FINAL

Marine Species Monitoring Report

For The

U.S. Navy's

Atlantic Fleet Active Sonar Training

(AFAST)

and

Virginia Capes, Cherry Point, Jacksonville,

and Gulf of Mexico Range Complexes

Annual Report 2013

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AFAST	Atlantic Fleet Active Sonar Training
AMAR	Autonomous Multi-channel Acoustic Recorder
AMR	Adaptive Management Review
ASW	anti-submarine warfare
ASWEX	Anti-Submarine Warfare Exercise
BiOp	Biological Opinion
CHPT	Cherry Point
CNO	Chief of Naval Operations
COMPTUEX	Composite-Training Unit Exercise
DNA	deoxyribonucleic acid
DoN	Department of the Navy
DUNCOC	Duke-UNC Oceanographic Consortium
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FIREX	Firing Exercise
ft	foot/feet
FY	Fiscal Year
GOMEX	Gulf of Mexico Range Complex
HARP	High-frequency Acoustic Recording/Recorder Package
hr	hour(s)
Hz	hertz
IAC	Integrated Anti-submarine Warfare Course
ICMP	Integrated Comprehensive Monitoring Program
IMPASS	Integrated Maritime Portable Scoring and Simulator
ITA	Incidental Take Authorization
JAX	Jacksonville
kHz	kilohertz
km	kilometer(s)
km^2	square kilometer(s)
LMMO	liaison MMO
LO	lookout
LOA	Letter of Authorization
m	meter(s)
min	minute(s)
MARU	Marine Autonomous Recording Unit
MFAS	mid-frequency active sonar
MINEX	Mine-neutralization Exercise
MISSILEX	Missile Exercise
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
NEFSC	Northeast Fisheries Science Center
N45	Environmental Readiness Division
NM	nautical mile(s)
NMFS	National Marine Fisheries Services
NUWCDIVNPT	Naval Undersea Warfare Center Division, Newport
OEIS	Overseas Environmental Impact Statement
ONR	Office of Naval Research
OPAREA	operating area
OT	observation team
PAM	passive acoustic monitoring
R&D	Research & Development
ROCCA	Real-time Odontocete Call Classification Algorithm
S&T	Science & Technology
SAG	Scientific Advisory Group
SEASWITI	Southeast Anti-submarine Warfare Integration Training Initiative
TTS	temporary threshold shift
ULT	Unit-Level Training
U.S.	United States
UNCW	University of North Carolina at Wilmington
USFF	U.S. Fleet Forces Command
USWTR	Undersea Warfare Training Range
VACAPES	Virginia Capes
VAQ	Virginia Aquarium & Marine Science Center
WMD	whistle and moan detector

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SECTION 1 – INTRODUCTION & BACKGROUND

1.1 Background

The United States (U.S.) Navy developed Range Complex monitoring plans to provide marine mammal and sea turtle monitoring as required under the Marine Mammal Protection Act (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973. In order to issue an Incidental Take Authorization (ITA) for an activity, Section 101(a)(5)(A) of the MMPA states that National Marine Fisheries Service (NMFS) must set forth "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 Code of Federal Regulations Section 216.104(a)(13) note that requests for Letters of Authorization (LOAs) must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present. While the ESA does not have specific monitoring requirements, recent Biological Opinions issued by NMFS also have included terms and conditions requiring the U.S. Navy to develop a monitoring program.

The U.S. Navy developed monitoring plans with specific study objectives for naval training exercises in the Atlantic Fleet Active Sonar Training (AFAST) Study Area; the Virginia Capes (VACAPES), Cherry Point (CHPT), and Jacksonville (JAX) Range Complexes (collectively referred to as the East Coast Range Complexes), and in the Gulf of Mexico (GOMEX) Range Complex as part of the issuance of annual LOAs for training in these areas (**Figure 1**). The U.S. Navy has previously submitted annual monitoring and mission activities reports for AFAST and the East Coast/GOMEX Range Complexes to NMFS for 2009 through 2012 (DoN 2009a, 2010a, 2010b, 2010c, 2010d, 2010e, 2011a, 2011b, 2011c, 2011d, 2012a, 2012b, 2012c, 2012d; 2013a, 2013b).

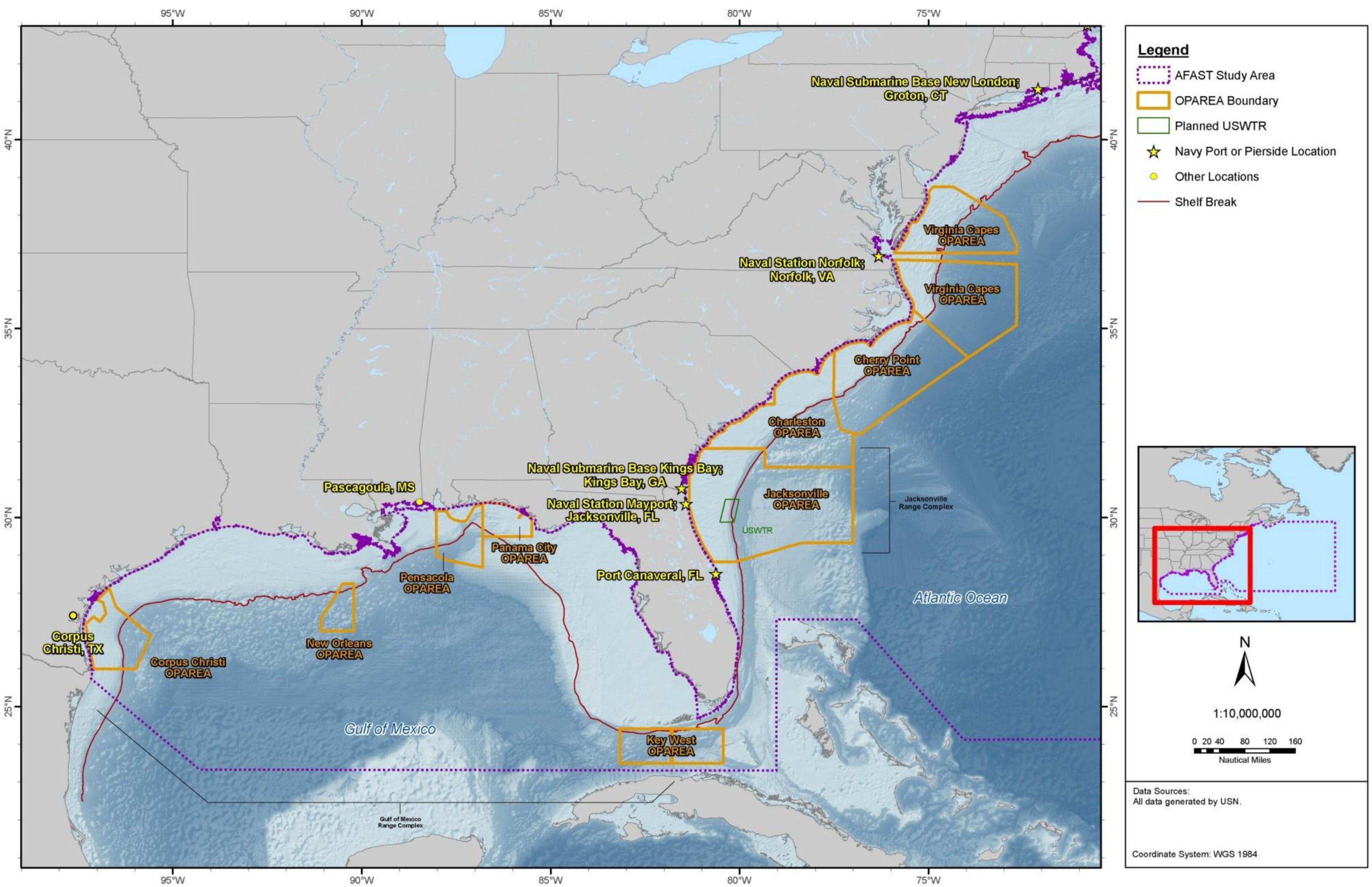

Figure 1. AFAST Study Area and East Coast/GOMEX Range Complexes included in the U.S. Navy's marine species monitoring program in the U.S. Atlantic.

Based on discussions with NMFS, Range Complex monitoring plans were designed as collections of focused "studies" to gather data that will attempt to address the following questions, which are described more fully in the monitoring plans:

1. Are marine mammals and sea turtles exposed to mid-frequency active sonar (MFAS), especially at levels associated with adverse effects (i.e., based on established criteria for behavioral harassment, temporary threshold shift [TTS], or permanent threshold shift)? If so, at what levels are they exposed?
2. If marine mammals and sea turtles are exposed to MFAS, do they redistribute geographically as a result of continued exposure? If so, how long does the redistribution last?
3. If marine mammals and sea turtles are exposed to explosives and MFAS, what are their behavioral responses to various levels?
4. Is the U.S. Navy's suite of mitigation measures for MFAS and explosives (e.g., Protective Measures Assessment Protocol) effective for avoiding TTS, injury, and mortality of marine mammals and sea turtles?

Monitoring methods used to support the AFAST and East Coast/GOMEX Range Complex monitoring plans include a combination of field methods designed both to support Range Complex-specific monitoring and to contribute information to a larger U.S. Navy-wide science-based monitoring program. These field methods include visual surveys from vessels and airplanes, passive acoustic monitoring (PAM), and marine mammal observers (MMOs) aboard U.S. Navy platforms participating in an exercise or training event. Each monitoring technique has advantages and disadvantages that vary temporally and spatially, and each method supports one particular study objective better than another. The U.S. Navy uses a combination of techniques so that detection and observation of marine animals is maximized, and meaningful information can be derived to address monitoring objectives within each of the Range Complex-specific monitoring plans and under the monitoring program as a whole.

A new MMPA authorization for Atlantic Fleet Training and Testing (AFTT) was issued in November 2013 superseding previous authorizations and monitoring requirements noted above (i.e. AFAST, VACAPES, CHPT, JAX, GOMEX). This new authorization requires implementation of a Strategic Planning Process for Marine Species Monitoring which serves to guide the investment of resources to most efficiently address ICMP objectives and intermediate scientific objectives developed through this process. More information on the Strategic Planning Process is provided in **Section 6**.

The U.S. Navy has invested over 15 million dollars (**Table 1**) in monitoring activities in the AFAST and East Coast Range Complex from 2009 through 2013. Additional information on the program is available on the U.S. Navy's Marine Species Monitoring Program website (http://www.navymarinespeciesmonitoring.us). The website serves as an online portal for information on the background, history, and progress of the program, and also provides access to reports, documentation, data, and updates on current monitoring projects and initiatives.

Table 1. Annual funding for marine species monitoring in the AFAST Study Area and East Coast Range Complexes (FY09-FY13).

Fiscal Year (1 Oct-30 Sept)	Funding Amount
FY09	$1,555,000
FY10	$3,768,000
FY11	$2,749,000
FY12	$3,483,000
FY13	$3,775,000
Total	**$15,330,000**

In addition to this Fleet-funded monitoring program, the Office of Naval Research (ONR) Marine Mammals and Biology (MMB) Program, and the Office of the Chief of Naval Operations (CNO) Energy and Environmental Readiness Division (N45) Living Marine Resources (LMR) Program support coordinated Science & Technology (S&T) and Research & Development (R&D) focused on understanding the effects of sound on marine mammals, including physiological, behavioral, ecological effects, and population-level effects (DoN 2010f). Collectively, the U.S. Navy has provided over $230 million for marine species research from 2004 to 2012. These programs currently fund several significant ongoing projects relative to potential operational impacts to marine mammals within some U.S. Navy Range Complexes. Additional information on these programs and other ocean resources-oriented initiatives can be found at the Navy's Green Fleet – Energy, Environment, and Climate Change website (http://greenfleet.dodlive.mil/environment/marine-mammals-ocean-resources).

1.2 Integrated Comprehensive Monitoring Program (ICMP)

The Integrated Comprehensive Monitoring Program (ICMP) provides the overarching framework for coordination of the U.S. Navy's monitoring efforts (DoN 2010g). It has been developed in direct response to permitting requirements for U.S. Navy ranges, which are established in the various MMPA Final Rules, ESA Consultations, Biological Opinions, and applicable regulations. As a framework document, the ICMP applies by regulation to those activities on ranges and operating areas (OPAREAs) for which the U.S. Navy sought and received ITAs.

The ICMP is intended for use as a planning tool to focus U.S. Navy monitoring priorities pursuant to ESA and MMPA requirements. Top priority will always be given to satisfying the mandated legal requirements across all ranges. Once legal requirements are met, any additional monitoring-related research will be planned and prioritized using guidelines outlined by the ICMP, consistent with availability of both funding and scientific resources. As a planning tool, the ICMP is a "living document" and will be routinely updated, as needed. Initial areas of focus for improving U.S. Navy marine species monitoring focused on development of a Strategic Planning Process to be incorporated as a major component of the ICMP to guide investments and help refine specific monitoring actions to more effectively and efficiently address ICMP goals and objectives.

The ICMP is evaluated through the Adaptive Management Review (AMR) process to: (1) assess progress, (2) provide a matrix of goals and objectives for the following year, and (3) make recommendations for refinement and analysis of the monitoring and mitigation techniques. This process includes conducting an annual AMR meeting at which the U.S. Navy and NMFS jointly consider the prior-year goals, monitoring results, and related science advances to determine if monitoring plan modifications are warranted to more effectively address program goals. Modifications to the ICMP that result from AMR discussions are incorporated into a revision to the ICMP and submitted to NMFS.

Under the ICMP, monitoring measures prescribed in range-specific monitoring plans and U.S. Navy-funded research relating to the effects of U.S. Navy training and testing activities on protected marine species should be designed to accomplish one or more of the following top-level goals as prescribed in the current revision of the ICMP (DoN 2010g):

(a) An increase in our understanding of the likely occurrence of marine mammals and/or ESA-listed marine species in the vicinity of the action (i.e., presence, abundance, distribution, and/or density of species).

(b) An increase in our understanding of the nature, scope, or context of the likely exposure of marine mammals and/or ESA-listed species to any of the potential stressors associated with the action (e.g., sound, explosive detonation, or expended materials), through better understanding of one or more of the following: (1) the nature of the action and its surrounding environment (e.g., sound-source characterization, propagation, and ambient noise levels); (2) the affected species (e.g., life history or dive patterns); (3) the likely co-occurrence of marine mammals and/or ESA-listed marine species with the action (in whole or part); and/or (4) the likely biological or behavioral context of exposure to the stressor for the marine mammal and/or ESA-listed marine species (e.g., age class of exposed animals or known pupping, calving, or feeding areas).

(c) An increase in our understanding of how individual marine mammals or ESA-listed marine animals respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible, e.g., at what distance or received level).

(d) An increase in our understanding of how anticipated individual responses, to individual stressors or anticipated combinations of stressors, may impact either: (1) the long-term fitness and survival of an individual; or (2) the population, species, or stock (e.g., through effects on annual rates of recruitment or survival).

(e) An increase in our understanding of the effectiveness of mitigation and monitoring measures, including increasing the probability of detecting marine mammals to better achieve the above goals (through improved technology or methodology), both generally and more specifically within the safety zone (thus allowing for more effective implementation of the mitigation). Improved detection technology will be rigorously and scientifically validated prior to being proposed for mitigation, and should meet practicality considerations (engineering, logistic, and fiscal).

(f) A better understanding and record of the manner in which the authorized entity complies with the ITA and incidental take statement.

CNO N45 is responsible for maintaining and updating the ICMP, as necessary, reflecting the results of regulatory agency rulemaking, AMRs, best available science, improved assessment methodologies, and more effective protective measures. This is done as part of the AMR process, in consultation with U.S. Navy technical experts, Fleet Commanders, and Echelon II Commands as appropriate.

1.3 Report Objectives

Design of the Range Complex monitoring plans represented part of a new U.S. Navy-wide and regional assessment, and as with any new program, there are many coordination, logistical, and technical details that continue to be refined. The scope of the Range Complex monitoring plans was to lay out the background for monitoring, as well as to define initial procedures to be used in meeting certain study objectives derived from NMFS-U.S. Navy agreements.

Overall, this report closes out monitoring and reporting requirements under previous MMPA authorizations for AFAST and the East Coast and GOMEX Range Complexes through 2013 and serves two main objectives:

1. Present data and results from the U.S. Navy-funded marine mammal and sea turtle monitoring conducted in the AFAST Study Area and East Coast and GOMEX Range Complexes during the reporting period through December 2013 (**Section 2**). Due to the time required to consolidate data and generate the 2012 annual monitoring report for AFAST, this report covers a time period that includes the last half of the previous year's LOA (02 August 2012–21 January 2013) as well as the final year. In addition, this report covers the final reporting year for the East Coast and GOMEX Range Complexes. This report focuses on summarizing the major accomplishments and providing an overview of each monitoring project over the reporting period.
2. Continue the Adaptive Management Review process by providing an overview of monitoring initiatives, progress, and development of a Strategic Planning Process for U.S. Navy monitoring. These initiatives continue to shape the evolution of the U.S. Navy Marine Species Monitoring Program for 2014 and beyond. Input and recommendations from the Scientific Advisory Group (SAG) (e.g., DoN 2011e) form a cornerstone of the Strategic Planning Process, reflecting input received from the scientific community and other stakeholders.

SECTION 2 – MONITORING COMMITMENTS AND ACCOMPLISHMENTS

2.1 Monitoring Commitments for 2013

The AFAST Study Area and East Coast and GOMEX Range Complexes encompasses waters along the U.S. Atlantic Coast and of the Gulf of Mexico (GOM), consisting of Range Complex OPAREAs and adjacent waters (**Figure 1**). Potential environmental effects associated with the use of active sonar technology and explosives during Atlantic Fleet training exercises; maintenance; and research, development, test, and evaluation activities are more fully described in the *Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement* (EIS/OEIS; DoN 2013c).

There are 43 species of marine mammals that may be observed either seasonally or year-round in the Study Area (DoN 2005, 2007, 2008a, 2008b, 2008c; Waring et al. 2013). All receive protection under the MMPA, while the following seven are afforded additional protection under the ESA: North Atlantic right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), blue whale (*Balaenoptera musculus*), sperm whale (*Physeter macrocephalus*), and West Indian manatee (*Trichechus manatus*). There are six species of threatened and endangered sea turtles that occur in the Study Area (DoN 2013c): leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), Kemp's ridley turtle (*Lepidochelys kempii*), and olive ridley turtle (*Lepidochelys olivacea)*. The distributions and habitat preferences of these protected marine species are reviewed in various U.S. Navy Marine Resources Assessments for the U.S. Atlantic Coast and GOM (DoN 2005, 2007, 2008a, 2008b, 2008c; Waring et al. 2013).

2.1.1 AFAST Monitoring Commitments for 2013

The goal of the AFAST Monitoring Plan is to implement field methods chosen to address the long-term monitoring objectives outlined in **Section 1**. In the original AFAST Monitoring Plan (DoN 2009b), the U.S. Navy proposed to implement a diversity of field methods to gather monitoring data for marine mammals and sea turtles in U.S. Navy training areas. For the 2013 monitoring period specifically, the U.S. Navy proposed to conduct visual surveys (aerial and vessels) and tagging studies, deploy PAM devices, and put MMOs aboard U.S. Navy vessels during training exercises to meet monitoring requirements. Studies were specifically designed to address the questions outlined in **Section 1**. **Table 2** shows the 2013 monitoring period commitments as agreed upon by NMFS and the U.S. Navy.

Table 2. 2013 monitoring commitments under AFAST Final Rule, LOA, and Biological Opinion.

Marine Mammal Observers (MMOs)	2 events in conjunction with exercises
MMO/ Lookout Comparison Study	40 hours (hr) data-collection trials (Navy-wide)
Aerial Surveys—VACAPES/CHPT/JAX OPAREAs	36 days
Vessel Surveys—VACAPES/CHPT/JAX OPAREAs	24 days
Marine Mammal Tagging	- Field work and data analysis in the JAX OPAREA in coordination with vessel surveys - Initiate tagging project in Hatteras survey area
Passive Acoustics – Baseline	Continue recording and data analysis for 3 strategically located HARPs
Passive Acoustics – Exercise Monitoring	Deployments of pop-up buoys in conjunction with ASW exercises

2.1.2 East Coast and GOMEX Ranges Monitoring Commitments for 2013

The U.S. Navy proposed to implement a diversity of field methods to gather monitoring data for marine mammals and sea turtles in U.S. Navy training areas under the VACAPES, CHPT, JAX, and GOMEX Monitoring Plans (DoN 2009c, 2009d, 2009e, 2011f), Specifically, the U.S. Navy proposed to use visual surveys (aerial or vessel), deploy PAM devices when possible, and put MMOs aboard U.S. Navy vessels to meet its goals during the current time period. **Tables 3 through 6** show the annual monitoring objectives as initially agreed upon by NMFS and U.S. Navy for these Range Complexes.

Table 3. Annual monitoring commitments under VACAPES Final Rule, LOA and Biological Opinion.

STUDY 1 (behavioral responses)		
Aerial or Vessel Surveys	- 2 explosive events per year (one involving multiple detonations). When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	Adaptive Management Review for 2013 (AMR)
Marine Mammal Observers (MMO)	- 1 explosive event per year.	
STUDY 2 (mitigation effectiveness)		
MMO/Lookout Comparison	- 1 explosive event per year.	AMR
Vessel or Aerial Surveys Before and After Training Events	- 2 explosive events per year (one involving multiple detonations). When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	

Table 4. Annual monitoring commitments under CHPT Final Rule, LOA and Biological Opinion.

STUDY 1 (behavioral responses)		
Aerial or Vessel Surveys	- 1 explosive event per year. When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	Adaptive Management Review for 2013 (AMR)
Marine Mammal Observers (MMOs)	- 1 explosive event per year.	
STUDY 2 (mitigation effectiveness)		
MMO/Lookout Comparison	- 1 explosive event per year.	AMR
Vessel or Aerial Surveys Before and After Training Events	- 1 explosive event per year. When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	

Table 5. Annual monitoring commitments under JAX Final Rule, LOA, and Biological Opinion.

STUDY 1 (behavioral responses)		
Aerial or Vessel Surveys	- 2 explosive events per year, one of which is a multiple detonation event. When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	Adaptive Management Review for 2013 (AMR)
Marine Mammal Observers (MMOs)	- 1 explosive event per year.	
STUDY 2 (mitigation effectiveness)		
MMO/Lookout Comparison	- 1 explosive event per year.	AMR
Vessel or Aerial Surveys Before and After Training Events	- 2 explosive events per year. When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	

Table 6. Annual monitoring commitments under GOMEX Final Rule, LOA, and Biological Opinion.

STUDY 1 (behavioral responses)		
Aerial or Vessel Surveys	- 1 explosive event per year. When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	Adaptive Management Review for 2013 (AMR)
Marine Mammal Observers (MMOs)	- 1 explosive event per year.	
STUDY 2 (mitigation effectiveness)		
MMO/Lookout Comparison	- 1 explosive event per year.	AMR
Vessel or Aerial Surveys Before and After Training Events	- 1 explosive event per year. When feasible, deploy hydrophone array during vessel surveys for passive acoustic monitoring.	

2.2 Monitoring Accomplishments

2.2.1 AFAST Monitoring Accomplishments for the Reporting Period

During the reporting period the U.S. Fleet Forces Command (FFC) implemented aerial and vessel surveys, conducted tagging studies on multiple species of marine mammals and sea turtles, analyzed previously collected PAM data, and deployed PAM devices. The monitoring effort for the reporting period was conducted in three primary locations—off Cape Hatteras, North Carolina, within the VACAPES OPAREA; Onslow Bay within the CHPT OPAREA; and the JAX OPAREA. These locations serve as primary study areas for longitudinal baseline-monitoring efforts and are also the primary locations for coordinated anti-submarine warfare (ASW) exercise monitoring events.

During the AMR process preceding AFAST monitoring in 2013, the U.S. Navy had proposed to reallocate some survey effort to support new initiatives that would more directly contribute to addressing the objectives of the ICMP. The modification did not include a change in overall effort, but rather was intended to enable the U.S. Navy to take advantage of additional monitoring locations within the VACAPES (Cape Hatteras survey area), CHPT (Onslow Bay survey area), and JAX OPAREAs and employ various research techniques to address the questions proposed in the AFAST Monitoring Plan.

Appendix A includes a listing of publications and presentations resulting from the AFAST monitoring program to date.

Major accomplishments from compliance monitoring in the AFAST Study Area for this reporting period include:

- Aerial Visual Surveys
    - Conducted monthly aerial surveys (weather permitting) at Cape Hatteras, Onslow Bay, and JAX sites to continue obtaining longitudinal baseline data.
- Vessel Visual Surveys
    - Conducted monthly vessel surveys (weather permitting) at Cape Hatteras, Onslow Bay, and JAX sites to continue obtaining longitudinal baseline data including photo-identification and biopsy sampling for population structure, residency, and distributional analyses.
    - Conducted photo-identification efforts, collecting large numbers of photographs—895 photographs at Cape Hatteras of short-finned pilot whales (*Globicephala macrorynchus*), common bottlenose dolphins (herein referred to as bottlenose dolphin, *Tursiops truncatus*), and a fin whale; 1,569 photographs at Onslow Bay of bottlenose dolphins, short-finned pilot whales, Risso's dolphins (*Grampus griseus*), and Atlantic spotted dolphins (*Stenella frontalis*); and 901 photographs at JAX of bottlenose dolphins, Atlantic spotted dolphins, and Risso's dolphins.
    - Conducted biopsy-sampling efforts, collecting 9 samples at Cape Hatteras of short-finned pilot whales, bottlenose dolphins; and a fin whale; 21 samples at Onslow Bay from bottlenose dolphins, short-finned pilot whales, Risso's dolphins, and Atlantic spotted dolphins; and 11 samples at JAX of bottlenose dolphins and Atlantic spotted dolphins.
    - Conducted vessel surveys during three unit level ASW training events in JAX in July 2013.

    - Completed U.S. Navy MMO surveys aboard a U.S. Navy Destroyer during an Integrated Anti-Submarine Warfare Course (IAC) training event in JAX.

- Passive Acoustic Monitoring
    - Maintained three High-frequency Acoustic Recording Packages (HARPs) in VACAPES/CHPT/ JAX—total of five deployments (one each in Onslow Bay, JAX, and off Cape Hatteras).
    - Deployed four synchronized Autonomous Multichannel Acoustic Recorders (AMARs) off Cape Hatteras as a pilot project for future training event monitoring.
    - Deployed five Marine Autonomous Recording Units (MARUs) off Cape Hatteras as part of a collaborative project to learn more about North Atlantic right whale migration patterns.
    - Developed odontocete detectors and classifiers specific to species in the AFAST Study Area to support analysis of acoustic recordings from vessel surveys. Prepared a ROCCA (Real-time Odontocete Call Classification Algorithm) User's Manual.
    - Invested heavily in analysis of previously collected PAM data.
- Marine Mammal Observers on U.S. Navy Platform
    - Three MMOs were deployed during an IAC training event in JAX onboard the ship using MFAS in July 2013.
- Observer Effectiveness Study
    - Funded development of additional novel analysis methodology and proof-of-concept.
    - Participated in 2 data collection trials in the Hawaii Range Complex.

Tables 7 and 8 present monitoring accomplishments for two different timeframes. **Table 7** summarizes the monitoring accomplishments for 02 August 2012 through December 2013, corresponding to the period covered by this report. As mentioned in **Section 1**, because the previous reporting period (02 August 2012 through 01 August 2013) spanned across two LOA annual periods, **Table 8** provides a summary of accomplishments for 22 January 2012 through 21 January 2013, corresponding to the fourth full LOA period. For the monitoring events that could not be accomplished due to safety issues, weather, and/or changing ship schedules, the U.S. Navy will continue working with NMFS to develop the best plan to either capture these events during the remaining permit period or to focus those resources on monitoring that would better achieve the overarching goals of the monitoring program.

Table 7. U.S. Navy-funded monitoring accomplishments within the AFAST Study Area for the period covered by this report (02 August 2012 through December 2013).

Study Type	Description of U.S. Navy EIS/LOA monitoring	Associated event type	MMPA/ESA requirement	Accomplished
Aerial surveys – Onslow Bay and JAX (study 2)	1) Monthly surveys in Onslow Bay 2) Monthly surveys in JAX 3) Surveys off Cape Hatteras	n/a	36 days.	27 days: 14 days Hatteras; 0 days Onslow Bay; 13 days JAX.
Vessel surveys – during training event (study 3)	n/a	SEASWITI, shallow COMPTUEX, or ULT	n/a	3 events.
Vessel surveys— Onslow Bay and JAX (study 2)	1) Monthly surveys at Cape Hatteras 2) Monthly surveys in Onslow Bay 3) Monthly surveys in JAX	n/a	24 days.	35 days: 17 days in Hatteras; 6 days in Onslow Bay; 12 days in JAX. 83 biopsies collected: Hatteras (49), Onslow Bay (22), JAX (12).
Marine Mammal Observers (studies 1 and 3)		SEASWITI or ULT	2 events in conjunction with exercises.	4 events: July 2013, ASW monitoring, CHPT.
Passive Acoustic Monitoring (study 2)	1) Maintenance of 4 HARPs (2 in Onslow Bay and 2 in JAX) 2) Use of pop-up buoys for exercise monitoring 3) Use of towed array during vessel surveys	SEASWITI, shallow COMPTUEX, or ULT	2 deployments of pop-up buoys in conjunction with exercises. Continue recording and data analysis for 3 strategically-located HARPs.	4 deployments of HARPs, in Hatteras, Onslow Bay, and JAX. 3 days (33.8 hr) towed array (Hatteras) and 2 days (18 hr) glider (Hatteras). 4 AMARs and 5 MARUs deployed in Hatteras.
MMO/Lookout Comparison Study	Develop observer comparison study and perform trials		40 hr data-collection trials.	Continued methods refinement and data collection. Data collected during 2 exercises conducted in HRC.
Tagging	Plan and conduct tagging studies on a variety of marine mammal and sea turtle species	n/a		Deep Diver project off Hatteras (May-Oct 2013). North Atlantic right whale tagging to begin in Feb 2014. Turtle tagging initiated in July 2013 in Chesapeake Bay and coastal Virginia waters.

Key: AMAR = Autonomous Multichannel Acoustic Recorder; ASW = anti-submarine warfare; COMPTUEX = Composite-Training Unit Exercise; ESA = Endangered Species Act; EIS = Environmental Impact Statement; HARP = High-frequency Acoustic Recording Package; hr = hour(s); HRC = Hawaii Range Complex; JAX = Jacksonville; LOA = Letter of Authorization; MARU = marine autonomous recording units; MMO = Marine Mammal Observer; MMPA = Marine Mammal Protection Act; n/a = not available; SEASWITI = Southeast Anti-Submarine Warfare Integration Training Initiative; ULT = Unit-Level Training.

Table 8. U.S. Navy-funded monitoring accomplishments within the AFAST Study Area from 22 January 2012 through 21 January 2013, corresponding to the fourth full year LOA period.

Study Type	Description of U.S. Navy EIS/LOA Monitoring	Associated Event Type	MMPA/ESA Requirement	Accomplished
Aerial surveys – Onslow Bay and JAX (study 2)	1) Monthly surveys in Onslow Bay 2) Monthly surveys in JAX 3) Surveys off Cape Hatteras	n/a	36 days.	29 days: 15 days in Hatteras, 0 days in Onslow Bay, 14 days in JAX.
Vessel surveys – during training event (study 3)	n/a	SEASWITI, shallow COMPTUEX, or ULT	n/a	1 event.
Vessel surveys— Onslow Bay and JAX (study 2)	1) Monthly surveys in Onslow Bay 2) Monthly surveys in JAX 3) Behavioral response study off Cape Hatteras	n/a	24 days.	29 days: 16 days in Hatteras; 6 days in Onslow Bay; 7 days in JAX. 126 biopsies collected: Hatteras (93), Onslow Bay (15), JAX (18).
Marine Mammal Observers (studies 1 and 3)		SEASWITI or ULT	2 events in conjunction with exercises.	1 event: May-June 2012, ASW monitoring, JAX
Passive Acoustic Monitoring (study 2)	1) Maintenance of 4 High-frequency Recording Packages (HARPs) 2) Use of pop-up buoys for exercise monitoring 3) Use of towed array during vessel surveys	SEASWITI, shallow COMPTUEX, or ULT	2 deployments of pop-up buoys in conjunction with exercises. Continue recording and data analysis for 3 strategically located HARPs	5 deployments of HARPs this period. 3 days (33.8 hr) towed array (Hatteras) and 2 days (18 hr) glider (Hatteras).
MMO/Lookout Comparison Study	Develop observer comparison study and perform trials		40 hr data-collection trials.	Completed study design and initial pilot study analysis. Continued methods refinement and data collection.
Tagging		n/a	JAX in coordination with vessel surveys - study design to be developed.	

Key: ASW=anti-submarine warfare; ASWEX=Anti-submarine Warfare Training Exercise; COMPTUEX=Composite-Training Unit Exercise; ESA=Endangered Species Act; EIS=Environmental Impact Statement; HARP=High-frequency Acoustic Recording Package; hr = hour(s); JAX=Jacksonville; LOA=Letter of Authorization; MMO=Marine Mammal Observer; MMPA=Marine Mammal Protection Act; n/a=not applicable; SEASWITI=Southeast Anti-Submarine Warfare Integration Training Initiative; ULT=Unit-Level Training.

2.2.2 East Coast and GOMEX Ranges Accomplishments for 2013

FFC conducted monitoring during 4 training events (i.e., firing or explosives exercises) during the reporting period for the East Coast and Gulf of Mexico Range Complexes. The monitoring effort for the reporting period was conducted in two primary locations—VACAPES and JAX OPAREAs.

Major accomplishments from compliance monitoring for the East Coast and Gulf of Mexico Ranges during this reporting period include:

- **VACAPES**
  - A vessel survey, MMOs, and PAM during a mine-neutralization exercise (MINEX) event conducted in W-50 MINEX training range during 24-26 October 2013.
  - Analysis of data from the noise measurement study conducted during a MINEX event in September 2012.
  - Continued data collection from two ecological acoustic recorders (EARs) deployed in August 2012 to monitor odontocete occurrence and acoustic activity at the W-50 MINEX training range.
  - Continued data collection from four C-PODs deployed beginning in August 2012 in the W-50 MINEX training range and adjacent Chesapeake Bay waters.
  - Aerial surveys during 13-14 March 2013 before a planned missile exercise (MISSILEX) event.
  - Aerial surveys during 28-29 October 2013 before and after a planned Firing Exercise (FIREX) with Integrated Maritime Portable Acoustic Scoring and Simulator (IMPASS)
  - Small vessel surveys for bottlenose dolphins in coastal and offshore waters off the coast of Virginia. Occurrence was determined and density was estimated, along with photo-identification efforts.
- **JAX**
  - Aerial surveys and U.S. Navy MMOs monitored before, during, and after a FIREX with IMPASS event conducted on 30 April 2013.

2.2.2.1 VACAPES Range Complex Accomplishments

FFC implemented vessel surveys and deployed PAM devices in the VACAPES Range Complex during the reporting period. The monitoring efforts for 2013 were conducted within W-50A/R-6606 in conjunction with a MINEX event and within the 7C/7D, 8C/8D training box during the FIREX with IMPASS event. Aerial surveys were also conducted in the primary MISSILEX 1A1-1A4 boxes as well as to the south of the primary MISSILEX region in W-72 2A1, 2A2, 2A3, and 2A4 boxes. See **Section 3** for details.

Major accomplishments from 2013 compliance monitoring in the VACAPES Range Complex are summarized in Table 9 and include:

- Aerial Visual Surveys
  - Completed aerial surveys before a MISSILEX event during 13 and 14 March 2013 (HDR 2013a).

- Completed aerial surveys before and after a FIREX with IMPASS event conducted on 29 October 2013 within the FIREX 7C/D and 8C/D training boxes (HDR 2013c).

- Vessel Visual Surveys
  - Completed vessel surveys before, during, and after a MINEX event during 24-26 October 2013 (DoN 2014b).
- Passive Acoustic Monitoring
  - Analysis of data from noise measurements made in September 2012 of underwater explosions near a MINEX event (Soloway and Dahl 2014).
  - Real-time passive acoustic detection and localization of marine mammal vocalizations was conducted in association with a MINEX event on 24-26 October 2013 (DoN 2014b).
  - Two Ecological Acoustic Recorders were deployed in August 2012 to monitor odontocete occurrence and acoustic activity at the W-50 MINEX training range (Lammers et al. 2014).
  - Four C-PODs were deployed beginning in August 2012 in W-50 of the MINEX area and adjacent Chesapeake Bay waters (Engelhaupt et al. 2014).
- Marine Mammal Observers on U.S. Navy Platform
  - MMOs monitored during a MINEX event conducted on 25 October 2013 (DoN 2014b).

Table 9. U.S. Navy-funded monitoring accomplishments within the VACAPES Study Area for 2013.

Monitoring Obligation (Study Type)	Description of U.S. Navy EIS/LOA Monitoring Completed	Event Types Available for Monitoring	MMPA/ESA Requirement	Total Accomplished
Vessel or Aerial Surveys – Before and After Event (study 1 and 2)	Vessel surveys before, during, and after 1 MINEX event.	MINEX, MISSILEX, FIREX, or BOMBEX	2 events (1 MDE)	3 events
Marine Mammal Observers (MMOs) (study 1 and 2)	MMOs visually surveyed before, during, and after 1 MINEX event.	MINEX, MISSILEX, or FIREX	1 event	1 event
Passive Acoustic Monitoring (PAM) (study 2)	Deployed passive acoustic buoys during 1 MINEX event.	MINEX, MISSILEX, FIREX, or BOMBEX	Deploy hydrophone array during vessel surveys when feasible	1 event

Key: BOMBEX = Bombing Exercise; EIS = Environmental Impact Statement; ESA = Endangered Species Act: FIREX = Firing Exercise; LOA = Letter of Authorization; MDE = Multiple Detonation Event; MINEX = Mine-neutralization Exercise; MISSILEX = Missile Exercise; MMOs = Marine Mammal Observers; MMPA = Marine Mammal Protection Act.; PAM = Passive Acoustic Monitoring.

2.2.2.2 CHPT Range Complex Accomplishments

There were three explosive events conducted in the CHPT Range Complex during the reporting period, but none of them provided reasonable monitoring opportunities due to location, scheduling, or weather conditions.

2.2.2.3 JAX Range Complex Accomplishments

Major accomplishments from 2013 compliance monitoring in the JAX Range Complex are summarized in Table 10 and include:

- Aerial Visual Surveys
  - Completed aerial surveys before, during, and after a FIREX with IMPASS event within the FIREX BB/CC training box during 29 April through 01 May 2013 (HDR 2013b).
- Marine Mammal Observers on U.S. Navy Platform
  - Three MMOs were deployed on a U.S. Navy ship during a FIREX with IMPASS event on 29 April 2013 (DoN 2013d).

Table 10. U.S. Navy-funded monitoring accomplishments within the JAX Study Area from January 2013 through December 2013.

Study Type	Description of U.S. Navy EIS/LOA Monitoring Completed	Event Types Available for Monitoring	MMPA/ESA Requirement	Total Accomplished
Vessel or Aerial Surveys Before and After Event (studies 1 and 2)	Aerial surveys during 2 MISSILEX events.	MINEX, MISSILEX, FIREX, or BOMBEX	2 events (1 MDE)	1 event
Marine Mammal Observers (studies 1 and 2)	MMOs visually surveying before, during and after 1 FIREX event.	MINEX, MISSILEX, or FIREX	1 event	1 event
Passive Acoustic Monitoring (study 2)	Not feasible for events monitored.	MINEX, MISSILEX, FIREX, or BOMBEX	Deploy hydrophone array during vessel surveys when feasible	Not feasible for events monitored

Key: BOMBEX = Bombing Exercise; EIS = Environmental Impact Statement; ESA = Endangered Species Act: FIREX = Firing Exercise; LOA = Letter of Authorization; MDE = Multiple Detonation Event; MINEX = Mine-neutralization Exercise; MISSILEX = Missile Exercise; MMO = Marine Mammal Observer; MMPA = Marine Mammal Protection Act.

2.2.2.4 GOMEX Range Complex Accomplishments

There were no monitoring opportunities available for explosive events in the GOMEX Range Complex during the reporting period.

2.3 Closeout Summary of Monitoring Accomplishments

As previously mentioned in **Section 1.1**, a new MMPA authorization for Atlantic Fleet Training and Testing (AFTT) was issued in November 2013 superseding previous authorizations and monitoring requirements for AFAST, VACAPES, CHPT, JAX, and GOMEX. This annual report serves as a closeout report for those previous authorizations. **Tables 11** and **12** provide a summary of monitoring commitments and accomplishments over the entire period covered by those previous MMPA authorizations.

Table 11. Summary of annual progress under the AFAST monitoring plan for 2009-2013.

Methods	Description	2009		2010		2011		2012		2013		Summary
		Commitment	Accomplishment	Commitment	Accomplishment	Commitment[1]	Accomplishment	Commitment[1]	Accomplishment	Commitment (Pro-rated)[1]	Accomplishment	
Aerial Surveys – During Training Event (studies 1 and 3)	N/A	30 hours	0 hours	1 event	2 events	1 event	2 events	N/A	N/A	N/A	N/A	**Commitments Met** (effort in 2010 and 2011 make up for 2009)
Aerial Surveys – Before and After Training Event (studies 2 and 4)	N/A	40 hours	33 hours	1 event	2 events	1 event	2 events	N/A	N/A	N/A	N/A	**Commitments Met** (effort in 2010 and 2011 make up for 2009)
Aerial Surveys – Onslow Bay and JAX (study 2)[2]	1) Monthly surveys in Onslow Bay 2) Monthly surveys in JAX	100 hours (Onslow Bay) 100 hours (JAX)	162 hours (Onslow) 162 hours (JAX)	48 days	52 days: 19 days Onslow Bay, 33 days JAX	48 days	31 days: 10 days in Hatteras, 4 days in Onslow Bay, and 17 days in JAX	36 days	29 days: 15 days in Onslow/Hatteras, 14 days in JAX	30 days	18 days: 9 days in Onslow/Hatteras, 9 days in JAX	**Not all days completed due to weather windows; ongoing effort will continue**
Vessel Surveys – During Training Event (study 3)	NA	100 hours	0 hours	2 events	1 event	2 events	1 event	N/A	1 event	N/A	3 events	**Commitments Met**
Vessel Surveys – Onslow Bay and JAX (study 2)[2]	1) Monthly surveys in Onslow Bay 2) 4 days in Cape Hatteras 3) July surveys in JAX	125 hours (Onslow Bay) 125 hours (JAX)	143 hours (Onslow) 91 hours (JAX) 26 hours (Cape Hatteras)	48 days	30 days: 12 days Onslow Bay, 18 days JAX	48 days	35 days: 23 days in Hatteras, 5 days in Onslow Bay, 7 days in JAX. 24 biopsies collected.	24 days	29 days: 22 days in Onslow/Hatteras, 13 tagging days in Hatteras, 7 days in JAX. 45 biopsies collected.	20 days	24 days: 4 days in Onslow/Hatteras, 10 tagging days in Hatteras, 10 days in JAX. 31 biopsies collected.	**Not all days completed due to weather windows; ongoing effort will continue**
Marine Mammal Observers (studies 1 and 3)	Observers on navy ships during training events	60 hours	60 hours	2 events	2 events	2 events	0 events	2 events	1 event	1 event	4 events	**Commitments Met**
Passive Acoustic Monitoring (study 2)	1) Deployment of 4 HARPS (2 in Onslow Bay and 2 in JAX) 2) Use of pop-up buoys for exercise monitoring 3) Use of towed array during vessel surveys	Deploy up to four devices and use pop-up buoys	Deployed four HARPs, used pop-up buoys in conjunction with 2 exercises, and a total of ~80 hours of towed array recording effort in Onslow and JAX	Maintenance of four devices (HARPS), use pop-up buoys and towed array (when feasible)	6 deployments of HARPs, no pop-ups deployed, and a total of ~70 hours of towed array effort in Onslow Bay and JAX	Maintenance of four devices (HARPS), use pop-up buoys and towed array (when feasible)	4 deployments of HARPs, and deployment of 12 JASCO buoys during JAX ASWEX.	Maintenance of three devices (HARPS), use pop-up buoys and towed array (when feasible)	3 HARPs maintained (Onslow, Hatteras, and JAX), no deployment of pop-ups.	Maintenance of three devices (HARPS), use pop-up buoys and towed array (when feasible)	3 HARPs maintained (Onslow, Hatteras, and JAX), deployed MARU pop-ups in Hatteras, deployed JASCO buoys in Hatteras.	**Commitments Met**
MMO/Lookout Comparison (study 5)	Conduct observer comparison trials	N/A	Completed study design and development	40 hours[3]	Completed study design, data collected during 5 exercises (2 HRC, 2 JAX, 1 SOCAL), and initial pilot analysis.	40 hours[3]	Further refined study design, data collected during 4 exercises, and initial pilot analysis (3 HRC, 1 SOCAL).	40 hours[3]	Funded development of additional novel analysis methodology, data collected during 1 exercise (HRC).	30 hours[3]	Data collected during 2 exercises (HRC).	**Commitments Met**
Tagging		N/A	N/A	N/A	N/A	N/A	23 days in Hatteras with 11 D-tags deployed	JAX in coordination with vessel surveys - study design to be developed.	13 tagging days in Hatteras with 9 D-tags deployed	Tagging projects in JAX and Hatteras	10 tagging days in Hatteras, 0 individuals tagged. Tagging trip planned for Nov/Dec in JAX.	**Commitments Met**

[1] Requirements were changed to reflect training events and survey days

[2] Survey area was expanded to include Cape Hatteras area in 2011

[3] Lookout comparison study requirements apply U.S. Navy-wide

Green=requirement fully met; Orange=requirement partially met; Red=requirement not met

Table 12. Summary of annual progress under monitoring plans for the East Coast and GOMEX Range Complexes for 2009-2013.

Range Complex	Monitoring Event	Annual Requirement	*Year 1* 05 June 2009 - 04 June 2010	*Year 2* 05 June 2010 - 04 June 2011	*Year 3* 05 June 2011 - 04 June 2012	*Year 4* 05 June 2012 - 04 June 2013	*Year 5* 05 June 2013 - 14 November 2013 (Pro-rated)	Total	
								Required (Pro-rated Year 5)	Completed
VACAPES	Aerial or Vessel Survey	2 (1 MDE)	2 MINEX (with PAM)	1 MINEX (with PAM), 1 IMPASS (1 MDE)	1 MINEX (with PAM), 1 IMPASS (1 MDE)	1 MINEX (with PAM), 1 MISSILEX	1 MINEX (with PAM), 1 IMPASS (1 MDE)	9 (4 MDEs)	**10 (3 MDEs)**
	MMOs on U.S. Navy Platform	1	2 MINEX	1 MINEX	1 IMPASS, 1 MINEX	1 MINEX	1 MINEX	5	**7**
CHPT	Aerial or Vessel Survey	1	0*	0*	1 IMPASS (1 MDE)	0	0	3**	**1 (1 MDE)**
	MMOs on U.S. Navy Platform	1	0*	0*	0	0	0	3**	**0**
JAX	Aerial or Vessel Survey	2 (1 MDE)	0	2 MISSILEX, 2 IMPASS (2 MDEs)	1 MISSILEX, 1 IMPASS (1 MDE)	1 MISSILEX, 2 IMPASS (2 MDE)	0	9 (5 MDEs)	**9 (5 MDEs)**
	MMOs on U.S. Navy Platform	1	0	1 IMPASS	0	2 IMPASS	0	4	**3**
Range Complex	**Monitoring Event**	**Annual Requirement**	***Year 1*** **18 MAR 2011 - 17 MAR 2012**	***Year 2*** **18 MAR 2012 - 17 MAR 2013**	***Year 3*** **18 MAR 2013 - 17 MAR 2014**	***Year 4*** **18 MAR 2014 - 17 MAR 2015**	***Year 5*** **18 MAR 2015 – 17 MAR 2016**	**Total**	
								Required	**Completed**
GOMEX	Aerial or Vessel Survey	1	0*	0*	0*	NA	NA	0*	**0**
	MMOs on U.S. Navy Platform	1	0*	0*	0*	NA	NA	0*	**0**

*No monitoring due to no training events being conducted.

**A total of 4 explosive events were conducted within CHPT during years three through five of the permit period, therefore the total monitoring requirement for the 5-year permit period is 3 events (1 per year over the three years with explosive events).

Key: CHPT = Cherry Point; GOMEX = Gulf of Mexico; IMPASS = Integrated Maritime Portable Acoustic Scoring and Simulator; JAX = Jacksonville; MDE = Multiple Detonation Event; MINEX = Mine-neutralization Exercise; MISSILEX = Missile Exercise; MMO = Marine Mammal Observer; NA = Not Applicable; PAM = Passive Acoustic Monitoring; U.S. = United States; VACAPES = Virginia Capes.

Green = requirement fully met; Orange = requirement partially met; Red = requirement not met.

SECTION 3 – MONITORING ACTIVITIES

3.1 Exercise Monitoring

Training exercise events monitored off the U.S. Atlantic and Gulf of Mexico coasts during the reporting period included ASWEX, MINEX, MISSILEX, and FIREX. A description of these various types of U.S. Navy training exercises is provided in the AFAST 5-year comprehensive monitoring report (DoN 2013e).

Monitoring of coordinated ASW exercises is one of the primary components being used to address specific monitoring questions posed in the AFAST Monitoring Plan (DoN 2009b) and the NMFS-issued LOA (NMFS 2009). Scheduling of protected marine species monitoring that involves civilian aircraft and ships operating concurrently with multiple U.S. Navy aircraft and ships in the same area requires extensive pre-survey coordination between multiple U.S. Navy commands. The FFC operational community provides a critical interface and coordination that is instrumental in allowing for researchers to conduct monitoring in close proximity to U.S. Navy assets.

As in previous years, cancellations or major date shifts in U.S. Navy training events based on logistics, fiscal, or operational needs were challenging to overcome. These kinds of changes are difficult to predict and, more importantly, difficult to reschedule from a monitoring perspective on short notice when contracts have been awarded; survey equipment purchased, rented, or relocated; and personnel availability and transport arranged.

Both passive acoustic and visual (i.e., aerial and vessel surveys) monitoring methods were employed to address before/after and before/during/after monitoring requirements for training exercises. Coordinated ASW exercise monitoring components for this reporting period are presented below.

3.1.1 Aerial Surveys

3.1.1.1 MISSILEX Event – VACAPES, March 2013

Aerial surveys were conducted in association with a MISSILEX training event off the coast of Virginia. Line-transect surveys were conducted on 13 and 14 March 2013 before the planned training event. Marine species sightings made during these surveys are presented in **Table 13**.

Table 13. Marine species sightings from the aerial surveys conducted during 13 March 2013 for the MISSILEX training event in VACAPES. There were no sightings made on 14 March.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Bottlenose dolphin	*Tursiops truncatus*	1	5
Fin whale	*Balaenoptera physalus*	1	1
Unidentified dolphin		2	35

Due to multiple exercises occurring in the primary range boxes of interest and safety concerns with multiple aircraft in the area on 13 March, aerial surveys were conducted south of the primary MISSILEX region in W-72 2A1, 2A2, 2A3, and 2A4 boxes (**Figure 2**). On 14 March, aerial surveys resumed in the primary MISSILEX 1A1-1A4 boxes (**Figure 3**). The MISSILEX was scheduled for 15 March, but was cancelled on 14 March due to poor weather conditions predicted for 15 March. While the planned MISSILEX did not occur on 15 March, an alternate exercise was conducted in the same range boxes during which three Griffin missiles were fired.

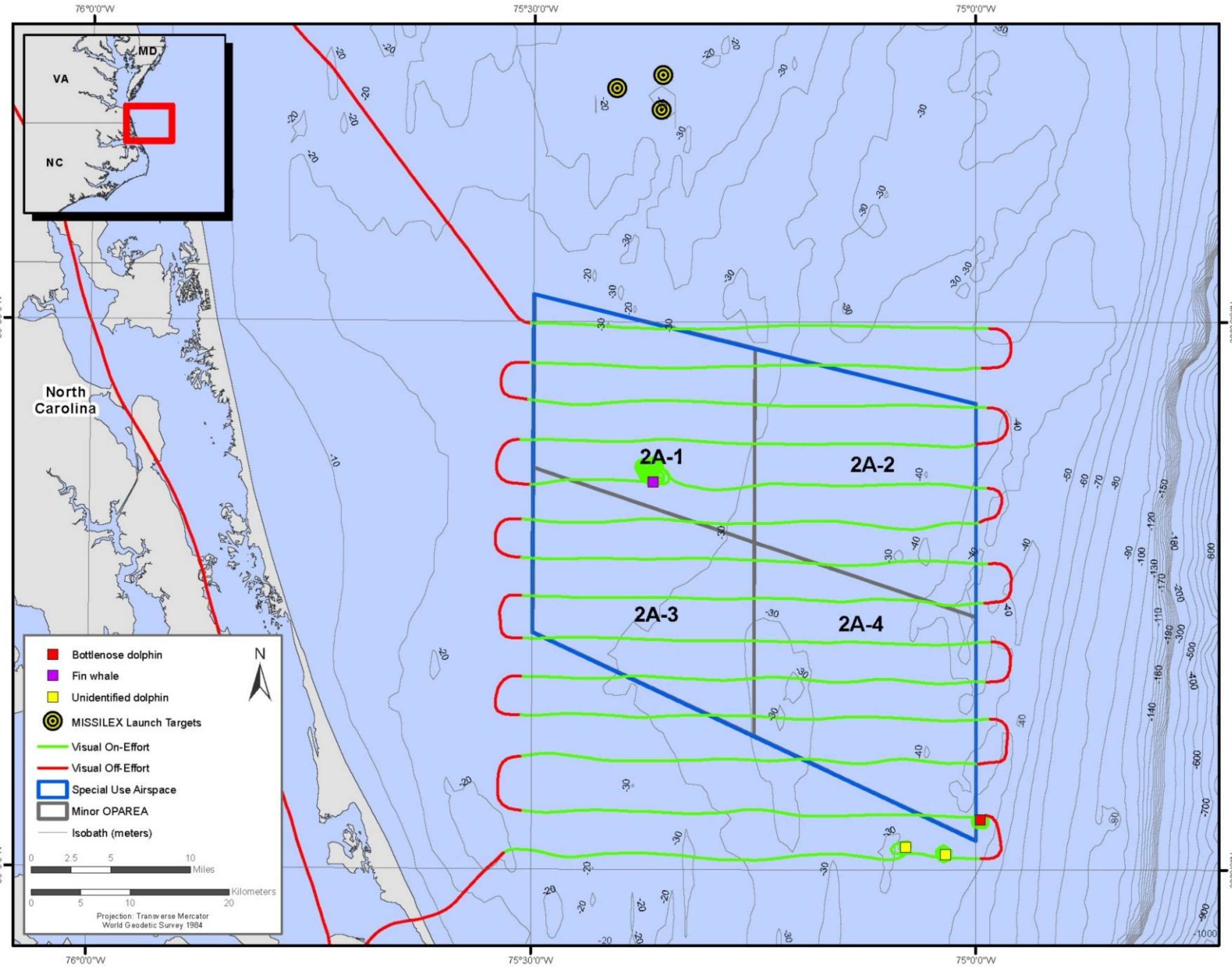

Figure 2. Locations of all cetacean sightings seen throughout the VACAPES MISSILEX pre-exercise monitoring period (13 March).

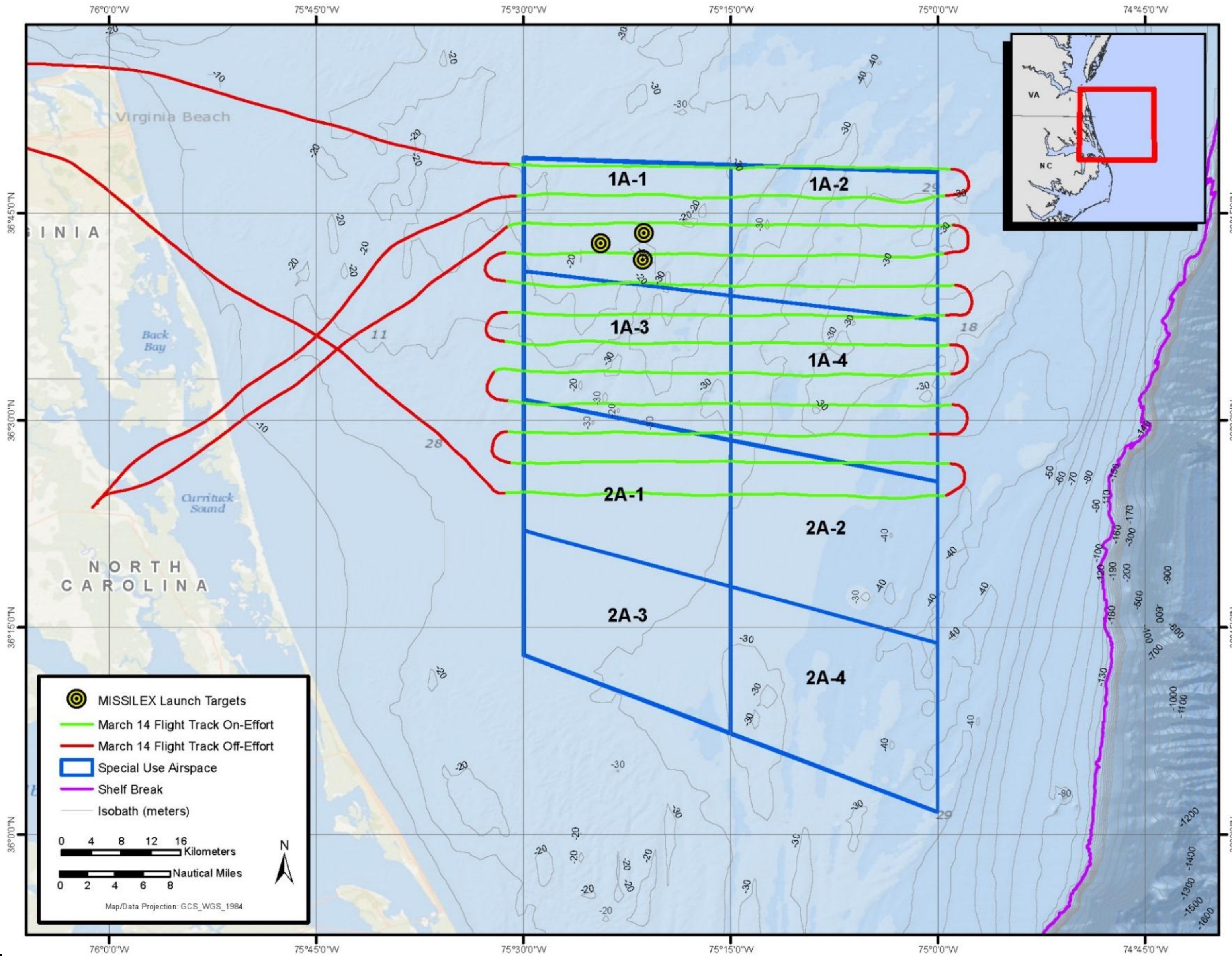

Figure 3. Survey flight track conducted throughout the VACAPES pre-MISSILEX monitoring period (14 March).

Sightings over the 2-day pre-MISSILEX survey period included one sighting of bottlenose dolphins, one sighting of a fin whale, and two sightings of unidentified dolphins; all sightings were made on 13 March during one day of the pre-MISSILEX survey period (**Figure 2**). Focal follows were attempted, but long deep dives by a fin whale and cloudy water conditions during dolphin sightings precluded the ability to collect detailed behavioral data. For additional details, refer to the March 2013 VACAPES MISSILEX Trip Report (HDR 2013a).

3.1.1.2 FIREX with IMPASS – VACAPES, October 2013

Aerial surveys were conducted in association with a FIREX with IMPASS training event off the eastern coast of Virginia. Line-transect surveys were conducted 28 through 29 October 2013 before and after the planned training event (**Figures 4 and 5**). Marine species sightings made during these surveys are presented in **Table 14**.

Table 14. Marine species sightings from the aerial surveys conducted during 28 through 29 October 2013 for the FIREX with IMPASS training event in VACAPES.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Bottlenose dolphin	*Tursiops truncatus*	5	95
Fin whale	*Balaenoptera physalus*	2	2
Mixed-species group of humpback whale and bottlenose dolphin	*Megaptera novaeangliae/ Tursiops truncatus*	1	1 whale, 8 dolphins
Loggerhead turtle	*Caretta*	4	4
Unidentified hardshell turtle		2	2

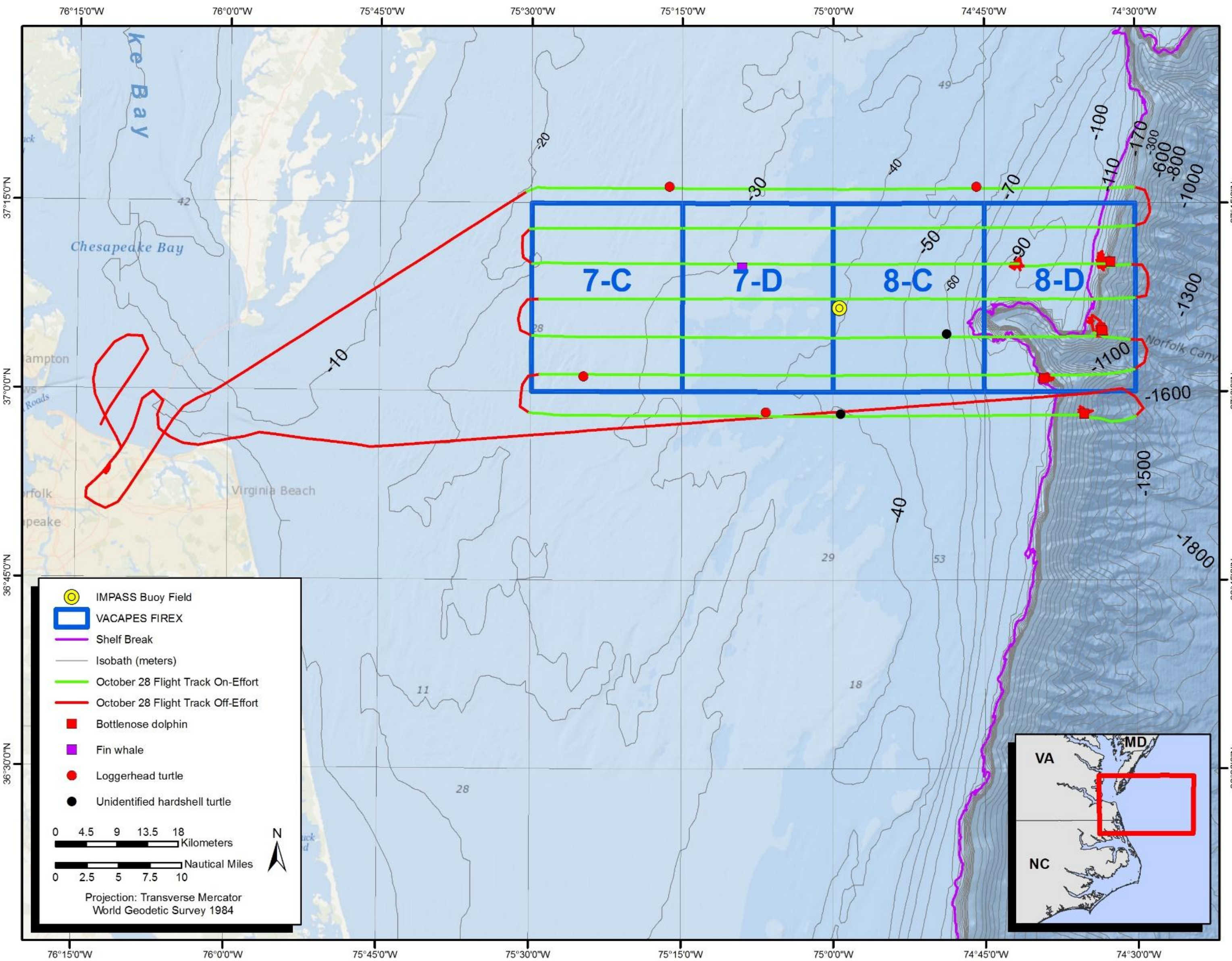

Figure 4. Locations of all cetacean and sea turtle sightings seen throughout the VACAPES pre-FIREX monitoring period (28 October).

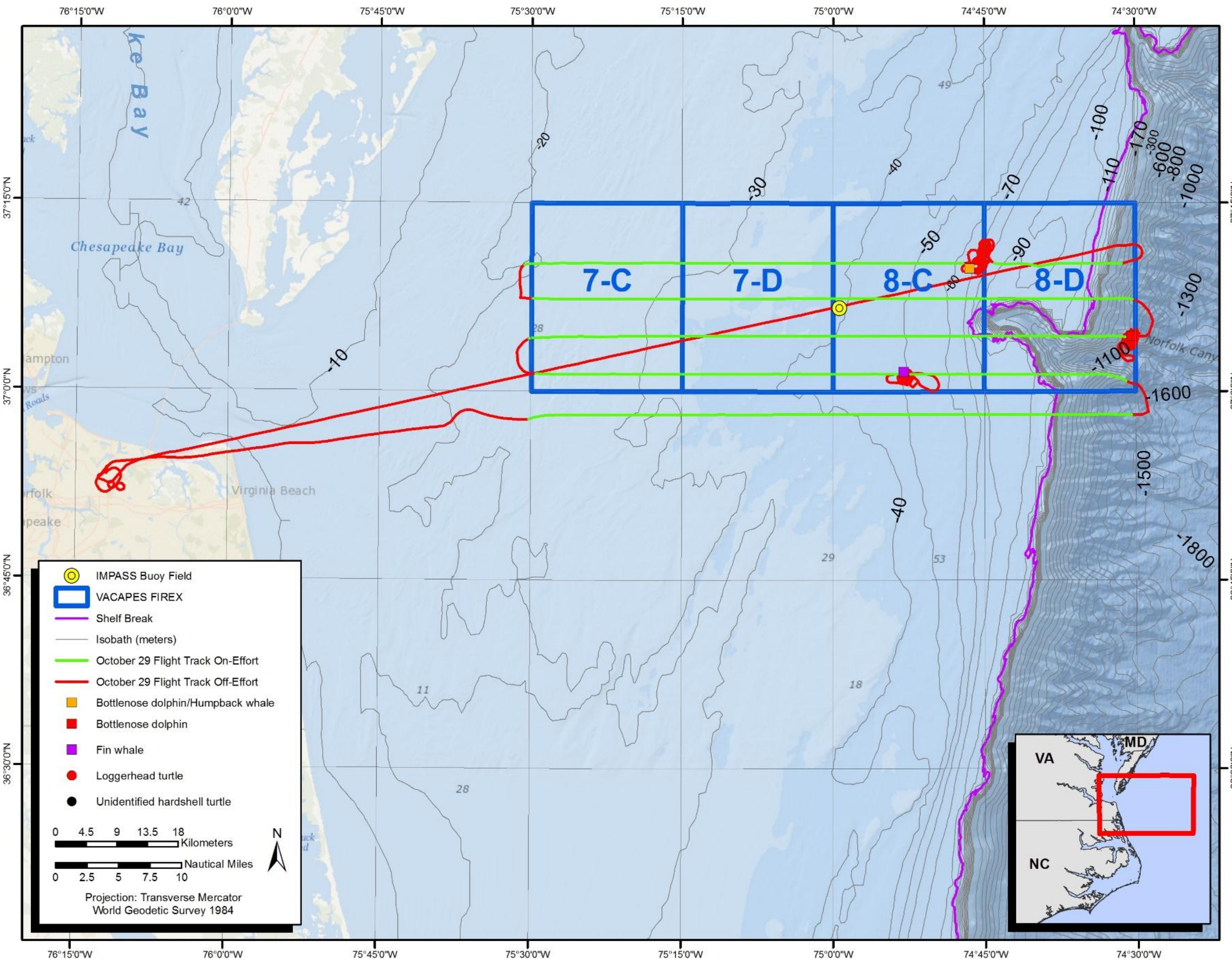

Figure 5. Locations of all cetacean sightings seen throughout the VACAPES post-FIREX monitoring period (29 October).

The FIREX event was conducted on 29 October. U.S. Navy operations precluded access to the survey area during the morning of the exercise and the post-event survey was truncated by two tracklines due to a combination of insufficient available lighting and increasing BSS conditions

Sightings over the 2-day period included five sightings of bottlenose dolphins, two sightings of fin whales, one sighting of a mixed-species group consisting of a single humpback whale with eight bottlenose dolphins, four sightings of loggerhead turtles, and two sightings of unidentified hardshell turtles (**Table 14**). Four sightings of bottlenose dolphins, one sighting of a single fin whale, and all six turtle sightings were made on 28 October during the 1-day pre-FIREX survey period (see **Figure 4**). There was one sighting of bottlenose dolphins, one sighting of a single fin whale, and one sighting of a mixed-species group consisting of a single humpback whale with 8 bottlenose dolphins made on 29 October during the 1-day post-FIREX survey period (see **Figure 5**).

The survey team attempted a total of five focal follows on 28 and 29 October. The first focal follow was a period of 21 minutes (min) spent with a group of approximately 45 bottlenose dolphins traveling quickly. The second focal follow was a period of 23 min spent with a group of approximately 35 bottlenose dolphins that were milling and active at the surface. The third focal follow was attempted, but terminated after approximately 7 min due to the inability to relocate a group of approximately 8 bottlenose dolphins that were traveling and active at the surface. The fourth focal follow was a period of 7 min spent with a group of approximately 22 bottlenose dolphins traveling slowly. The data for the fifth focal follow, a mixed-species group of a humpback whale and approximately 8 bottlenose dolphins, were lost due to an equipment malfunction and additional information is not available. For additional details, refer to the October 2013 VACAPES FIREX with IMPASS Trip Report (HDR 2013c).

3.1.1.3 FIREX with IMPASS – JAX, April-May 2013

Aerial surveys were conducted in association with a FIREX with IMPASS training event off the eastern coast of Florida. Line-transect surveys were conducted 29 April through 01 May 2013 before, during, and after the planned training event (**Figures 6 through 8**). Marine species sightings made during these surveys are presented in **Table 15**.

Table 15. Marine species sightings from aerial surveys conducted during 29 April through 01 May 2013 for the FIREX with IMPASS training event in JAX. There were no sightings made on 29 or 30 April.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Loggerhead turtle	*Caretta caretta*	3	3

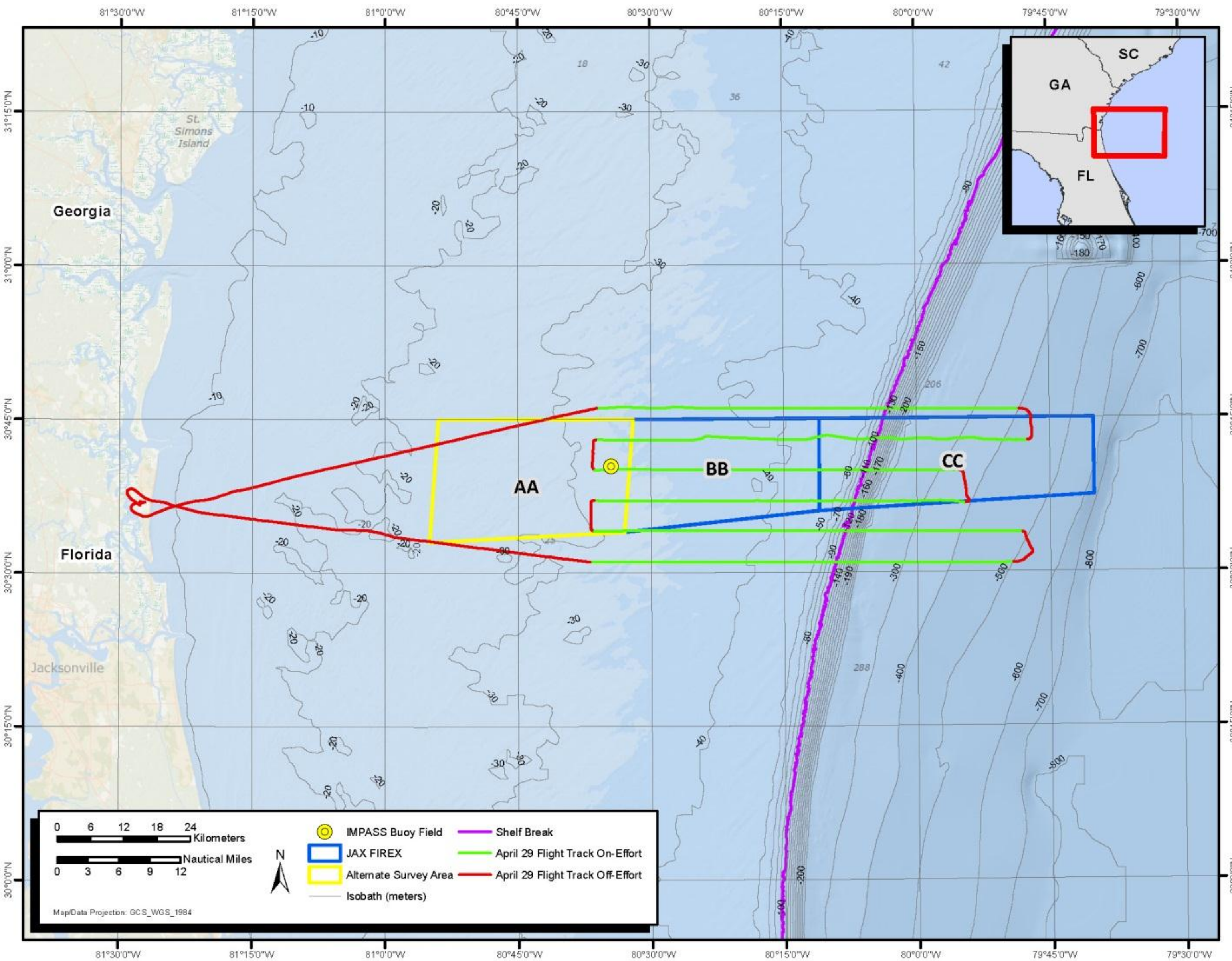

Figure 6. Survey flight track conducted throughout the JAX pre-FIREX monitoring period (29 April).

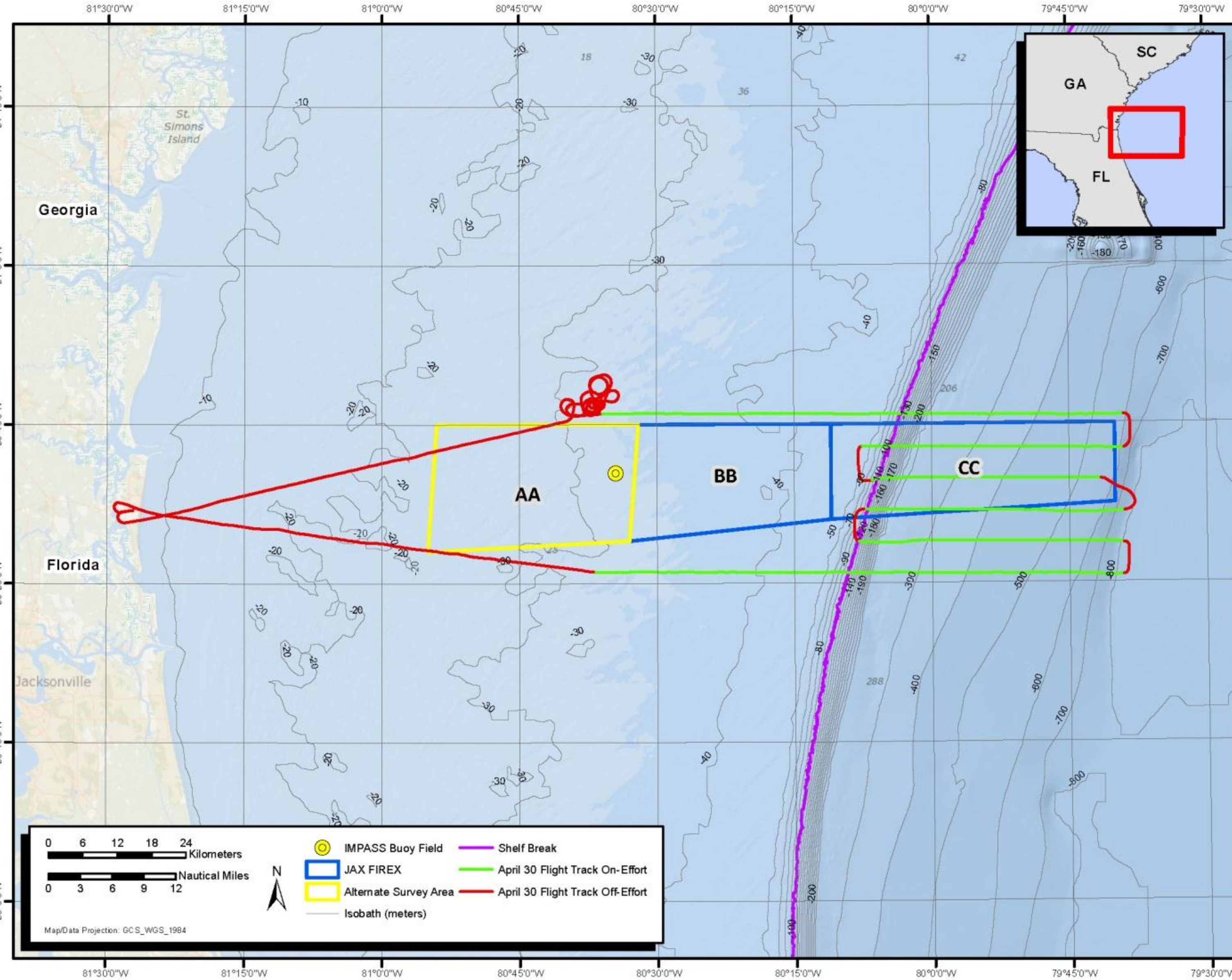

Figure 7. Survey flight track conducted throughout the JAX during-FIREX monitoring period (30 April).

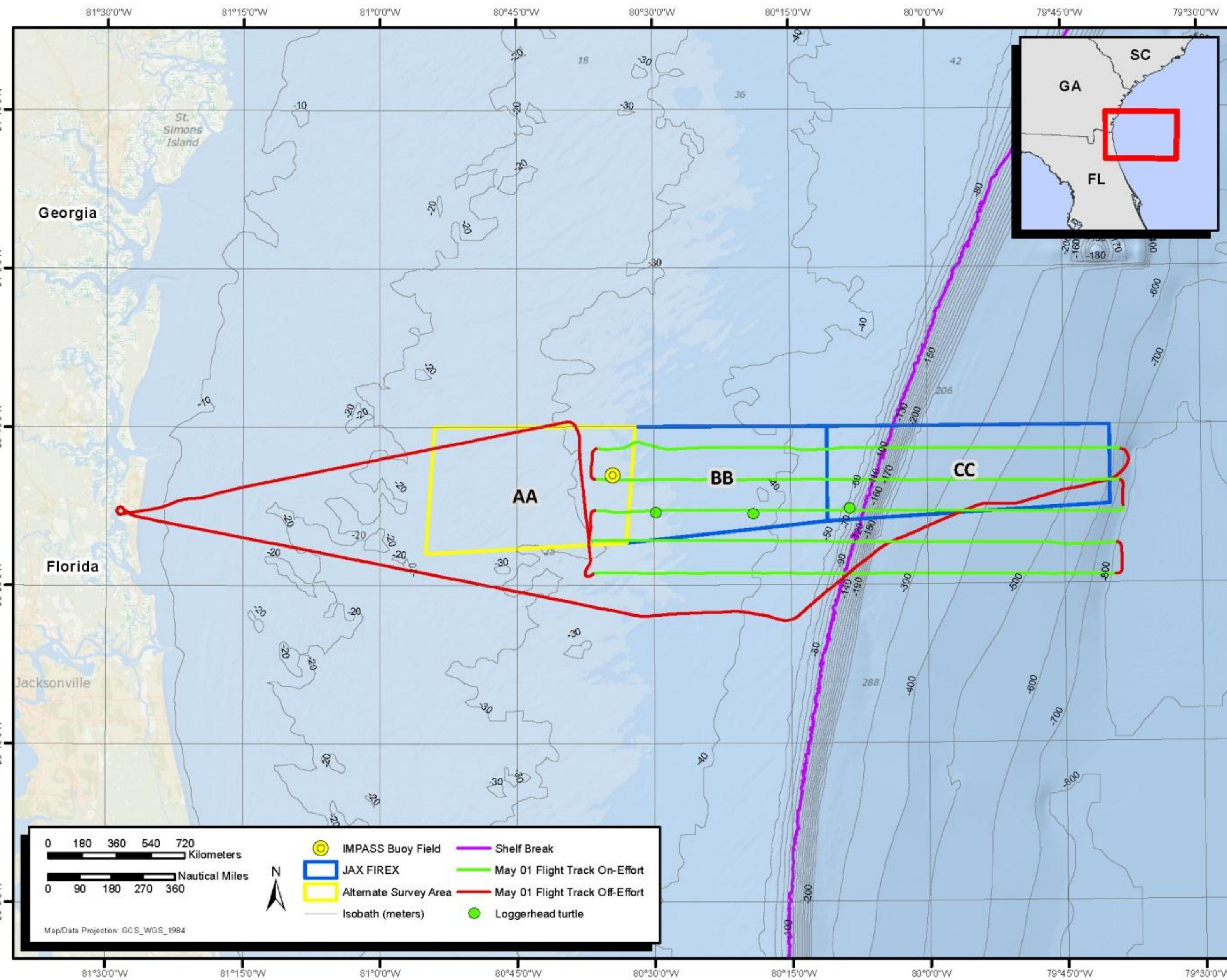

Figure 8. Locations of all sea turtle sightings seen throughout the JAX post-FIREX monitoring period (01 May).

The FIREX event was conducted on 30 April. Survey efforts, hampered by poor weather conditions including thunderstorms and fog, resulted in truncated tracklines. The weather conditions during the post-event survey were so poor throughout most of the survey area such that pilots had to break survey tracklines in order to avoid thunderstorms and survey effort was eventually terminated by the pilots due to safety concerns.

Sightings over the 3-day period consisted of three sightings of loggerhead turtles (*Caretta caretta*), all made during the 1-day post-FIREX survey period on 01 May. No marine mammals were sighted during this monitoring effort. For additional details, refer to the April-May 2013 JAX FIREX with IMPASS Trip Report (HDR 2013b).

3.1.2 Vessel Surveys

3.1.2.1 ASW Events – JAX, July 2013

Vessel surveys were conducted in association with three Anti-Submarine Warfare training events using MFAS off the coast of Florida. Surveys were conducted within the vicinity of the training events on 18 July 2013. A total of two marine mammal sightings and three loggerhead sea turtle sightings were recorded by the observers. The first marine mammal sighting was a group of six bottlenose dolphins sighted just off-shelf. The second marine mammal sighting was a group of six unidentified dolphins sighted just on-shelf. The loggerhead sea turtles were all sighted off-shelf.

3.1.3 Marine Mammal Observers

3.1.3.1 IAC Event – CHPT, July 2013

Vessel surveys were conducted in association with an Integrated Anti-Submarine Warfare Course (IAC) using MFAS off the coast of North Carolina. Three MMOs were stationed aboard a U.S. Navy vessel. Surveys were conducted on 23 through 25 July 2013 during the training course. A total of four events were conducted over this time period.

A total of two marine mammal sightings and one sea turtle sighting were recorded by the U.S. Navy MMOs during the 3-day monitoring period (**Table 16; Figure 9**). One marine mammal sighting was of an unidentified species of pilot whale (*Globicephala* sp.) and the other was of an unidentified dolphin. There was one sighting of an unidentified hardshell turtle. One protected marine species was recorded during each day of the monitoring period. There was one marine mammal sighting made on 23 July, one marine mammal sighting made on 24 July, and one sea turtle sighting made on 25 July. For additional details, refer to the July 2013 Navy MMO Report for the CHPT IAC Event (DoN 2013f).

Table 16. Summary of protected marine species sightings recorded by U.S. Navy MMOs while conducting monitoring from a U.S. Navy vessel off the coast of North Carolina during the 23-25 July 2013 Integrated Anti-submarine Warfare Course.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Pilot whale	*Globicephala* sp.	1	1
Unidentified dolphin		1	1
Unidentified hardshell turtle		1	1

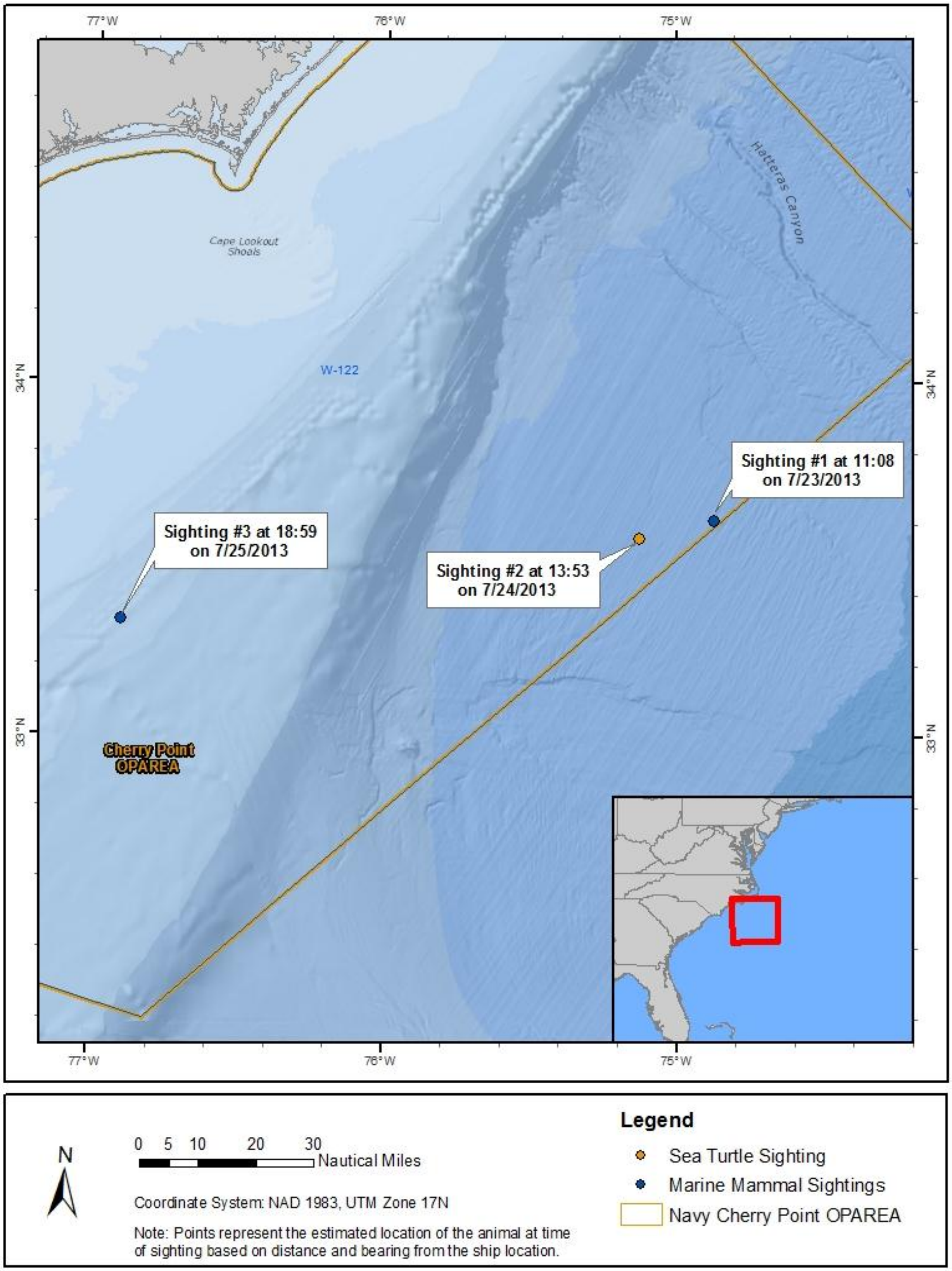

Figure 9. Marine mammal and sea turtle sightings made by U.S. Navy MMOs during 23-25 July 2013 Integrated Anti-submarine Warfare Course monitoring in the CHPT Range Complex.

No injuries or mortalities of marine mammals or turtles were observed during the IAC training course. The sightings of the pilot whale and unidentified hardshell turtle occurred when MFAS was not in use. The unidentified dolphin was observed when MFAS was in use. Although the dolphin was not sighted within the mitigation zones, the dolphin may have been exposed at MFAS levels that could result in behavioral disturbance. The sighting of the unidentified dolphin was very brief. The animal was sighted 50 degrees relative to the bow of the U.S. Navy ship on the port side of the vessel, approximately 1,500 yd away, and seemed to be traveling parallel to the vessel. No atypical behavior or change in behavior was observed.

3.1.3.2 FIREX Event – JAX, April 2013

A vessel survey was conducted in association with a FIREX with IMPASS training event off the coast of Florida on 30 April 2013. Three MMOs were stationed aboard a U.S. Navy vessel.

A total of six marine mammal sightings and one unidentified hardshell turtle sighting were recorded by the U.S. Navy MMOs during the 1-day monitoring period (**Table 17; Figure 10**). One striped dolphin sighting (*Stenella coeruleaolba*), two sightings of unidentified species of spotted dolphin (*Stenella* sp.), one sighting of an unidentified dolphin, and one sighting of an unidentified hardshell turtle were recorded.

Table 17. Summary of marine species sightings recorded by U.S. Navy MMOs while conducting monitoring from a U.S. Navy vessel off the coast of Florida during the 30 April 2013 FIREX with IMPASS training event.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Spotted dolphin	*Stenella* sp.	2	20
Striped dolphin	*Stenella coeruleoalba*	1	10
Unidentified dolphin		3	19->20
Unidentified hardshell turtle		1	1

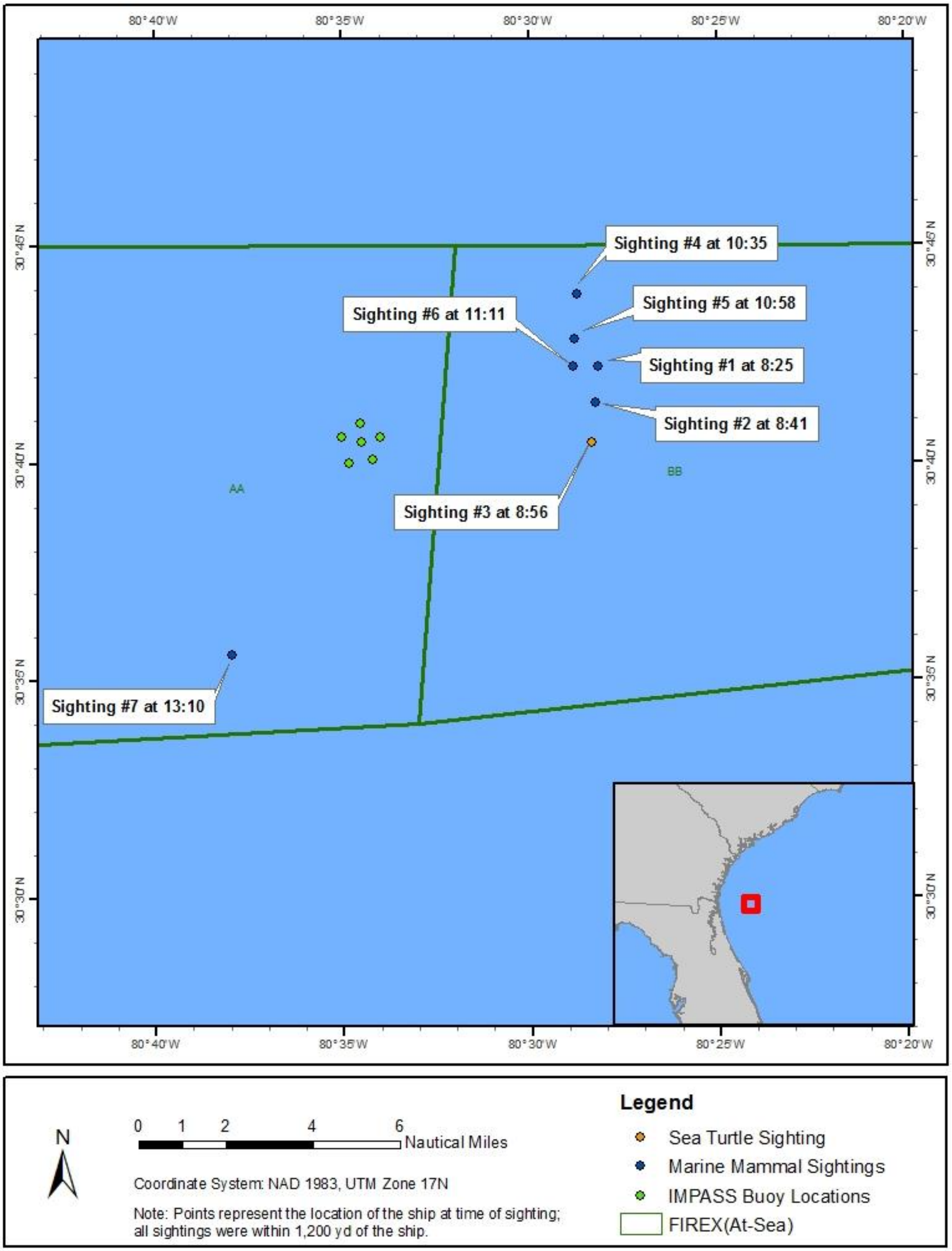

Figure 10. Marine mammal and sea turtle sightings made by U.S. Navy MMOs during the 30 April 2013 FIREX with IMPASS monitoring in the JAX Range Complex.

Because inert ordnance was used in this FIREX with IMPASS event, there was no potential for exposure of marine mammals and sea turtles to explosives. Three marine mammal sightings and one sea turtle sighting occurred during the FIREX within the 70-yd mitigation zone around the vessel. Mitigation was implemented (firing was delayed) as soon as each of the sightings within the mitigation zone was reported. No atypical behavior or change in behavior was observed. In each instance, firing did not recommence until the animals were confirmed to be outside of the mitigation zone. For additional details, refer to the April 2013 Navy MMO Report for the JAX FIREX with IMPASS Event (DoN 2013d).

3.1.4 MINEX Event – VACAPES, October 2013

3.1.4.1 Marine Mammal Observers

Vessel surveys were conducted in association with a MINEX training event off the coast of Virginia Beach, Virginia. Surveys were conducted on 24-26 October 2013 before, during, and after the training event.

A total of 19 marine mammal sightings and a single unidentified hardshell sea turtle sighting were recorded by the Navy MMOs during the 3-day monitoring trip (**Table 18**). All marine mammal sightings were of Atlantic bottlenose dolphins. Three marine mammal sightings were made on 24 October, the day before the event (**Figure 11**). One sea turtle sighting was made on 25 October, the day of the MINEX event (**Figure 12**). Nine Sixteen marine mammal sightings were recorded on 26 October, the day after the MINEX event, as shown in **Figure 13**. For additional details, see the 2013 VACAPES U.S. Navy MMO MINEX Event Trip Report (DoN 2014b).

Table 18. Summary of marine species sightings recorded by U.S. Navy MMOs while conducting monitoring from a U.S. Navy vessel off the coast of Virginia during the October 2013 MINEX event.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Bottlenose dolphin		19	66-124
Unidentified hardshell turtle		1	1

No injuries or mortalities of marine mammals or turtles were observed during the MINEX training event on 25 October. The turtle sighting on 25 October (day of event) was made approximately 70 min prior to the detonation, and was approximately 6,750 yd away from the detonation site. The sighting was brief, and the animal breathed twice and then dove. No unusual behavior was observed.

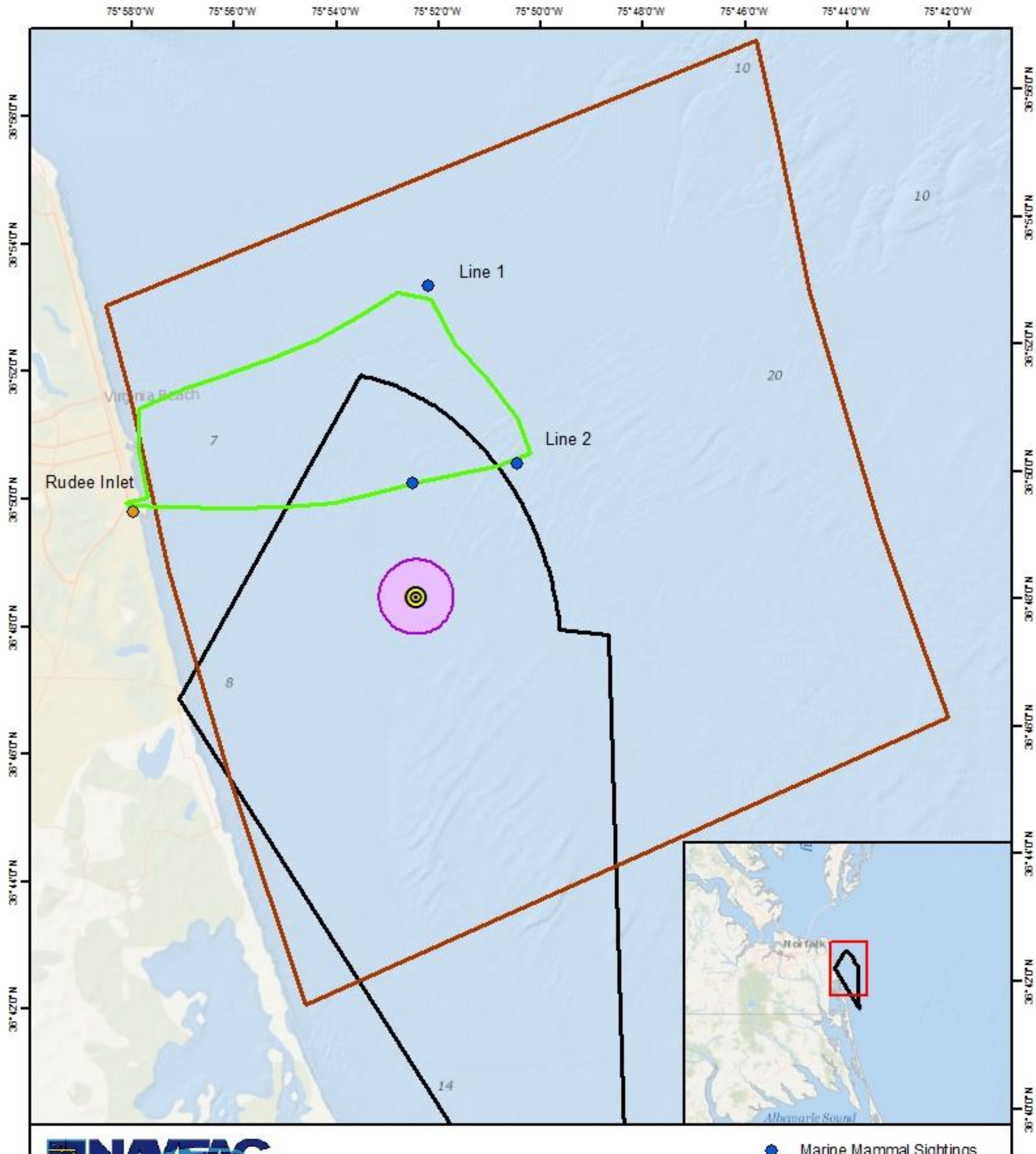

Figure 11. Pre-event visual survey tracklines and location of sightings on 24 October 2013

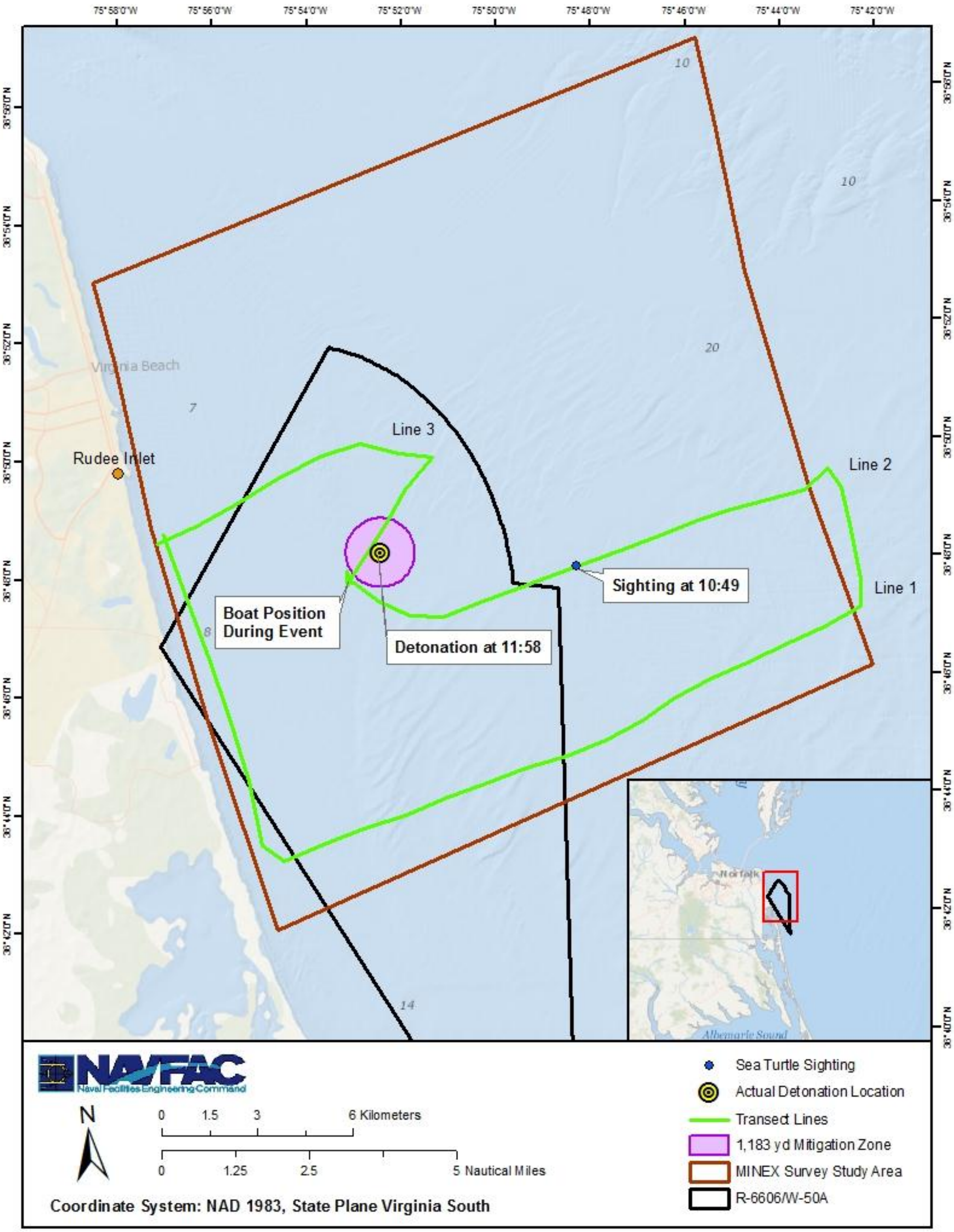

Figure 12. Visual survey tracklines and location of MINEX event and sightings on 25 October 2013

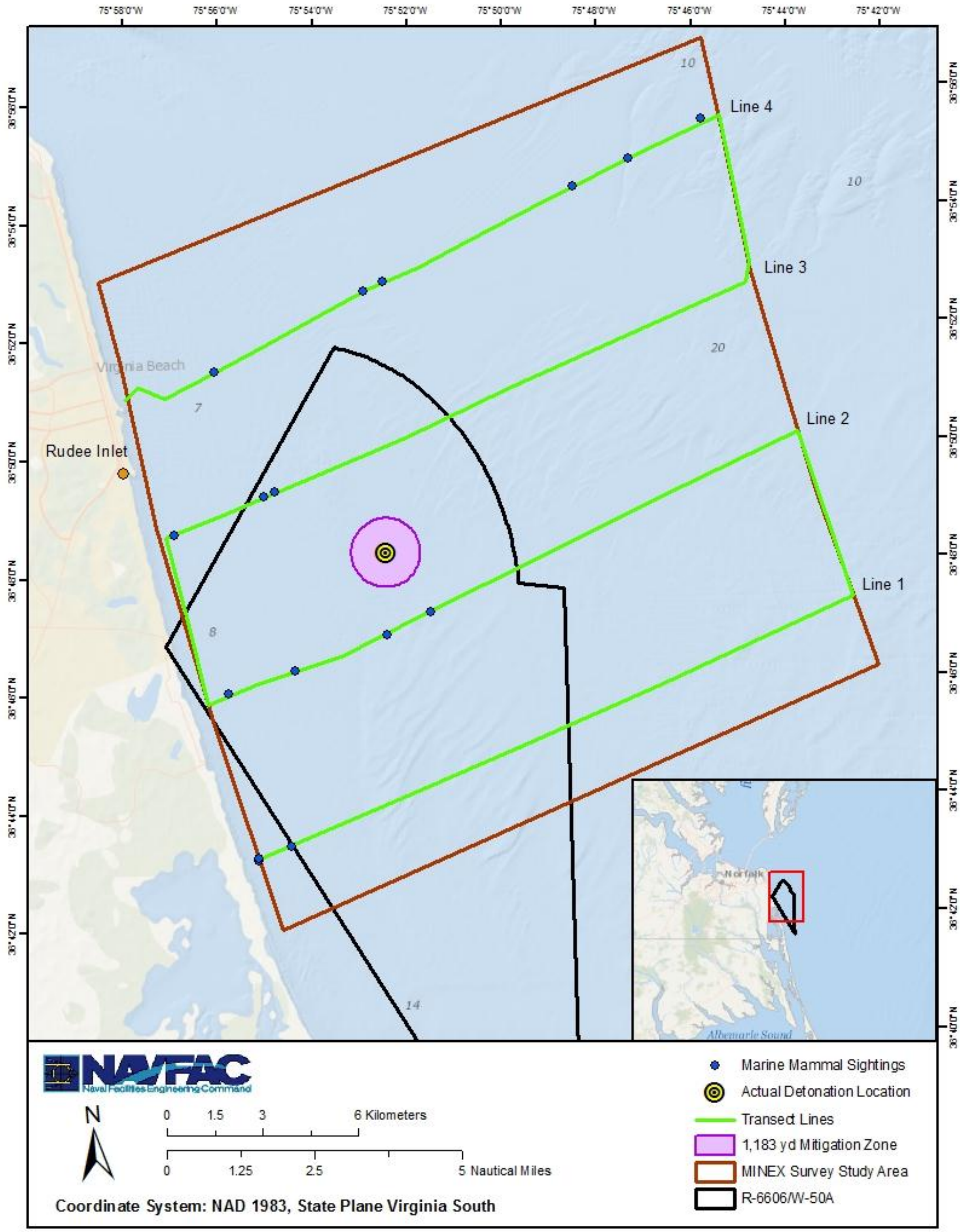

Figure 13. Post-event visual survey tracklines and location of sightings on 26 October 2013

3.1.4.2 Passive Acoustic Monitoring

Passive acoustic monitoring was conducted in association with a MINEX detonation event scheduled for 25 October 2013, as part of a pilot project to: a) investigate differences in detection rates between visual and passive acoustic monitoring methods; and b) test new technologies for detecting, locating, and tracking marine mammals in near real-time. Acoustic surveys were conducted on the day before, day of, and day after the event by U.S. Navy MMOs from Naval Facilities Engineering Command, Atlantic, and U.S. Fleet Forces Command on the *Instigator*, operated by a commercial captain. On each day, five passive acoustic moorings were deployed in an array centered around the expected detonation location. Each mooring contained an archival recording system and was tethered to a 53F or 53F-GPS sonobuoy to enable real-time monitoring of marine mammal vocalizations. Signals from the sonobuoys were processed aboard the Instigator with a portable Marine Mammal Monitoring on Navy Ranges (M3R) system developed by Naval Undersea Warfare Center (NUWC). Analysis of these data are not complete at this time; however, preliminary localizations were recorded in real-time on 24 October. No marine mammal vocalizations were detected on 25 October. On 26 October, despite multiple detections and visual observations of bottlenose dolphins within the array, no localizations were obtained. This was likely due to high levels of background noise from vessel activity on this day.

For additional details, see the 2013 VACAPES U.S. Navy MMO MINEX Event Trip Report (DoN 2014b).

3.1.5 Underwater Sound Measurement Trials

Naval activities such as ordinance disposal, demolition, and requisite training, can involve detonation of small explosive charges in shallow water. On 11 September 2012, a team from the University of Washington along with personnel from NAVFAC LANT, and HDR Environmental, conducted a set of measurements of the underwater sound generated by sub-surface explosions, as part of a naval training exercise 7 km off the coast of Virginia Beach, Virginia. Upon completion of the fieldwork, an intense analysis effort was conducted from October 2012 through February 2014 with the results summarized here. The main objectives of this experiment were to present underwater sound measurements with a focus on peak pressures, sound exposure levels, and time series analysis. Additionally, the influences of elastic properties in the seabed were investigated. The ultimate goal of this project is to provide both accurate ground truth data, and improved modeling of such sound, in order to minimize the impacts on marine life inhabiting the area.

3.1.5.1 Methods

Five tests were conducted with explosive charges ranging from 0.1 to 6.0 kilogram trinitrotoluene (TNT)-equivalent (**Table 19**). Underwater sound measurements with focus on peak pressures, sound exposure levels (SELs), and time series analysis were collected at three locations: at a range of 165 m for Tests 1 and 2; a range of 430 m for Tests 1 through 5; and at a range of 950 m for Tests 3 through 5 (**Figure 14**). Acoustic data were recorded at 430 m using a vertical line array (VLA) consisting of 9 hydrophones with 0.7-m spacing which was attached to a DASH20 data recorder, and single-element autonomous Loggerhead Instruments systems (i.e., ocean acoustic datalogger) were set at ranges of 165 m for Tests 1 and 2; 430 m for Tests 1 through 5; and 950 m for Tests 3 through 5 (see **Figure 15**).

Table 19. Test Charges Used During the 2012 Virginia Beach MINEX Trial.

Test	Local Time	Water Depth (m)	Explosive	Charge Depth	Charge Weight (Kg)	TNT Equivalent	TNT Equivalent

							Weight
1	11:04:09	15.0	C-4	Mid-water	0.2	1.34	0.3
2	11:12:02	15.0	C-4	Bottom	0.6	1.34	0.6
3	12:49:51	14.8	C-4	Mid-water	2.3	1.34	3
4	13:09:34	14.7	C-4	Bottom	4.5	1.34	6
5	16:11:59	14.7	CH-6	Mid-water	0.07	1.50	0.1

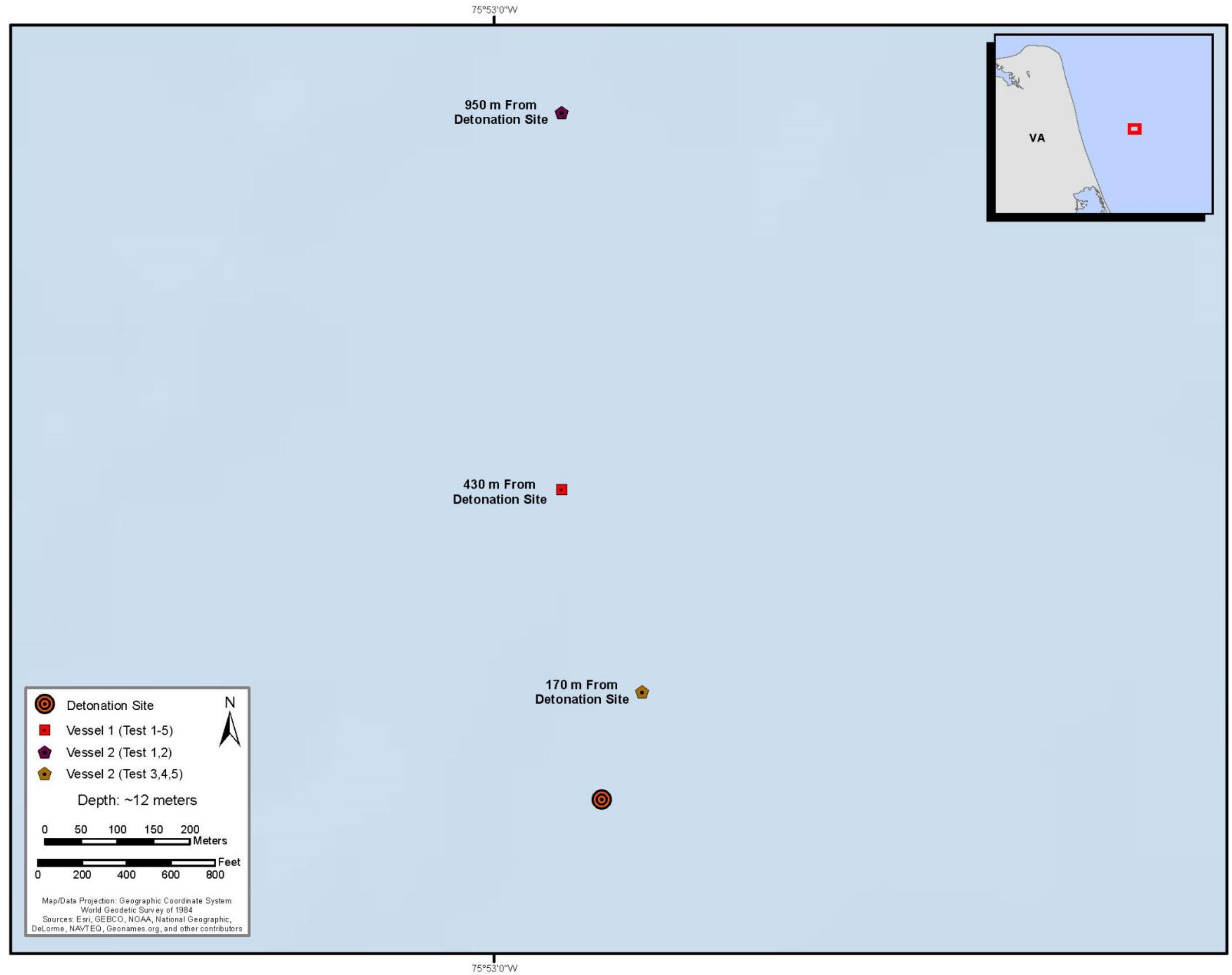

Figure 14. Location of measurement sites, vessels, and detonation site for the 2012 Virginia Beach MINEX Trial

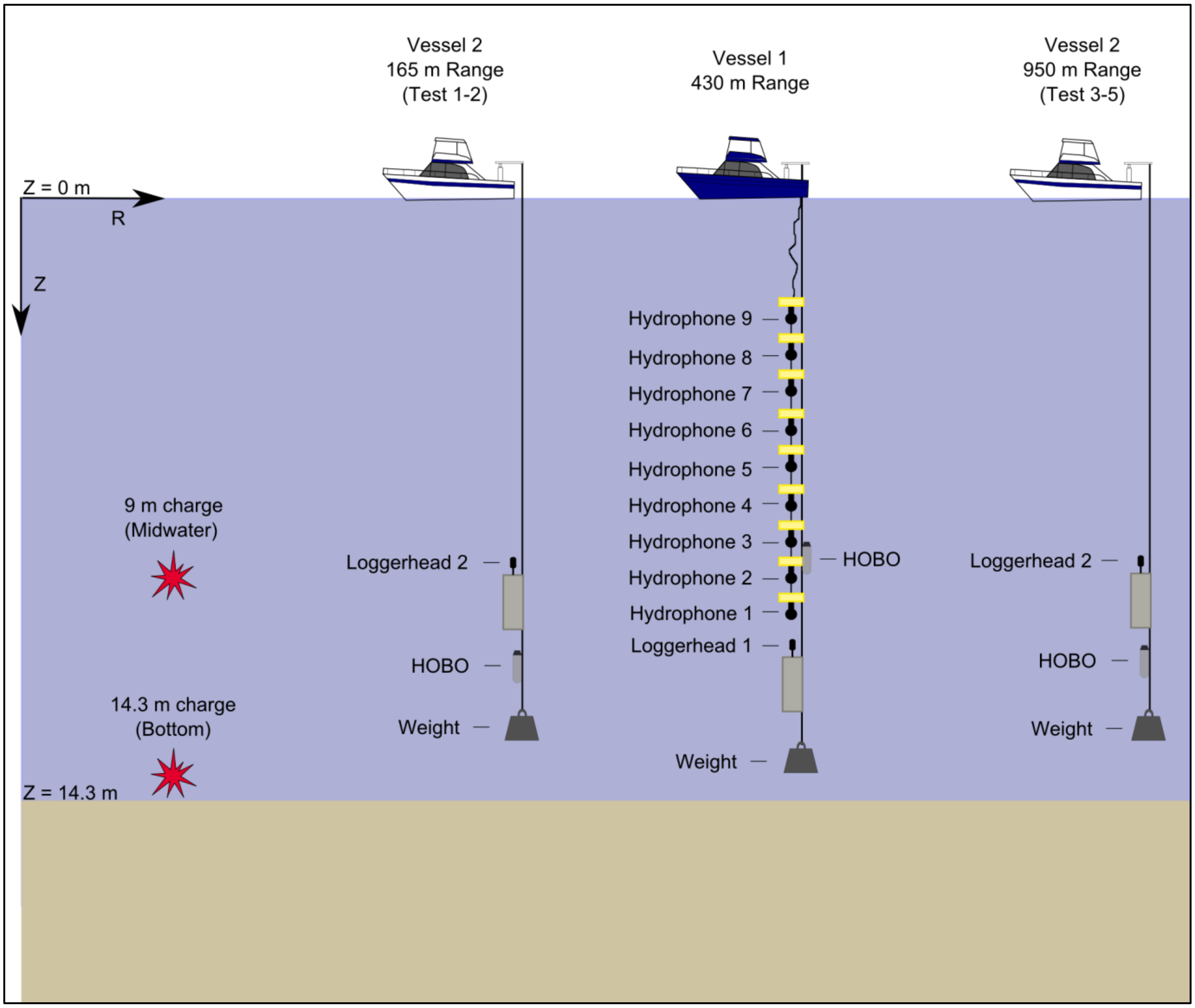

Figure 15. Experiment geometry for the Virginia Beach MINEX trial. Hydrophone depths located in Table 2.

3.1.5.2 Results

Measured peak pressure and bubble pulse delays were compared to semi-empirical equations of scaled range and are in good agreement for scaled ranges of 250 $\mathrm{m\,kg^{-1/2}}$ to 650 $\mathrm{m\,kg^{-1/2}}$. For scaled ranges of 650 $\mathrm{m\,kg^{-1/2}}$ to 2000 650 $\mathrm{m\,kg^{-1/2}}$, measured results varied up to 3 dB from predicted levels. Overall, the measurements and predicted peak pressures are in good agreement. The bubble pulse periods for the C-4 charges (Tests 1 through 4) are in good agreement with the semi-empirical equation. The bubble pulse period for the CH-6 charge (Test 5), however, varies significantly from the predicted time.

The measured 90 percent SELs ranged from 174 $\mathrm{dB\ re\ 1\,\mu\,Pa^2 s}$ to as high as 190.4 $\mathrm{dB\ re\ 1\,\mu\,Pa^2 s}$. Unlike the peak pressure equation, various charge weights with the same scaled range do not exhibit the same levels. For two charges with the same scaled range, the larger charges will generate a higher SEL. Plotting the $\mathrm{SEL_{90}}$ using an alternate scaling approach borrowed from the empirical equation for the energy flux spectrum however shows promise for the development of an empirical equation for SEL.

Most of the energy is contained in the low-frequency range approximately between 100 and 1,000 hertz (Hz). These results are in good agreement with previous studies (e.g., Weston 1960; Kibblewhite and Denham 1970). Furthermore, the energy spectral density levels are highly dependent on the charge weight with the larger charges exhibiting higher levels.

Measurements of Scholte interface waves were recorded during Tests 3 and 4. The Scholte waves have arrival times between 1 and 4 seconds after the direct water arrival, and are of very low frequencies on the order of O (1 to 10 Hz). Based on these arrivals, the shear speed in the sediment is estimated to approximately be in the range of 100 to 370 meters per second. These estimates have been confirmed through preliminary modeling using the wavenumber integration approach. Additionally, time-frequency analysis of the Scholte waves reveal dispersive characteristics where low frequencies arrive first followed later by higher frequencies.

3.1.5.3 Recommendations

Although peak pressure levels can be predicted using methods described in this report, suitable methods to predict the sound field produced by small underwater explosives in shallow water do not exist. The following are recommendations that will further the research:

1. Development of suitable model for predicting the sound field produced by underwater explosions.
2. Measurements at additional sites to extend the prediction model beyond the Virginia Beach measurement site. A similar study is being conducted in the Southern California Range Complex by the University of Washington in an attempt to understand variations between physical conditions in different range complexes.
3. Further study on how the proximity of the detonation to the seabed influences the peak pressure, and subsequently the levels predicted by the semi-empirical peak pressure equation.
4. Continued investigation using the scaling from the energy flux density to develop an empirical equation for SEL prediction and weighted SEL prediction for use by NAVFAC and other regulatory agencies.
5. Continued investigation of Scholte waves generated by underwater explosions, and how they can be utilized to develop suitable geo-acoustic model for a given measurement site.

For more information on this study, refer to the final report for this study (Soloway and Dahl 2014). A similar study is also being conducted in the Southern California Range Complex by the University of Washington in an attempt to understand variations between physical conditions in different range complexes.

3.2 Occurrence, Distribution, and Population Structure

In 2005, the U.S. Navy contracted with a consortium of researchers from Duke University, the University of North Carolina at Wilmington (UNCW), the University of St. Andrews, and the NMFS Northeast Fisheries Science Center (NEFSC) to conduct a pilot study and to develop subsequently a survey and monitoring plan. The plan included a recommended approach for data collection at the proposed site of the Undersea Warfare Training Range (USWTR) in Onslow Bay off the coast of North Carolina. The identified methods included surveys (aerial/shipboard, frequency, spatial extent, etc.), PAM, photo identification, and data analysis (e.g., standard line-transect, spatial modeling) appropriate to establish a fine-scale seasonal baseline of protected marine species distribution and abundance. As a result, a protected marine species monitoring program was initiated in June 2007 in Onslow Bay. Due to a re-evaluation of the proposed location for USWTR, the preferred location was changed to the JAX OPAREA. Therefore, a parallel monitoring program was initiated in January 2009 at the proposed USWTR site off the coast of Jacksonville, Florida. In 2011, the program expanded beyond the previous Onslow Bay focus site to include a region of high U.S. Navy training activity off the coast of Cape Hatteras to the north. This study area also serves to complement a pilot whale behavioral study that was initiated in that region at the same time. The overall approach to program design and methods has been consistent with the work that has been performed in Onslow Bay over the past 6 years, and work across the locations continues to evolve in response to the AMR process and changing priorities.

In 2012, the longitudinal baseline study consisted of year-round multi-disciplinary monitoring through the use of aerial and vessel-based visual surveys, photo-identification studies, biopsy sampling, and PAM with HARPs. Monthly visual surveys were conducted year-round (weather permitting) using sets of established track lines and standard Distance-sampling techniques. A summary of accomplishments and basic results of these monitoring efforts for the reporting period is presented in the following subsections. The annual reporting period for this component of the AFAST monitoring program has been adjusted to avoid bisecting the field season and to allow researchers sufficient time to conduct analyses. As a result, the most recent “annual” report covers activities for January through December 2013 (DoN 2014[JTB1]a), although summary information included here begins spans August 2012 through December 2013 to be consistent with the period covered by this report.. All previous annual reports on this component of the AFAST monitoring program are available through the U.S. Navy’s Marine Species Monitoring Program web portal (www.navymarinespeciesmonitoring.com). Future annual reports will be available in approximately March of each year.

Although the initial intent of the Onslow Bay and JAX monitoring program was to support development of the planned USWTR, the program has evolved into established fixed sites for the overall AFAST monitoring program. The intention was to provide robust baseline data—supporting projects designed to examine the potential long-term effects to marine species that may be chronically exposed to ASW training as the USWTR is completed and becomes operational. The monitoring work at these sites provides a longitudinal baseline of marine species distribution and abundance in key U.S. Navy training areas during periods when training is not occurring. In addition, these sites are also used as areas to conduct coordinated ASW exercise monitoring employing a variety of methods including aerial/shipboard visual surveys and temporary fixed passive-acoustic arrays. Monitoring during and outside (pre- and post-) of training events is intended to gather important data that will begin to address the questions outlined in the Introduction.

Sections 3.2.1 and 3.2.2 provide a summary of the visual baseline aerial and vessel surveys conducted during the reporting period. Detailed reporting of survey effort and associated analyses are provided in the annual technical report for this component of the monitoring program (DoN 2014[JTB2]a)

3.2.1 Visual Baseline Aerial Surveys

Figure 16 shows the Cape Hatteras, Onslow Bay, and JAX survey areas with established tracklines used for line-transect aerial surveys. Aerial surveys were conducted using standard Distance-sampling protocols in all sites. During the current reporting period (August 2012 through December 2013), the Cape Hatteras and JAX sites were surveyed. No aerial surveys of the Onslow Bay survey site were conducted during this period.

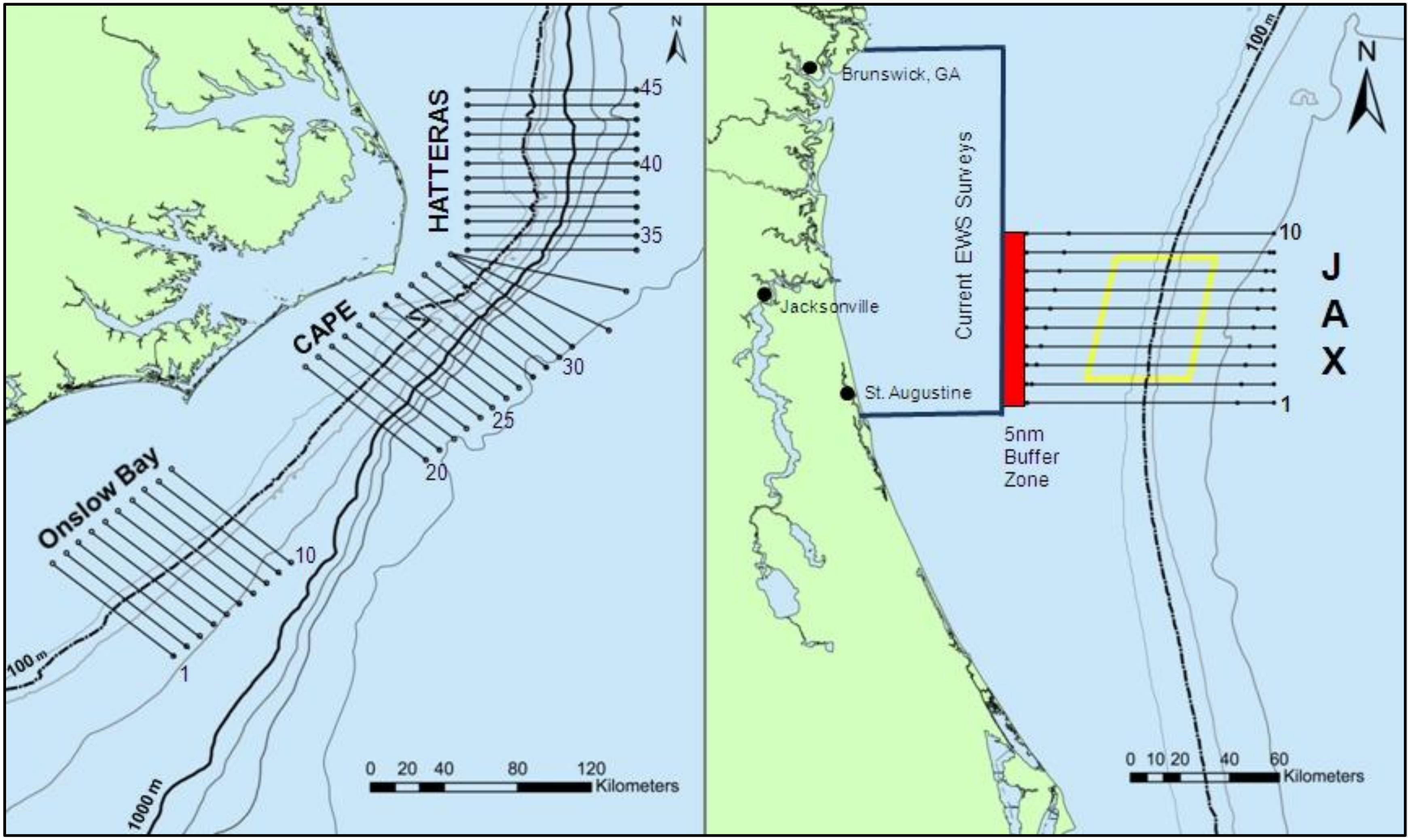

Figure 16. Cape Hatteras, Onslow Bay, and Jacksonville survey areas and established tracklines used for longitudinal baseline monitoring. Aerial surveys at the Jacksonville location are coordinated with the North Atlantic right whale Early Warning System (EWS) surveys to maximize coverage of potential right whale ocurrence within the region.

3.2.1.1 Cape Hatteras

Fourteen days of aerial survey effort were conducted during August 2012 through December 2013. Aerial survey coverage was 107.5 tracklines. Observations included the identification of 10 cetacean, two sea turtle, and three pelagic fish species within the survey area. Sightings and effort data are presented in **Tables 20 and 21**, and **Figures 17 and 18**. No aerial surveys were conducted during October 2012, or January, February, April, June, September, November, and December 2013, due to unfavorable weather conditions.

Table 20. Sightings from aerial surveys conducted in the Cape Hatteras survey area, August 2012 through December 2013. On- and off-effort sightings are represented by #/# (on-/off-effort).

Common Name	Scientific Name	# of Sightings	# of Individuals
Minke Whale	*Balaenoptera acutorostrata*	1/1	1/1
Humpback Whale	*Megaptera novaeangliae*	3/2	6/2
Common Dolphin	*Delphinus delphis*	3/0	206/0
Risso's Dolphin	*Grampus griseus*	7/1	100/30
Short-finned Pilot Whale	*Globicephala macrorhynchus*	31/0	382/0
Gervais' Beaked Whale	*Mesoplodon europaeus*	3/0	11/0
Unidentified Beaked Whale	*Mesoplodon* sp.	7/0	19/0
Sperm Whale	*Physeter macrocephalus*	5/3	13/8
Atlantic Spotted Dolphin	*Stenella frontalis*	12/0	754/0
Bottlenose Dolphin	*Tursiops truncatus*	57/1	913/14
Cuvier's Beaked Whale	*Ziphius cavirostris*	14/1	45/5
Unidentified Delphinid		1/0	6/0
Loggerhead Sea Turtle	*Caretta caretta*	46/0	55/0
Leatherback Sea Turtle	*Dermochelys coriacea*	7/0	7/0
Unidentified Sea Turtle		3/0	3/0
Unidentified Shark		15/0	20/0
Manta Ray	*Manta birostris*	10/0	17/0
Cownose Ray	*Rhinoptera bonasus*	1/0	225/0
Ocean Sunfish	*Mola mola*	10/0	11/0

Table 21. Effort details for aerial surveys conducted in the Cape Hatteras survey area, August 2012 through December 2013.

Number of Survey Days	14
Total Hr Underway*	89.3
Total Tracklines Covered	107.5

* Total hr underway reported as Hobbs hr = total engine time

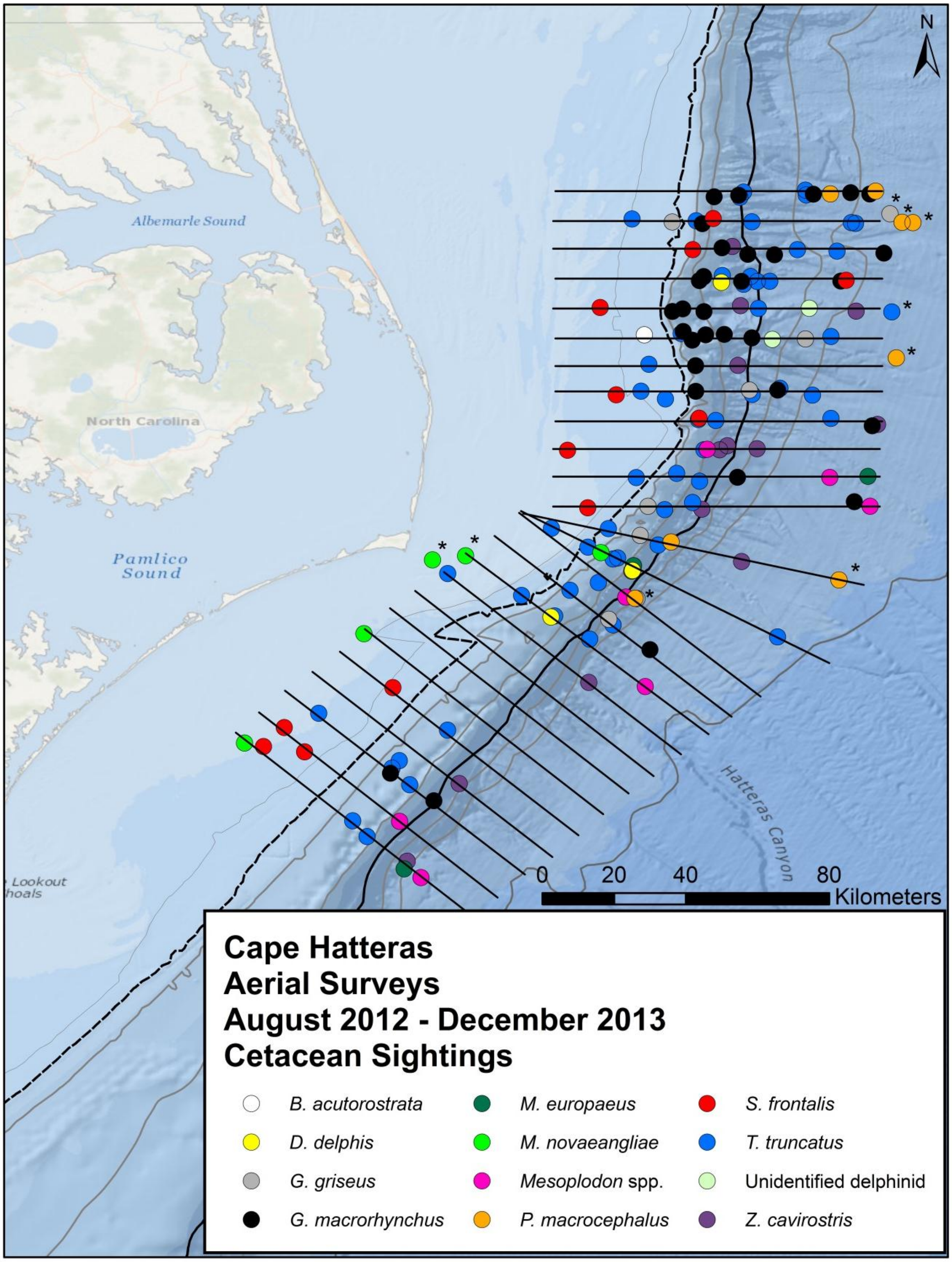

Figure 17. Locations of cetacean sightings from aerial surveys conducted in the Cape Hatteras survey area, August 2012 through December 2013. Asterisk denotes sightings were made off-effort.

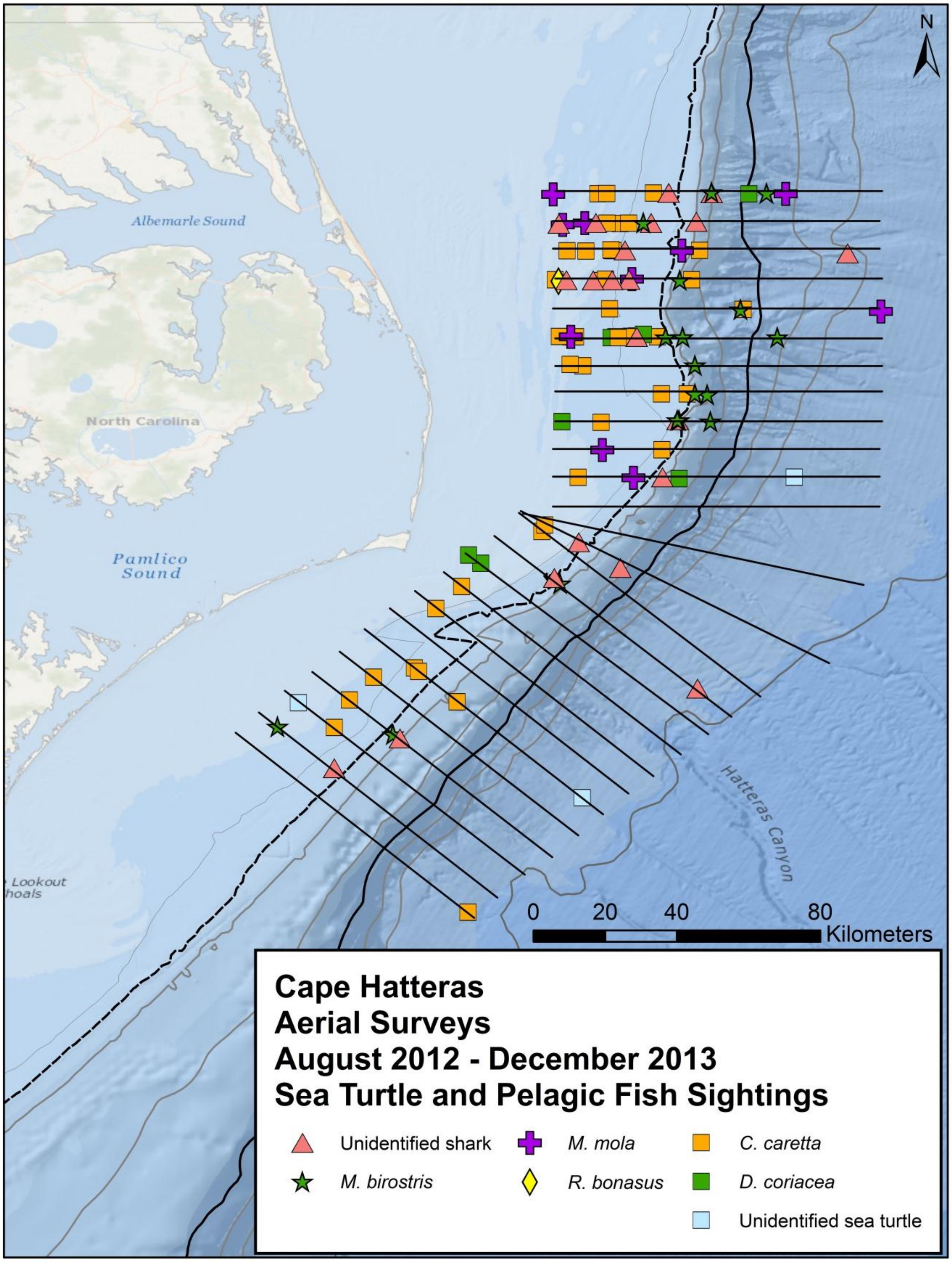

Figure 18. Locations of sea turtle and pelagic fish sightings from aerial surveys conducted in the Cape Hatteras survey area, August 2012 through December 2013. All sightings were made on-effort.

We continue to increase our understanding of the spatial and temporal distribution of cetaceans in the Cape Hatteras survey area. The consistent appearance of beaked whales at or beyond the 1,000-meter (m) isobath is of special interest. Frequent observations of beaked whales continued, with 15 sightings of Cuvier's beaked whales (*Ziphius cavirostris*) (including one off-effort sighting), and 10 sightings of *Mesoplodon* sp. Cuvier's beaked whales were recorded during all months except two of survey effort and mesoplodont beaked whales were observed in five of the nine months of effort. In three of the 10 *Mesoplodon* sightings reported here, high quality photos of head features (including rostrum shape and placement of teeth) and pigmentation and scarring patterns were collected to identify the animals as Gervais' beaked whales (*Mesoplodon europaeus*). This is the first year that it was possible to make this species-level distinction, and in some cases, even determine the sex of the animals (i.e., teeth erupted in adult males). Photos of confirmed Gervais' beaked whales will be used to compare with past and future sightings to better identify this and other beaked whale species' presence in the Cape Hatteras survey area.

Overall patterns of cetacean abundance are also emerging within the survey area. During this reporting period, survey effort was distributed approximately evenly across the range, but as was observed during the previous reporting period for the U.S. Navy, more sightings were recorded in the northern portion of the survey area. Similarly, the majority of sightings also occurred beyond the 100-m isobath. No new species were observed during the current reporting period, as compared to all previous effort, and the total number of species observed remains at 18 in the survey area.

The high species diversity in the survey area resulted in a number of sightings of multiple species encountered at the same survey break. Adhering to the protocols of line-transect methodology, only the species for which the initial sighting cue was attached is classified as "on effort"; secondary sightings of other species encountered after the initial cue are therefore listed as "off effort." These off-effort sightings, as well as animals that were encountered while transiting between tracklines on the inshore or offshore portion of the range, are included in the tables and are represented by #/# (on-/off-effort). Off-effort sightings are also included in the maps and identified with an asterisk (*).

3.2.1.2 Onslow Bay

No aerial surveys of the Onslow Bay survey site were conducted during the reporting period.

3.2.1.3 JAX

Thirteen days of aerial survey effort were conducted during this period. Aerial survey coverage was 105 tracklines. No survey effort was conducted in JAX in August, October and December 2012, and January, February, April, July, August, November, and December 2013, due to unfavorable weather conditions or plane maintenance issues. Observations included the identification of six cetacean, two sea turtle, and three pelagic fish species within the JAX site. One new species, the pantropical spotted dolphin (*Stenella attenuata*), was observed during this reporting period. Sightings and effort details are presented in **Tables 22 and 23**, and **Figures 19 through 21**.

Table 22. Sightings from aerial surveys conducted in the JAX survey area, August 2012 through December 2013. On- and off-effort sightings are represented by #/# (on-/off- effort).

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Risso's Dolphin	*Grampus griseus*	8/0	92/0
Short-finned Pilot Whale	*Globicephala macrorhynchus*	0/1	0/10
Rough-toothed Dolphin	*Steno bredanensis*	1/0	28/0
Atlantic Spotted Dolphin	*Stenella frontalis*	38/0	599/0
Bottlenose Dolphin	*Tursiops truncatus*	62/1	368/7
Pantropical Spotted Dolphin	*Stenella attenuata*	1/0	25/0
Unidentified Delphinid		7/0	11/0
Loggerhead Sea Turtle	*Caretta caretta*	231/0	325/0
Leatherback Sea Turtle	*Dermochelys coriacea*	16/0	18/0
Unidentified Sea Turtle		13/0	15/0
Unidentified Shark		33/0	56/0
Great White Shark	*Carcharodon carcharias*	1/0	1/0
Manta Ray	*Manta birostris*	13/0	16/0
Ocean Sunfish	*Mola mola*	3/0	3/0

Table 23. Effort details for aerial surveys conducted in the JAX survey area, August 2012 through December 2013.

Number of Survey Days	13
Total Hr Underway*	77.9
Total Tracklines Covered	105

* Total hr underway reported as Hobbs hr = total engine time

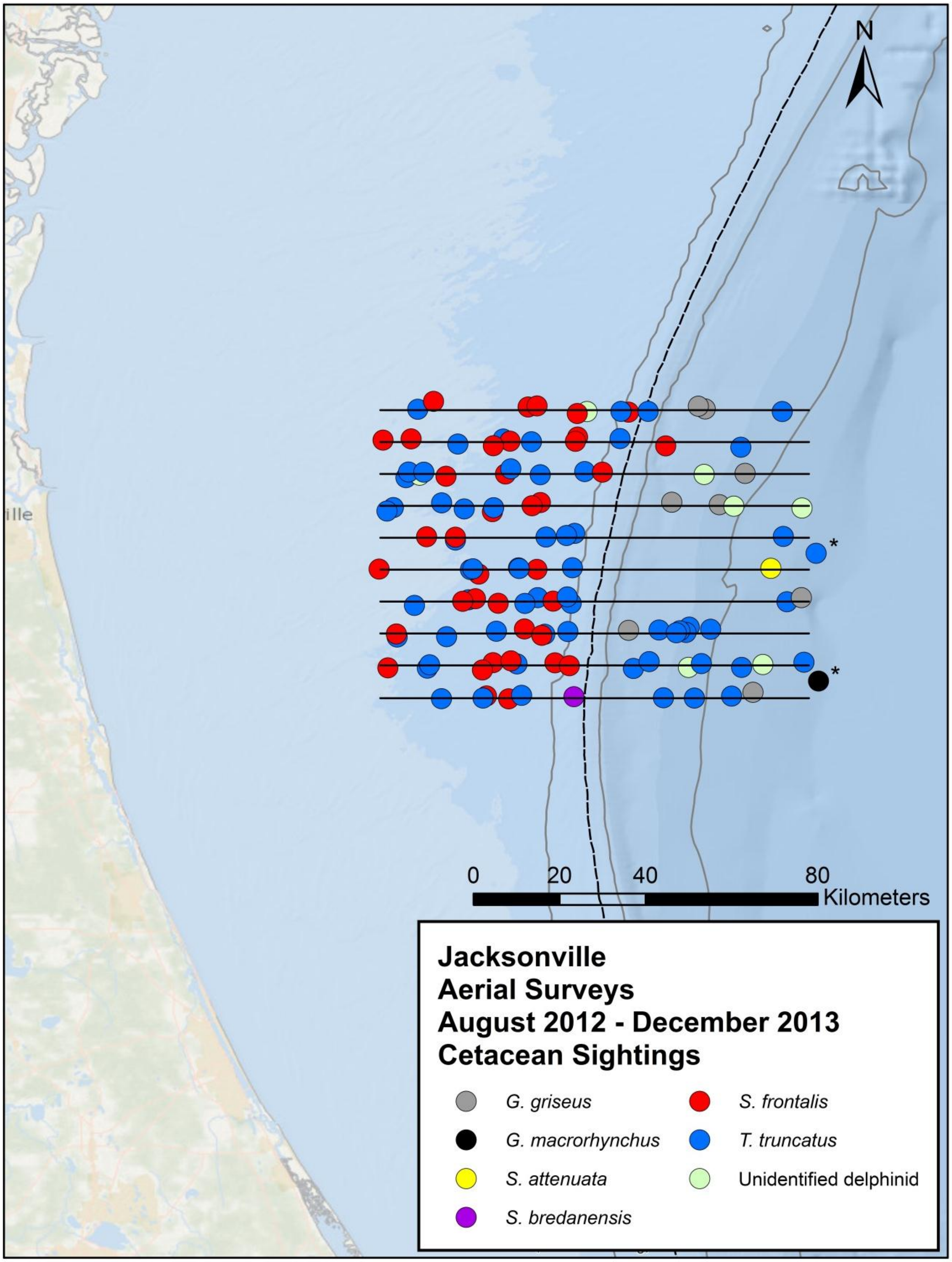

Figure 19. Locations of cetacean sightings from aerial surveys conducted in the JAX survey area, August 2012 through December 2013. Asterisk denotes sightings were made off-effort.

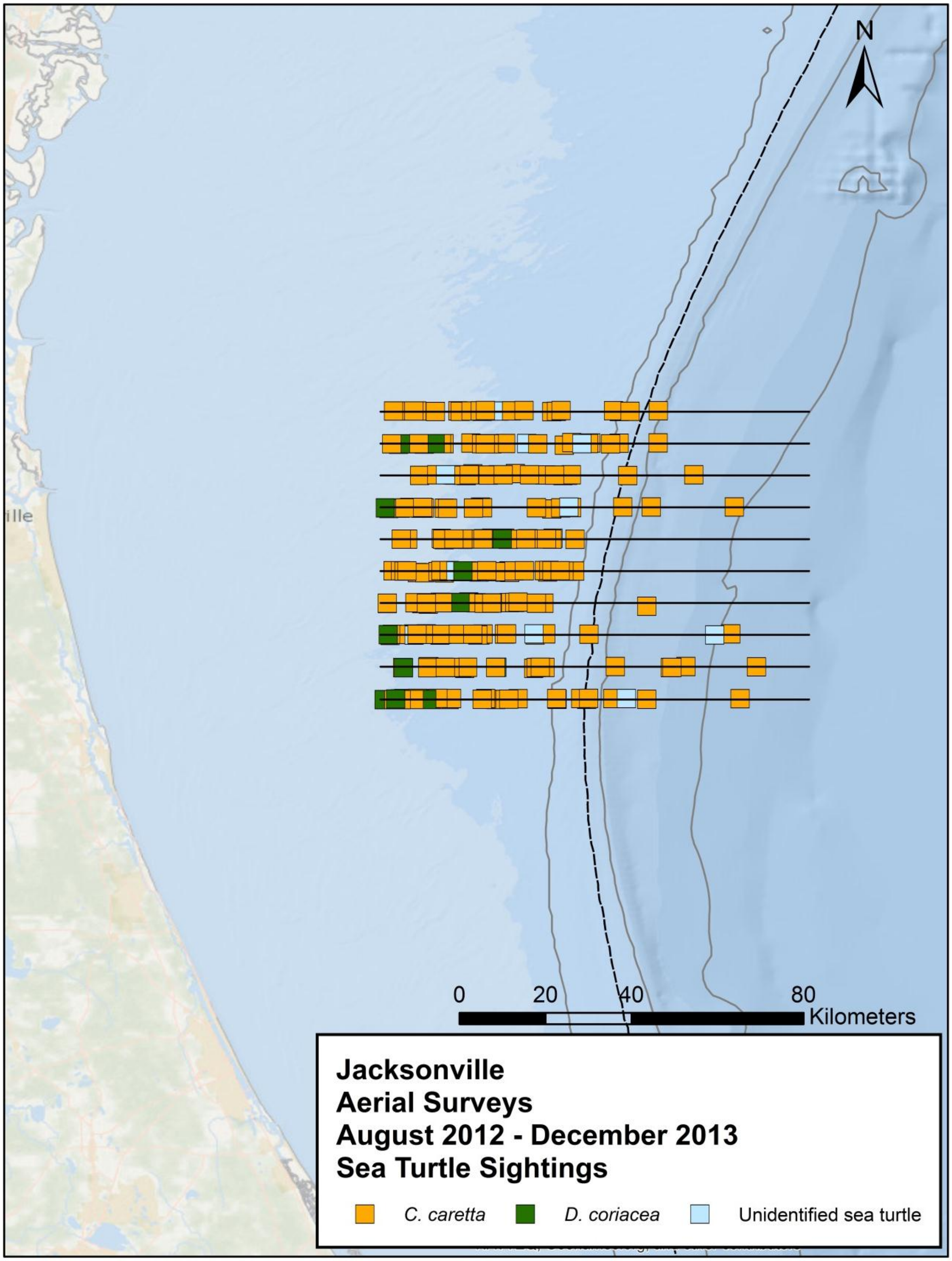

Figure 20. Locations of sea turtle sightings from aerial surveys conducted in the JAX survey area, August 2012 through December 2013. All sightings were made on-effort.

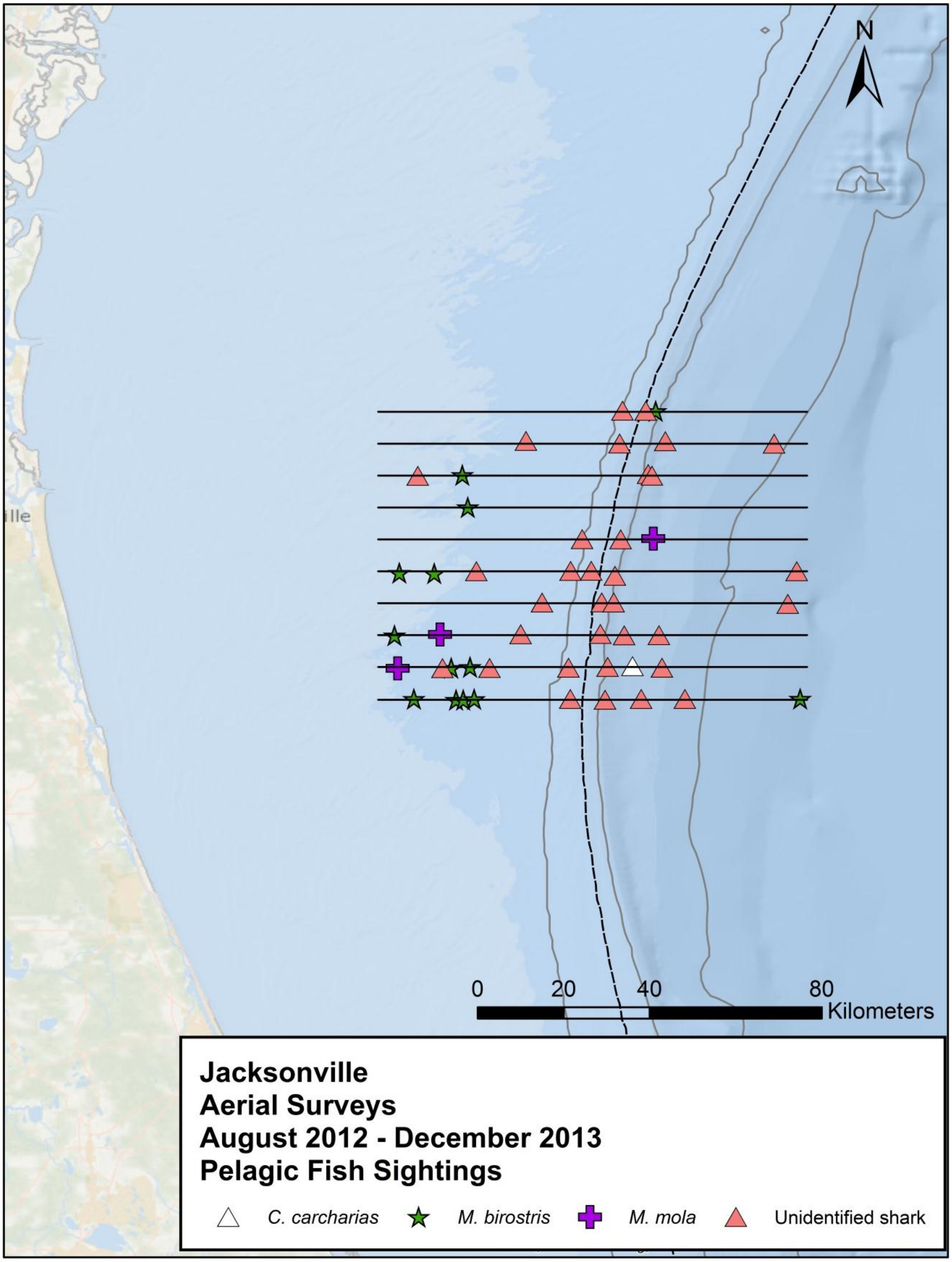

Figure 21. Locations of pelagic fish sightings from aerial surveys conducted in the JAX survey area, August 2012 through December 2013. All sightings were made on-effort.

The distribution patterns of the two most abundant species within the JAX survey site remained similar to last year's reporting period. Bottlenose dolphins were seen throughout the site while Atlantic spotted dolphins were found largely west of the 100-m isobath. In contrast, short-finned pilot whales, which previously were recorded in the offshore waters of the site, were only encountered once during an "off-effort" sighting between Tracklines 1 and 2.

One sighting of a great white shark (*Carcharodon carcharias*) was recorded in March representing the first observation of this species in the JAX survey area. The timing of this sighting is consistent with the seasonal interactions reported between white sharks and North Atlantic right whales in shallower waters off Jacksonville, Florida (Taylor et al. 2013).

3.2.2 Visual Baseline Vessel Surveys

Vessel surveys integrating biopsy and photo-identification protocols were conducted in the Cape Hatteras, Onslow Bay, and JAX survey areas during 01 August 2012 through 31 December 2013.

3.2.2.1 Cape Hatteras

Seven days of biopsy and photo-identification sampling surveys were conducted as part of the baseline monitoring program from August 2012 to October 2013. Three of the 7 survey days consisted of small-vessel work, while the remaining 4 days occurred during a research cruise aboard the research vessel (R/V) *Cape Hatteras* from 07 to 12 October 2012. The ship time for this cruise was made available by the Duke-UNC Oceanographic Consortium (DUNCOC). As in previous years, bottlenose dolphins and short-finned pilot whales dominated the sightings followed by two sightings of Risso's dolphins, one fin whale, and one loggerhead turtle. Most survey effort was concentrated along the shelf break and extended into deeper, pelagic waters. Survey effort and sightings are summarized in **Tables 24 and 25,** and **Figure 22.**

Table 24. Effort details for vessel surveys conducted in the Cape Hatteras study area, August 2012 through December 2013.

Number of Survey Days	7
Total Survey Time (hr:min)	146:00
Time On Effort (hr:min)	45:58
Total km Surveyed	421.2

Table 25. Sightings from vessel surveys conducted in the Cape Hatteras study area, August 2012 through December 2013. All sightings were made on-effort.

Common Name	Scientific Name	# of Sightings	# of Individuals
Bottlenose Dolphin	*Tursiops truncatus*	29	278
Short-finned Pilot Whale	*Globicephala macrorhynchus*	21	402
Risso's Dolphin	*Grampus griseus*	2	8
Unidentified Delphinid		3	12
Fin Whale	*Balaenoptera physalus*	1	1
Loggerhead Sea Turtle	*Caretta caretta*	1	1

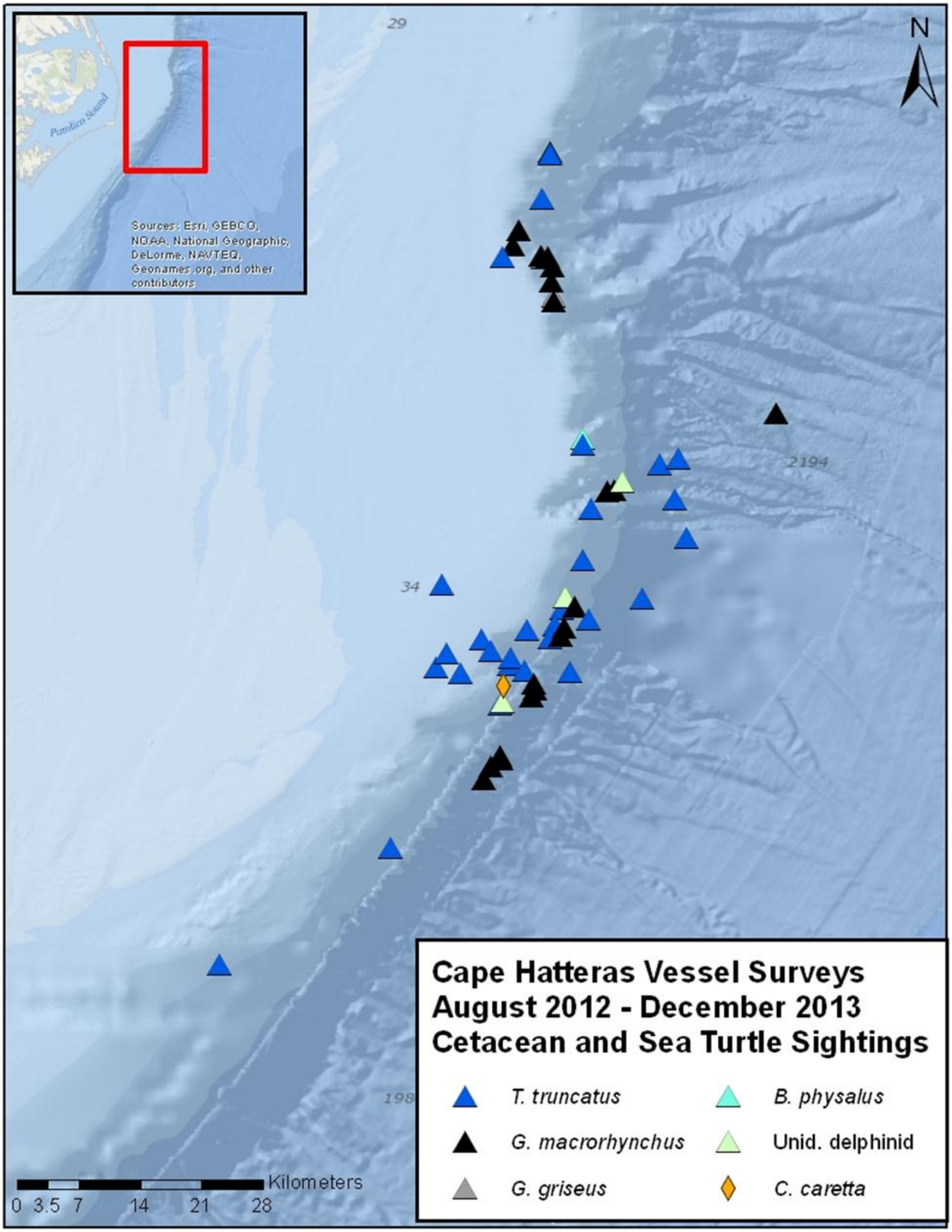

Figure 22. Locations of cetacean and sea turtle sightings from vessel surveys conducted in the Cape Hatteras study area, August 2012 through December 2013. All sightings were made on-effort.

Nine biopsy samples were collected from three species off Cape Hatteras: bottlenose dolphin (*n*=4); short-finned pilot whale (*n*=4); and fin whale (*n*=1) (**Table 26**). A total of 895 photographs were taken of three species: bottlenose dolphin, short-finned pilot whale, and fin whale (**Table 27**). Three bottlenose dolphins and eight pilot whales have been matched to catalogs of these species in Cape Hatteras. Re-sightings of pilot whales span up to 6 years and several individuals have been observed on multiple occasions. Genetic analysis of extracted deoxyribonucleic acid (DNA) from bottlenose dolphin biopsy samples collected in Cape Hatteras, NC confirms that all of the sampled dolphins were of the offshore ecotype, suggesting that there is limited overlap between coastal and offshore populations (see below).

Table 26. Biopsy samples taken from animals in the Cape Hatteras survey area, August 2012 through December 2013.

Common Name	Scientific Name	Samples
Bottlenose Dolphin	*Tursiops truncatus*	4
Short-finned Pilot Whale	*Globicephala macrorhynchus*	4
Fin Whale	*Balaenoptera physalus*	1

Table 27. Comparison of photographs taken of animals in the Cape Hatteras survey area, August 2012 through December 2013, with existing photo-ID catalogs, showing matches made so far between this year's photos and the catalogs.

Common Name	Scientific Name	Photos Taken	Catalog Size to Date	Matches to Date
Bottlenose Dolphin	*Tursiops truncatus*	323	107	3
Short-finned Pilot Whale	*Globicephala macrorhynchus*	513	253	8
Risso's Dolphin	*Grampus griseus*	22	3	0
Fin Whale	*Balaenoptera physalus*	37	1	0
Common Dolphin	*Delphinus delphis*	0	20	1
Atlantic Spotted Dolphin	*Stenella frontalis*	0	14	0
Sperm Whale	*Physeter macrocephalus*	0	2	1
Cuvier's Beaked Whale	*Ziphius cavirostris*	0	0	0
Unidentified Beaked Whale		0	n/a	n/a
Mesoplodon spp.	*Mesoplodon* spp.	0	n/a	n/a
Humpback Whale	*Megaptera novaeangliae*	0	2	0

n/a = not applicable

3.2.2.2 Onslow Bay

Six days of biopsy and photo-identification sampling surveys were conducted from August 2012 through December 2013. Bottlenose dolphins, Risso's dolphins and Atlantic spotted dolphins were observed along the 200-m isobath along with three loggerhead turtles. Some survey effort was conducted to the east of the original USWTR survey area, close to the 1,000-m isobath, to search for deep-diving odontocetes. This pelagic effort resulted in sightings of bottlenose dolphins, one sighting of a *Mesoplodon* spp. and a group of short-finned pilot whales. Survey effort and sightings are summarized in **Tables 28 and 29,** and **Figures 23 and 24**.

Table 28. Effort details for vessel surveys conducted in the Onslow Bay survey area, August 2012 through December 2013.

Number of Survey Days	6
Total Survey Time (hr:min)	59:51
Time On Effort (hr:min)	32:24
Total km Surveyed	475.0

hr = hour(s); km = kilometer(s); min = minute(s)

Table 29. Sightings from vessel surveys conducted in the Onslow Bay survey area, August 2012 through December 2013. All sightings were made on-effort.

Common Name	Scientific Name	Number of Sightings	Number of Individuals
Bottlenose Dolphin	*Tursiops truncatus*	9	96
Short-finned Pilot Whale	*Globicephala macrorhynchus*	1	30
Risso's Dolphin	*Grampus griseus*	1	60
Atlantic Spotted Dolphin	*Stenella frontalis*	1	150
Unidentified *Mesoplodon* spp.	*Mesoplodon* spp.	1	1
Loggerhead Sea Turtle	*Caretta caretta*	3	3

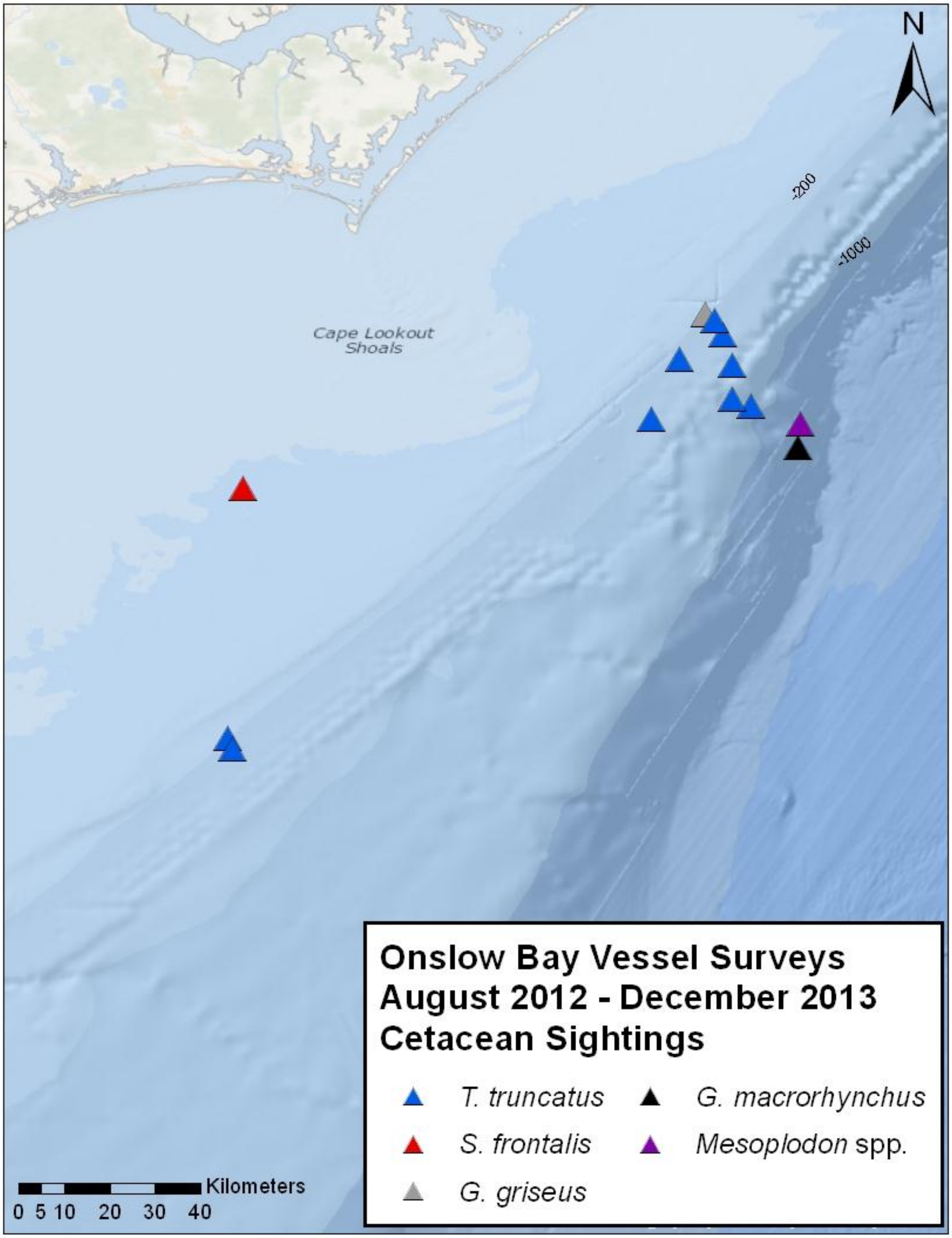

Figure 23. Locations of cetacean sightings from vessel surveys conducted in the Onslow Bay survey area, August 2012 through December 2013. All sightings were made on-effort.

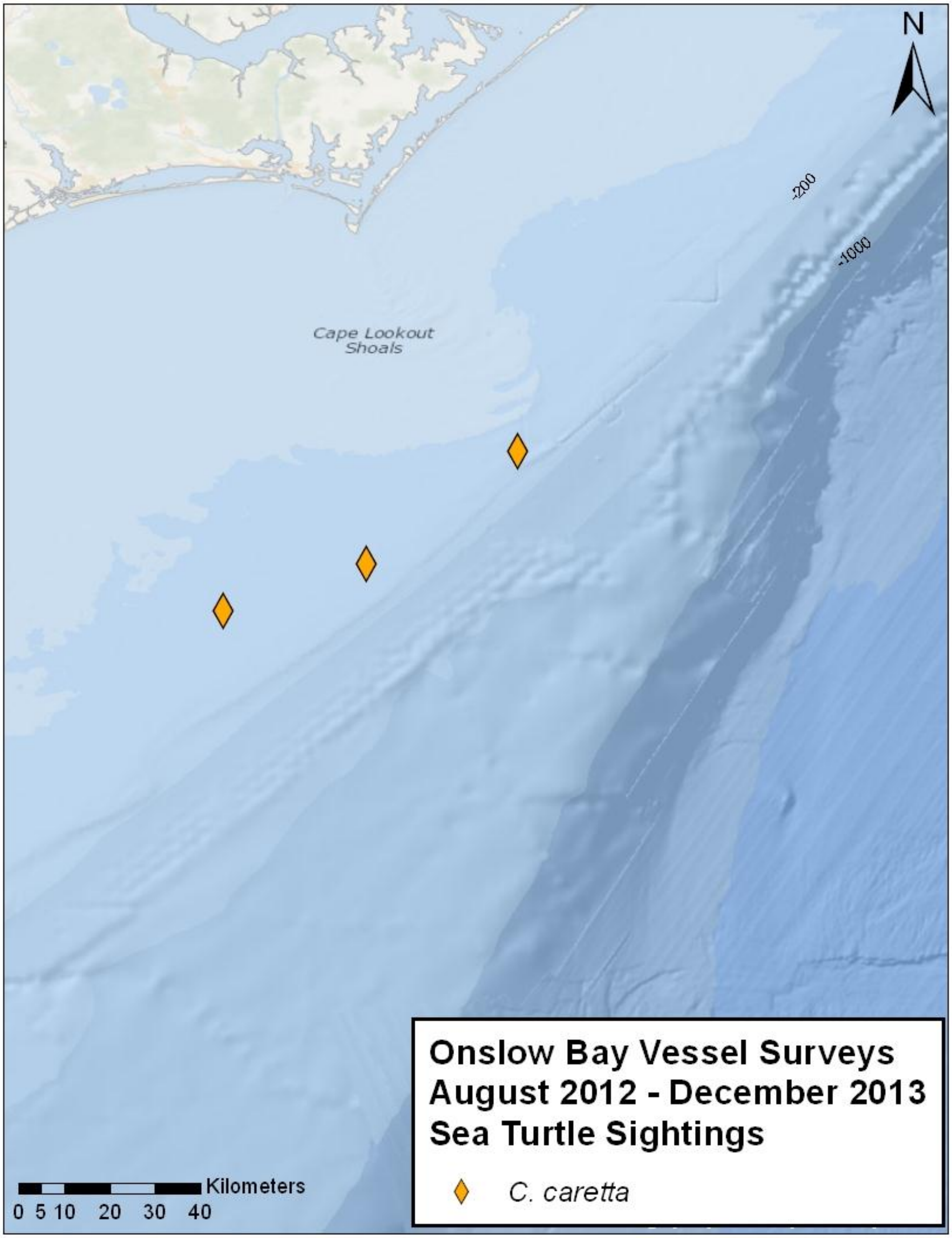

Figure 24. Locations of sea turtle sightings from vessel surveys conducted in the Onslow Bay survey area, August 2012 through December 2013. All sightings were made on-effort.

Twenty one biopsy samples were collected from four species in Onslow Bay: bottlenose dolphin (*n*=11); short-finned pilot whale (*n*=3); Risso's dolphin (*n*=5); and Atlantic spotted dolphin (*n*=2) (**Table 30**). A total of 1,569 photographs were taken of the same four species. Since the beginning of the monitoring program in Onslow Bay, eight bottlenose dolphins and four Atlantic spotted dolphins have been re-sighted (**Table 31**). Re-sightings of bottlenose dolphins and Atlantic spotted dolphins in Onslow Bay span up to 6 and 10 years, respectively. In addition, two bottlenose dolphins were re-sighted together in both 2009 and 2010. Genetic analysis of extracted DNA from bottlenose dolphin biopsy samples collected in Onslow Bay confirms that all of the sampled dolphins were of the offshore ecotype, suggesting that there is limited overlap between coastal and offshore populations in the study area (see below).

Table 30. Biopsy samples taken from animals in the Onslow Bay survey area, August 2012 through December 2013.

Common Name	Scientific Name	Number of Samples
Bottlenose Dolphin	*Tursiops truncatus*	11
Short-finned Pilot Whale	*Globicephala macrorhynchus*	3
Risso's Dolphin	*Grampus griseus*	5
Atlantic Spotted Dolphin	*Stenella frontalis*	2

Table 31. Comparison of photographs taken of animals in the Onslow Bay survey area, August 2012 through December 2013, with existing photo-ID catalogs, showing matches made so far between this year's photos and the catalogs.

Common Name	Scientific Name	Photos Taken	Catalog Size to Date	Matches to Date
Bottlenose Dolphin	*Tursiops truncatus*	747	126	8
Short-finned Pilot Whale	*Globicephala macrorhynchus*	116	23	0
Risso's Dolphin	*Grampus griseus*	536	22	0
Atlantic Spotted Dolphin	*Stenella frontalis*	170	78	4
Unidentified *Mesoplodon* spp.	*Mesoplodon* spp.	0	n/a	n/a
Rough-toothed Dolphin	*Steno bredanensis*	n/a	12	0

n/a = not applicable

3.2.2.3 JAX

Thirteen days of biopsy and photo-identification surveys were conducted in the JAX survey area during this reporting period. Three cetacean species (bottlenose dolphin, Atlantic spotted dolphin, and Risso's dolphin) and three sea turtle species (loggerhead turtle, leatherback turtle, and Kemp's ridley turtle) were identified during these surveys. Sightings and effort details are presented in **Tables 32 and 33**, and **Figures 25 and 26**.

Table 32. Sightings from vessel surveys conducted in the JAX survey area, August 2012 through December 2013. All sightings were made on-effort.

Common Name	Scientific Name	# of Sightings	# of Individuals
Bottlenose Dolphin	*Tursiops truncatus*	19	59
Atlantic Spotted Dolphin	*Stenella frontalis*	11	89
Unidentified Delphinid		4	9
Risso's Dolphin	*Grampus griseus*	1	10
Loggerhead Sea Turtle	*Caretta caretta*	37	41
Leatherback Sea Turtle	*Dermochelys coriacea*	1	1
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	1	1
Unidentified Sea Turtle		1	1

Table 33. Effort details for vessel surveys conducted in the JAX survey area, August 2012 through December 2013.

Number of Survey Days	13
Total Survey Time (hr:min)	125:00
Time On Effort (hr:min)	65:28
Total km Surveyed	1143.5

hr = hour(s); km = kilometer(s); min = minute(s)

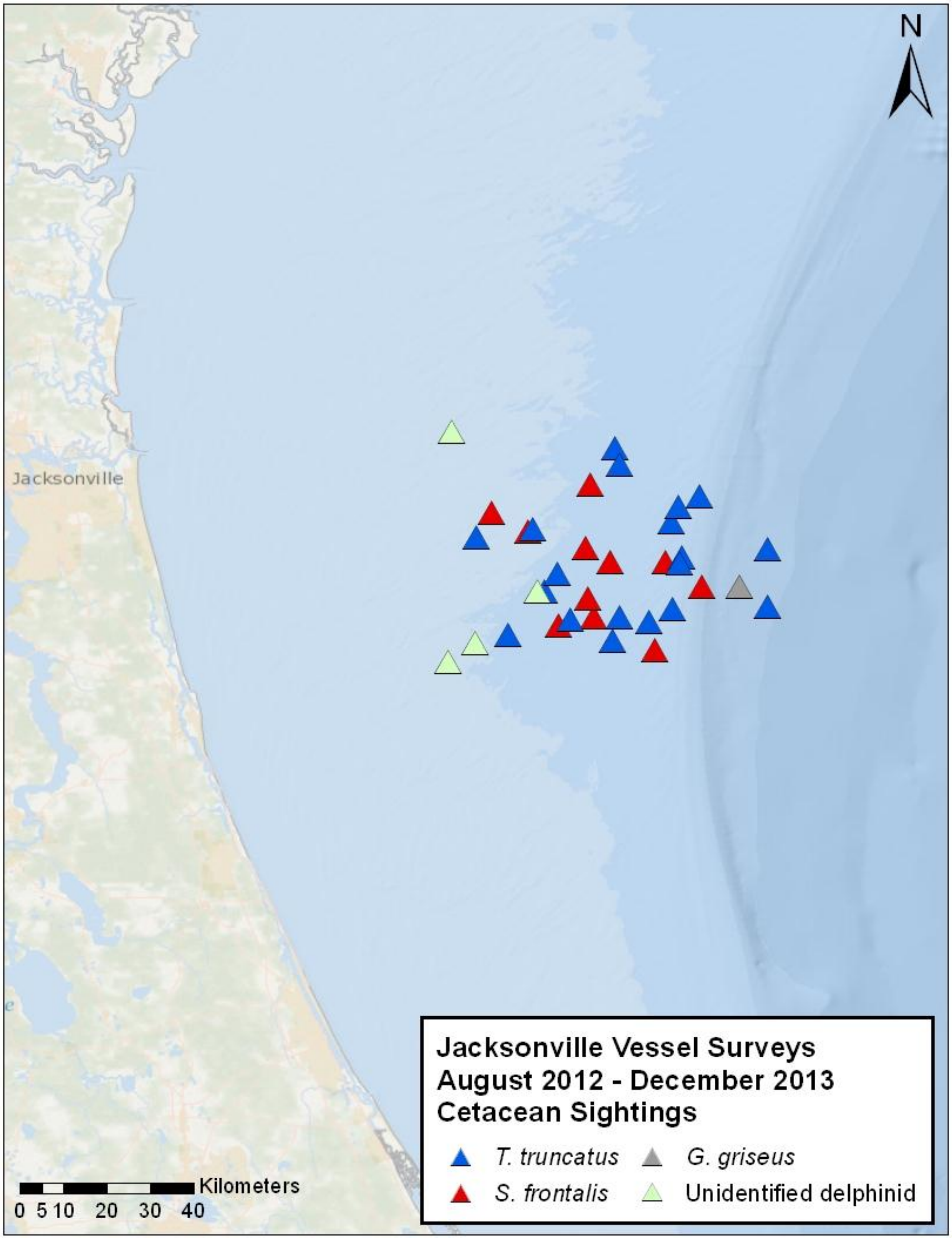

Figure 25. Locations of cetacean sightings from vessel surveys conducted in the JAX survey area, August 2012 through December 2013. All sightings were made on-effort.

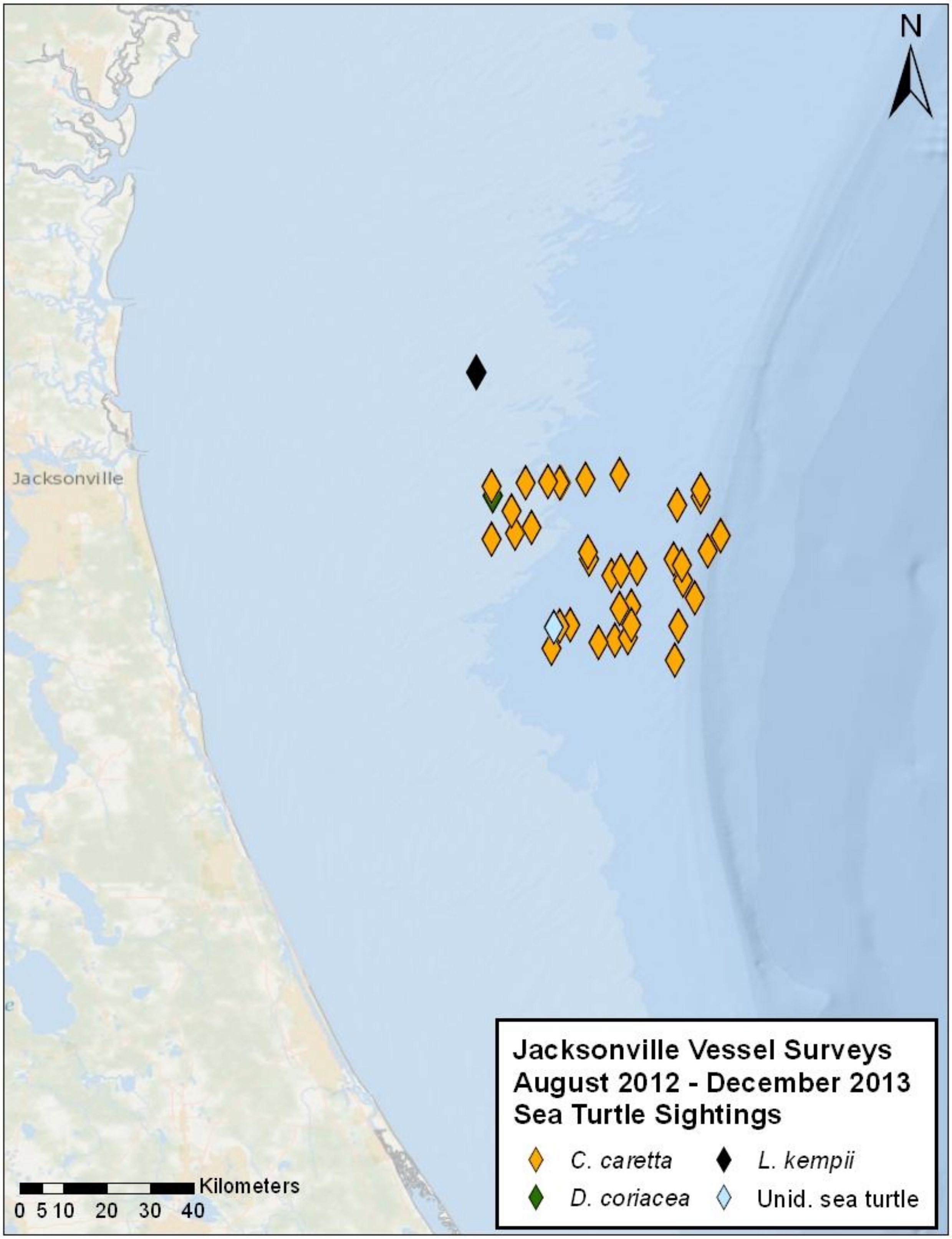

Figure 26. Locations of sea turtle sightings from vessel surveys conducted in the JAX survey area, August 2012 through December 2013. All sightings were made on-effort.

Eleven biopsy samples were collected from bottlenose dolphins (*n*=5) and Atlantic spotted dolphins (*n*=6) (**Table 34)**. A total of 901 photographs were taken of three species (bottlenose dolphin, Atlantic spotted dolphin, and Risso's dolphin), with two matches made to the photo-identification catalogs for Atlantic spotted dolphins (*n*=2). In addition, two bottlenose dolphins were re-sighted together in both 2012 and 2013 (**Table 35**). Genetic analysis of extracted DNA from bottlenose dolphin biopsy samples collected in Jacksonville, Florida, confirms that all of the sampled dolphins were of the offshore ecotype, suggesting that there is limited overlap between coastal and offshore populations in this area as well (see below).

Table 34. Biopsy samples taken from animals in the JAX survey area, August 2012 through December 2013.

Common Name	Scientific Name	Samples
Bottlenose Dolphin	*Tursiops truncatus*	5
Atlantic Spotted Dolphin	*Stenella frontalis*	6

Table 35. Comparison of photographs taken of animals in the JAX survey area, August 2012 through December 2013, with existing photo-ID catalogs, showing matches made so far between this year's photos and the catalogs.

Common Name	Scientific Name	Photos Taken	Catalog Size to Date	Matches to Date
Bottlenose Dolphin	*Tursiops truncatus*	369	52	2
Atlantic Spotted Dolphin	*Stenella frontalis*	345	77	2
Risso's Dolphin	*Grampus griseus*	187	7	0
Short-finned Pilot Whale	*Globicephala macrorhynchus*	n/a	12	0

n/a = not applicable

3.2.2.4 Analysis of Biopsy Samples

Molecular analysis of cetacean tissue-biopsy samples collected as part of this program commenced in June 2013. This analysis is intended to provide information on population identity and structure of cetaceans encountered during survey efforts. This work is coordinated closely with the molecular laboratory of Dr. Patricia Rosel (NMFS' Southeast Fisheries Science Center). In the first phase of this work, analysis is concentrating on an investigation of genetic variation across the mitochondrial control region in short-finned pilot whales and bottlenose dolphins. Genetic variation in the mitochondrial control region is one of the primary tools used to differentiate populations. However, previous studies of the five-prime end of the mitochondrial control region in short-finned pilot whales have identified little genetic variation in this species, hindering attempts to describe population structure in this species. This project extended sequences across the entire mitochondrial control region in an effort to identify additional variation that might be used to differentiate among short-finned pilot whales in the study area. DNA was extracted from 39 short-finned pilot whale biopsy samples, and 819 base pairs were sequenced from the 3 prime end of the mitochondrial control region. Polymerase chain reactions and sequencing were conducted using the primers L16061 and H00651. Four variable sites were identified in the 819-base-pair region. However, variation was very rare at three of the four sites; variants at these sites were observed in only a single sample. Overall, the results indicate very little genetic variation across the entire mitochondrial control region in short-finned pilot whales.

DNA extraction and sequencing of bottlenose dolphin biopsy samples to identify offshore and coastal morphotypes was completed in August 2013. The offshore and coastal morphotypes were distinguished by aligning sequences from the mitochondrial control region to known variant sequences. DNA was extracted from 55 bottlenose dolphin biopsy samples and 489 base pairs of the mitochondrial control region were amplified and sequenced using the primers L15824 and H16498. This dataset included all bottlenose dolphins sampled in Onslow, Jacksonville, and Cape Hatteras between May 2011 and July 2013, except for one sample (DMW-13-001) that had insufficient tissue. Dr. Rosel confirmed that all of the sampled dolphins were of the offshore ecotype. These data suggest that there is little overlap between coastal and offshore populations in the sample areas. We plan to examine photographs of these 55 offshore bottlenose dolphins to describe their morphology and patterns of pigmentation and determine whether we can use external features to identify dolphins of this ecotype in the field.

3.2.3 Norfolk Vessel Surveys

3.2.3.1 Coastal/Inshore and Offshore/MINEX Vessel Surveys

A monitoring program was initiated during August to provide quantitative data and information on the seasonal occurrence, distribution, and density of marine mammals in coastal waters around Virginia Beach and Norfolk, VA. The study area includes waters around Naval Station Norfolk [NSN]), Joint Expeditionary Base Little Creek (JEB-LC) and Joint Expeditionary Base Fort Story (JEB-FS), all located adjacent to Chesapeake Bay, and W-50 of the VACAPES OPAREA where MINEX training is conducted. A combination of line-transect, photo-identification, and automated PAM methods are used to gather important baseline information on the occurrence, distribution, and density of marine mammals in this area. The following is a summary of information found in the annual progress report for this project (Engelhaupt et al. 2014).

The study area was divided into two zones: coastal/inshore zone and offshore MINEX zone. The coastal/inshore zone (a 310.4-square kilometer [km^2] area covering a strip extending from the shoreline out to 3.7 km (2.0 NM]) includes the Chesapeake Bay waters near NSN, extends past JEB-LC and JEB-FS, and extends down the Atlantic coast towards the Virginia/North Carolina border). The offshore/MINEX zone (a 909.6 km^2 area covering Atlantic waters from 3.7 km [2.0 NM] to 33.3 km [18.0 NM] from shore. The offshore/MINEX zone includes the entire VACAPES MINEX W-50 training area.

Twenty-five line-transect surveys were completed in the two zones (14 in the coastal/inshore and 11 in the offshore/MINEX) from August 2012 through December 2013. Observers visually surveyed 2,810 km (coastal/inshore: 1,685 km; offshore/MINEX: 1,125 km) of on-effort trackline for approximately 149 hr (coastal/inshore: 89.4 hr; offshore/MINEX: 59.7 hr) of on-effort status. A total of 225 and 42 sightings of marine mammals and sea turtles, respectively, was recorded. The vast majority (97 percent; n=219) of marine mammal sightings were of bottlenose dolphins; the other species sighted included four solitary humpback whales, one group of short-beaked common dolphins, and one group of unidentified dolphins (**Figure 27**). The unidentified dolphins had a similar shape to the short-beaked common dolphins, but the observer team was unable to re-sight the group to confirm species identification. Twelve marine mammal groups were sighted in the offshore/MINEX zone, while 213 were sighted in the inshore/coastal zone area. Twenty of the sea turtles were identified as loggerhead turtles, 14 as leatherback turtles, and eight as unidentified turtles (**Figure 28**). All leatherback turtles were sighted on the same day (27 July 2013) in the offshore/MINEX zone. Of the remaining turtle sightings, four were in the coastal/inshore zone, while 24 were in the offshore/MINEX zone.

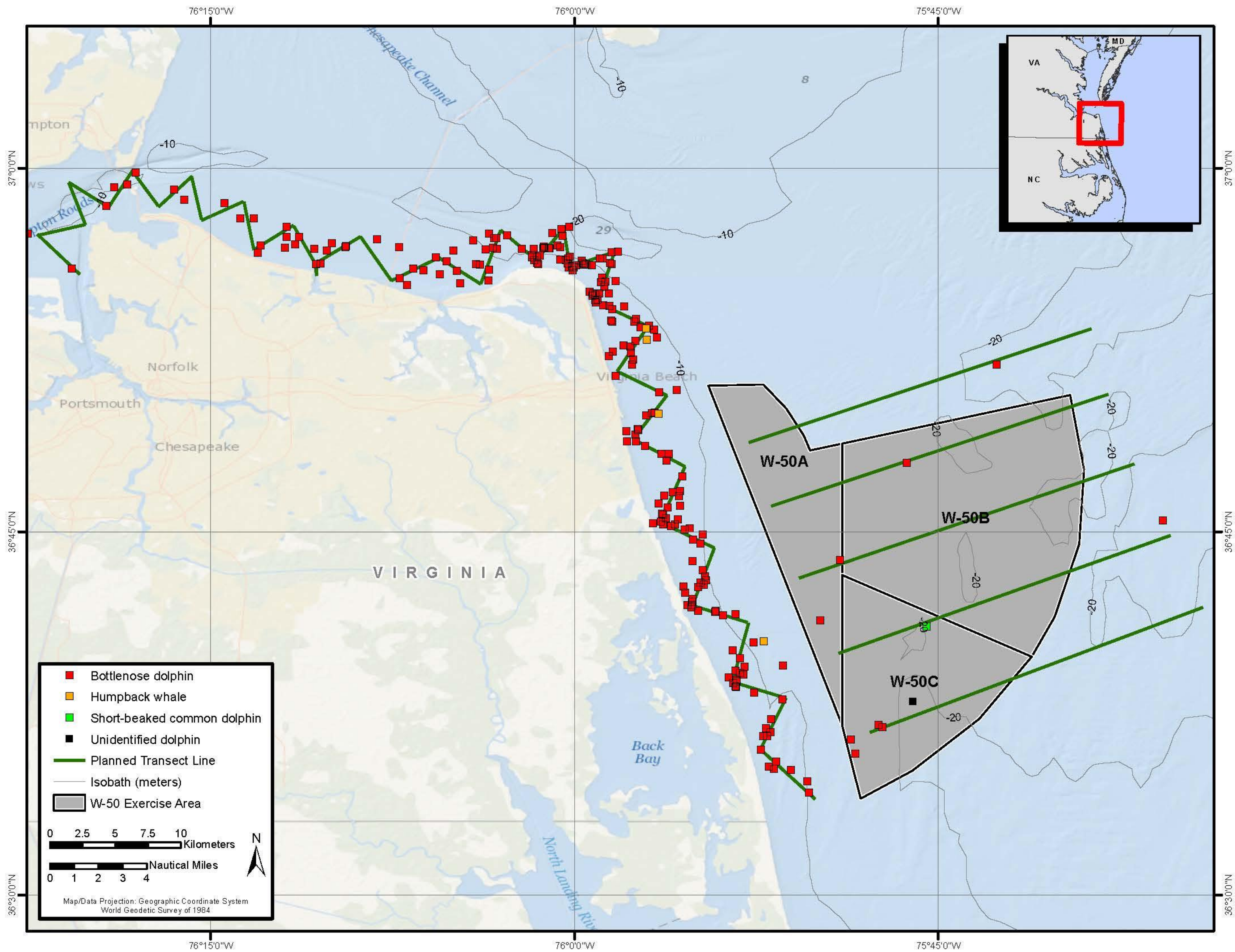

Figure 27. Marine mammal sightings during all line-transect surveys from August 2012 through December 2013.

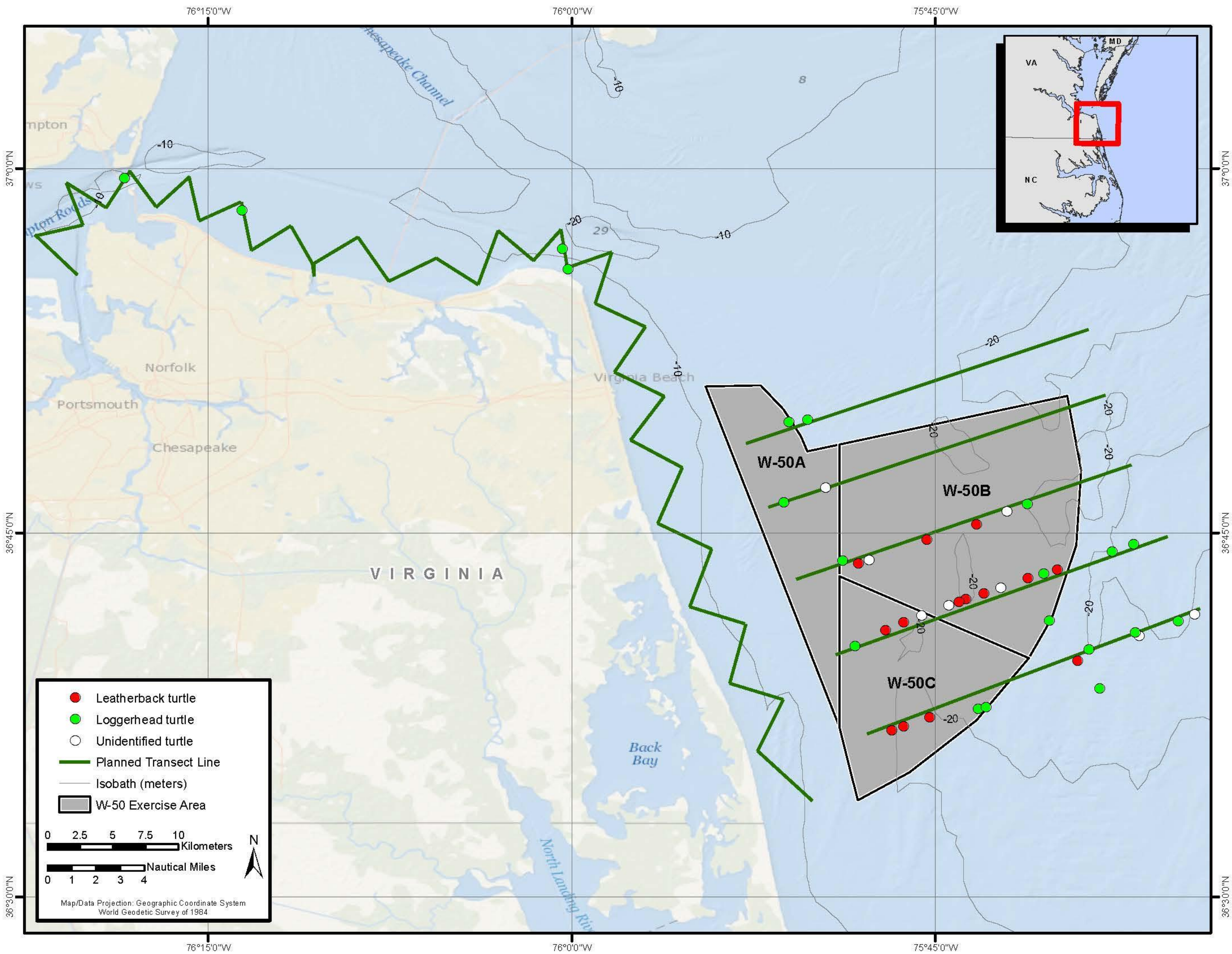

Figure 28. Sea turtle sightings during all line-transect surveys from August 2012 through December 2013.

Conventional line-transect analysis of bottlenose dolphin sightings showed both spatial and seasonal variation in density and abundance (represented as N), with greatest abundance in the coastal/inshore zone during summer months. Sighting densities in the inshore/coastal zone were calculated as 3.05 individuals per km^2 (N=948) in fall, 0.40 individuals per km^2 (N=123) in winter, 1.09 individuals per km^2 (N=337) in spring, and 3.52 individuals per km^2 (N=1,094) in summer. Densities in the offshore/MINEX zone were calculated as 0.11 individuals per km^2 (N=105) in fall, 0.00 individuals per km^2 (N=0) in winter, 0.10 individuals per km^2 (N=90) in spring, and 0.16 individuals per km^2 (N=148) in summer.

3.2.3.2 Passive Acoustic Monitoring

C-POD acoustic data loggers were deployed in four locations (MINEX, JEB-FS, NSN, JEB-LC; **Table 36**) determined based on the likelihood of overlap between dolphin occurrence and U.S. Navy activities. The MINEX and JEB-LC C-PODs were recovered in October 2012; however, the instrument deployed at JEB-LC and recovered on a nearby beach approximately 6 km from the deployment location, was found badly damaged. The initial mooring systems were inadequate and the C-POD deployed at JEB-FS also broke free and was found ashore at Duck, North Carolina (approximately 90 km from its original deployment location). Despite instruments drifting from their mooring and some being significantly damaged, all recovered C-PODs contained data. While the JEB-FS unit contained detections, meaningful data comparisons with the other sites cannot be made because it is unknown when the device broke free.

Table 36. Deployment details of C-POD Automated Acoustic Recorders.

Deployment Date	Location	Coordinates	Total Days Deployed
06 August 2012	MINEX	36 49.905'N, 75 52.860'W	70
16 August 2012	JEB-FS	36 56.411'N, 76 01.165'W	54
16 August 2012	NSN	36 57.061'N, 76 20.444'W	Not recovered
16 August 2012	JEB-LC	36 56.929'N, 76 10.937'W	50
07 December 2012	NSN	36 57.056'N, 76 20.498'W	138
07 December 2012	JEB-LC	36 56.940'N, 76 10.872'W	138
17 April 2013	NSN	36 57.071'N, 76 20.510'W	Not recovered
17 April 2013	JEB-LC	36 56.936'N, 76 10.869'W	154

Key: MINEX = Box W-50A in the Mine Neutralization Exercise Area; NSN = Naval Station Norfolk; JEB-LC = Joint Expeditionary Base Little Creek; JEB-FS = Joint Expeditionary Base Fort Story.

In December 2012, C-PODs were re-deployed at JEB-LC and NSN using more robust mooring systems. These instruments lasted for the duration of the deployment (138 days) and a subsequent deployment was made at JEB-LC for another 154 days. The NSN unit was also deployed in April 2013 but not recovered. It is suspected that dredging or fishing activity interfered with the unit, either damaging or moving it out of range for release. In total, there were three successful deployments at JEB-LC and one successful deployment each at NSN, JEB-FS, and MINEX sites (**Table 36**).

C-PODs logged events occurring between 20 and 160 kilohertz (kHz). C-POD acoustic detection data were analyzed for the relative presence of echolocation clicks. Each of the units recovered contained data that were processed using custom software provided by Chelonia Limited (www.chelonia.co.uk). A custom KERNO classifier was used to identify click trains and classify species. Harbor porpoises (*Phocoena phocoena*) were detected at low rates throughout the study area. Bottlenose dolphin detections were common throughout the four deployment sites, and supported the visual survey data in many ways, with a few exceptions. For example, the C-POD at the NSN site showed some dolphin detections even in the winter months—in contrast to the visual transect survey results, where no dolphin groups were sighted near the NSN deployment site. C-PODs deployed at JEB-LC were the only deployments spanning a time period longer than 3 months. Aside from 32 days between October and December 2012, a full year of data was collected. In general, bottlenose dolphin presence, measured by detection positive minutes (DPM), was higher in the summer months. Detections were still made sporadically during the winter, but dolphin presence was only consistent in the summer months. The highest number of detections occurred in the early fall (late August through September). Though the number of dolphins in the area cannot be determined using the C-POD detections, the substantial presence of bottlenose dolphins is noteworthy as this location is also a busy port for the U.S. Navy. The strong diurnal trend that was evident, with more echolocation activity occurring during nighttime hours, is very common for most odontocete species. The JEB-FS C-POD data support the increased presence of bottlenose dolphins near Cape Henry, as also determined by the visual surveys. A strong diurnal pattern was still observed, indicating more acoustic activity occurring during nighttime hours. The high number of dolphin detections by the MINEX C-POD (mean Dolphin DPM/Day = 193.1) is in contrast to visual survey results, in which the abundance estimates for the MINEX transect coverage area was only 148 for summer and 105 for fall (C-POD monitoring was from 16 August to 13 October 2012). Although a comparison of abundance estimates and acoustic detections is not reasonable, one would expect very few detections from the C-POD when considering the summer and fall bottlenose dolphin sightings for the MINEX area. The coastal/inshore area for summer and fall, however, show that in the nearshore waters adjacent to the MINEX area, there are numerous sightings during transect surveys over those seasons.

For more information on C-POD analyses, refer to the annual progress report for this project (Engelhaupt et al. 2014).

To better understand the impact of MINEX training on marine mammals, an effort was begun by Oceanwide Science Institute in August 2012 to monitor odontocete activity in W-50 of the VACAPES OPAREA using passive acoustic methods (refer to **Section 3.3.3**).

3.2.3.3 Photo-identification Effort

Nine photo-identification surveys were completed between August 2012 and November 2013 for approximately 75.2 hr of survey effort. The surveys were not always completed each month as planned due to poor weather conditions. Effort was focused on conducting photo-identification of as many individuals within each encountered group as possible. Sixty-eight dolphin groups were encountered with a total of 1,569 animals. To date (February 2014), the catalog contains 308 identifiable individuals. A catalog was created using both photos taken on photo-identification surveys and photos taken on transect surveys, and to date includes all photo-identification and transect photographs taken through July 2013.

A sighting and re-sighting of a freeze-branded individual, known as FB405 (Kim Urian, Duke University, personal communication) also is included in the photo catalog, even though the sighting photographs from this date have not yet been cataloged. After the initial sighting in the field, HDR communicated with relevant parties to determine where the animal had been branded. It was confirmed that prior to sightings at Cape Henry, Virginia on 31 August 2013, 26 September 2013, and 02 October 2013, this individual had been photographed in Roanoke Sound, North Carolina, and caught for tagging and freeze-branding at Cape Lookout, North Carolina, on 09 November 1999.

Re-sighting rates across surveys were low. Following creation of the catalog, there have been 33 matches of cataloged individuals, 3 of which were re-sighted twice**.** All re-sightings in the study area were recorded less than 15 km from the location of the initial sighting. Dolphins sighted in the Chesapeake Bay were not re-sighted along the Atlantic side of Virginia Beach, in the southern portion of the study area.

More survey effort and photo-identification are required to discern clear patterns of site fidelity. Upon completion of cataloging all photographs taken on photo-identification and transect surveys in the study area, images will be contributed and compared to the existing Mid-Atlantic Bottlenose Dolphin Catalog, established by NMFS and curated by Kim Urian with Duke University (Urian et al. 1999). The contribution will be made to find matches to adjacent areas and piece together information on bottlenose dolphin movement patterns on a larger scale.

For more information on this study, refer to the annual progress report for this project (Engelhaupt et al. 2014).

3.3 Tagging Studies

3.3.1 Deep Diving Odontocete Tagging - Hatteras

Between May and October 2013, 8 days of surveys were conducted as part of the Deep Diver Tagging project, focusing on the distribution and ecology of beaked, short-finned pilot, and sperm whales. The first year of this project was focused on locating and approaching deep-diving animals, specifically sperm whales, off Cape Hatteras. A custom-made directional hydrophone was constructed and used to localize sperm whales by detecting echolocation clicks produced during their dives. The survey vessel essentially homes in on the position of a sperm whale by stopping frequently to listen for clicks and determining the direction of the vocalizing whale. Sperm whale echolocation clicks were detected on 3 survey days in May 2013, resulting in three sightings of six sperm whales. Individual whales were located and tracked on 2 of the 3 days which resulted in one biopsy sample and approximately 200 photo-identification images. In addition to sperm whales, nine species of cetaceans were encountered in the Cape Hatteras study area including 39 sightings of deep-diving species: short-finned pilot whale (*n*=32), Cuvier's beaked whale (*n*=2), unidentified beaked whale (*n*=4), and an unidentified *Mesoplodon* spp. (*n*=1). The remaining 41 sightings included bottlenose dolphin (*n*=30); Risso's dolphin (*n*=3); short-beaked common dolphin (*n*=3; herein referred to as common dolphin); Atlantic spotted dolphin (*n*=3); fin whale (*n*=1); and an unidentified delphinid (*n*=1). Seven loggerhead turtles and one green turtle were also observed. Most survey effort was concentrated along the shelf break and extended into deeper, pelagic waters. Sightings and survey effort are presented in **Tables 37 and 38,** and **Figures 29 and 30.**

Table 37. Sightings from vessel surveys conducted during the Deep Diver Project in the Cape Hatteras survey area, May 2013 through December 2013. All sightings were made on-effort.

Common Name	Scientific Name	# of Sightings	# of Individuals
Short-finned Pilot Whale	*Globicephala macrorhynchus*	32	855
Bottlenose Dolphin	*Tursiops truncatus*	30	529
Risso's Dolphin	*Grampus griseus*	3	17
Common Dolphin	*Delphinus delphis*	3	160
Atlantic Spotted Dolphin	*Stenella frontalis*	3	145
Sperm Whale	*Physeter macrocephalus*	3	6
Unidentified Delphinid		1	3
Fin Whale	*Balaenoptera physalus*	1	3
Cuvier's Beaked Whale	*Ziphius cavirostris*	2	7
Unidentified Beaked Whale		4	9
Unidentified *Mesoplodon* spp.	*Mesoplodon* spp.	1	2
Loggerhead Sea Turtle	*Caretta caretta*	7	7
Green Sea Turtle	*Chelonia mydas*	1	1

Table 38. Effort details for vessel surveys conducted during the Deep Diver Project in the Cape Hatteras survey area, May 2013 through December 2013.

Number of Survey Days	8
Total Survey Time (hr:min)	104:41
Time On Effort (hr:min)	59:30
Total km Surveyed	815.3

hr = hour(s); km = kilometer(s); min = minute(s)

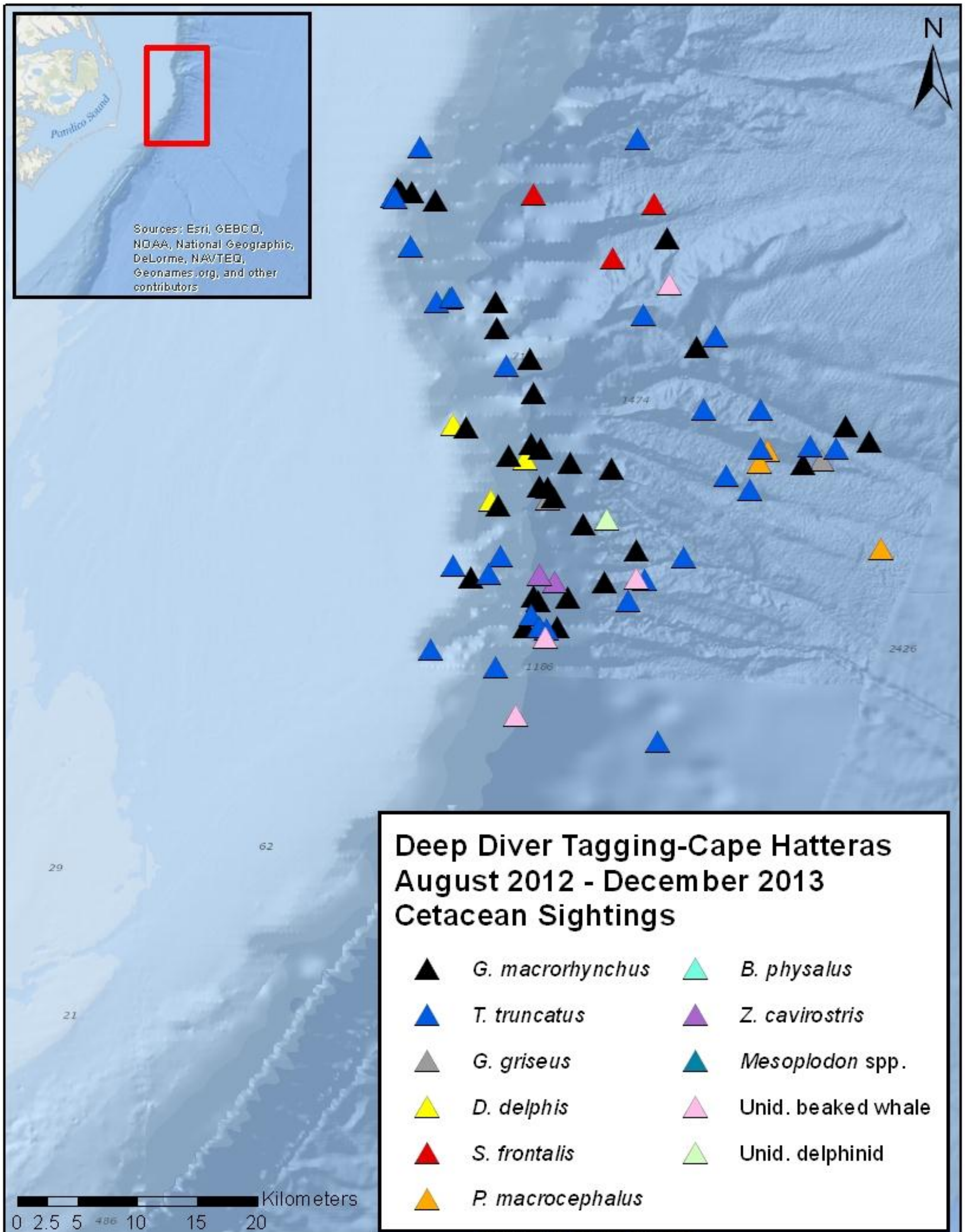

Figure 29. Locations of cetacean sightings from vessel surveys conducted during the Deep Diver Project in the Cape Hatteras survey area, May 2013 through December 2013. All sightings were made on-effort.

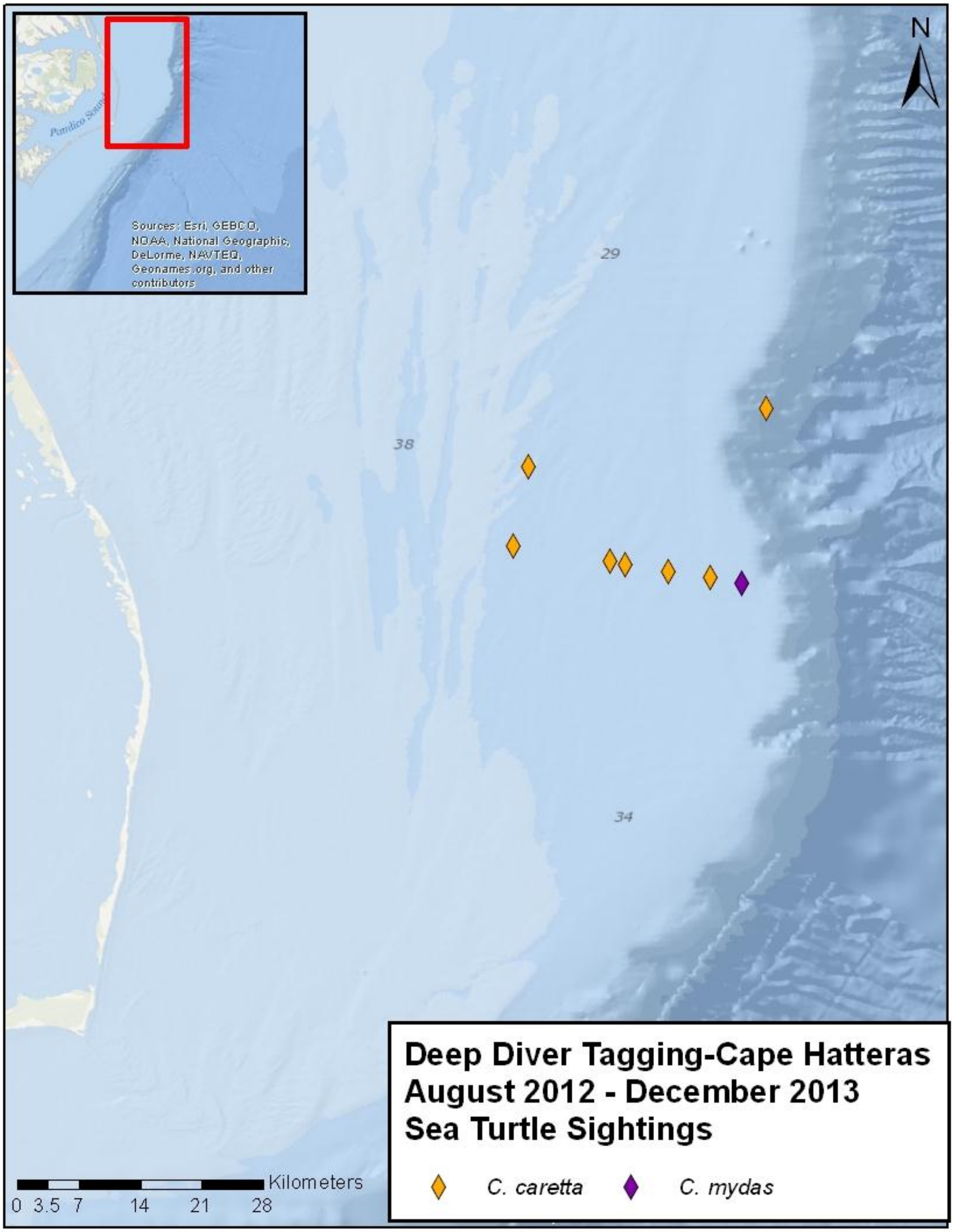

Figure 30. Locations of sea turtle sightings from vessel surveys conducted during the Deep Diver Project in the Cape Hatteras survey area, May 2013 through December 2013. All sightings were made on-effort.

Forty biopsy samples were collected from eight species including three deep-diving species: short-finned pilot whale (*n*=14); Cuvier's beaked whale (*n*=2); and sperm whale (*n*=1) (**Table 39**). A total of 2,768 photographs were taken of each of the species observed, collectively. In addition to the re-sightings of bottlenose dolphins and pilot whales reported in **Section 3.2.2.1**, one match was made in the photo-identification catalog for common dolphins; an individual sighted in 2007 was re-sighted in 2012. One sperm whale was seen in two different sightings on the same survey day (**Table 40**).

Table 39. Biopsy samples taken from animals during the Deep Diver Project in the Cape Hatteras survey area, May 2013 through December 2013.

Common Name	Scientific Name	Number of Samples
Short-finned Pilot Whale	*Globicephala macrorhynchus*	14
Bottlenose Dolphin	*Tursiops truncatus*	14
Risso's Dolphin	*Grampus griseus*	2
Common Dolphin	*Delphinus delphis*	2
Atlantic Spotted Dolphin	*Stenella frontalis*	2
Fin Whale	*Balaenoptera physalus*	3
Sperm Whale	*Physeter macrocephalus*	1
Cuvier's Beaked Whale	*Ziphius cavirostris*	2

Table 40. Comparison of photographs taken of animals during the Deep Diver Project in the Cape Hatteras survey area, May 2013 through December 2013, with existing photo-ID catalogs, showing matches made so far between this year's photos and the catalogs.

Common Name	Scientific Name	Photos Taken	Catalog Size to Date	Matches to Date
Short-finned Pilot Whale	*Globicephala macrorhynchus*	1246	253	8
Bottlenose Dolphin	*Tursiops truncatus*	730	107	3
Risso's Dolphin	*Grampus griseus*	106	3	0
Common Dolphin	*Delphinus delphis*	48	20	1
Atlantic Spotted Dolphin	*Stenella frontalis*	126	14	0
Sperm Whale	*Physeter macrocephalus*	196	2	1
Fin Whale	*Balaenoptera physalus*	79	1	0
Cuvier's Beaked Whale	*Ziphius cavirostris*	222	0	0
Unidentified Beaked Whale		3	n/a	n/a
Unidentified *Mesoplodon* spp.	*Mesoplodon* spp.	12	n/a	n/a
Humpback Whale	*Megaptera novaeangliae*	0	2	0

n/a = not applicable

3.3.2 North Atlantic Right Whale Tagging - JAX

The endangered North Atlantic right whale migrates to coastal waters off Florida and Georgia during the winter months. The planned construction and use of USWTR off the coast of Florida may cause disturbance to this species on its winter calving ground. The primary aspects of the range development that could, theoretically, impact North Atlantic right whales is the potential for exposure to high-intensity sounds that could result in behavioral reactions and potential displacement of right whales from habitat areas important for calving and/or migration.

Aerial- and vessel-based visual surveys and PAM are currently being used to detect right whales in the coastal waters of Florida and Georgia. These methods give the location of individual whales, but only provide information about location at a single point in time. Currently there are few data on the movement patterns of individuals, including movement rates both in North/South and East/West directions, dive depths, and dive durations and on the rates of sound production by individuals. Also poorly understood are the vocalization rates of right whales on these wintering grounds. These data are important to assess the effectiveness of current monitoring techniques and to assess the potential for disturbance to right whales as the training range construction and implementation commences.

To study North Atlantic right whales in their southeastern United States wintering grounds, scientists with Duke University and Syracuse University will use observational methods combined with short-term, non-invasive, suction-cup-attached multi-sensor acoustic recording tags. These tags continuously record the orientation, heading, and depth of the tagged animal in complete synchrony with sounds recorded by the hydrophone. By recording behavior and sound synchronously, the tags can unambiguously capture behavior that is not observable from the surface.

In addition to the diving and acoustic behavior, information on two-dimensional movement patterns of the whales is needed. To accomplish this goal, Duke University scientists will use Fastloc™ GPS incorporated into the non-invasive tags. Beginning in February 2014, scientists will attach tags and follow the whales. To conduct this work, particularly the tagging, requires relatively calm sea conditions, so to obtain a reasonable sample size (*n*=≥8 tagged whales), so a field team will be on-site for a month. Two vessels will be used to conduct this work. During good weather, the team will operate from the R/V *Stellwagen,* which previously has been used successfully for right whale work, and from a rapid response vessel equipped with a custom-mounted pulpit to conduct the tagging and some of the focal-follow behavioral data collection. Tag deployments will be targeted for 24 hr, so that data can be collected for a full diurnal cycle of the whales.

At the time of preparing this report, a total of 3 females with calves had been tagged. Additional results of the February 2014 tagging effort will be made available in a technical report and as part of a future Annual Monitoring Report for Atlantic Fleet Training and Testing (AFTT). For additional information on progress of this project see the project profile page on the Navy's marine species monitoing website.

3.3.3 Sea Turtle Tagging - Chesapeake Bay and Coastal Waters of Virginia

In July 2013, the Virginia Aquarium & Marine Science Center (VAQ) and Naval Facilities Engineering Command Atlantic initiated a collaborative turtle tagging project in lower Chesapeake Bay and coastal Virginia waters. The goal of the project is to assess the occurrence, habitat use, and behavior of loggerhead, green, and Kemp's ridley turtles in the Hampton Roads region to better assess the impacts that U.S. Navy activities may have on these protected marine species. The project includes analysis of historic sea turtle tag data and deployment of satellite and sonic tags on sea turtles captured, incidentally caught, and rehabilitated in Virginia. VAQ gains access to sea turtles in three ways: (1) capture using tangle or dip nets in the vicinity of naval facilities and training areas; (2) incidental capture in Virginia pound nets (fish traps), and (3) rehabilitated turtles from the Virginia Aquarium Stranding Response Program.

An exciting aspect of the project is the leveraging of the U.S. Navy's existing underwater passive acoustic receiver array, initially established to track sturgeon. This is the first use of the Chesapeake Bay acoustic receiver array for sea turtles. This array records the presence of animals using small sonic (i.e., acoustic) tags either inserted surgically into the body (in the case of fishes) or attached externally using epoxy (for sea turtles). These tags have a battery life of 250 days to more than 10,000 days, depending on the model and parameters of the tag. The smallest tags weigh less than 10 grams and can be placed on small juvenile green and Kemp's ridley turtles, species that are known to use Chesapeake Bay, but which are usually too small to be outfitted with traditional satellite tags. The objective in using these underwater acoustic arrays and tags is to learn more about residency time and migration patterns while tagging more turtles given the equipment's lower costs. Each tag transmits a specific coded signal that is used to identify the individual as it moves from one location to another. As the turtle moves around areas where receiver arrays are present, the arrays detect the pings from the tag and record the information, which is later downloaded by researchers for analysis. For these turtles, the sonic tag also emits a signal that indicates the approximate depth of the turtle when it is in range of the array. These data will help establish a baseline for habitat use and movement patterns by sea turtles in areas where U.S. Navy training and testing activities occur. The collected data also will contribute to the density estimation process for sea turtles in the region.

Some larger turtles will be double tagged with sonic and satellite tags. The data-logging satellite telemetry tags are produced by Wildlife Computers and the Sea Mammal Research Unit and can record behaviors, such as dive depth and duration of the turtle, and track movements over long ranges. Initially, the satellite tags will be used to help ground truth the performance of the acoustic receiver array and inform the placement of future acoustic receiver elements.

In the late summer and fall of 2013, VAQ conducted five capture trips, deploying a 91- to 183-m tangle net for 3 to 5 hr surrounding a slack tide. The net was deployed in 1.8 to 3 m of water on sandy bottoms. During these trips, however, no sea turtles were caught, but previous trips for other projects have successfully captured Kemp's ridley turtles. There are plans to deploy the net again in 2014.

Fourteen turtles (11 loggerhead, two green, and one Kemp's ridley) were tagged during summer and fall (July through November) 2013 (**Table 41**). Four loggerhead turtles were incidentally captured in pound nets; sonic tags were placed on all four, with one turtle also receiving a U.S. Navy-funded satellite tag. In addition, VAQ released (after rehabilitation) seven loggerheads, one Kemp's ridley, and two green turtles with sonic tags. Four of the loggerheads also received U.S. Navy-funded satellite tags. Five loggerheads that received sonic tags received satellite tags as a part of other VAQ projects ('non-Navy' in the PTT column in **Table 41**). Most of these tags were deployed before the Navy tags were delivered. Data from these tags will be available to Naval Facilities Engineering Command Atlantic following completion of current projects. Unfortunately, four of the turtles, one green and three loggerheads, stranded dead after being released with tags (**Table 41**). None of the four stranded turtles retained their sonic tags, and one turtle stranded with the satellite tag, which can be redeployed. Cause of death was not attributed to the tags or tagging procedures.

Table 41. Tags deployed during July through November 2013. Several turtles that received U.S. Navy sonic tags also received satellite tags as part of other projects (non-Navy in PTT column). Data from these tags will be shared with the U.S. Navy as part of Year 2 of the project.

Field Number	Species	Date	Source	Release Location				Satellite Tag		VEMCO Sonic Tag	
				City/County	State	Latitude	Longitude	PTT	Model	VUE Tag ID	Model
VAQS20122171	Cm	07/11/2013	rehabilitated	Virginia Beach	VA	36.9195	-76.0542	NA	NA	A69-1601-9888	V13-1X
VAQS20122185	Cm	07/11/2013	rehabilitated	Virginia Beach	VA	36.9195	-76.0542	NA	NA	A69-1601-9890	V13-1x
VAQS20122180	Lk	08/27/2013	rehabilitated	Atlantic Ocean	VA	36.8816	-75.9418	NA	NA	A69-1601-11895	V9-2x
VAQS20122163	Cc	08/27/2013	rehabilitated	Atlantic Ocean	VA	36.8816	-75.9418	non-Navy	NA	A69-1601-11901	V13-1x
VAQR2013015	Cc	09/07/2013	pound net	Northampton	VA	37.1278	-75.9492	non-Navy	NA	A69-1601-11908	V16-1x
VAQR2013018	Cc	09/12/2013	pound net	Northampton	VA	37.1660	-75.9881	non-Navy	NA	A69-1601-11907	V16-1x
VAQR2013019	Cc	09/16/2013	pound net	Northampton	VA	37.1660	-75.9881	132362	SMRU 9000x-SRDL	A69-1601-11904	V16-1x
VAQR2013013	Cc	09/19/2013	pound net	Northampton	VA	37.1660	-75.9881	non-Navy	NA	A69-1601-11898	V13-1x
VAQS20132106	Cc	09/28/2013	rehabilitated	Virginia Beach	VA	36.9190	-76.0551	132363	SMRU 9000x-SRDL	A69-1601-11909	V16-1x
NAIB1240CC	Cc	10/20/2013	rehabilitated	Virginia Beach	VA	36.7453	-75.9425	132364	SMRU 9000x-SRDL	A69-1601-11905	V16-1x
VAQS20132126	Cc	10/20/2013	rehabilitated	Virginia Beach	VA	36.7453	-75.9425	non-Navy	NA	A69-1601-11906	V16-1x
VAQS20132102	Cc	10/20/2013	rehabilitated	Virginia Beach	VA	36.7453	-75.9425	132365	WC SPLASH-284A	A69-1601-9084	V16-5x
VAQS20132086	Cc	10/20/2013	rehabilitated	Virginia Beach	VA	36.7453	-75.9425	132366	WC SPLASH-284A	A69-1601-9086	V16-5x
VAQS20132141	Cc	11/22/2013	rehabilitated	Atlantic Ocean	NC	34.2110	-75.8700	132368	WC SPOT-5	A69-1601-11900	V16-5x

Key: Cc = Loggerhead turtle (*Caretta caretta*); Cm = Green turtle (*Chelonia mydas*); ID = identification; Lk = Kemp's ridley turtle (*Lepidochelys kempii*); NA = not applicable; NAIB = National Aquarium in Baltimore; NC = North Carolina; PTT = Platform Transmitting Terminal; SMRU = Sea Mammal Research Unit; SPOT = Smart Position or Temperature Transmitting; VA = Virginia; VAQ = Virginia Aquarium & Marine Science Center.

Satellite tags from this and other VAQ projects indicate that, as of 15 January 2014, eight of the 10 turtles are alive and their tags are transmitting normally. All satellite-tagged turtles had moved out of Virginia and were distributed from North Carolina to Florida (**Figure 31**; **Table 42**). Satellite tag data can be viewed online at seaturtle.org (http://www.seaturtle.org/tracking/?project_id=917) and the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP) NAVFAC collaborative project page (http://seamap.env.duke.edu/partner/NAVY).

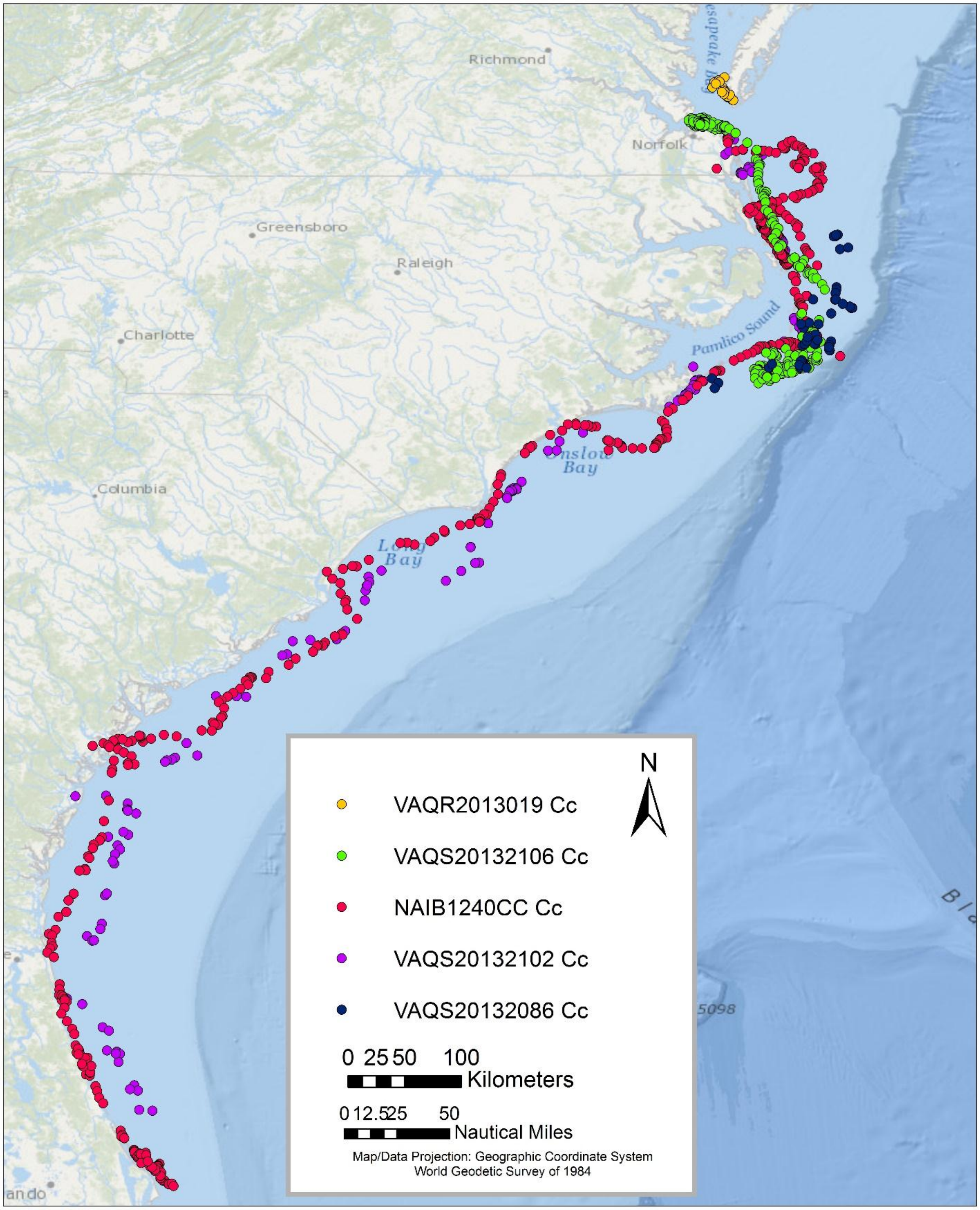

Figure 31. Locations for turtles satellite-tagged as part of this project. Tag data was downloaded on 15 January 2014. Turtle 132362 (yellow) stopped transmitting after 2 days and was later found dead. All satellite-tagged turtles also received a sonic tag.

Table 42. Results for tags deployed from July through November 2013. After September, turtles were released south of the acoustic array and thus were not expected to have any detections during 2013. Acoustic array results are through 15 October 2013. The *Days* column in the Acoustic Array section indicates the number of different days tags were detected and *Days* in the Satellite Tracking section indicate number of days since release as of 15 January 2014.

Field Number	Species	Date	Acoustic Array				Satellite Tracking		
			Tag ID	Detections	Receivers	Days	PTT	Days	Status
VAQS20122171	Cm	07/11/2013	A69-1601-9888	0	0	0	NA	NA	stranded dead
VAQS20122185	Cm	07/11/2013	A69-1601-9890	23	3	2	NA	NA	NA
VAQS20122180	Lk	08/27/2013	A69-1601-11895	15	2	2	NA	NA	NA
VAQS20122163	Cc	08/27/2013	A69-1601-11901	383	14	7	non-Navy	146	still transmitting
VAQR2013015	Cc	09/07/2013	A69-1601-11908	0	0	0	non-Navy	129	still transmitting
VAQR2013018	Cc	09/12/2013	A69-1601-11907	5	2	1	non-Navy	7	stranded dead
VAQR2013019	Cc	09/16/2013	A69-1601-11904	0	0	0	132362	2	stranded dead
VAQR2013013	Cc	09/19/2013	A69-1601-11898	7	2	2	non-Navy	35	stranded dead
VAQS20132106	Cc	09/28/2013	A69-1601-11909	55	3	2	132363	109	still transmitting
NAIB1240CC	Cc	10/20/2013	A69-1601-11905	0	0	0	132364	86	still transmitting
VAQS20132126	Cc	10/20/2013	A69-1601-11906	0	0	0	non-Navy	86	still transmitting
VAQS20132102	Cc	10/20/2013	A69-1601-9084	0	0	0	132365	86	still transmitting
VAQS20132086	Cc	10/20/2013	A69-1601-9086	0	0	0	132366	86	still transmitting
VAQS20132141	Cc	11/22/2013	A69-1601-11900	0	0	0	132368	53	still transmitting

Key: Cc = Loggerhead turtle (*Caretta caretta*); Cm = Green turtle (*Chelonia mydas*); NA = not applicable; NAIB = National Aquarium in Baltimore; PTT = Platform Transmitting Terminal; VAQ = Virginia Aquarium & Marine Science Center.

In addition to satellite telemetry data, there were 488 detections of six turtles by the acoustic receiver array through 15 October 2013 (see **Table 42**; **Figures 32 through 34**). The number of detections from these 6 individuals ranged from five to 383. Detections were recorded by up to 15 different receivers for a single animal. One turtle (PTT 132363/satellite tag VAQS20132106 in **Figure 32**) spent 2 days in the vicinity of Thimble Shoals and was detected 55 times. Of the eight turtles that were not detected by the array, five were released in the fall, south of the array, while two stranded shortly after release. Tags placed on the latest (i.e., fall) releases should continue to be active and be detected by the array when the turtles return to the Chesapeake Bay area in the spring.

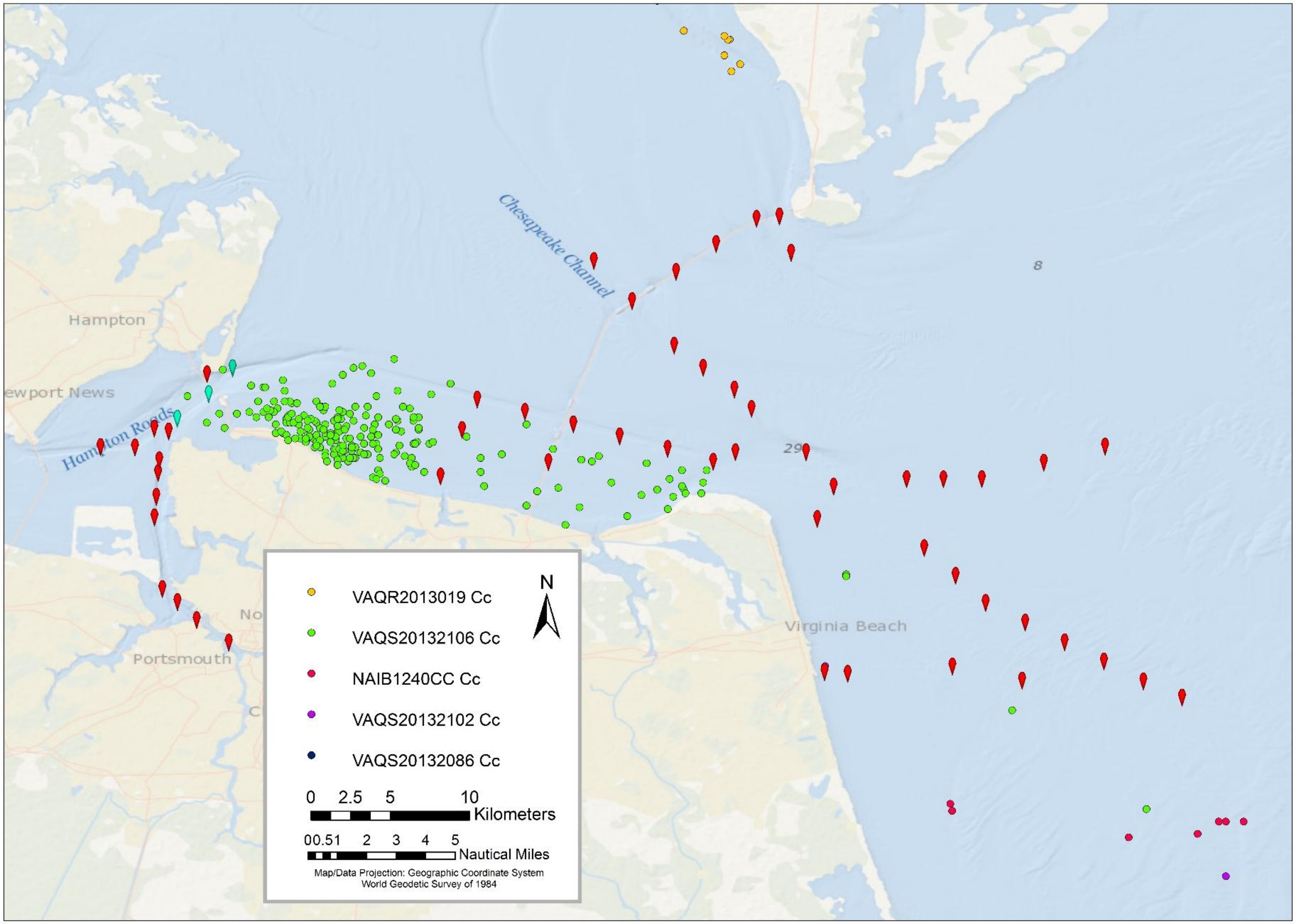

Figure 32. Location of acoustic array receivers (red) in comparison with locations of satellite-tagged turtles. Turtle number VAQS20132106 (green; PTT 132363) was detected 55 times by three receivers (blue) over the course of 2 days (See Figure 31). Turtle ID numbers correspond to field number in Tables 36 and 37.

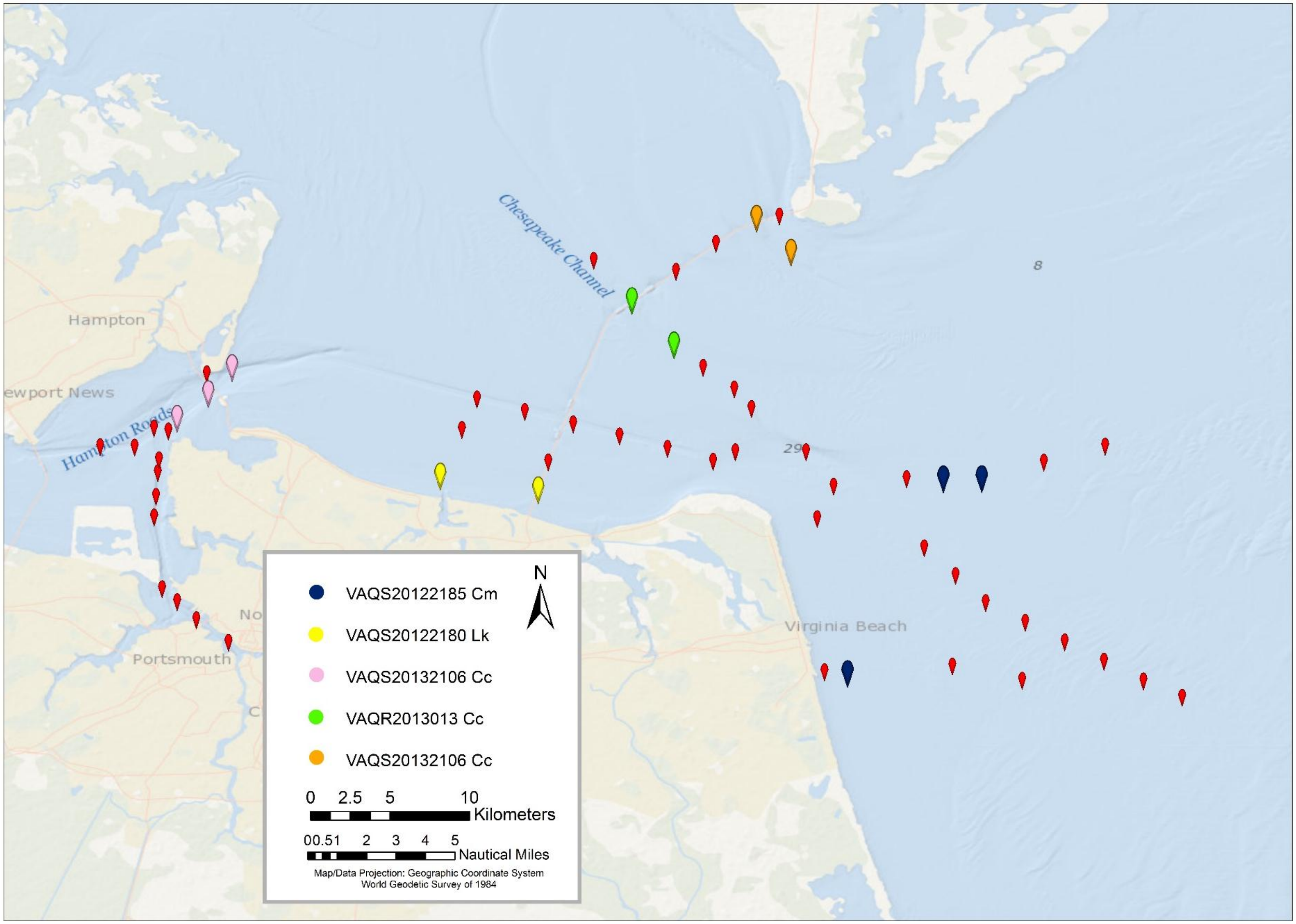

Figure 33. Acoustic detections of tagged turtles from 01 July through 15 October 2013, including 5 turtles (1 green, 1 Kemp's ridley, and 3 loggerheads) detected by 2 to 3 receivers each.

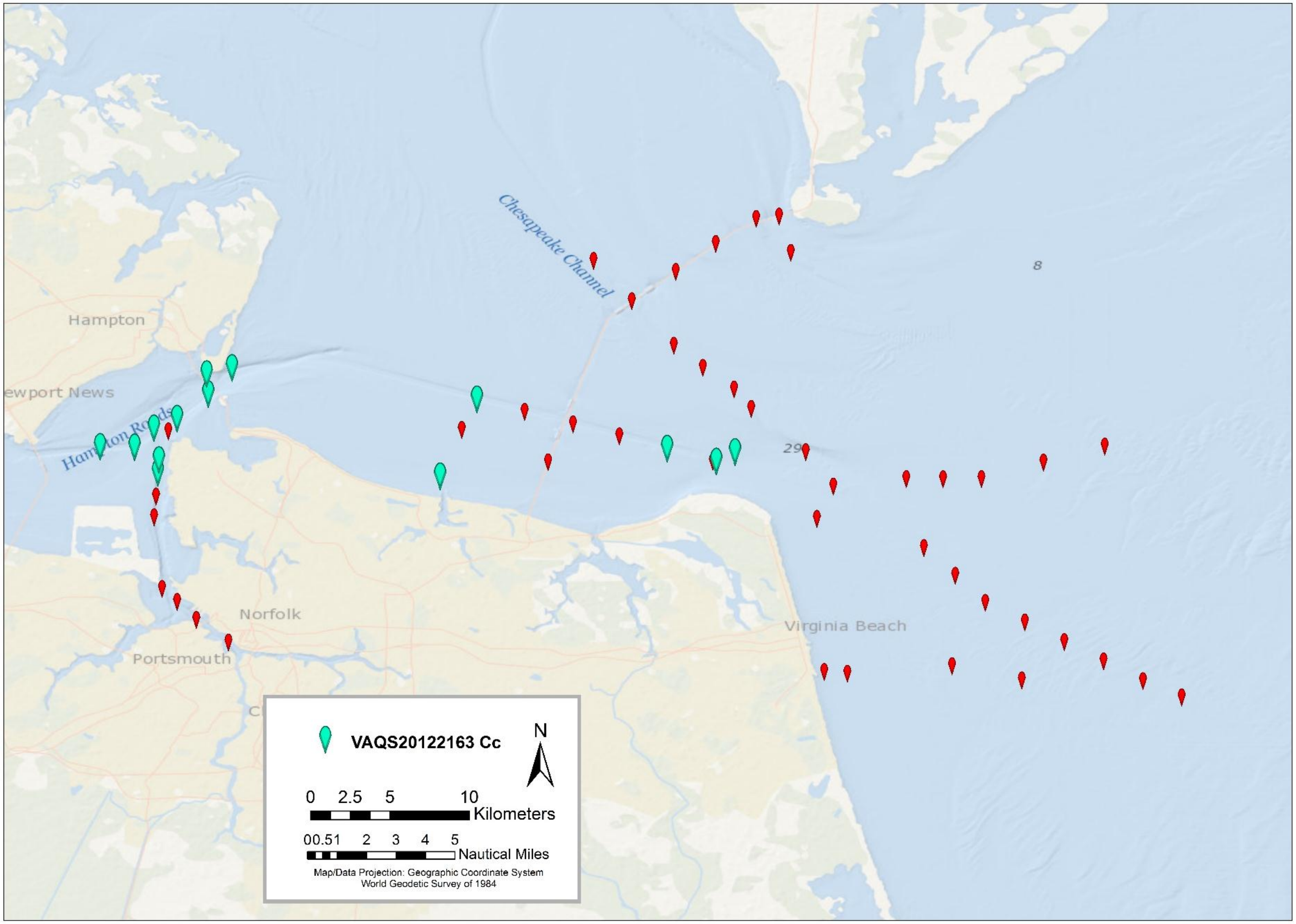

Figure 34. Acoustic detections of tagged turtles from 01 July through 15 October 2013, including 1 loggerhead turtle. (VAQS20122163 Cc) that was detected by 14 receivers.

Along with the currently deployed tags, VAQ is sharing data from 19 previously deployed tags for home range and density analyses (**Figures 35 and 36**). These data will be combined with the data collected by the U.S. Navy-funded tags and may also help to direct placement of future acoustic receivers to enhance sonic detections in the region.

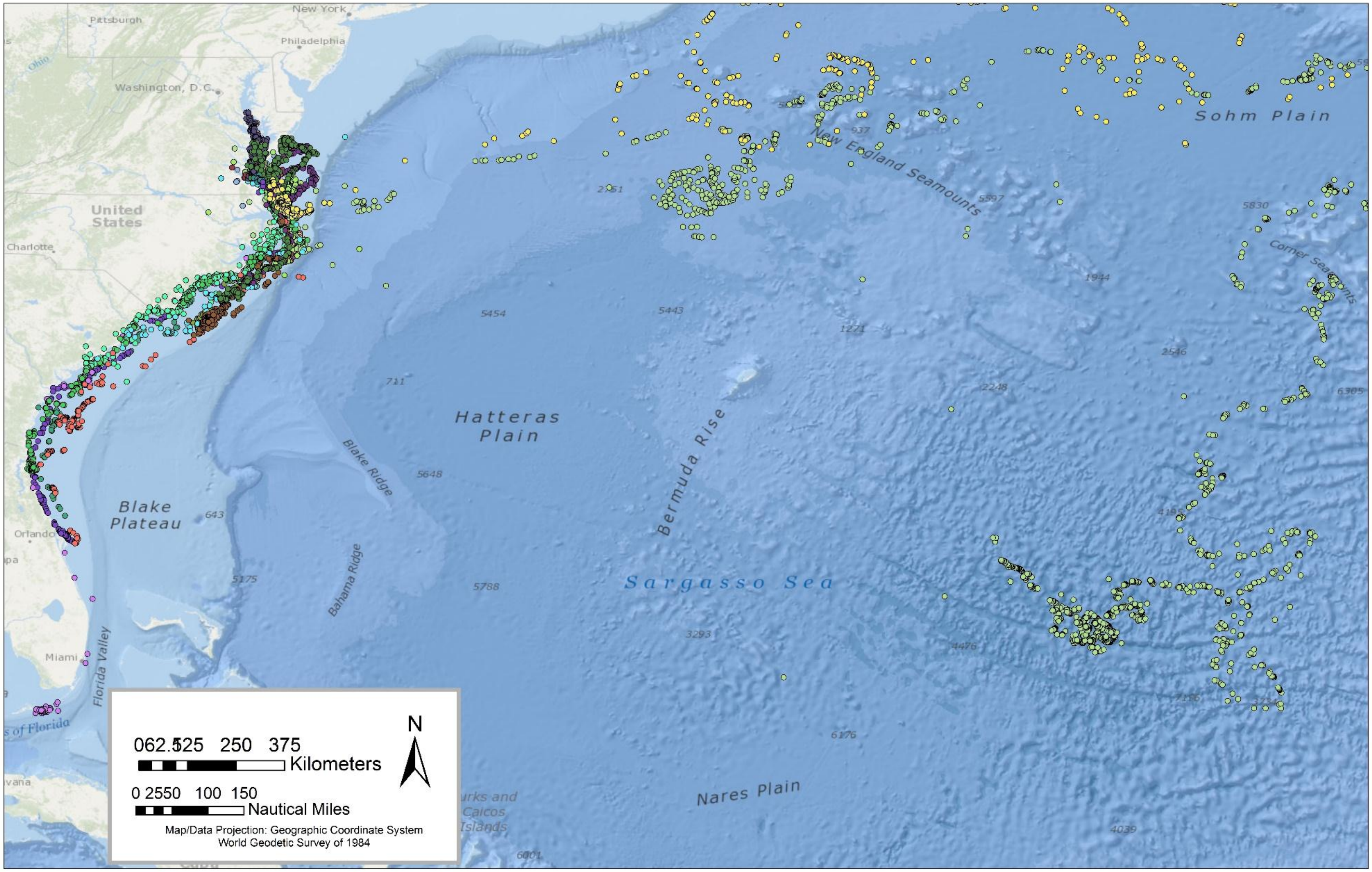

Figure 35. Argos location points of historically tagged turtles by VAQ to be included in the project for habitat use and density modeling. The map includes 19 turtles tagged between 2005 and 2013 as well as the five turtles tagged for the project in 2013.

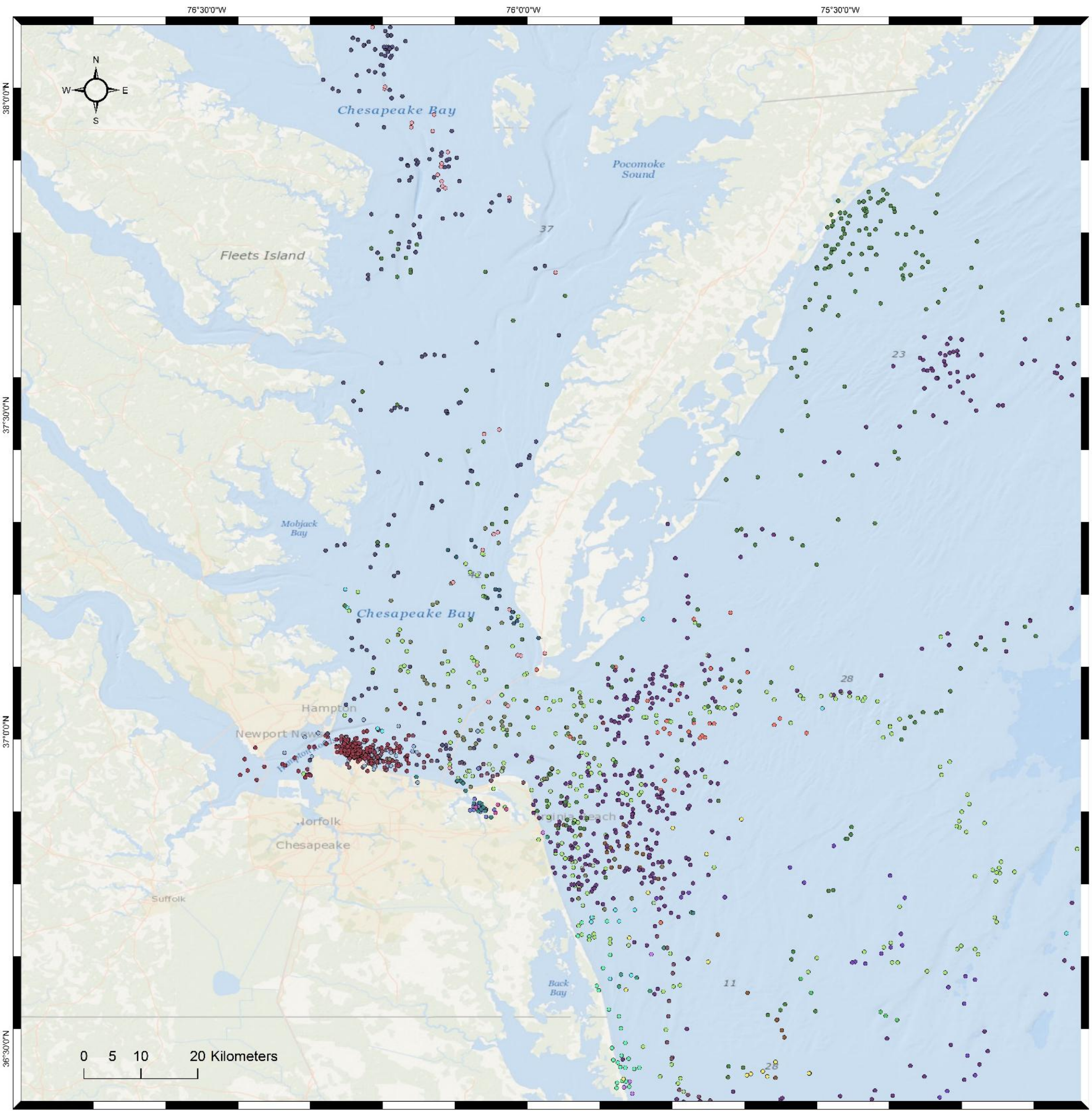

Figure 36. Argos location points of historically tagged turtles by VAQ to be included in the project for habitat use and density modeling.

During December 2013, U.S. Navy GIS analysts met with VAQ to determine roles for analysis of the first year of data, recognizing that many of the tags are still actively transmitting. Exploratory data products, including a comparison of satellite telemetry and acoustic tag data from a double-tagged animal and home ranges for historical tags, will be completed in Spring 2014 and reported in next year's Annual Monitoring Report.

For the remainder of this study, VAQ has one U.S. Navy-funded Wildlife Computers SPOT-5 tag and six VEMCO sonic tags to deploy in the remainder of the 2014 field season. In-water work for 2014 will commence in May when water temperatures rise to support the migration of turtles into Virginia waters. In May and June, when water temperatures are relatively cool and sea turtles tend to bask on the water's surface, VAQ will attempt to capture animals in ocean waters (out to 18.5 km offshore) using dip nets. As waters warm and turtles move into shallow bay waters, we will deploy the tangle net in Chesapeake Bay. Currently VAQ has a total of nine animals in rehabilitation (four loggerheads, four Kemp's ridleys, and one green), seven of which are potential candidates to be released with tags in 2014.

For more information, refer to the annual progress report for this project (Barco and Lockhart 2014).

3.4 Passive Acoustic Monitoring

3.4.1 Towed Array and Seaglider

During 3 days (09–11 October 2012) of the DUNCOC cruise off Cape Hatteras, a four-element hydrophone array was towed approximately 170 m behind the R/V *Cape Hatteras* in order to detect the presence of vocalizing cetaceans. Passive acoustic recordings were collected on 2 days (09–10 October 2012) during this cruise by a buoyancy-driven iRobot Seaglider®, outfitted with a digital acoustic monitor programmed to make continuous acoustic recordings. Additionally, while conducting a survey as part of the Deep Diving Odontocete project (see **Section 3.2.1**), a four-element hydrophone array was towed for approximately 30 min following a sighting of a *Mesoplodon* spp. on 28 May 2013. These acoustic recordings were analyzed for beaked whale clicks and none were identified, although echolocation clicks and whistles from other nearby unknown cetacean species were present.

The towed-array recordings made during the 3 days (09–11 October 2012) of vessel surveys in the Cape Hatteras survey area, totaling 33.8 hr, were analyzed in 10-min time bins and scored for presence or absence of odontocete vocalizations. **Table 43** summarizes the detections made in the recordings.

Table 43. Summary of detections of marine mammal vocalizations made in the October 2012 Cape Hatteras towed array recordings. Note that measurements are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed). Unidentified odontocete whistles and clicks, which often occurred concurrently, were separated into different call types (and also combined) here.

Species	Call Type	Total Detection Duration (hr)	Percent of Total Recording Time
Unidentified Odontocete	Whistles	23.2	68.5
Unidentified Odontocete	Clicks	19.0	56.2
Unidentified Odontocete	All (whistles & clicks)	24.5	72.4
Sperm Whale	Clicks	0.3	0.88

The passive acoustic recordings collected by the glider from 09 to 10 October 2012, totaling approximately 18 hr, were analyzed for marine mammals sounds after removing periods of noise that were unusable due to the seaglider making course corrections or adjusting buoyancy. Sixty-second time bins were scored for presence or absence of odontocete vocalizations. **Table 44** summarizes the detections made in the recordings.

Table 44. Summary of detections of marine mammal vocalizations made in the October 2012 Cape Hatteras seaglider recordings. Note that measurements are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed). Unidentified odontocete whistles and clicks, which often occurred concurrently, were separated into different call types (and also combined) here.

Species	Call Type	Total Detection Duration (hr)	Percent of Total Recording Time
Unidentified Odontocete	Whistles	12.9	78.6
Unidentified Odontocete	Clicks	8.0	48.8
Unidentified Odontocete	All (whistles & clicks)	13.5	81.5

3.4.2 High-Frequency Acoustic Recording Packages (HARPs)

High-Frequency Acoustic Recording Package (HARP) deployments continue to be a primary component of the baseline monitoring effort in the VACAPES, CHPT, and JAX Range Complexes. Although data analysis is ongoing, the following sections provide a summary of activities performed during the reporting period. **Table 45 and Figure 37** summarize all HARP deployments made to date with links to available technical reports. **Table 46** summarizes all HARP deployment data analyzed during the reporting period.

Table 45. All HARP deployments made from 2007 through 2013.

Location	Deployment ID	Latitude	Longitude	Depth (m)	Deployment Date	Retrieval Date	Recording Start Date	Recording End Date	Duty Cycle (minutes on/off)	Status of Analysis	Report Available
JAX											
JAX A	JAX01A	30.2771	-80.1258	82	30MAR09	16SEP09	02APR09	25MAY09	5/10	HF	No
JAX B	JAX01B	30.2582	-80.4282	37	30MAR09	16SEP09	02APR09	05SEP09	5/10	HF, LF	No
JAX A	JAX02A	30.28052	-80.21603	83	16SEP09	21FEB09	16SEP09	15DEC09	5/10	HF, LF	No
JAX B	JAX02B	30.25820	-80.42800	39	23SEP09	21FEB09	No data	No data	5/10	N/A	No – no data
JAX A	JAX03A	30.28111	-80.21530	89	21FEB10	26AUG10	22FEB10	30JUL10	5/10	HF, M	No
JAX B	JAX04B	30.25919	-80.42566	38	09MAR10	26AUG10	09MAR10	19AUG10	5/10	HF, M	Yes - D
JAX A	JAX05A	30.26819	-80.20894	91	26AUG10	01FEB11	26AUG10	25JAN11	5/10	HF, LF	Yes - T, D
JAX B	JAX05B	30.25708	-80.43269	37	26AUG10	01FEB11	27AUG10	01FEB11	5/10	HF, LF	Yes - T, D
JAX A	JAX06A	30.27818	-80.22085	91	01FEB11	14JUL11	01FEB11	14JUL11	5/10	HF, LF	Yes - T, D
JAX B	JAX06B	30.25768	-80.42781	37	02FEB11	14JUL11	02FEB11	14JUL11	5/10	HF, LF	Yes - T, D
JAX A	JAX08A	30.28501	-80.22141	91	24JAN12	abandoned	27JAN12	unknown	continuous	abandoned	No – no data
JAX C	JAX09C	30.33287	-80.20071	94	12MAY13	N/A	13MAY13	N/A	continuous	N/A	N/A
ONSLOW											
Onslow Bay A	USWTR01A	33.79138	-76.52382	162	09OCT07	27MAY08	10OCT07	16JAN08	5/5*	HF, LF	Yes - T
Onslow Bay B	USWTR02B	33.81107	-76.42829	232	30MAY08	24NOV08	30MAY08	10SEP08	5/5	HF, LF	Yes - T
Onslow Bay A	USWTR03A	33.78951	-76.51920	174	24APR09	16SEP09	24APR09	09AUG09	5/5	HF, LF	Yes - T
Onslow Bay A	USWTR04A	33.78733	-76.52409	171	08NOV09	19JUN10	08NOV09	24FEB10	5/10	HF, LF	Yes - T
Onslow Bay C	USWTR04C	33.67784	-76.47689	335	08NOV09	19JUN10	08NOV09	20APR10	5/10	HF, LF	Yes - T
Onslow Bay A	USWTR05A	33.79316	-76.51620	171	29JUL10	10JUN11	30JUL10	03MAR11	5/5	HF, LF	Yes - T
Onslow Bay D	USWTR05D	33.58065	-76.55015	338	29JUL10	10JUN11	30JUL10	24FEB11	5/5	IP, F	No
Onslow Bay E	USWTR06E	33.77794	-75.92641	952	18AUG11	13JUL12	19AUG11	01DEC11	5/5	HF, LF	Yes - T, D
Onslow Bay E	USWTR07E	33.78666	-75.92915	914	13JUL12	24OCT12	14JUL12	02OCT12	5/5	HF, LF	Yes - T, D
Onslow Bay E	USWTR08E	33.78696	-75.92801	853	24OCT12	08AUG13	24OCT12	30JUN13	5/5	NS	No
CAPE HATTERAS											
Cape Hatteras A	Hatteras01A	35.34054	-74.85761	950	15MAR12	09OCT12	15MAR12	11APR12	continuous	HF, LF	Yes - T
Cape Hatteras A	Hatteras02A	35.3406	-74.85590	970	09OCT12	29MAY13	09OCT12	09MAY13	continuous	IP	No
Cape Hatteras A	Hatteras03A	35.34445	-74.8521	970	29MAY13	N/A	29MAY13	N/A	continuous	N/A	N/A

Notes: For Status of Analysis: HF = high-frequency (odontocete, > 1 kHz) analysis completed; LF = low-frequency (mysticete, < 1 kHz) analysis completed; F = low-frequency analysis completed only for fin whale 20-Hz pulses; M = low-frequency analysis completed only for minke whale pulse trains; IP = analysis in progress; N/A = not applicable, because data is not yet available for analysis; NS = analysis not started, but data is available for analysis. For Report of Details?: T = technical report; D = detailed report; N/A = not applicable, because HARP is still in the field. Key: JAX = Jacksonville Range Complex; m = meter(s); USWTR=Undersea Warfare Training Range. * = represents the initial duty cycle, but instrument recorded continuously starting 01 January 2008.

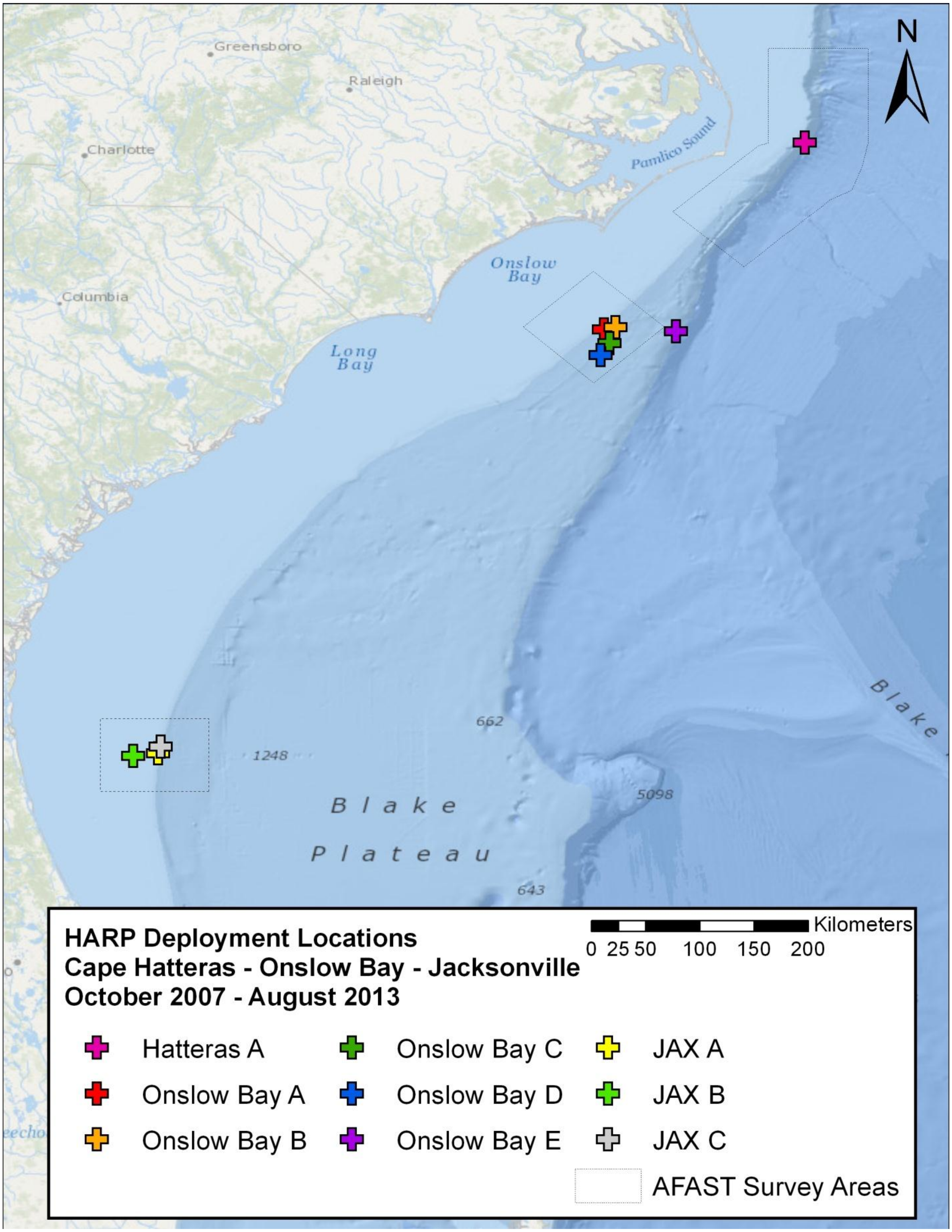

Figure 37. HARP deployment locations in the Cape Hatteras, Onslow Bay, and JAX survey areas.

Table 46. HARP deployments analyzed during the reporting period.

Location	Site	Latitude	Longitude	Depth (m)	Recording Period	Sampling Rate	Duty Cycle
Hatteras	A	35.34054	-74.85761	950	15 March 2012 – 11 April 2012	200 kHz	Continuous
Onslow Bay	A	33.79316	-76.51620	171	30 July 2010 – 03 March 2011	200 kHz	5-Min On/5-Min Off
JAX	A	30.26819	-80.20894	90	26 August 2010 – 25 January 2011	200 kHz	5-Min On/10-Min Off
JAX	B	30.25708	-80.43269	35	27 August 2010 – 01 February 2011	200 kHz	5-Min On/10-Min Off
JAX	A	30.27818	-80,22085	91	01 February 2011 – 14 July 2011	200 kHz	5-Min On/10-Min Off
JAX	B	30.25768	-80.42782	37	02 February 2011 – 14 July 2011	200 kHz	5-Min On/10-Min Off

Key: JAX = Jacksonville; kHz = kilohertz; min = minute(s)

3.4.2.1 Cape Hatteras

Two HARP deployments were made at Site A in the Cape Hatteras survey area during this reporting period (**Table 47, Figure 37**). The HARP most recently deployed on 29 May 2013 is scheduled to be retrieved, refurbished, and redeployed in February or March 2014.

Table 47. Deployment details for the Hatteras HARPs, August 2012 through December 2013.

Site	Deployment Date	Retrieval Date	Latitude	Longitude	Depth (m)	Sampling Rate	Duty Cycle	Amount of Data
A	15-Mar-12	09-Oct-12	35.34054	-74.85761	950	200 kHz	Continuous	0.88 TB
A	09-Oct-12	29-May-13	35.34060	-74.85590	970	200 kHz	Continuous	6.66 TB
A	29-May-13	N/A	35.34445	-74.85210	970	200 kHz	Continuous	N/A

Key: kHz = kilohertz; m = meter(s); N/A = not available; TB = terrabyte

During the reporting period, the data from the March–April 2012 Cape Hatteras Site A HARP deployment (see **Table 46** for location and recording period information) were manually scanned for marine mammal vocalizations using the "logger" version of *Triton* (v1.81.20121030). **Table 48** summarizes the acoustic detections found in the data. The spectral characteristics of the beaked whale clicks were measured and compared with known beaked whale species templates using custom *Matlab* scripts. Each vocal event was tentatively identified as either Gervais' beaked whale (eight events) or Cuvier's beaked whale (three events).

Table 48. Summary of detections of marine mammal vocalizations made in the March–April 2012 Cape Hatteras Site A HARP data. For all species, total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in 1-minute bins. Note that all parameters are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed).

Species	Call Type	Total Duration of Vocalizations (hr)	Percent of Recording Duration	Days with Vocalizations	Percent of Recording Days
Fin Whale	20 Hz	45.13	7.09	14	50.00
Minke Whale	Pulse train (Slow-down, Speed-up, Regular)	51.5	8.10	27	96.43
Unidentified Odontocete	Clicks, Whistles, Burst-pulses	491.57	77.20	28	100
Beaked Whale sp.	Clicks	1.77	0.28	11	39.29
Kogia sp.	Clicks	0.1	0.02	1	3.57
Risso's Dolphin	Clicks	2.47	0.39	2	7.14
Sperm Whale	Clicks	65.27	10.25	26	92.86

Key: hr = hour(s); Hz = hertz

Analysis is currently underway for the Cape Hatteras HARP deployed at Site A on 09 October 2012. Analysis of beaked whale and sperm whale clicks has been completed for this HARP.

3.4.2.2 Onslow Bay

Two HARP retrievals and one HARP deployment were made at Site E in the Onslow Bay survey area during the reporting period (**Table 49, Figure 37**). There is no HARP currently deployed in Onslow Bay because weather conditions during a deployment trip in August 2013 did not allow for a safe deployment. In early October of 2013, attempts to deploy the HARP failed due to engine issues with the charter vessel. The charter vessel is now fixed and a HARP with an extra battery pressure case is ready to be deployed in Onslow Bay at Site E during the next available weather window.

Table 49. Deployment details for the Onslow Bay HARPs, August 2012 through December 2013.

Site	Deployment Date	Retrieval Date	Latitude	Longitude	Depth (m)	Sampling Rate	Duty Cycle	Amount of Data
E	13-Jul-12	24-Oct-12	33.78666	-75.92915	914	200 kHz	5-min on/5-min off	1.27 TB
E	24-Oct-12	8-Aug-13	33.78696	-75.92801	853	200 kHz	5-min on/5-min off	3.91 TB

Key: kHz = kilohertz; m = meter(s); N/A = not available; TB = terrabyte

The HARP recovered in October 2012 contained just over 2 months of data, less than originally expected. After conducting freezer experiments with the alkaline battery packs, it was determined that the battery power was likely not affected by the colder temperatures at deeper deployment sites and that issues with the firmware when collecting duty-cycled data was the most probable cause of the lower yield of data. Future deployments will record continuously to avoid these issues.

During the reporting period, the data from the July 2010–March 2011 Onslow Bay Site A HARP deployment (see **Table 46** for location and recording period information) were manually scanned for marine mammal vocalizations using the "logger" version of *Triton* (v1.81.20121030). **Table 50** summarizes the acoustic detections found in the data.

Table 50. Summary of detections of marine mammal vocalizations made in the July 2010–March 2011 Onslow Bay Site A HARP data. For all species, total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in 1-minute bins. Note that all parameters are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed).

Species	Call Type	Total Duration of Vocalizations (hr)	Percent of Recording Duration	Days with Vocalizations	Percent of Recording Days
Blue Whale	A and B Calls (Mainly A)	57.35	2.02	72	33.03
Possible Blue Whale	26 – 27 Hz	8.17	0.29	7	3.21
Fin Whale	20 Hz	93.67	3.31	65	29.82
Minke Whale	Pulse Train (Slow-down, Speed-up, Regular)	48.58	1.72	56	25.69
North Atlantic Right Whale	Up-call, Moan, Variable Call	0.43	0.02	2	0.92
Possible Sei Whale	Downsweep	9.95	0.35	20	9.17
Unidentified Odontocete	Clicks, Whistles, Burst-pulses	441.27	15.58	207	94.95
Kogia sp.	Clicks	0.27	0.01	4	1.83
Risso's Dolphin	Clicks	12.63	0.45	19	8.72
Sperm Whale	Clicks	5.45	0.19	14	6.42

Key: hr = hour(s); Hz = hertz

Analysis is currently underway for the Onslow Bay HARP deployed at Site D (33.58065° N, 76.55015° W) at a depth of 338 m on 29 July 2010. Analysis of minke whale (*Balaenoptera acutorostrata*) pulse trains and fin whale 20-Hz calls has been completed for this HARP.

3.4.2.3 JAX

During the reporting period, several attempts (including trying to communicate at various distances around the drop site and using a Humminbird® 998c side-scan sonar to search the area) were made to retrieve the HARP that was deployed at Site A (30.28501° N, 80.22142° W) on 24 January 2012 at a depth of 91 m. A decision was made to cease recovery efforts when these attempts failed.

Also during this reporting period, one HARP was deployed at Site C in the JAX survey area (**Table 51, Figure 37**). This HARP is scheduled to be retrieved, refurbished, and redeployed in January-February 2014.

Table 51. Deployment details for the JAX HARPs, August 2012 through December 2013.

Site	Deployment Date	Retrieval Date	Latitude	Longitude	Depth (m)	Sampling Rate	Duty Cycle	Amount of Data
A	24-Jan-12	Abandoned	30.28501	-80.22142	91	200 kHz	Continuous	N/A
C	12-May-13	N/A	30.33287	-80.20071	94	200 kHz	Continuous	N/A

Key: kHz = kilohertz; m = meter(s); N/A = not available

During the reporting period, members of the Scripps Whale Acoustics Lab manually scanned the data from the 26 August 2010 and 01 through 02 February 2011 JAX HARP deployments at Sites A and B (see **Table 46** for location and recording period information) for marine mammal vocalizations and anthropogenic sounds using the "logger" version of *Triton*. Debich et al. (2013) provides the full report of these findings, but **Tables 52 through 55** summarize the acoustic detections found in these datasets.

Analysis for mysticete vocalizations in the JAX HARP deployments from Sites A and B that occurred between March 2009 and August 2010 will be conducted during the next reporting period.

Table 52. Summary of detections of marine mammal vocalizations made in the August 2010–January 2011 JAX Site A HARP data. *For mysticetes, total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in hourly bins; for odontocetes, total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in 1-minute bins. Note that all parameters are calculated individually for each species' call type and thus should not be examined by row (and rows should not be summed).

Species	Call Type	Total Duration of Vocalizations (hr)*	Percent of Recording Duration*	Days with Vocalizations	Percent of Recording Days
Fin Whale	20 Hz	39	1.09	6	3.92
Minke Whale	Pulse Train (Slow-down, Speed-up)	105	2.95	14	9.15
Minke Whale	Pulse Train (Regular)	2	0.06	1	0.65
Possible Sei Whale	Downsweep	2.52	0.22	2	1.31
Possible Mysticete	5-pulse Sound	120	3.37	24	15.69
Unidentified Odontocete	Clicks, Whistles	788.45	60.94	151	98.69
Risso's Dolphin	Clicks	15.42	1.19	20	13.07

Key: hr = hour(s); Hz = hertz

Table 53. Summary of detections of marine mammal vocalizations made in the February 2011–July 2011 JAX Site A HARP data. Note that most of the low- and mid-frequency data could not be analyzed due to high ambient noise levels. Total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in 1-minute bins. Note that all parameters are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed).

Species	Call Type	Total Duration of Vocalizations (hr)	Percent of Recording Duration	Days with Vocalizations	Percent of Recording Days
Unidentified Odontocete	Clicks, Whistles	735.65	56.46	151	92.07
Risso's Dolphin	Clicks	0.65	0.05	1	0.61

Table 54. Summary of detections of marine mammal vocalizations made in the August 2010–February 2011 JAX Site B HARP data. Note that all of the low- and mid-frequency data could not be analyzed due to high ambient noise levels. Total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in 1-minute bins. Note that are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed).

Species	Call Type	Total Duration of Vocalizations (hr)	Percent of Recording Duration	Days with Vocalizations	Percent of Recording Days
Unidentified Odontocete	Clicks, Whistles	338.92	25.03	148	93.08

Table 55. Summary of detections of marine mammal vocalizations made in the February 2011–July 2011 Jacksonville Site B HARP data. *For mysticetes, total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in hourly bins; for odontocetes, total duration of vocalizations (hr) and percent of recording duration are based on data analyzed in 1-minute bins. Note that are calculated individually for each species' call type and thus should only be examined by row (and rows should not be summed).

Species	Call Type	Total Duration of Vocalizations (hr)*	Percent of Recording Duration*	Days with Vocalizations	Percent of Recording Days
Humpback Whale	Song or Non-song (Unspecified)	1	0.03	1	0.61
Unidentified Odontocete	Clicks, Whistles	316.43	23.23	139	85.28

3.4.3 Passive Acoustic Monitoring of Dolphins in the VACAPES W-50 MINEX Range

To better understand the potential impact of MINEX training on marine mammals, an effort was initiated by Oceanwide Science Institute in August 2012 (and is currently still ongoing) to monitor odontocete activity at the W-50 MINEX training range in the VACAPES Range Complex using passive acoustic methods. The initial objectives of the project were to establish the daily and seasonal patterns of occurrence of dolphins in the W-50 MINEX training range, to detect explosions related to MINEX activities, and to determine whether dolphins in the area show evidence of a response to MINEX events. EARs programmed to achieve continuous monitoring were deployed and refurbished approximately every 2 months. The EAR is a microprocessor-based autonomous recorder that samples the ambient sound field on a programmable duty cycle (Lammers et al. 2008).

During August 2012, four EARs were programmed to sample at a rate of 50 kHz for 180 seconds (3 min) every 360 seconds (6 min), providing approximately 25 kHz of Nyquist bandwidth recording at a 50 percent duty cycle. This bandwidth is sufficient to detect signals (whistles and the low frequency end of clicks) from Atlantic bottlenose dolphins and other delphinid species potentially occurring in the area that produce signals at frequencies less than 25 kHz; however, harbor porpoise (*Phocoena phocoena*) clicks, with center and peak frequencies of 130 to 140 kHz (Goodson and Sturtivant 1996), are above the recording range of these EARs.

The four EARs were paired and co-located approximately 1 km apart and their recording periods were offset so that one unit was recording while the other was off. As a result, one of the paired units was always 'on' in order to detect any nearby explosions. Two of the paired EARs (units A and B) were placed in 13 m and 14 m water depths, respectively and approximately 1 km from a site that was considered to be the 'epicenter' of MINEX activity (**Figure 38**). This is a search field location where the majority (approximately 95 percent) of MINEX detonations were expected to occur each year. The other two EARs (units C & D) were deployed in 15 m and 16 m water depth (respectively) approximately 5 km to the SSE of EARs A and B near another mine search field area. Of the four EARs that were initially deployed in August 2012, only one (from site B) was successfully retrieved 2 months later. The EAR from site A was recovered on a beach in North Carolina in November 2012 but the hard drive was damaged and the data were unusable. The EARs from site C and D were not recovered. The loss of the three EARs was likely due to a malfunction in the EAR anchoring system. As a result of the loss of the two instruments, monitoring at sites C and D was discontinued. The EARs were recovered, refurbished and re-deployed by staff from HDR, Inc. approximately every 2 months, or as weather conditions and logistics allowed.

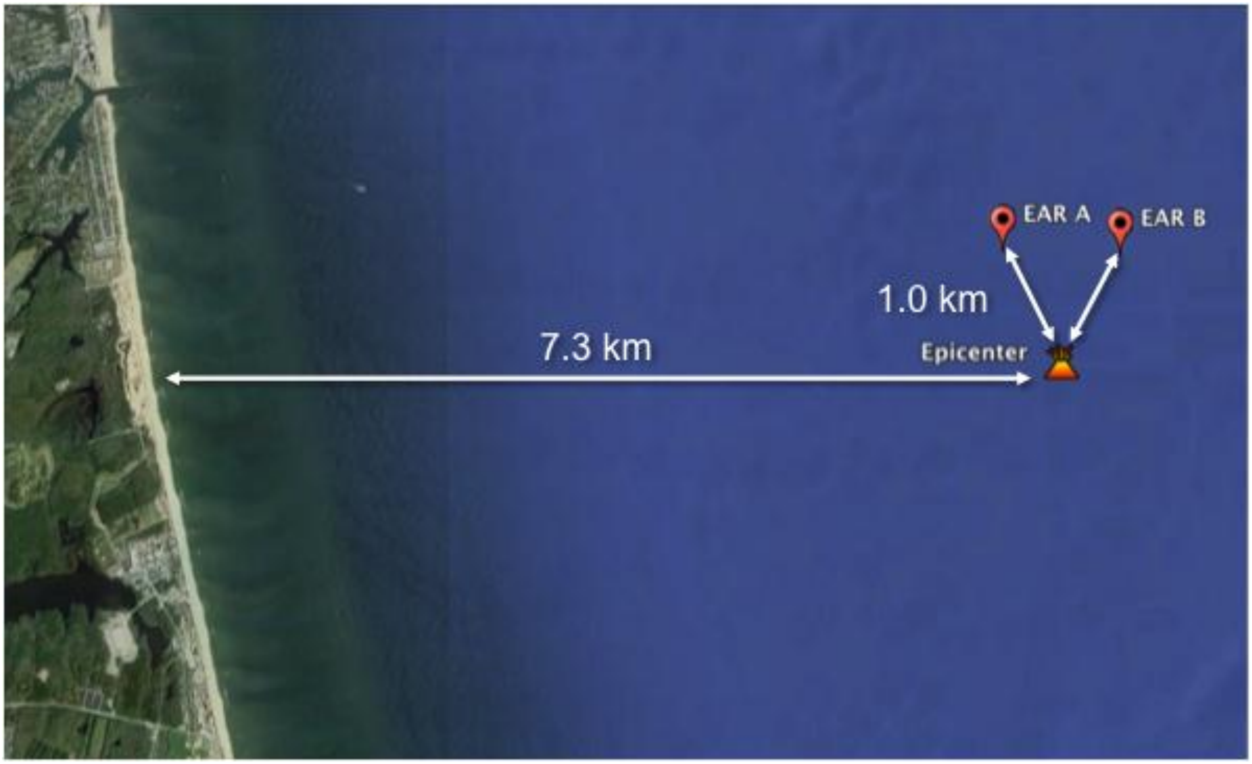

Figure 38. Configuration and spacing of EARs A and B in relation to the Virginia coastline and the 'epicenter' of MINEX activity during the first year of monitoring.

The analysis of recordings for the presence/absence of dolphin signals from site B was completed for the period of 15 August 2012 to 31 July 2013. Preliminary analyses reveal that dolphins are present daily in or near the MINEX range; detections were made on 98 percent of the 308 recording days (**Figure 39**). Species identity for the detections cannot be verified without the application of classification algorithms, but it is reasonable to assume that based on small-vessel survey effort conducted to date (refer to **Section 3.2.3.1**), that the majority of detections are from bottlenose dolphins. The results indicate that dolphins are present daily in or near the MINEX range, but that there are significantly fewer detections made during the period between December and February (One-way ANOVA, $p < 0.001$), with the lowest overall activity observed in February (**Figure 40**). No data are available for November 2012, because the EAR was not deployed due to weather and logistical constraints.

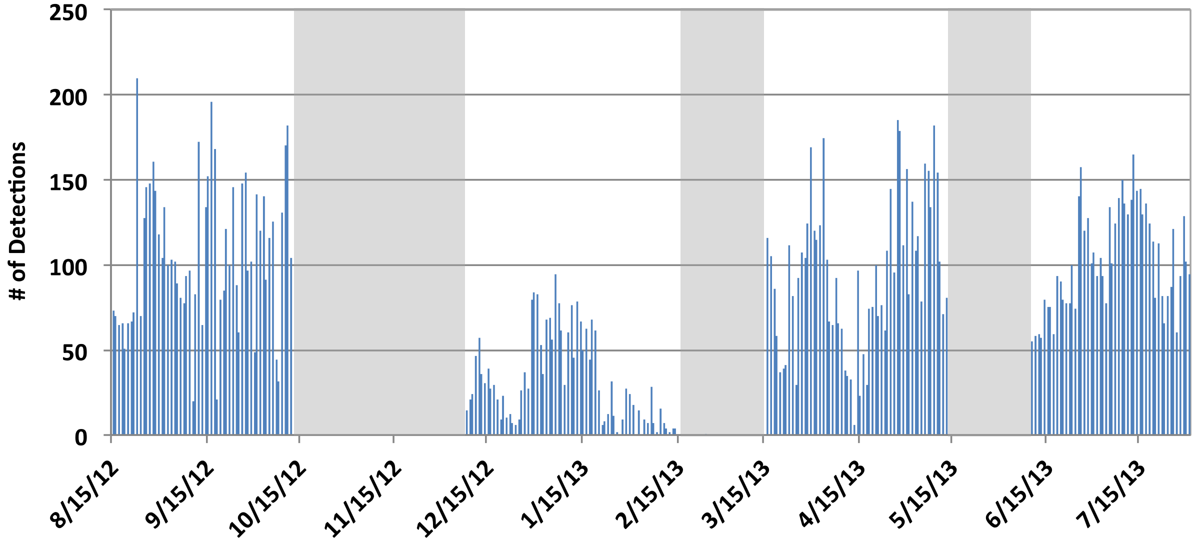

Figure 39. Daily number of dolphin detections at EAR site B from 15 August 2012 through 31 July 2013. Shaded areas represent periods when the EAR was not deployed, or was not recording due to battery failure.

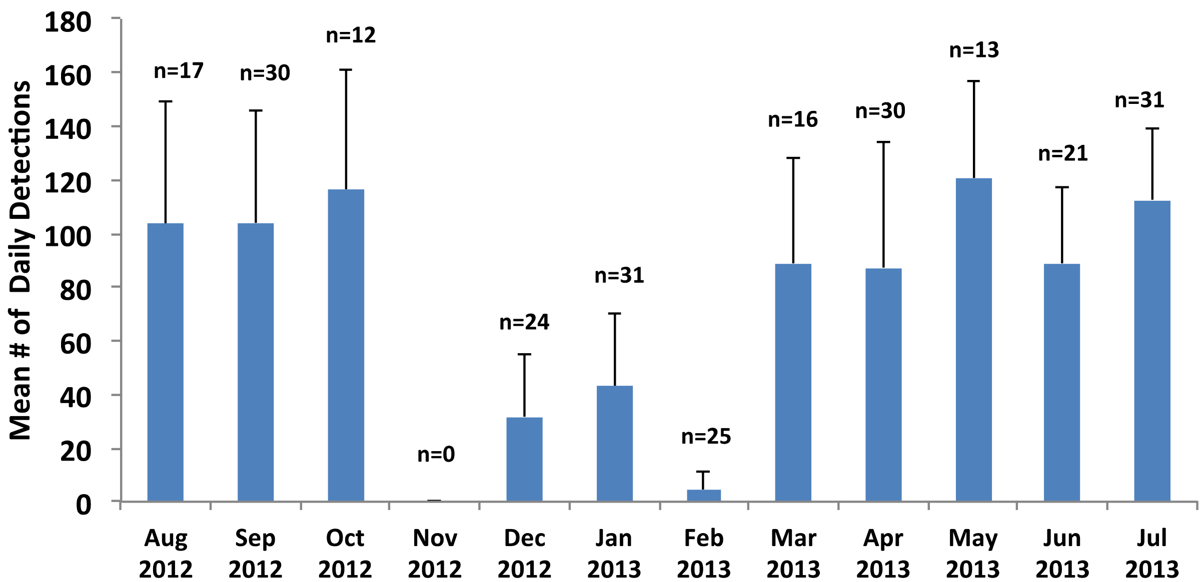

Figure 40. Mean number of daily dolphin detections at EAR site B by month. Error bars represent one standard deviation. 'n' values give the number of days that were monitored during each month. No data were collected in November 2012.

A total of 18 explosions were detected in the data analyzed between 15 August 2012 and 19 August 2013. Dolphin acoustic activity was quantified for the day before, during, and after explosions for 17 of these events. Two explosions on 11 September 2012 occurred within 5 min of each other, so they were treated as a single event. The acoustic activity associated with the explosion on 30 July 2013 is currently being analyzed, and results will be presented in a future technical report. Dolphin activity was quantified and compared on progressively longer time scales (seconds, min, hr, days) relative to each explosion.

Figure 41 shows the mean number of whistles counted during the 30 seconds immediately preceding and following an explosion. The data reveal that dolphins exhibit a short-term acoustic response immediately following an explosion event.

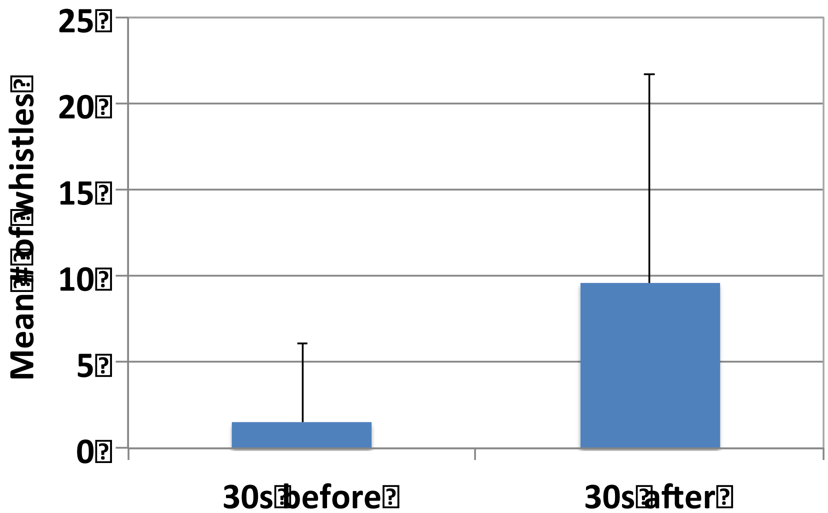

Figure 41. Whistle production observed 30 seconds before and after explosions (*n*=16). Error bars represent one standard deviation.

Acoustic activity increases briefly and then declines substantially during the hours following an explosion. There were significantly more whistles recorded immediately after an explosion (Mann-Whitney U-test, *n*=16, p=0.02). This pattern is also shown in **Figure 42** where the mean acoustic indices are presented for the recordings before, during, and after an explosion. The mean index was significantly greater for the recordings containing the explosion than for the recordings before and after the explosion (One-way ANOVA, *n*=16, p=0.05). This response persists during the day following the exercise. The duration of the response until normal behavior is re-established is not yet known.

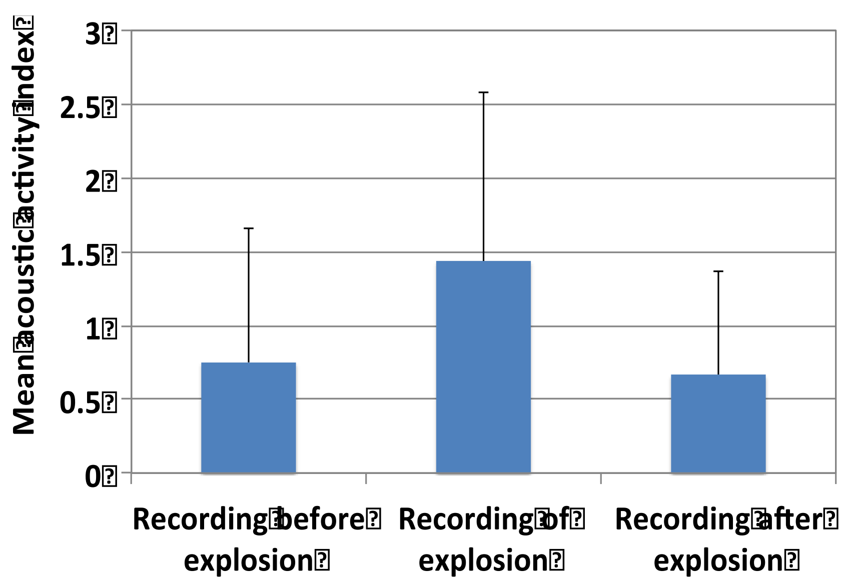

Figure 42. Dolphin acoustic activity observed in the 3-minute recording before, during, and after an explosion (*n*=16). Error bars represent one standard deviation.

It is not clear yet whether the responses observed represent a shift in acoustic behavior or a spatial redistribution of animals. To address these issues, a second phase to the project was begun in September 2013. Alternating 2-month deployments in 2013 and 2014 will consist of two different EAR array configurations. The data obtained from liner coastal array deployments will be used to examine the acoustic activity of dolphins at the four locations during the days before, during, and after MINEX training events to determine the range at which an acoustic response by dolphins is observed. Data from the four coastal locations will also be used to determine whether there is a re-distribution of animals following MINEX training activities.

During the first linear coastal array configuration that was deployed on 21 September 2013, four EARs were placed southerly-oriented, with units spaced at distances of 1 km (unit B), 3 km (unit E), 5 km (unit F) and 10 km (site G) from the known primary MINEX training site (the 'epicenter'). Only three of the units were successfully retrieved on 11 November 2013. The EAR located 5 km from MINEX training area (unit F) did not respond to commands from the surface transponder used to communicate with the acoustic release and is presumed lost. The most likely explanation is that it was moved or picked up by a fishing trawler. The lost EAR will be replaced with a new unit before the next linear coastal array deployment planned for February 2014. The linear coastal array will be shifted to the east and to the north during subsequent alternating EAR redeployments (**Figure 43**).

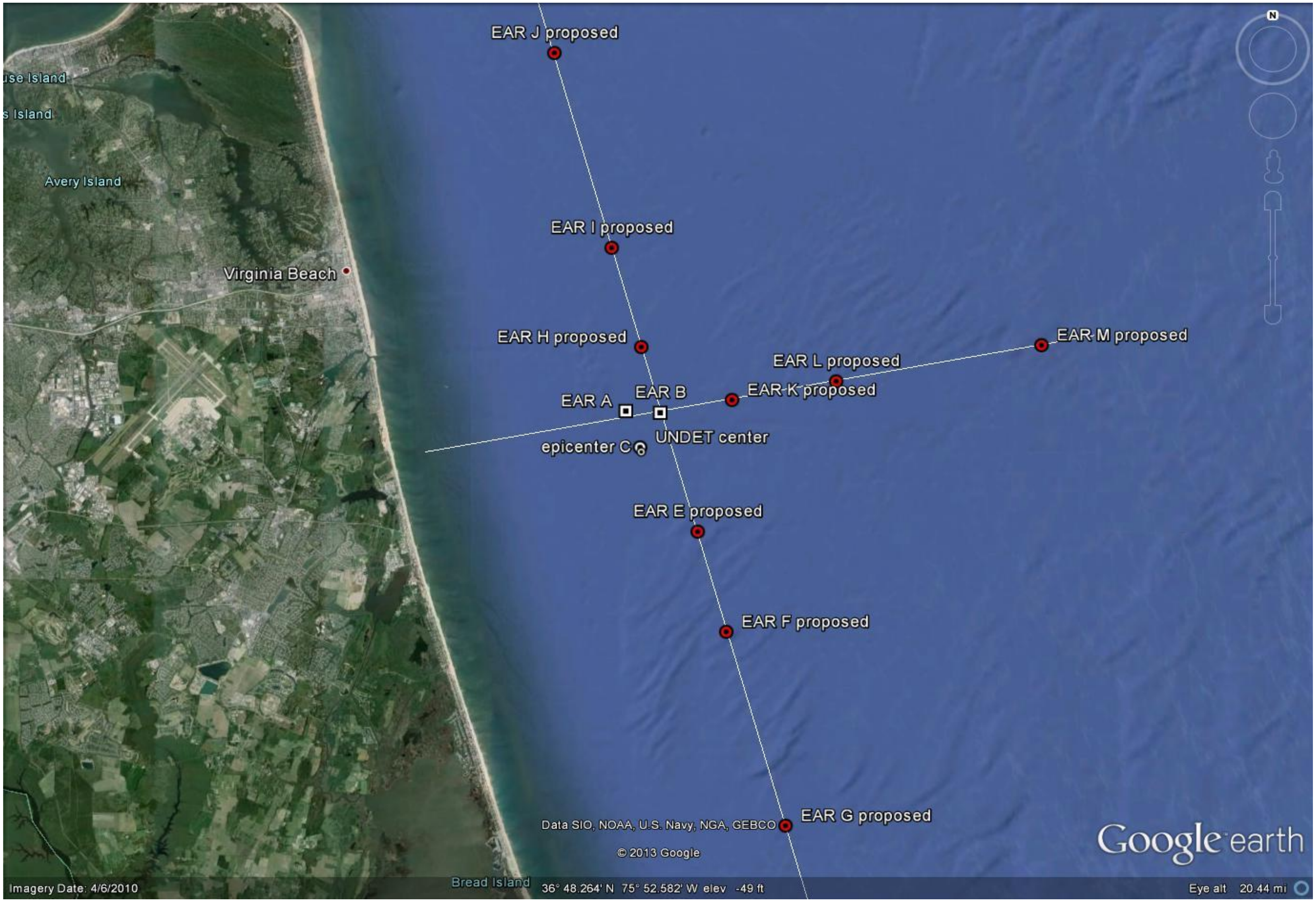

Figure 43. Spatial configuration of three linear coastal EAR arrays (north, east and south) that will be used during the second year of the project. Only one 4-EAR linear array will be deployed at any given time.

In the second configuration, EARs are arranged in a localization array to determine the distances that animals occur from MINEX training activities. This information will be useful to better understand the nature of behavioral responses and will inform any future efforts to establish sound exposure levels. Other open questions still to be addressed include the duration of the responses exhibited by dolphins to MINEX training events, and whether the magnitude/duration of the responses is tied to factors such as the time of year, weather, and the size of the explosive charges used. The first localization array, with EARs separated by approximately 100 m, was deployed on 16 November 2013, and is currently in the field.

For additional details, refer to the annual progress report for this project (Lammers et al. 2014). The reader is also referred to **Section 3.2.3.1** for analyses of C-PODs deployed off the coast of Virginia that provide information complementary to the study using EARs.

3.4.4 Autonomous Recorder Deployments

Autonomous recorders have been used for monitoring during ASW exercises. These recorders are typically deployed 1 week prior to planned ASW exercises and record for approximately 1 week following an exercise. **Table 56** lists autonomous recorder deployments from 2008 through 2013 in the AFAST Study Area; deployments prior to this reporting period were discussed in detail during the Annual Report for the previous monitoring period (DoN 2012a) and in the 5-year comprehensive report (DoN 2013e). Details on deployments during the current reporting period are discussed here.

Table 56. Summary of autonomous recorder deployments during 2008 through 2013.

Deployment Date	Type of Autonomous Recorder	Study Area	For More information on Deployments and/or Analysis
July 2008	MARUs	Onslow Bay	DoN (2012a)
September 2009	9 MARUs	JAX	Norris et al. (2012); Oswald et al. (2014)
December 2009	9 MARUs	JAX	Norris et al. (2012); Oswald et al. (2014)
September 2011	12 AMARs	JAX	DoN (2012a)
November 2013	4 AMARs	VACAPES	Martin (2014)

Note: AMAR = Autonomous Multi-channel Acoustic Recorders (www.jasco.com); MARU = Marine Autonomous Recording Units, (www.birds.cornell.edu/brp/hardware/pop-ups), also known as "pop-ups."

Cape Hatteras Localization Trial

As the U.S. Navy continues its due diligence and environmental compliance efforts to improve and expand monitoring and research activities to understand and minimize the potential for impacts to marine mammals from sonar operations, there is a pressing need to assess how marine mammals respond in situ to real-world naval activities. While there has been progress and useful data generated in experimental behavioral response studies (BRS) to measure the effects of military sonar (Southall et al. 2007; Tyack et al. 2011, Southall et al. 2012), to date these studies are limited in applicability to realistic scenarios by their use of scaled-down and often stationary sound sources.

Measurements of behavioral responses of marine mammals to active sonar systems associated with actual naval exercises remain critically needed. The Scientific Advisory Group (DoN 2010e) reiterated the top-level goals of the U.S. Navy's ICMP which included, "an increase in our understanding of how individual marine mammals…respond (behaviorally or physiologically) to the specific stressors associated with the action (in specific contexts, where possible e.g., at what distance or received level)." The SAG went on to emphasize the need to consider the contextual aspects of exposure and to specify the importance of monitoring realistic operations. The U.S. Navy has made recent advances in this field, most notably in the monitoring of responses to sonar operations at the Atlantic Undersea Test and Evaluation Center (AUTEC) range in the Bahamas (McCarthy et al. 2011, Jarvis et al. 2014). However these operations occur in one particular location and only potentially impact a limited number of resident or seasonally resident marine mammal species, which have a long and repeated history of exposure to Navy sonars.

In 2012, a collaborative effort involving researchers from Marine Acoustics, Inc., (MAI), Cornell University, and Southall Environmental Associates (SEA) proposed to extend the assessment of responses to active sonar systems associated with realistic exercises. The primary objective of this effort was to analyze a large classified passive acoustic dataset collected during an actual U.S. Navy ASW operation off the east coast of Florida in Fall 2011 in order to assess responses of marine mammals to naval activities. Results of the study would have ultimately been presented in an unclassified manner in order to provide empirically-based scientific information for assessing potential impacts on marine mammals during actual U.S. Navy operations, and to inform modifications to subsequent PAM deployment strategies around U.S. Navy training operations. Unfortunately, the AMARs experienced both hardware and software issues that affected all recorded data. As a result, the analysis effort was delayed indefinitely until these issues could be resolved and new data sets collected reliably.

Four JASCO AMARs were deployed off Cape Hatteras near the edge of the Albemarle Shelf in November 2013 and retrieved in January 2014 (**Figure 44**) as a pilot study to test improvements to equipment and software. All recorders operated from deployment to 19 December 2013. Three moorings containing a "deep" AMAR were arranged in a triangle, and in the center of the triangle, was one mooring containing a "deep" AMAR and acoustic projector (i.e., pinger). The center mooring (P1) had an AMAR recorder approximately 400 feet (ft) off the ocean bottom, and a deep rated acoustic pinger located approximately 25ft off the ocean bottom (**Figure 45**). Moorings A1, A2 and A3 had an AMAR recorder located approximately 15ft off the ocean bottom and were at the apexes of an equilateral triangle with 1,000-m sides. The pinger emitted a stepped-frequency-modulated (FM) pulse every 12hr to synchronize the AMAR clocks for time delay of arrival localization of the detected clicks. The AMARs included GeoSpectrum M8E hydrophones that were programmed to continuously record for 1 month. Data were recorded to memory modules at a sampling rate of 128 kHz (10 Hz to 64 kHz recording bandwidth) with 24-bit resolution. Data will be used to localize noise-producing sources present during the deployment time, and detailed results of the data analysis will be made available via a technical report expected in June 2014. Current progress of this research effort is summarized below and presented in Martin (2014).

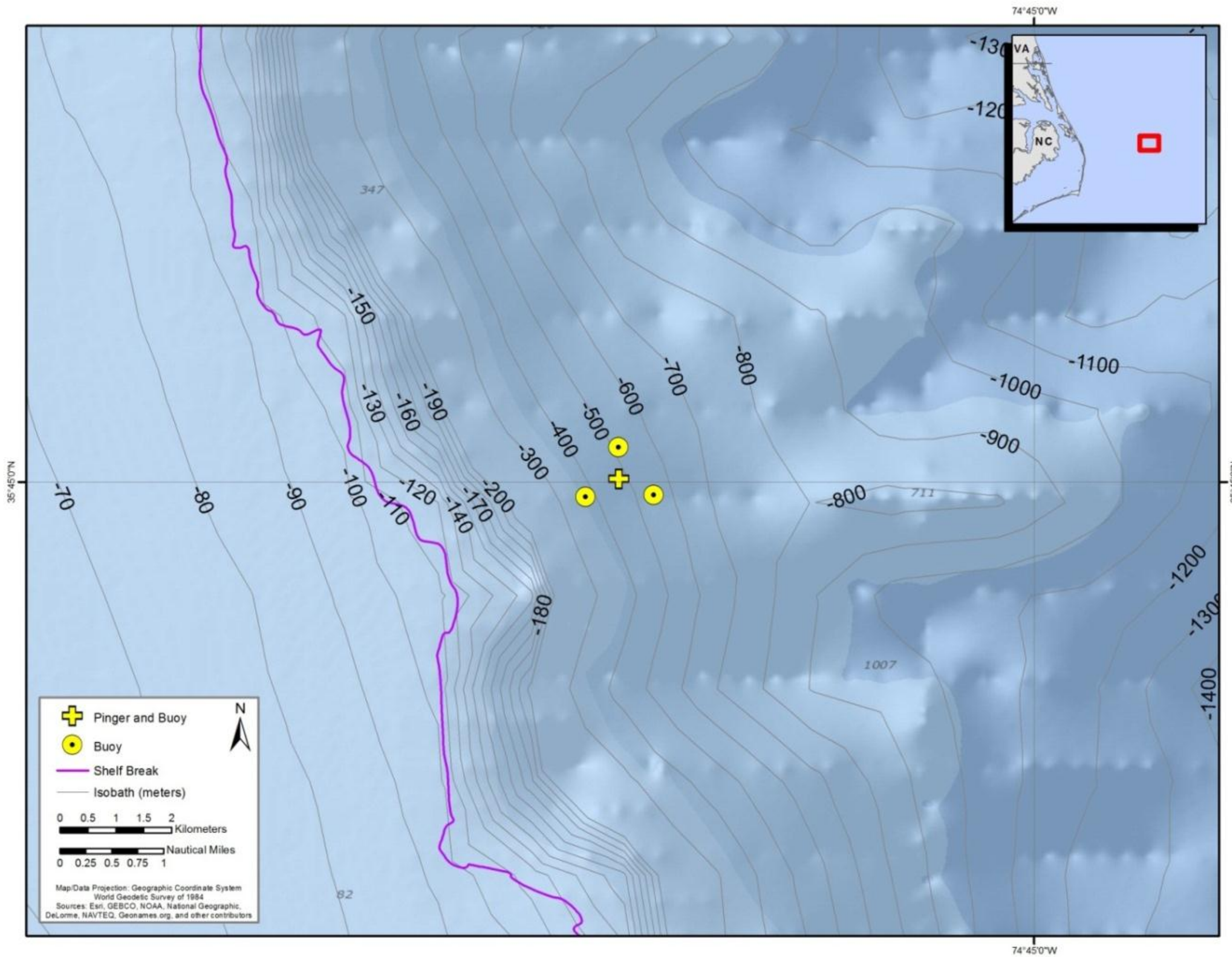

Figure 44. Location of AMARs deployed in November 2013 off Cape Hatteras.

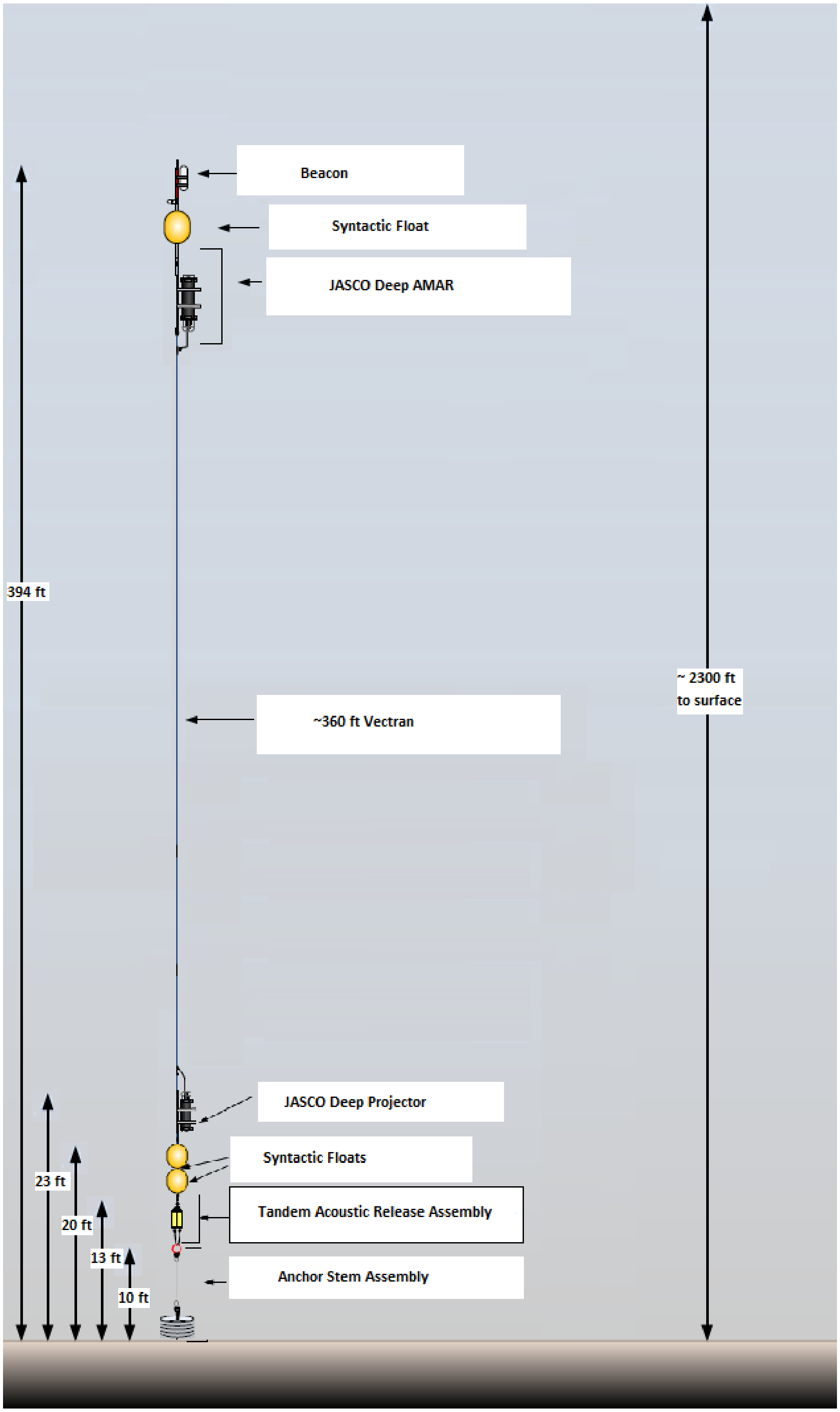

Figure 45. Autonomous Multichannel Acoustic Recorder (AMAR) mooring with tandem acoustic release and syntactic floats for array P1.

All recordings were analyzed with the Acoustic Analysis tool-suite (which includes SpectroPlotter, JASCO Applied Sciences). Ocean sound levels were quantified using a 1-Hz resolution frequency domain analysis; results were averaged to produce spectral density values for each minute of recording. These values directly compare to the Wenz curves (**Figure 46**), which represent typical sound levels in the ocean. The ambient analysis also yields 1/3-octave-band and decade-band sound pressure levels for each minute of data. The peak amplitudes, peak-to-peak amplitudes, and root-mean-square (rms) amplitudes of the time series were computed and stored for each minute and each second of data. Clicks from sperm, killer, pilot, and beaked whales and dolphins were detected automatically based on the energy ratios between several frequency bands. A simple moan and whistle detector identified time periods that were likely to contain marine mammal moans and whistles.

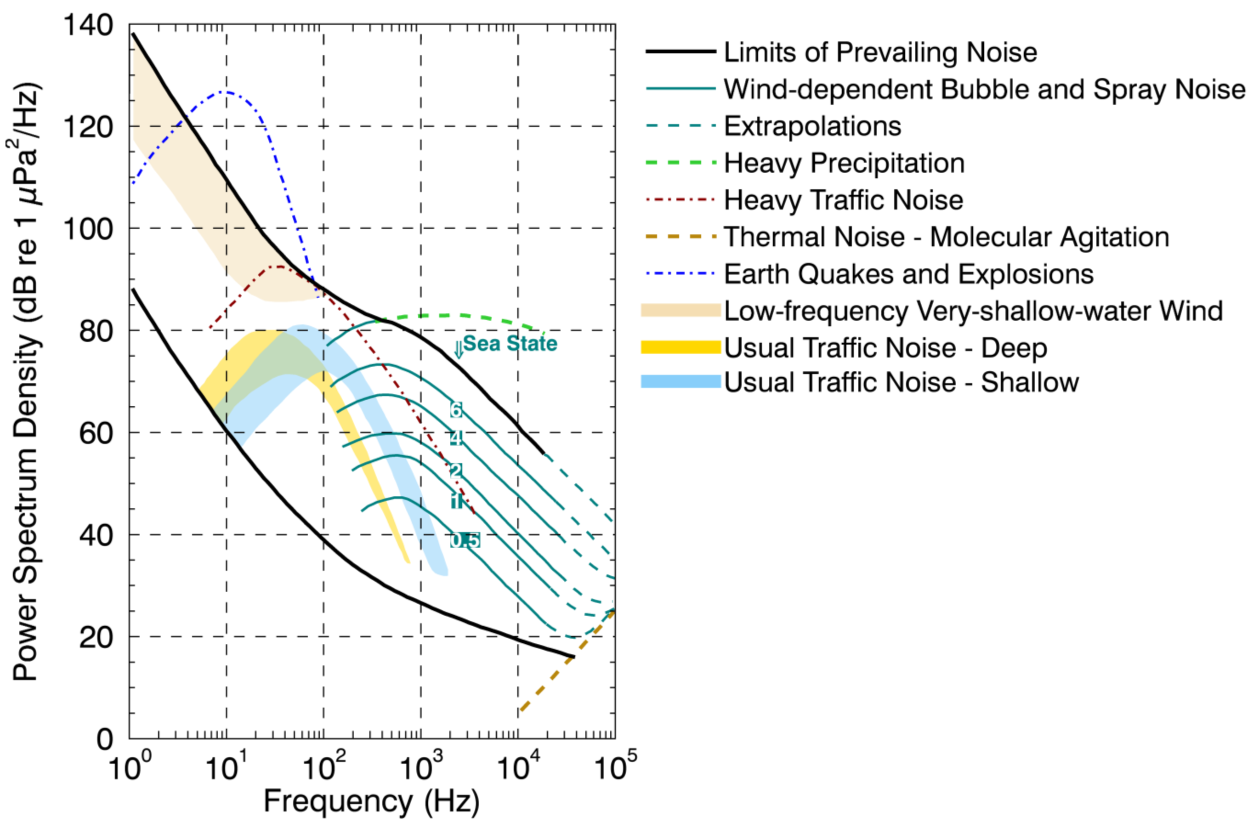

Figure 46. Wenz curves (NRC 2003), adapted from Wenz (1962) describing pressure spectral density levels of marine ambient noise from weather, wind, geologic activity, and commercial shipping.

Results

While the analysis of the data collected is incomplete, preliminary results are encouraging. **Figure 47** shows a time-series and spectrogram spanning 30 min from 10 December 2013 showing pilot whales, fin whales, dolphins, and the pinger. Over the next 3 months, JASCO will continue to analyze the data and provide a dataset that will include 1) automated detection and quantification of ambient noise and anthropogenic noise levels; 2) automated detections of data files with significant numbers of mammal calls; and 3) selection and detailed localization analysis of three sets of mammal clicks or whistles.

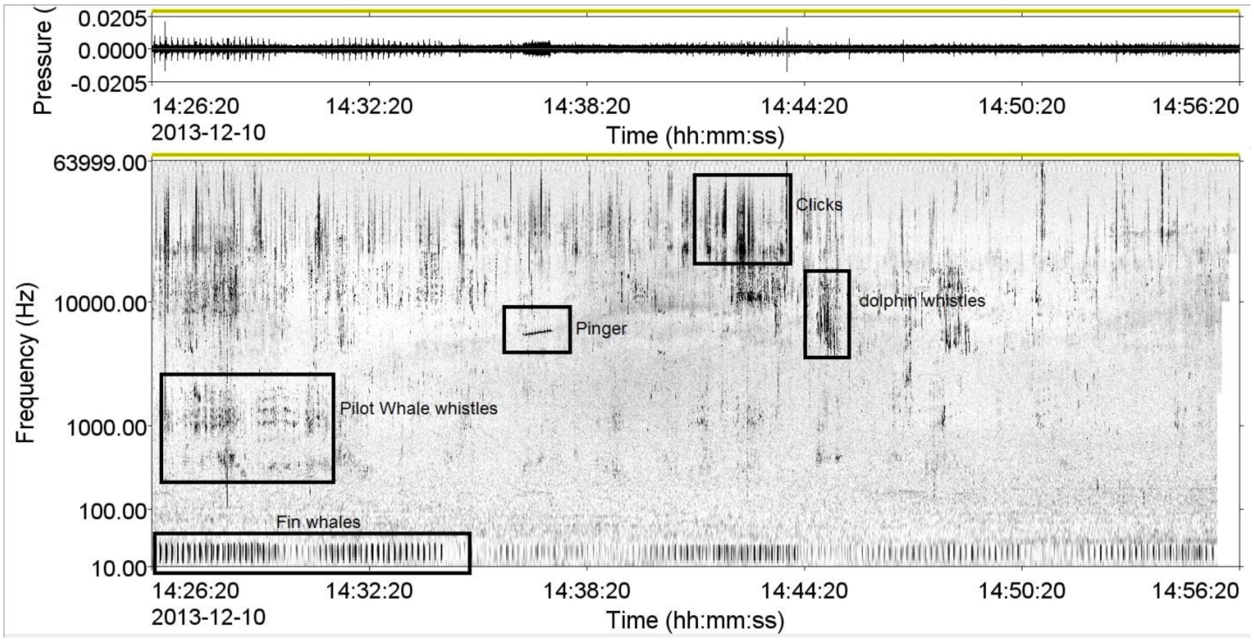

Figure 47. Time-series and spectrogram of 30 minutes of data from 10 December 2013. Detections include fin whales, pilot whale whistles, dolphin clicks and whistles, and the pinger.

3.4.5 Development of Statistical Methods for Examining Relationships Between Cetacean Vocal Behavior and Navy Sonar Signals

In an effort designed to examine marine mammal vocal behavior before, during and after MFA sonar exercises by the U.S. Navy, acoustic recordings were made off Jacksonville, Florida and Onslow Bay, North Carolina using seafloor deployed Marine Acoustic Recording Units (MARUs). The intent for location and timing of the MARU deployment was to target ASW training exercises, with the units deployed 7 to 10 days prior to the exercise and recording for at least 7 to 10 days post-exercise. Previous annual monitoring reports for AFAST (DoN 2012c) referred to a pilot study in Onslow Bay that employed MARUs, which was conducted during July 2008. Data for JAX was initially analyzed to understand the presence/absence/species of animals within the area during an ASW exercise (Norris et al. 2012). The second stage of the study summarized here is a collaborative effort involving researchers at Cornell University, Bio-Waves, Inc., and St. Andrews University to develop robust statistical methods that can be used to analyze vocal behavior before, during, and after MFA sonar events on a species-by-species basis when possible. Progress to date for both the Onslow Bay and JAX recordings is summarized here and detailed in Oswald et al. (2014). A full report detailing the development of statistical methods for examining relationships between odontocete vocal behavior and MFAS signals will be available within the U.S. Navy's next annual monitoring report. Upon completion of this effort, this project is expected to provide a suite of analysis techniques that can be used in multiple locations and situations to further our understanding of the potential effects of MFAs on marine mammal vocal behavior.

MARUs were deployed with two different recording configurations. "High-frequency" MARUs recorded with a 32-kHz sample rate, resulting in a nominal recording band of 0 to 16 kHz. "Low-frequency" MARUs recorded with a sample rate of 2 kHz, resulting in a nominal recording band of 0 to 1 kHz. Only 32-kHz MARUs were capable of recording whistling delphinids and MFAS signals. Both the 32-kHz and 2-kHZ MARUs could record North Atlantic right, fin, and minke whales. Sperm whales could be reliably recorded on 32-kHz MARUs, and in some cases, on 2-kHz MARUs. There was a single deployment of seven MARUs in Onslow Bay from 06 July through 27 July 2008 – though one was not recovered and one unit's hard drive failed. For the successful MARU deployments, two were deployed in shallow water (64- to 73-m depth), one was deployed at medium depth (236 m), and two were deployed in deep water (366+ m). There were two deployments of six 32-kHz MARUs and three 2-kHz MARUs off Jacksonville. The first deployment was in fall (13 September – 04 October 2009), and the second deployment occurred in winter (04-26 December 2009). Three MARUs were deployed in shallow water (44- to 46-m depth), three were deployed in medium-depth water (168- to 201-m) and three were deployed in deep water (305+ m). **Figures 48 and 49** show the locations of all the MARUs deployed in Onslow Bay and JAX, respectively.

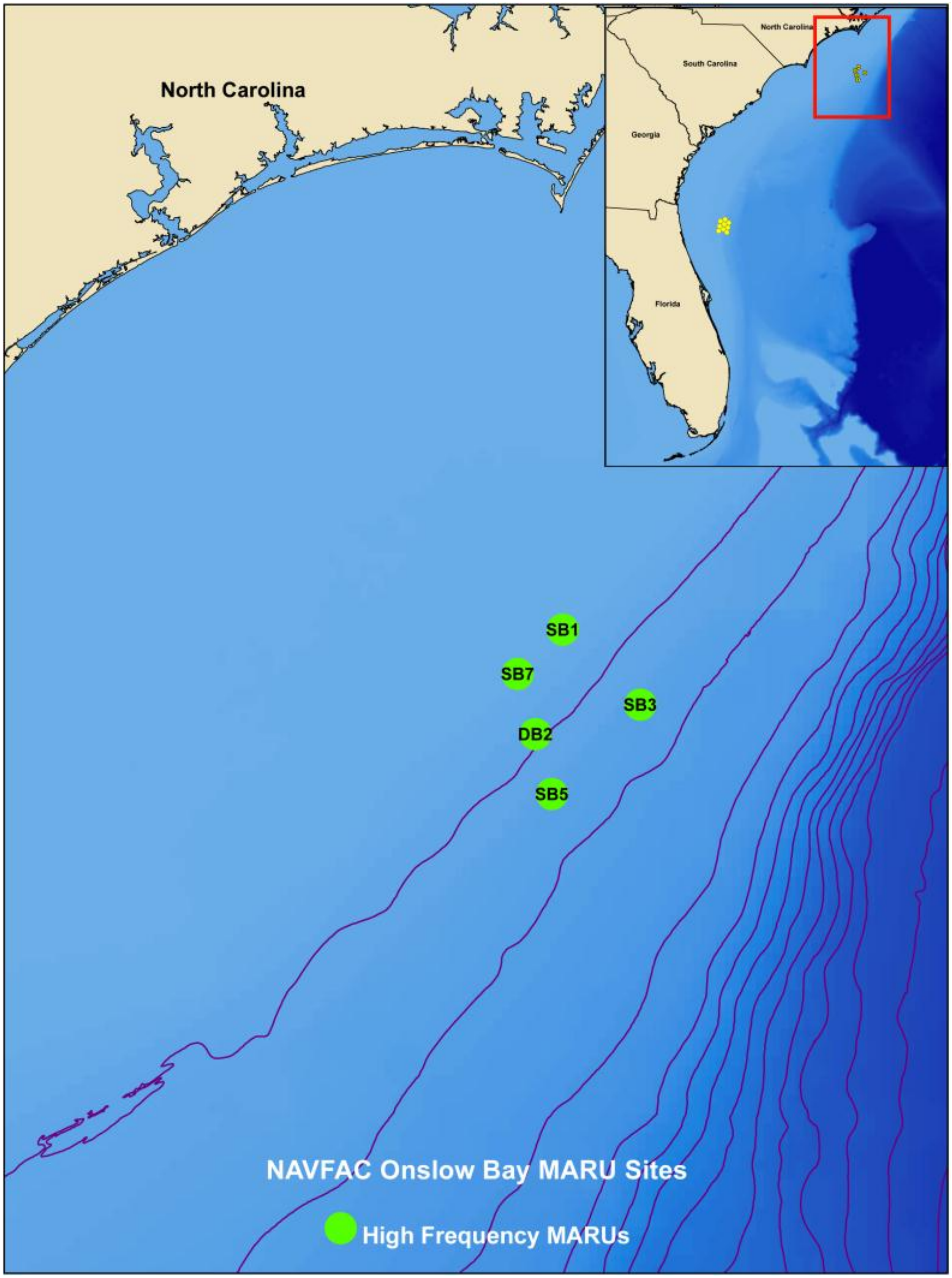

Figure 48. Locations of MARUs deployed in Onslow Bay, North Carolina during 2008.

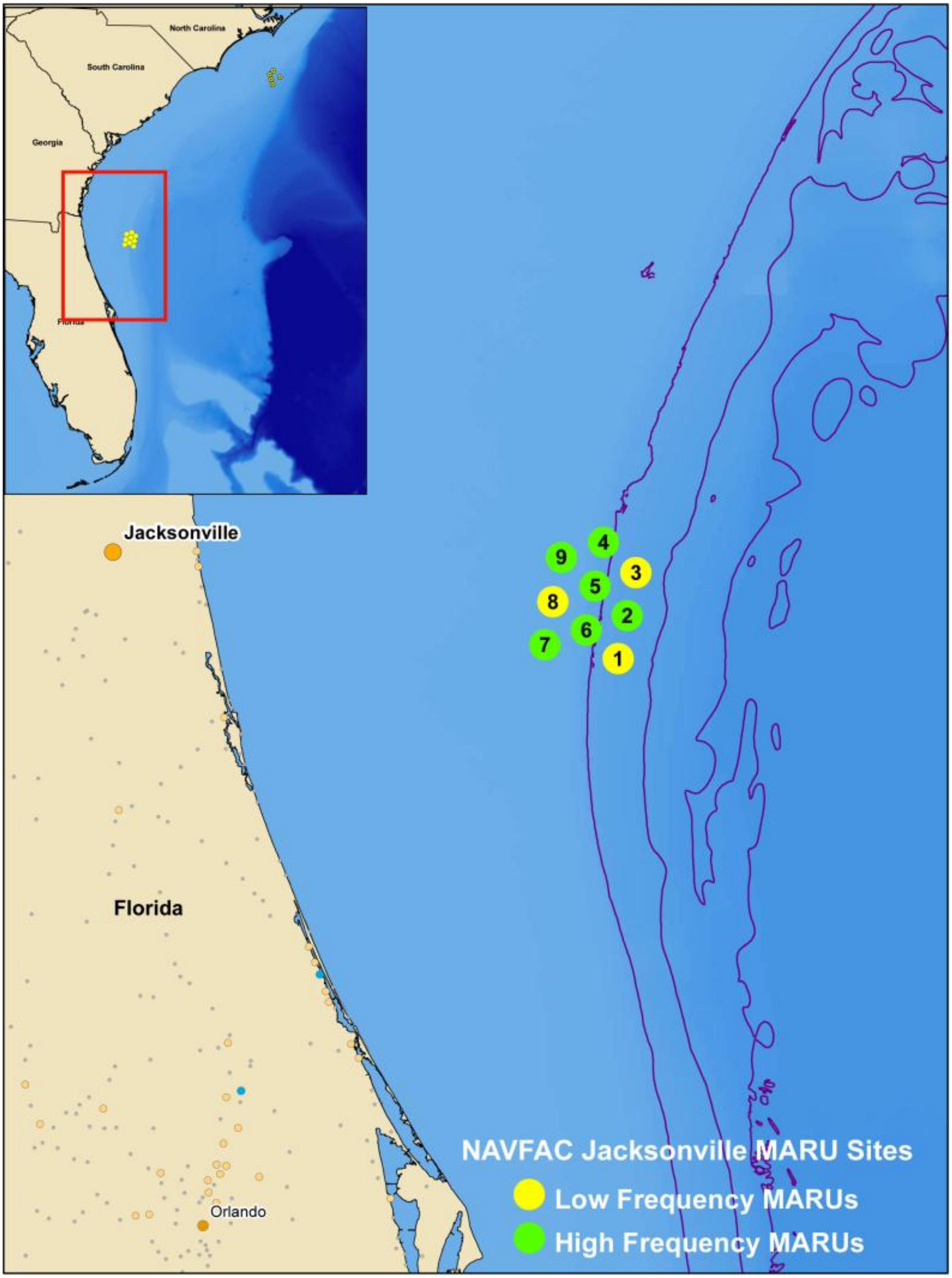

Figure 49. Locations of MARUs deployed in JAX during 2008 and 2009.

In a previous analysis of the MARU data recorded off of Jacksonville, the probabilities of detecting calls produced by marine mammals in the presence and absence of sonar were calculated for several species of cetaceans and two taxonomic categories: 'delphinids' and 'blackfish' (including pilot whales, false killer whales and melon-headed whales) (Norris et al. 2012). These two general taxonomic categories were used instead of species because whistles are difficult to classify to species without detailed analysis and trained classification algorithms (Oswald 2013). The results of the probability analysis for these taxonomic categories were indeterminate, likely because the analysis was performed on species-groups rather than on individual species. In this current study, the dolphin whistle classification algorithm 'Real-time Odontocete Call Classification Algorithm' (ROCCA), available as a module in the acoustic processing software platform PAMGuard (Oswald 2013; Oswald and Oswald 2013) was used to classify dolphin whistle to species before additional analyses were conducted. This classification analysis allowed whistles to be assigned to species so that the relationships between vocal behavior and the presence of sonar could be examined on a species-by-species (or species-group, as sample size and classification results allow) basis. MFAS was detected and classified by running an automated detection and measurement algorithm called SonarFinder (Bio-Waves, Inc. 2013). SonarFinder measures several variables that characterize individual sonar pings and sonar events. For large whales, automated detection algorithms were used to find sonar transmissions ("pings") and sounds of right, minke, fin, and sperm whales in the recordings from both sites. A detailed description of the detection algorithms will be included in the final report on the project.

Due to limited resources, detection results were not reviewed for all sites of all deployments. Potential sonar detections were reviewed for one site from each deployment. Limited sampling of multiple sites during periods of sonar activity indicated that most sonar pings were detectable on all MARUs in a deployment. For potential whale detections, review effort was prioritized to sites within each deployment judged most likely to yield confirmed detections, based on known distribution and ecology of each species. Recordings from the two JAX deployments were analyzed first and were used to refine procedures and protocols for working with these data. Lessons learned from the JAX analysis informed the analysis of the Onslow Bay recordings.

3.4.5.1 Large whales

For Onslow Bay, potential right whale detections were reviewed for recordings from site SB7. Only one event (on 16 July 2008) was judged to be a possible right whale upcall. However, based on the co-occurrence of other similar noise events that were judged to be probably non-biological, and on the absence of any other events resembling upcalls nearby in time, the event was not considered a reliable upcall detection. No minke whale or fin whale detections were confirmed. Most sonar transmissions were during daylight hours, when no sperm whale clicks were detected. During the few nighttime periods when sonar transmissions occurred, there was no conspicuous change in the occurrence of sperm whale clicks relative to times with no sonar. Any firm conclusion regarding possible effects of sonar on sperm whale click occurrence would require rigorous statistical analysis that has not yet been undertaken. The small number of discrete continuous episodes of sonar transmission available in these recordings, and their close proximity in time, may preclude robust statistical analysis. Sustained periods of sonar activity occurred on only two days, 16 through 17 July, about halfway through the entire deployment period. A few brief periods of sonar transmission occurred during the last three complete days of recording, 24 through 26 July 2008. Numerous sperm whale click trains occurred on every day of recording, and were limited almost exclusively to nighttime hours. Over all days, 90.0 percent of sperm whale detections occurred at night. For individual days, the percentage of sperm whale detections that were at night varied between 64.0 and 98.6 percent.

For JAX Deployment 1, potential right whale detections were reviewed for all nine recording sites. Although a total of five isolated events on three different MARUs were identified as being possible upcalls, all were ultimately rejected because of poor signal-to-noise ratio, proximity to similar non-biological sounds, or absence of other likely upcalls nearby in time. There were no confirmed fin whale detections at any recording site during JAX Deployment 1. Potential minke whale detections were reviewed for all nine sites, and there were no confirmed minke detections. Sonar activity was concentrated primarily in a 4-day period (16 through 19 September), beginning on the third complete day of recording. During these days, there are gaps of 0.5 to 5.5 hr with no detected sonar activity. Shorter periods of lower-level sonar activity occurred during the first two complete days of recording (14 through 15 September) and on 01 October. Sperm whale click trains occurred on every day of the deployment. On most days, almost all sperm whale detections occurred during periods after sunset and before sunrise. However, a few days deviated from this pattern, with high levels of sperm whale activity over many daylight hours. Over the entire deployment, 81.7 percent of sperm whale detections were at night. For individual days, the percentage of sperm whale detections that were at night varied between 45.4 and 100 percent. During Jacksonville deployment 1, sonar transmissions occurred during both day and night hours. Inspection of the data does not reveal any conspicuous difference between the occurrence of sperm whale clicks in time periods with and without sonar.

For JAX Deployment 2, potential right whale detections were reviewed, and although a total of 11 isolated events on four different MARUs were identified as being possible upcalls, three were ultimately identified as humpback whale sounds, and the remaining eight events were ultimately rejected because of poor signal-to-noise ratio, proximity to similar non-biological sounds, or absence of other likely upcalls nearby in time. There were no confirmed fin whale detections at any recording site. Sonar activity was detected on six of the 21 complete recording days. Potential minke whale detections were reviewed for all nine recording sites. The highest numbers of confirmed minke pulse trains were found at the three deepest sites, with 1241 to 2705 confirmed detections. The three mid-depth sites each yielded 308 to 497 total detections. Across the three shallow sites, only one minke pulse-train-detection was confirmed. Minke whale call detections showed a weak diel pattern, with lower-than-average call rates during nighttime hours and highly variable rates during daylight hours. This pattern is in contrast to that observed in late summer and fall in waters off of Massachusetts, when minke whale acoustic detections were much higher at night than during the day (Risch et al. 2013). No minke whale pulse trains were detected on the one day with high levels of sonar activity (10 December). However, because no pulse trains were detected during the 27 hr immediately preceding the start of sonar detections, the absence of pulse trains during the period of sonar activity on this day does not provide evidence of any sonar-induced change in acoustic activity of minke whales. As in the Onslow Bay and JAX Deployment 1 data sets, there was a strong diel pattern to the occurrence of sperm whale click trains, with 98.8 percent of all detections occurring at night. For individual days, the percentage of sperm whale detections that were at night varied between 86.4 and 100 percent. During JAX Deployment 2, most sonar transmissions (81.6 percent) occurred during daylight hours, when sperm whales were not detected. The number of nighttime sonar transmissions was too small to discern any potential impact on sperm whale detection rates.

3.4.5.2 Delphinids

The random forest model used to analyze the MARU data was a two-stage model trained using whistles recorded from single-species schools in the northwest Atlantic Ocean. A two-stage model was used because it resulted in much higher correct classification scores than a one-stage model that classified whistles directly to species (Oswald 2013). Five species were included in the model: bottlenose dolphins, short-beaked common dolphins, striped dolphins, Atlantic spotted dolphins, and short-finned pilot whales. The two-stage model first classified whistles to one of two broad categories: small delphinids (including common and striped dolphins) and medium-sized delphinids (including pilot whales, bottlenose, and spotted dolphins). Whistles within each category were then classified to species in stage two. When the model was evaluated using a test dataset of visually validated recordings, 78 percent of whistles (*n*=1,034) and 86 percent of events (*n*=131) were correctly classified.

A total of 1,259 delphinid acoustic events were logged from Onslow Bay and JAX (Deployments 1 and 2). The greatest number of events was logged from JAX Deployment 1 (*n*=550) and the fewest events were logged from Onslow Bay (*n*=265). Most delphinid acoustic events were not included in the ROCCA analysis, because they contained few or no whistles, or because the whistles were not of sufficient quality for contour extraction.

For Onslow Bay, 100 delphinid acoustic events were analyzed using ROCCA. All events analyzed were classified as either short-beaked common dolphin (*n*=48), striped dolphin (*n*=37), or short-finned pilot whale (*n*=15). No delphinid acoustic events for Onslow Bay were classified as bottlenose dolphin or Atlantic spotted dolphin. A total of 72 sonar events in Onslow Bay consisting of 158.5 hr were detected by SonarFinder. The mean duration of sonar events was 2.2 hr, with a standard deviation of 3.3 hr. There were 30,403 sonar pings detected during the events.

For JAX Deployment 1, 158 dolphin acoustic events were analyzed using ROCCA. All events that were included in the ROCCA analysis were classified as either striped dolphin (*n*=74), short beaked common dolphin (*n*=54), or short finned pilot whale (*n*=30). No delphinid acoustic events for JAX Deployment 1 were classified as bottlenose dolphin or Atlantic spotted dolphin. A total of 58 sonar events comprising 421.2 hr were detected by SonarFinder. The mean duration of sonar events was 7.3 hr, with a standard deviation of 11.3 hr. There were 31,826 sonar pings detected during events.

For JAX Deployment 2, 55 dolphin vocalization events were analyzed using ROCCA. All events that were included in the ROCCA analysis were classified as either striped dolphin (*n*=21), short finned pilot whale (*n*=18), or short-beaked common dolphin (*n*=16). No delphinid acoustic events for either of the two JAX deployments were classified as bottlenose dolphin or Atlantic spotted dolphin. As noted earlier, during a previous analysis (Norris et al. 2012), a total of 63 sonar events comprising 95.5 hr of sonar was logged using Triton for JAX Deployment 2.

Analysis of MFA sonar was conducted using the program SonarFinder (Bio-Waves, Inc. 2013). This Matlab-based program was designed to automatically detect sonar pings and measure acoustic variables that characterize them. In this study, a MFA sonar event was defined as a series of sonar pings with no longer than 30 min elapsing between pings. SonarFinder was only run on recordings from Onslow Bay and JAX Deployment 1, because the sonar events in Jacksonville deployment 2 were considered too short and sporadic to be useful in the statistical analysis. Sonar events for JAX Deployment 2 were logged manually using Triton during a previous analysis by Norris et al. (2012).

Delphinid responses to MFA sonar

To identify potential changes in delphinid vocal behavior in response to MFA sonar, observations from periods during or after sonar must be compared to observations from a control period without sonar. Statistical analyses were conducted on data recorded during sonar exercises, as well as the 24 hr before and after these exercises (**Table 57**). A modeling approach of generalized estimating equations (extension of generalized linear models) was used, where a response variable was related to explanatory covariates that could best describe the pattern in the response. To investigate whether schools vocalized more or less in the presence of sonar, vocalization rate was used as the response variable for one modeling approach and the probability of vocalizing as the response variable in a second approach. To investigate whether one of the vocalization types (e.g., whistles, clicks, buzzes) was used more or less frequently than the others, presence and absence of the different types of vocalizations as the response was used. To address whether delphinid whistles change before, during, after, or in between the presence of sonar, information was combined from multiple whistle parameters into a dose response variable, which was used as the response.

Table 57. Dates of all MFA sonar events recorded by six MARUs deployed in JAX and five MARUs deployed in Onslow Bay (OB).

Site	Dates
JAX 2	14-20 Sept 2009, 01 Oct 2009
JAX 4	14, 16-20 Sept 2009, 01 Oct 2009
JAX 5	14-20 Sept 2009, 01 Oct 2009
JAX 6	14-20 Sept 2009, 01 Oct 2009
JAX 7	15-20 Sept 2009
JAX 9	14, 16-19 Sept 2009, 01 Oct 2009
OB 152	13, 16, 17, 22, 24-27 July 2008
OB 154	13, 16, 17, 22, 24-27 July 2008
OB 159	13, 16, 17, 22, 24-27 July 2008
OB 161	10, 16, 17, 22, 24, 27 July 2008

3.4.5.3 Possible inference from models

While results are tentative, for delphinids it was determined that the approach of modeling 'proportions of time spent vocalizing' was better than modeling 'vocalization rate.' However, one has to keep in mind what kind of inference can be drawn from these models. The models do not explain variability in the proportion of time that animals were vocalizing. They only describe changes in the probability of detecting vocalizing animals. Inference on long-term responses (including those longer than 10 min) of delphinid vocal behavior to any of these measurements individually was not possible. We cannot directly infer that animals spent a larger proportion of time vocalizing. For the latter, we would need to make the implicit assumption that by looking at the probability of detecting vocalizations on a MARU, we are examining the probability of animals calling. But this is far from axiomatic. Alternative explanations could be that, while animals spent the same proportion of time vocalizing, animal density changed or animals redistributed themselves. As the probability of detecting vocalizations is range dependent (see next section), this would also have an effect on the proportion of time vocalizing. Other possibilities, including source levels of vocalizations or orientations of animals, may change as a result of sonar. All of these possibilities would result in fewer detections of vocalizations.

Using passive acoustic monitoring devices such as MARUs has the advantage of providing large amounts of data at relatively low cost. However, some difficulties exist when analyzing data obtained from passive acoustic monitoring devices. In particular, inference related to the number of delphinids in the study area, be it via an estimate of density or abundance, is limited. Detection probabilities generally decay with increasing distance of vocalizing delphinid schools from the hydrophone (e.g., Helble et al.

2013, Küsel et al. 2011). This decay in detection probabilities may also vary among different devices due to varying technical properties of the devices or different sound propagation properties or background noise levels at the mooring locations. If we were able to measure or estimate the distances to the vocalizing dolphin schools, e.g. by using sound propagation models, or localizing detections, we could apply Distance sampling methods to estimate density of delphinid vocalization cues around the hydrophone locations. If, at each study site, the MARUs were located near enough to each other so that the same vocalization could be captured at more than one hydrophone, spatially explicit capture recapture methods could be applied to estimate density of vocalizations (Borchers 2012, Borchers et al. submitted, Marques et al. 2009; Martin et al. 2013). To convert estimates of vocalization density into estimates of dolphin density requires additional information to estimate vocalization rates and average school sizes, which was not available for our study. Therefore, inference on potentially varying dolphin densities at the study sites in relation to sonar activities was beyond the scope of this study.

3.4.6 Odontocete Detector/Classifier Development

Researchers and software engineers from Bio-Waves, Inc. developed a whistle classification program called ROCCA (Real-time Odontocete Call Classification Algorithm), which is currently available as a module in PAMGuard. ROCCA was developed for the identification of delphinid species based on their whistles. ROCCA can be used to extract whistles and tonal calls from spectrograms using either a semi-automated method (ROCCA's 'pick points' function) or a fully automated method (PAMGuard's 'whistle and moan detector' [WMD] module). Currently, ROCCA contains a random-forest classifier that was developed for whistles from eight different species of delphinids occurring in the tropical Pacific Ocean (Oswald et al. 2013). The U.S. Navy funded Bio-Waves, Inc. to develop ROCCA classifiers for whistles produced by delphinids in the western North Atlantic Ocean.

Acoustic recordings of delphinid encounters were made during ship-based visual and acoustic line-transect surveys conducted by the Southeast Fisheries Science Center and the NEFSC of the National Marine Fisheries Service, and Duke University. The surveys took place off the Atlantic coast of the United States between central Florida and Georges Bank in the Gulf of Maine. Duke University researchers also provided acoustic data recorded with DTAGs (Digital-Acoustic Recording Tags) attached to short-finned pilot whales. Acoustic recordings of single-species schools that met the criteria for analysis were available for nine delphinid species. The numbers of acoustic encounters and, the numbers of whistle contours detected manually and automatically for each species, are shown in **Table 58**.

Table 58. Numbers of acoustic encounters per species and total numbers of whistle contours for each species detected using ROCCA (manually-detected) and using PAMGuard's WMD (auto-detected).

Species	Encounters (*n*)	Whistle Contours	
		Manually-detected (*n*)	Auto-detected (*n*)
Bottlenose dolphin	74	1,632	1,719
Atlantic spotted dolphin	45	706	988
Striped dolphin	12	293	648
Short-finned pilot whale	15	259	749
Short-beaked common dolphin	9	249	475
Risso's dolphin	8	119	99
Clymene dolphin	2	99	64
Rough-toothed dolphin	3	98	109
False killer whale	2	70	176
Total	**170**	**3,525**	**5,027**

For the short-finned pilot whale, 6 of the 15 encounters were recorded using DTAGs. In general, the number of contours were much greater for the auto-detector (*n*=5,027) than for the manual method (*n*=3,525), because the auto-detector fragmented some whistles, causing those whistles to be counted more than once. The auto-detector also produced false detections that were used as whistle contours in this project. Only species with at least four encounters and 200 manually detected whistle contours were included in the analysis. This was the minimum amount of data that we considered to be adequate for reliable training and testing of classifiers. Because of these strict criteria, data from only the following five species were used: short-beaked common dolphin, striped dolphin, Atlantic spotted dolphin, bottlenose dolphin, and short-finned pilot whale.

Two classification approaches were tested: a single-stage random-forest approach, where whistles were classified directly to species, and a two-stage random-forest approach, where whistles were first classified into species groups (i.e., “large dolphin” or “small dolphin”) in stage 1 and then classified again, to species within those groups, in stage 2. The two-stage approach produced more accurate results when the classifier was trained and tested using manually-detected/extracted whistles and when the classifier was trained/tested using automatically-detected/extracted whistles. Individual whistles within an acoustic encounter were classified as ‘small dolphins’ (short-beaked common dolphins, striped dolphins) or large dolphins (bottlenose dolphins, Atlantic spotted dolphins, short-finned pilot whales) in stage 1 of the manual classifier, and as short-finned pilot whales or dolphins (short-beaked common, striped, Atlantic spotted, bottlenose) in stage 1 of the automated classifier. Both classifiers were used to identify individual whistles to species and then to identify encounters (i.e., groups of whistles produced during an acoustic encounter) based on the combined classification results for all of the whistles in each encounter. Overall correct classification scores for the manual classifier were 78 percent (sd=1.2 percent) for individual whistles and 86 percent (sd=2.5 percent) for encounters. For the automated classifier, correct classification scores were 80 percent (sd=1.9 percent) for whistles and 91 percent (sd=2.4 percent) for encounters. These results compare very favorably with multi-species classifiers trained for other species groups and locations (see Oswald 2013). Both classifiers have been incorporated into PAMGuard’s ROCCA module, and will be made available to users via PAMGuard’s website (www.pamguard.org) in the next PAMGuard software update. Until that time, users can obtain the update directly from Bio-Waves, Inc. (www.bio-waves.com). A user's manual describing the set-up and use of both the manual and the automated classifiers is available, and detailed help files are contained within the software (Oswald and Oswald 2013).

SECTION 4 – DATA MANAGEMENT

The draft version of the U.S. Navy's Marine Species Monitoring Data Management Plan (DMP, HDR 2010) outlines procedures related to the collection, quality control, formatting, security, classification, governance, processing, archiving and reporting of data acquired under the U.S. Navy's monitoring program. The DMP provides the necessary framework for the effective management of all data acquired under the monitoring program, from the initial step of data collection through the final step of data archival. The DMP establishes the method by which data flows through the management system and the controls applied to the data during the process. Additionally, the DMP is an important tool that promotes the fullest utilization of the data through data sharing and integration amongst Navy departments, environmental planners, and researchers. This is achieved in part via the documentation and standardization of data collection techniques among various researchers. Procedures related to marine species monitoring data collection and data management have evolved since 2010 due to refined survey methodologies, improved technologies, and an expanded knowledge base. The DMP is intended to be a living document that reflects this evolution, and a revised DMP is currently in preparation for submission in 2014. Revisions have been triggered by two factors: (1) adaptive data management based on maturation of the program, and (2) evolving U.S. Navy guidance on specific data management procedures. Notable updates to the DMP include:

- Added a new section on shore-based/theodolite data collection and management
- Expanded a section on geospatial data processing with more detailed information
- Updated aerial and vessel-based data collection protocols to track evolving procedures followed by teaming partners/field researchers
- Expanded the section on PAM tools to include a more comprehensive overview of available (and recently developed) towed, fixed, drifting, diving, and animal-borne receiving systems and recording devices
- Included appendices outlining revised U.S. Navy guidance on required electronic data deliverable formats, handling procedures for Ocean Observing Systems data, and the revised Data Rights Agreement developed by the U.S. Navy, and HDR and its teaming partners.

4.1 Data Standards Development

One requirement of the monitoring program is that all acquired data be maintained for ready dissemination to U.S. Navy environmental planners, analysts, and researchers, and formatted to ensure compatibility with existing marine databases. This is achieved in part by the application of a data standard to all marine species monitoring datasets. A data standard involves listing all potential data elements collected under the program (for example, species, sighting position, environmental variables, etc.), their definitions, required formats for each data element, and any notes, background information, or instructions associated with data collection or data entry for each element. Marine species data is collected under the monitoring program by a variety of researchers, using multiple visual survey platforms (vessel, aerial, shore-based), following a range of survey protocols. Standardization of the multiple data types collected within the monitoring program provides a common vocabulary for data collectors to use and to conduct analysis, and allows large datasets to be compiled for analysis and interpretation. Standardization also enables these datasets to comply and be compatible with any applicable Federal data standards and data management frameworks. Examples include Spatial Data Standards for Facilities, Infrastructure and Environment, the Department of Defense's Environmental

Information Management System (EIMS), the Navy Marine Species Density Database (NMSDD), and the Protected Species Observer and Data Management Program (PSO program) currently being developed by the National Oceanic and Atmospheric Administration.

The U.S. Navy is currently developing a marine species data standard, applicable to visual survey data acquired under the monitoring program. The standard is also capable of consuming relevant "legacy data" collected prior to the start of the program in 2010. Survey data fall into three broad categories: sightings, effort, and environmental information. Examples of sighting information include species, sighting location, number of animals, presence of calves, and behavioral information. Effort refers to the amount of time spent looking for animals, platform type, number of observers, distance traveled, and effort type (e.g., random, systematic, or transiting). Environmental conditions are also recorded, including sea state, visibility, glare, and cloud cover. The data standard specifies the required field header names for each data variable, units in which the data are expressed, and formats for each field (i.e., numeric, text, Boolean, etc.). This consistent data organization across surveys facilitates back-end data processing and analysis, and streamlines reporting and information sharing among various researchers and stakeholders. It should be pointed out that the marine species data standard is designed primarily to accommodate visual survey data, and is not intended for other types of survey data such as passive acoustic information, biopsy data, photo-identification, or animal telemetry data.

4.2 Survey Software Development

The U.S. Navy has supported the development of specialized software (*Mysticetus*, Entiat River Technologies) designed for marine species data collection under the monitoring program. Under this program, data is gathered from a variety of survey platforms, by various researchers and according to diverse survey protocols. The goal of this software development is to provide an intuitive, easily configured datalogging tool that enables standardization of marine species monitoring survey data collection protocols among multiple users. Features include real-time GPS integration; the ability to calculate sighting position using observer position, bearing and distance to sighting; and an intuitive user interface that streamlines data entry in the field (**Figure 50**). Each new data entry is automatically assigned a location, time stamp, and sequential sighting number. The program integrates site-specific bathymetric and topographic data to produce detailed sighting and effort maps, and includes reporting functions that provide summary statistics including total distance surveyed, number of sightings, species observed, and percentage of survey time spent on versus off effort. Future directions for *Mysticetus* development include the creation of survey-specific data entry "templates," such as line-transect aerial and vessel surveys, focal follow surveys, and U.S. Navy Watchstander Lookout Effectiveness studies. Other features in development include the formatting of data outputs to facilitate back-end data processing and geospatial data analysis, and creation of a data export "profile" that formats selected *Mysticetus* output to align with the data headers, formats, and units defined in the marine species data standard.

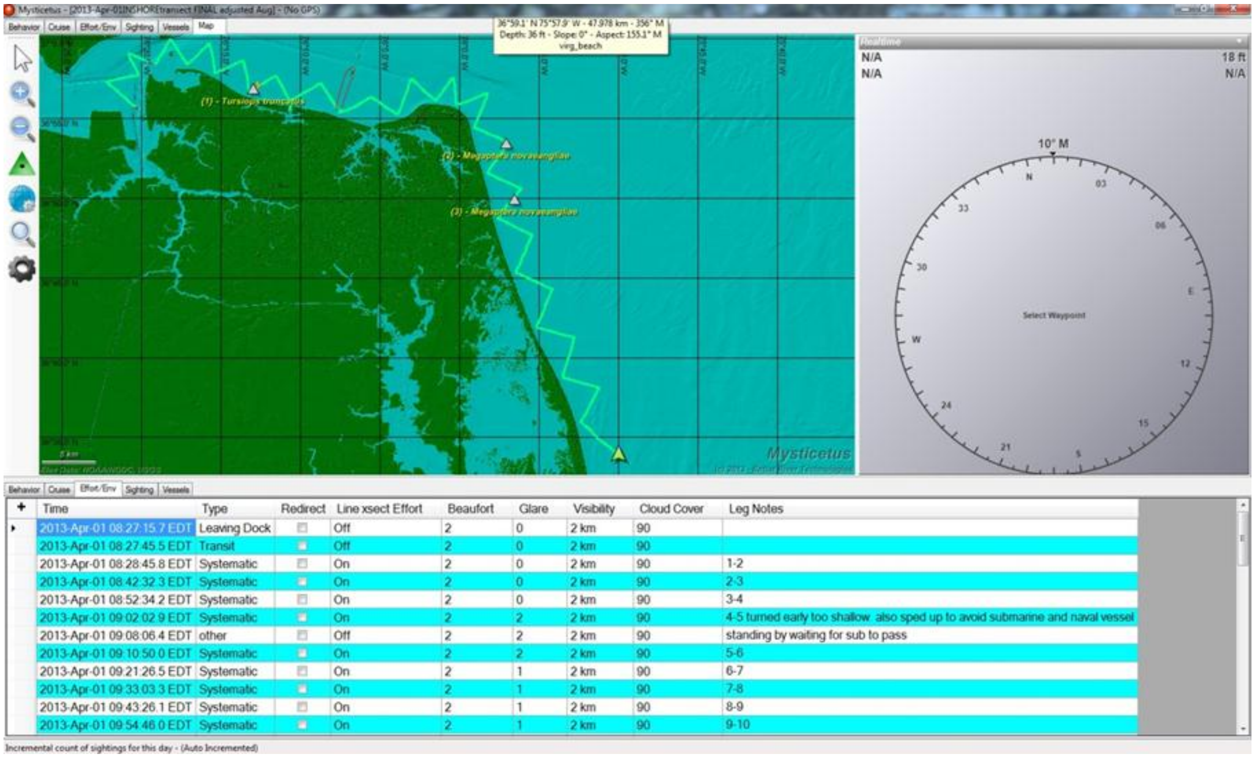

Figure 50. Example of *Mysticetus* user interface

4.3 EIMS and OBIS-SEAMAP Archiving

As mentioned above, all data acquired under the marine species monitoring program must be maintained for ready dissemination to U.S. Navy environmental planners, analysts, and researchers, and formatted to ensure compatibility with existing marine databases. In 2012, the U.S. Navy mandated the upload of all visual survey data collected under the marine species monitoring program to a Department of Defense environmental data repository called EIMS. Data is uploaded to EIMS in the form of personal geodatabase files, containing feature classes for sightings (points) and survey tracklines (polylines). Source data from all surveys is also uploaded for archival purposes, accompanied by all relevant metadata. Marine species data maintained in this centralized location allows the U.S. Navy to track all marine species monitoring data collected in various training ranges, and also to incorporate this information into the NMSDD.

Another important goal of marine species monitoring data management is effective data dissemination that facilitates information sharing among stakeholders, and contribution to the general knowledge of marine species distribution and behavior. This information dissemination is achieved in part by the delivery of marine species monitoring visual survey data to the OBIS-SEAMAP database, maintained by researchers at Duke University's Marine Geospatial Ecology and Marine Conservation Ecology laboratories. OBIS-SEAMAP is a spatially and temporally interactive online archive for marine mammal, sea turtle and seabird data, and datasets are contributed by researchers all over the world. The U.S. Navy contributes all marine species monitoring survey data via this collaborative effort to improve our knowledge of global patterns of marine species distribution and biodiversity. Data sets currently available through OBIS-SEAMAP can be viewed and downloaded through the Navy's data provider page.

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SECTION 5 – U.S. NAVY LOOKOUT EFFECTIVENESS STUDY

The U.S. Navy undertakes monitoring of marine mammals during naval exercises and has mitigation procedures designed to minimize risk to these animals. One key component of this monitoring and mitigation is the shipboard lookouts (LOs, also known as watchstanders), who are part of the standard operating procedure that ships use to detect objects (including marine mammals) within a specific area around the ship during events. The watchstanders are an element of monitoring requirements specified by NMFS in the MMPA LOAs. The goal is to detect mammals entering ranges of 200, 500, and 1,000 yards around the vessel, which correspond to distances at which various mitigation actions should be performed. In addition to the LOs, officers on the bridge search visually and sonar operators listen for vocalizations. We refer to all of these observers together as the observation team (OT). The aim of this study is to determine the OT effectiveness in terms of detecting and identifying marine mammals. Of particular interest is the probability of an animal getting within a defined range of the vessel without being observed by the OT, as well as determining the accuracy of the OT (primarily the LO) in identifying the species group (whale, dolphin, etc.), assessing group size, and estimating their position. In order to achieve this, experienced MMOs search and collect information on marine mammals that are detected by themselves and/or the OT.

Work was previously conducted to design and test a protocol for determining the effectiveness of the LOs in visually detecting marine mammals. The field protocol for the experiments was developed in consultation with members of the Naval Undersea Warfare Center Division, Newport; USFF; Naval Facilities Engineering Command; Commander, U.S. Pacific Fleet; and NMFS. The basic concept is that trained MMOs are situated onboard a vessel during daylight at-sea exercises, in locations where they can watch for marine mammals and communicate with one another, but not cue the LO. The MMOs then conduct opportunistic trials where they detect a surfacing of a marine mammal at a measured location and record whether that surfacing was also detected (a successful trial) or not (an unsuccessful trial) by the LO.

It was found to be necessary to have an additional "liaison" MMO (LMMO) stationed with the LO, and in communication with the other MMOs, to help report when and where LOs detected surfacings. It was also necessary to have an additional team member tasked solely with data recording. In addition to recording surfacing events, MMOs attempted to keep track of which surfacings belonged to the same school or animals. The revised protocol (Burt and Thomas 2010) was applied to one further at-sea exercise (off Southern California), making four datasets in total.

In parallel with field protocol development, methods have been developed for using the data generated by these experiments to estimate the probability of animals entering the standoff range undetected. Intermittent availability models are necessary because many marine mammals remain below the surface for significant periods during dives. The extended methods currently only use information about the location of LO detections, but could conceivably be extended further to use information from the MMO/LO trials. During the previous reporting period, a new analysis method was developed and tested that allows estimation of the probability of animals approaching to within a specified stand-off range without being detected (the "sneak-up probability"). The method is flexible in allowing for a variety of animal surfacing behaviors: "clustered instantaneous," where animal surfacings last just for an instant, but where these surfacings are clustered together in time, interspersed between extended periods underwater; "intermittent," where animals are at the surface for longer periods between dives; and "continuous," where one or more member of each animal group is always at the surface. The method models detection probability in two dimensions (forward of and perpendicular to the vessel), and can model both LO and MMO detections, although it is also possible to focus just on the LO detection probabilities. This method has been tested on simulated data and found to perform satisfactorily for large sample sizes, however the sample size of real data collected from trials to date is insufficient for reliable inferences to be drawn at this time.

Based on the recommendations in last years report, current data-collection efforts have been focuses on a single vessel type and Navy continues to identify opportunities in areas where the number of trials-per-cruise is likely to be maximized. Resources would be devoted to extending the intermittent-availability models so that they use both the locations of observed animals and the outcomes of the MMO trials, thereby unifying the models developed to date for instantaneous and intermittent availability.

U.S. Navy Fleet training organizations are continually evaluating training programs to identify improvements where they are warranted. Oe project to improve watchstander knowledged and proficiency is the revision of Marine Species Awareness Training. As more data become available, other options for improving lookout training will be evaluated as appropriate.

SECTION 6 – ADAPTIVE MANAGEMENT AND STRATEGIC PLANNING

Adaptive management is an iterative process of optimal decision-making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring and feedback. Within the natural resource management community, adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense and in terms of the adaptive process itself. Adaptive management focuses on learning and adapting, through partnerships of managers, scientists, and other stakeholders. Adaptive management helps managers maintain flexibility in their decisions, knowing that uncertainties exist, and provides managers the latitude to change direction so as to improve understanding of ecological systems to achieve management objectives. Taking action to improve progress toward desired outcomes is another function of adaptive management.

As outlined in the U.S. Navy's Comprehensive Exercise and Monitoring Report (DoN 2013e), the Phase I monitoring programs from 2009 to the 2013 have not been static and have evolved due to the intrinsic nature of discovering new science, and application of lessons learned.

During this time, monitoring approaches have evolved dynamically with the realization that different methods of monitoring are optimized for characterizing marine species in the environment at different scales, and with the realization that some monitoring scientific questions need to be recast.

These programs have improved from their initial implementation through changes including:

1. Realization of the limitations from effort-based metrics only
2. Recasting the original five broad study questions (DoN 2009b) to a revised conceptual framework
3. Shift to monitoring projects based on scientific objectives to facilitate generation of statistically meaningful results upon which natural resources management decisions may be based
4. Focus on regions within U.S. Navy range complexes where there is relatively little biological information yet a high degree of naval activity, or in regions within Navy range complexes for which there may be sufficient baseline information and therefore good opportunities to assess potential impacts
5. Increase transparency of the program and management standards, improve collaboration among participating researchers, and facilitate improved accessibility to data and information resulting from monitoring activities

The process of structuring the current transition of Phase I Compliance Monitoring to Phase II monitoring under the Strategic Planning Process has developed over several years. A U.S. Navy-sponsored marine species monitoring meeting in 2010 initiated a process to critically evaluate the current range-specific Navy monitoring plans and begin development of revisions and updates to existing region-specific plans as well as the ICMP. Discussions at that meeting, and at the U.S. Navy/NMFS annual adaptive management meetings and through the continual U.S. Navy/NMFS adaptive management process, established a way ahead for refinement of the U.S. Navy's monitoring program. This process included establishing the SAG composed of technical experts to provide objective scientific guidance for U.S. Navy consideration. A Strategic Plan was intended to be a primary component of the ICMP and to provide a "vision" for U.S. Navy monitoring across geographic regions, serving as guidance for determining how to most efficiently process and effectively invest the marine species monitoring resources to address ICMP top-level goals and to satisfy MMPA regulatory requirements for all LOAs issued for U.S. Navy training and testing activities. The objectives of the Strategic Plan, and its more recent incarnation as the Strategic Planning Process (DoN 2013g) is to continue the evolution of U.S. Navy marine species monitoring toward a single integrated program, incorporating expert review and recommendations, as appropriate, and establishing a more transparent framework for soliciting, evaluating, and implementing monitoring investments across the U.S. Navy range complexes and study areas.

As a result, U.S. Navy's compliance monitoring is undergoing a transition with the implementation of the Strategic Planning Process under a new MMPA Authorization for Atlantic Fleet Training and Testing, issued in November 2013 (NMFS 2013). Under this process Intermediate Scientific Objectives will serve as the basis for developing and executing new monitoring projects across the U.S. Navy's training and testing ranges (both Atlantic and Pacific). The full transition to project selection under the Strategic Planning Process is anticipated to extend into 2015 as existing projects are phased out and gradually replaced with new work.

Implementation of the Strategic Planning Process involves coordination among Fleets, SYSCOMs, CNO-N45, NMFS, and the Marine Mammal Commission (MMC). Although details of the process are currently being finalized, the Strategic Planning Process has five primary steps:

1. **Identify overarching intermediate scientific objectives** – Through the adaptive management process, the U.S. Navy will coordinate with NMFS as well as the MMC to review and revise the list of intermediate scientific objectives that are used to guide development of individual monitoring projects. Examples include addressing gaps in species occurrence and density, evaluating behavioral response of marine mammals to U.S. Navy training activities, and developing tools and techniques for passive acoustic monitoring.
2. **Develop individual monitoring project concepts** – This step will generally take the form of soliciting input from the scientific community in terms of potential specific monitoring projects that address one or more of the intermediate scientific objectives. This can be accomplished through a variety of forums including professional societies, regional scientific advisory groups, and contractor support.
3. **Evaluate, prioritize, and select monitoring projects** – U.S. Navy technical experts and program managers will review and evaluate all monitoring project concepts and develop a prioritized ranking. The goal of this step is to establish a suite of monitoring projects that address a cross-section of intermediate scientific objectives spread over a variety of range complexes.
4. **Execute and manage selected monitoring projects** – Individual projects will be initiated through appropriate funding mechanisms and include clearly defined objectives and deliverables (e.g. data, reports, publications).
5. **Report and evaluate progress and results** – Progress on individual monitoring projects will be updated through the U.S. Navy's Marine Species Monitoring Web Portal as well as through annual monitoring summary reports to NMFS. Both internal review and discussions with NMFS through the adaptive management process will be used to evaluate progress toward addressing the primary objectives of the ICMP and serve to periodically recalibrate the focus on the navy's marine species monitoring program.

These steps serve three primary purposes: 1) to facilitate the U.S. Navy in developing specific projects addressing one or more intermediate scientific objectives; 2) to establish a more structured and collaborative framework for developing, evaluating, and selecting monitoring projects across all areas where the U.S. Navy conducts training and testing activities; and 3) to maximize the opportunity for input and involvement across the research community, academia, and industry. Furthermore, this process is designed to integrate various elements including:

- Integrated Comprehensive Monitoring Program top-level goals
- Scientific Advisory Group recommendations
- Integration of regional scientific expert input
- Ongoing adaptive management review dialog between NMFS and U.S. Navy
- Lessons learned from past and future monitoring at U.S. Navy training and testing ranges
- Leverage research and lessons learned from other U.S. Navy-funded science programs

The Strategic Planning Process clearly identifies the goals and objectives of the U.S. Navy monitoring program, presents the guidance and expert review that will be used to direct efforts, and defines the process for evaluating and selecting how the U.S. Navy's marine species monitoring program budget is invested. It is anticipated that some current monitoring efforts will continue to be similar to past practices, but the level of effort and investment may be allocated differently across U.S. Navy ranges.

The initial step in this transition is to assess the current state of knowledge and existing monitoring work across U.S. Navy range complexes as preparations are made to set priorities and establish intermediate scientific objectives under the Strategic Planning Process. The transition involves replacing previous effort-based monitoring metrics with objective-based monitoring projects. Compliance and performance is based on progress towards addressing the primary objectives of the ICMP. While this process is being initiated, the adaptive management process has allowed U.S. Navy monitoring to gradually evolve from a set of matric-based monitoring requirements to a suite of objective-based scientific studies. **Table 59** summarizes the U.S. Navy monitoring projects underway in the Atlantic for 2014. Additional details on these projects as well as results, reports, and publications will be made available through the U.S. Navy's Marine Species Monitoring Web Portal as they are available.

1 **Table 59. Summary of monitoring projects underway in the Atlantic for 2014.**

Intermediate Scientific Objective[1]	Project Description	Status
• **Establish the baseline habitat uses and movement patterns of marine mammals where Navy training and testing activities occur.** • **Establish the baseline vocalization behavior of marine mammals and sea turtles where Navy training and testing activities occur**	**Title:** Tagging and Tracking of Endangered North Atlantic Right Whales in Florida Waters **Location:** JAX Range Complex **Objectives:** Assess movement patterns of right whales in coastal waters off Florida, rates of travel of individual whales, dive depths, rates of sound production **Methods:** Observational methods combined with short term (ca. 24 hour) non-invasive suction cup attached multi-sensor acoustic recording tags with fastloc GPS **Performing Organizations:** Duke University, Syracuse University **Timeline:** 2014 through 2015 – anticipated 2 field seasons **FY13 Funding:** $335K	**New start (FY13) – Field work to commence February 2014**
• **Estimate the density of marine mammals and sea turtles in Navy range complexes and in specific training areas** • **Establish the baseline habitat uses and movement patterns of marine mammals and sea turtles where Navy training and testing activities occur.**	**Title:** Lower Chesapeake Bay Sea Turtle Tagging and Tracking **Location:** Lower Chesapeake Bay (Hampton Roads) **Objectives:** Assess occurrence and behavior of loggerhead, green, and Kemp's ridley sea turtles in the Hampton Roads region of Chesapeake Bay and coastal Atlantic Ocean **Methods:** Satellite, GPS, and acoustic transmitter tags **Performing Organizations:** Virginia Aquarium and Marine Science Center Foundation, NAVFAC Atlantic **Timeline:** 2013 through 2015 – anticipated 3 field seasons **FY13 Funding:** $180K	**New start (FY13) – Field work to commence Summer 2013**

[1] Intermediate Scientific Objectives are established in coordination with NMFS through the Strategic Planning Process to help prioritize monitoring investments

Intermediate Scientific Objective[1]	Project Description	Status
• **Determine what populations of marine mammals are exposed to Navy training and testing activities** • **Establish the baseline behavior (foraging, dive patterns, etc.) of marine mammals where Navy training and testing activities occur** • **Evaluate behavioral responses by marine mammals exposed to Navy training and testing activities**	**Title:** Assessment of Deep Diving Cetacean Behavior in Relation to Navy Training Activities **Location:** Cape Hatteras **Objectives:** Establish behavioral baseling and foraging ecology. Assess behavioral response to acoustic stimuli and Navy training activities **Methods:** Visual surveys, biopsy sampling, PAM, DTags Performing Organizations: Duke University, Woods Hole Oceanographic Institute **Timeline:** 2013-2016 – anticipated 3 field seasons **FY13 Funding:** $250K	**New start (FY13) – Field work to commence Summer 2013**
• **Estimate the density of marine mammals and sea turtles in Navy range complexes and in specific training areas** • **Determine what species and populations of marine mammals and sea turtles are present in Navy range complexes** • **Establish the baseline habitat uses and movement patterns of marine mammals and sea turtles where Navy training and testing activities occur.**	**Title:** Norfolk/VA Beach Marine Mammal Surveys **Location:** Hampton Roads coastal Atlantic Ocean, W-50 MINEX training range **Objectives:** Assess occurrence, seasonality, and stock structure of *Tursiops* in the coastal waters of Hampton Roads military installations **Methods:** Small vessel visual line transect surveys, photo ID, PAM **Performing Organizations:** HDR Inc. **Timeline:** 2012 through 2014 **FY13 Funding:** $325K	**Continuation from FY12 – Field work ongoiong through summer 2014**
• **Establish the baseline vocalization behavior of marine mammals where Navy training and testing activities occur** • **Develop analytic methods to evaluate behavioral responses based on passive acoustic monitoring techniques** • **Evaluate behavioral responses by marine mammals exposed to Navy training and testing activities**	**Title:** Evaluating Response of *Tursiops* to MINEX Training activities **Location:** Hampton Roads coastal Atlantic Ocean, W-50 MINEX training range **Objectives:** Assess occurrence of *Tursiops* in the vicinity of the W-50 MINEX range. Assess vocal response of *Tursiops* to underwater explosions **Methods:** PAM **Performing Organizations:** Oceanwide Science Institute **Timeline:** 2012 through 2014 **FY13 Funding:** $150K	**Continuation from FY12 – Field work ongoiong through summer 2014**

Intermediate Scientific Objective[1]	Project Description	Status
• **Determine what populations of marine mammals are exposed to Navy training and testing activities** • **Establish the baseline habitat uses and movement patterns of marine mammals where Navy training and testing activities occur** • **Establish the baseline behavior (foraging, dive patterns, etc.) of marine mammals where Navy training and testing activities occur**	**Title:** Cetacean Tagging on the Planned Undersea Warfare Training Range (USWTR) **Location:** Jacksonville Range Complex - USWTR **Objectives:** Establish movement patterns and diving behavior of cetacean species (e.g. pilot whales, Risso's dolphins, *kogia*, beaked whales) on the planned USWTR. **Methods:** Visual surveys, biopsy sampling, satellite tags Performing Organizations: Duke University, Cascadia Research Collective **Timeline:** 2013-2014 **FY12[2] Funding:** $257K	**Funded in FY12 – Field work to commence Summer 2013**
• **Determine what species and populations of marine mammals and sea turtles are present in Navy range complexes** • **Estimate the density of marine mammals and sea turtles in Navy range complexes and in specific training areas** • **Determine what populations of marine mammals are exposed to Navy training and testing activities** • **Establish the baseline vocalization behavior of marine mammals where Navy training and testing activities occur** • **Evaluate trends in distribution and abundance of populations that are regularly exposed to sonar and underwater explosives**	**Title:** Baseline Monitoring for Marine Mammals in the East Coast Range Complexes **Location:** Virginia Capes, Cherry Point, and Jacksonville Range Complexes **Objectives:** Assess occurrence, habitat associations, density, stock structure, and vocal activity of marine mammal and sea turtle in key areas of Navy range complexes. **Methods:** Aerial and vessel visual surveys, biopsy sampling, photo ID, PAM **Performing Organizations:** Duke University, UNC Wilmington, University of St Andrews, Scripps Institute of Oceanography **Timeline:** Ongoing **FY13 Funding:** $1.7M	**Continuation – began in 2008 as preliminary USWTR baseline monitoring**

[2] Project was funded in FY12 but coordination of field work has delayed start of data collection to FY13

Intermediate Scientific Objective[1]	Project Description	Status
• **Determine what behaviors can most easily be assessed for potential response to Navy training and testing activities** • **Develop analytic methods to evaluate behavioral responses based on passive acoustic monitoring techniques** • **Evaluate behavioral responses by marine mammals exposed to Navy training and testing activities**	**Title:** Assessment of Marine Mammal Vocal Response to Sonar **Location:** Cherry Point and Jacksonville Range Complexes **Objectives:** Develop analytic methods to evaluate the vocal response of odontocetes and mysticetes to sonar from navy training activities **Methods:** PAM **Performing Organizations:** Bio-Waves Inc, Cornell University, University of St. Andrews **Timeline:** 2013-2014 **FY13 Funding:** $335K	**Continuation from FY12 – Analysis of previously collected data**

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SECTION 8 – ACKNOWLEDGEMENTS

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Appendix A

Publications and Presentations Resulting from AFAST-related Monitoring Efforts

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Appendix A – Publications and Presentations Resulting from AFAST-related Monitoring Efforts

2007

Urian, K. W., A. J. Read, W. A. McLellan, D. A. Pabst, C. Paxton, D. Borchers, R. J. McAlarney, and P. B. Nilsson. 2007. Monitoring plan for the proposed Undersea Warfare Training Range in Onslow Bay, NC USA. Abstracts, Seventeenth Biennial Conference on the Biology of Marine Mammals. 29 November - 3 December 2007. Cape Town, South Africa.

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