fin whale	0.002	1	2[2]	0.06	No data
Blue whale	6.73[6]	17	17	3.86	No data
Sperm whale	7.06	18	18	0.79	No data
Dwarf sperm whale	0.001	2	3	0.17	No data
Pygmy sperm whale	0.001	2	3	0.17	No data
Cuvier's beaked whale	0.124	3	4	0.06	No data
Gervais' beaked whale	0.124	3	4	0.06	No data
Sowerby's beaked whale	0.124	3	4	0.06	No data
Unidentified Mesoplodon /Ziphid: True's, Blainville, northern bottlenose whale	0.124	1	4	0.06	No data
Rough-toothed dolphin	0	0	0	0	No data
Bottlenose dolphin (pelagic)	111.3	279	349	0.45	No data
Bottlenose dolphin (coastal)	111.3	279	349	3.02	No data
Pantropical spotted dolphin	0	0	0	0	No data
Atlantic spotted dolphin	36.1	90	113	0.25	No data
Spinner dolphin	0	0	0	0	No data
Striped dolphin	0	0	59	0.11	No data
Short-beaked common dolphin	0	0	23	0.01	No data
White-beaked dolphin	0	0	0	0	No data
Atlantic white-sided dolphin	0	0	19	0.04	No data
Risso’s dolphin	13.6	35	44	0.24	No data
False killer whale	0	0	0	0	No data
Pygmy killer whale	0	0	0	0	No data
Killer whale	0	0	0	0	No data
Long-finned pilot whale	0.184	1	12	0.05	No data
Short-finned pilot whale	0.184	1	12	0.06	No data
Harbor porpoise	0.008[4]	1	3	0.0038	No data
Gray seal	0	0	15	0.005	Increasing
Harbor seal	44.43[4]	112	140	0.20	No data
Harp seal	0	0	5	0.00007	Increasing

[1] Except where noted, densities are the mean values for the survey area calculated from the SERDP SDSS NODES summer model (Read et al., 2009) as presented in Table 3 of the Observatory’s application.
[2] Proposed take includes increases for mean group size or cow/calf pairs based on Palka, 2012; NJDEP, 2010; or increases for gray and harp seals based on stranding data from the NJ Marine Mammal Stranding Center. We have also increased the proposed take estimates by a factor of 25 percent to conservatively account for new animals entering or passing through the ensonified area.
[3] Table 1 in this notice lists the stock species abundance estimates used in calculating the percentage of species/stock. Population trend information from Waring et al., 2013. No data = Insufficient data to determine population trend.
[4] NMFS revised estimate based on the NODES model using the spring mean density estimate for that species in survey area.
[5] NMFS revised estimate based on the SERDP SDSS Duke Habitat Model using the summer mean density estimate for humpback whales in survey area.
[6] NMFS revised estimate based on the SERDP SDSS Duke Habitat Model using the summer mean density estimate for baleen whales in survey area.

Whitt et al. (2013) conducted acoustic and visual surveys for North Atlantic right whales off the coast of New Jersey from January 2008 to December 2009 and observed one sighting of a cow-calf pair in May 2008, but no other sightings of cow-calf pairs throughout the remainder of the study. NMFS considered this information (presented on page 15 of NSF's draft EA and in the notice for the proposed authorization and concluded that it was appropriate to increase the Observatory's original request for incidental take related to North Atlantic right whales from zero to three (3) to be conservative in estimating potential take for cow/calf pairs.

Our *Federal Register* notice for the proposed Authorization and the Observatory's application contain complete descriptions of how we derived the take estimates. We do not expect the proposed activities to impact rates of recruitment or survival for any affected species or stock. Further, the activities would not adversely affect marine mammal habitat.

Under Alternative 1, the proposed action has no unmitigable adverse impact to subsistence uses, because there are no permitted subsistence uses of marine mammals in the region.

4.2 Effects of Alternative 2– No Action Alternative

Under the No Action Alternative, we would not issue an Authorization to the Observatory. As a result, the Observatory would not receive an exemption from the MMPA prohibitions against the take of marine mammals and would, if they proceeded with their activities, be in violation of the MMPA if take of marine mammals occurs.

The impacts to elements of the human environment resulting from the No Action alternative—conducting the 3-D seismic survey program in the absence of required protective measures for marine mammals under the MMPA—would be greater than those impacts resulting from Alternative 1, the Preferred Alternative.

4.2.1 Impacts to Marine Mammal Habitat

Under the No Action Alternative, the survey would have no additive effects on the physical environment beyond those resulting from the Observatory's activities, which we evaluated in the referenced documents. This Alternative would result in similar effects on the physical environment as Alternative 1.

4.2.2 Impacts to Marine Mammals

Under the No Action Alternative, the Observatory's activities would likely result in increased amounts of Level B harassment to marine mammals and possibly takes by injury (Level A harassment), serious injury, or mortality—specifically related to acoustic stimuli—due to the absence of mitigation and monitoring measures required under the Authorization.

While it is difficult to provide an exact number of takes that might occur under the No Action Alternative, we would expect the numbers to be larger than those presented in Table 8 because of the lack of restrictions imposed on the Observatory's survey operations. The Observatory could take significantly more marine mammals by harassment due to the lack of required mitigation measures including shutdowns and power downs for marine mammals.

If the activities proceeded without the protective measures and reporting requirements required by a final Authorization under the MMPA, the direct, indirect, or cumulative effects on the human or natural environment of not issuing the Authorization would include the following:

- Marine mammals within the survey area could experience injury (Level A harassment) and potentially serious injury or mortality. The lack of mitigation measures that would otherwise be required in an Authorization could lead to vessels not altering their course or speed around marine mammals, not ramping up or powering or shutting down airguns when marine mammals are within applicable injury harassment zones; and not shutting down for North Atlantic right whales;
- Increases in the number of behavioral responses and frequency of changes in animal distribution because of the lack of mitigation measures required in the Authorization. Thus, the incidental take of marine mammals would likely occur at higher levels than we have already identified and evaluated in our *Federal Register* notice on the proposed Authorization; and
- We would not be able to obtain the monitoring and reporting data needed to assess the anticipated impact of the activity upon the species or stock; and increased knowledge of the species as required under the MMPA.

Under Alternative 2, the action has no unmitigable adverse impact to subsistence uses, as there are no permitted subsistence uses of marine mammals in the region.

4.3 Effects of Alternative 3 – Issuance of with Additional Mitigation Measures

4.3.1 Impacts to Marine Mammal Habitat

Effects to the physical environment would be the same under Alternative 3 as those described above for Alternative 1. We would expect no additional effects beyond those already described.

4.3.2 Impacts to Marine Mammals

Under this Alternative, marine mammals would still experience harassment by the Observatory's proposed seismic survey in the Atlantic Ocean. As described in Alternative 1, anticipated impacts to marine mammals associated with the Observatory proposed activities primarily result from noise propagation. Potential impacts to marine mammals might include one or more of the following: tolerance, 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 we would anticipate under the Preferred Alternative (Alternative 1)

The primary difference under Alternative 3 is that we would require additional mitigation and monitoring measures for detecting marine mammals. These additional measures include requiring an alternate time for the survey; implementing operational restrictions for nighttime operations; and the use of alternate technologies to augment monitoring.

Alternate Survey Timing: This measure would require the Observatory to postpone their research after the summer season to minimize interactions with marine life. The Foundation considered this mitigation measure in their EA (NSF, 2014) and concluded that the proposed dates for the cruise (June – August) met the Purpose and Need of their action because the personnel and equipment essential to meet the overall project objectives were available. This measure, however, may have the added effect of increasing the number of takes for North Atlantic right whales due to their increased presence off the New Jersey in the fall and winter.

Whitt et al. (2013) concluded that right whales were not present in large numbers off New Jersey during the summer months (Jun 22 – Sep 27) which corresponds to the effective dates of the seismic survey (June – August). In contrast, peak acoustic detections for the whales occurred in the winter (Dec 18 – Apr 9) and in the spring (Apr 10– Jun 21) for north Atlantic right whales (Whitt, et al., 2013).

Operational Restrictions: This measure would require the Observatory to suspend their activities in low-light/nighttime conditions and minimize the number of repeated tracklines for the survey. This measure fails to meet the meet one of the Observatory's research requirements which is to conduct the survey in the shortest time span possible, day and night. The MMPA requires NMFS to take into account the practicability of mitigation measures. Restricting activities to daytime operations only would unnecessarily lengthen the time to complete the survey which would not be practicable from an operational standpoint.,. Suspending the survey at night would inevitably increase the number of days to complete the survey and would likely result in increased amounts of Level B harassment to marine mammals over a longer duration of time. While the additional measure may provide some added protection for marine mammals present in the research area during nighttime operations, we do not expect that this measure would reduce the overall level of effects. Level B harassment of marine mammals would still occur.

Augmented Monitoring: This measure would require the use of alternative methods to detect marine mammals beyond the proposed visual observation and acoustic monitoring. The Foundation considered this mitigation measure in their EA (NSF, 2014) and concluded that at the present time, these technologies are still not feasible, commercially viable, or appropriate to meet their Purpose and Need.

While the technologies for these monitoring methods are still being developed and refined, we expect that they would allow for additional detection of marine mammals beyond visual observations from shipboard observers. These additional monitoring measures could allow for necessary mitigation measures (*i.e.*, power-downs and shutdowns) to be implemented more quickly and more frequently, thereby potentially reducing further the number of marine mammal takes. However, until these technologies are developed and fully tested, we are unable to provide a reasonable estimate of this reduction in take levels.

Under Alternative 3, the action has no unmitigable adverse impact to subsistence uses, as there are no permitted subsistence uses of marine mammals in the region.

4.4 Compliance with Necessary Laws – Necessary Federal Permits

We have determined that the issuance of an Authorization is consistent with the applicable requirements of the MMPA, ESA, MSFMCA, and CZMA, and our regulations. Please refer to section 1.4 of this EA for more information.

4.5 Unavoidable Adverse Impacts

The Observatory's application, our *Federal Register* notice of a proposed Authorization, and other environmental analyses identified previously summarize unavoidable adverse impacts to marine mammals or the populations to which they belong or on their habitats, as well as subsistence uses of marine mammals, occurring in the seismic survey area. We incorporate those documents by reference.

We acknowledge that the incidental take authorized would potentially result in unavoidable adverse impacts. However, we do not expect the Observatory's activities to have adverse consequences on the viability of marine mammals in the Atlantic Ocean. We do not expect the marine mammal populations in that area to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild. We expect that the numbers of individuals of all species taken by harassment would be small (relative to species or stock abundance), that the seismic survey and the take resulting from the seismic survey activities would have a negligible impact on the affected species or stocks of marine mammals, and that there would not be an unmitigable adverse impact to subsistence uses of marine mammals in the northwest Atlantic Ocean.

4.6 Cumulative Effects

NEPA defines cumulative effects 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 can result from individually minor but collectively significant actions that take place over a period of time.

The proposed seismic survey would add another, albeit temporary activity to the marine environment in the Atlantic Ocean and the proposed survey would be limited to a relatively small area for a comparatively short period of time. The Foundation's EA (NSF, 2014) summarizes the potential cumulative effects to marine mammals or the populations to which they belong or on their habitats occurring in the survey area. This section incorporates the Foundation's EA by reference and provides a brief summary of the human-related activities affecting the marine mammal species in the action area.

4.6.1 Previous Seismic Research Surveys in the Same Area

The Foundation's EA (NSF, 2014) acknowledges that scientists have conducted numerous 2-D seismic surveys in the general vicinity of the proposed survey from 1979 to 2002. The previous surveys used different airgun array configurations (*e.g.*, a 6-airgun, 1,350-in^3 array in 1990; a single, 45-in^3 GI Gun in 1996 and 1998; and two 45-in^3 GI Guns in 2002).

4.6.2 Future Seismic Research in the Atlantic Ocean

The U.S. Geological Survey (USGS) has proposed to conduct a seismic survey to support the delineation of the U.S. Extended Continental Shelf (ECS) in the Atlantic Ocean August through September, 2014, and April to August, 2015. The USGS would use the *Langseth* to conduct survey for approximately 18 to 21 days covering approximately 3,000 km of seismic tracklines. On June 23, 2014, NMFS announced a proposed Authorization for the USGS's proposed survey (79 *Fed. Reg*. 35641) and preliminarily determined that 34 species of marine mammals could be potentially affected by Level B harassment related to acoustic disturbance. We also preliminarily determined that that the taking by Level B harassment would have a negligible impact on the affected marine mammal species and/or stocks. This project would not overlap with the proposed survey area and the USGS has prepared a separate EA for their action.

The Observatory has also proposed to conduct a 2-D seismic survey to investigate the Eastern North American Margin (ENAM) on the *Langseth* in the Atlantic Ocean off the coast of North Carolina September through October, 2014. The seismic survey would take place outside of North Carolina state waters and almost entirely within the federal waters. This project would not

overlap with the proposed survey area and the Foundation has prepared a separate EA for their action.

Both surveys are dispersed both geographically and temporally, are short-term in nature, and all of the Authorization holders would be required to use mitigation and monitoring measures to minimize impacts to marine mammals and other living marine resources in the activity area. We are unaware of any synergistic impacts to marine resources associated with reasonably foreseeable future actions that may be planned or occur within the same region of influence as the proposed survey.

4.6.3 Unusual Mortality Event (UME) for Bottlenose Dolphins

NOAA has declared an UME for bottlenose dolphins along the Atlantic coast from early July 2013 through the present. Elevated strandings of bottlenose dolphins have occurred in New Jersey. All age classes of bottlenose dolphins are involved and strandings range from a few live animals to mostly dead animals with many very decomposed (NMFS, 2014a).. Based upon preliminary diagnostic testing and discussion with disease experts, the tentative cause of this UME could be cetacean morbillivirus (NMFS, 2014b). However the investigation is still ongoing and additional contributory factors to the UME are under investigation including other pathogens, biotoxins, range expansion, etc. (NMFS, 2014b).

4.6.4 Military Activities

The proposed survey is located within the U.S. Navy's Atlantic City Range Complex (ACRC). The Boston, Narragansett Bay, and Atlantic City range complexes are within the Northeast Range Complexes. The types of activities that could occur in the ACRC would include the use of active sonar, gunnery events with both inert and explosive rounds, bombing events with both inert and explosive bombs, and other similar events. The ACRC includes special use airspace, Warning Area W-107 (NSF, 2014).

4.6.5 Future Oil and Gas Exploration

The proposed survey site is outside of the Outer Continental Shelf proposed geological and geophysical activities in the Mid-Atlantic and South Atlantic Planning Areas (NSF, 2014).

4.6.6 Climate Change

The 2007 Intergovernmental Panel on Climate Change concluded that there is very strong evidence for global warming and associated weather changes and that humans have "very likely" contributed to the problem through burning fossil fuels and adding other "greenhouse gases" to the atmosphere (IPCC, 2007a, 2007b). This study involved numerous models to predict changes in temperature, sea level, ice pack dynamics, and other parameters under a variety of future conditions, including different scenarios for how human populations respond to the implications of the study.

Increased ocean temperatures will reduce oxygen, and atmospheric CO_2 will reduce ocean pH and threaten the health of the marine ecosystem. Ocean circulation patterns will change, with less mixing of cold and warm water in tropical and subtropical areas, affecting the ability of near-surface species to reach nutrients at lower depths (NJCAA, 2014). At more northern latitudes mixing could actually increase with melting of sea ice, but general ocean warming will alter migration and breeding patterns and push species further northward (NJCAA, 2014).

With the large degree of uncertainty on the impact of climate change to marine mammals in the northwest Atlantic Ocean, we recognize that warming of this region could affect the prey base and habitat quality for marine mammals. Nonetheless, we expect that the conduct of the seismic survey and the issuance of an Authorization to the Observatory would not result in any noticeable contributions to climate change.

CHAPTER 5 – LIST OF PREPARERS AND AGENCIES CONSULTED

Agencies Consulted:

Marine Mammal Commission
4340 East West Highway, Room 700
Bethesda, Maryland 20814

NOAA – National Marine Fisheries Service
Office of Protected Resources
Endangered Species Act Interagency Cooperation Division
1315 East West Highway, SSMC 3
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REFERENCES

Akamatsu, T., Hatakeyama, Y., & Takatsu, N. (1993). Effects of pulse sounds on escape behavior of false killer whales. *Bulletin - Japanese Society of Scientific Fisheries, 59*, 1297-1297.

Bain, D. E., & Williams, R. (2006). *Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance*. Cambridge, UK.

Carey, J. S., Sheridan, R. E., & Ashley, G. M. (1998). Late Quaternary sequence stratigraphy of a slowly subsiding passive margin, New Jersey continental shelf. *AAPG Bulletin, 82*(5), 773-791.

Castellote, M., Clark, C. W., & Lammers, M. O. (2012). Acoustic and behavioural changes by fin whales (Balaenoptera physalus) in response to shipping and airgun noise. *Biological Conservation, 147*(1), 115-122.

Clark, C. W., & Gagnon, G. C. (2006). Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales. *IWC/SC/58 E, 9*.

Crone, T. J., Tolstoy, M., & Carton, H. D. (2013). *Calibration of the R/V Marcus G. Langseth Seismic Array in shallow Cascadia waters using the Multi-Channel Streamer.* Paper presented at the AGU Fall Meeting Abstracts.

DeRuiter, S. L., Boyd, I. L., Claridge, D. E., Clark, C. W., Gagnon, C., Southall, B. L., & Tyack, P. L. (2013). Delphinid whistle production and call matching during playback of simulated military sonar. *Marine Mammal Science, 29*(2), E46-E59.

Di Iorio, L., & Clark, C. W. (2010). Exposure to seismic survey alters blue whale acoustic communication. *Biology Letters, 6*(1), 51-54.

Diebold, J. B., Tolstoy, M., Doermann, L., Nooner, S. L., Webb, S. C., & Crone, T. J. (2010). R/V Marcus G. Langseth seismic source: Modeling and calibration. *Geochemistry, Geophysics, Geosystems, 11*(12), 20.

Dunn, R. A., & Hernandez, O. (2009). Tracking blue whales in the eastern tropical Pacific with an ocean-bottom seismometer and hydrophone array. *The Journal of the Acoustical Society of America, 126*(3), 1084-1094.

Ellison, W., Southall, B., Clark, C., & Frankel, A. (2012). A New Context-Based Approach to Assess Marine Mammal Behavioral Responses to Anthropogenic Sounds. *Conservation Biology, 26*(1), 21-28.

Fewtrell, J. L., & McCauley, R. D. (2012). Impact of air gun noise on the behaviour of marine fish and squid. *Marine pollution bulletin, 64*(5), 984-993.

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

Finneran, J. J., & Schlundt, C. E. (2010). Frequency-dependent and longitudinal changes in noise-induced hearing loss in a bottlenose dolphin (Tursiops truncatus). *The Journal of the Acoustical Society of America, 128*(2), 567-570.

Finneran, J. J., & Schlundt, C. E. (2013). Effects of fatiguing tone frequency on temporary threshold shift in bottlenose dolphins (Tursiops truncatus). *The Journal of the Acoustical Society of America, 133*(3), 1819-1826.

Finneran, J. J., Schlundt, C. E., Carder, D. A., Clark, J. A., Young, J. A., Gaspin, J. B., & Ridgway, S. H. (2000). Auditory and Behavioral Responses of Bottlenose Dolphins (Tursiops truncatus) and a Belga Whale (Delphinapterus leucas) to Impulsive Sounds Resembling Distant Signatures of Underwater Explosions. [e-paper]. *Journal of the Acoustical Society of America, 108*(1), 417-431.

Finneran, J. J., Schlundt, C. E., Carder, D. A., & Ridgway, S. H. (2002). Auditory filter shapes for the bottlenose dolphin (Tursiops truncatus) and the white whale (Delphinapterus leucas) derived with notched noise. [e-paper]. *The Journal of the Acoustical Society of America, 112*(1), 322-328.

Greene Jr., C. R., Altman, N. S., & Richardson, W. J. (1999). The influence of seismic survey sounds on bowhead whale calling rates. *The Journal of the Acoustical Society of America, 106*(4), 2280-2280.

Harris, D. E., & Gupta, S. (2006). GIS-based analysis of ice-breeding seal strandings in the Gulf of Maine. *Northeastern Naturalist, 13*(3), 403-420.

Harris, R. E., Miller, G. W., & Richardson, W. J. (2001). Seal responses to airgun sounds during summer seismic surveys in the Alaskan Beaufort Sea. *Marine Mammal Science, 17*(4), 795-812.

Holst, M., & Beland, J. (2010). Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's Shatsky Rise marine seismic program in the Northwest Pacific Ocean, July–September 2010. LGL Rep. TA4873-3. Rep. from LGL Ltd.,. King City, Ontario for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY. 70 p. pp.

Holst, M., & Smultea, M. A. (2008). Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program off Central America, Feburary-April 2008. TA4342-3. Palisades, New York. Lamont-Doherty Earth Observatory of Columbia University. 133 pp.

Holst, M., Smultea, M. A., Koski, W. R., & Haley, B. (2005). Marine mammal and sea turtle monitoring during Lamont-Doherty Earth Observatory's marine seismic program in the Eastern Tropical Pacific Ocean off Central America, November–December 2004. *Report from LGL Ltd., King City, Ontario, for Lamont-Doherty Earth Observatory of Columbia Univ., Palisades, NY, and National Marine Fisheries Service, Silver Spring, MD. Report TA2822-30. 125 p.*

IPCC. (2007a). Climate Change 2007: Synthesis Report. Valencia, Spain. Intergovernmental Panel on Climate Change.

IPCC. (2007b). IPCC, 2007: Climate change 2007: The physical science basis. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change.

Jefferson, T. A., Webber, M. A., & Pitman, R. L. (2008). Marine mammals of the world: a comprehensive guide to their identification.

Kastak, D., & Schusterman, R. J. (1998). Low-frequency amphibious hearing in pinnipeds: Methods, measurements, noise, and ecology. *The Journal of the Acoustical Society of America, 103*(4), 13.

Kastak, D., Schusterman, R. J., Southall, B. L., & Reichmuth, C. J. (1999). Underwater temporary threshold shift induced by octave-band noise in three species of pinniped. *The Journal of the Acoustical Society of America, 106*(2), 1142-1148.

Kastelein, R. A., & Jennings, N. (2012). Impacts of anthropogenic sounds on Phocoena phocoena (harbor porpoise) in *The Effects of Noise on Aquatic Life* (pp. 311-315): Springer.

Kujawa, S. G., & Liberman, M. C. (2009). Adding insult to injury: cochlear nerve degeneration after "temporary" noise-induced hearing loss. *The Journal of Neuroscience, 29*(45), 14077-14085.

Lavigne, D. M., & Kovacs, K. M. (1988). *Harps and Hoods: Ice-breeding Seals of the Northwest Atlantic*. Waterloo, Ontario: University of Waterloo Press.

LGL. (2013). Request for an Incidental Harassment Authorization to Allow the Incidental Take of Marine Mammals during a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, June–July 2014. Prepared by LGL Limited environmental research associates. LGL Report TA8349-2. 41.

Lin, H. W., Furman, A. C., Kujawa, S. G., & Liberman, M. C. (2011). Primary neural degeneration in the Guinea pig cochlea after reversible noise-induced threshold shift. *Journal of the Association for Research in Otolaryngology, 12*(5), 605-616.

Lucke, K., Siebert, U., Lepper, P. A., & Blanchet, M.-A. (2009). Temporary shift in masked hearing thresholds in a harbor porpoise (Phocoena phocoena) after exposure to seismic airgun stimuli. *The Journal of the Acoustical Society of America, 125*(6), 4060-4070.

Macleod, K., Simmonds, M. P., & Murray, E. (2006). Abundance of fin (Balaenoptera physalus) and sei whales (B. borealis) amid oil exploration and development off northwest Scotland. *Journal of Cetacean Research and Management, 8*(3), 247.

Madsen, P. T., & Møhl, B. (2000). Sperm whales (Physeter catodon L. 1758) do not react to sounds from detonators. *The Journal of the Acoustical Society of America, 107*(1), 668-671.

Malme, C. I., Miles, P. R., Clark, C. W., Tyack, P., & Bird, J. E. (1983). *Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior. Final report for the period of 7 June 1982 - 31 July 1983* Anchorage, AK. Report No. 5366. 64 pp.

Malme, C. I., Miles, P. R., Clark, C. W., Tyack, P., & Bird, J. E. (1984). *Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior: phase II: January 1984 migration*. (5586). Anchorage, AK. 357 pp.

McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M.-N., Penrose, J. D., . . . McCabe, K. (2000). Marine Seismic Surveys: Analysis And Propagation of Air-Gun Signals; And Effects of Air-Gun Exposure On Humpback Whales, Sea Turtles, Fishes and Squid. *Rep. from Centre for Marine Science and Technology, Curtin Univ., Perth, Western Australia, for Australian Petrol. Produc. & Explor. Association*, 203 pages.

McCauley, R. D., Jenner, M. N., Jenner, C., McCabe, K. A., & Murdoch, J. (1998). The response of humpback whales (Megaptera novaeangliae) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. *Appea Journal, 38*(1), 692-707.

McDonald, M. A., Hildebrand, J. A., & Webb, S. C. (1995). Blue and fin whales observed on a seafloor array in the northeast Pacific. *Journal of the Acoustical Society of America, 98*(2 Part 1), 712-721.

Miller, P. J. O., Biassoni, N., Samuels, A., & Tyack, P. L. (2000). Whale songs lengthen in response to sonar. [10.1038/35016148]. *Nature, 405*(6789), 903-903.

MMSC. (2014). 2014 Reported Strandings by the Marine Mammal Stranding Center Retrieved March 2014, from http://www.mmsc.org/strandings/current.html

Navy. (2007). *Navy OPAREA Density Estimate (NODE) for the Northeast OPAREAs. Prepared for the Department of the Navy, U.S. Fleet Forces Command, Norfolk, Virginia. Contract #N62470-02-D-9997, CTO 0030. Prepared by Geo-Marine, Inc., Hampton, Virginia*.

Navy. (2013). Atlantic Fleet Training and Testing Final Environmental Impact Statement / Overseas Environmental Impact Statement. Norfolk, VA. Department of the Navy. NAVFAC Atlantic. 2,890 pp.

Nieukirk, S. L., Stafford, K. M., Mellinger, D. K., Dziak, R. P., & Fox, C. G. (2004). Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. *The Journal of the Acoustical Society of America, 115*(4), 1832-1843.

NJCAA. (2014). New Jersey Climate Adaptation Alliance. A Summary of Climate Change Impacts and Preparedness Opportunities Affecting Natural Resources in New Jersey, March 2014. Rutgers The State University of New Jersey. 17 pp.

NJDEP. (2010). New Jersey Department of Environmental Protection Baseline Studies Final Report Volume III: Marine Mammal and Sea Turtle Studies. Plano, TX. Geo-Marine Inc. 259 pp.

NMFS. (2014a, May 20, 2014). 2013-2014 Bottlenose Dolphin Unusual Mortality Event in the Mid-Atlantic Retrieved 6/3/2014, 2014, from http://www.nmfs.noaa.gov/pr/health/mmume/midatldolphins2013.html

NMFS. (2014b). FAQs on the 2013-2014 Bottlenose Dolphin UME in the Mid-Atlantic Retrieved 6/3/2014, 2014, from http://www.nmfs.noaa.gov/pr/health/mmume/mid-atlantic2013.html

NSF. (2011). Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. Arlington, VA. National Science Foundation and the U.S. Geological Survey. 801 pp.

NSF. (2014). Draft Environmental Assessment of a Marine Geophysical Survey by the R/V Marcus G. Langseth in the Atlantic Ocean off New Jersey, June–July 2014. King City, Ontario. Prepared by LGL Ltd., environmental research associates for the Division of Ocean Sciences. National Science Foundation. 87 pp.

Parks, S. E., Clark, C. W., & Tyack, P. L. (2007). Short- and long-term changes in right whale calling behavior: The potential effects of noise on acoustic communication. *Journal of the Acoustical Society of America, 122*(6), 3725-3731. doi: 10.1121/1.2799904

Parsons, E. C. M., Dolman, S. J., Jasny, M., Rose, N. A., Simmonds, M. P., & Wright, A. J. (2009). A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practise? *Marine Pollution Bulletin, 58*(5), 643-651.

Peña, H., Handegard, N. O., & Ona, E. (2013). Feeding herring schools do not react to seismic air gun surveys. *ICES Journal of Marine Science: Journal du Conseil*, fst079.

Pirotta, E., Brookes, K. L., Graham, I. M., & Thompson, P. M. (2014). Variation in harbour porpoise activity in response to seismic survey noise. *Biology Letters, 10*(5), 20131090.

Richardson, W. J., Greene, C. R., Malme, C. I., & Thomson, D. H. (1995). *Marine Mammals and Noise*. San Diego, California: Academic Press.

Richardson, W. J., & Wursig, B. (1997). Influences of man-made noise and other human actions on cetacean behaviour. *Marine And Freshwater Behaviour And Physiology, 29*(1-4), 183-209.

Richardson, W. J., Würsig, B., & Greene Jr., C. R. (1986). Reactions of bowhead whales, Balaena mysticetus, to seismic exploration in the Canadian Beaufort Sea. *The Journal of the Acoustical Society of America, 79*(4), 1117-1128.

Risch, D., Corkeron, P. J., Ellison, W. T., & Van Parijs, S. M. (2012). Changes in humpback whale song occurrence in response to an acoustic source 200 km away. *PloS one, 7*(1), e29741.

Schlundt, C. E., J. J. Finneran, B. K. Branstetter, J. S. Trickey, & Jenkins, K. (2013). *Auditory effects of multiple impulses from a seismic air gun on bottlenose dolphins (Tursiops truncatus).* Paper presented at the Twentieth Biennial Conference on the Biology of Marine Mammals Dunedin, New Zealand.

Schlundt, C. R., Finneran, J. J., Carder, D. A., & Ridgway, S. H. (2000). Temporary shift in masked hearing thresholds of bottlenose dolphins, Tursiops truncatus, and white whale, Delphinapterus leucas, after exposure to intense tones. *Journal of the Acoustical Society of America, 107*(6), 3496-3508.

Smultea, M. A., Holst, M., Koski, W. R., & Stoltz, S. (2004). Marine mammal monitoring during Lamont-Doherty Earth Observatory's seismic program in the Southeast Caribbean Sea and adjacent Atlantic Ocean, April-June 2004. LGL Rep. TA2822-26 King City, Ontario.

Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Jr., G., . . . Tyack, P. L. (2007). Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals, 33*(4), 411-522.

Southall, B. L., Rowles, T., Gulland, F., Baird, R. W., & Jepson, P. D. (2013). Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon headed whales (Peponocephala electra) in Antsohihy, Madagascar (pp. 75): Madagascar.

Stenson, G. B., & Sjare, B. (1997). *Seasonal distribution of harp seals, Phoca groenlandica, in the Northwest Atlantic.* Paper presented at the ICES Council Meeting Papers.

Thompson, D. R., Sjoberg, M., Bryant, M. E., Lovell, P., & Bjorge, A. (1998). Behavioural and physiological responses of harbour (Phoca vitulina) and grey (Halichoerus grypus) seals to seismic surveys. *Report to European Commission of BROMMAD Project. MAS2 C, 7940098*.

Thompson, P. M., Brookes, K. L., Graham, I. M., Barton, T. R., Needham, K., Bradbury, G., & Merchant, N. D. (2013). Short-term disturbance by a commercial two-dimensional seismic survey does not lead to long-term displacement of harbour porpoises. *Proceedings of the Royal Society B: Biological Sciences, 280*(1771), 20132001.

Tollit, D. J., Thompson, P. M., & Greenstreet, S. P. R. (1997). Prey selection by harbour seals, Phoca vitulina, in relation to variations in prey abundance. *Canadian Journal of Zoology, 75*(9), 1508-1518.

Tolstoy, M., Diebold, J., Doermann, L., Nooner, S., Webb, S. C., Bohnenstiehl, D. R., . . . Holmes, R. C. (2009). Broadband calibration of the R/V Marcus G. Langseth four-string seismic sources. *Geochemistry, Geophysics, Geosystems, 10*(8).

Tolstoy, M., Diebold, J. B., Webb, S. C., Bohnenstiehl, D. R., Chapp, E., Holmes, R. C., & Rawson, M. (2004). Broadband calibration of R/V Ewing seismic sources. *Geophysical Research Letters, 31*(14).

Toth, J. L., Hohn, A. A., Able, K. W., & Gorgone, A. M. (2011). Patterns of seasonal occurrence, distribution, and site fidelity of coastal bottlenose dolphins (Tursiops truncatus) in southern New Jersey, USA. *Marine Mammal Science, 27*(1), 94-110.

Toth, J. L., Hohn, A. A., Able, K. W., & Gorgone, A. M. (2012). Defining bottlenose dolphin (Tursiops truncatus) stocks based on environmental, physical, and behavioral characteristics. *Marine Mammal Science, 28*(3), 461-478.

Waring, G. T., Gilbert, J. R., Belden, D., Van Atten, A., & DiGiovanni Jr., R. A. (2010). A review of the status of harbour seals (Phoca vitulina) in the Northeast United States of America. *NAMMCO Scientific Publications, 8*, 191-212.

Waring, G. T., Josephson, E., Fairfield-Walsh, C. P., Maze-Foley, K., & Rosel, P. E. (2014). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2013 Volume 1. National Marine Fisheries Service. 484 pp.

Weir, C. R. (2008). Short-finned pilot whales (Globicephala macrorhynchus) respond to an airgun ramp-up procedure off Gabon. *Aquatic Mammals, 34*(3), 349-354.

Whitt, A. D., Dudzinski, K., & Laliberté, J. R. (2013). North Atlantic right whale distribution and seasonal occurrence in nearshore waters off New Jersey USA, and implications for management. *Endangered Species Research 20*, 59-69.

Wright, A. J. (2014). Reducing Impacts of Human Ocean Noise on Cetaceans: Knowledge Gap Analysis and Recommendations (pp. 98). Ottawa, Canada: World Wildlife Fund Global Arctic Programme.