COVER PAGE: CONTINUATION APPLICATION

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Project Title: Modeling Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf

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Modeling Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Continental Shelf: Annual Report for the First Budget Period

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A. PROJECT SCOPE AND IMPACT

This study addresses the "Removal of Market Barriers" objective identified by the Department of Energy's (DOE) Wind and Water Power Program in "A National Offshore Wind Strategy: Creating an Offshore Wind Energy Industry in the United States" (February 2011). The goal of the study is to provide regulators, developers, and the public with the necessary data to "help identify high-priority areas for protection, existing data gaps, and the best manner by which to efficiently incorporate natural resource considerations into the permitting and siting process." To address this goal, we are studying bird, sea turtle, and marine mammal distributions, densities, and movements on the mid-Atlantic Outer Continental Shelf (OCS), to determine how these characteristics of animal populations vary with environmental factors and across space and time.

During the first budget period, Biodiversity Research Institute (BRI) has conferred and/or cooperated with the National Oceanographic and Atmospheric Administration (NOAA), the Bureau of Ocean Energy Management (BOEM) and other groups that are currently funding or conducting wildlife research within our study area. We do not want to duplicate the efforts of Atlantic Marine Assessment Program for Protected Species (AMAPPS) or other ongoing efforts, so coordinating with these agencies has been an important part of BRI's and DOE's project administration for this study.

There have been no deviations from the Statement of Project Objectives (SOPO) during the first budget period for the project, but minor changes to project tasks (such as timing, locations, small changes to study design, etc.) are noted in the "Changes to Project Tasks" section (Section F).

The products developed over the course of this project will provide federal regulators and wind energy developers with two years of high-quality baseline monitoring data for the study area on the mid-Atlantic OCS; identify species at high risk to potential turbine interactions in this area; develop U.S.-based technological resources for future monitoring efforts; and explore technological advancements and assessment methods aimed at simplifying and minimizing the cost of environmental risk assessments.

B. PROJECT GOALS AND OBJECTIVES

Project Objective

The objective of this study is to produce the data required to inform siting and permitting processes for offshore wind energy development in the mid-Atlantic. Data on bird, sea turtle, and marine mammal abundance and movements will be collected and analyzed in scientifically sound ways, using a variety of technologies and methods, and will be presented to stakeholders and regulators in easily accessible formats that are useful for planning and decision-making.

Project Goals

- Quantify bird, sea turtle, and marine mammal densities seasonally and annually throughout the study region and develop hierarchical models to examine spatial patterns and trends.
- Use historic abundance data and data collected during the project period to predict the combinations

of environmental conditions likely to support large densities of birds, turtles, and marine mammals.

- Use individual tracking data from satellite telemetry to provide information on animal movements and site fidelity for hierarchical abundance modeling.
- Compare high definition (hi-def) video aerial and boat-based survey data, and publish results to establish the validity of hi-def aerial surveys as a survey method for offshore development in U.S. waters.
- Help overcome the market barrier associated with National Environmental Policy Act (NEPA), Marine Mammal Protection Act, and Endangered Species Act requirements by contributing several years of data and analysis towards future Environmental Impact Statements.
- Identify species at potential risk from turbine construction and operation due to their movements, behavior, or migration strategies.
- Disseminate project data to stakeholders and regulators through publicly accessible and readily available technical and summary reports, geospatial map layers, scientific manuscripts, and in-person briefings.

C. TASKS TO BE PERFORMED FOR BUDGET PERIOD 1: SUMMARY AND TASK STATUS

Task 1.0 Boat-based surveys, Budget Period 1

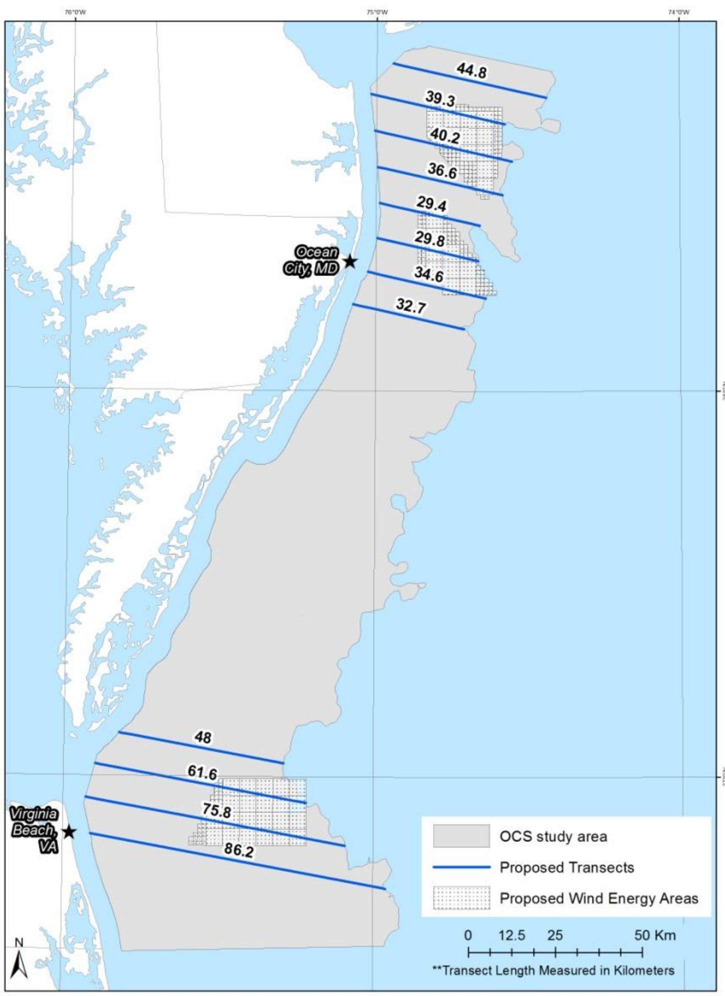
Task Summary: Standardized boat-based surveys are a widely used method of obtaining density data for birds, sea turtles, and marine mammals. In our boat-based surveys, transects extend perpendicularly to the coastline, from three nautical miles offshore to the 30 m isobath or the eastern extent of the Wind Energy Areas (WEAs), whichever is furthest. These boat surveys count all observed animals to one side of the ship, and also estimate distance and angle to individuals whenever possible. We photograph cetaceans when possible and submit the photos for individual identification using the established North Atlantic Fin Whale, Humpback and North Atlantic Right Whale catalogues. While conducting surveys we also collect appropriate environmental covariate data to assess fine scale patterns of these environmental variables in relation to wildlife densities. Eight boat surveys are planned for the first budget period.

In order to test the bias, efficiency, and utility of high definition aerial video surveys on the Atlantic coast, and to integrate new aerial survey data with historical data, we have compared the aerial data to boat-based surveys using experimentally controlled methods.

Methods and Results for the First Budget Period: During the current reporting period, project partners contracted with a 60-foot charter boat and captain for surveys; installed an echosounder transducer in the hull, in order to obtain prey density information during surveys; finalized an initial survey design for boat transects; identified experienced observers for boat surveys; obtained the necessary equipment to conduct boat surveys and ancillary data collection; and conducted six boat surveys in the project study area (April 25-29; June 18-21; August 10-14; September 6-9; November 4-5 and 10-11; and December 15-16 and January 1-3). Project co-PI Dr. Richard Veit of the City University of New York personally served as lead observer and supervised observers on five of the six boat surveys.

Surveys are generally run from the ports of Ocean City, Maryland, and Virginia Beach, Virginia. Boat transects follow the survey design outlined in Figure 1; they are spaced 10 km apart to ensure the independence of each transect, and extend at least one transect north and south of each WEA. Total transect distance is approximately 559 kilometers (excluding distance traveled between transects). Each survey generally requires 4-5 days to complete (barring weather interruptions). Survey dates vary with weather and other limitations, but the anticipated schedule is outlined in Table 1.

Figure 1. Boat survey map. Lengths of transects are noted in kilometers.



During surveys, teams of two observers rotate and use combined strip and line transect methods to observe and record animals. They count all animals within a 300 m strip to one side of the boat (and beyond, if possible) and also record the distance and angle of all animals from the boat. Observational data is recorded using Toughbook laptop computers. The seabird and marine mammal observation program, dLOG, is used to record geo-referenced seabird and marine mammal data as well as the vessel track. One observer, in addition to recording data, focuses on spotting cetaceans and sea turtles. Sea state is recorded hourly using the Beaufort scale, and sea surface temperature and salinity are measured and recorded every half hour during surveys using a YSI Pro30 conductivity device. Biomass density underwater is measured using the Simrad EK60 scientific echosounder (Kongsberg Maritime AS) employing a 120 khz transducer. Echosounder data is processed using Echoview (Myriax Software Pty Ltd) processing software. Environmental data is automatically downloaded from the measurement equipment onto computers aboard the boat.

Surveys are conducted in "passing mode," meaning that the boat stays on transect and at constant survey speed (10 knots) except when complying with National Marine Fisheries Service (NMFS) rules about approaching marine mammals, including rules regarding vessel speed and encounters with endangered North Atlantic Right Whales (*Eubalaena glacialis*). Surveys in passing mode, where the boat stays on transect and does not break off to approach or circle marine mammals or sea turtles when they are sighted, have been shown to have reduced bias in estimated encounter rates of these animals. These surveys also have lower rates of species identification (particularly for delphinids) and poorer estimation of group size for pods. However, our research consortium believes it to be the best method available to ensure that we are getting accurate counts for all other taxa, and can use the data in the statistical models we plan to use. "Closing mode" surveys, which would involve breaking transect to approach animals when they are sighted (a survey type generally used only for cetacean-specific surveys), would constitute harassment or "take" under the Endangered Species Act and Marine Mammal Protection Act, and we believe that it would be counterproductive for the stated goals of the study, which involve all wildlife taxa in the study area, not just cetaceans. By conducting surveys in passing mode we will obtain the best possible data for most taxa, and will hopefully be able to develop abundance models for many species of interest, while also obtaining the best presence-absence data we can for marine mammals. This type of binary data, while not useful for abundance modeling, can still be used in occupancy models. Given the expected density of many marine mammals in the study area, occupancy models may be the best we can do for some taxa regardless of survey mode.

Table 1: Ideal schedule for boat and aerial surveys

Survey Period	**Timing for Boat Surveys**	**Timing for Aerial Surveys**
Early spring	Late March (into early April if needed)	Late March (into early April if needed)
Late spring	Early to mid-May	May (pref. early to mid-May)
Early summer	June (pref. late June)	Late June
Late summer	Early August	(none)
Early fall	September (pref. early to mid-Sept.)	Sept (pref. early Sept.)
Late fall	October (pref. mid- to late Oct.)	Oct. (pref. mid- to late Oct.)
Early winter	December (pref. mid-Dec.)	December (pref. mid-Dec.)
Late winter	Late Jan. or early Feb.	Late Jan. or early Feb.

Echosounder data on the earlier boat surveys showed noise from the boat's electrical system leaking in to echosounder recordings; use of individual batteries and new inverters resolved the issue for the August survey. Preliminary processing of April, June, and August echosounding data has been completed to date. Initial processing of observational data from five surveys has been completed, and the species observed in each survey are listed in Table 2 and in greater detail in Appendix I. Data management, QA/QC, and georeferencing of sightings based on GPS vessel tracks are still ongoing for all six completed surveys, but preliminary maps of raw data for several taxa from the first survey (April 2012) are included in Appendix II.

The project is on schedule to complete the planned number of boat surveys (eight) in the first project period, with the last two surveys tentatively planned for late January/early February and March of 2013.

Table 2: Preliminary summary data for April-November 2012 boat surveys (by species group). Data are presented in order of abundance based on the total count from all five surveys.

Species Group	**April**	**June**	**Aug.**	**Sept.**	**Nov.**	**Total Count**	**% of Total Observations**
Gannets	486	2	0	0	2321	**2809**	32.9%
Gulls	209	67	145	213	978	**1612**	18.9%
Terns	108	99	332	395	56	**990**	11.6%
Loons	510	7	0	0	275	**792**	9.3%
Storm-Petrels	3	230	129	7	0	**369**	4.3%
Scoters	1	0	0	0	334	**335**	3.9%
Unidentified Birds	1	0	0	10	142	**153**	1.8%
Cormorants	10	5	0	3	128	**146**	1.7%
Passerines	12	2	48	49	14	**125**	1.5%
Ducks and Geese (excluding scoters)	0	0	0	30	61	**91**	1.1%
Wading birds and shorebirds	9	5	3	57	3	**77**	0.9%
Shearwaters	0	44	1	5	1	**51**	0.6%
Pelicans	0	4	1	18	2	**25**	0.3%
Jaegers and Skuas	11	2	0	1	2	**16**	0.2%
Raptors	0	2	0	1	0	**3**	0.0%
All Birds	**1360**	**469**	**659**	**789**	**4317**	**7594**	**88.9%**
Marine Mammals	225	202	99	106	34	**666**	7.8%
Fish - individuals	1	70	0	61	9	**141**	1.7%
Sea Turtles	15	13	22	8	2	**60**	0.7%
Bait balls (many fish)	0	19	25	6	0	**50**	0.6%
Rays	0	3	14	1	0	**18**	0.2%
Jellyfish	0	5	0	1	3	**9**	0.1%
Bats	0	0	0	1	0	**1**	0.0%
All Non-avian Animals	**241**	**312**	**160**	**184**	**48**	**945**	**11.1%**

Project partners have developed a design for the aerial-boat comparison study (Appendix III), which required a special aerial survey day during a planned boat survey; this comparison effort occurred in March of 2013 and resulting data will not be available for comparison until the summer of 2013. In the meantime, project collaborators have conducted informal comparisons of data from aerial and boat surveys conducted to date. Specific numbers or identifications of animals should not be compared between survey types using the raw data presented here, as the surveys were not conducted in tandem, and moreover have different survey designs and biases. However, to date there appear to be some recurring differences in detection and identification rates for certain taxa; detection rates for sea turtles, for instance, seem to be better for the high-definition aerial surveys than for boat surveys to date. Aerial surveys also appear to be better for detecting and counting sharks, rays, and large fishes. In contrast, analysis of aerial video from initial surveys has provided lower rates of identification to species than have boat observers for some bird taxa. Such potential differences in boat and aerial survey results will be explored further in the next budget period.

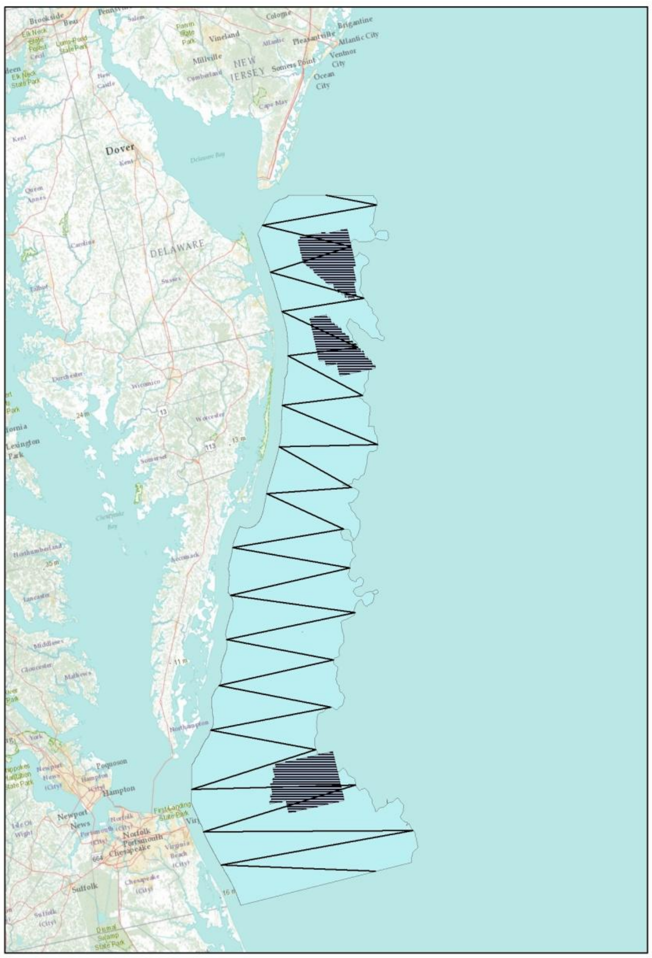
Task 2.0 Aerial surveys, Budget Period 1

Task Summary: The project team is conducting large-scale surveys across the entire study area using high-definition video on an aerial platform. Wildlife locations, taxonomic identities, behaviors, and flight heights are observed from the video footage. Aerial transects are being flown at high densities within the Delaware, Maryland, and Virginia Wind Energy Areas (WEAs) to obtain accurate abundance estimates within these specific footprints; the remainder of the study area is being surveyed on an efficient sawtooth transect path to provide broad-scale context for the intensive WEA surveys (Figure 2). The study design until September 2012 specified a narrower camera angle for the WEA coverage, to obtain a higher ground spatial resolution, and wider-angle cameras on the sawtooth flight to survey a wider transect at a lower resolution. Project collaborators determined the lower-resolution footage from the sawtooth transects was not sufficiently detailed to allow desired identification rates, and from September 2012 onwards all transects in all surveys were conducted at the higher ground spatial resolution. Aerial surveys are planned to occur seven times in the first budget period.

Methods and Results for the First Budget Period: Aerial surveys are conducted by project vendor HiDef Aerial Surveying, Inc., out of the company's Boston, Massachusetts office. HiDef conducts seven surveys per year following to the schedule outlined in Table 1 (weather permitting). All surveys are flown using GPS to ensure location accuracy. Each survey is completed using two aircraft from the civilian aircraft fleet, allowing complete coverage of the study area in two days (weather permitting). The aircraft are multi-engined to enhance safety when operating over the sea and are equipped with camera openings on the lower fuselage to facilitate surveys; long range fuel tanks are fitted to maximize endurance and obtain maximum efficiency and safety. Surveys are flown under Visual Flight Rule (VFR) conditions. Each survey is conducted at roughly 2,000 feet, or 610 m (minimum of 1500 ft, or 457 m) using four high definition video cameras and data management equipment fitted to the aircraft. Total combined transect length for each survey is approximately 2,866 km. Due to the height at which surveys are flown, no permits are required from NMFS. Flights comply with all Federal Aviation Administration (FAA) regulations. Recorded images are stored on heavy duty disk drives or solid state recording devices for subsequent review and analysis. Survey aircraft for the WEA surveys have four cameras set to 2 cm Ground Spatial Resolution (GSR); prior to September 2012, the 'saw tooth' was flown with four cameras set at 3cm GSR, but beginning with the September survey the sawtooth was also flown at 2 cm GSR. This methodological change resulted from difficulties with identification to species for many taxa at the lower resolution; a summary of this topic and a written justification for the change may be found in Appendix IV.

In the current reporting period, project partners finalized a contract with the aerial survey vendor, HiDef Aerial Surveying, Inc.; finalized an initial survey design for aerial surveys; obtained the necessary equipment to conduct video transfers and analysis; and flew six aerial surveys of the study area (March 26-28; May 6-7; June 16 and 18; September 11; October 12-13; and December 13-14, 2012). The project is on schedule to complete eight aerial surveys in the first project period, with the last survey tentatively planned for March.

Figure 2. Aerial survey map.



Subtask 2.1 High definition video data analysis

Task Summary: Video data are reviewed by the aerial survey vendor to identify video segments containing objects (including wildlife, boats, and other items), via both a manual review process and a parallel automated review process. Both the manual and automated review processes are audited by experienced staff according to the vendor's standard 20% blind sampling audit methodology. Once this process is complete, all video segments containing objects for identification are sent to BRI for analysis, and trained BRI biologists identify objects to species or species grouping. Twenty percent of object identifications are also independently reviewed, to determine the rate of agreement among analysts; a third reviewer examines all objects for which the original analyst and Quality Assurance (QA) reviewer disagree. Completed analysis provides data on the number of target organisms in the video; the species or species grouping of organisms; the approximate flight height for flying birds and bats; and geospatial data for all objects that may be used in modeling efforts.

Methods and Results for the First Budget Period: High-definition video is analyzed by HiDef employees to isolate targets in the video and estimate flight height using HiDef's parallax technology, and by BRI biologists to identify targets to species or species grouping. Summary data from the first three aerial surveys (March, May, and June of 2012) are presented in Tables 3 and 4. More detailed summaries are presented in Appendix V, and preliminary maps of raw data for several taxa are also included in Appendix VI. The data presented in the tables below and in these appendices are still preliminary, and may change slightly as the QA process continues. "Definite" identifications mean that the reviewer was more than 95% certain that their identification of the animal was correct; "Probable" identifications were when the reviewer was 50-95% certain of their identification; and "Possible" identifications were when the reviewer was 0-50% certain. If a reviewer feels that they really can't hazard a guess that an object is a "possible Wilson's Storm-Petrel," for instance, then they might call the object a "definite unidentified storm-petrel," based on the specific criteria used for identifications of that species or category (size, color, shape, flight pattern, clarify of image, etc.).

Large numbers of birds were observed in the sawtooth transects during in the first three surveys (Table 3), due in part to the length of the sawtooth (over 50% of the full survey length), and in part to the location of several large flocks of scoters on sawtooth transects during the March survey (Table 4 and Figure VI.1 in Appendix VI). The Maryland WEA had the least total animal detections to date (290 birds, marine mammals, sea turtles, sharks, rays, and individually counted fish) during the three surveys. Many of the common species observed in all areas in March (loons, scoters, gannets, etc.) became much less common over the course of the first three surveys, as birds wintering or migrating through the study area moved north to breed. In contrast, comparatively few sea turtles, sharks and rays were seen in March, but these taxa became more prevalent (particularly off of Virginia, at the southern end of the study area) as water temperatures rose throughout the spring.

Table 3. Preliminary raw count data for March-June 2012 aerial surveys (by location and taxon). "Total" counts represent birds, marine mammals, sea turtles, sharks, rays, and individually counted fish; these counts exclude bait balls (e.g., large groups of fish that were not counted individually) and other biota such as jellyfish.

Area	**% of total transect length**	**Resolution**	**Total**	**Birds**	**Marine Mammals**	**Sea Turtles**	**Sharks and Rays**	**Fish (Individuals)**
Sawtooth	53%	3 cm	15,347	11,925	258	270	2,574	320
DE WEA	16%	2 cm	3,033	373	24	7	15	2614
MD WEA	12%	2 cm	290	207	15	18	10	40
VA WEA	19%	2 cm	3,711	386	12	224	3,058	31

As of January 30, 2013, BRI biologists have completed initial species identifications for the September dataset, and are currently conducting initial species identifications for the fifth (October) survey. HiDef reviewers are currently locating objects in the sixth (December) survey, and are conducting flight height calculations and assigning geospatial information to objects for the September survey. Species identification rates have varied widely by survey, due to differences in ground spatial resolution of video and to the ease with which various species may be identified. BRI's video review team's rates for birds varied from 48-83% between surveys; the identification rate overall for birds for the first three surveys was 42% for 2 cm footage from WEAs, and 82% for 3 cm footage from the sawtooth (Table 5). Higher identification rates for birds at the 3 cm resolution were driven by flocks of easily identifiable scoters present on the sawtooth (but not in the WEAs) during the March survey. Fish identification effort has been minimal to date; if desired, these fish data can be revisited for additional analysis at a later date. The review team is currently working to improve their identification rates (particularly for sea turtles and certain bird taxa) via consultations with project collaborators and with biologists from other organizations.

A detailed video analysis and quality assurance/quality control (QA/QC) protocol has been developed by BRI biologists in consultation with HiDef biologists and reviewers. This written protocol is still in draft form, and is currently being reviewed internally. It is expected that this draft protocol will be distributed to U.S. Fish and Wildlife Service personnel for peer review early in the second budget period. These QA/QC procedures currently include 20% re-analysis of all objects identified as biota, to determine the rate of agreement in identifications among analysts. This audit was not conducted for the first (March 2012) survey, as object identifications for those data were performed collectively among BRI biologists to develop a common identification process (including identification criteria, certainty criteria, etc.) and pool their existing expertise. Beginning with the May 2012 survey, all object identifications are conducted independently, and the initial 20% audit of the results has been conducted for the May and June 2012 data (the September dataset is currently in progress). The acceptable agreement rate identified in the protocol is 90% or better (e.g., <10% disagreement among analysts).

Table 4. Preliminary summary data for March-June 2012 aerial surveys (by species group). Data are presented in order of abundance based on the total count from all three surveys. Counts include definite, probable, and possible identifications (see text).

Species groups	**March survey**	**May survey**	**June survey**	**Total count**	**% of total observations**
Scoters	9408	1	0	9409	41.9%
Loons	887	548	11	1446	6.4%
Terns and Terns/Small Medium Gulls	265	198	50	513	2.3%
Unidentified Birds	275	152	76	503	2.2%
Gulls	288	143	27	458	2.0%
Gannets	337	71	0	408	1.8%
Shearwaters	0	0	75	75	0.3%
Storm-Petrels	1	0	53	54	0.2%
Jaegers	0	4	3	7	0.0%
Pelicans	0	3	2	5	0.0%
Grebes	4	0	0	4	0.0%
Wading birds and Shorebirds	2	2	0	4	0.0%
Eagles and Ospreys	0	1	1	2	0.0%
Geese	0	0	1	1	0.0%
Fulmars	0	0	1	1	0.0%
Passerine	0	0	1	1	0.0%
All Birds	**11467**	**1123**	**301**	**12891**	**57.4%**
Rays	0	1	5535	5536	24.7%
Fish - individuals	2526	196	283	3005	13.4%
Sea turtles	29	293	197	519	2.3%
Marine mammals	39	200	67	306	1.4%
Sharks	1	13	107	121	0.5%
Bait Balls (many fish)	0	0	41	41	0.2%
Cetacean/Seal/Shark	4	22	8	34	0.2%
Jellyfish	0	1	3	4	0.0%
All Non-Bird Animals	**2599**	**726**	**6241**	**9566**	**42.6%**

Table 5. Preliminary summary data for March-June 2012 aerial surveys (by video resolution and percentages of animals that were identified to species). Higher identification rates for birds at the 3 cm resolution are driven by scoter flocks in March (which were easily identifiable and only occurred in the sawtooth area, not in the WEAs).

Species Group	WEA (2 cm) Total Count	WEA (2 cm) % ID to Species	Sawtooth (3 cm) Total Count	Sawtooth (3 cm) % ID to Species
Birds	966	53%	11,925	82%
Marine Mammals	51	82%	258	49%
Sea Turtles	249	42%	270	12%
Sharks and Rays	3,083	90%	2,574	23%

The agreement rate among reviewers as a result of this audit process was found to be 80% for the May survey and 93% for the June survey; this included data at both 2 cm and 3 cm resolution. Because the June agreement rate was >90%, no additional review was required. Table 6 includes initial audit results for species codes representing greater than 5% of survey objects from the May 2012 survey that had less than 90% agreement between auditors (e.g., the species codes that caused the majority of the disagreements). The majority of the disagreement in May identifications appeared to be related to difficulties differentiating between Common and Red-throated Loons, and to high numbers of "unidentified birds," the designation for objects that are clearly birds but that cannot be more definitively identified. Both problems were greatly exacerbated by the difficulty inherent to analyzing 3 cm resolution video footage, which as mentioned above and in Appendix IV presented numerous identification issues.

The problems with identifications from 3 cm footage appear to be unavoidable, and have been addressed by discontinuing all use of 3 cm GSR for surveys (Appendix IV). The remainder of the May 2012 audit issues largely stemmed from disagreements in certainty over loon identifications. We still have not resolved (e.g., closed) the May audit because we are compiling expert opinions from analysts in the United Kingdom and loon experts in the United States on the loon identifications from this audit (e.g., what criteria can be used to definitely separate Red-throated and Common Loons from each other? What range of body sizes—the criteria most commonly used for loon identifications in the United Kingdom—can we expect for each species in the mid-Atlantic region?) These recommendations will be used to reassess loons from the May survey, and we expect to close the audit from this survey prior to the end of the budget period.

Table 6. Initial audit results for species codes representing >5% of survey objects from the May 2012 survey that had <90% agreement rate between auditors. COLO = Common Loon; UNLO = Unknown Loon Species; UNBI = Unknown Bird Species.

	2cm				**3cm**			
	# of audit mis-matches	# of audit matches	Audit Total	**% Correct**	# of audit mis-matches	# of audit matches	Audit Total	**% Correct**
COLO	6	32	38	84%	15	19	34	56%
UNLO	0	5	5	100%	6	12	18	67%
UNBI	2	8	10	80%	8	12	20	60%
Total	**8**	**45**	**53**	**85%**	**29**	**43**	**72**	**60%**

Task 3.0 Individual tracking, Budget Period 1

Task Summary: While visual surveys from boat and aerial platforms can be effective in examining patterns of daytime animal density, satellite telemetry can be useful for determining smaller scale avian movements. We are tracking the movements of three focal avian taxa: seabirds (the Red-throated Loon, *Gavia stellata,* and Northern Gannet, *Morus bassanus*); sea ducks (the Surf Scoter, *Melanitta perspicillata*); and raptors (the Peregrine Falcon, *Falco peregrinus*). The project team uses several methods to track known individuals from these focal species, with goals of providing an improved understanding of migratory speed, effects of weather patterns on movements, and seasonal use of space on the outer continental shelf. Such data may also be able to refine the density estimates resulting from surveys or may be useful in assessing individual risk of turbine interactions.

Methods and Results for the First Budget Period: During the current reporting period, project partners and staff captured and successfully deployed transmitters on 17 Red-throated Loons, 15 Northern Gannets, one Surf Scoter, and seven Peregrine Falcons. Capture efforts were conducted in North Carolina (Pamlico Sound), Delaware Bay, Chesapeake Bay, Rhode Island (Block Island), and Cape St. Mary's in Newfoundland, Canada. Project partners and collaborators for this project component include the U.S. Fish and Wildlife Service Region 5 Migratory Bird Program, the Bureau of Ocean Energy Management, Sea Duck Joint Venture, the U.S. Geological Survey, and Memorial University of Newfoundland, among others.

In March of 2012, six Northern Gannets were outfitted with transmitters in a highly successful first attempt to capture adult gannets at sea. Three were fitted with tail-mounted external transmitters, which were lost when the birds molted their tail feathers in the autumn of 2012. The other three birds were implanted with internal transmitters, a surgical process that has been successfully used with other seabirds but never before with gannets. The three implanted birds appear to be doing well, and their transmitters are continuing to send movement data to project collaborators. Due to the success of these gannet implants in the first field season, project collaborators are planning to only use implants for this winter's deployments. In September 2012, an additional nine tail-mounted transmitters were deployed by project collaborator Dr. William Montevecchi at the Cape St. Mary's gannet colony in Newfoundland, Canada.

Seventeen implanted Red-throated Loon transmitters were deployed between January and March of 2012, more than the seasonal goal of 15. However, seven of these birds suffered mortalities while still on the wintering grounds, and one of their transmitters was recovered and refurbished for redeployment this season. Project partners and collaborators have identified methods to minimize stress to the birds during captures in the upcoming 2013 field season (where we are scheduled to deploy 24 transmitters).

Since captures of gannets and loons in early 2012, project partners have tracked the movements of these tagged birds around the mid-Atlantic study area, northwards to their breeding grounds in Canada and Greenland, and more recently on their southward migration back to the mid-Atlantic region. Tagged gannets demonstrated regional-scale movements along the Atlantic coast of the United States during winter, and about mid-April began a more consistent migration northward towards Bonaventure Island, Québec, where all six birds appeared to breed (Appendix VII). More recently these birds, as well as the nine birds tagged at the Cape St. Mary's colony, have moved south to the mid-Atlantic or Gulf of Mexico for the winter. Red-throated Loons demonstrated smaller winter movements, on average, but spent the summer at much more widely dispersed locations, in some cases migrating huge distances to Nunavut, Ontario, Québec, and northwest Greenland (Appendix VIII). Though all but one of the Red-throated Loons with transmitters migrated along the east coast of North America in the spring, about half of the birds returned to the mid-Atlantic in the autumn via a different migration pathway, in which they flew south to the Great Lakes before moving eastward to the coast.

A single Surf Scoter transmitter was deployed by project partners this winter, despite an unofficial goal of 7-8 deployments. Poor capture success was experienced by all crews trying to catch Surf and White-winged Scoters on the Atlantic during the 2011-2012 winter season (including crews from the U.S. Geological Survey (USGS) and the Rhode Island Department of Environmental Management, although the three USGS field crews did have some success in late March). BRI and these other organizations have discussed capture strategies with Sea Duck Joint Venture (SDJV), the funder for most of the scoter transmitters for this study, and BRI is planning to use a larger boat for scoter captures this winter in order to more swiftly and safely approach scoter rafts offshore in the mid-Atlantic study area. Additionally, SDJV funded a pilot study in the autumn of 2012 to determine if Surf Scoters could be more easily captured at a fall migration staging area in the Gulf of St. Lawrence in Canada. The pilot study was highly successful, and almost all of the birds implanted with transmitters in the Gulf of St. Lawrence have since migrated to the mid-Atlantic region. Due to the success of this effort and the apparent overlap in the two sampled populations, BRI (with partial funding from BOEM) is intending to deploy five transmitters on Surf Scoters in the mid-Atlantic in March 2013, and (with partial funding from SDJV) to deploy another 25 transmitters in the Gulf of St. Lawrence this autumn.

Eight Peregrine Falcons were successfully fitted with backpack-style satellite transmitters. One of the eight birds was found under a power line on Block Island several days following its release. This individual was brought to and later released from a rehabilitation facility; its transmitter was removed and redeployed on another individual later in the season. Several different types of transmitters were used: four females were fitted with GPS transmitters, while smaller Doppler transmitters (which provide less precise location data) were fitted to two males. Additionally, one prototype GSM (Global System for Mobile Communications) transmitter donated to the project was fitted to a female.

Of the seven birds with transmitters, three are still transmitting data. Because six of the seven falcons were young (hatch year) birds, which are estimated to have up to a 75% mortality rate during their first year, this success rate is not entirely unexpected. One mortality was confirmed in Honduras; two are considered likely mortalities based on sensor data from the transmitter (one appears to have been directly related to Hurricane Sandy); and there was one apparent transmitter failure (Appendix IX). Of the three functioning transmitters remaining, one female (the only adult in the group) is currently in Jamaica; a hatch year female is in the Bahamas; and a hatch year male is in Colombia.

Task 4.0 Hierarchical modeling of animal abundance with environmental covariates, Period 1

Task Summary: Given the difficulties associated with estimating animal abundance (or occurrence) based on count data from large-scale surveys (Royle et al. 2007), modeling spatial and temporal distributions of animals can help to determine areas of high and low use and inform siting decisions for development (Garthe and Hüppop 2004, Kinlan et al. 2012). However, distributions of animals in the offshore environment can be highly variable, and are driven by environmental and biophysical factors working at a variety of temporal and spatial scales (O'Connell et al. 2009, Zipkin et al. 2010). Modeling approaches that can incorporate survey data on relative abundance as well as environmental covariates at various scales have been identified as the most promising avenue for understanding the underlying causes of offshore wildlife distributions and predicting future occurrence (O'Connell et al. 2009, Zipkin et al. 2010, Zipkin et al. in press).

By combining our boat and aerial survey data with oceanographic habitat data collected remotely and from the survey boat, we can use hierarchical spatio-temporal modeling methods to estimate the influence of environmental factors on the distribution and relative abundance of species of interest. Accurately assessing such relationships is essential for predicting spatial distributions and the potential shifts in these geographic distributions caused by changing environmental conditions. Data will be modeled within a hierarchical framework, a proven suite of statistical methods for separating observational and ecological processes and understanding the environmental factors influencing species distributions and relative abundance. This modeling framework is useful for dealing with marine wildlife data, which often are highly clustered, zero-inflated, or over-dispersed. This method is highly flexible and can provide more accurate results than other methods (Gardner et al. 2008, Mordecai et al. 2011), and will synthesize new and existing data into comprehensive predictive and risk assessment frameworks. We will provide statistical analysis of boat and aerial surveys using spatial models with covariates for sea bird species, and if enough data are available for sea turtles and marine mammals. Environmental data will include information on prey biomass (collected from the boat during surveys), and is also expected to include such climatic variables as fluctuations in sea surface pressure (e.g., the North American Oscillation; Zipkin et al. 2010) and habitat variables such as sea surface temperature (Gardner et al. 2008, Zipkin et al. 2010), chlorophyll concentrations (Kinlan et al. 2012), bathymetry (Gardner et al. 2008, Zipkin et al. 2010), and other factors.

Previous efforts to model wildlife densities in parts of the study area have revolved around kernel density estimators for spatial interpolation and generalized additive models to look at correlations with environmental variables (Geo-Marine Inc. 2010). We intend to increase the scope and quality of these past studies by incorporating decades of historical data (O'Connell et al. 2009), increasing the spatial and temporal scale of surveys, collecting habitat and movement data, and using more statistically robust modeling methods (Royle et al. 2007, Gardner et al. 2008), and possibly to account for prominent issues such as detectability of individuals. Between historic data (see Task 4.1) and the survey and tracking efforts conducted for this study (Tasks 1-3), we will have access to the largest existing database of mid-Atlantic marine wildlife surveys and movement data.

Hierarchical models allow an explicit and formal representation of the data into constituent models of the observations and of the underlying ecological or state process. Hierarchical models yield a cohesive treatment of many technical issues (e.g., components of variance, combining sources of data, 'scale'), and allow us to integrate data collected at multiple scales under different techniques. When integrating data at different scales, one must be cautious to match the scale of inference to the scale of covariates (e.g., SST, chlorophyll, ship-collected plankton data).

Hierarchical modeling encompasses a wide variety of models; for the sake of clarity, we will demonstrate one very simple example model of count data. For a given population size N_i of species i, the probability of observing a count of y_{ijk} from transect survey j (e.g., here an aerial video transect) during sample occasion k might follow a Poisson distribution:

$$y_{ijk} \sim Poisson(\lambda_{ijk})$$

where λ_{ijk} is the intensity (or expected mean of the counts) for species i at survey j during sample k. We might assume the counts have some spatial autocorrelation and are influenced by covariates. Thus we model variation in λ_{ijk} on the log-linear scale such that:

$$log(\lambda_{ijk}) = \alpha_i + \beta * \boldsymbol{X} + z_j$$

Here, α_i is the species specific intercept, **X** is a matrix of covariates that can be site or occasion-specific, and the random spatial effects, z_j, are included by applying a Gaussian conditional autoregressive (CAR) prior distribution on the spatial neighborhood (see Mattsson et al. in press for an example of the CAR prior in modeling occupancy of avian species). In this example, we may relate the data collected at various scales by discretizing space and using the additive property of the Poisson distribution to aggregate data across the discrete units, or we might consider the neighborhood as related to the linear nature of the survey method. We can vary the neighborhood grid in this model to increase or decrease the scale of relatedness, but still estimate the spatial relatedness as a parameter within the model.

Hierarchical Bayes approaches are useful for situations where distribution patterns or resource use vary with scale, and where species of interest are highly mobile and may be periodically unavailable for detection (Mordecai et al. 2011). Examples of such modeling efforts in the published literature (Diez and Pulliam 2007, Gardner et al. 2008, Zipkin et al. 2010, Mordecai et al. 2011) describe how distribution models are chosen to fit the observed data (for counts of wildlife at sea, which tend to be sporadic and highly aggregated, zero-inflated or overdispersed distributions are commonly used; Gardner et al. 2008, Zipkin et al 2010, Zipkin et al. *in press*), how environmental covariates are identified and incorporated into the model structure, and how Bayesian modeling approaches allow for the calculation of posterior model probabilities (which provide an easily interpretable measure of uncertainty). Specifics of our modeling approach (for instance, which distribution model will best fit the count data) will be defined once the data have been collected and examined. Outputs from the planned modeling effort are likely to include:

- Analysis of the quality, quantity and limitations of data used in modeling efforts.
- Analysis of the utility of movement data for correcting survey count data (e.g., by informing estimates of detectability, double-counting, etc.)

- Spatial models that use individual movement data from telemetry to estimate resighting (e.g., double-counting) and detection probabilities for survey data for focal species.
- Spatial models that predict relative abundance and distribution of focal species throughout the study area by season (winter, spring, summer and fall). Focal species will be identified based on estimated vulnerability to wind power development and on quantity and quality of available survey data, but are expected to include Northern Gannets, Common and Red-throated Loons, and several scoter and shearwater species, among others. Geospatial models will be developed for both the entire study area and for specific areas of interest within that study area (e.g., Wind Energy Areas) if possible. Data will be presented as a series of maps of predicted relative abundance by species and season, and related figures that communicate uncertainty of estimates.
- For species of interest with insufficient data to model relative abundance, occupancy models may be developed as an alternative (as they require less data to produce robust estimates), or data may be grouped by taxon to increase sample size. Project collaborators will determine which approach provides the most useful results for each species of interest. Some sea turtle species, for instance, may need to be grouped prior to modeling, as relatively few individuals are reliably identified to the species level in survey data.

Results for the First Budget Period: Project collaborator Dr. Beth Gardner, who is overseeing hierarchical modeling efforts, has hired a postdoctoral research associate to work on the project beginning in May of 2013. Modeling efforts will begin in earnest at that point. In the meantime, project collaborators have worked together to refine and change survey study designs as needed; to identify historical data to include in modeling efforts; and have begun discussions of how both satellite tracking and survey datasets must be formatted before they can be used in modeling efforts. Beth is also in communication with other statisticians working on similar efforts, such as Dr. Brian Kinlan at NOAA, regarding incorporation of environmental covariates in modeling and coordination with other efforts to model seabird distribution and abundance along the Atlantic coast (BOEM 2011, North Atlantic Landscape Conservation Cooperative 2012).

As noted for Task 2.0 above, video data for aerial surveys from September 2012 onwards have a ground spatial resolution (GSR) of two cm. For the three surveys conducted earlier in 2012, however, two cm GSR video was used during high-density coverage of the WEAs, and three cm coverage was used elsewhere. These early aerial survey data collected at multiple ground spatial resolutions may present difficulties during modeling, as the detectability of some species (e.g., the ability of video reviewers to identify those animals to the species level) varies between video resolutions. There are several ways to deal with this difference in detectability between surveys; depending upon what method seems most reasonable, the 2 cm data collected in different geographic areas during the same surveys (or 2 cm data collected in the same geographic areas during surveys conducted the following year) may be used to inform counts from 3 cm transects. GSR can also be incorporated as a covariate in models. For some species, there may not be sufficient data to develop reliable spatial relative abundance models, and the difference in GSRs may become moot (as related species may need to be grouped and modeled together). The exact strategy or strategies for dealing with this issue will be determined once the full dataset and historical data are in hand and can be examined collectively.

Subtask 4.1 Incorporation of historical data into modeling efforts

Task Summary: Through our collaboration with the U.S. Geological Survey, we have access to the Northwest Atlantic Seabird Compendium (O'Connell et al. 2009), a relational database that contains hundreds of thousands of data points and associated survey effort across a broad spatial scale. The Northwest Atlantic Seabird Compendium is the main repository for observations and survey data collected in Atlantic waters from Florida to Maine since 1906 (including data on marine mammals, sea turtles, and other wildlife as well as seabirds). More information on datasets included in the Compendium, as well as the computer programs and processes used in data management, is available in the 2009 BOEM report by O'Connell et al. (on which both Beth and Andrew Gilbert of BRI are coauthors). Andrew built the Compendium database while working for USGS, and is currently managing the database to add new datasets and extract data for statistical modeling. Andrew is overseeing the inclusion of new survey data from this project into the Compendium, and will work with Beth to extract both those new data and historical data that meet criteria for data quality, coverage, etc. as a combined dataset that can be used for modeling.

Results for the First Budget Period: Between 2010 and 2012 the Compendium remained largely static. Project collaborators have identified recent datasets to be incorporated into the Avian Compendium database, and Andrew has begun coordinating with investigators leading these recent survey efforts in order to standardize and incorporate these more recent datasets into the Compendium.

Subtask 4.2 Incorporation of satellite tracking data into modeling efforts

Task Summary: The project team will use tracking data from this and other studies to improve species relative abundance estimates, if possible. Satellite tracking data has historically been analyzed separately from survey data of wildlife distributions. However, it is possible that telemetry data could be useful for parameterizing models based on survey data, as well. Models that estimate densities and population parameters of animals from data collected on trap arrays have been developed by Beth and her collaborators (Gardner et al. 2010, Noss et al. 2012) and data from radio telemetry have been incorporated into this general model framework to inform model parameters related to individual locations and movements (Sollmann et al. 2013). The models are currently specific to data collected on trap arrays, but the general idea of combining data from telemetry with spatially replicated counts is relevant. It is possible that the accuracy of count data for these species may be improved if modeled movement data could be used to correct for detection bias, for example, or to estimate double counting of individuals during surveys.

Results for the First Budget Period: The individual tracking data used in this modeling effort is expected to include the seabird telemetry data from this project (much of which was co-funded by the Bureau of Ocean Energy Management or Sea Duck Joint Venture, SDJV). This includes at least 41 RTLO, 35 Northern Gannets, and 20 Surf Scoters. We also expect to be able to include other individual tracking data for these or other seabird species of interest. BRI is managing all SDJV telemetry data as of 2013, and has permission from SDJV to use these data in the Mid-Atlantic Baseline Studies modeling effort. Thus, species tracked by SDJV collaborators such as Surf Scoters and Black Scoters may also be possible to include in modeling efforts. Datasets will be transferred to Beth for modeling efforts beginning in May of 2013, when the project's postdoctoral research associate begins work at North Carolina State University.

Task 5.0 Nocturnal migration monitoring, Budget Period 1

The project team is attempting to understand the species composition, general spatial patterns, and weather-dependent and seasonal variation in offshore bird migration through a combination of acoustic and radar data collection. Both the nocturnal passive acoustic avian monitoring from the boat (Task 5.1) and the analysis of WSR-88 radar data, also known as NEXt generation RADar (NEXRAD; Task 5.2) are being approached as pilot studies, and have been undertaken to determine the utility of these approaches for examining avian migration in the offshore environment. As such (and due to the limitations inherent to data collected via these methods), these datasets will not be analyzed in conjunction with the survey and individual movement data described in Tasks 1-3. Each of these tasks will be completed with a self-contained analysis of the data obtained during the course of the study, and an analysis of the relative utility of these tools to answer relevant biological questions.

Subtask 5.1 Acoustic data collection

Task Summary: Most bird species migrate at night, and many emit short vocalizations during flight (Evans 2012). These flight calls are thought to be a form of communication between individuals, or possibly serve as a type of "echolocation," helping birds determine their altitude (Evans 2012). Many bird species can be identified by their vocalizations, so nocturnal acoustic monitoring stations can achieve species-specific presence-absence data and indices of abundance for birds that vocalize during migration.

During nights spent at sea in boat surveys (generally one night per survey), a Song Meter 2 acoustic recording setup (Wildlife Acoustics, Inc.) is deployed with a weatherproof microphone designed especially for recording distant night flight calls in the sky. The setup stores data on flash cards for subsequent downloading and analysis. The microphone is set atop a 6-foot pole, topped with a Plexiglas plate to reduce the amount of ground-level noise that reaches the microphone. The setup is operated on the upper deck of the survey vessel, and operates nonstop between nautical sunset and nautical sunrise to record flight calls of nocturnally migrating birds. The vessel is anchored at variable locations at sea (between 3 and 25 nautical miles offshore on any given survey) during this time. Acoustic data are downloaded to a laptop at the end of each boat survey by the observers, and sent to BRI for analysis. Resulting flight call data are analyzed to identify bird species (when possible) and provide information on the timing and intensity of nocturnal migration activity.

Bird acoustic analysis is generally conducted using Tseep and Thrush (Old Bird Inc.) and Program Raven (Cornell Lab of Ornithology) software programs. Tseep and Thrush are algorithms used to isolate potential night flight calls from the recordings. Thrush is tuned to pick out calls in the 3-5 KHz range while Tseep focuses on higher pitched calls greater than 6KHz. Early analysis of Tseep and Thrush results indicated that these programs were doing a poor job of isolating flight calls from the recordings from the boat, and as a result the scanning of audio files to find calls is also being conducted manually by a BRI ornithologist to ensure that flight calls are not missed. The isolated flight call files are then brought into Program RAVEN for species identification (via visual analysis of audio spectrograms) by experienced BRI ornithologists. Calls are identified to species or to a complex of species with similar calls (Evans 2012, Murray 2004); calls that cannot be definitively identified to species or species grouping are labeled as "no ID," but are still used in analyses of nightly migratory activity (Evans 2012).

Collection of nocturnal avian acoustic data offshore, and particularly from a boat platform (as opposed to an oil platform or other static structure) is largely untested, and this is very much a pilot study. Data products are expected to include the following:

- Usable flight call data will be georeferenced and presented as evidence of species presence at study sites

- Patterns of migratory activity over the course of the night will be analyzed when possible, and presented graphically
- The weather conditions related to high and low migratory activity will be assessed
- The utility of passive acoustic monitoring for nocturnal avian migration from a boat platform will be assessed, and recommendations for future use of this method in the offshore environment will be presented.

Results for the First Budget Period: During the current reporting period, project partners developed a database for storing passive acoustic data for the project; prepared the necessary equipment for conducting acoustic surveys from the boat platform; and recorded six nights of data (every night to date which the survey vessel spent offshore, rather than in port). We have collected nighttime acoustic data on the May, June, August, September, and November boat surveys, primarily from areas offshore of Maryland. No data was collected in December, due to short daylight hours and poor weather, which led to an erratic boat schedule for the December survey.

Recording quality on the April survey was hampered by weather and boat engine interference. However, recording conditions have been generally favorable to date, with minimal overlap in frequencies between flight calls and wind and wave action against the boat. Project collaborators feel confident in the proof of concept for the use of this passive acoustic recording system from an anchored boat platform. Detections of non-migratory calls from seabirds (gulls, terns, storm petrels, etc.) are common, but migratory flight calls from at least fifteen species of loon, passerine and shorebird have also been detected to date (Appendix X). Species identifications and analysis of call frequencies and timing are ongoing.

Subtask 19.1 NEXRAD analysis

Task Summary: WSR-88 (NEXRAD) radar units measure reflected microwaves from matter in the atmosphere. In addition to weather, such units can also detect “bioscatter,” or reflectivity caused by migratory animals in the atmosphere. The United States’ national network of weather monitoring stations have long been detecting bird and bat migratory movements, but now there are analyses that can be done to unfiltered NEXRAD data to estimate the relative abundance, direction of movement, speed, and altitude of migrants based on radar reflectivity data (Horn and Kunz 2008). The results of NEXRAD analysis are superficially similar to traditional marine radar, but the data are collected over a much broader geographic scale and lack the single target identification abilities of site-based radar. Though they lack the fine scale resolution of traditional marine radar, NEXRAD data allows for efficient monitoring of geographical and temporal patterns in migration on a broad scale, and the monitoring may be done at any time of day or night (weather permitting, as rain and fog can obscure the presence of birds).

Radar data is obtained from the National Oceanic and Atmospheric Administration National Severe Storms Laboratory database, housed at the University of Oklahoma, which collects and archives data from WSR-88 and Doppler radar stations located around the country. Data on radar reflectivity (db Z) will be included from peak migration hours for all nights without weather inference, and will be converted to the more biologically useful metric of relative reflectivity db η (Chilson et al. 2011) for analyses. Analysis will use open-source Geographic Information System (GRASS GIS; http://grass.osgeo.org/). Custom-written scripts for data mining, management, and interpretation will be made available in accordance with guidelines of the open-source geospatial community. Project collaborators will process radar data, weather data, and vector images for standardized comparison sites around the study region, and model multiple years of NEXRAD reflectivity data from migration periods. Analysis of the resulting dataset could involve the use of a generalized linear mixed model that controls for variables such as weather covariates and distance to the radar and examines relative migratory activity between sites; a similar model was developed for a recent terrestrial study (Williams et al. 2012 in prep.). However, there is relatively poor NEXRAD coverage of offshore areas in comparison to areas on land in the United States, and the use of these data for predicting migratory patterns in the offshore environment is relatively unstudied. As such, this analysis will be regarded as pilot study, with the following objectives:

- Examine whether NEXRAD data are useful for examining nocturnal migratory movements offshore;
- Examine whether NEXRAD data are useful specifically for the WEAs in our study area, given locations of nearby radar stations; and
- If NEXRAD analysis does appear to have enough coverage of our study area to be useful, see what information can be gleaned about environmental covariates of migratory flights and locations of major migratory pathways offshore (if any).

In our study area, if NEXRAD data prove useful at all, they are expected to only include migratory activity at fairly high altitudes, not at rotor height. NEXRAD analyses are not intended to examine site-specific risk, but may prove useful for developing a better understanding of environmental factors affecting migration (wind speed, direction, etc.) in our study area, and may be helpful for identifying major migration routes in our study area (again, at high altitudes). This metric is most useful for describing the timing and direction of broad-scale migratory activity. The only similar study that we know of was performed by Geo-Marine Inc. for the New Jersey Department of Environmental Protection (2010). We aim to present an objective view of the utility of NEXRAD data for studying migration offshore, and specifically for our study area in the mid-Atlantic.

Results for the First Budget Period: During the current reporting period, Dr. Philip Chilson of the School of Meteorology and Atmospheric Radar Research Center at the University of Oklahoma was identified as a key project collaborator. Dr. Chilson is an internationally recognized expert in the use of NEXRAD data to examine biological migration. Dr. Chilson has identified a student who will be assisting him with analyses beginning in early 2013. NEXRAD analyses were originally identified as a task for the third budget period, but project collaborators have determined that for practical reasons related to the use of students in conducting analyses, the effort is best spread out over a longer time period. Analysis efforts have begun in the current budget period and will continue through the third budget period.

Task 6.0 Study coordination and dissemination of project results, Budget Period 1

Task Summary: DOE will coordinate discussions between the funding recipients and representatives from relevant efforts to discuss collaboration. A project summary will be made available to the public on BRI's website. Project updates will be communicated to developers and regulators at one or more relevant conferences.

Results for the First Budget Period: Information on study design, study area, and survey protocols have been shared with other researchers in the mid-Atlantic region through a series of conference calls, informal meetings, and a two-day workshop hosted by the Department of Energy on July 24-25, 2012. The workshop was titled "Mid-Atlantic Marine Wildlife Surveys, Modeling, and Data: Workshop to Establish Coordination & Communication," and brought together active researchers conducting offshore wildlife research between Cape Cod and Cape Hatteras to discuss study designs, research foci, and potential areas for coordination of field efforts and analysis. The workshop report, including details on study design for the project, will be made publicly available by conference organizers. As a result of connections made at the July workshop, project collaborators and DOE project managers worked with NOAA colleagues in August and September to conduct the part of the September AMMAPPS (Atlantic Marine Assessment Program for Protected Species) aerial survey and BRI's September aerial survey at similar times and locations, in order to enable a comparison of the AMAPPS and BRI survey protocols. AMAPPS surveys are flown at 600 feet; are focused on marine mammals and sea turtles; and use visual observers, so are different in several respects from the high-definition video aerial surveys conducted in this study. As a result of this collaboration, AMAPPS and BRI survey flights of the Maryland and Delaware WEAs were flown within a day of each other. Once the high definition survey data are finalized, project collaborators will approach NOAA about beginning a comparison of results.

In the current reporting period a project PI also gave platform presentations summarizing the Mid-Atlantic Baselines Studies Project and activities to date at the 2012 Northwest Atlantic Marine Bird Conservation Cooperative meeting (February 27-28, 2012); the Global Offshore Wind Conference in London (June 13-14); the EnergyOcean International conference in Boston (June 19-21, 2012); the North American Ornithological Conference (August 14-18); and the American Wind Energy Association (AWEA) Offshore Wind conference (October 9-11). Poster presentations on the study, focused particularly on aerial survey results to date, were also given at the Bird Conservation in the Northeast meeting (October 7-8, 2012) and the National Wind Coordinating Collaborative (NWCC) biannual meeting (November 28-30, 2012). Copies of these presentations have been sent to the DOE project monitor. A flyer summarizing the project has also been created to hand out to interested parties at conferences (Appendix XI). Additionally, Caleb Spiegel from the U.S. Fish and Wildlife Service (FWS) presented at the Bird Conservation in the Northeast conference on the Diving Bird Telemetry Project, which is collaboratively funded by DOE, FWS, and the Bureau of Ocean Energy Management (BOEM), and includes the Red-throated Loon and Northern Gannet satellite telemetry projects. Project collaborators are also planning to deliver oral presentations at the Pacific Seabird Group annual meeting (Feb. 21-23, 2013), and are scheduled for web-accessible presentations as part of the USFWS Science Seminar Series (Feb. 28) and the NOAA Brown Bag Seminar Series (March 5, 2013).

In addition to coordinating efforts via conference calls, workshops and conferences, some public information on the study is available. A summary of project goals and objectives is available on the project website at: http://www.briloon.org/research/research-programs/wildlife-renewable-energy-program/mabs. A news article published on October 11, 2012 about offshore wind and wildlife (entitled "Offshore wind: Wildlife studies in mid-Atlantic seen as crucial to industry's future") also describes the Mid-Atlantic Baseline Studies Project's methods and goals as part of a larger discussion of offshore wind and wildlife topics (http://www.eenews.net/public/Greenwire/2012/10/11/2).

Task 7.0 Project management and reporting, Budget Period 1

Task Summary: This task includes overall project management, communications and coordination with project collaborators, manuscript development, and other needs. Reports and other deliverables are provided in accordance with the Federal Assistance Reporting Checklist following the instructions included therein.

Results for the First Budget Period: Project management, including communications and coordination with project collaborators, is ongoing. Major activities during the current reporting period included the finalization of an assistance agreement with the Department of Energy in February of 2012; negotiation of subcontracts with project partners and vendors; refinement of survey designs for aerial and boat surveys; administration of boat survey, aerial survey, nocturnal avian migration, and satellite telemetry field projects; administration of the boat-aerial comparison survey; administration of aerial survey video review; coordination with other studies in the mid-Atlantic region, and communication of project goals and results to date to broader audiences; regular reporting to DOE project managers via email, conference calls, and quarterly reports; and preparation for future project components.

D. PRODUCTS AND DELIVERABLES

Products / Deliverables

The five major project deliverables listed in the SOPO for the first budget period are:

- Submission of an annual progress report to the DOE Wind and Water Power Program. This requirement is fulfilled with the submission of this continuation application document.
- Submission of an annual technical report with preliminary analyses. This requirement is fulfilled with the submission of this continuation application document.
- Beginning to compare aerial and boat-based survey techniques. Project partners developed a design for the aerial-boat comparison study, which required a special aerial survey day during a planned boat survey. This comparison effort occurred on March 22, 2013, and data analysis will begin in the next budget period. In the meantime, project collaborators have conducted informal comparisons of data from aerial and boat surveys conducted to date; though regular surveys are not conducted in tandem (and thus specific numbers or identifications of animals should not be compared between survey types), some recurring differences in detection and identification rates for certain taxa are suggestive (Task 1.0 above).
- To conduct at least 75% of the planned surveys for the time period. As of January, we have already conducted more than 75% of the planned surveys for the budget period, which ends April 30, 2013. Barring unexpected delays, we are on schedule to complete all planned surveys for the budget period.
- To present at the DOE Wind and Water Power Program Review Meeting. Our project managers at DOE have informed us (via email to lead PI on 17 January, 2013) that an in-person presentation of results to date will not be necessary in 2013. We have kept project managers up to date through emails and conference calls on a monthly basis, if not more frequently. We will plan to conduct this in-person presentation and review in future budget periods as required.

Additionally, project partners have produced many other deliverables or interim products during the current budget period, including coordination with other studies and dissemination of project results at eight conferences (details in Task 6.0, above). In addition to conference proceedings and related information, some public information on the study is also available; there is a summary of project goals and objectives on the project website at: http://www.briloon.org/research/research-programs/wildlife-renewable-energy-program/mabs, and a news article published on October 11, 2012 about offshore wind and wildlife (entitled "Offshore wind: Wildlife studies in mid-Atlantic seen as crucial to industry's future") describes the Mid-Atlantic Baseline Studies Project's methods and goals as part of a larger discussion of offshore wind and wildlife topics (http://www.eenews.net/public/Greenwire/2012 /10/11/2). Manuscripts on the presence of bats in the offshore environment, the flight trajectory of raptors on their offshore migration during Hurricane Sandy, and the spatiotemporal distribution of cownose rays in the study area are currently in preparation by BRI staff.

Project partners have also developed data deliverables during the budget period, including data collection, data management and development of quality assurance procedures. Large amounts of data are being generated during the course of this project. Internal databases have been developed by BRI staff to house the telemetry data and passive acoustic data. Video data are being stored in a database designed by HiDef Aerial Surveying, and are being housed at both BRI and HiDef offices. Boat survey data are entered in dLOG, a commonly used software program for at-sea surveys, and after QA processes at BRI are being held by both the City University of New York and BRI. Active acoustic data (echosounder data from the vessel) are stored by BRI and are being analyzed using Echoview, a software program from Myriax Software Ltd. that is commonly used in conjunction with SIMRAD echosounding equipment for fisheries research. To date, data produced by project partners include results from six aerial and six boat surveys; individual tracking data of 43 individuals from four focal bird species; echosounding data to accompany each day of boat surveys; and six nights of nocturnal passive acoustic avian migration monitoring offshore, among other data. Historical datasets are also being collected, and are being managed similarly to original data collected for the project, so that both types of data may be easily integrated and incorporated into modeling efforts. Preliminary results are shared with DOE project managers during regular conference calls, but most data produced to date have not undergone the necessary QA or analysis processes to be released to the public.

E. CHANGES TO PROJECT TASKS

There have been no changes to the project SOPO. However, smaller changes to project tasks have occurred due to scheduling delays, technical difficulties, and other considerations. Though these changes do not affect the overall project timeline or the ability of project partners to achieve project objectives, details are included below.

Task 1.0 Boat surveys: The last boat survey is currently planned for March of 2014; though originally scheduled to January/February 2014, this change (due to initial delays with equipment installation) will not affect the survey schedule as laid out in the SOPO. The aerial-boat comparison survey was pushed back from a tentative date of autumn 2012 to spring 2013 due to extra time needed to obtain the necessary equipment. This comparison occurred in March of 2013.

Echosounder data on the earlier boat surveys showed noise from the boat's electrical system leaking in to echosounder recordings; use of individual batteries and new inverters resolved the issue beginning with the August survey.

Boat surveys are conducted in "passing mode" (see Task 1.0), meaning that the ship stays on transect and does not break speed when observers spot animals. Due in part to this study design there have been few opportunities for observers to take photographs of cetaceans and submit the photos for individual identification using the established North Atlantic Fin Whale, Humpback or North Atlantic Right Whale catalogues. Additionally, as of 30 January 2013, only a single individual from these cetacean species had been observed on boat surveys (a humpback whale on the November survey). If opportunities for photographs arise, the observers will to take advantage of them, but we anticipate that we may not be able to provide much in the way of individual identification data for large whales in our study area.

Task 2.0 Aerial surveys: The last aerial survey is tentatively scheduled for February of 2014, which is in line with the schedule laid out in the project SOPO. Surveys suffered from initial equipment and technical issues; one of the four super high-definition belly-mounted cameras on one of the planes used in the first aerial survey in March was incorrectly focused, and species identifications with the resulting blurry imagery were extremely difficult and in some cases impossible. The aerial survey vendor recognized the issue after the first survey, could not satisfactorily ameliorate the focus issue with the existing equipment, and switched out the entire camera array prior to the second survey. Video from later surveys also appear to have some blurriness in some reels, though not to the same extent as the first survey. Project collaborators continue to work with the aerial survey vendor to ensure that proper quality assurance procedures are conducted prior to each survey flight and that cameras are properly focused for future surveys.

The ground spatial resolution (GSR) of aerial survey video on the saw-tooth transects (outside of the WEAs) has been reduced from 3 cm to 2 cm, to match the GSR of video within the WEAs and improve species identification rates for animals observed in the sawtooth footage. All surveys have been conducted at 100% 2 cm GSR from the September 2012 aerial survey onwards (more information is available in Appendix IV).

Analysis of the first survey, flown in March, was highly collaborative among the four video reviewers, and project partners thus determined that it would not be included in the normal QA process. The four reviewers have conducted video review of all subsequent surveys individually, with some discussion as they encountered new animal types, thus facilitating their ability to conduct normal QA processes for these surveys. As of 30 January 2013, biologists were currently completing the QA process for the September survey data.

Task 3.0 Individual Tracking: Field efforts to capture and track the four focal bird species for the project have been successful on the whole, but several modifications to study plans have been identified:

- Due to the success of transmitter implants with Northern Gannets in the first field season, project collaborators used only implants (as opposed to tail-mounted transmitters) in this winter's deployments.
- Project partners have worked with the Fish and Wildlife Service Region 5 Migratory Bird Program and BOEM (key funders for the seabird telemetry studies), wildlife veterinarians, and

others to identify strategies for minimizing stress to captured Red-throated Loons during the upcoming field season; these include changes to handling and sedation protocols.

- Collaborators for the Surf Scoter study are planning to split capture efforts in 2013 between the mid-Atlantic and the Gulf of St. Lawrence in Canada. A pilot study in the autumn of 2012 determined that Surf Scoters could be more easily captured at a fall migration staging area in the Gulf of St. Lawrence than on their wintering grounds in the mid-Atlantic region.
- An additional satellite transmitter, representing in kind from the Biodiversity Research Institute, was deployed during the Peregrine Falcon tracking study. An experimental GSM-type transmitter was also donated to the project, bringing the total number of deployed falcon transmitters for 2012 to seven.

Task 4.0 Hierarchical modeling of animal abundance: Data management and preparation are underway, but modeling activities are expected to begin in earnest in May of 2013, with the hire of a postdoctoral associate at North Carolina State University. This is slightly later than originally anticipated, but will leave a full two years of project time for modeling efforts and will not affect project outcomes. Rearrangement of funds between budget periods to accommodate this change was included in the budget modification submitted to project managers on 3 January, 2013.

Task 5.0 Nocturnal migration monitoring: NEXRAD analyses were originally identified as a task for the third budget period, but project collaborators have determined that for practical reasons related to the use of students in conducting analyses, the effort is best spread out over a longer time period. As such, the same amount of project resources are being contributed towards NEXRAD analyses, but are being spread out over a longer time period, and efforts began in early 2013. Rearrangement of funds between budget periods to accommodate this change was included in the budget modification submitted to project managers on 3 January, 2013.

Task 6 Dissemination of project results: Additional venues for dissemination of project results were identified during the first budget period. Project partners took advantage of several of these opportunities, and included travel expenses related to these workshops or conferences in the budget modification submitted to project managers on 3 January, 2013.

Task 7 Project management and reporting: There were no changes to the project SOPO during this budget period, but a modified budget justification was submitted to project managers at DOE on 3 January, 2013. This modification included the following changes:

- Redistribution of contractual funding between budget periods for several subrecipients and vendors;
- Adjustment of indirect and fringe rates to match the indirect rate proposal submitted to DOE in October 2012;
- Reduction in estimated costs of hard drives for short- and long-term storage of video data, due to reduction of prices for these items on the global market;
- Adjustments in estimates of personnel hours, travel costs, supplies costs, and other costs required for various project tasks, based on hours/expenses incurred to date;

- Changes in salaries paid to certain personnel, based on current pay rates;
- Reclassification of certain costs from "contractual" to "other" (for services provided by CLS America, Inc.); and
- Inclusion of travel costs that were not anticipated at the beginning of the project (such as travel expenses for project PIs to attend the July DOE workshop, which had not been planned when the budget justification was created).

F. PLANS FOR THE NEXT BUDGET PERIOD

In the second budget period, project partners expect to complete the following tasks, which are reflected in Tab A of the accompanying RPPR Tables spreadsheet:

- Finish all boat and aerial surveys;
- Continue conducting aerial video review and analysis;
- Continue management and compilation of boat data;
- Continue analysis of echosounding data;
- Continue management of incoming satellite telemetry data;
- Analyze data and begin manuscript development for the boat-aerial comparison study;
- Deploy additional transmitters on Surf Scoters and Peregrine Falcons (planned deployments by species: 25 scoters and 5 falcons);
- Begin hierarchical modeling efforts, primarily focused on gathering relevant data and determining the utility of individual tracking data to inform modeling efforts;
- Continue nocturnal migration monitoring efforts via passive acoustics and NEXRAD analysis;
- Continued coordination with other studies, including AMAPPS;
- Development of at least one draft manuscript for publication;
- Sharing information about the project in several formal and informal venues; and
- Fulfilling regular reporting requirements to project managers, including quarterly reports, regular conference calls, and other reports as required.

Deliverable milestones for the upcoming budget period include the submission of annual progress/technical report to the DOE Wind and Water Power Program that includes modeling results with an initial evaluation of the quality of the data, preliminary analyses, and GIS maps; a draft comparison of aerial and boat-based survey techniques; completion of at least 75% of the planned surveys for the time period; and a presentation at the DOE Wind and Water Power Program Review Meeting in April of 2014.

G. LITERATURE CITED

[BOEM] Bureau of Ocean Energy Management. 2011. Environmental Studies Program, Ongoing Studies: Compendium of Avian Information, Part 2. BOEM Study Number NT-11-x24. (14 March 2013; *http://boem.gov/uploadedFiles/BOEM/Environmental_Stewardship/Environmental_Studies/Renewable_Energy/NT-11-x24%20%20Avian%20Compendium%20Part%202.pdf*)

Chilson PB, Frick WF, Stepanian PM, Shipley JR, Kunz TH, Kelly JF. 2012. Estimating animal densities in the aerosphere using weather radar: to Z or not to Z? Ecosphere 3(8):72. 19 pp.

Diez JM, Pulliam HR. 2007. Hierarchical analysis of species distributions and abundance across environmental gradients. Ecology 88(12):3144-3152.

Evans WR. 2012. Avian acoustic monitoring study at the Maple Ridge Wind Project, 2007-2008: Final Report. NYSERDA Report 12-23. Accessed 21 February 2013; http://www.nyserda.ny.gov/Publications/Research-and-Development-Technical-Reports/Environmental-Reports.aspx.

Gardner B, Sullivan PJ, Epperly S, Morreale SJ. 2008. Hierarchical modeling of bycatch rates of sea turtles in the western North Atlantic. Endangered Species Research 5:279-289.

Gardner B, Repucci J, Lucherini M, Royle JA. 2010. Spatially explicit inference for open populations: estimating demographic parameters from camera-trap studies. Ecology 91(11):3376-3383.

Garthe S, Hüppop O. 2004. Scaling possible adverse effects of marine wind farms on seabirds: developing and applying a vulnerability index. Journal of Applied Ecology 41:724-734.

Geo-Marine, Inc. 2010. New Jersey Department of Environmental Protection Baseline Studies. Final Report Vol II: Avian Studies. (8 March 2013; *www.nj.gov/dep/dsr/ocean-wind/report.htm*)

Horn, JW, TH Kunz. 2008. Analyzing NEXRAD Doppler radar images to assess nightly dispersal patterns and population trends in Brazilian free-tailed bats (*Tadarida brasiliensis*). Integrative and Comparative Biology 48: 24-39.

Kinlan BP, Menza C, Huettmann F. 2012. Chapter 6: Predictive modeling of seabird distribution patterns in the New York Bight. Pp. 87-148. In: Menza C, Kinlan BP, Dorfman DS, Poti M, Caldow C (eds.). 2012. A biogeographic assessment of seabirds, deep sea corals and ocean habitats of the New York Bight: Science to support offshore spatial planning. NOAA Technical Memorandum NOS NCCOS 141. Silver Spring, MD. 224 pp.

Mattsson, B.J., Zipkin, E.F., Gardner, B., Blank, P.J., Sauer, J.R. and Royle, J.A. In press. Explaining local scale species distributions: relative contributions of spatial autocorrelation and landscape heterogenity for an avian assemblage. PLoS ONE.

Mordecai RS, Mattsson BJ, Tzilowski CJ, Cooper RJ. 2011. Addressing challenges when studying mobile or episodic species: hierarchical Bayes estimation of occupancy and use. Journal of Applied Ecology 48:56-66.

Murray J. 2004. Nocturnal flight call analysis as a method for monitoring density and species composition of migratory songbirds (Order Passeriformes) across southern Vancouver Island, British Columbia in 2004. Rocky Point Bird Observatory, Vancouver. Accessed 2 May 2011. Available at: http://www.islandnet.com/~rpbo/acousticmonjjm.pdf.

North Atlantic Landscape Conservation Cooperative. 2012. Mapping the distribution, abundance and risk assessment of marine birds in the northwest Atlantic Ocean. North Atlantic LCC Project NALCC_2011_07. (14 March 2013; *www.northatlanticlcc.org/projects/mapping-the-distribution-abundance-and-risk-assessment-of-marine-birds-in-the-northwest-atlantic-ocean*)

Noss AJ, Gardner B, Maffei L, Cuéllar R, Montano R, Romero-Munoz A, Sollmann R, O'Connell AF. 2012. Assessment of density estimation methods for animal populations with camera traps in the Kaa-Iya del Gran Chaco landscape. Animal Conservation 15:527-535.

O'Connell AF, Gardner B, Gilbert AT, Laurent K. 2009. Compendium of Avian Occurrence Information for the Continental Shelf Waters along the Atlantic Coast of the United States, Final Report (Database Section - Seabirds). USGS Patuxent Wildlife Research Center, Beltsville, MD. Bureau of Ocean Energy Management Headquarters, OCS Study BOEM 2012-076.

Royle JA, Kéry M, Gautier R, Schmid H. 2007. Hierarchical spatial models of abundance and occurrence from imperfect survey data. Ecological Monographs 77(3):465-481.

Sollmann R, Gardner B, Parsons AW, Stocking JJ, McClintock BT, Simons TR, Pollock KH, O'Connell AF. 2013. A spatial mark-resight model augmented with telemetry data. Available as a preprint online at Ecology (http://www.esajournals.org/toc/ecol/0/0).

Williams KA, Adams EM, Fiely J, Yates D, Evers DC. 2013. Migratory Bird and Bat Monitoring in the Thousand Islands Region of New York State: Final Report, March 2013. Report to the U.S. Fish and Wildlife Service Columbus, Ohio Field Office. Report BRI 2013-11, Biodiversity Research Institute, Gorham, Maine.

Zipkin EF, Gardner B, Gilbert AT, O'Connell AF Jr, Royle JA, Silverman ED. 2010. Distribution patterns of wintering sea ducks in relation to the North American Oscillation and local environmental characteristics. Oecologia 163:893-902.

Zipkin E.F., Leirness J.B., Kinlan B.P., O'Connell A.F., and Silverman E.D. In press. Fitting statistical distributions to sea duck count data: implications for survey design and abundance estimation. Statistical Methodology. Invited paper for a special issue on statistical methods in ecology.

Appendix I. Summary Tables from April-November Boat Surveys

Table I.1: Birds observed during the first five boat surveys. Data are presented in order of abundance based on the total count from all five surveys. Note that data are preliminary.

Species or Group	April	June	Aug.	Sept.	Nov.	Total	% of Total Bird Observations
Northern Gannet	486	2	0	0	2321	**2809**	37.0%
Laughing Gull	113	63	136	110	325	**747**	9.8%
Common Loon	496	7	0	0	237	**740**	9.7%
Common Tern	42	35	263	233	10	**583**	7.7%
Bonaparte's Gull	35	0	0	0	430	**465**	6.1%
Wilson's Storm-Petrel	0	228	128	6	0	**362**	4.8%
Royal Tern	48	58	52	124	2	**284**	3.7%
Unidentified Gull	0	0	0	76	79	**155**	2.0%
Unidentified Bird	1	0	0	10	142	**153**	2.0%
Unidentified Scoter	0	0	0	0	152	**152**	2.0%
Double-crested Cormorant	10	5	0	3	119	**137**	1.8%
Great Black-backed Gull	8	2	6	17	89	**122**	1.6%
Black Scoter	0	0	0	0	101	**101**	1.3%
Herring Gull	47	2	0	8	39	**96**	1.3%
Unidentified Tern	14	5	9	25	6	**59**	0.8%
Unidentified Dark Scoter	0	0	0	0	49	**49**	0.6%
Purple Martin	0	1	45	2	0	**48**	0.6%
Red-throated Loon	14	0	0	0	30	**44**	0.6%
Forster's Tern	4	0	0	1	37	**42**	0.6%
Surf Scoter	1	0	0	0	31	**32**	0.4%
Great Shearwater	0	32	0	0	0	**32**	0.4%
Unidentified Duck	0	0	0	0	26	**26**	0.3%
Brant	0	0	0	0	25	**25**	0.3%
Brown Pelican	0	4	1	18	2	**25**	0.3%
Unidentified Phalarope	0	0	0	23	0	**23**	0.3%
Mallard	0	0	0	20	0	**20**	0.3%
Black Tern	0	0	8	12	0	**20**	0.3%
Lesser Black-backed Gull	6	0	3	0	8	**17**	0.2%
Unidentified Shorebird	0	0	1	14	0	**15**	0.2%
Unidentified Warbler	0	0	1	14	0	**15**	0.2%

Species or Group	April	June	Aug.	Sept.	Nov.	Total	% of Total Bird Observations
Red-necked Phalarope	1	0	0	13	0	**14**	0.2%
Barn Swallow	12	1	1	0	0	**14**	0.2%
Parasitic Jaeger	11	0	0	0	2	**13**	0.2%
Unidentified Passerine	0	0	0	8	5	**13**	0.2%
Cory's Shearwater	0	6	1	5	0	**12**	0.2%
Unidentified Swallow	0	0	0	12	0	**12**	0.2%
Green-winged Teal	0	0	0	10	0	**10**	0.1%
Unidentified Cormorant	0	0	0	0	9	**9**	0.1%
Unidentified Loon	0	0	0	0	8	**8**	0.1%
Unidentified Storm-Petrel	3	2	1	1	0	**7**	0.1%
Tree Swallow	0	0	0	7	0	**7**	0.1%
Unidentified Peep	0	0	0	6	0	**6**	0.1%
American Black Duck	0	0	0	0	5	**5**	0.1%
Wilson's Plover	0	5	0	0	0	**5**	0.1%
Whimbrel	5	0	0	0	0	**5**	0.1%
Black-legged Kittiwake	0	0	0	0	5	**5**	0.1%
Unidentified Dark Duck	0	0	0	0	4	**4**	0.1%
Manx Shearwater	0	3	0	0	0	**3**	0.0%
Unidentified Shearwater	0	2	0	0	1	**3**	0.0%
Great Blue Heron	1	0	0	0	2	**3**	0.0%
Ring-billed Gull	0	0	0	0	3	**3**	0.0%
Osprey	0	2	0	0	0	**2**	0.0%
American Coot	1	0	0	0	1	**2**	0.0%
Sanderling	0	0	2	0	0	**2**	0.0%
Sabine's Gull	0	0	0	2	0	**2**	0.0%
Unidentified Jaeger	0	1	0	1	0	**2**	0.0%
American Pipit	0	0	0	0	2	**2**	0.0%
Myrtle Warbler	0	0	0	0	2	**2**	0.0%
Red-winged Blackbird	0	0	0	0	2	**2**	0.0%
Wood Duck	0	0	0	0	1	**1**	0.0%
White-winged Scoter	0	0	0	0	1	**1**	0.0%
Audubon's Shearwater	0	1	0	0	0	**1**	0.0%
Green Heron	1	0	0	0	0	**1**	0.0%
White-rumped Sandpiper	0	0	0	1	0	**1**	0.0%

Species or Group	April	June	Aug.	Sept.	Nov.	Total	% of Total Bird Observations
Roseate Tern	0	1	0	0	0	**1**	0.0%
Unidentified Dark Tern	0	0	0	0	1	**1**	0.0%
Unidentified Skua	0	1	0	0	0	**1**	0.0%
Merlin	0	0	0	1	0	**1**	0.0%
Red-breasted Nuthatch	0	0	0	0	1	**1**	0.0%
Ruby-crowned Kinglet	0	0	0	0	1	**1**	0.0%
American Robin	0	0	0	0	1	**1**	0.0%
Northern Waterthrush	0	0	1	0	0	**1**	0.0%
Tennessee Warbler	0	0	0	1	0	**1**	0.0%
Mourning Warbler	0	0	0	1	0	**1**	0.0%
American Redstart	0	0	0	1	0	**1**	0.0%
Blackpoll Warbler	0	0	0	1	0	**1**	0.0%
Black-throated Blue Warbler	0	0	0	1	0	**1**	0.0%
Brown-headed Cowbird	0	0	0	1	0	**1**	0.0%
Totals	**1360**	**469**	**659**	**789**	**4317**	**7594**	**100.0%**

Table I.2: Summary of non-avian wildlife observed during the first five boat surveys. Data are presented in order of abundance based on the total count from all five surveys. Note that data are preliminary.

Species or Group	**April**	**June**	**Aug.**	**Sept.**	**Nov.**	**Total**	**% of Total Non-Avian Animals**
Bottlenose Dolphin	223	174	94	87	28	**606**	64.1%
Unidentified Fish	0	69	0	2	9	**80**	8.5%
Flying Fish	0	0	0	59	0	**59**	6.2%
Unidentified Dolphin	2	28	5	19	4	**58**	6.1%
Baitfish schools	0	19	25	6	0	**50**	5.3%
Loggerhead Turtle	12	11	19	3	2	**47**	5.0%
Unidentified Ray	0	3	14	1	0	**18**	1.9%
Leatherback Turtle	0	1	2	4	0	**7**	0.7%
Unidentified Turtle	3	1	1	1	0	**6**	0.6%
Jellyfish	0	1	0	1	3	**5**	0.5%
Portuguese Man o' War	0	4	0	0	0	**4**	0.4%
Red Bat	0	0	0	1	0	**1**	0.1%
Minke Whale	0	0	0	0	1	**1**	0.1%
Humpback Whale	0	0	0	0	1	**1**	0.1%
Ocean Sunfish	1	0	0	0	0	**1**	0.1%
Tuna	0	1	0	0	0	**1**	0.1%
Total	**241**	**312**	**160**	**184**	**48**	**945**	**100.0%**

Appendix II. Maps from April 2012 Boat Survey

Figure II.1: Observations of Northern Gannets from the April 2012 boat survey. Data are raw observations and should be regarded as strictly preliminary.

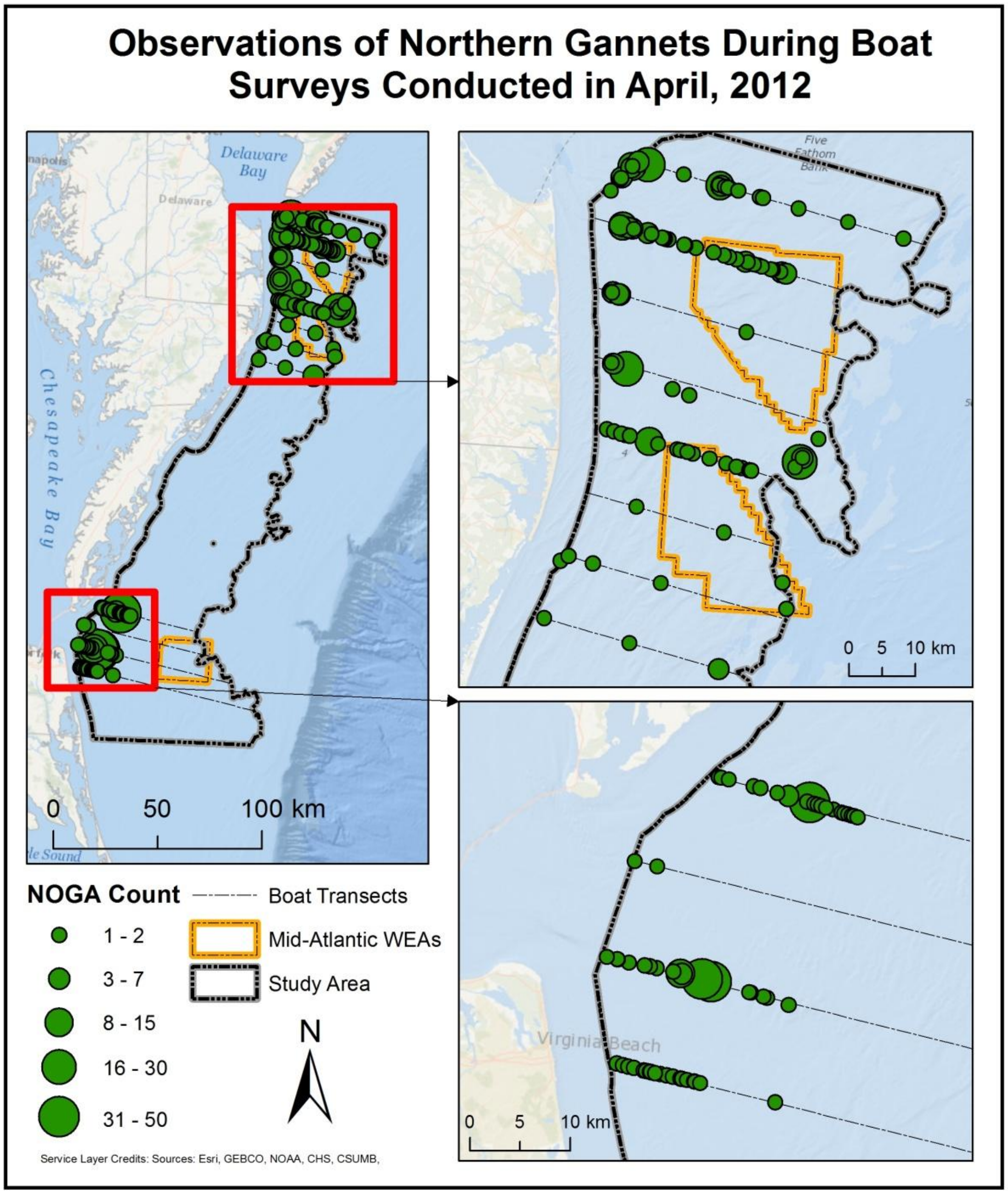
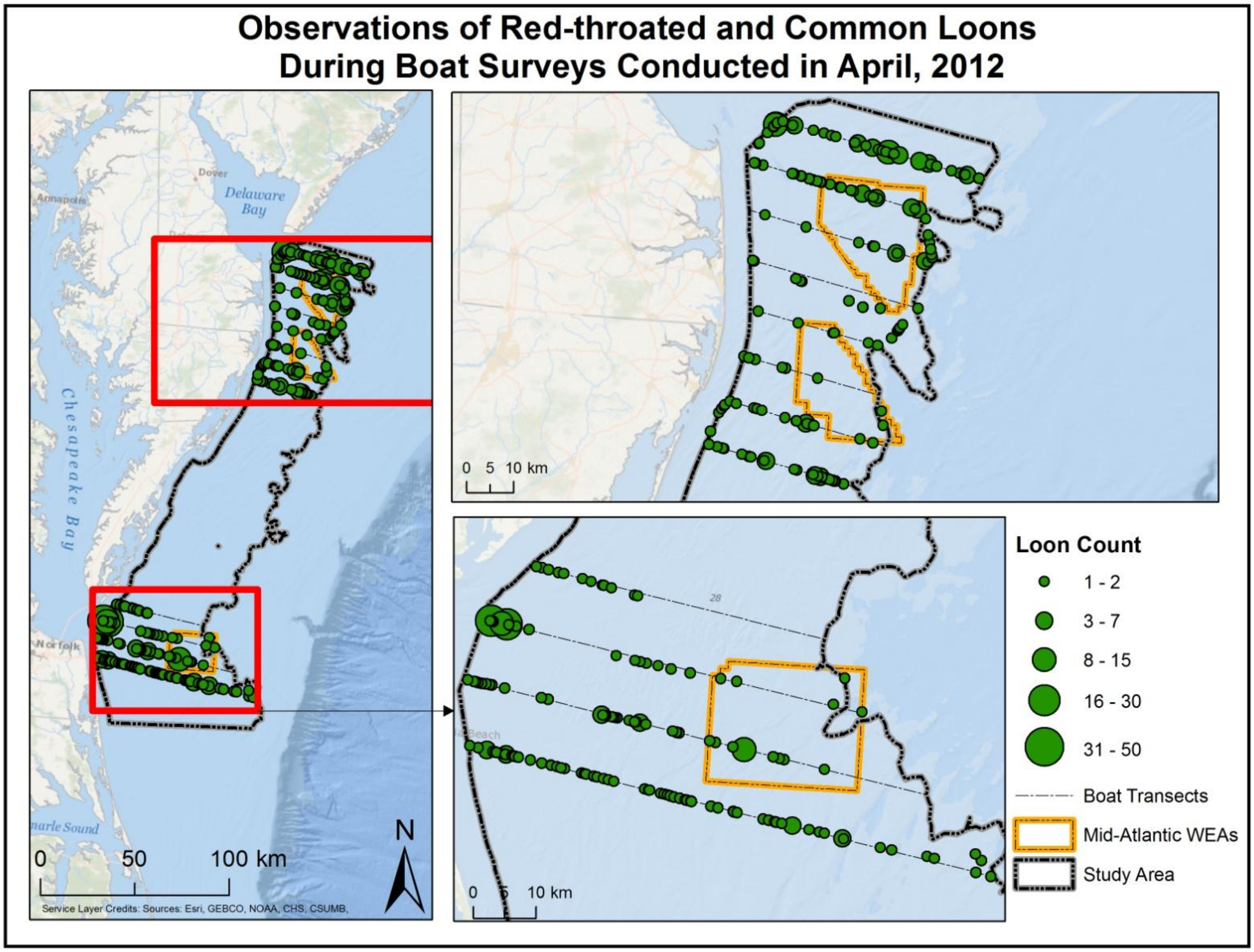


Figure II.2: Observations of Loon species from the April 2012 boat survey. Data are raw observations and should be regarded as strictly preliminary.



Appendix III. Study Design for Boat-Aerial Comparison study: DOE Mid-Atlantic Baseline Studies Project, March 2013

Overview

A day of simultaneous boat and aerial surveys will be conducted in late March or early April of 2013 to examine correlations and differences in data from the two survey techniques (including detection rates, species identification rates, and other metrics). The comparison study area will include 2-3 boat transects (Figure III.1), and is expected to require a single day of boat time to survey. The plane will survey the same transects as the boat for this comparison, but due to the plane's higher speed will repeat the 2-3 transects 4+ times over the course of the day.

If possible, the comparison study should be conducted in an area and at a time of year with relatively high animal densities. Based upon where animals were seen in the large-scale portion of the March 2012 aerial survey (Figure III.2), the comparison study should ideally be conducted off of Virginia or Delaware. Potential study locations, listed from highest to lowest desirability, are included in Table III.1.

The aerial survey will be conducted along the same transect paths as the boat during this one-day comparison study. The plane will start surveys approximately 0.5 hours after the boat. Transect start and end points are listed in Table III.2. Given the difference in speed between the two platforms while on transect (10 nautical miles per hour or knots for the boat, vs. approximately 150 knots for the plane), the plane is expected to complete the focal transects at least four times over the course of the day, while the boat will complete the survey transects once. The plane will repeat the same transect while the boat is on that transect (thus crossing the boat's path multiple times). When the boat moves to the next transect, the plane will pause surveys for a refueling stop, and catch back up with the boat to fly the next transect while the boat is on it.

As a result of this study design, at least four complete aerial surveys of the focal transects will be completed for each boat survey. While exact spatial and temporal overlap during the two types of survey will not be possible except on a few occasions, the close spatial and temporal proximity afforded by this design is intended to allow boat and aerial surveys to sample approximately the same population of animals. Comparisons are expected to be made between the boat survey results and a single complete circuit of the aerial survey (e.g., one of the repetitions); between the boat survey results and the average of all aerial surveys' results; and between each of the aerial survey circuits, if feasible.

The comparison survey will be undertaken during the normal boat survey scheduled for late March or early April of 2013. Weather conditions must be reasonably conducive to both types of survey (e.g., wind conditions of Beaufort 5 or below; no low cloud cover, mist or fog). The boat captain will maintain close communication with BRI project managers so that as soon as the decision is made to begin boat surveys on a given date, the aerial surveying team can be notified. Boat surveys will, if all possible, begin out of Virginia Beach rather than Ocean City, so that the aerial surveying team has several days of opportunity in the primary target location for comparison (boat transects 9-12) before the less desirable areas for comparison are surveyed by the boat team. The window for surveys will begin March 20, and surveys will begin as soon as weather permits after that date.

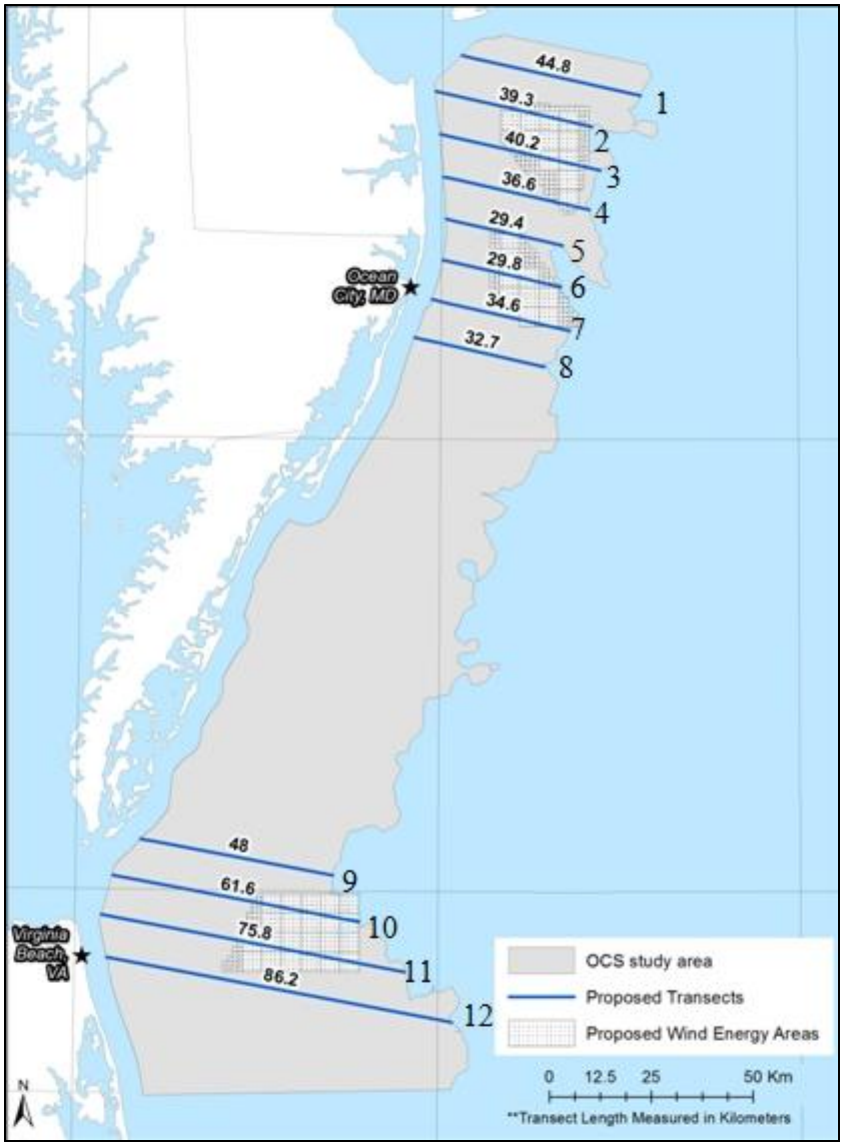


Figure III.1. Boat survey study design for Baseline Studies Project. Comparison study would occur in a smaller area, ideally off the coast of Virginia, that incorporates two of the four transects in this area.

The aerial surveying team will also maintain close communication with BRI project managers, coordinated through Rhys Hexter out of HiDef's UK office. The one-day comparison flight is in addition to the normally scheduled aerial survey for late March or early April of 2013 (since the transects are different than those normally covered during aerial surveys); however, if possible the aerial surveying team may attempt to conduct the regularly scheduled aerial survey in conjunction with the comparison survey (e.g., one plane starting the regular survey while a second conducts the comparison study with the boat).

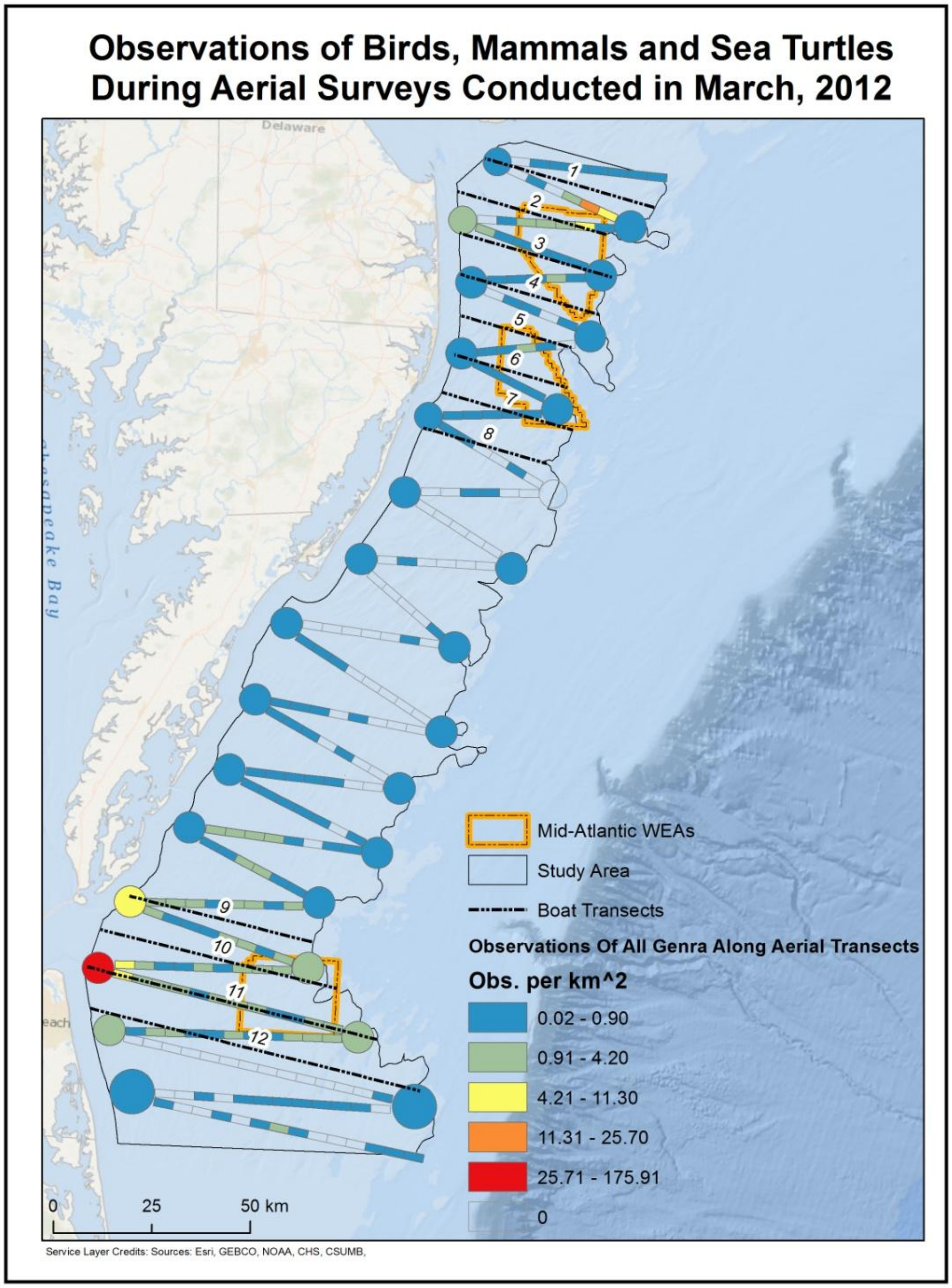


Figure III.2. Counts per km^2 of birds, sea turtles and marine mammals from the "sawtooth" broad-scale aerial survey conducted in March 2012.

Table III.1. Potential areas for comparison study (listed in descending order of desirability). Boat transect numbers are noted in Figures III.1 and III.2, above.

Boat transects	Total transect length (km)
11-12	162
9-10	109.6
1-2	84.1
3-5	106.2
6-8	97.1

Table III.2. Start and end points for boat surveys (in decimal degrees).

Transect Number	Transect Length (km)	West Latitude	West Longitude	East Latitude	East Longitude
1	44.8	38.848392	-74.944557	38.760116	-74.441040
2	39.3	38.768883	-75.018367	38.691964	-74.577717
3	40.2	38.674330	-75.005030	38.595459	-74.554250
4	36.6	38.580273	-74.994620	38.508445	-74.584413
5	29.4	38.486750	-74.987328	38.429288	-74.659008
6	33.3	38.402946	-75.035751	38.337728	-74.663405
7	38.6	38.315731	-75.070631	38.241147	-74.639448
8	37.4	38.234271	-75.126446	38.161303	-74.710031
9	48.0	37.111411	-75.821999	37.035370	-75.290488
10	61.6	37.030575	-75.897745	36.933041	-75.216877
11	75.8	36.943288	-75.927546	36.822949	-75.091138
12	86.2	36.849463	-75.910731	36.711957	-74.960641

Boat survey logistics

Surveys are generally run from the ports of Ocean City, Maryland, and Virginia Beach, Virginia. Boat surveys are conducted from a 60-ft recreational fishing vessel. Boat transects follow the survey design outlined in Figure III.1, and the vessel is operated at an average speed of 10 knots while on transect over an approximately 4-5 day time period. This is compliant with European Seabirds At Sea (ESAS) and Eastern Canadian Seabirds at Sea (ECSAS) standards for boat surveying and is comparable many other boat surveys conducted in the United States and elsewhere. Surveys may be performed in wind conditions up to and including Beaufort Scale 5. For the comparison, the boat survey team will plan to conduct the southern section of the survey first (so that if weather or other delays occur, a comparison could potentially be rescheduled for the northern section of boat surveys off of Maryland and Delaware). While on surveys, the boat observers will use a spot tracker to provide real-time information to collaborators about the boat's location (via the Spot Tracker website). The boat survey team will keep BRI project managers appraised of potential survey dates and starting locations. BRI will in turn notify the aerial survey team, and will work with the boat and aerial survey teams to ensure that weather at the chosen times/locations will be conducive to both types of survey.

During each survey, teams of two observers alternated observation periods and use combined strip and line transect methods to observe and record animals. A continuous watch is maintained by one observer, who counts all animals within a 300 m strip to one side of the boat. The second observer records data and also watches outside the strip transect (primarily to spot cetaceans and sea turtles). Each record includes data on species, number of animals, behavior, radial distance from the ship, degree of the animal's angle to the bow of the boat, direction of movement, and where possible age and plumage/molt state. The method of recording is the same regardless of behavior, except that animals that are stationary or milling are not given a direction of movement. Animals are also recorded outside of the 300 m transect (especially marine mammals), but are noted as outside the transect zone during data processing. The seabird and marine mammal observation program, dLOG, is used to record geo-referenced seabird and marine mammal data as well as the vessel track. Location data are recorded approximately every 30 seconds and each animal observation entered into dLOG is individually georeferenced. Sea state is recorded hourly using the Beaufort scale, and sea surface temperature and salinity are measured and recorded every half hour during surveys using a YSI Pro30 conductivity device. Biomass density underwater is measured using the Simrad EK60 scientific echosounder (Kongsberg Maritime AS) employing a 120 khz transducer.

Aerial survey logistics

The aerial survey will be overseen by HiDef Aerial Surveying, Inc., out of the company's Boston, Massachusetts office, working in conjunction with Keystone Aerial Surveying (based in Philadelphia, Pennsylvania). Subject to safe flying conditions (no low clouds, mist or fog) aerial surveys can be performed in wind conditions up to and including Beaufort Scale 6. Rather than following normal aerial survey transects for the Mid-Atlantic Baseline Studies Project, the comparison survey will be flown along several of the boat survey transects. As such, the spacing between transects and locations of transects will be different than normal aerial surveys. Other methodologies for aerial surveys (flight height, camera arrays, analysis and QA/QC protocols, etc.) will be maintained as closely as possible to "normal" methods, in order to produce an accurate comparison of the two survey methods.

The comparison flight is expected to require a maximum of eight hours of flight time over the survey area. The plane will fly at normal survey height and conditions, as described above, but instead of following normal aerial transects it will fly the same transect paths as the boat during this one-day comparison study (start and end points for all boat transects are listed in Table III.2). The aerial survey will be initiated approximately 0.5 hours after the boat survey, and will fly the first transect repeatedly (at least four times) while the boat is covering the same transect. After multiple passes of the first transect, the plane will return to shore to refuel, and within an hour will catch back up to the boat to cover the next transect while the boat is on it. (If the comparison study is conducted off of Delaware or Maryland, refueling may happen between the second and third transects rather than the first and second).

The boat survey team will keep BRI appraised of potential survey dates and starting locations. BRI will in turn notify the aerial survey team, and will work with the boat and aerial survey teams to ensure that weather at the chosen times/locations will be conducive to both types of survey. When the aerial surveying team is notified of a planned start date for boat surveys, they will work to get a plane into position and ready to conduct the comparison, including coordinating permissions for flying in areas with military airspace restrictions. If possible, the comparison will occur off of the coast of Virginia (where boat transects 9-12 are located; Figure III.1). The boat survey team will plan to conduct this section of the survey first, so that if delays occur due to weather, airspace restrictions, or other factors, a comparison could potentially be rescheduled for the northern section of boat surveys off of Maryland and Delaware. However, all reasonable efforts should be made to conduct the comparison in Virginia waters.

Surveys are completed using two multi-engined Cessna 300 series aircraft from Keystone Aerial Surveying, which are equipped with camera openings on the lower fuselage. Surveys are flown under Visual Flight Rule (VFR) conditions and at an average speed of 150 knots. Flights are conducted at 610m above sea level (2000 ft), using four high definition video cameras and data management equipment fitted to the aircraft. Each camera will be set to 2 cm Ground Spatial Resolution (GSR), and will have a strip width of 50m (for a total strip width of 200m). All camera sampling strips are non-overlapping. Position data for the aircraft is captured from a Garmin GPSMap 296 receiver with differential GPS enabled to give 1 m precision for the positions. Updates in location are recorded at 1 second intervals for later matching to bird and mammal observations. Due to the height at which surveys will be flown, there is little or no risk of affecting the behavior of animals at or near the water's surface, and no permits are required from the National Marine Fisheries Service (NMFS). Flights will comply with all Federal Aviation Administration (FAA) regulations.

Appendix IV. Justification for Changing the Survey Design of High Definition Video Aerial Surveys

The initial survey design for high definition video aerial surveys specified the recording of video footage at 2 cm Ground Spatial Resolution (GSR) for transects within the WEAs, and recording of footage at 3 cm GSR for transects on the broader "sawtooth" survey. The March, May and June 2012 surveys were flown according to this protocol. However, beginning with the September 2012 survey the sawtooth was also flown at 2 cm GSR. This methodological change resulted from difficulties with identification to species for many taxa at the lower resolution, as is discussed in Subtask 2.1 in this report.

Video shot at 3 cm GSR provides lesser clarity and color rendition, which can mean the difference between being able to identify or not identify an animal to the species level, particularly for smaller organisms. However, the overall identification rate of animals to species in 2 cm vs. 3 cm footage can be somewhat misleading, as identification rates vary by species, and the geographic distribution of some species means that they are mostly seen in either the sawtooth or the WEAs (but not both). As an example, the majority of avian records from the March-June surveys were scoters, which are relatively easy to identify to species in most cases (regardless of which resolution of footage is examined). However, scoters occurred almost exclusively in the sawtooth rather than within the WEAs. Because of this geographic distribution, the rate of identification to species for birds is actually higher from the sawtooth than from the WEAs; but if scoters are excluded from this analysis, 16% more birds were identified to species level in 2 cm footage than 3 cm footage (Table IV.1). Several comparisons of 2 cm vs. 3 cm survey results by taxa are presented for the March-June surveys in the table below. In each case, the identification rate to species was lower for the sawtooth (3 cm GSR) footage than for the 2 cm footage from the WEAs.

For many species, given an equal number of individuals in each survey area, 3 cm footage will provide a lower rate of identification than 2 cm footage. While 3 cm footage has a broader transect strip width (and thus can cover a higher percentage of the study area), the percentage of additional coverage provided by conducting the sawtooth at 3 cm rather than 2 cm was determined to be outweighed by the resulting difficulties with species identifications. As such, project leaders (in consultation with DOE project managers and the aerial survey vendor) made the decision to switch the sawtooth transects to 2 cm footage beginning in September of 2012.

Table IV.1: Comparison of 2 cm vs. 3 cm GSR video data from the March, May and June 2012 surveys.

Statistic	**2 cm GSR**	**3 cm GSR**
Percentage of Unknown Birds (UNBI)	26%	74%
Percentage of all birds from each resolution that were not identified to species (excluding scoters)*	47%	63%
Percentage of Unknown Loons (UNLO) overall	15%	85%
Percentage of all loons from each resolution that were not identified to species	30%	58%
Percentage of Unknown Terns and Gulls overall	26%	74%
Percentage of all gulls and terns from each resolution that were not identified to species	66%	87%
Percentage of Small Turtles (SMTU; e.g., non-leatherback turtles) that could not be more definitely identified overall	38%	62%
Percentage of the sea turtles from each resolution that were not classifiable to species (e.g., all SMTU)	58%	88%
Percentage of Unknown Cetaceans overall	20%	80%
Percentage of the marine mammals from each resolution that were not classifiable to species (e.g., all UNCE, UNDO, UNPO)	18%	51%
Percentage of Unknown Chondrichthyes (Sharks and Rays) overall	13%	87%
Percentage of the sharks and rays from each resolution that were not classifiable to species	10%	77%
Disagreement rate among observers during audits (as percentage of all biota audited; includes only May and June data)	7%	12%

* Excluded because scoters occurred disproportionately in 3 cm footage.

Appendix V. Summary Tables from March-June Aerial Surveys

Table V.1: Summary of birds observed during the project's first three aerial surveys in 2012 (these are preliminary data only; data are still being reviewed for quality assurance purposes). Data are presented in order of abundance by family, based on the total count from all three surveys. "Definite" identifications mean that the reviewer was more than 95% certain that their identification of the animal was correct; "Probable" identifications were when the reviewer was 50-95% certain of their identification; and "Possible" identifications were when the reviewer was 0-50% certain. If a reviewer feels that they really can't hazard a guess that an object is a "possible Wilson's Storm-Petrel," for instance, then they might call the object a "definite unidentified storm-petrel," based on the specific criteria used for identifications of that species or category (size, color, shape, flight pattern, clarify of image, etc.)

Species or Group	**March Definite**	**March Probable**	**March Possible**	**May Definite**	**May Probable**	**May Possible**	**June Definite**	**June Probable**	**June Possible**	**Grand Total**	**% of Total Birds Observed**
Greater Snow Goose	0	0	0	0	0	0	0	1	0	1	0.0%
Surf Scoter	337	180	9	0	0	0	0	0	0	526	4.2%
Black Scoter	3182	5084	6	0	1	0	0	0	0	8273	65.8%
White-winged Scoter	0	1	2	0	0	0	0	0	0	3	0.0%
Unidentified Scoter	579	28	0	0	0	0	0	0	0	607	4.8%
Anatidae Total	**4098**	**5293**	**17**	**0**	**1**	**0**	**0**	**1**	**0**	**9410**	**74.8%**
Red-throated Loon	36	134	1	23	22	14	1	0	0	231	1.8%
Common Loon	58	46	1	162	60	53	0	4	0	384	3.1%
Unidentified Loon	181	283	147	89	59	17	2	1	0	779	6.2%
Gaviidae Total	**275**	**463**	**149**	**274**	**141**	**84**	**3**	**5**	**0**	**1394**	**11.1%**
Bonaparte's Gull	70	46	0	0	0	0	0	0	0	116	0.9%
Laughing Gull	0	0	0	1	0	1	2	2	0	6	0.0%
Ring-billed Gull	0	1	0	0	0	0	0	0	0	1	0.0%
Herring gull	6	11	1	2	3	0	2	2	0	27	0.2%
Lesser Black-backed Gull	2	0	0	0	0	0	0	2	0	4	0.0%

Species or Group	March Definite	March Probable	March Possible	May Definite	May Probable	May Possible	June Definite	June Probable	June Possible	Grand Total	% of Total Birds Observed
Great Black-backed Gull	0	2	0	8	9	1	1	2	1	24	0.2%
Unidentified small gull	16	6	5	2	0	0	0	0	0	29	0.2%
Medium Gull	4	4	0	4	2	0	1	1	0	16	0.1%
Unidentified Large Gull	5	0	1	3	21	1	5	0	0	36	0.3%
Unidentified Gull	48	56	4	30	32	23	4	1	0	198	1.6%
Laridae Total	**151**	**126**	**11**	**50**	**67**	**26**	**15**	**10**	**1**	**457**	**3.6%**
Northern Gannet	304	28	5	51	16	4	0	0	0	408	3.2%
Sulidae Total	**304**	**28**	**5**	**51**	**16**	**4**	**0**	**0**	**0**	**408**	**3.2%**
Least Tern	0	0	0	0	0	0	0	0	1	1	0.0%
Caspian Tern	0	0	0	0	0	0	0	2	0	2	0.0%
Common Tern	0	0	0	0	0	0	0	1	0	1	0.0%
Royal Tern	1	0	2	0	0	0	0	4	2	9	0.1%
Unidentified small Tern	0	0	0	8	0	0	1	0	0	9	0.1%
Medium Tern	4	3	0	60	17	1	6	2	4	97	0.8%
Unidentified large Tern	5	31	0	9	0	0	3	0	0	48	0.4%
Unidentified Tern	0	1	0	36	1	0	7	1	1	47	0.4%
Sternidae Total	**10**	**35**	**2**	**113**	**18**	**1**	**17**	**10**	**8**	**214**	**1.7%**
Northern Fulmar	0	0	0	0	0	0	0	1	0	1	0.0%
Cory's Shearwater	0	0	0	0	0	0	3	4	1	8	0.1%
Great Shearwater	0	0	0	0	0	0	13	37	7	57	0.5%
Sooty Shearwater	0	0	0	0	0	0	0	2	0	2	0.0%
Unidentified Shearwater	0	0	0	0	0	0	2	2	4	8	0.1%

Species or Group	March Definite	March Probable	March Possible	May Definite	May Probable	May Possible	June Definite	June Probable	June Possible	Grand Total	% of Total Birds Observed
Procellariidae Total	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**46**	**12**	**76**	**0.6%**
Wilson's Storm-Petrel	0	0	0	0	0	0	2	36	13	51	0.4%
Unidentified Storm-petrel	0	0	1	0	0	0	0	2	0	3	0.0%
Hydrobatidae Total	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**38**	**13**	**54**	**0.4%**
Tern/Small or Medium Gull	136	78	4	26	21	19	5	4	6	299	2.4%
Pomarine Jaeger	0	0	0	0	0	0	0	1	0	1	0.0%
Parasitic Jaeger	0	0	0	2	0	0	0	0	0	2	0.0%
Unidentified Jaeger	0	0	0	2	0	0	0	1	1	4	0.0%
Stercorariidae Total	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**2**	**1**	**7**	**0.1%**
Brown Pelican	0	0	0	2	1	0	2	0	0	5	0.0%
Pelecanidae Total	**0**	**0**	**0**	**2**	**1**	**0**	**2**	**0**	**0**	**5**	**0.0%**
Horned Grebe	0	1	0	0	0	0	0	0	0	1	0.0%
Unidentified Grebe	0	0	3	0	0	0	0	0	0	3	0.0%
Podicipedidae Total	**0**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0.0%**
Snowy Egret	0	0	0	2	0	0	0	0	0	2	0.0%
Ardeidae Total	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**	**0.0%**
Unidentified Phalarope	0	0	2	0	0	0	0	0	0	2	0.0%
Scolopacidae Total	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0.0%**
Osprey	0	0	0	0	0	0	0	1	0	1	0.0%
Pandionidae Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0.0%**
Bald Eagle	0	0	0	0	1	0	0	0	0	1	0.0%
Accipitridae Total	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0.0%**
Barn Swallow	0	0	0	0	0	0	1	0	0	1	0.0%

Species or Group	March Definite	March Probable	March Possible	May Definite	May Probable	May Possible	June Definite	June Probable	June Possible	Grand Total	% of Total Birds Observed
Passeriformes Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0.0%**
Unidentified Bird	210	44	21	93	58	40	53	17	9	545	**4.3%**
Totals	**5048**	**5990**	**211**	**589**	**303**	**155**	**111**	**130**	**44**	**12581**	**100.0%**

Table V.2: Summary of non-avian animals observed during the project's first three aerial surveys in 2012 (these are preliminary data only; data are still being reviewed for quality assurance purposes). Data are presented in order of abundance based on the total count from all three surveys. "Definite" identifications mean that the reviewer was more than 95% certain that their identification of the animal was correct; "Probable" identifications were when the reviewer was 50-95% certain of their identification; and "Possible" identifications were when the reviewer was 0-50% certain. If a reviewer feels that they really can't hazard a guess that an object is a "possible Cownose Ray," for instance, then they might call the object a "definite unidentified ray," based on the specific criteria used for identifications of that species or category (size, color, shape, flight pattern, clarify of image, etc.)

Species or Group	March Definite	March Probable	March Possible	May Definite	May Probable	May Possible	June Definite	June Probable	June Possible	Grand Total	% of Total Non-Avian Animals Observed
Cownose Ray	0	0	0	0	0	0	3354	0	0	**3354**	35.1%
Fish - individuals	1072	1451	2	110	7	32	273	6	0	**2953**	30.9%
Unidentified Ray	0	0	0	0	0	1	2181	0	0	**2182**	22.8%
Small Sea Turtles (not Leatherback)	16	2	4	195	22	9	130	1	4	**383**	4.0%
Bottlenose Dolphin	5	6	1	3	100	1	0	47	3	**166**	1.7%
Small beaked cetacean (to 3m)	7	0	0	83	10	0	12	5	0	**117**	1.2%
Unidentified Sharks	0	0	1	7	4	0	102	0	0	**114**	1.2%
Loggerhead Sea Turtle	0	6	0	3	18	33	7	32	8	**107**	1.1%
Ocean Sunfish	0	1	0	41	2	4	3	0	1	**52**	0.5%
Bait Balls (thousands of fish)	0	0	0	0	0	0	41	0	0	**41**	0.4%
Cetacean/Seal/Shark	4	0	0	19	0	0	7	1	0	**31**	0.3%
Kemp's Ridley Sea Turtle	0	0	0	4	3	4	0	5	6	**22**	0.2%
Unidentified Dolphin	18	1	1	0	0	0	0	0	0	**20**	0.2%
Green Sea Turtle	0	0	1	1	1	0	0	0	2	**5**	0.1%
Hammerhead Shark	0	0	0	1	0	0	4	0	0	**5**	0.1%

Species or Group	March Definite	March Probable	March Possible	May Definite	May Probable	May Possible	June Definite	June Probable	June Possible	Grand Total	% of Total Non-Avian Animals Observed
Jellyfish	0	0	0	0	1	0	0	1	2	**4**	0.0%
Harbor Porpoise	0	0	0	0	3	0	0	0	0	**3**	0.0%
Leatherback Sea Turtle	0	0	0	1	0	0	2	0	0	**3**	0.0%
Unidentified Cetacean	0	0	0	1	1	0	0	0	0	**2**	0.0%
Scalloped Hammerhead	0	0	0	0	0	0	1	0	0	**1**	0.0%
Thresher Shark	0	0	0	1	0	0	0	0	0	**1**	0.0%
Seal/Dolphin	0	0	0	0	1	0	0	0	0	**1**	0.0%
Manta Ray	0	0	0	0	0	0	1	0	0	**1**	0.0%
Totals	**1122**	**1467**	**10**	**470**	**173**	**84**	**6118**	**98**	**26**	**9568**	**100.0%**

Appendix VI. Maps from March-June 2012 Aerial Surveys

Figure VI.1: Detections of Black Scoters during the March 2012 aerial survey. Data are raw observations and should be regarded as strictly preliminary.

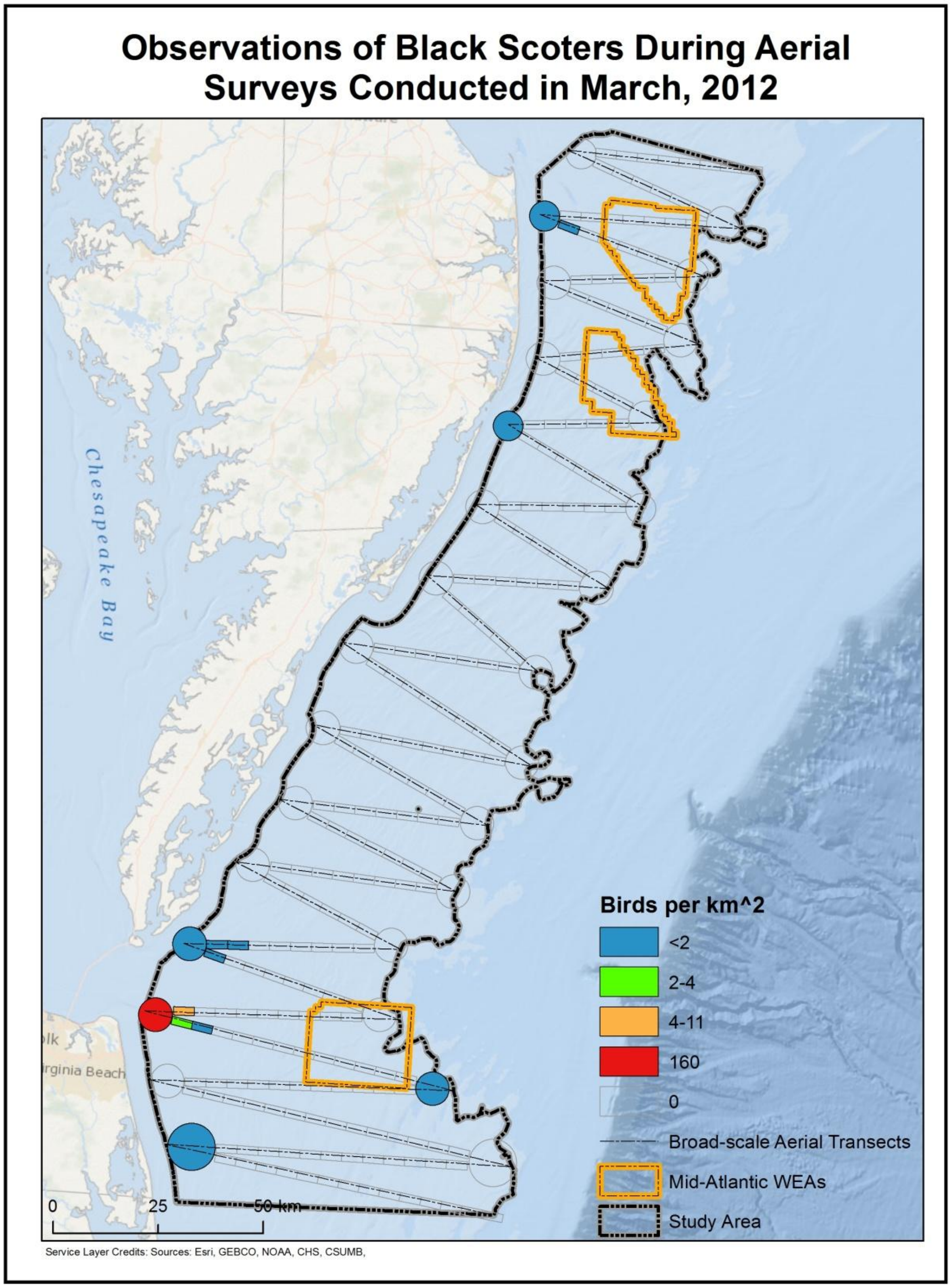


Figure VI.2: Detections of Northern Gannets during the March 2012 aerial survey. Data are raw observations and should be regarded as strictly preliminary.

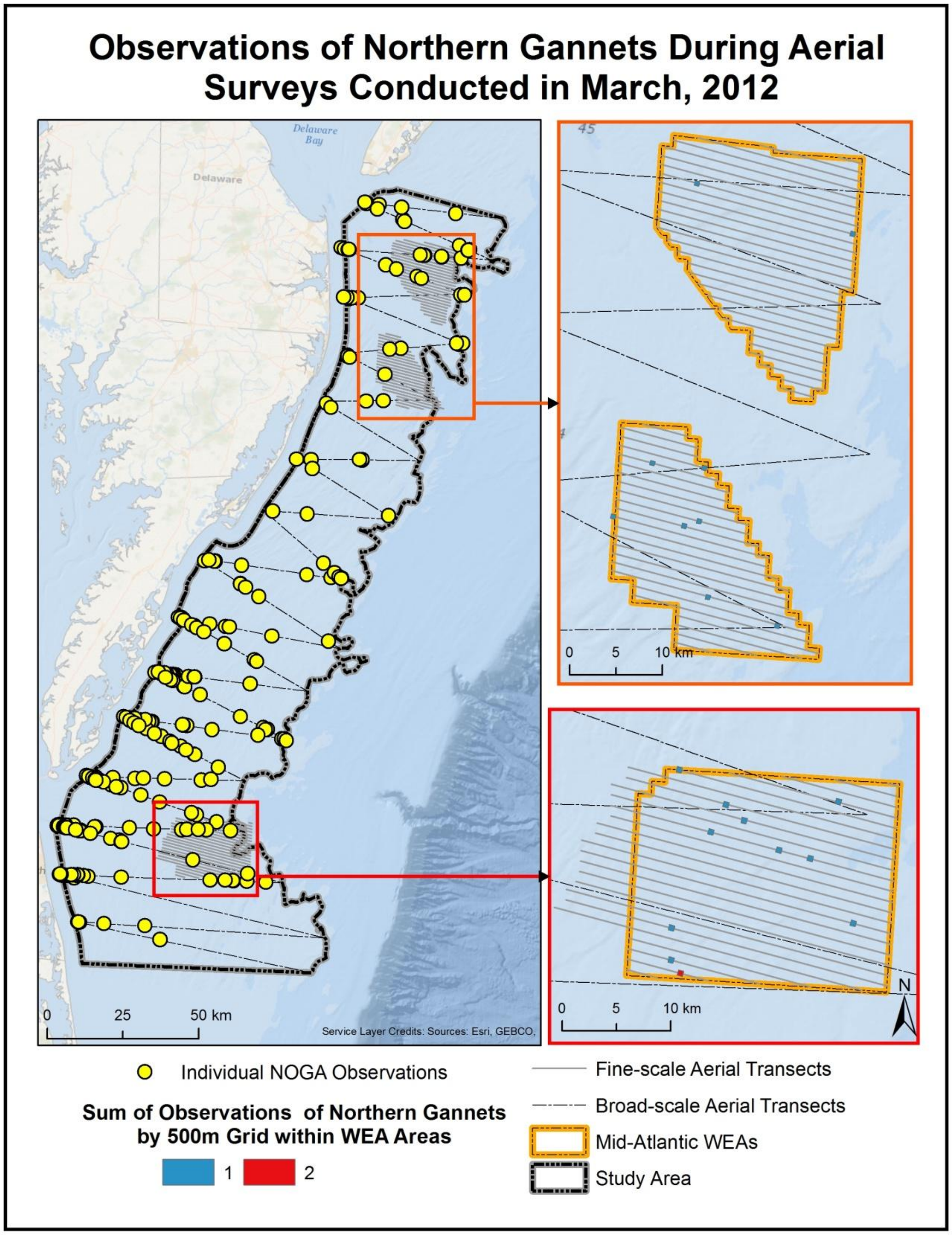


Figure VI.3: Detections of Sea Turtles (all species) during the May 2012 aerial survey. Data are raw observations and should be regarded as strictly preliminary.

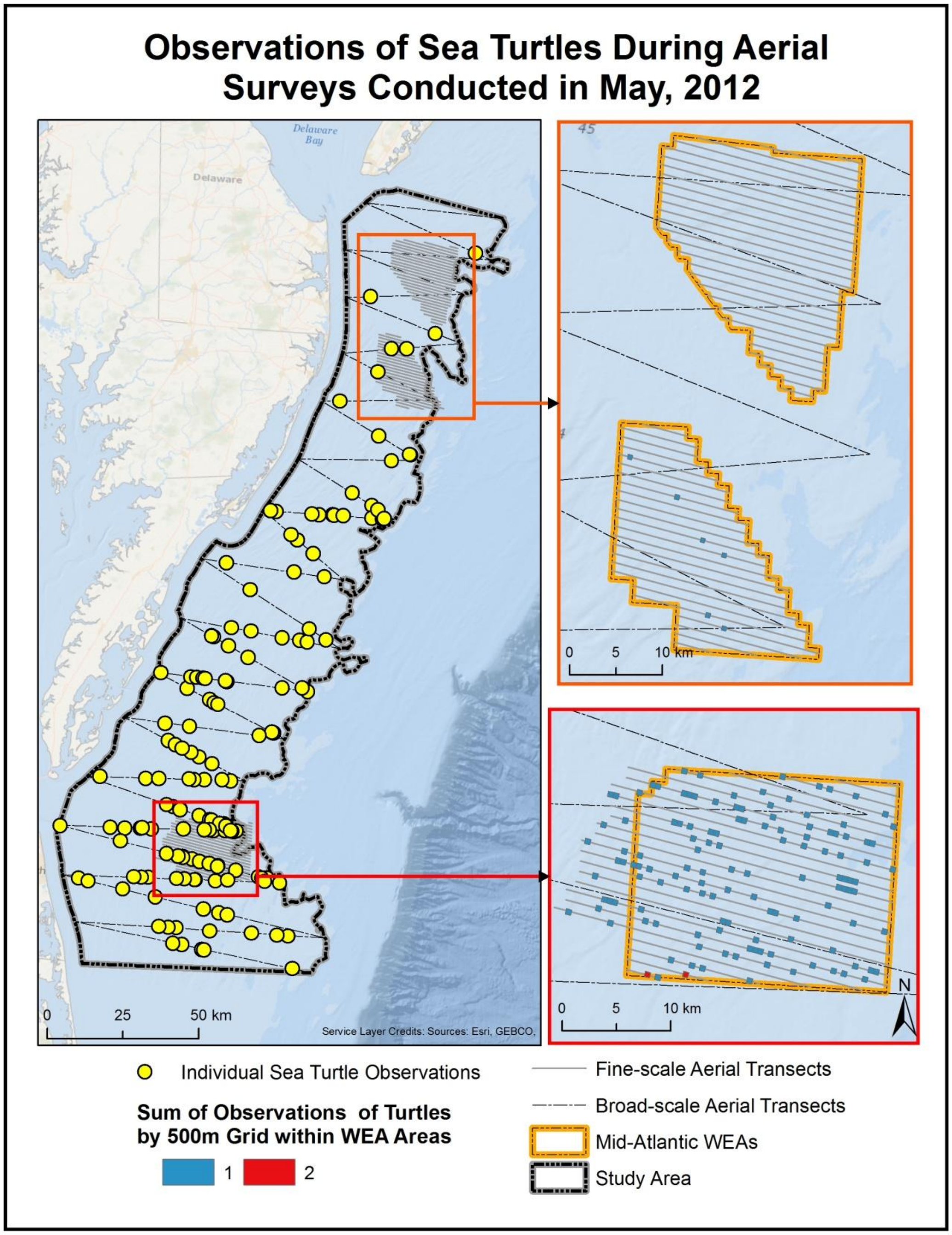


Figure VI.4: Detections of Sea Turtles (all species) during the June 2012 aerial survey. Data are raw observations and should be regarded as strictly preliminary.

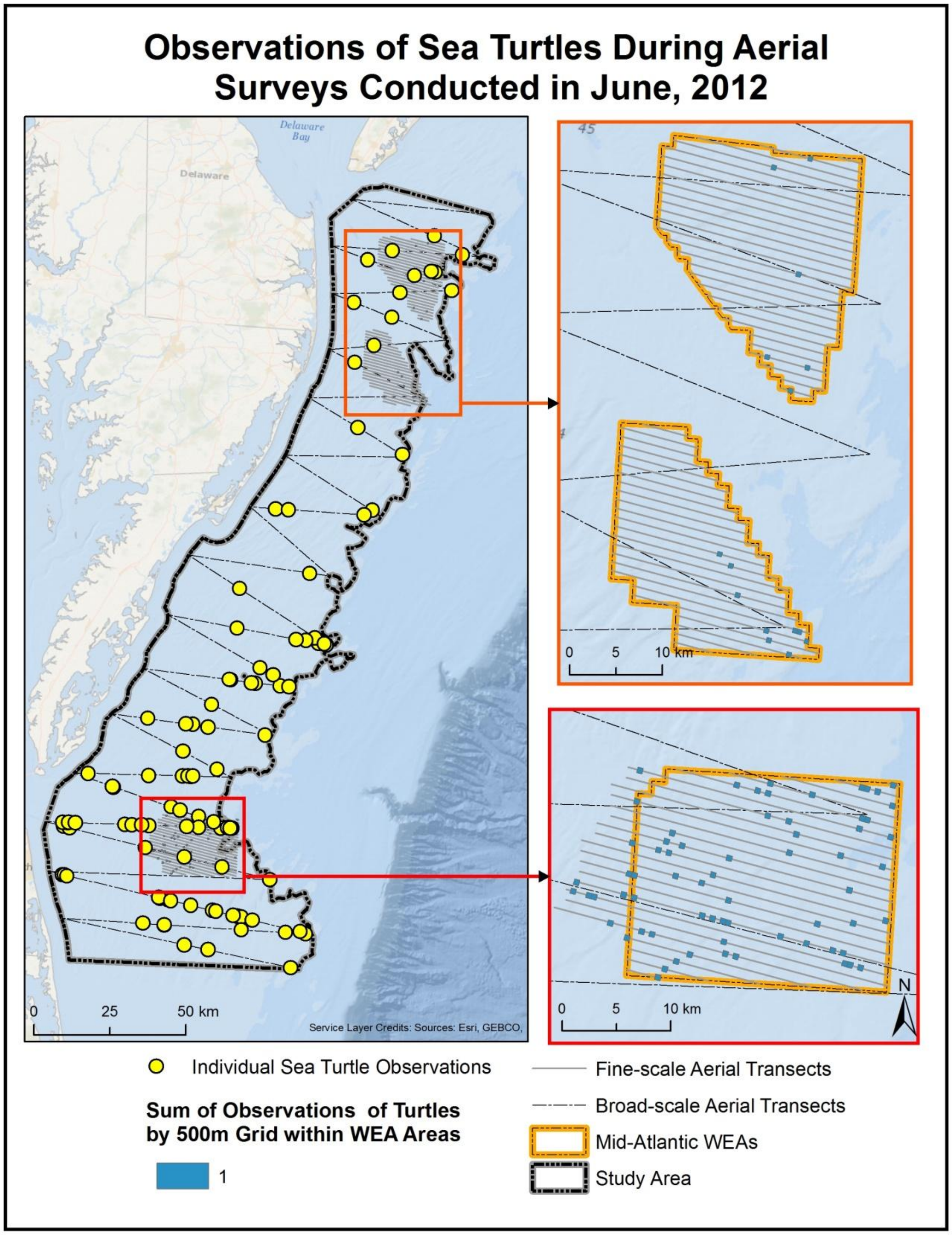


Figure VI.5: Detections of Cownose Rays during the June 2012 aerial survey. Data are raw observations and should be regarded as strictly preliminary.

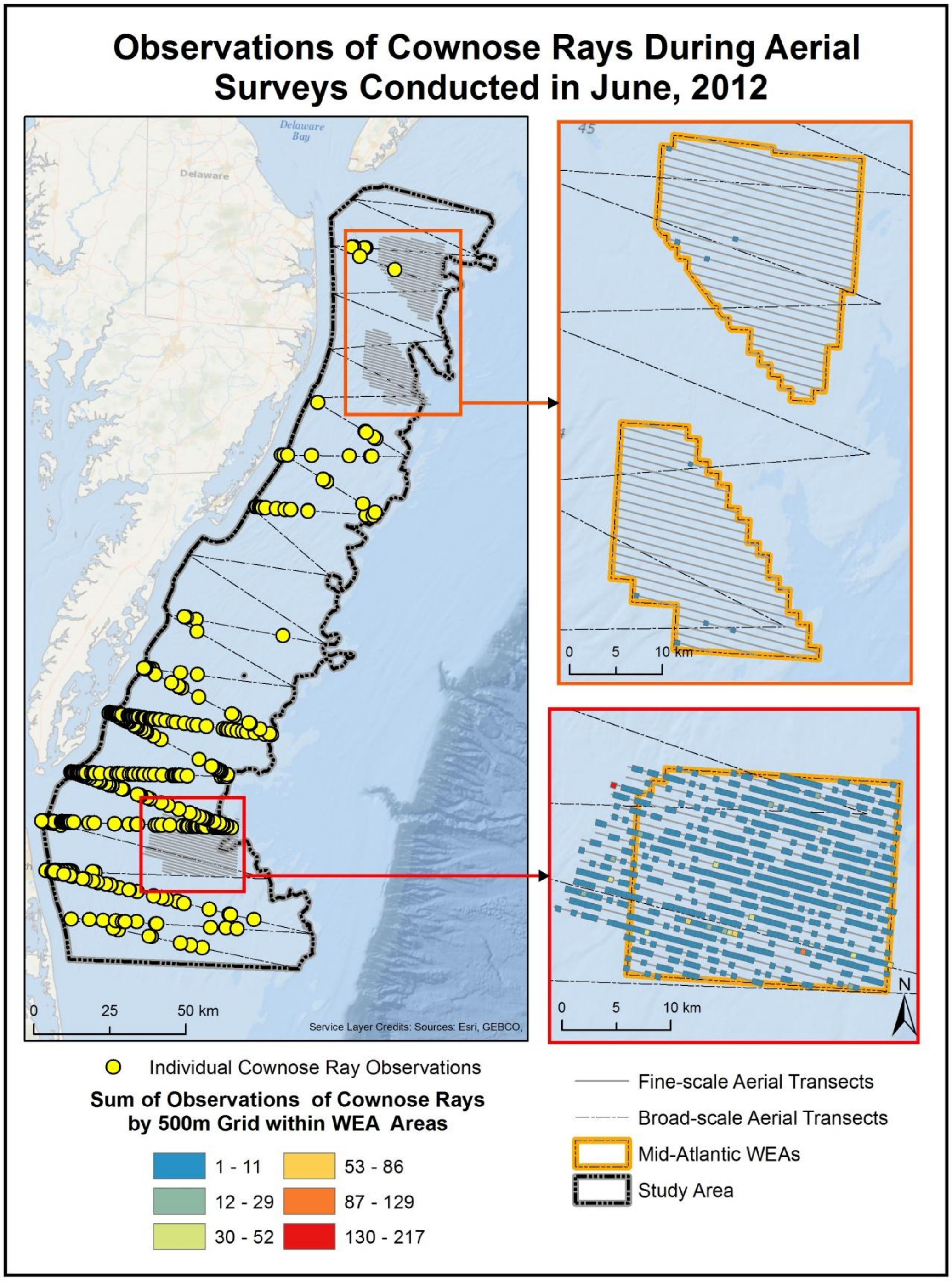
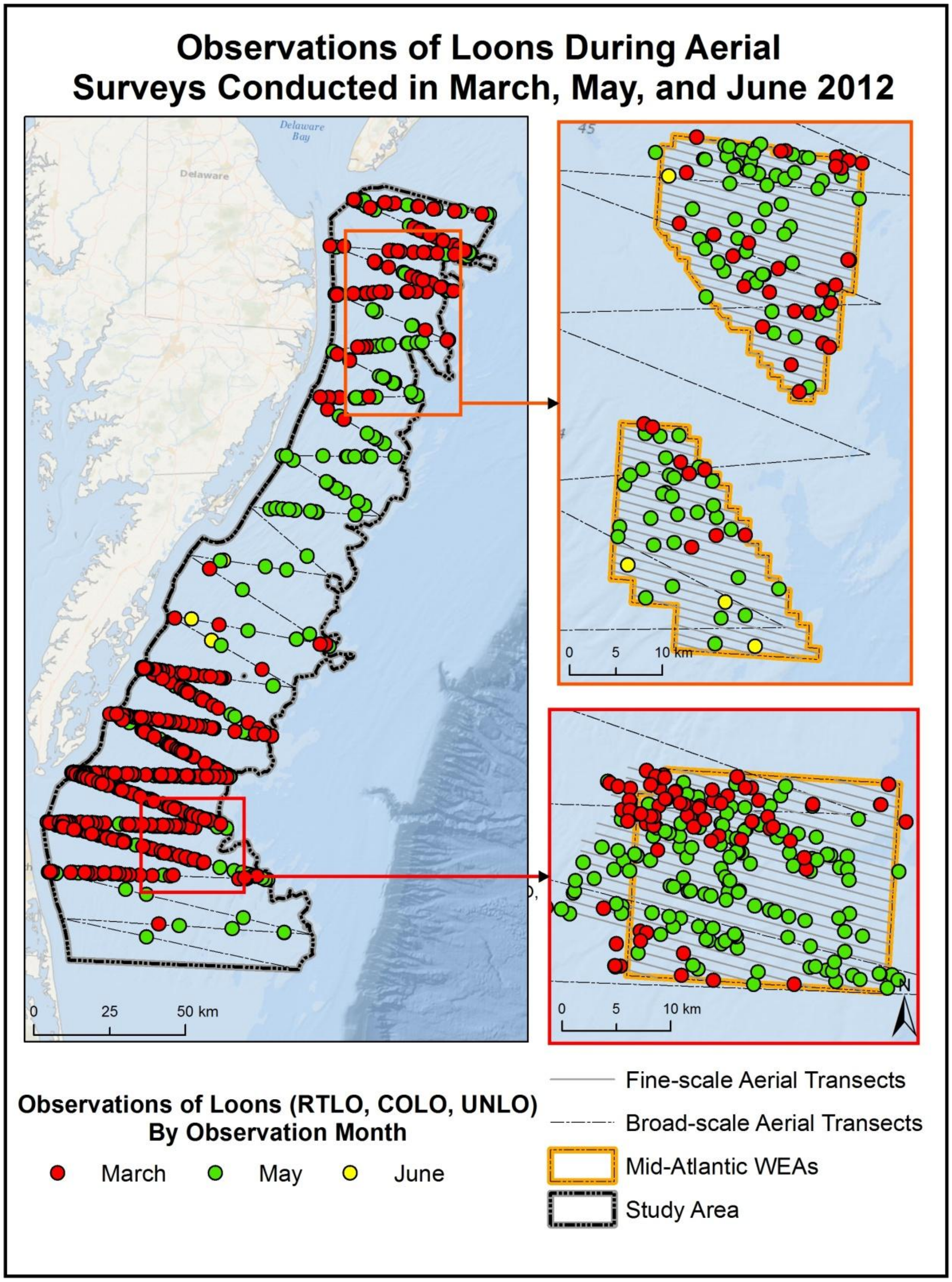


Figure VI.6: Detections of Loons (all species) during the March, May and June 2012 aerial surveys. Data are raw observations and should be regarded as strictly preliminary.



Appendix VII. Preliminary Maps of Northern Gannet Movements

Disclaimer: Caution should be used in identifying patterns or drawing conclusions from maps. Locations and movement tracks have not been proofed or analyzed. Track lines are shortest distances between points, and not necessarily flight paths taken. More formal data interpretation will be conducted for the Bureau of Ocean Energy Management and in peer reviewed manuscripts. Questions? Contact: Caleb Spiegel, caleb_spiegel@fws.gov.

Note: maps include only gannets captured in the winter of 2012-2013 in the mid-Atlantic region, and do not include recent data from gannets tagged on the breeding colony in Canada in September 2012.

Figure VII.1: Large-scale movements of Northern Gannets tagged in the mid-Atlantic (March 2012-Jan. 2013). Each color represents movements of an individual bird.

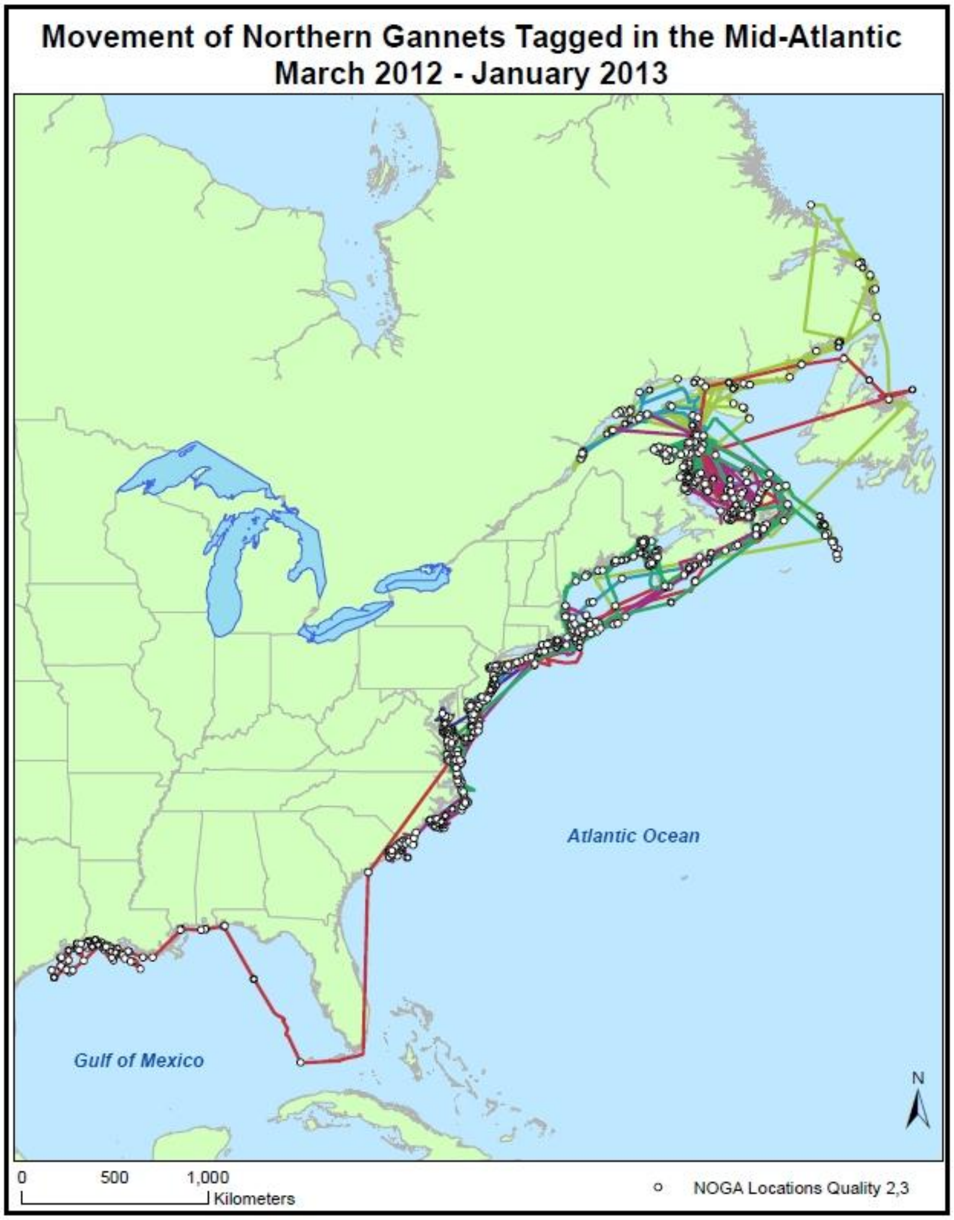
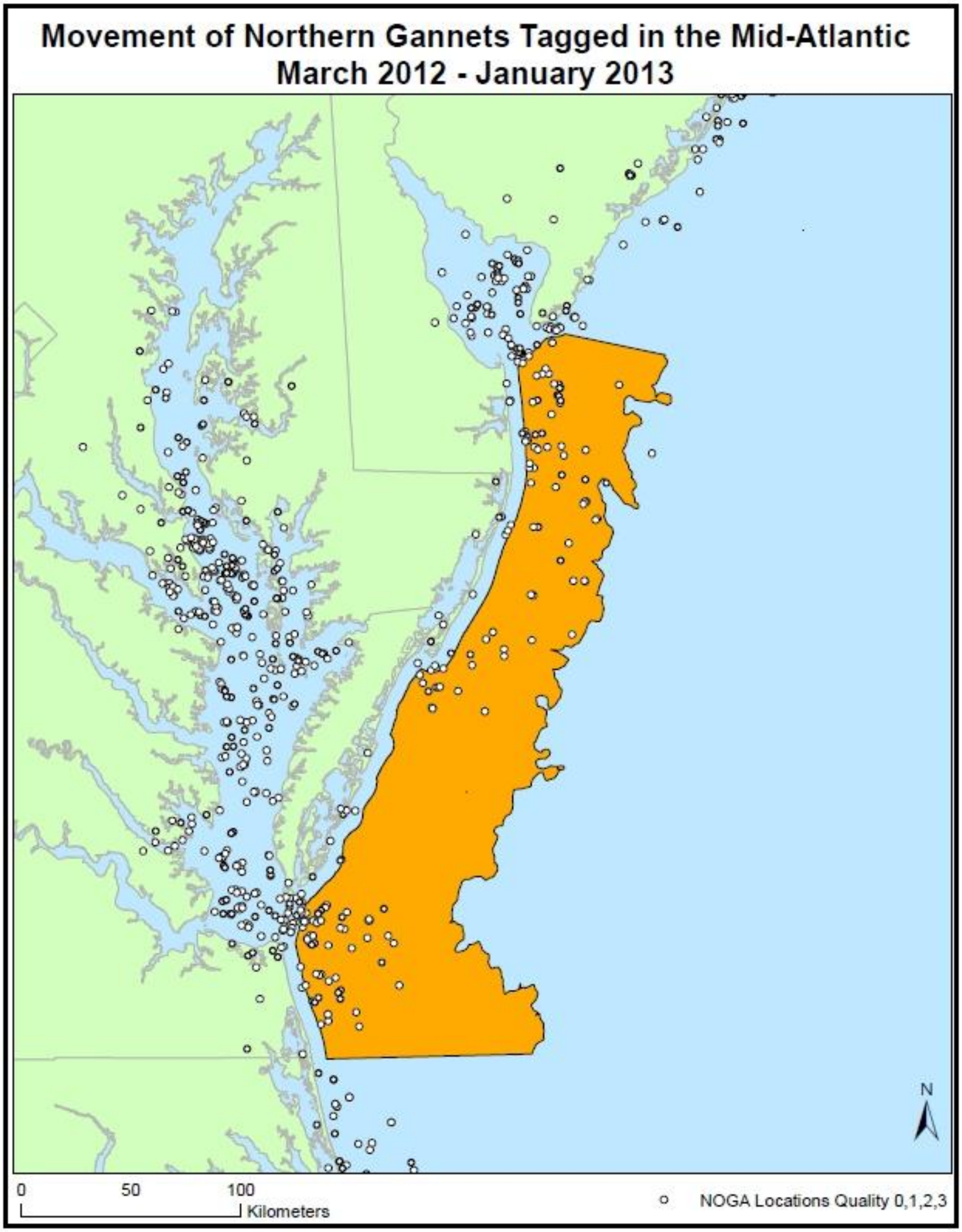


Figure VII.2: Satellite locations of Northern Gannets tagged in the mid-Atlantic in and around the project study area (March 2012-Jan. 2013).



Appendix VIII. Preliminary Maps of Red-throated Loon Movements

Disclaimer: Caution should be used in identifying patterns or drawing conclusions from maps. Locations and movement tracks have not been proofed or analyzed. Track lines are shortest distances between points, and not necessarily flight paths taken. More formal data interpretation will be conducted for the Bureau of Ocean Energy Management and in peer reviewed manuscripts. Questions? Contact: Caleb Spiegel, caleb_spiegel@fws.gov.

Figure VIII.1: Large-scale movements of Red-throated Loons tagged in the mid-Atlantic (March 2012-Jan. 2013). Each color represents movements of an individual bird.

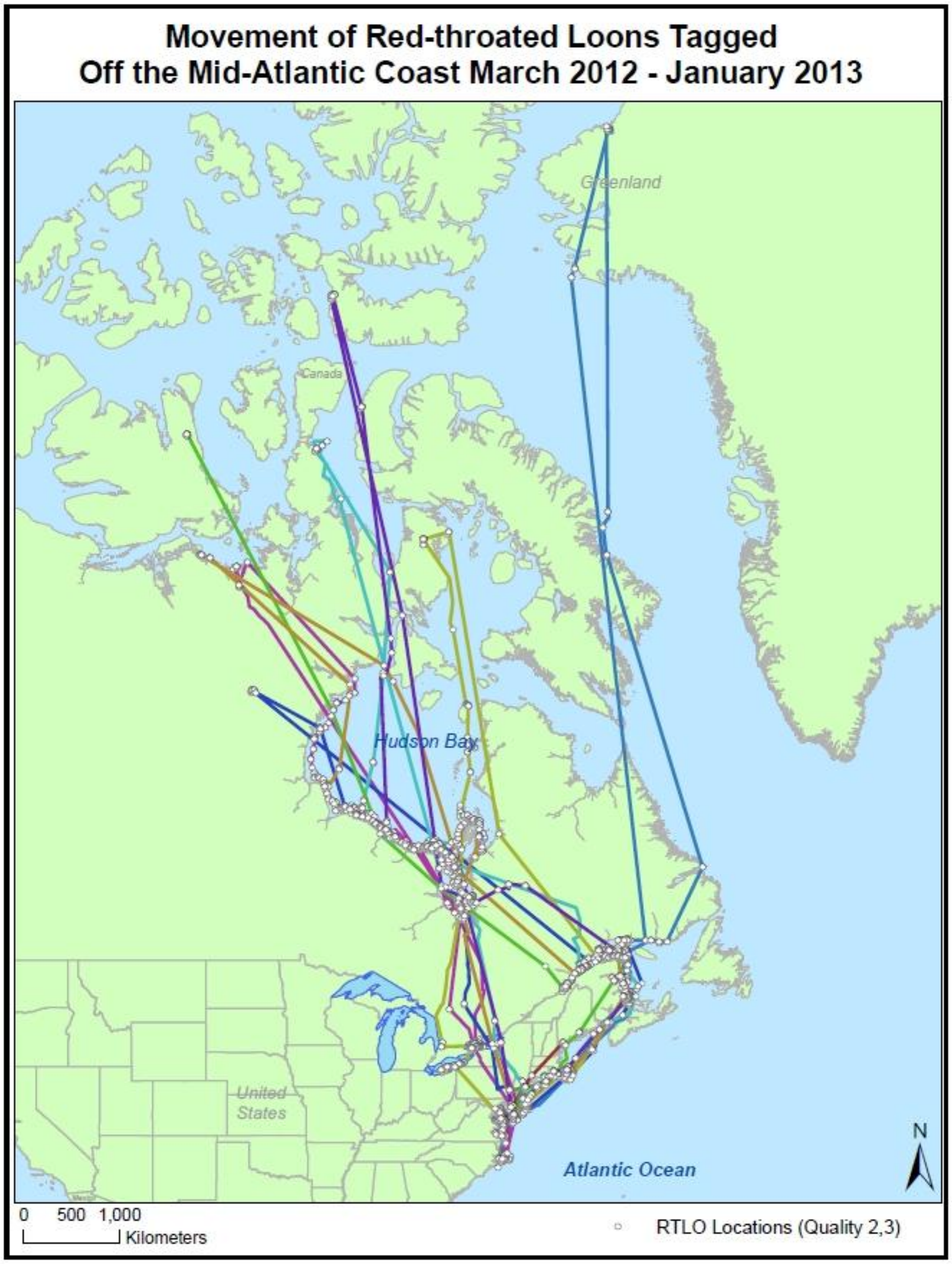
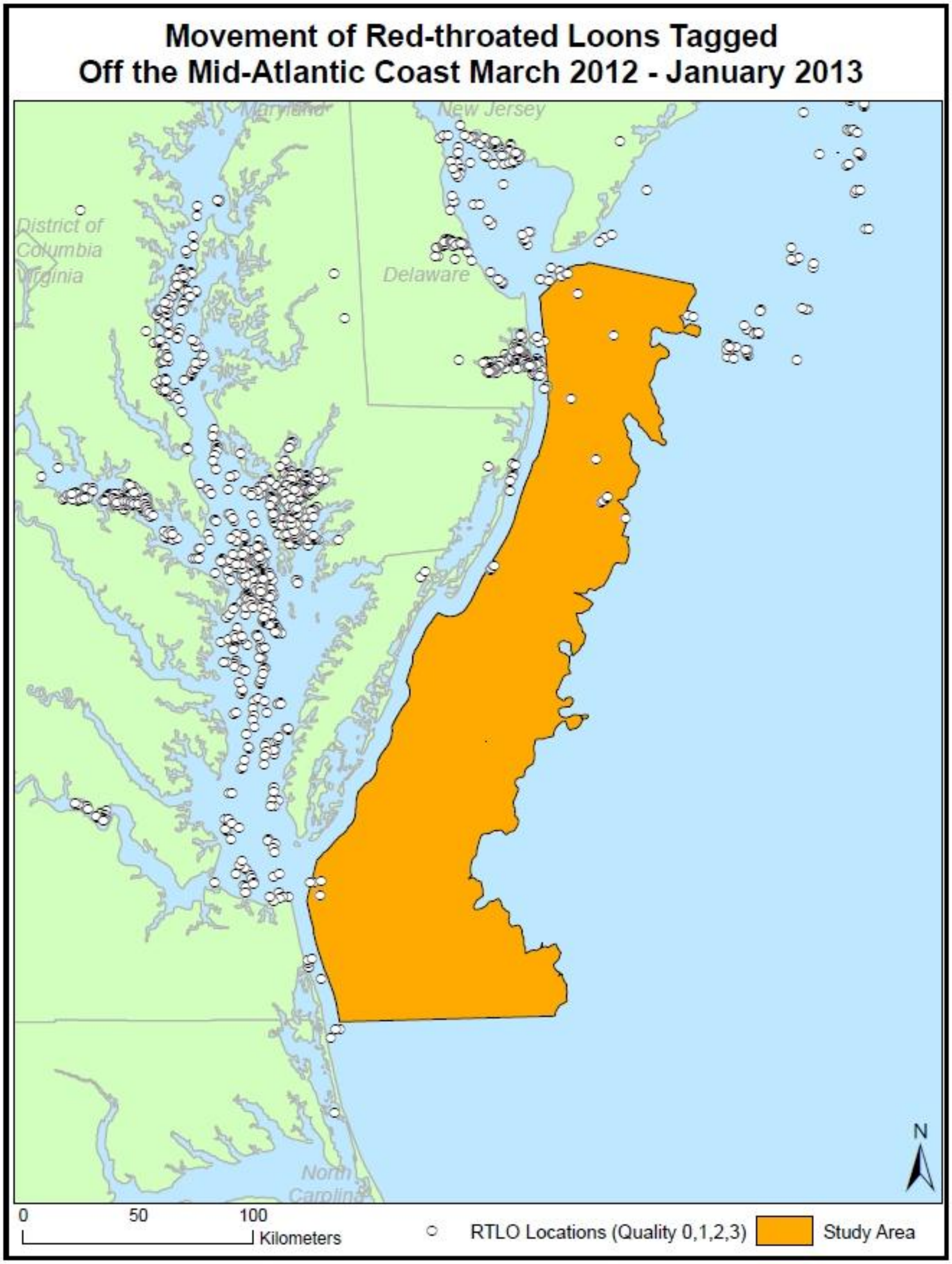


Figure VIII.2: Satellite locations of Red-throated Loons tagged in the mid-Atlantic in and around the project study area (March 2012-Jan. 2013).



Appendix IX. Preliminary Maps of Peregrine Falcon Movements

Disclaimer: Caution should be used in identifying patterns or drawing conclusions from maps. Locations and movement tracks have not been proofed or analyzed. Track lines are shortest distances between points, and not necessarily flight paths taken. More formal data interpretation will be conducted in later budget periods.

Figure IX.1: Large-scale movements of Peregrine Falcons tagged on Block Island (Oct. 2012-Jan. 2013). Each color represents movements of an individual bird.

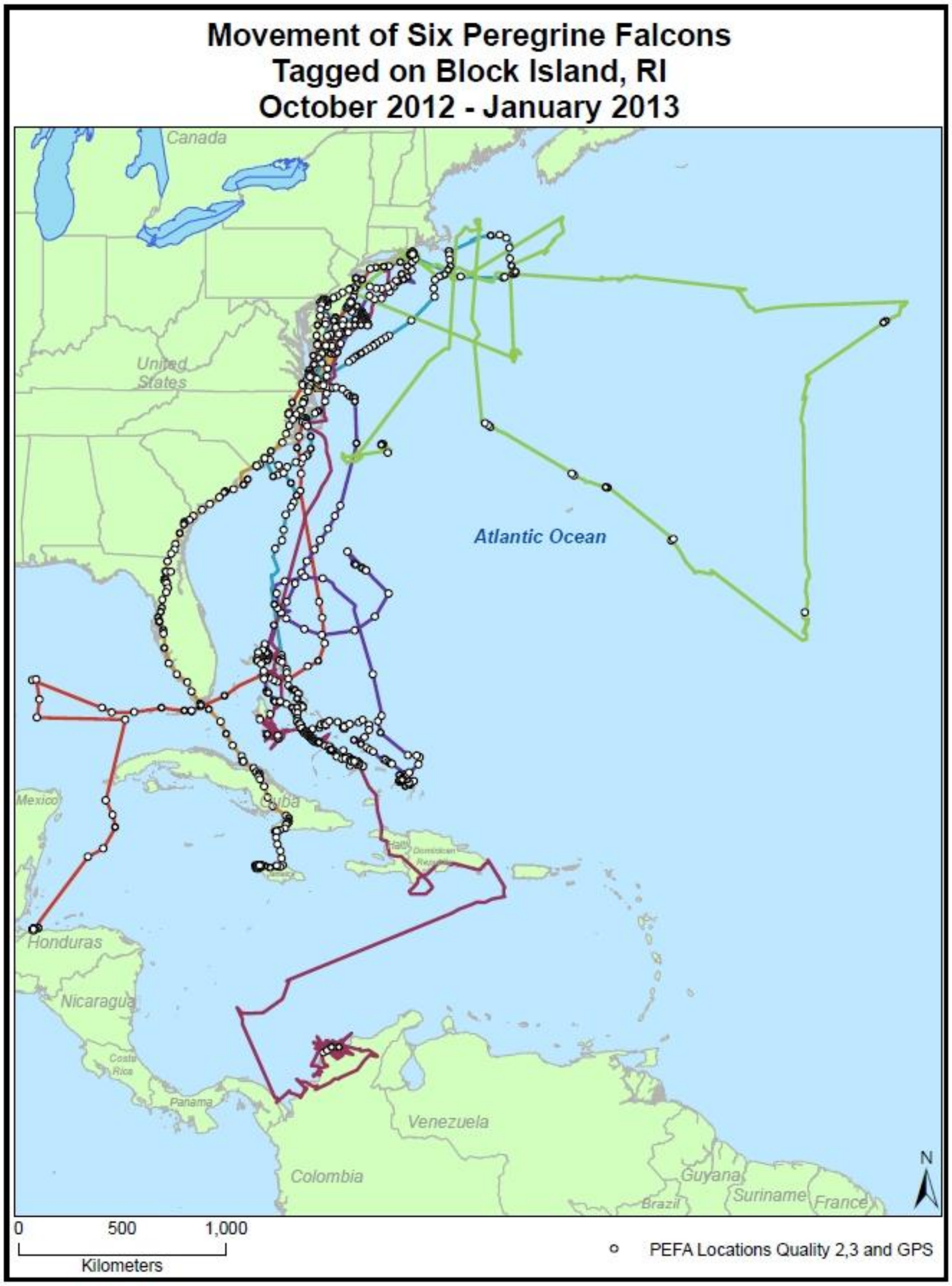
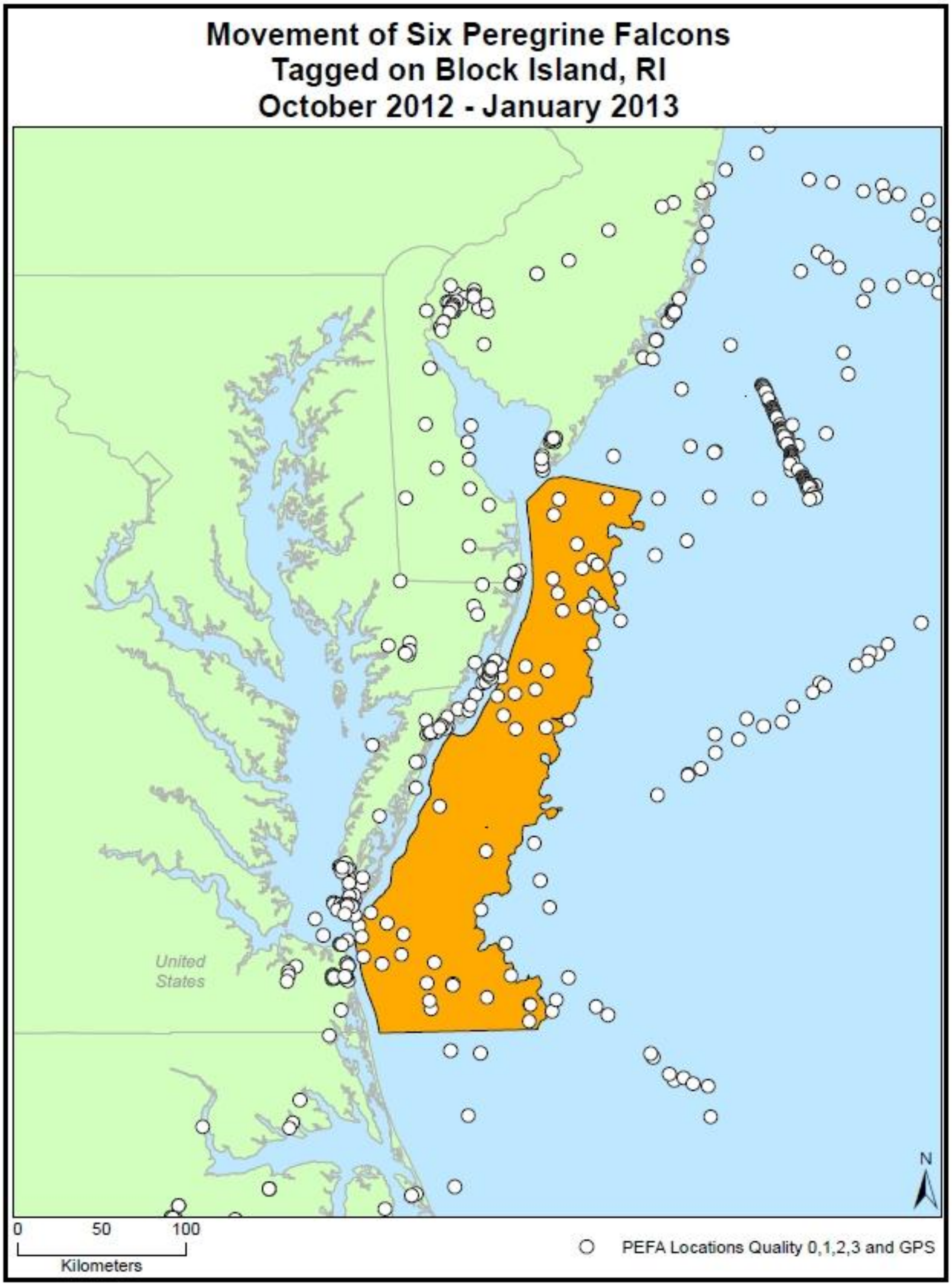


Figure IX.2: Satellite locations of Peregrine Falcons tagged tagged on Block Island (Oct. 2012-Jan. 2013).



Appendix X. Passive Acoustic Nocturnal Monitoring for Birds from the Boat Platform

Passive acoustic nocturnal monitoring for birds (conducted from the boat survey vessel during nights spent offshore) is presented for 2012 surveys in the tables below. Detections include only migratory flight calls, and thus exclude many non-migratory calls from gulls, terns, storm petrels, and other seabirds.

Table X.1: Summary of migratory flight calls detected during offshore acoustic surveys to date.

Date of Survey	# of flight calls detected	# of calls identified to spp. or spp. group	Conditions for recording	Comments
4/28/2012	1	1	Poor	Common Loon
6/18/2012	0	0	Good	No flight calls detected
8/13/2012	1	1	Excellent	Sparrow spp.
9/06/2012	123	95	Fair	See Table VIII.2 for species summary
11/11/2012	3	2	Good	Dunlin

Table X.2: Migratory flight calls detected during the September 2012 acoustic survey.

Species or Group	Flight Calls Detected
American Redstart	8
Canada Warbler	1
Cape May Warbler	1
Common Yellowthroat	2
Northern Waterthrush	3
Yellow-rumped Warbler	14
Ovenbird	2
Warbler spp.	1
Song Sparrow	2
Chipping Sparrow	1
Sparrow spp.	6
Least Sandpiper	7
Semipalmated Sandpiper	3
Shorebird spp.	1
American Goldfinch	1
Finch spp.	28
Thrush spp.	14
Unknown	28
Total flight calls detected:	**123**

Appendix XI. Two-page Flyer on the Mid-Atlantic Baseline Studies Project.

The Mid-Atlantic Baseline Studies Project

The Mid-Atlantic Baseline Studies Project: producing ecological monitoring data to inform siting and permitting processes for offshore wind energy development on the mid-Atlantic outer continental shelf of the United States.

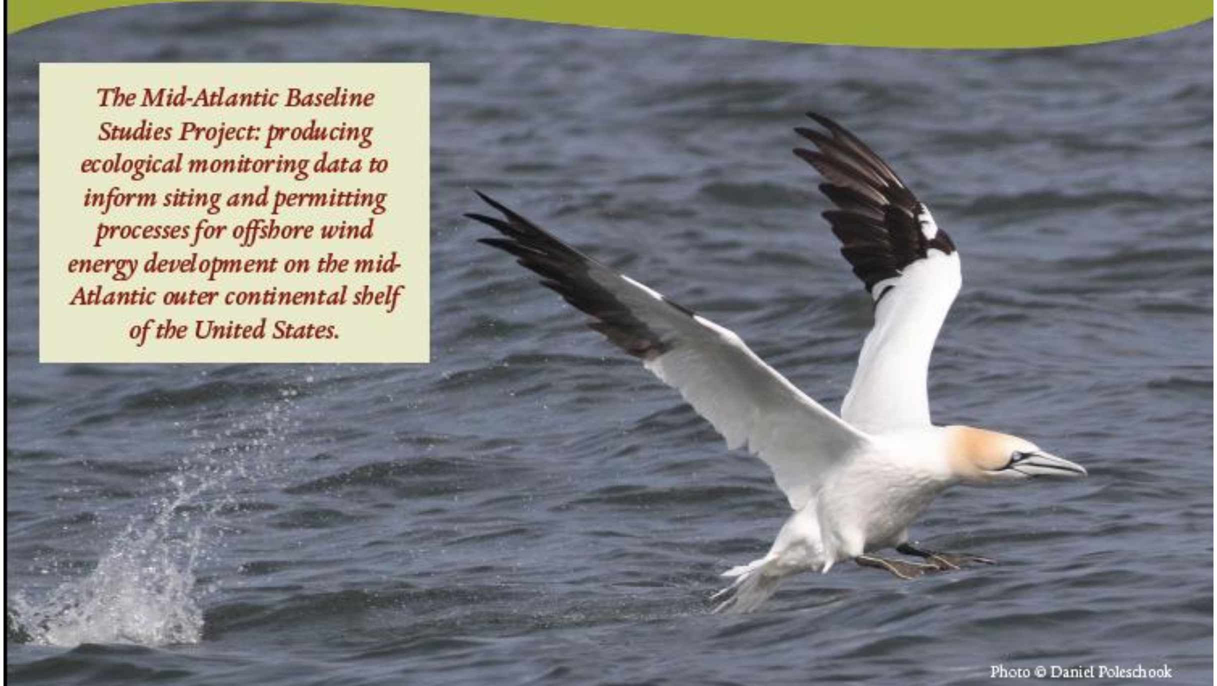


Photo © Daniel Poleschook

The three-year collaborative Mid-Atlantic Baseline Studies Project, begun in early 2012, includes researchers from the Biodiversity Research Institute, North Carolina State University, Duke University, City University of New York, HiDef Aerial Surveying Inc., and other organizations. The study is primarily funded by the U.S. Department of Energy (DOE), with additional support from the U.S. Fish and Wildlife Service, the Bureau of Ocean Energy Management, and the Bailey Foundation.

The goal of the project is to gather baseline information on the distribution, abundance, and movements of wildlife on the mid-Atlantic outer continental shelf (from three miles offshore to the 30 meter isobath). Data on birds, sea turtles, and marine mammals are collected and analyzed using a variety of technologies and methods, and will be presented in easily accessible formats to stakeholders, regulators, and developers.

Though environmental issues are poorly understood in offshore waters, there are a number of predicted and known effects to wildlife from offshore wind farms. The Baseline Studies Project is collecting detailed information on a regional scale about where and when wildlife spend their time, and how they move through space. Such data may help indicate the potential for harmful interactions, such as displacement or collisions, with offshore development. Thus, such data are not only useful for estimating risk from wind development in locations that have already been proposed, but may also be used to help determine future development locations where wildlife conflicts can be minimized.

Collaborating and Funding Organizations

U.S. DEPARTMENT OF ENERGY, BOEM, HiDef, NC STATE UNIVERSITY, Duke University, CSI CUNY

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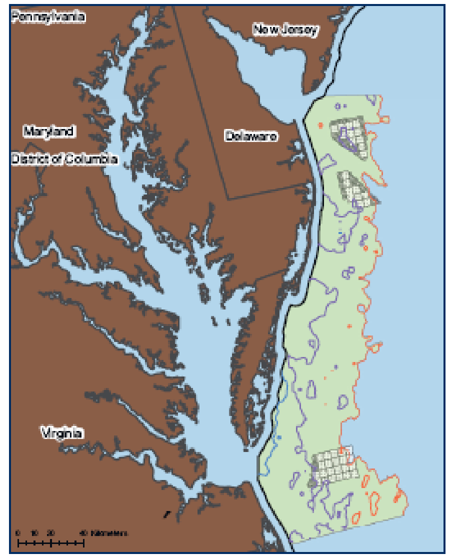
Survey efforts are particularly focused on the federally identified Wind Energy Areas (WEAs) off the coasts of Maryland, Delaware and Virginia. Project components include:

- Two full years of high-definition video aerial and boat surveys in and around the three WEAs. Aerial and boat surveys were initiated in April of 2012. Surveys obtain data on bird, sea turtle, and marine mammal distributions and densities, and also obtain environmental covariate data (water temperature, salinity, and echosounding data on prey densities).
- A comparison of high definition video aerial and boat-based survey data, to establish the validity of high definition aerial surveys as a survey method for offshore development in U.S. waters.
- Collaboratively funded satellite tracking studies of focal bird species (Northern Gannets, Surf Scoters, Red-throated Loons, and Peregrine Falcons) to provide information on animal movements and site fidelity for hierarchical abundance modeling in the mid-Atlantic.
- Nocturnal passive acoustic migration monitoring and NEXRAD (next generation radar) data analysis to understand more about avian migratory patterns and timing offshore.
- Collection of remote sensing environmental covariate data and incorporation of historical data from the Northwest Atlantic Seabird Compendium into modeling efforts.
- Modeling of data within a hierarchical framework, a proven statistical method for separating observational and ecological processes and understanding factors that influence species distributions and relative abundance.
- Dissemination of project results to stakeholders and regulators through publicly accessible technical and summary reports, geospatial map layers, and scientific manuscripts, as well as targeted outreach and communication efforts.



Study area for the Mid-Atlantic Baseline Studies Project. Wind Energy Areas (WEAs) are designated by the Bureau of Ocean Energy Management for potential wind development and expedited leasing processes.

Biodiversity Research Institute's mission is to assess emerging threats to wildlife and ecosystems through collaborative research, and to use scientific findings to advance environmental awareness and inform decision makers.

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