

Appendix 5.7-D

**A Late Winter and Early Spring
2002 Waterbirds Survey for
The Cape Wind Energy Project**

**APPENDIX 5.7-D
A LATE WINTER AND EARLY SPRING 2002 WATERBIRDS SURVEY
FOR THE CAPE WIND ENERGY PROJECT
NANTUCKET SOUND**

Prepared for:

Cape Wind Associates
75 Arlington Street
Boston, Massachusetts

Prepared by:

ESS Group, Inc.
90 Route 6A, Unit 4B
Sandwich, Massachusetts 02563
508-833-6226; fax 508-833-9687

Jeremy J. Hatch, PhD
Biology Department
University of Massachusetts
Boston, Massachusetts 02125
617-287-6615; fax 617-287-6650

and

Paul Kerlinger, PhD
Curry & Kerlinger, LLC
P.O. Box 453
Cape May Point, New Jersey 08212
609-884-2842; fax 609-884-4569

ESS Project No. E159

October 24, 2003

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
EXECUTIVE SUMMARY	I
1.0 INTRODUCTION.....	1
2.0 METHODS.....	1
2.1 Location of Study Area and Alternative Sites	1
2.2 Aerial Surveys	2
2.3 Boat Survey	3
2.4 Comparison of Survey Methods.....	4
3.0 RESULTS	4
3.1 Aerial Surveys	5
3.2 Boat Survey	6
3.3 Migration Staging	7
3.4 Altitude of Flying Birds	7
3.5 Distribution of Waterbirds Within the Study Area.....	7
4.0 DISCUSSION.....	8
5.0 CONCLUSION.....	10
5.0 LITERATURE CITED.....	10

TABLES

Table 1	Aerial Survey Coverage and Percentage of each Alternative Site Flown
Table 2	Species Observed during Winter 2002 Aerial and Boat Surveys
Table 3	Summary of Dates, Times, Weather and Water Conditions during the Five Winter Waterbird Aerial Surveys in Nantucket Sound, 2002
Table 4	Species Totals: Individuals Recorded within the Study Area during Five Aerial Surveys
Table 5	Summary of Dates, Times, and Weather Conditions during the Winter Waterbird Boat Survey in Nantucket Sound, 2002
Table 6	Boat Survey Observations for April 17-18, 2002
Table 7	Densities (individuals/km ²) of Waterbirds Observed in the Study Area during Aerial Surveys
Table 8	Comparison of the Numbers of Waterbirds Found in Alternative Area 1 to Regional Populations

FIGURES

Figure 1	Transects for Winter/Spring Avian Surveys 2002 within Nantucket Sound
----------	---

ATTACHMENTS

Attachment 1	Distribution of waterbirds for all aerial surveys combined
Attachment 2	Species totals and densities by site alternatives for all aerial surveys combined
Attachment 3	Estimated numbers of winter birds for aerial surveys 1-5

EXECUTIVE SUMMARY

Five aerial surveys and one boat survey were conducted during March and April of 2002 to evaluate the abundance and distribution of wintering and transient waterbirds in the proposed site for the Wind Park (Alternative 1) and two alternative sites (Alternatives 2 and 3) in Nantucket Sound and in the waters surrounding these areas. The surveys were conducted by day in good weather conditions along north/south transects in a study area of about 322 mi² (834 km²) that encompassed approximately 58% of Nantucket Sound. The study area excluded most of the immediate inshore waters, less than 1.2 miles (2 km) from land. All three alternative sites (Alternatives 1, 2, and 3) as well as areas outside these sites were evaluated by the survey. The total distance flown for each of the aerial surveys was approximately 258 linear miles (415 km). The surveys were conducted at an altitude of approximately 250 feet (75 m). Birds were counted and identified over a distance of 656 feet (200 m) on each side of the transect (a total of 1,312 feet (400 m)) resulting in a total coverage area of approximately 65 mi² (168 km²) for each survey. The boat survey followed the same transect lines and used the same offset distances for counts and identification.

A total of 22 species were observed during the aerial and boat surveys, which were conducted before the winter birds left the area. Three species of scoters (*Melanitta spp.*), Common Eiders (*Somateria mollissima*) and Long-tailed Ducks (*Clangula hyemalis*) accounted for the majority (>90%) of individuals observed. No listed species (those on the Federal or Massachusetts lists of endangered, threatened, or candidate species) were observed during the surveys. Common Loons (*Gavia immer*), a Massachusetts species of special concern, were observed on every survey and were abundant in April. Small numbers of newly-arrived Common Terns (*Sterna hirundo*), also a Massachusetts species of special concern and summer resident in Nantucket Sound, were observed on April 18, 2002 during the boat survey. Large increases in the numbers of scoters, Long-tailed Ducks, loons, and perhaps gannets and eiders, were observed on aerial surveys in late March, but numbers were low during the boat survey in mid-April suggesting that certain birds use portions of Nantucket Sound as a migration staging area. Bird numbers present through the winter may be lower if observations in late winter (mid-March) are representative of the entire winter.

The numbers of waterbirds within each of the three areas surveyed comprised less than approximately one percent of the Atlantic Flyway, or eastern North American populations of these species, although the cumulative number of waterbirds using the areas surveyed was likely to have been greater due to turnover (individuals departing before others arrive to the area). The densities of the three most common groups (scoters, eiders, and Long-tailed Ducks) varied greatly among the alternative sites and were greatest outside the three alternative sites. The density of scoters outside the alternative sites was about twice that of Alternative 1, the proposed Wind Park site. Eider density outside of the alternative sites was nearly 10 times the density within Alternatives 2 and 3, and over five times the density of Alternative 1. Long-tailed Duck densities were five times greater outside the alternative sites. Gulls (*Larus spp.*), Razorbills (*Alca torda*), loons, and Northern Gannets (*Morus bassanus*) were less abundant overall and were more evenly distributed; there were no noticeable differences in densities of these species between alternative sites and outside of those sites.

In summary, the numbers of waterbirds observed within the three alternative sites in Nantucket Sound considered for the proposed Wind Park were relatively small in comparison to other parts of the Sound and to total numbers estimated in the Northeast. Furthermore, waterbird numbers observed in the proposed Wind Park area are very small compared to those killed by hunters along the Atlantic Flyway every year. The overall numbers within Nantucket Sound during late winter (mid-March) appear to be lower than in spring (late-March through early-April), when portions of the Sound appear to become a migration staging area for several species. The density of the three most abundant species groups (scoters, eiders, and Long-tailed Ducks) outside the proposed Wind Park site and the two other alternative sites was generally greater than within these sites. Although neither of the survey methods (plane nor boat) enables exact measurements of the height at which individual birds were flying, birds were rarely observed in the height range of the proposed wind turbine rotors (75 – 417 feet (23 – 127 m)).

The aerial surveys had little influence on the behavior of birds. The majority of individuals that were observed on the water remained there, and those flying were rarely interrupted or changed direction. Exceptions included; species observed flying at altitudes near the plane altered their heading to avoid the plane, and black scoters and

sometimes long-tailed ducks flew off the water and away from the plane as it passed. These individuals typically flew away from the plane, close to the water before landing shortly thereafter. During the boat surveys, birds that were already aloft were unaffected by the presence of the boat. However, birds (typically seaducks) that were on the water, flew away from the boat as it approached. Shortly following the passing of the boat, these individuals typically returned to the water in the same general vicinity where they were resting prior to the interruption.

1.0 INTRODUCTION

Paragraphs preceded by * contain only information that is repeated in each of the relevant Appendices, although wording may differ. These paragraphs refer principally to the background and the methods used. The material is repeated so that each report is a stand-alone document.

During the late winter-early spring of 2002, a study of waterbirds utilizing Nantucket Sound was conducted within and adjacent to three alternative sites for the wind park proposed by Cape Wind Associates, LLC (Cape Wind or the Applicant).

*As presented in the Environmental Notification Form (ENF) to the Massachusetts Environmental Policy Act Office, a preliminary avian risk assessment was conducted by Kerlinger and Hatch (2001) for the Cape Wind Energy Project (the Project), see Appendix 5.7-A. This assessment included a review of existing literature and found that several species of waterbirds are likely to overwinter within Nantucket Sound in or near the areas being considered for the Project and there was a need for more quantitative information about their numbers and distribution.

*To establish the scope of work needed, the US Army Corps of Engineers hosted meetings between Cape Wind (and ESS Group, Inc), the U. S. Fish and Wildlife Service (USFWS), the Massachusetts Division of Fisheries and Wildlife (MADFW), and the Massachusetts Audubon Society (Mass Audubon). These meetings concluded that the DEIS should include quantitative information about how birds use the proposed site for the Wind Park and the surrounding waters of Nantucket Sound including the two other alternative sites, and a characterization of their behavior in relation to potential risk from the proposed development. In response to these meetings, the study described herein was initiated.

*The survey methods used are comparable to those used by waterfowl biologists who determine population and harvest levels for the MADFW and the USFWS. These methods include both aerial and boat surveys in the open waters of Nantucket Sound. The information provided in this study significantly expands upon the quantitative material reviewed by Kerlinger and Hatch (2001) in their preliminary risk assessment and more accurately assesses the potential for Project impacts to waterbirds that use Nantucket Sound during the winter and spring. Specifically, the data on numbers and distribution will contribute to evaluation of bird-use of the proposed and alternative sites and to the evaluation of potential impacts of the proposed project.

This report summarizes investigations of waterbirds in Nantucket Sound made by means of aerial and boat surveys during the period when the winter residents are supplemented by spring migrants. The report examines the numbers and species present and their temporal and spatial distribution with a particular focus on the three alternative sites within the Sound proposed for the Wind Park. The importance of these areas for birds is addressed by comparing the survey results with regional populations of these species. Subsequent reports address similar topics for the spring/summer 2002 (Appendix 5.7-F), the fall 2002/winter 2003 (Appendix 5.7-G) and the winter/spring 2003 (Appendix 5.7-K). Additional surveys will be conducted two times per month through February 2004 and the results from these additional surveys (September 2003 through February 2004) will be presented in future reports.

2.0 METHODS

2.1 Location of Study Area and Alternative Sites

Two preliminary survey flights were conducted in December 2001 to examine the presence and distribution of wintering waterbirds within Nantucket Sound as a basis for designating a study area to be used in subsequent aerial surveys. No quantitative data from these two flights are included in this report.

*The study area in the center of Nantucket Sound includes the three alternative sites and surrounding areas as shown on Figure 1 and excludes almost all waters within 1.2 miles (2 km) of land because areas close to shore commonly have a different avifaunal community from the principal areas of concern. A small portion near the southern edge of the study area, approximately 5 mi² (13 km²), was within the 1.2 miles (2 km) of land (near Muskeget Island). This area was included in the study area due to its proximity to Alternative 2 and because

Muskeget Island extends into Nantucket Sound. The area of Nantucket Sound is approximately 560 mi² (1,450 km²) of which the study area comprises approximately 322 mi² (834 km²) (or about 58% of Nantucket Sound). The areas of each alternative site, and that portion of the study area surrounding them, are summarized in Table 1. The three alternative sites are identified as:

- Alternative #1-Horseshoe Shoal, the Proposed Alternative Site for the Wind Park;
- Alternative #2-Monomoy-Handkerchief Shoal, an area in the northeast part of the Sound; and
- Alternative #3-Tuckernuck Shoal, an area south and west of the main shipping channels.

*The total distance flown for each of the aerial surveys was approximately 258 linear miles (415 km). The surveys were conducted at an altitude of about 250 feet (75 m). Birds were counted and identified over a distance of 656 feet (200 m) on each side of the transect (a total of 1,312 feet (400 m)) resulting in a total area of approximately 65 mi² (168 km²) for each survey (Table 1). As shown in Table 1 a minimum of 19% of each alternative site was sampled during each survey. This percentage of area surveyed was derived by multiplying the distance flown along each transect by the distance observed on each side of the plane, (within which all birds were counted) and dividing by the total area of the alternative site being studied.

Table 1
Aerial Survey Coverage and Percentage of each Alternative Site Flown

Alternative Site	Area (km ² /mi ²)	Kilometers ² /Miles ² Surveyed	% Area Surveyed
1	110 km ² (42.5 mi ²)	21.0 km ² (8.1 mi ²)	19%
2	52 km ² (20.1 mi ²)	9.8 km ² (3.8 mi ²)	19%
3	89 km ² (34.4 mi ²)	16.8 km ² (6.5 mi ²)	19%
OUTSIDE	582 km ² (224.7 mi ²)	120.4 km ² (46.5 mi ²)	21%
TOTAL	834 km ² (322.0 mi ²)	168.0 km ² (64.9 mi ²)	20%

2.2 Aerial Surveys

Five aerial surveys (March 17, 19, 25, 29, and April 5, 2002) were flown in a Cessna-206 floatplane at 250 feet (75 m) above sea level at an air speed of 90 knots (167km/h). The goal of these surveys was to measure bird densities (numbers per unit area) by means of standardized protocols developed for use throughout the year and are the continuation of studies suggested by avian experts from the U.S. Fish and Wildlife Service (USFWS), the Massachusetts Division of Fisheries and Wildlife (MADFW), and the Massachusetts Audubon Society (Mass Audubon).

The aerial surveys had little influence on the behavior of birds. The majority of individuals that were observed on the water remained there and those flying were rarely interrupted or changed direction. Exceptions included; species observed flying at altitudes near the plane altered their heading to avoid the plane, and black scoters and sometimes long-tailed ducks flew off the water and away from the plane as it passed. These individuals typically flew away from the plane, close to the water before landing shortly thereafter. During the boat surveys, birds that were already aloft were unaffected by the presence of the boat. However, birds (typically seaducks) that were on the water, flew away from the boat as it approached. Shortly following the passing of the boat, these individuals typically returned to the water in the same general vicinity where they were resting prior to the interruption.

For each survey, 16 pre-determined systematic transects (Figure 1) were flown in north/south directions, with approximately 1.2 miles (2 km) between each transect. Surveys were flown at different times of the day, at different tides, and in varying weather (as discussed below in Section 3.1), but visibility was good or excellent during every survey. Flights were also varied in their starting point and direction of flight.

*Two observers were located on either side of the plane. To identify outer transect boundaries, an aluminum rod was attached perpendicular to the wing strut on each side of the plane. A clinometer was used to measure the calculated angle for the placement of these aluminum rods. The distances visible between the plane's float and the aluminum rods were then verified by flying over the airport at 250 feet (75 m) using pre-measured markers on the ground. The area visible between the float on the plane and the aluminum rod provided each observer with a 200-meter (656 foot) transect width within which all birds were counted.

*The survey team consisted of the pilot, a data recorder, and two observers (Jeremy Hatch and Jeffrey Burm). The pilot was responsible for keeping the plane on transect, at the correct altitude and speed, and for maintaining the wing level attitude. The data recorder and observers were in direct communication through the use of aviation headsets. The observers identified species, number of individuals, activity of bird (i.e., foraging or flying), and exact time of sighting. The data recorder was responsible for entering the data identified by the observers and recording a Global Positioning System (GPS) point of the exact location at the beginning and end of each transect in addition to a GPS point every minute during each transect. Each observer's sightings were also independently recorded on an audiotape linked directly to each headset.

*During the aerial surveys the altitude of flying birds was estimated in relation to the surface of the water and the known altitude of the plane (250 ft). Flight altitudes were recorded to the data recorder in 30-foot (10 meter) increments. Although this methodology was not precise and not commonplace among the research, it was sufficient to determine if birds were within or near the rotor swept zone (75-417 feet (23 to 127 m) above MLLW). In practice, few birds were observed at altitudes near the rotor-swept zone.

For compiling data from aerial surveys it is assumed that all individuals detected within a transect are recorded and that individuals are recorded only once. In our experience in Nantucket Sound, few birds were flushed by the plane and those individuals tended to circle round and settle near where they had been earlier. The number of individuals that flew far enough to be counted in adjacent transects was probably negligible, although we have no data to confirm this.

Data Compilation for Aerial Surveys

After each aerial survey, audio tape recordings were reviewed to correct errors introduced while compiling data sheets during flight. Data was manually transferred into an Excel spreadsheet and reviewed for quality and accurateness.

During data compilation, points were converted from WGS 1984 Latitude/Longitude to Massachusetts State Plane Mainland North American Datum 1983. The points were overlaid on NOAA Digital Nautical Chart #13237 in a Geographic Information System (GIS) using ESRI Software products. Each observation was assigned a specific location based on the time of the sighting and precise position of the plane (Attachment 1).

2.3 Boat Survey

A boat survey was conducted on April 17 and 18, 2002 to complement the aerial surveys and to make observations as to whether birds were flying or sitting on the water. The survey vessel used (the Minuteman from Patriot Party Boats) was a 40-foot (12.2 m) trawler with a freeboard of 5 feet (1.5 m). Observations were made from a height of approximately 11 feet (3.4 m) above the water. The same transects used for the aerial surveys were used for the boat survey. Due to slower speeds (14 knots) and inclement sea conditions, the boat survey took 2 days. Furthermore, transects were cut short in the south on several transects due to insufficient water depth.

The survey team consisted of the captain, a data recorder, and two observers (Jeremy Hatch and Jeffrey Burm) positioned on opposite sides of the boat, on the foredeck when conditions permitted, observing from about 11 feet (3.4 m) above sea level.

The altitude at which the waterbirds fly over Nantucket Sound is of particular interest because of concerns about possible collisions with turbine rotors (75-417 feet (23 to 127 m) MLLW). Estimating altitudes at sea is difficult because of the general lack of appropriate "yardsticks". The height above sea level for birds within 328 feet (100 m) of the boat was estimated using bird size, wave height and the boat as benchmarks and placing each estimate into a 20 ft (6 m) interval. In practice, few birds were observed at altitudes near the rotor-swept zone. During the surveys in the first winter (reported here), the survey team did not systematically record bird altitudes.

Data Compilation for Boat Survey

*As observations were made, the data were relayed verbally to the recorder, who entered a GPS point, species type, number of species, and activity into a database using a Trimble GeoExplorer 3C GPS unit. This GPS unit contains a data dictionary with pre-loaded attributes. Observer sightings were also recorded on an audiotape to provide independent recordings and backup for each observer.

*After each boat survey, data (rover files) were transferred from the GPS unit to a PC using GPS Pathfinder Office 2.90. Rover files were differentially corrected using base files from the Rhode Island Trimble Reference Station. Corrected rover files were exported as ArcView shapefiles and projected into the Massachusetts State Plane North American Datum 1983. Shapefiles were then plotted on a digital NOAA Nautical Chart (#13237) using a GIS with ESRI Software products.

2.4 Comparison of Survey Methods

*The two survey methods, aerial and boat, offered different viewpoints of the study area. From the boat, observers had a better opportunity to identify individual bird species and to count bird flocks since the vessel speed was slower than the airplane. However the birds were alerted more readily due to the presence of the vessel. Furthermore, the low vantage point from the boat may have resulted in missed birds in the transect due to the sea conditions. In some portions of the study area (north of Muskeget), the survey vessel was not able to navigate the transect line due to shallow waters.

*From the plane, the height chosen (250 ft (75 m)) provided an advantage over the boat survey as most of the birds within the transect could be seen before the presence of the airplane disturbed them. However, the ability to distinguish and count similar species, especially large numbers in mixed flocks, was reduced due to plane speed.

For this report, data from the boat survey and the five aerial surveys were not combined for the reasons just described and also because the boat survey was conducted later in the season, after many birds had departed on migration.

3.0 RESULTS

During the five aerial surveys and one boat survey conducted during March and April of 2002, a total of 22 species were observed as presented in Table 2.

**Table 2
 Species Observed during Winter 2002 Aerial and Boat Surveys**

Common Name	Scientific Name
Red-throated Loon	<i>Gavia stellata</i>
Common Loon	<i>G. immer</i>
Grebe	<i>Podiceps sp.</i>
Northern Gannet	<i>Morus bassanus</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Double-crested Cormorant	<i>P. auritus</i>
Common Eider	<i>Somateria mollissima</i>
Long-tailed Duck	<i>Clangula hyemalis</i>
Black Scoter	<i>Melanitta nigra</i>
Surf Scoter	<i>M. perspicillata</i>
White-winged Scoter	<i>M. fusca</i>
Goldeneye	<i>Bucephala sp.</i>
Red-breasted Merganser	<i>Mergus serrator</i>
Laughing Gull	<i>Larus atricilla</i>
Bonaparte's Gull	<i>L. philadelphia</i>
Herring Gull	<i>L. argentatus</i>
Great Black-backed Gull	<i>L. marinus</i>
Unknown Gull	<i>L. unknown</i>

Common Name	Scientific Name
Black-legged Kittiwake	<i>Rissa tridactyla</i>
Common Tern	<i>Sterna hirundo</i>
Razorbill	<i>Alca torda</i>
Atlantic Puffin	<i>Fratercula arctica</i>
American Goldfinch	<i>Carduelis tristis</i>

3.1 Aerial Surveys

Five aerial surveys were conducted between March 17 and April 5, 2002. Details of the times, dates, tide, and weather conditions are provided in Table 3. Weather varied from survey to survey and included different wind conditions, tides, cloud cover, and precipitation regimes. There was precipitation on only one day consisting of light drizzle. Flights in heavy rain and wind were deemed too dangerous.

Table 3
Summary of Dates, Times, Weather and Water Conditions during the Five Winter Waterbird Aerial Surveys in Nantucket Sound, 2002

Survey	Date	Start	Finish	Start Point ¹	High Tide ²	Wind	Temp F	Weather
1	17-Mar	12:31	15:31	1 South	19:34	NW 8 Knots	40s	Sunny
2	19-Mar	10:27	13:32	16 South	20:54	NE 7-11 Knots	40s	Slight Drizzle
3	25-Mar	11:13	14:14	16 North	14:19	NE 9 Knots	40s	Overcast
4	29-Mar	06:07	09:07	16 North	17:43	0 Knots	up 40s	Partly Cloudy
5	5-Apr	14:32	17:28	1 North	11:46	N 6 Knots	mid 40s	Partly Cloudy

¹ Start Point refers to transect (Fig. 1)

² High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts (www.harbertides.com)

Species and Abundances

A total of 19 species of waterbirds were observed during the five aerial surveys (Table 4). For total counts of birds, five groups of related species were pooled, as follows: (1) scoters: the three species of scoters observed were the Black, Surf, and White-winged; (2) Eiders: all eiders were treated as Common Eiders, although King Eiders (*Somateria spectabilis*) could have been present in small numbers (none were identified); (3) Cormorants: the two species potentially observed were Double-crested and Great; (4) Gulls: the two species of large gulls, Great Black-backed and Herring, which have similar immature plumages, were pooled when individuals could not be identified readily to species, and (5) Loons: Common Loons greatly outnumbered Red-throated Loons but species was not always recorded.

Table 4
Species Totals: Individuals Recorded within the Study Area during Five Aerial Surveys

Species	March 17	March 19	March 25	March 29	April 5	Total
Loon: Common and Red-throated	124	138	191	782	2,004	3,239
Grebe	0	0	0	0	2	2
Northern Gannet	28	100	27	82	123	360
Cormorant: Great and Double-crested	0	0	9	0	1	10
Common Eider	4,359	2,885	3,347	4,904	5,125	20,620
Long-tailed Duck	1,261	1,234	1,857	3,230	3,493	11,075
Scoter: Black, White-winged, and Surf	5,049	6,769	9131	8389	11744	41,082
Goldeneye	0	2	1	0	1	4
Red-breasted Merganser	2	0	6	10	22	40
Bonaparte's Gull	0	0	0	0	57	57
Herring Gull	21	1	9	19	54	104
Great Black-backed Gull	58	16	6	5	0	85
Unknown Gull	0	0	2	1	14	17
Black-legged Kittiwake	17	1	0	0	0	18
Razorbill	59	20	86	129	268	562
Atlantic Puffin	0	1	0	0	0	1
Totals	10,978	11,167	14,672	17,551	22,908	77,276

The following three species or species groups accounted for more than 90% of all birds observed during the aerial surveys (Table 4): scoters (41,082), eiders (20,620) and Long-tailed Ducks (11,075). Each of the five aerial surveys sampled approximately 20 percent of the area, such that the totals for each species for all five surveys indicate the approximate numbers present in the entire study area over the survey period. (This topic is addressed further with estimates of densities in Attachment 2.) Loons numbered 3,239 sightings with much larger numbers in early-April than in March. Smaller numbers of gannets and razorbills were observed: less than 1,000 of each. The birds enumerated as Razorbills could have included some Murres (*Uria*), which are not readily distinguished under the conditions of observation for this survey but are not frequent in the area (Veit and Petersen, 1993).

The seven maps presented in Attachment 1 summarize the five aerial surveys for the abundant species groups (loons, gannets, eiders, scoters, Long-tailed Ducks, gulls and kittiwake, and razorbills). They show that the waterbirds were not uniformly distributed in the study area and that the species present differed by area. For example, the largest numbers of eiders were found to the south and southwest of Alternative 3, near Muskeget Island and off Chappaquidick Island. Another large cluster was found southwest of Monomoy. A smaller cluster was present in the western portion of Alternative 1. These patterns were generally consistent for all the flights. For Long-tailed Ducks, the largest cluster was to the west of Monomoy, with some of this cluster extending into Alternative 2 and even as far west as Alternative 1. The scoter pattern was not as distinct. These birds were more evenly distributed without large, dense clusters. Other species, like loons and gannets, were spread over a much larger area with no particularly distinct clusters.

3.2 Boat Survey

One boat survey was conducted over two days on April 17 and 18, 2002. Details of the times, dates, tide, and weather conditions are summarized in Table 5. The survey vessel could not enter areas of shallow water near Muskeget Island, so approximately 2.6 miles (4 km) of the southern ends of transects 3 through 7 were not covered (total 13 miles (21 km)). All of transect 10 and the southern half of transect 2 were also omitted due to rough seas and impending darkness.

**Table 5
 Summary of Dates, Times, and Weather Conditions during the Winter Waterbird Boat Survey in
 Nantucket Sound, 2002**

Survey	Date	Start	Finish	Start Point ¹	High Tide ²	Wind	Temp °F	Weather
1	17-Apr	06:00	18:10	16 North	16:09	S 12 Knots	70s	Sunny
2	18-Apr	05:45	17:54	10 South	16:58	NE 15 Knots	50s	Hazy

¹ Start Point refers to transect (Fig. 1)

² High Tide data for Cape Poge, Chappaquidick Island, Massachusetts (www.harbertides.com)

Species and Abundances

A total of 17 species were observed during the boat survey (Table 6). As mentioned earlier, one of the advantages of the boat survey was identifying individual species as opposed to species groups. Similar to the aerial surveys, scoters (4,067) and Long-tailed ducks (1,947) were the most abundant, although numbers were notably lower than during aerial surveys two weeks earlier. This was true for all species except gulls (339). The decrease in numbers for most species is attributed to several factors including: many individuals had already departed on migration, part of the study area was inaccessible, and visibility was poorer from the boat. The greater disturbance effect of the boat compared to the aircraft probably accounts for the large difference in the proportions of birds seen flying rather than on the water (Table 6). The first Common Terns of the summer season were seen on April 18, 2002.

Table 6
Boat Survey Observations for April 17-18, 2002

Species	Boat Survey 1		
	Flying	On Water	Total
Red-throated Loon	47	46	93
Common Loon	112	223	335
Grebe	0	5	5
Northern Gannet	87	222	309
Double-crested Cormorant	3	0	3
Common Eider	264	15	279
Long-tailed Duck	701	1,246	1,947
Black Scoter	344	326	670
Surf Scoter	883	1,438	2,321
White-winged Scoter	475	557	1,032
Unknown Scoters	7	37	44
Laughing Gull	0	1	1
Bonaparte's Gull	2	93	95
Herring Gull	34	47	81
Great Black-backed Gull	60	102	162
Common Tern	19	0	19
Razorbill	41	30	71
American Goldfinch	1	0	1
Total	3,080	4,388	7,468

3.3 Migration Staging

A rapid increase in bird numbers was noted from mid to late March for several species (Table 4). Between the first surveys in March and the last aerial survey in early April, loon numbers increased considerably from 124 to more than 2,000 per survey. In the same period, gannets and razorbills experienced five-fold increases; Long-tailed Ducks experienced a threefold increase; and scoters more than doubled in numbers. In April, during the boat survey, few individuals of many of these species were observed, and even fewer were recorded during the first summer survey in May (Appendix 5.7-F). This rapid increase and then decrease strongly suggests that Nantucket Sound is a migration staging area during the spring months and that wintering numbers of these birds in the Sound are likely to be similar to those pre-migration numbers observed during the earliest surveys in March. The lower numbers of some species, particularly eiders, observed during the boat survey suggests that large numbers of this species migrate out of Nantucket Sound by mid-April. A more complete account of annual movements will be possible after completion of surveys in the fall and the other winter months and comparing numbers to late winter and early spring.

3.4 Altitude of Flying Birds

Neither of the survey methods (plane nor boat) enables precise measurements of the height at which birds were flying, and estimated altitudes were not systematically recorded; despite this, there was a very strong impression that the great majority of waterbirds flew within 100 feet (30 m) of the water surface. Exceptions during the surveys included small numbers of loons, gannets, and gulls flying above approximately 230 feet (70 m). While returning from the boat survey on April 18, 2002, there was an incidental sighting of three flocks of scoters above approximately 230 feet (70 m), which were probably departing migrants. However, it was evident that very few birds were observed in the height range of the proposed wind turbine rotors (75 – 417 feet (23 – 127 m)).

3.5 Distribution of Waterbirds Within the Study Area

The three most abundant species groups (scoters, eiders, and Long-tailed Ducks) were not evenly distributed within the Study Area (Table 7, also see Attachment 2, which includes additional information). Density was measured by adding individuals from the five aerial surveys and dividing by the number of square kilometers flown. For scoters, the density of birds outside the alternative sites was greater than within any of the three sites. In the "outside" area, density was about 266 birds per km², more than twice the density observed within

Alternative 1. Alternatives 2 and 3 had lower densities than the “outside” area, but the difference was not substantial. For eiders, the density outside of the three alternative sites was almost ten times the density observed within Alternatives 2 and 3 and about 5.7 times greater than Alternative 1. The “outside” area hosted about 162 birds per km² vs. 16 to 28 per km² in the three alternative sites. For Long-tailed Ducks, the density was greatest outside the three alternative sites, but the difference was not substantial. The exception was Alternative 3, which had a density many times lower than the density in the other areas.

Table 7
Densities (individuals/km²) of Waterbirds Observed in the Study Area during Aerial Surveys

Species	Alternative 1	Alternative 2	Alternative 3	Outside	Total Study Area
Loons, 2 species	17.67	30.92	23.27	18.06	19.28
Gannet	1.00	1.33	1.90	2.44	2.14
Eider	28.29	16.53	18.45	162.41	122.74
Long-tailed Duck	50.19	57.76	7.80	77.44	65.92
Scoters, 3 species	128.62	218.27	247.98	266.41	244.54
Gulls	2.14	0.41	1.13	1.77	1.67
Razorbill	3.10	5.82	2.80	3.26	3.35

The remaining species, including loons, gannets, gulls, razorbills, and the others were thinly and relatively evenly spaced throughout the survey areas. For example, the density of razorbills ranged from 2.8 per km² to about 5.8 per km². The relative differences in density between areas were considerable (twofold in the case of razorbills), although the absolute numerical differences were minor. For loons the density ranged from approximately 18 to 31 birds per km², with Alternative 1 having the lowest density of the three alternatives. Eiders density was greatest in the “outside” area, with little variability among Alternatives 1, 2, and 3. Long-tailed Duck densities in Alternative 3 were much lower than in the other areas. Scoter density in Alternative 1 was half that of the other alternatives. Among the other species, differences were minor and there was no general trend as to where densities were greatest.

Waterbird numbers for each part of the study area on each survey, estimated by extrapolating observed densities to the entire areas, are summarized in Attachment 3. These bar graphs show spatial distributions within the study area (with the largest numbers outside the alternative areas) and temporal changes within the study period (with increases in the later counts for some species).

4.0 DISCUSSION

The number of wintering birds in Nantucket Sound, and especially within any of the Alternative Sites, must be judged relative to larger units, such as regional populations, in order to assess the importance of the area and to evaluate potential impacts of the proposed project. Although many waterbirds winter in Nantucket Sound or pass through the area during migration, these numbers are modest in comparison to regional (flyway) populations (Table 8). While the exact numbers of wintering birds in Nantucket Sound are not precisely known, ranges are provided that represent the best estimates available and demonstrate that the numbers of birds using the proposed Wind Park site (Alternative 1) are small fractions of the regional populations.

Table 8
Comparison of the Numbers of Waterbirds Found in Alternative Area 1 to Regional Populations

Species	Alternative #1 Average	Massachusetts Winter ¹	North American Atlantic Flyway ²	Annual Hunting Harvest ³
Loons (2 sp.)	391	300	>75,000*	N/A
Northern Gannet	22	~10,000	168,000	N/A
Eider	625	180,000-500,000	500,000+	17,000-23,000
Long-tailed Duck	1109	180,000-250,000	250,000+	10,000-13,000
Scoters (3 spp.)	2843	30,000	375,000+	18,000

Source:

¹ The Massachusetts Winter are derived from: Veit and Peterson 1993, Davis 1997, Krohn et al. 1992, Mass Department of Fish and Wildlife.

² Northern American Atlantic Flyway are derived from: Cape May Bird Observatory (Ward and Sutton 2001, D. Mizrahi personal comm.), Veit and Peterson 1993, National Audubon Society Christmas Bird Counts.

³ Annual Harvest Numbers are derived from: Martin and Padding 2002, and Paul Padding, US Fish and Wildlife personal communication.

Table 8 compares the numbers of the principal species observed in Alternative 1 during the aerial surveys with the numbers of these species in the waters of Massachusetts in winter/early spring, the North American/Atlantic Flyway population, and the numbers killed by hunters each year. The statistic "Alternative 1 Average" is intended to be an integrated measure of the varying number of birds using the area, and thus potentially at risk. These numbers were calculated by adding the total individuals observed within Alternative 1 during the five aerial surveys, dividing the total by 0.19 (the fraction of the area surveyed), and dividing that total by the amount of surveys flown (5). These numbers probably include some individual winter residents observed on more than one survey, as well as many transients seen only once.

For each species, the estimated number for Alternative 1 is most likely higher than the average overwintering population because it includes the abundant staging migrants. The patchy distribution of seaducks means that extrapolations to estimate these numbers must be treated with caution. However, these numbers make for a conservative comparison of wintering birds in the study areas with biologically relevant populations. It is not possible to distinguish the winter residents from the individuals that use the Sound as a staging area during spring migration.

The Atlantic coast population of Common Eiders is believed to be about 300,000 to 500,000+ individuals and the Massachusetts wintering population has been estimated to be 180,000-500,000 (Table 8). The numbers observed in Alternative 1 during the study period suggest that the birds using Alternative 1 represent a small percentage of that population. For perspective, the annual (legal) hunting kill of eiders in the Atlantic Flyway, according to USFWS statistics (Martin et al, 2002; Paul Padding, personal communication) is nearly 30 times the number of eiders present within Alternative 1 during an average survey. The annual hunting kill in the US was reported as 24,000 by Goudie et al. (2000).

Long-tailed Ducks and scoters show similar patterns to eiders, with only small numbers observed in Alternative 1 compared to the Atlantic populations and to the annual kills by hunters. For scoters, the harvest is about 6 times the numbers observed in Alternative 1 and for Long-tailed Ducks the harvest is about 9-10 times the numbers observed in Alternative 1. For scoters the average number observed in Alternative 1 is less than 1% of the Atlantic wintering population. For Long-tailed Ducks, the average number observed in Alternative 1 amounted to less than one-half of 1 percent of the Atlantic Flyway population.

For loons and gannets, species that are not hunted, the average numbers observed in Alternative 1 are approximately less than one percent of the estimated numbers in North American Atlantic Flyway populations. The total numbers of loons migrating along the Atlantic Coast is in excess of 75,000 in southern New Jersey (D. Mizrahi, personal communication), and more of these birds winter to the north of New Jersey (from Christmas Bird Counts, National Audubon Society – 2001 database), so it is likely that the entire population of these birds in the eastern Atlantic is in excess of 80,000 birds.

Aside from the three-species/groups of seaducks that made up 90% of the birds observed, relatively few other birds were recorded in these surveys. None of the species observed is listed as endangered, threatened, or is a candidate species for listing on the federal or state level. However, two species, the Common Loon and the Common Tern, are Massachusetts state-listed species of concern. Common Loons that winter in Nantucket Sound and the adjacent waters may include some from the small Massachusetts population but most come from throughout New England and eastern Canada. The loons observed were either Red-throated or Common Loons. Both species of loons were observed during the study but were not always differentiated during observations. Small numbers of newly-arrived Common Terns were observed during the April 18, 2002 boat survey. Since these small numbers of terns reflect the early arrival of Common Terns, further discussion of terns will be deferred to the summer survey reports.

5.0 CONCLUSION

The quantitative surveys commenced in March, and it is likely that the two earliest surveys are more representative of winter waterbird numbers and the later surveys are representative of species staging within Nantucket Sound during the spring migration. The surveys demonstrated that the waterbirds using Nantucket Sound during late winter and the spring migration season of 2002 were not a diverse array of species. The species found were mostly common birds, and did not include any endangered, threatened, or candidate species.

The densities of birds in the three alternative sites were found to be lower, in general, than outside these areas. Moreover, Alternative 1 had lower densities than Alternatives 2 or 3, for 5 of the 7 principal species groups.

The numbers observed in Alternative 1 comprise only a small fraction of those wintering in Massachusetts or in the Atlantic Flyway. Furthermore, the numbers observed in Alternative 1 are very small compared to those killed by hunters along the Atlantic Flyway every year.

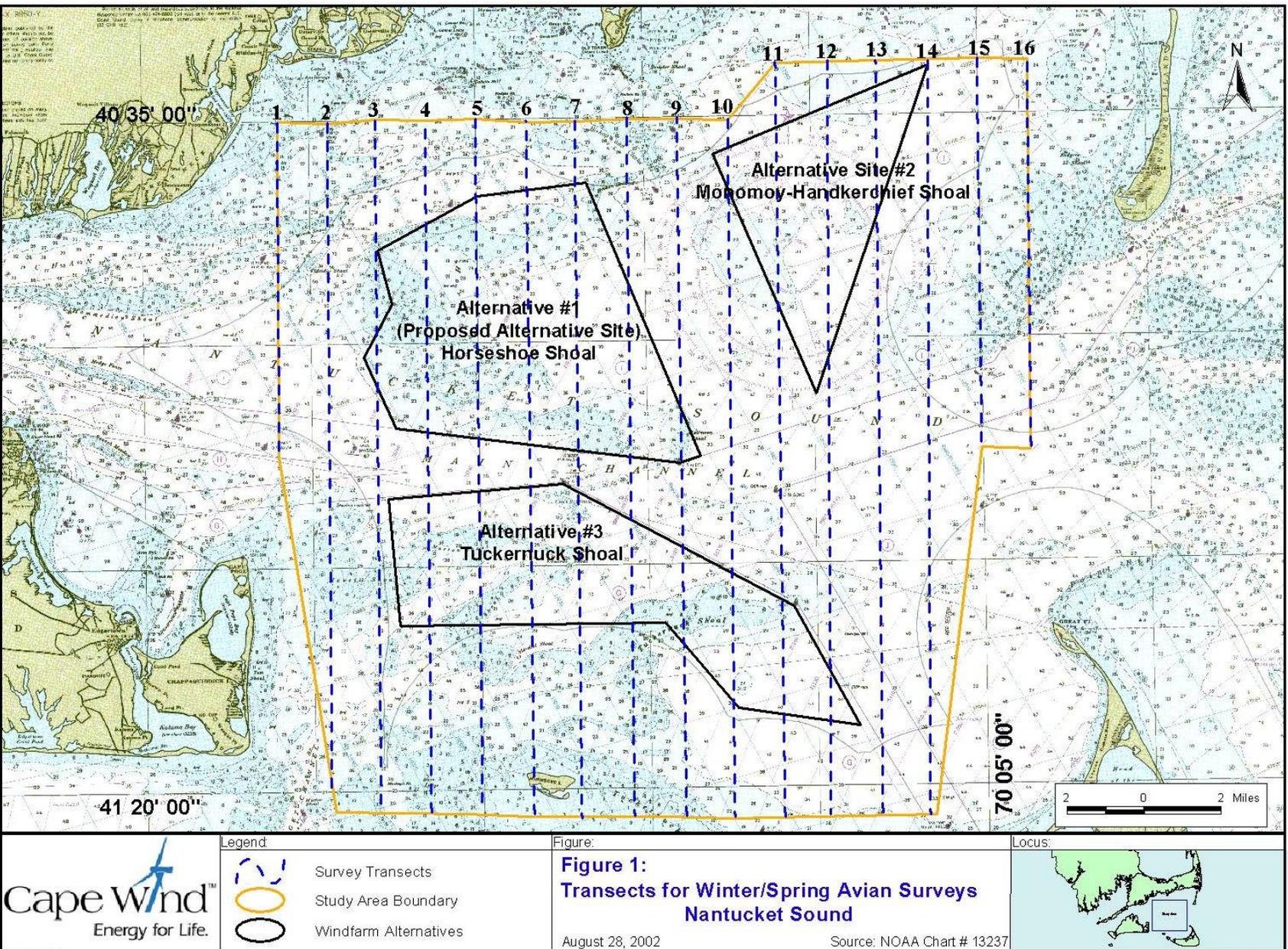
Additional surveys are planned during the mid-winter and early winter/autumn migration period. These surveys, when combined with the early March surveys will permit a determination of the number and densities of these species that are present in winter.

5.0 LITERATURE CITED

- Davis, W.E. 1997. The Nantucket Oldsquaw flight: New England's greatest bird show? *Bird Observer* 25: 16-22
- Goudie, R.I., G.J. Robertson, and A. Reed. 2000. Common Eider (*Somateria mollissima*). In *The Birds of North America*, No. 546 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Kerlinger, P., and J.J. Hatch. 2001. Preliminary avian risk assessment for the Cape Wind Energy Project. November 2001. Report prepared for Cape Wind Associates, LLC and Environmental Science Services, Inc (Appendix 5.7-A).
- Krohn, W.B., P.O. Corr, and A.E. Hutchinson. 1992. Status of the American Eider with special reference to northern New England. U.S. Fish Wildl. Serv. Tech. Rep. Ser. 12, Washington, DC.
- Martin, E.M., and P. I. Padding. 2002. Preliminary estimates of waterfowl harvest and hunter activity in the United States during the 2001 hunting season. U. S. Fish and Wildlife Service, Division of Migratory Bird Management, Laurel, MD, July 2002.
- Veit, R.R., and W.R. Petersen. 1993. *Birds of Massachusetts*. Massachusetts Audubon Society, Lincoln, MA.
- Ward, D., and C.C. Sutton. 2001. The history of the Avalon Seawatch. In *Hawkwatching in the Americas*. Eds. K.L. Bildstein and D. Klem. Hawk Migration Association of North America, North Wales, PA.

Figures

Figure 1 - Transects for Winter/Spring Avian Surveys 2002 within Nantucket Sound



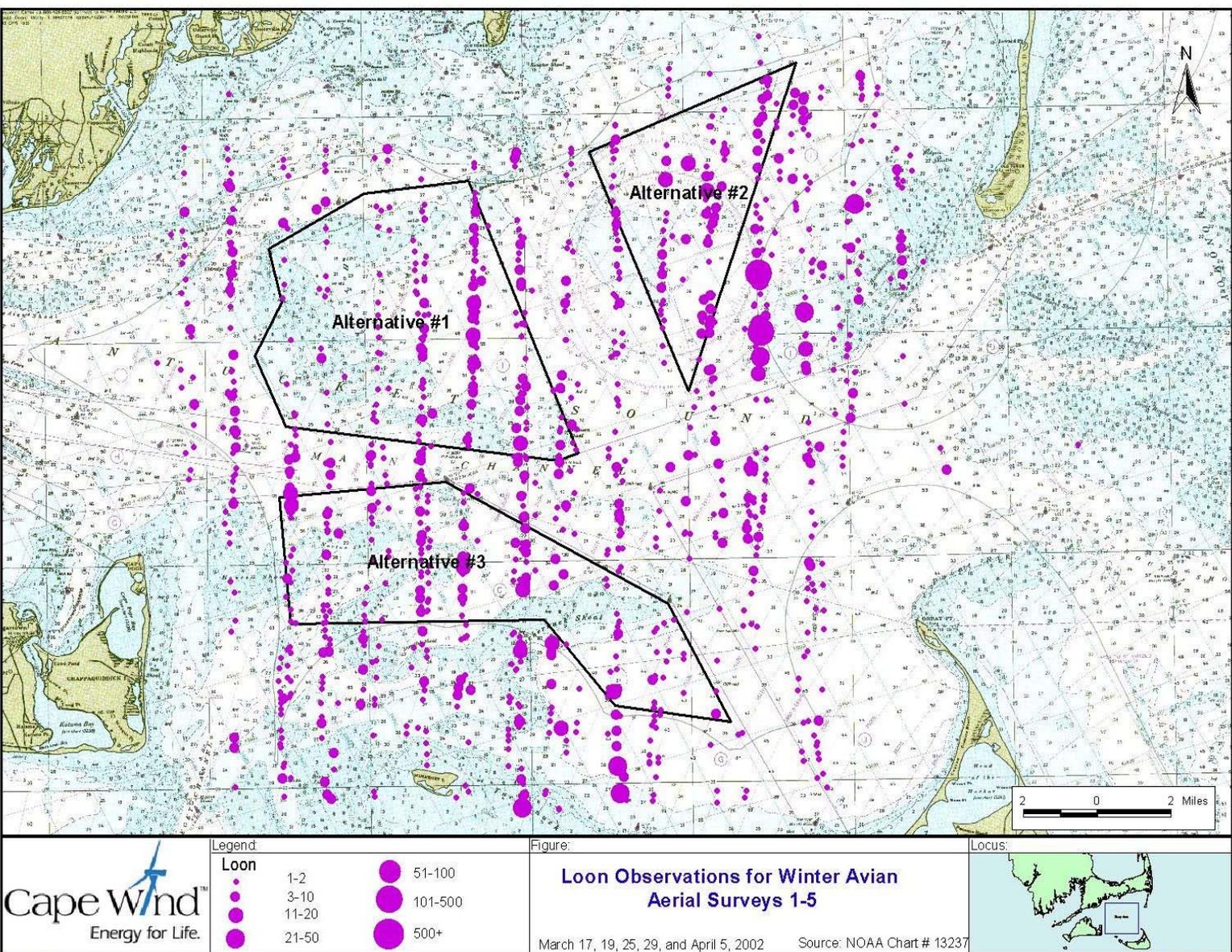
Legend	
	Survey Transects
	Study Area Boundary
	Windfarm Alternatives

Figure:
Figure 1:
Transects for Winter/Spring Avian Surveys
Nantucket Sound
 August 28, 2002
 Source: NOAA Chart # 13237



ATTACHMENT 1

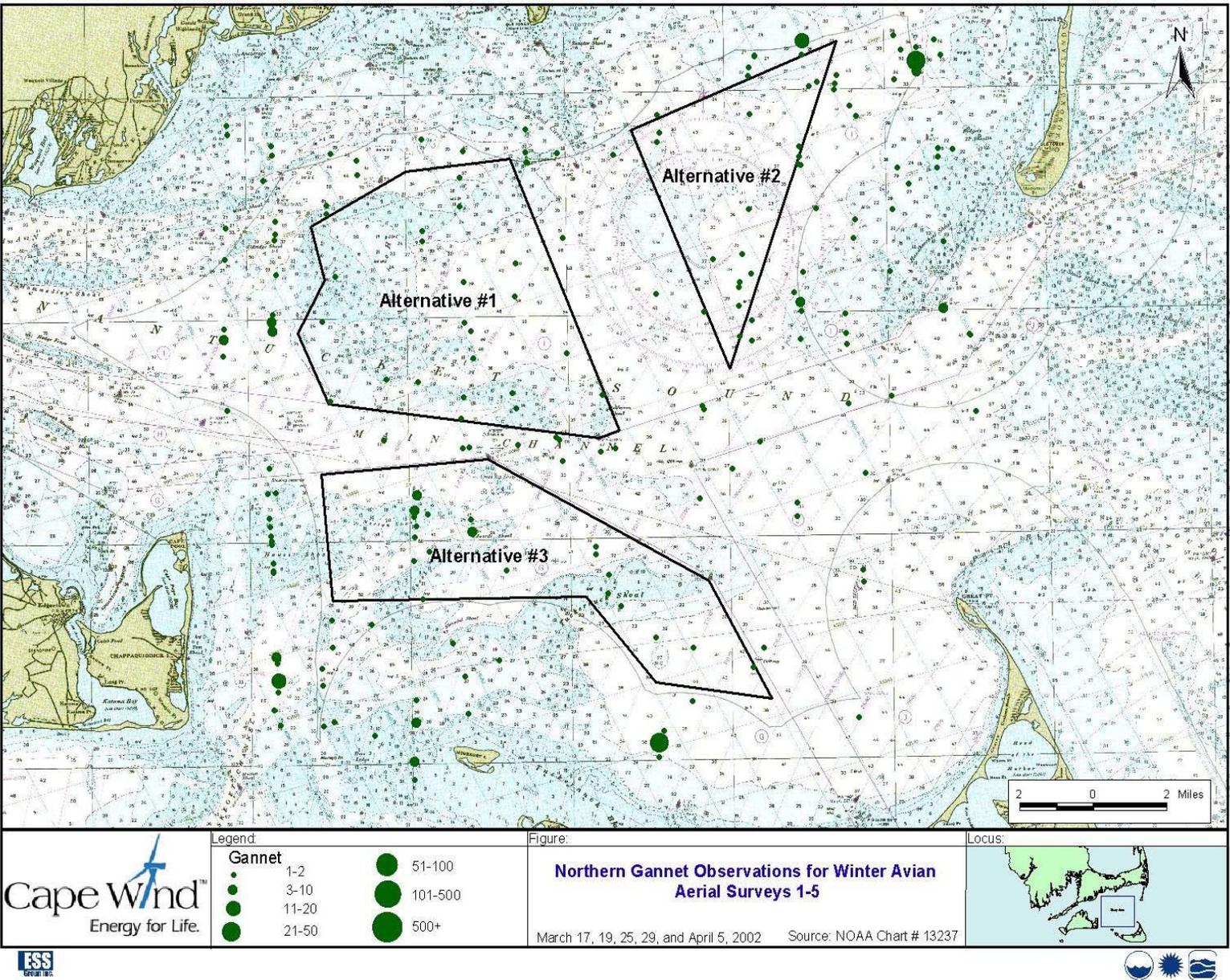
Distribution of Waterbirds for
All Aerial Surveys Combined

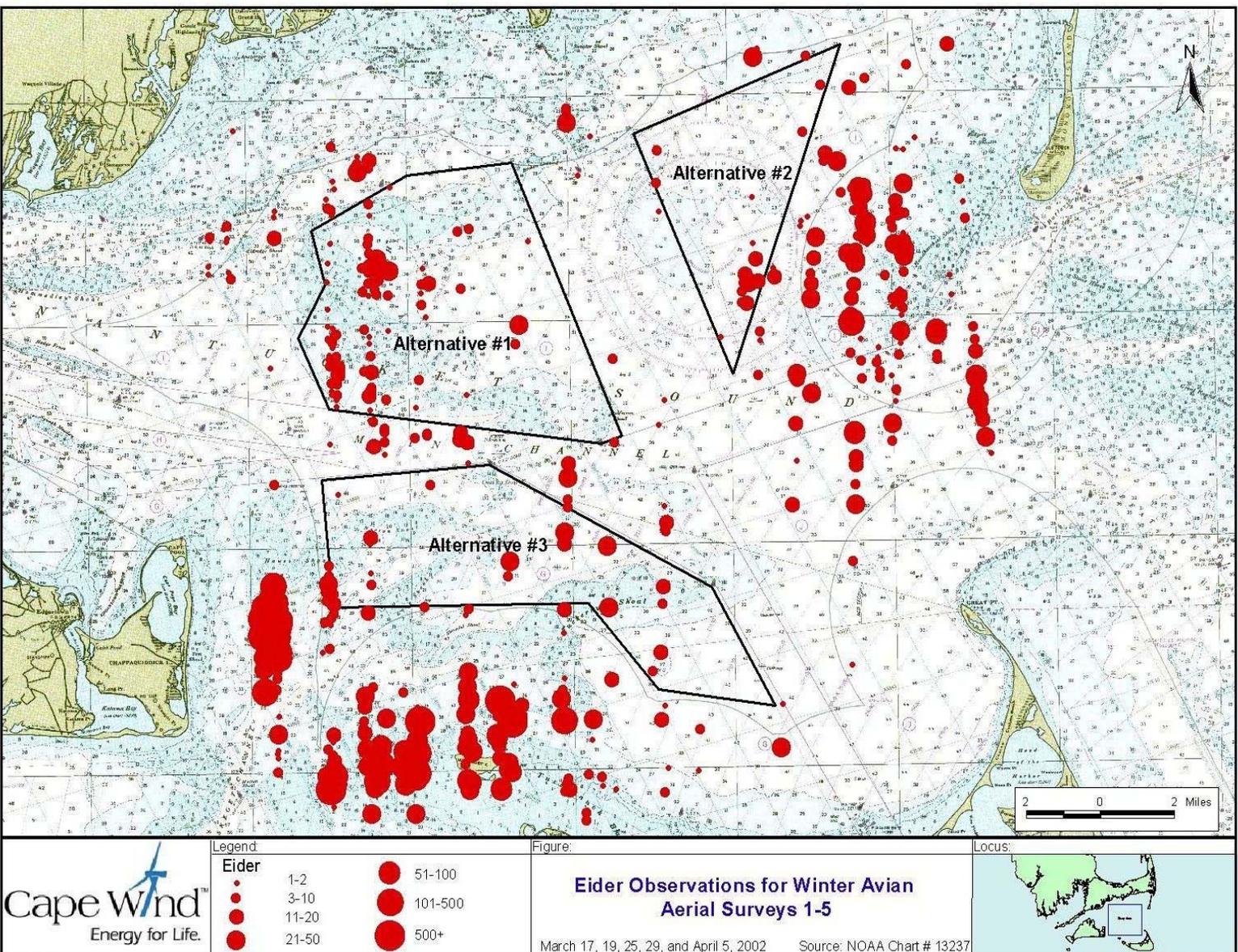


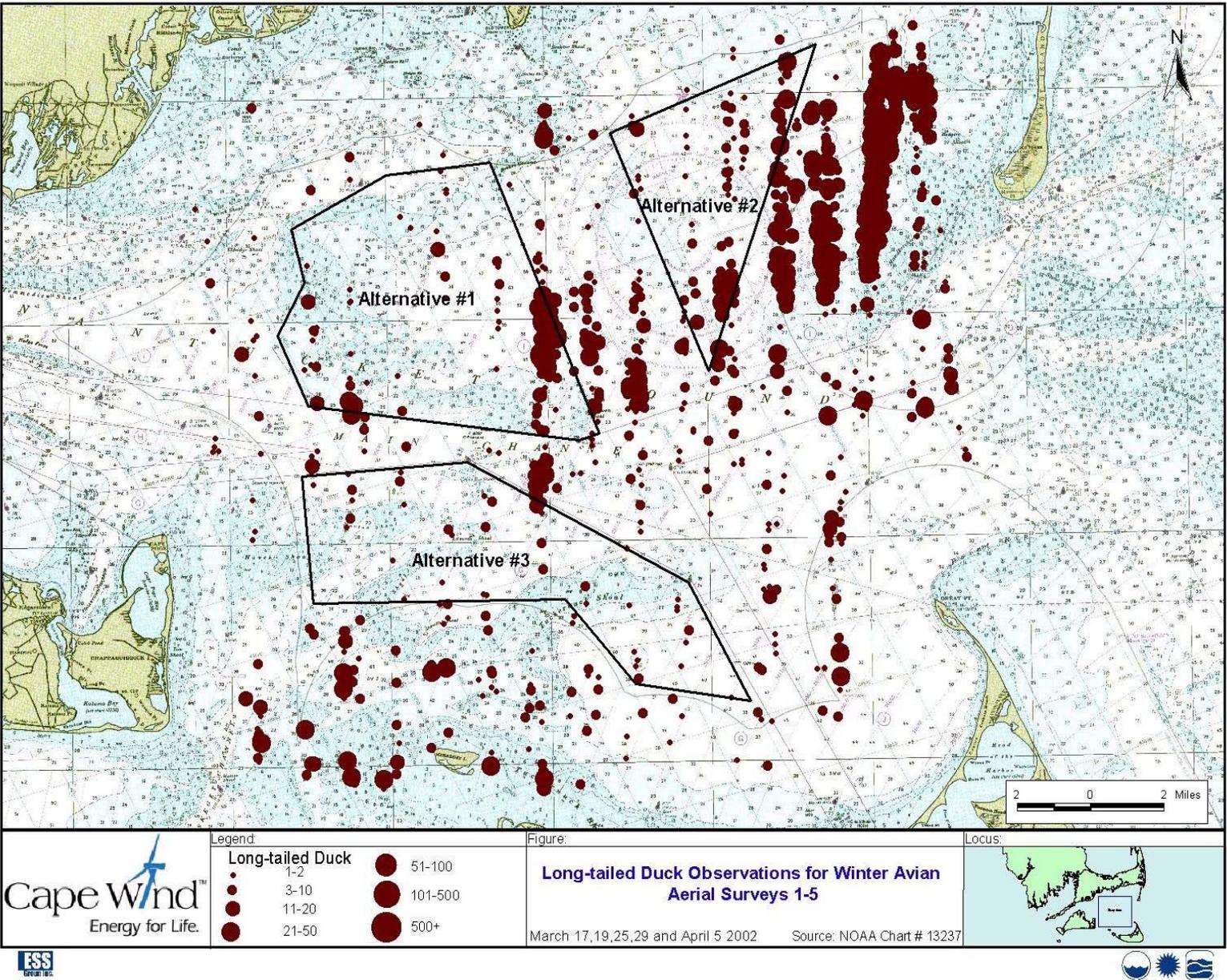
Legend	
Loon	
1-2	51-100
3-10	101-500
11-20	500+
21-50	

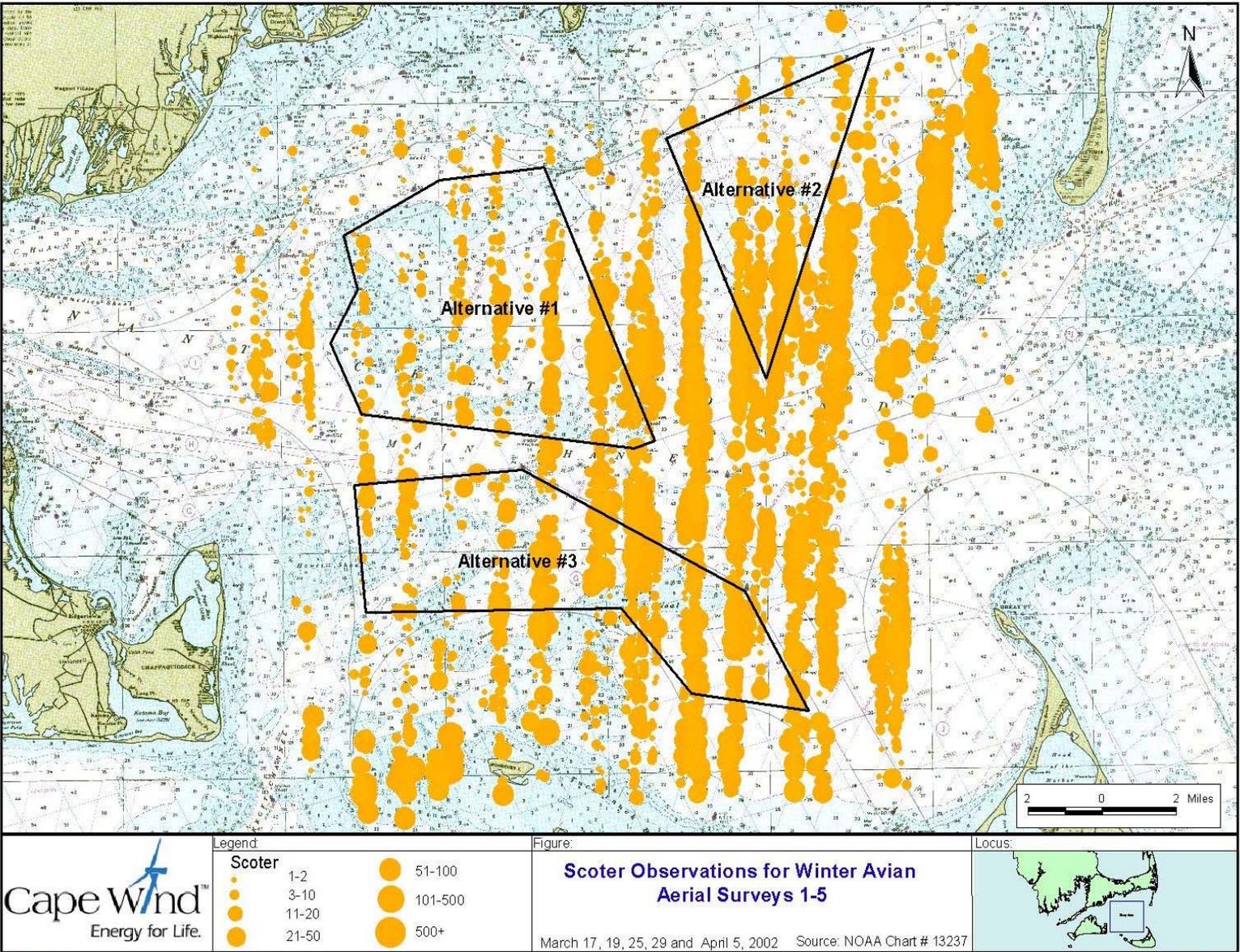
Figure: **Loon Observations for Winter Avian Aerial Surveys 1-5**
 March 17, 19, 25, 29, and April 5, 2002 Source: NOAA Chart # 13237

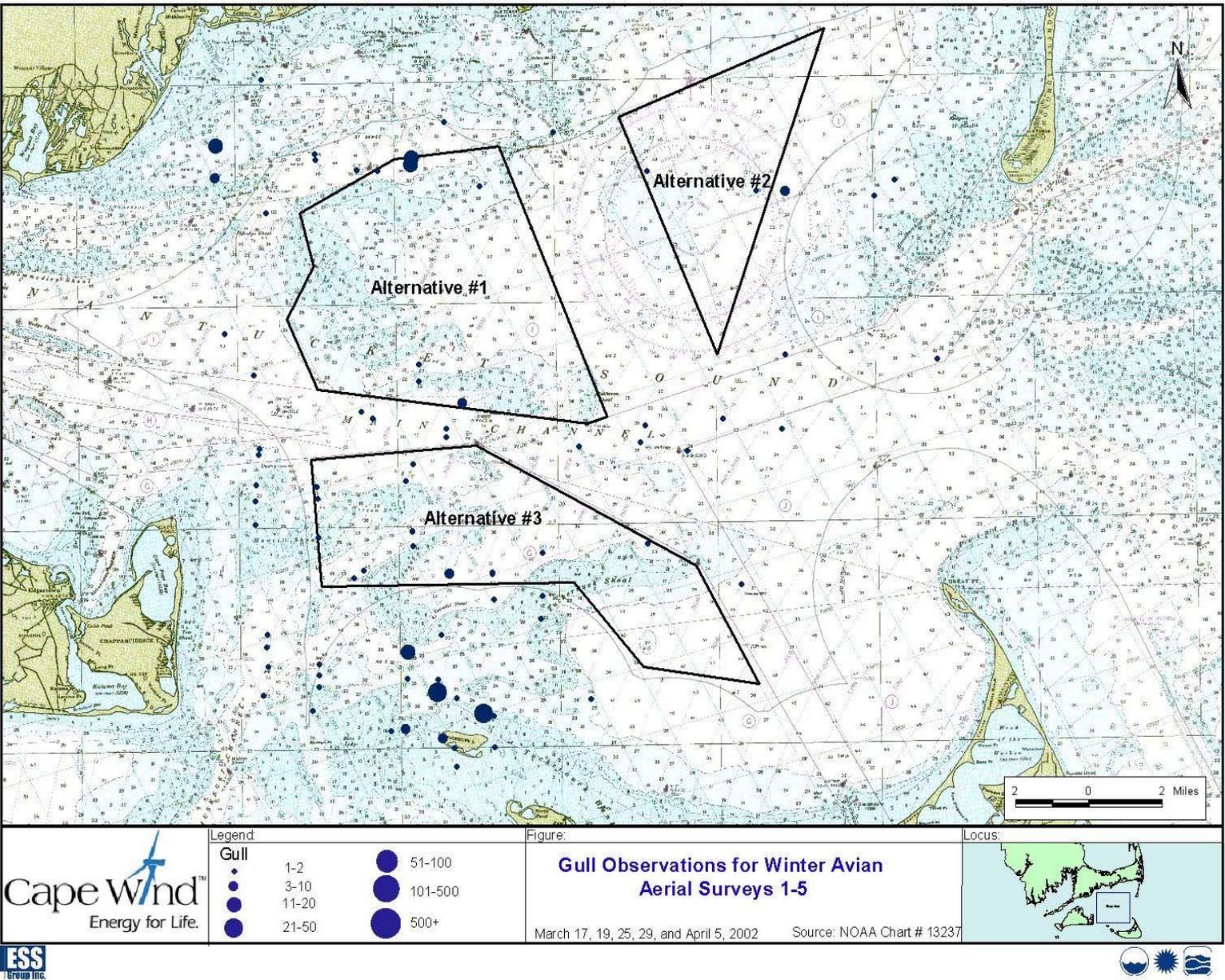


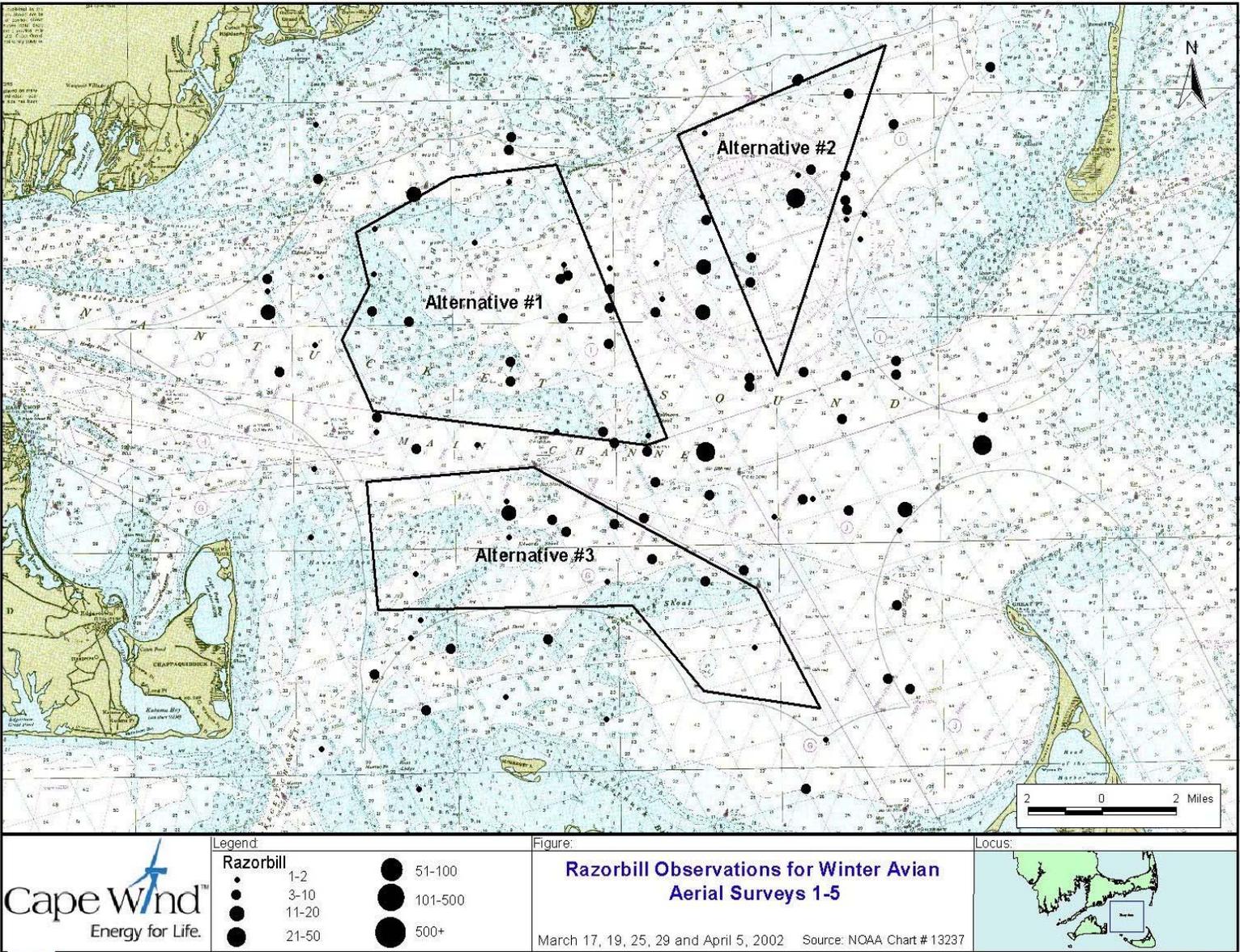












ATTACHMENT 2

Species Totals and Densities by
Site Alternatives for all Aerial
Surveys Combined

Species Totals and Densities By Site Alternatives For All 5 Aerial Surveys Combined

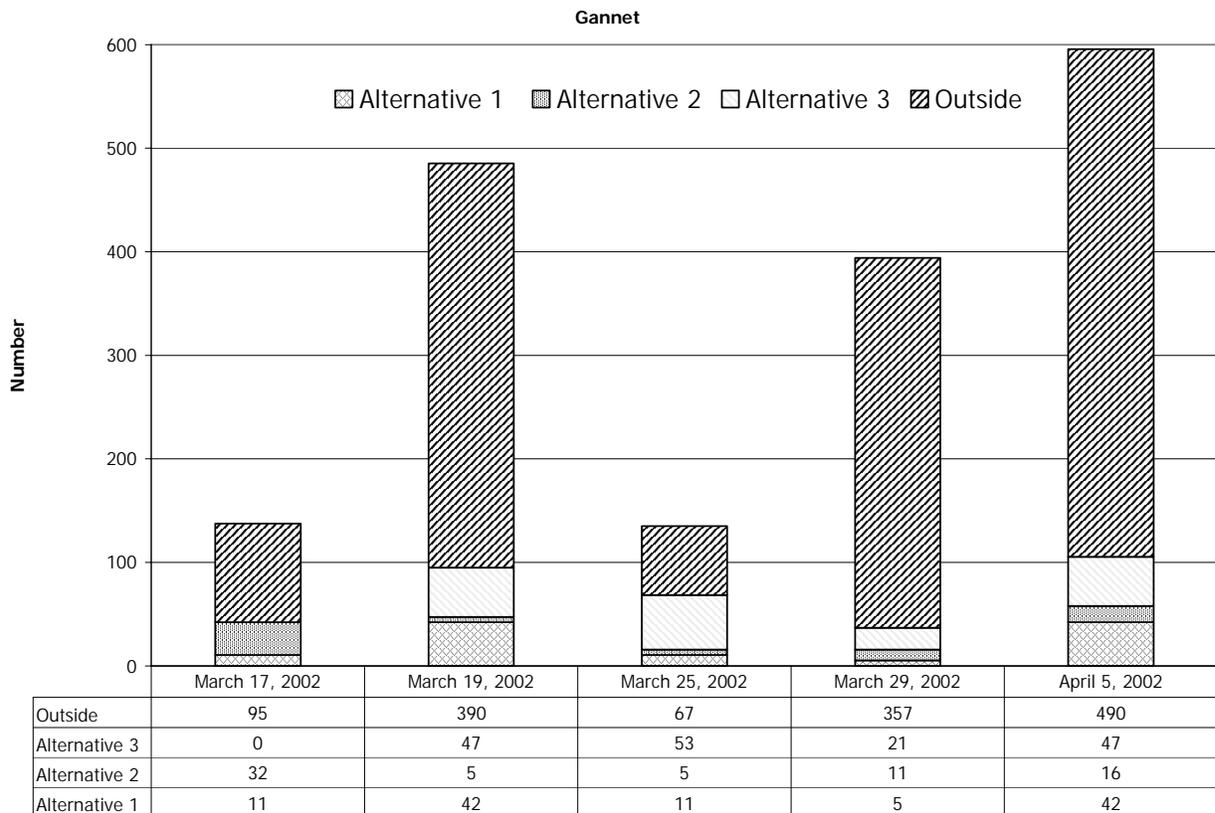
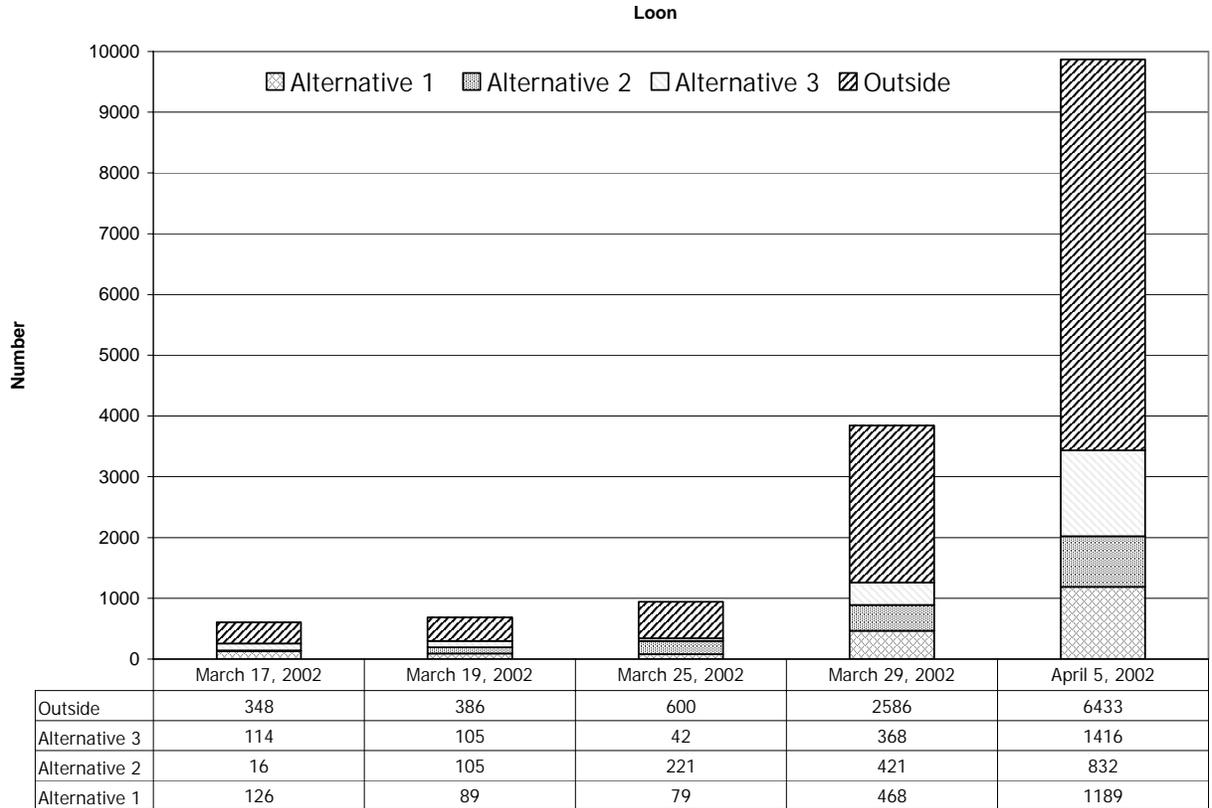
Species	Location	Total Number Observed	Max/Min Number	Density (indivs/km ²)	Estimated* Number Present	Estimated Number Present per Survey
Loon	Alternative 1	371	226/15	17.67	1,953	391
Loon	Alternative 2	303	158/3	30.92	1,595	319
Loon	Alternative 3	391	269/8	23.27	2,058	412
Loon	Outside	2,174	1,352/73	18.06	10,352	2,070
Loon	Total	3,239		19.28	16,195	3,239
Gannet	Alternative 1	21	8/1	1.00	111	22
Gannet	Alternative 2	13	6/1	1.33	68	14
Gannet	Alternative 3	32	10/0	1.90	168	34
Gannet	Outside	294	103/15	2.44	1,400	280
Gannet	Total	360		2.14	1,800	360
Eider	Alternative 1	594	143/53	28.29	3,126	625
Eider	Alternative 2	162	84/0	16.53	853	171
Eider	Alternative 3	310	247/0	18.45	1,632	326
Eider	Outside	19,554	5,013/2,716	162.41	93,114	18,623
Eider	Total	20,620		122.74	103,100	20,620
Long-tailed Duck	Alternative 1	1,054	326/126	50.19	5,547	1,109
Long-tailed Duck	Alternative 2	566	225/17	57.76	2,979	596
Long-tailed Duck	Alternative 3	131	61/5	7.80	689	138
Long-tailed Duck	Outside	9,324	3,041/997	77.44	44,400	8,880
Long-tailed Duck	Total	11,075		65.92	55,375	11,075
Scoter	Alternative 1	2,701	1,034/151	128.62	14,216	2,843
Scoter	Alternative 2	2139	740/167	218.27	11,258	2,252
Scoter	Alternative 3	4,166	1,114/484	247.98	21,926	4,385
Scoter	Outside	32,076	9,174/3991	266.41	152,743	30,549
Scoter	Total	41,082		244.54	205,410	41,082
Gull	Alternative 1	45	35/0	2.14	237	47
Gull	Alternative 2	4	36586	0.41	21	4
Gull	Alternative 3	19	15/0	1.13	100	20
Gull	Outside	213	90/9	1.77	1,014	203
Gull	Total**	281		1.67	1,405	281
Razorbill	Alternative 1	65	28/1	3.10	342	68
Razorbill	Alternative 2	57	45/0	5.82	300	60
Razorbill	Alternative 3	47	25/3	2.80	247	49
Razorbill	Outside	393	172/12	3.26	1,871	374
Razorbill	Total	562		3.35	2,810	562

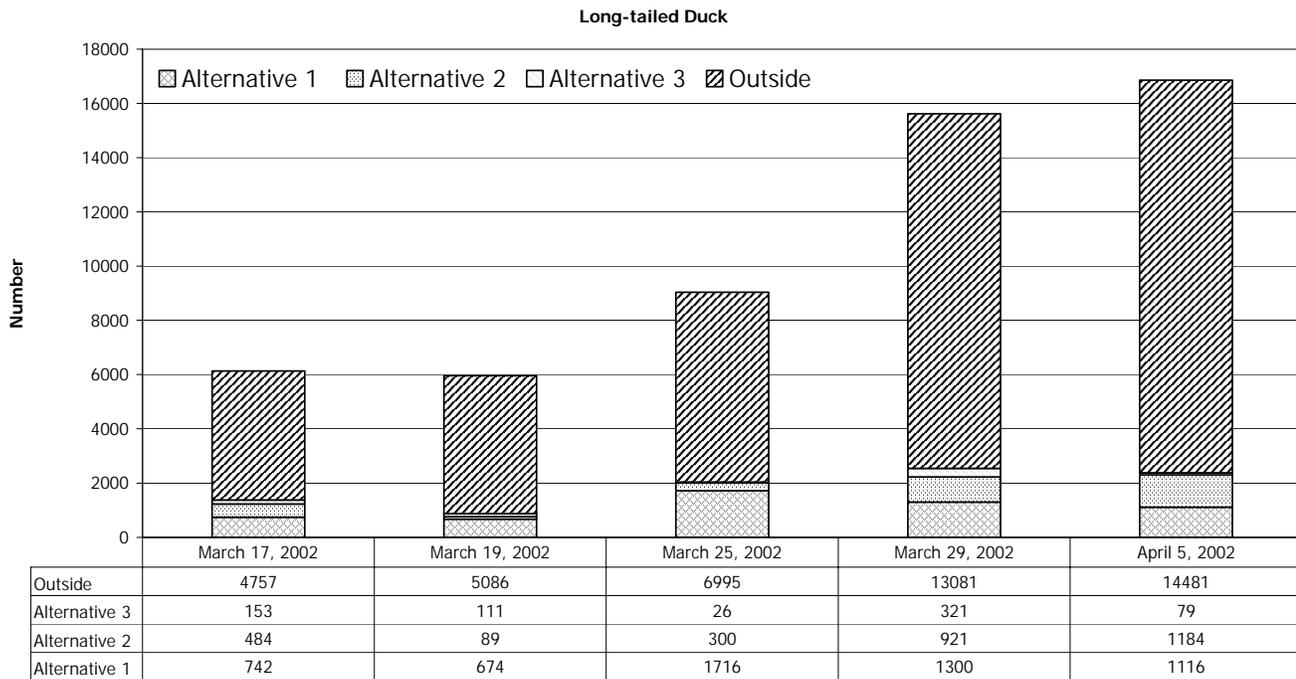
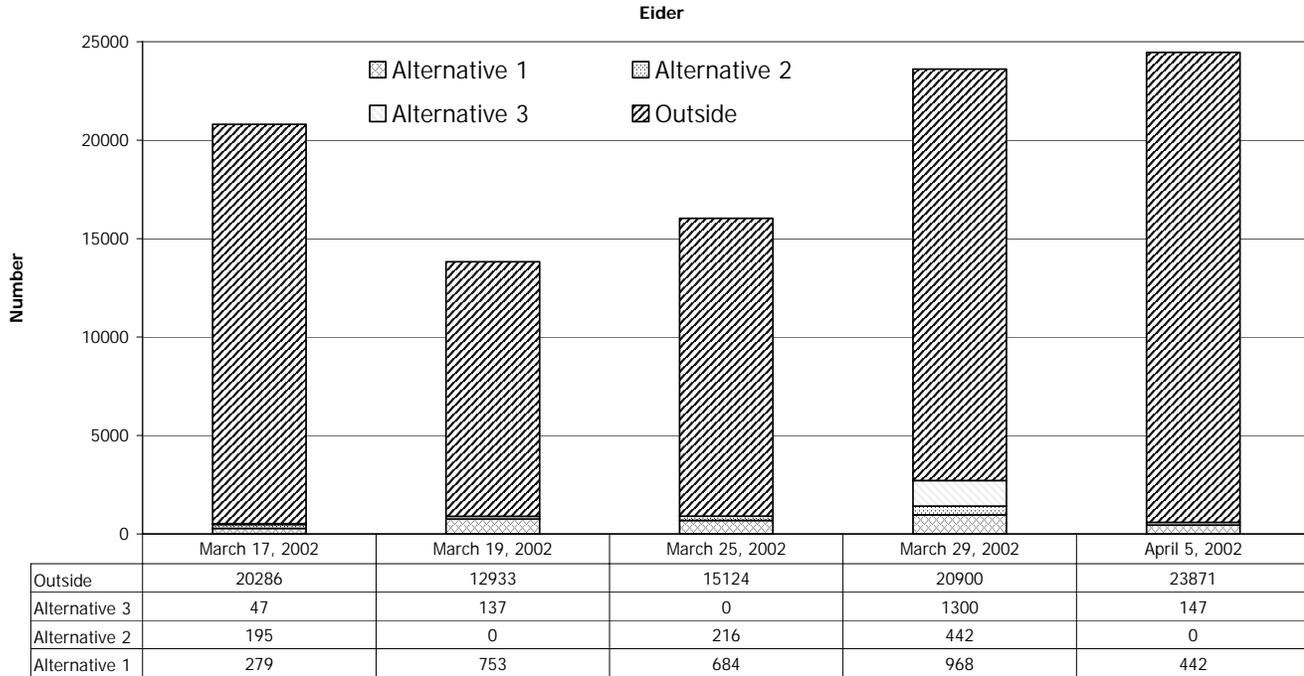
*Estimated Number Present is calculated by dividing the total number observed by fraction of area surveyed flown.

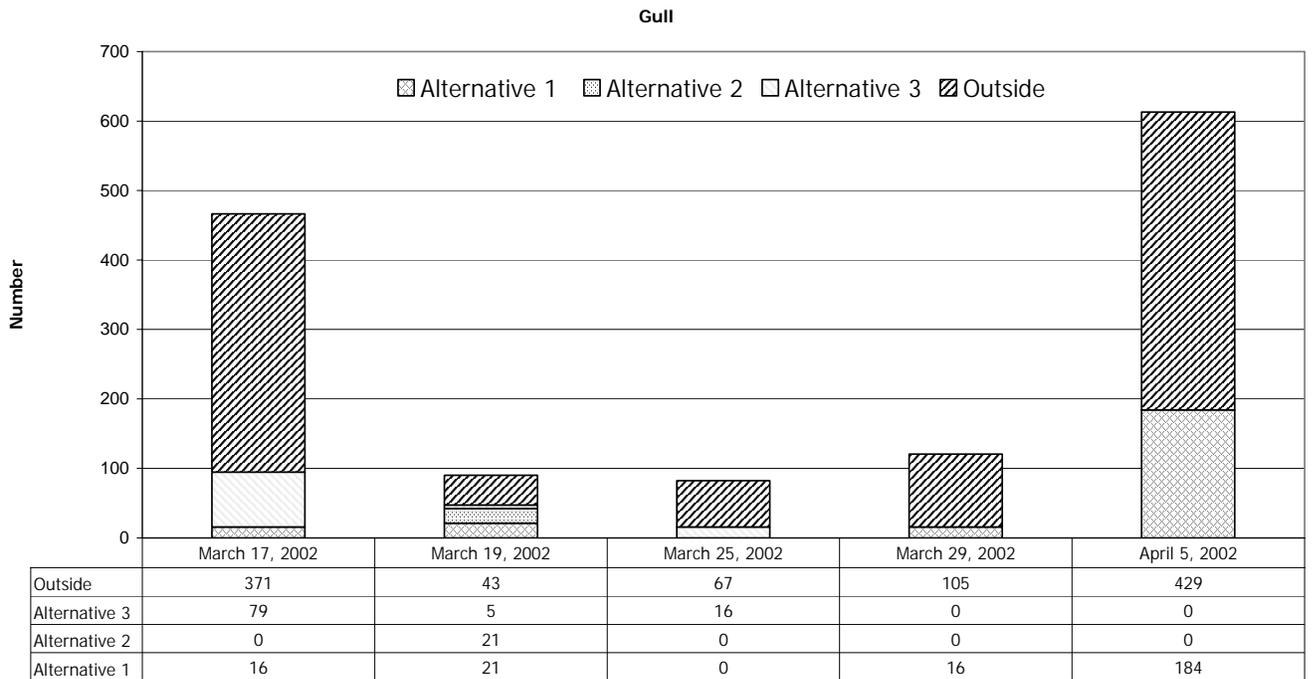
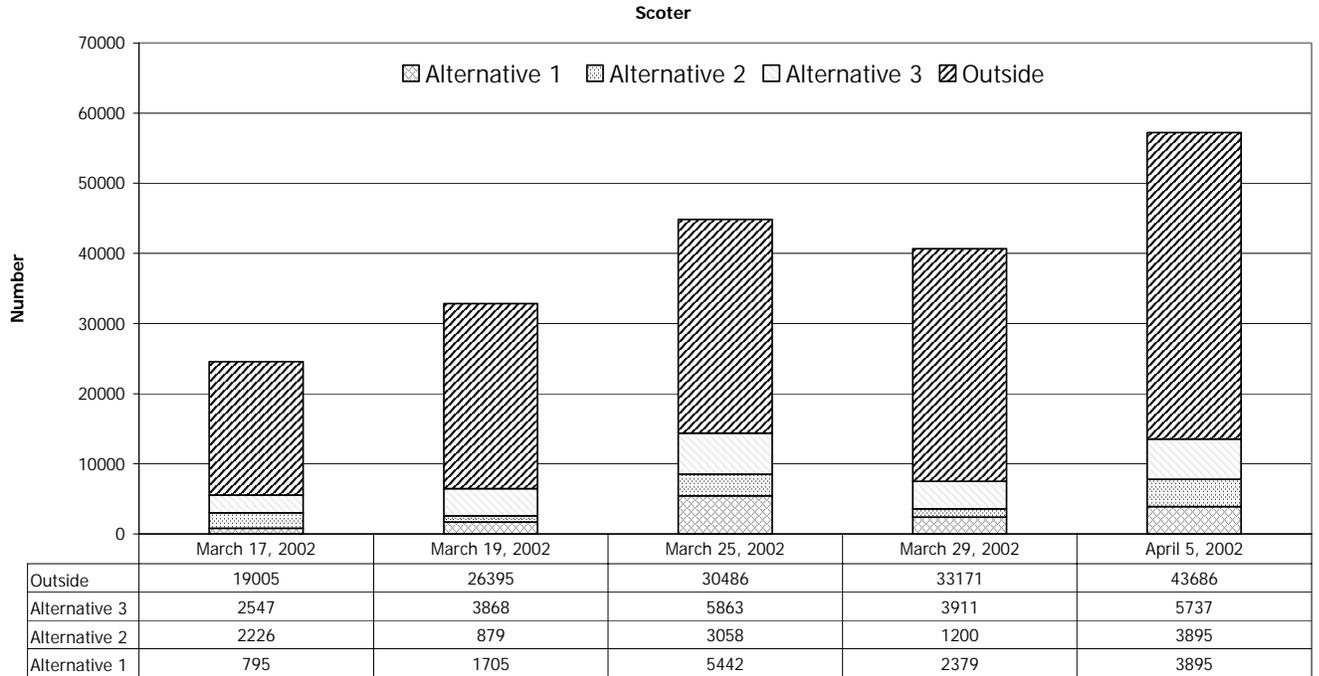
** Includes Black Legged Kittiwake

ATTACHMENT 3

Estimated Numbers of Winter
Birds for Aerial Surveys 1-5







Razorbill

