

**Appendix 5.7-M**

**Fall 2003 and Winter 2004  
Waterbirds Survey for  
the Cape Wind Energy Project**

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**APPENDIX 5.7-M  
FALL 2003 AND WINTER 2004 WATERBIRDS SURVEY  
FOR THE  
CAPE WIND ENERGY PROJECT  
NANTUCKET SOUND**

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## **EXECUTIVE SUMMARY**

To evaluate the abundance and distribution of waterbirds in Nantucket Sound during fall and winter, twelve aerial and one boat survey were conducted between September 12, 2003 and February 27, 2004. This period includes the premigration season for terns, as well as portions of the migration and winter season for other birds such including seaducks, loons, grebes, and other waterbirds. The aerial surveys used the same standardized procedures as the previous winter surveys (March – April 2002 (Appendix 5.7-D), and September 2002 – February 2003 (Appendix 5.7-G)) and focused on the same study area including three alternative sites proposed for installation of wind turbines and the surrounding waters. The surveys were conducted by day in fair weather along north/south transects in a study area of about 322 mi<sup>2</sup> (834 km<sup>2</sup>) that encompassed about 58% of Nantucket Sound. During the February 2 survey, approximately 80% of the Sound was covered by ice. The study area excluded most inshore waters less than 1.2 miles (2 km) from land. The total distance flown within the study area for each of the aerial surveys was about 258 linear miles (415 km). The survey plane flew 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 transect width of about 1,312 feet (400 m)) resulting in an area of about 65 mi<sup>2</sup> (168 km<sup>2</sup>) examined per survey. The boat survey was conducted on September 12, 2003 in the Horseshoe Shoal and Monomoy area of Nantucket Sound to complement the aerial surveys and make observations of bird behavior, particularly terns during post breeding (Figure 3).

Twenty-seven (27) species of waterbirds were observed during the aerial and boat surveys within the study area and an additional ten species were seen on opportunistic flights. Seaducks, including three species of scoters (*Melanitta* spp), Common Eiders (*Somateria mollissima*), and Long-tailed Ducks (*Clangula hyemalis*), accounted for >95% of the 157,396 individuals observed within the study area and 18,228 birds observed elsewhere in Nantucket Sound. With respect to listed species, Federal or Massachusetts endangered, threatened, or candidate species, were observed within the study area during the surveys, 3 Roseate Terns were observed on September 15, 2003. Small numbers of Common Terns (*Sterna hirundo*), a Massachusetts's species of special concern and summer resident, were also observed during the first five aerial surveys (until November 19, 2003). Common Loons (*Gavia immer*), a Massachusetts species of special concern (although the birds present may not have been from Massachusetts), were observed on all 12 aerial surveys and were relatively evenly distributed throughout the study area. Common Loons and Common Terns could easily have been migrants from populations to the north of Massachusetts. The remainder of the species were represented by smaller numbers of individuals and most were southbound migrants that either wintered farther south or in Massachusetts waters.

The densities of seaducks (the most common species) varied among the alternative sites and other areas surveyed. Eider and Long-tailed Duck densities were greatest outside the three alternative sites. Eider density outside of the alternative sites was nearly eight times the density within Alternatives 2 and 3, and almost 2 times the density of Alternative 1. Long-tailed Duck density outside of the alternative sites was more than 3 times that of Alternative 3. Alternative 1 and 2 were less but similar to that outside. Scoter densities were highest in Alternative 3, more than twice that of Alternative 1, the proposed Wind Park site. Gulls (*Larus sp.*), Northern Gannets (*Morus bassanus*) and Red-breasted Mergansers (*Mergus serrator*) were greatest outside the three alternatives. Razorbills (*Alca torda*) and loons (*Gavia sp.*) had the highest density in Alternative 3 and 2, respectively. Overall densities of birds were lower within the alternative areas than outside those areas, and for most species the densities were lowest in Alternative #1.

A small percentage (5.5%) of all birds observed on aerial surveys were seen flying. Although neither of the survey methods (plane nor boat) enabled exact measurements of the height at which individual birds were flying, few flying birds (120 of 8719, or 1.4%, <0.1% of all birds observed on aerial surveys) were observed in the height range of the proposed wind turbine rotors (75 – 417 feet (23 – 127 m)).

Results on the 2003-2004 surveys were similar to results reported for 2002-2003 study of the same area. Some differences were observed, but overall the species observed, their numbers and distributions, as well as behaviors were consistent between the years.

## **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.**

This report is one of a multi-year series of studies describing waterbird use of Nantucket Sound and is a continuation of studies that began in March 2002 at the suggestion the U.S. Fish and Wildlife Service (USFWS), the Massachusetts Division of Fisheries and Wildlife (MADFW), and the Massachusetts Audubon Society (Mass Audubon).

Information about the types and numbers of birds that were observed in Nantucket Sound and nearby areas during twelve (12) aerial and one boat survey conducted from September 12, 2003 – February 27, 2004 is presented in this report. The surveys focused on the areas within and around the three alternative wind park sites identified by the Applicant (Figure 1, Alternatives 1, 2, and 3). These surveys were conducted to corroborate the findings of the earlier studies in winter/spring of 2002 (five flights: March 17 to April 5) (Appendix 5.7-D), in spring/summer 2002 (six flights: May 22 to August 30) (Appendix 5.7-F), in fall 2002/winter 2003 (eleven flights: September 25 to February 21) (Appendix 5.7-G), in late winter/spring 2003 (March 19 – June 2) (Appendix 5.7-K), and in summer 2003 (June 16 – August 29) (Appendix 5.7-L). This report concludes more than two full years of avian studies. The principal goal of these studies is to provide quantitative data that fills in gaps in quantitative information identified and reviewed by Kerlinger and Hatch (Appendix 5.7-A, 2001) in their preliminary risk assessment. That report reviewed what was known about the birds of Nantucket Sound, assessed potential risk to those birds from the Project, and identified gaps in our knowledge of waterbirds that use Nantucket Sound. The survey methods used are comparable to those used by the waterbird biologists who determine population and hunting harvest levels for the MADFW and the USFWS in the waters of Massachusetts as well as much of the eastern seaboard.

To provide additional context for the surveys, this report includes observations made while in transit to/from the study area, on the distribution of species principally in near-shore areas of the Sound.

## **2.0 METHODS**

### **2.1 Location of Study Area and Alternative Sites**

\*The same area examined in all previous surveys was used for the fall 2003/winter 2004 surveys (Figure 1). This study area excludes almost all waters within 1.2 miles (2 km) of the shore because such areas commonly have a different avifaunal community from the principal areas of concern. However, a small portion of the study area, approximately 5 mi<sup>2</sup> (13 km<sup>2</sup>), is within the 1.2 miles (2 km) of land (near Muskeget Island at the southern edge of the study area). This area was included in the study due to its proximity to Alternative 2 and because Muskeget Island extends into Nantucket Sound. The area of Nantucket Sound studied is approximately 560 mi<sup>2</sup> (1,450 km<sup>2</sup>), which is approximately 58% (322 mi<sup>2</sup> or 834 km<sup>2</sup>) of the 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:

- Alternative #1-Horseshoe Shoal, the Proposed 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 mi<sup>2</sup> (168 km<sup>2</sup>) for each survey (Table 1). A minimum of 19% of each alternative 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	Study Area (km <sup>2</sup> /mi <sup>2</sup> )	Kilometers <sup>2</sup> /Miles <sup>2</sup> Surveyed	% Area Surveyed
1	110 (42.5)	21.0 (8.1)	19
2	52 (20.1)	9.8 (3.8)	19
3	89 (34.4)	16.8 (6.5)	19
OUTSIDE	582 (224.7)	120.4 (46.5)	21
TOTAL	834 (322.0)	168.0 (64.9)	20

**2.2 Aerial Surveys**

**2.2.1 Within the Study Area**

Twelve systematic aerial surveys of the study area were flown: September 15 and 22, October 17 and 31, November 19 and 24, December 5 and 14, 2003, January 9 and February 2, 20, and 27, 2004. 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. The surveys reported herein which are continuations of studies suggested by avian experts from the USFWS, the MADFW, and the Mass Audubon.

\*The survey plane was a Cessna-206 floatplane, flying at 250 feet (75 m) above sea level at an air speed of 90 knots (167 km/h). Plane altitude was a compromise between covering as large an area as possible, identifying and counting the birds seen, and putting as few birds as possible to flight before counting. For each survey, 16 pre-determined 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 day, at different tides and in varying weather (see Section 3.1, Table 3), but visibility was good during every survey. Flights were also varied in their starting point and direction of flight.

\*Two observers were employed, one on each 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. The placement of these rods was determined with a clinometer to measure the calculated angle and the distances were verified by flying over the airport at 250 feet (75 m) using pre-measured 200-meter (656 feet) 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. Additional sightings beyond the transect were recorded incidentally but were not used for density calculations.

\*The survey team consisted of the pilot, a data recorder, and two observers (Jeremy Hatch and Jeffrey Burm) who sat on either side of the plane in the back seats. 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 aviation headsets. The observers identified species, number of individuals, activity (i.e. foraging, flying) and time of sighting. The data recorder was responsible for entering the data conveyed by the observers and recording a Global Positioning System (GPS) point. Each observer's sightings were also recorded on independent audiotapes linked directly to each headset to provide a recorded backup for each observer.

\*During aerial surveys the altitude of flying birds was estimated in relation to the surface of the water and known altitude of the plane (250 feet). Flight altitudes were reported to the data recorder in 30-foot (10 meter) increments. Although this methodology was not precise and not often used by researchers, 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 during these surveys.

\*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. Based upon previous 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.

### **2.2.2 Outside the Study Area**

In addition to the systematic surveys of the study area, observations were made in nearby areas to provide a wider context for interpreting the surveys. These additional observations included opportunistic extensions of the twelve systematic surveys, principally along selected shorelines of Nantucket Sound, Vineyard Sound and Buzzards Bay (Figure 2) while in transit to and from the study area. These extension surveys were sometimes flown at higher altitudes and provide information on birds sighted, but these data were not used for calculating densities within the central study area.

### **Data Compilation for Aerial Surveys**

\*During aerial surveys data were relayed verbally to the recorder as observations were made. A GPS point, the species, number of individuals, and activity were then entered into a database using a Trimble GeoExplorer 3C GPS unit containing a data dictionary with preloaded attributes. Observer sightings were also recorded on an audiotape to provide independent recordings and backup for each observer.

\*After each aerial survey, data (rover files) were transferred from the GPS unit to a PC using GPS Pathfinder Office 2.90. Observer entries were verified against the independent audiotapes. 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 Geographic Information System (GIS) with ESRI Software products. Each observation was assigned a specific location based on the time of the sighting and precise position of the plane (the resulting maps are presented in Attachment 2).

### **2.3 Boat Surveys**

One boat survey was conducted on September 12, 2003 to complement the aerial surveys and to make observations of bird behavior (Figure 3). The "Minuteman" from Patriot Party Boats, a 40-foot (12.2 m) trawler with a freeboard of 5 feet (1.5 m), was used as the survey vessel. Observations were made from a height of about 11 feet (3.4 m) above the water. The boat survey route started and ended in Falmouth with visits first to Horseshoe Shoal (Figure 3) and then to areas west of Monomoy Island. The boat traveled at about 10 knots (18.5 km/h) and was on the water for approximately six hours. Specific attention was paid as to how individual birds reacted to the presence of boats. Observations were recorded on species present, as well as their numbers, altitude, direction of flight, and other behaviors. Surveys were conducted by traveling to areas (including Horseshoe Shoal) where birds were known to forage or roost, and observations were made on species, number, behavior and altitude of flight. No specific transect routes were followed (Figure 3). There were fish weirs west of Monomoy that had large numbers of mixed terns foraging and sitting on the wires.

\*The survey team consisted of the captain and two observers (Jeffrey Burm and Jeremy Hatch). The captain was responsible for keeping the boat on course, while the observers recorded species, number of individuals, activity (i.e. foraging or flying), and altitude of bird into a GPS each time a species was observed. Additional GPS points were recorded at the beginning and end of each transect.

\*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.

**Data Compilation for Boat Surveys**

\*As observations were made, the observer recorded 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.

\*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 Geographic Information System (GIS) with ESRI Software products.

**2.4 Comparison of Survey Methods**

\*The aerial and boat surveys provided different information regarding avian use of Nantucket Sound. From the plane, the height chosen (250 ft (75 m)) enabled abundance and density estimates via counts of birds within the transect to be made 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 because of plane speed. From the boat, observers could more readily identify individual birds to species and count bird flocks since the vessel speed was slower than the airplane. However, birds were alerted more readily by the presence of the vessel and the low vantage point from the vessel may have resulted in birds being missed because of wave height.

**3.0 RESULTS**

A total of 37 species were observed during the twelve systematic aerial surveys, the aerial surveys conducted outside the study area, and the one boat survey conducted between September 2003 and February 2004, (Table 2).

**Table 2: Species Observed during the Aerial and Boat Surveys: Fall 2003 - Winter 2004**

<b>Common Name</b>	<b>Scientific Name</b>
Red-throated Loon	<i>Gavia stellata</i>
Common Loon	<i>G. immer</i>
Horned Grebe	<i>Podiceps auritus</i>
Red-necked Grebe	<i>P. grisegena</i>
Northern Gannet	<i>Morus bassanus</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Double-crested Cormorant	<i>P. auritus</i>
Great Blue Heron	<i>Ardea herodias</i>
Snowy Egret	<i>Egretta thula</i>
Mute Swan	<i>Cygnus olor</i>
Canada Goose	<i>Branta canadensis</i>
Brant	<i>Branta bernicla</i>
American Black Duck	<i>Anas rubripes</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>
Common Goldeneye	<i>Bucephala clangula</i>
Bufflehead	<i>Bucephala albeola</i>
Red-breasted Merganser	<i>Merqus serrator</i>
Osprey	<i>Pandion haliaetus</i>
Shorebirds	
Parasitic Jaeger	<i>Stercorarius parasiticus</i>

Common Name	Scientific Name
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>
Black-legged Kittiwake	<i>Rissa tridactyla</i>
Roseate Tern	<i>Sterna dougallii</i>
Common Tern	<i>S. hirundo</i>
Forster's Tern	<i>S. forsteri</i>
Least Tern	<i>S. hirundo</i>
Black Tern	<i>Chlidonias niger</i>
Dovekie	<i>Alle alle</i>
Razorbill	<i>Alca torda</i>
Tree Swallow	<i>Tachycineta bicolor</i>

For total counts, related species in eight groups were often pooled together because of biological similarities and difficulties of identification or counting under the conditions of the surveys, as follows: (1) Loons: Common Loons greatly outnumbered Red-throated Loons but species could not always be distinguished, (2) grebes: Horned and Red-necked (3) cormorants: Double-crested and Great, (4) eider: all eiders were treated as Common Eider, (5) scoters: Black, Surf, and White-winged; (6) unknown gulls: the two species of large gulls, Great Black-backed and Herring, which are similar in size, shape, and to a lesser extent immature plumage, were pooled when individuals could not be identified readily to species; (7) mixed terns: Black, Common and Roseate Terns were pooled when individuals could not be identified readily to species or if flocks were mixed with more than one species, and (8) razorbills: species characterized 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 visitors in the area (Veit and Petersen, 1993).

### 3.1 Aerial Surveys

Twelve aerial surveys were conducted between September 15, 2003 and February 27, 2004. Details of the dates, times, tide, and weather conditions are provided in Table 3. Weather varied from survey to survey and included varying (mostly moderate) wind conditions, tides and cloud cover regimes. Flights in heavy rain and wind were not conducted for safety reasons. During the flight on February 2, 2004 about 80 % of Nantucket Sound was covered by ice, following several days of intense cold. Much of the ice was solid for several miles, with large tracts of "ice rafts" of varying density.

\*The numerical results of the aerial surveys consist of counts or estimates of the numbers and identities of birds present over a distance of 656 feet (200 m) on each side of the plane. The large numbers of birds sometimes present precluded any use of distance-sampling (Buckland et al, 1993) which is intended to address the changes of detection-probabilities with distance. Instead, it was assumed that all birds were detected within the narrow transect and these observed densities were extrapolated to calculate numbers for the wider areas of interest. Much of the raw data are presented numerically and graphically in four Attachments. Maps to show the locations of sightings for each species of interest are presented in Attachment 2. All the individual sightings are plotted on these maps with symbols to indicate number (they do not show densities (individuals per unit area) and symbols overlap in many instances).

**Table 3; Summary of Dates, Times, Weather and Water Conditions during the Twelve Fall/Winter Waterbird Aerial Surveys in Nantucket Sound, 2003 and 2004**

Survey	Date	Start	Finish	Start Point <sup>1</sup>	High Tide <sup>2</sup>	Wind <sup>3</sup>	Temp F	Weather
A35	15-Sep-03	8:49	13:28	1 North	15:51	SE 10-12 Knots	high 60s	Overcast
A36	22-Sep-03	8:36	13:10	1 North	9:42	NE 4-6 Knots	low 70's	Clear
A37	17-Oct-03	8:27	12:16	15 North	5:25	WNW 4-7 Knots	mid 50's	Clear
A38	31-Oct-03	8:18	12:12	16 South	4:17	SSE 5-10 Knots	high 50's	Clear
A39	19-Nov-03	8:08	12:20	16 North	7:25	SSE 12-22 Knots	mid 50's	Overcast
A40	24-Nov-03	11:33	15:24	16 North	11:34	ESE 7-10 Knots	mid 40's	Overcast

Survey	Date	Start	Finish	Start Point <sup>1</sup>	High Tide <sup>2</sup>	Wind <sup>3</sup>	Temp F	Weather
						(later SSE 8-12 Knots)		
A41	5-Dec-03	7:17	11:21	16 South	9:31	NNE 7-10 Knots	high 20s	Clear
A42	14-Dec-03	8:14	12:19	16 South	15:32	E 6-11 Knots	low 30's	Clear
A43	9-Jan-04	10:24	14:21	16 South	13:00	NNW 18-25 Knots	10-11F	Clear
A44 <sup>4</sup>	2-Feb-04	10:44	14:51	16 North	9:03	ENE 3-9 Knots	mid 30's	Clear
A45	20-Feb-04	12:44	17:55	16 North	11:46	E (SW later) 5-10 Knots	mid 30's	Clear
A46	27-Feb-04	12:17	18:15	16 North	17:17pm	NNE 12-20 Knots (later NW 4 Knots)	high 30's	Clear

<sup>1</sup> Start Point refers to Figure 1.

<sup>2</sup> High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts ([www.harbertides.com](http://www.harbertides.com))

<sup>3</sup> 1 knot = 1.85 km/h

<sup>4</sup> ice covered 80% of Nantucket Sound

### 3.1.1 Species and Abundances

During the aerial surveys of the study area a total of 27 species were observed; an additional ten species were recorded during the opportunistic extensions of these surveys, principally in coastal areas. Table 4 summarizes the total numbers of each species recorded within and outside the study area and Attachment 1 provides the numbers recorded during each survey. The numbers presented for outside the study area have been organized to reflect the birds observed in Nantucket Sound, principally along the edges of the Sound, and the birds observed in Vineyard Sound and Buzzards Bay (Table 4). The observations within and outside the study area are not directly comparable because of differences in observational methods and the number of visits.

**Table 4: Numbers of Individuals Recorded in the Study Area During Twelve Aerial Surveys Within and Outside the Study Area on the Extended Flights (September 2003 – February 2004)**

Species	Total Within Study Area	Surveys Observed	Total Outside of Study Area		Total
			Within Nantucket Sound Area	Within Vineyard Sound/Buzzards Bay Area	
Loon (2): Red-throated and Common	1,260	12	127	86	1,473
Grebe (2): Horned and Red-necked	91	10	13	14	118
Northern Gannet	306	7	69	52	427
Cormorant (2) Great and Double-crested	103	7	2,868	749	3,720
Great Blue Heron	0	0	0	1	1
Snowy Egret	0	0	1	1	2
Mute Swan	1	1	1	0	2
Canada Goose	0	0	28	10	38
Brant	7	1	30	120	157
American Black Duck	109	4	0	44	153
Common Eider	42,632	10	11,909	74,794	129,335
Long-tailed Duck	12,539	10	2,503	222	15,264
Scoter (3): Black, Surf and White-winged	96,183	12	3,816	8,097	108,096
Common Goldeneye	1	1	144	76	221
Bufflehead	0	0	65	437	502
Red-breasted Merganser	1,052	10	820	479	2,351
Osprey	0	0	1	0	1
Shorebird	0	0	650	0	650
Jaeger	0	0	1	0	1
Laughing Gull	1	1	99	125	225
Bonaparte's Gull	761	8	369	124	1,254
Herring Gull	555	12	244	234	1,033
Great Black-backed Gull	514	12	269	136	919
Black-legged Kittiwake	231	6	21	4	256
Unknown Gull	75	6	1422	580	2,077
Roseate Tern	3	1	11	2	16
Common Tern	83	5	2,046	3,040	5,169

Species	Total Within Study Area	Surveys Observed	Total Outside of Study Area		Total
			Within Nantucket Sound Area	Within Vineyard Sound/Buzzards Bay Area	
Forster's Tern	1	1	0	0	1
Least Tern	0	0	221	0	221
Black Tern	0	0	1	1	2
Unknown Tern	56	2	984	1,982	3,022
Dovekie	13	6	0	11	24
Razorbill	819	10	124	43	986
Tree Swallow	0	0	0	100	100
Total	157,396		28,857	91,564	277,817

Within the study area seaducks accounted for more than 95% of all 157,396 birds observed during the aerial surveys (Table 4): scoter (96,183), eider (42,632) and Long-tailed Duck (12,539). Seaducks were generally absent in September. By mid-October scoters began to arrive, by late October eiders began to arrive, and by mid-November Long-tailed Ducks began to arrive (Attachment 1, Table A). The large numbers of scoters observed in October and November suggest that Nantucket Sound serves as a staging or stopover area for individuals that winter further south.

Gulls were the next most numerous group within the study area, totaling 2,137 sightings (1.4%). Greater numbers of gulls (847) were observed in November during the migration season than during mid-winter. Loons were the next most numerous group, totaling 1,260 sightings (0.8%) with greater numbers observed in later November and early December, again due to the southbound migration season. A total of 1,052 Red-breasted Mergansers (0.7%) were sighted with greater numbers observed during the migration season; mid-November through mid-December. Few Cormorants were observed within the study area (103, <1%). Razorbill sightings totaled 819 (0.5%) with an influx in mid-December and again in February, both being times when this species migrates.

On February 2, 2004, when about 80% of Nantucket Sound was covered by ice, the aerial survey revealed only 7,182 birds, about one-half the numbers observed on all other counts (October through February, Attachment 1, Table A). Also during this survey, the largest total numbers of birds (29,003) were observed outside Nantucket Sound, southwest of Martha's Vineyard, an area almost entirely free of ice (Attachment 1, Table C).

Outside the study area, the seaducks predominated, with relatively larger numbers of cormorants, gulls and inshore ducks (Table 4). During September, terns dominated outside the study area, where 8402 (98%) of the total were observed.

The aerial surveys had minor effects 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. Several exceptions were noted. Species observed flying at altitudes near the plane altered their headings to avoid the aircraft. Black scoters and sometimes long-tailed ducks took flight as the plane. These individuals typically flew away from the plane, at a few meters above the water before landing 100-200 m (330-655 feet) away.

### **3.1.2 Distribution of Waterbirds Within the Study Area**

The 11 maps in Attachment 2 summarize the distribution of the major species groups (Loons, Grebes, Northern Gannet, Cormorants, Eider, Long-tailed Duck, Scoters, Merganser, Gulls, Terns, and Razorbill) during the fall 2003/winter 2004 by combining the observations made during the twelve aerial surveys. These maps include not only the birds recorded during the 12 systematic surveys of the study area but also various observations in other areas obtained during the non-standardized extensions of these flights.

Visual examination of these maps shows that the cumulative distribution of individuals within the study area varied from apparently uniform or random distribution for some species (e.g. loon, razorbill) to strongly clumped distributions for species such as eider or scoter. In general more birds were observed in the southern part of the study area, near the islands, and the northeastern section, near Monomoy, than were observed in the central areas. The largest numbers of eiders were found to the south and southwest of Alternative 3, near Muskeget

Island and off Chappaquiddick Island. There were also clusters found southwest of Monomoy and on the western and southern portion of Alternative 1 Long-tailed Ducks were found in largest numbers west of Monomoy, and in the southern section of the study area in and around Tuckernuck Shoals. The scoter pattern was not as distinct because of large numbers were spread throughout the study area, although numbers were greatest in the eastern and southern portions of the study area. Other species, like loons and razorbills, were spread evenly over a large area. Gannets were present mostly in the southwestern and eastern section of the study area and, grebes and mergansers were more abundant in the southern part of the study area. Terns and Cormorants were rarely observed within the study area, but were common in large numbers near Monomoy, Tuckernuck and Nantucket Islands. Gulls were observed throughout the study area but were more abundant in the southern section of the study area and off Monomoy.

The three numerically dominant species groups (scoters, eiders, and Long-tailed Ducks) were not evenly distributed within the study area (Table 5, also see the maps in Attachment 2). Density (individuals per km<sup>2</sup>) was measured by adding individuals from the twelve aerial surveys and dividing by square kilometers flown within each of the alternatives and outside areas surrounding the three alternatives (Attachment 3). The "outside area" is defined as the zone within the study area and outside the alternatives. For scoters, the density of birds in Alternative 3 was greater than within the other two sites and the "outside area". The density within Alternative 3 was more than twice that observed in Alternative 1. The density of scoters within Alternative 2 was 69% greater than Alternative 1. For eiders, the density outside of the three alternative sites was much greater than any of the alternatives. The "outside area" hosted about 319 birds per km<sup>2</sup> vs. 26 to 159 per km<sup>2</sup> (2 to 12 times greater) in the three alternative sites. Alternative 1 had the second highest density of the three areas and eiders in this area were usually 4 to 6 times denser. For Long-tailed Ducks, the density was greatest outside the three alternative sites (83/km<sup>2</sup>), as opposed to within the alternatives which ranged between about 26 (Alternative 3) and 78 per km<sup>2</sup>. The difference between Alternative 2 and the Outside Area was negligible. The density of the Outside Area was 26% greater than Alternative 1.

**Table 5: Densities (individuals/km<sup>2</sup>) of Waterbirds Observed within the Study Area During 12 Aerial Surveys, September 2003 – February 2004**

Species	Alternative 1	Alternative 2	Alternative 3	Outside Area*	Total Area Density
Loons	4.19	13.47	7.68	7.57	7.50
Grebe	0.67	0.10	0.30	0.59	0.54
Gannet	0.52	0.31	0.54	2.35	1.82
Cormorant	0.00	0.00	0.00	0.86	0.61
Eider	159.38	26.22	39.64	318.62	253.76
Long-tailed Duck	65.67	77.65	26.43	82.68	74.64
Scoters	438.86	742.55	963.45	527.44	572.52
Merganser	5.48	0.00	0.00	7.78	6.26
Gulls	2.90	3.16	7.08	16.00	12.72
Tern	0.14	0.00	0.24	1.13	0.85
Razorbill	3.81	3.27	6.85	4.92	4.88

\*"Outside Area" refers to the area surrounding the three alternative sites within the study area.

The remaining species, including loons, grebes, gannet, gulls, razorbill, and the others were thinly spaced throughout the survey areas. These species were also not distributed evenly. For species such as gulls, the densities in Alternative 3, for example, were more than 2 times the densities in Alternatives 1 and 2 and densities of the Outside Area were about 2 to 4+ times greater than the Alternative areas. Loon densities were greatest in Alternative 2 and were nearly 2 times the density of Alternative 3 and the Outside Area. Alternative 1 had the lowest loon densities. Tern densities were much lower in the three Alternative Areas as opposed to the Outside Area. Densities were nearly eight times greater in the Outside area as opposed to Alternative 1 and more than 4 times greater than Alternative 3. Gannets were much less dense in the three Alternative Areas than found for the Outside Area. In the Outside Area gannets were 4 to 7 times more densely distributed than in the Alternative Areas. An even greater disparity was found to be the case for cormorants. For grebes and razorbills differences in densities were less evident, although distinctly lower densities were evident for the former species within two of the Alternative Areas and density was greatest in Alternative #1. However, overall densities of these species were extremely low both within and outside of the alternative areas.

Waterbird numbers within the study area (both within and outside the alternative areas) on each survey were estimated by extrapolating observed densities to the entire areas (Attachment 4). These graphs show the spatial distribution and the temporal changes for the most common species or species group observed during each aerial survey.

### **3.1.3 Distribution of Waterbirds Outside the Study Area During Extended Flights**

In addition to individuals observed within the study area, Table 4 summarizes the number of individuals observed outside the study area, both within and outside Nantucket Sound. These numbers are also summarized in Attachment 1 (Tables B and C). The majority of gulls were observed close to Monomoy Island and in the southern section of Nantucket Sound near Muskeget, Tuckernuck and Monomoy Islands. These species were also observed along the south shore of Cape Cod and the north shore of Nantucket Island, Eiders were observed in large numbers (74,794) outside of Nantucket Sound southwest of Martha's Vineyard and Cuttyhunk, with flocks of up to 20,000 individuals. The majority (82%) of these individuals were observed during the February 2, 2004 survey, when the majority of Nantucket Sound was frozen.

Other notable observations from outside the Sound include large flocks (up to 2,200 individuals) of mixed scoters southwest of Martha's Vineyard, off Gay Head, Squibnocket and Buzzards Bay.

### **3.2 Boat Surveys**

One boat survey was conducted on September 12, 2003 to study the presence and behavior of birds that are present in the area and how they react to the presence of boats. Details of the time, date, tide and weather condition are summarized in Table 6. During the boat survey, Horseshoe Shoal and Monomoy area were visited and observations were made on species present, as well as their numbers, altitude, direction of flight, and other behaviors (Figure 3).

**Table 6: Summary of Dates, Times, and Weather Conditions During the Waterbird Boat Survey in Nantucket Sound, Fall 2003 – Winter 2004**

Survey	Date	Start	Finish	High Tide <sup>3</sup>	Wind	Temp F	Weather
B13	12-Sep	07:30	15:30	13:57	East 15 - 28 Knots	56-67	Sunny and Clear. Height of waves observed 2-4 feet.

<sup>1</sup> High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts ([www.harbertides.com](http://www.harbertides.com))

#### **3.2.1 Species and Abundances**

A total of 10 species were observed during the boat survey (Table 7), all of which were also observed during the aerial surveys, with the exception of Osprey and jaeger. The majority of species observed during the boat survey were Common Terns (1,679, 98.0%). The next most common species was Double-breasted Cormorant (33, 1.8%). A single Roseate Tern was observed, although other individuals of this species may have been amongst mixed terns. The flocks of mixed terns included a Forster's tern and several Roseate terns were heard.

**Table 7: Boat Survey Observations for September 12, 2003**

Species	Flying	On water	Total Number
Common Loon	0	1	1
Double-crested Cormorant	4	29	33
White-winged Scoter	3	0	3
Great Black-backed Gull	2	13	15
Herring Gull	5	9	14
Common Tern	1,679	0	1,679
Roseate Tern	1	0	1
Mixed Terns	12	0	12
Black Terns	3	6	40
Parasitic Jaeger	4	0	4
Osprey	1	0	1
Total	1,714	52	1,766

During the boat surveys, birds that were already aloft were unaffected by the presence of the boat. However, seaducks and some others (loons, grebes and razorbills) that were on the water, flew away as the boat approached. Shortly following the passing of the boat, these individuals typically returned to the water in the near where they were resting or feeding prior to the interruption.

### 3.3 Altitude of Flying Birds

During the aerial surveys the altitude of flying birds was estimated in relation to the surface of the water and the altitude of the plane (250 feet (75 m)). Within the study area, 157,396 individuals were recorded; of these 5.5% (8,719 individuals) were flying. Altitudes of flight for these birds is summarized in Table 8: 120 (1.4%) were flying within the range of the rotors (75-417 feet (23-127 m)). In terms of all birds seen during the aerial surveys, this amounts to <<0.1%. These individuals included 2 Northern Gannets observed at 75 and 150 feet, 40 scoters (a single flock of Black Scoters) at 250 feet and 79 Gulls at 75 - 350 feet (23 - 46 m). No terns were observed flying at the height of the rotors.

**Table 8: Altitude of Flying Waterbirds: Numbers Observed From the Plane**

Species	Altitude (Feet)					Total
	<20	20-40	41-60	61-80*	80+*	
Loon	26	4	0	0	0	30
Grebe	3	0	0	0	0	3
Cormorant	4	0	0	0	0	4
Gannet	227	8	3	1	1	240
Eider	587	40	1	0	0	628
Long-tailed Duck	1164	42	5	0	0	1211
Scoter	4,674	162	6	0	40	4882
Merganser	307	0	0	0	0	307
Gull	956	135	35	6	75	1207
Tern	139	3	1	0	0	143
Razorbill	42	17	0	0	0	59
Dovekie	5	0	0	0	0	5
<b>Total</b>	<b>8,134</b>	<b>411</b>	<b>51</b>	<b>7</b>	<b>115</b>	<b>8719</b>

\* Five of the seven individuals in the 61-80 foot range were at turbine blade height (75+ feet)(1 gannets and 4 gulls). All of the individuals in the 80+ foot range were within turbine blade height.

During the boat survey, the altitude of birds in flight was estimated whenever they were close to the boat. Altitude estimates were made for 1,767 flying waterbirds (Table 9). Of these, 1689 (96%) were flying less than 21 feet (6 m) from the water's surface, 72 (4%) were between 21-40 feet, 5 (<1%) were between 41-60 feet, 1 (<1%) were between 61-80 feet, and none were above 80 feet (24 m). The Common Tern observed flying between 61 and 80 feet was estimated to be flying at 70 feet (21 m) asl. This individual may have been flying at rotor height. No other birds were observed flying at rotor height. Most flying terns observed were foraging in flocks near Great Island or were traveling to or foraging at the fish weirs located near North Monomoy.

**Table 9: Altitude of Flying Waterbirds: Numbers Observed From the Boat**

Species	Altitude (Feet)					Total
	<21	21-40	41-60	61-80*	80+**	
Common Loon	1	0	0	0	0	1
Double Crested Cormorant	32	0	1	0	0	33
White-winged Scoter	3	0	0	0	0	3
Osprey	0	1	0	0	0	1
Jaeger	0	0	3	0	0	3
Herring Gull	15	0	0	0	0	15
Great Black-backed Gull	14		0	0	0	14
Common Tern	1,606	71	1	1	0	1,679
Roseate Tern	1	0	0	0	0	1
Unknown Tern	16	0	0	0	0	16
Unknown Swallow	1	0	0	0	0	1
<b>Total</b>	<b>1,689</b>	<b>72</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>1,767</b>

Although neither of the survey methods (plane or boat) resulted in precise measurements of the height at which individual birds were flying, the accuracy was sufficient to show that very few birds were observed in the height range of the prospective turbine rotors (75-417 feet (23-127 m)).

## **4.0 DISCUSSION**

### **4.1 Numbers, Distribution and Behavior of Species Present**

This section combines and compares the results of the systematic aerial surveys and the boat observations conducted between September 2003 and February 2004 and provides a composite summary, comparison, and interpretation of the numbers and distribution of each group of birds. The aerial surveys provide quantitative data for the study area, including the alternative sites, but the observations for the other parts of the Sound are not quantitatively comparable. The boat-based observations provide additional information on occurrences as well as behavior.

Loons – During the fall 2003 through winter 2004 surveys, loons were observed on all 12 aerial surveys as well as the boat survey. Most were Common Loons (87%), with smaller numbers of Red-throated Loons (13%). Numbers increased through October and peaked in late November-early December, suggesting that Nantucket Sound is a staging area for southbound migrants. The fact that the numbers of Red-throated Loons amounted to but a few percent of the numbers counted migrating farther down the Atlantic Coast in New Jersey (Ward and Sutton 2001), suggests that the study area is not an important stopover area for this species. Of the 1,260 loons observed within the study area during the aerial surveys, 911 (72.3%) were observed in the waters surrounding the three alternative sites (7.5/km<sup>2</sup>) and only 88 (7.0%) were observed within Alternative 1. A total of 127 individuals were observed during the additional flightlines conducted outside the study area but within Nantucket Sound and 86 were observed outside the Sound.

Loons occurred singly or in small parties on the water, rarely flying. The observed occurrences are consistent with historical reports (Veit and Petersen, 1993).

Grebes – These winter residents are seen regularly in coastal waters and were recorded on 10 consecutive surveys of Nantucket Sound from October 2003 through February 2004. Two species were present: Horned and Red-necked, but were not routinely distinguished. A total of 91 individuals were observed with the majority found in the southern part of the study area. Grebes were observed occurred singly or in small flocks on the water, rarely flying. Of the 91 observed, 74 (81.3%) were observed outside the three alternative sites.

Northern Gannet – Relatively small numbers of Northern Gannets were observed in the Study Area from late-October to early January (305 of 306 observed, 99.6%). After January, only one gannet was observed suggesting that most of these birds winter south of Nantucket Sound, which is corroborated by CBCs (National Audubon) and yearly migration counts in New Jersey (Ward and Sutton 2001 and New Jersey Audubon Society/Cape May Bird Observatory unpublished data) which have exceeded 50,000 birds in a single fall migration. The aerial surveys indicated that this species was more abundant in the southern part of the Sound and south of Martha's Vineyard. Gannets occurred singly or in loose flocks: some individuals were observed on the water and many were observed flying.

Cormorants – Double-crested Cormorants were somewhat numerous in September and October 2003 at daytime resting areas and staging areas on Bishop & Clerks' Lighthouse, Monomoy Island, and on the sandbars north of Muskeget Island, but were rarely seen thereafter. A total of 103 individuals were recorded in the study area, but none of them were observed within the 3 alternative sites. A further 2,868 individuals were observed outside the study area within Nantucket Sound during the same timeframe, of which the majority were observed near Monomoy, Tuckernuck and Nantucket Islands. The large numbers observed in September and October is consistent with the post-breeding dispersal and migration of this species (Ward and Sutton 2001, New Jersey Audubon Society/Cape May Bird Observatory unpublished data). Double-crested Cormorants winter primarily to the south of Nantucket Sound. The 200,000 Double-crested Cormorants that are counted as migrating along the southern New Jersey shore provides perspective to the numbers observed on the surveys in and near Nantucket Sound for this study.

Common Eider – This species is abundant in the winter. Eiders were observed on 10 of the 12 systematic aerial surveys starting in October, and during the additional flightline surveys. No individuals were seen on the first two systematic aerial surveys (September 15 and 22, 2003), but eiders were abundant from mid-October through February. The extensive ice-cover on February 2, 2004 was associated with smaller numbers in the study area. A total of 42,632 eiders were observed within the study area, mostly outside (319/km<sup>2</sup>) the three alternative sites, occurring principally in the southwestern section between Muskeget Island and Cape Poge and west of Monomoy Island. Considerable numbers (159/km<sup>2</sup>) were observed in the western part of Alternative 1, but few individuals were observed in Alternatives 2 and 3. Of the total 42,632 eiders observed, only 3,347 were observed within Alternative 1. Outside of the study area, an additional 86,703 eiders were observed (11,909 within Nantucket Sound and 74,794 in Vineyard Sound and Buzzards Bay).

Eiders occurred singly or in small flocks, but most characteristically were seen in large dense flocks (“rafts”) that tended to be in the same location on each survey. Recorded flock sizes ranged up to 20,000 individuals (seen outside Nantucket Sound during the February 2, 2004 aerial survey when the majority of the Sound was frozen); however the methodology did not include estimating entire flocks in the study area if they extended beyond the swath width.

Long-tailed Duck – This species is abundant in the winter in Massachusetts’s waters, but numbers are difficult to interpret because of daily movements (see below). None were observed during September, and numbers peaked on November 19, 2003 when 1,691 were observed. The majority of these birds were observed west of Monomoy and peaked again in mid-February on February 20, 2004 when 2,388 were observed within the study area, primarily off Monomoy and on Horseshoe Shoal. A total of 12,539 individuals were observed within the study area during the aerial surveys, occurring in loose flocks numbering up to 300 individuals.

Long-tailed ducks were more common in the waters outside (33%) the three alternative sites (26%, 31%, and 10%, respectively), with the greatest concentrations in the southern and in the northeastern sections of the study area, west of Monomoy. The lowest densities recorded were in Alternative 3 (26/km<sup>2</sup>). An additional 2,503 individuals were observed outside the study area within Nantucket Sound.

Long-tailed Ducks are reported to roost at night in Nantucket Sound (Veit and Petersen 1993) and then fly in large flocks over Nantucket and Tuckernuck Islands to forage over the Nantucket Shoals during the day (Veit and Petersen 1993, Davis 1997). These movements are not well understood: for instance it is not known if individuals behave consistently day-by-day (or year-by-year) nor if there is a consistent roosting area. However, many of these ducks are seen from Nantucket Island during daytime and counts of more than 175,000 have been registered from the island on Christmas Bird Counts (Veit and Petersen 1993). Several attempts were made during the aerial surveys to locate roosting birds and/or flocks of flying ducks traveling to/from a roost but they yielded incomplete information, perhaps in part because many move before sunrise and after sunset. On February 2, 2004, when the Sound was largely covered by ice, more Long-tailed Ducks were recorded in the study area than during the two preceding surveys. Over one-half (1,002) of these individuals were observed in the southern part of the study area. This pattern could have been caused by an influx from elsewhere or a change in local movements.

Scoters – Scoters were the most abundant seabirds observed within Nantucket Sound. During the present surveys a total of 96,183 were recorded within the study area and 3,816 individuals elsewhere within Nantucket Sound. An additional 8,097 individuals were observed outside of Nantucket Sound, the majority of which occurred southwest of Martha’s Vineyard and Cuttyhunk. Scoters were observed in large numbers on every systematic flight except for the two surveys in September, which was early in the migration period, when 68 individuals were observed. Scoters were observed throughout the Sound but with lower numbers along the northern edge of the study area and near the southern shore of the Cape. In the study area the highest density was recorded in Alternative 3 (963/km<sup>2</sup>) and the lowest density in Alternative 1 (438/km<sup>2</sup>).

Mergansers – Only Red-breasted Mergansers were identified: a total of 1,052 individuals were recorded on ten of the aerial surveys, with a peak in abundance from mid-November through mid-December. Of the 1,052 observed, 115 were observed within Alternative 1, an average of 11.5 per survey. The majority of the remainder were near the shores of Muskeget and Tuckernuck Islands. Considerable numbers were also seen during the additional

flights along the southern Cape Cod shoreline. These are similar trends to finding from the field surveys in 2002 and 2003 (Appendix 5.7-D and 5.7-G).

Gulls – Bonaparte's gull was the most numerous gull observed (761, 36% of all gulls observed) in the study area during the aerial surveys. They were encountered mostly between November and December during southbound migration, usually foraging close to the surface of the water or resting on the water. Great Black-backed and Herring gulls were the two other species that were commonly observed and recorded on every flight and on the boat survey. Herring Gulls (555) outnumbered the Great Black-backed Gulls (514): a pattern that is the opposite of the summer. During the flights, gulls were more abundant in the southwestern part of the Sound (Alternative 3). The incidental observations from the plane suggest that many more gulls occurred close to the shore than over the open water. Black-legged Kittiwakes were observed on six aerial surveys as well as one Laughing Gull. A total of 79 (6%) of the flying gulls were seen in the altitude of the rotor swept zone (75-417 feet (23 to 127 m) above MLLW).

Terns – Terns are abundant in Nantucket Sound during the spring and summer (see Appendices 5.7-F, 5.7-K and 5.7-L) but are generally absent from the Nantucket Sound area between late October and April (Veit and Petersen 1993). Common and Roseate terns were observed in small numbers during the first five aerial surveys between September and mid-November. One Forster's Tern was observed on October 31, 2003. A total of 83 Common, 3 Roseate Terns, and 56 mixed terns were observed, with only three (all Common) being observed within Alternative 1 and four (2 Roseate and 2 Common) being observed within Alternative 3. During the boat survey on September 12, 1,696 terns were observed, the majority of which were west of Monomoy Island. These were typically Common terns with a few Roseates, Blacks and one Forster's mixed in.

Auks/Alcids -- Razorbills were observed on ten of the aerial surveys from October 2003 - February 2004. A total of 819 individuals were observed within the study area, with highest densities recorded in Alternative 3 (6.8/km<sup>2</sup>) and lowest densities recorded in Alternative 2 (3.27/km<sup>2</sup>). This species was relatively evenly distributed in small numbers throughout the rest of the study area. However, the majority of individuals were observed in the areas surrounding the three alternative sites. Dovekies were seen in small numbers (13).

Four additional species were observed in the study area during the aerial surveys, including Mute Swan (1), Brant (7), American Black Duck (109), and Common Goldeneye (1) (Table 4). These species were observed in very small numbers indicating that they are not important members of the Nantucket Sound avifauna away from shore.

## **4.2 Alternative Areas**

The numbers of birds recorded in the three alternative areas during these surveys in Nantucket Sound for the Wind Park and the densities in each alternative area are given in Attachment 3. These summaries indicate that Horseshoe Shoal (Alternative 1) was not preferred by wintering birds. For each of the 11 principal species groups, the bird densities were higher in other Alternatives or in outside areas for all species except for the small numbers of Grebes.

## **4.3 Variability in numbers and the effects of ice**

Numerous factors are likely to contribute to the large variations in numbers of birds encountered during the standardized surveys. All of the following apply to some degree to most species but are exemplified by conspicuous examples. The brief presence of staging birds, on their way south, seems particularly relevant to scoters and Red-throated Loons. With respect to these species, the largest numbers spend little time in the Nantucket Sound area, preferring to move farther south in autumn. The numbers of these birds that winter on the Sound appears to be a small percentage of the population, as evidenced by comparisons with the migration counts from southern New Jersey which have exceeded 250,000 individuals in a single autumn (records of the Cape May Bird Observatory). The patchy distribution resulting from formation of large flocks is particularly evident for Eiders. The occurrence of daily movements of unknown extent are potentially of particular relevance to Long-tailed Ducks. The presence of ice may exclude waterbirds from habitat. Extensive ice-cover in Nantucket Sound is an occasional event. The present findings suggest that the ice in February 2004 had only transient effects on

the numbers of birds and it is likely that many moved to suitable ice-free habitat nearby, such as the shallow waters southwest of Martha's Vineyard.

#### **4.4 Conclusion**

The surveys conducted between September 2003 and February 2004, like those in the two preceding winters, demonstrated that the waterbirds using Nantucket Sound during this season, were principally seaducks with relatively smaller numbers of other species. The temporal and spatial distributions of the principal species were similar to those found in earlier reports.

#### **5.0 LITERATURE CITED**

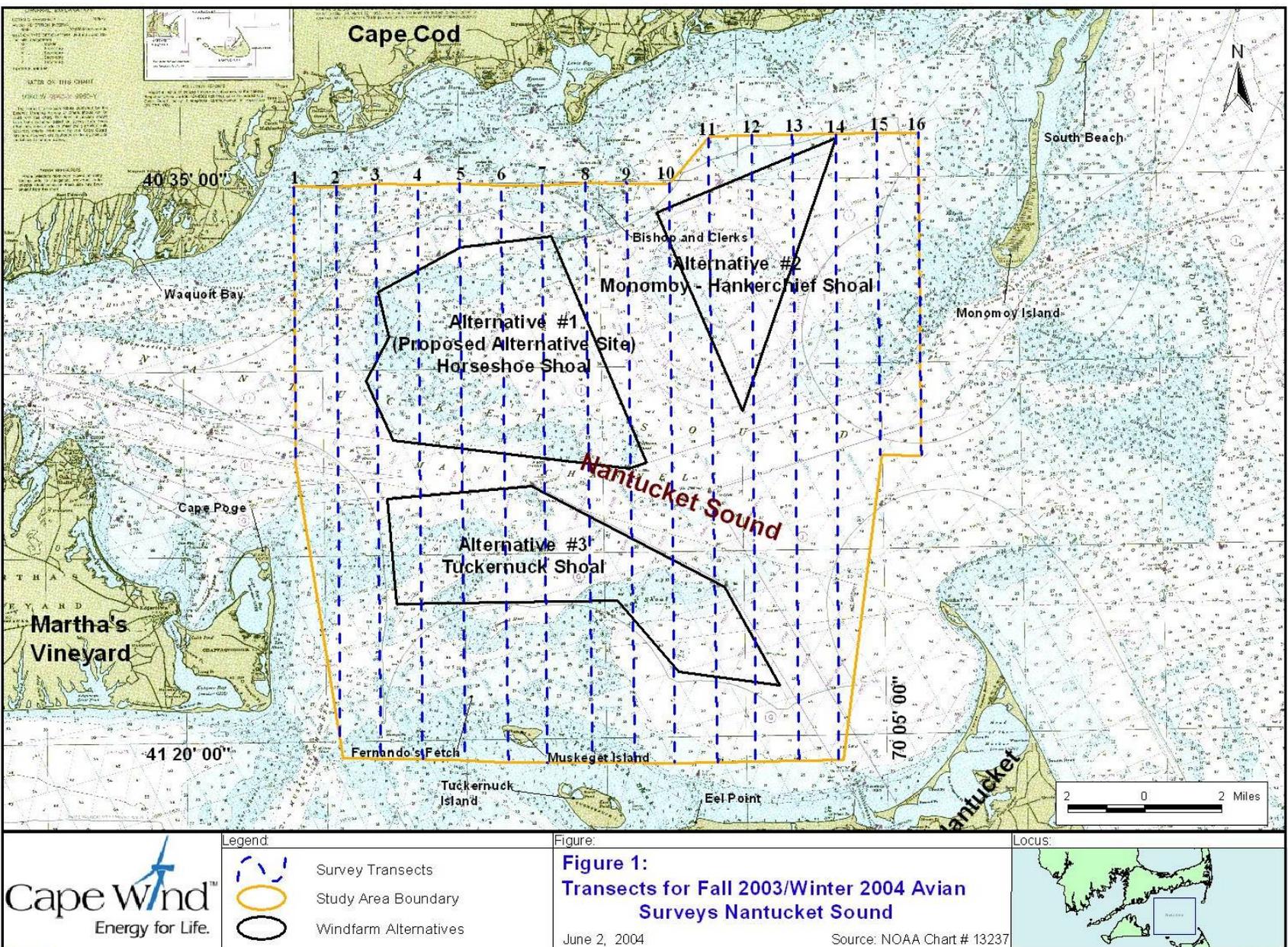
- Barr, J. F., C. Eberl, and J. W. McIntyre 2000. Red-throated Loon (*Gavia stellata*). In The Birds of North America, No. 177 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Bordage, D., and J-P. L. Savard. 1995. Black Scoter (*Melanitta nigra*). In The Birds of North America, No. 651 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Brown, P. W., and L. H. Frederickson. 1997. White-winged Scoter (*Melanitta fusca*). In The Birds of North America, No. 274 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Buckland, S.T., Anderson, D.R., Burnham, K.P. and Laake, J.L. 1993. *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman and Hall, London. 446pp.
- Davis, W.E. 1997. The Nantucket Oldsquaw flight: New England's greatest bird show? Bird Observer 25: 16-22
- ESS Group, Inc., J.J.Hatch, and P.Kerlinger. 2002. A late winter and early spring 2002 waterbird survey for the Cape Wind Energy Project Nantucket Sound. Prepared for Cape Wind Associates. Appendix 5.7-D of the DEIS-DEIR.
- ESS Group, Inc. and Kerlinger. 2003. A Comparison of the Audubon Christmas Bird Counts and MassWildlife Winter Waterfowl Populations. Prepared for Cape Wind Associates. Appendix 5.7-B of the DEIS-DEIR.
- 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.
- Guillemette, M., J.K.Larsen, and I Clausager. 1999. Assessing the impact of the Tuno Knob wind park on sea ducks: the influence of food resources. NERI Tech. Report No 263, Denmark.
- Guillemette, M.,and J.K.Larsen 2002. Postdevelopment experiments to detect anthropogenic disturbances: the case of seaducks and wind parks. Ecol. Appl. 12: 868-877.
- 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.

- McIntyre, J. W., and J. F. Barr. 1997. Common Loon (*Gavia immer*). In *The Birds of North America*, No. 313 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Mowbray, T. B. 2002. Northern Gannet (*Morus bassanus*). In *The Birds of North America*, No. 693 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Robertson, G. J., and J-P. L. Savard. 2002. Long-tailed Duck (*Clangula hyemalis*). In *The Birds of North America*, No. 651 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Savard, J-P. L., D. Bordage, and A. Reed 1998. Surf Scoter (*Melanitta perspicillata*). In *The Birds of North America*, No. 363 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- 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

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Figure 1 - Transects for Fall 2003-Winter 2004 Avian Surveys within Nantucket Sound



**Figure 2 - Flightlines for the 12 Additional Routes Outside the Study Area During Fall 2003-Winter 2004 Aerial Surveys in Nantucket Sound**

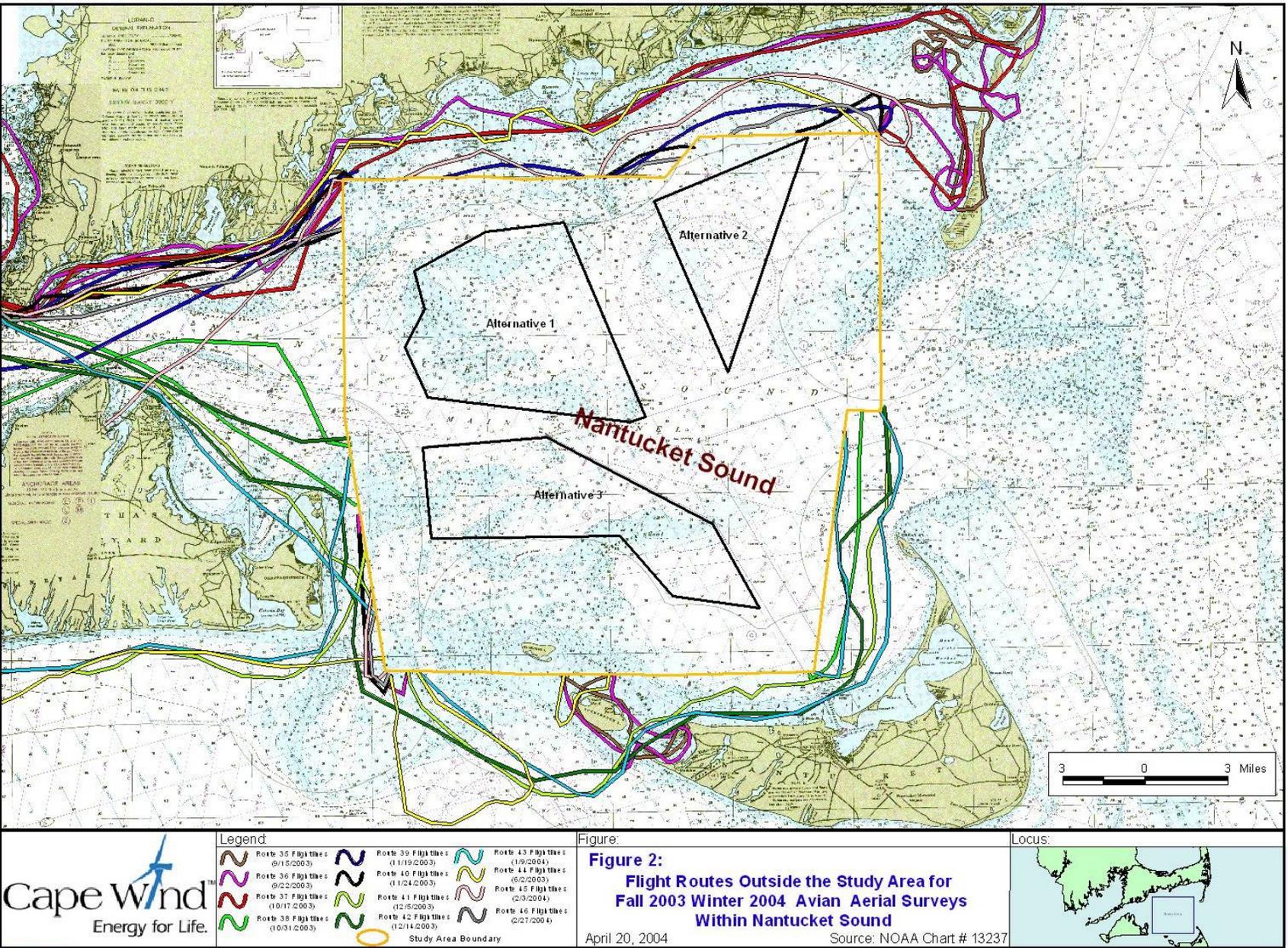
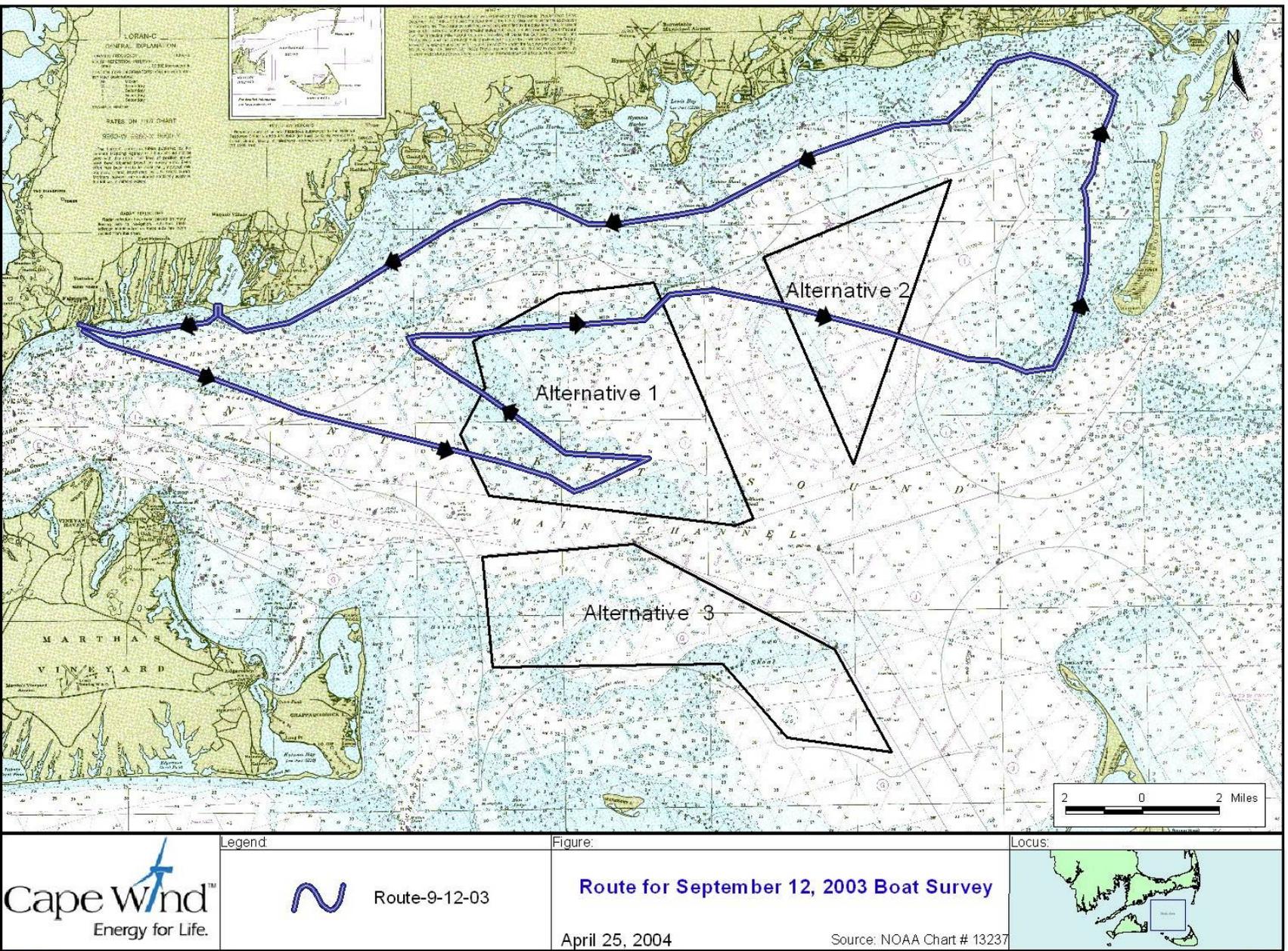


Figure 3. Route For Fall 2003 Boat Survey



## ATTACHMENT 1

Numbers of Individuals Observed  
On Each of the 12 Aerial Surveys  
In Nantucket Sound, MA,  
September 2003 - February 2004

**Table A: Species Totals: Individuals Recorded Within the Study Area During Twelve Systematic Aerial Surveys**

Species	15-Sep-03	22-Sep-03	17-Oct-03	31-Oct-03	19-Nov-03	24-Nov-03	5-Dec-03	14-Dec-03	9-Jan-04	2-Feb-04	20-Feb-04	27-Feb-04	Totals
Loon (2): Red-throated and Common	3	4	32	125	135	268	267	103	73	25	117	108	1,260
Grebe (2): Horned and Red-necked	0	0	1	6	12	3	9	27	5	1	17	10	91
Northern Gannet	0	0	0	4	126	153	10	4	8	0	0	1	306
Cormorant (2) Great and Double-crested	5	23	30	25	7	12	0	0	0	0	1	0	103
Mute Swan	0	0	1	0	0	0	0	0	0	0	0	0	1
Brant	0	0	0	0	0	0	0	0	0	7	0	0	7
American Black Duck	0	1	20	0	0	34	0	54	0	0	0	0	109
Common Eider	0	0	1,519	3259	1827	2924	2571	2776	7142	2257	5163	13194	42632
Long-tailed Duck	0	0	94	887	1691	1565	1234	662	695	2002	2388	1321	12539
Scoter (3): Black, Surf and White-winged	2	66	13,813	9811	14857	16615	10605	11336	7499	2733	6124	2722	96183
Common Goldeneye	0	0	0	0	0	0	0	0	1	0	0	0	1
Red-breasted Merganser	0	0	8	28	308	204	177	205	42	54	12	14	1052
Laughing Gull	0	0	0	1	0	0	0	0	0	0	0	0	1
Bonaparte's Gull	0	0	0	12	153	413	39	126	13	0	2	3	761
Herring Gull	22	32	6	191	97	40	58	31	29	19	18	12	555
Great Black-backed Gull	75	84	6	40	70	35	67	28	16	7	54	32	514
Black-legged Kittiwake	0	0	0	0	25	14	6	66	118	2	0	0	231
Unknown Gull	0	40	0	0	0	0	2	1	0	3	3	26	75
Roseate Tern	3	0	0	0	0	0	0	0	0	0	0	0	3
Common Tern	26	16	1	5	35	0	0	0	0	0	0	0	83
Forster's Tern	0	0	0	1	0	0	0	0	0	0	0	0	1
Unknown Tern	46	10	0	0	0	0	0	0	0	0	0	0	56
Dovekie	0	0	0	0	0	1	3	0	2	5	1	1	13
Razorbill	0	0	6	7	16	19	93	206	31	67	132	242	819
<b>Total</b>	182	276	15,537	14,402	19,359	22300	15141	15625	15674	7182	14032	17686	157,396

**Table B: Species Totals: Individuals Recorded Outside the Study Area Within Nantucket Sound During Twelve Aerial Surveys**

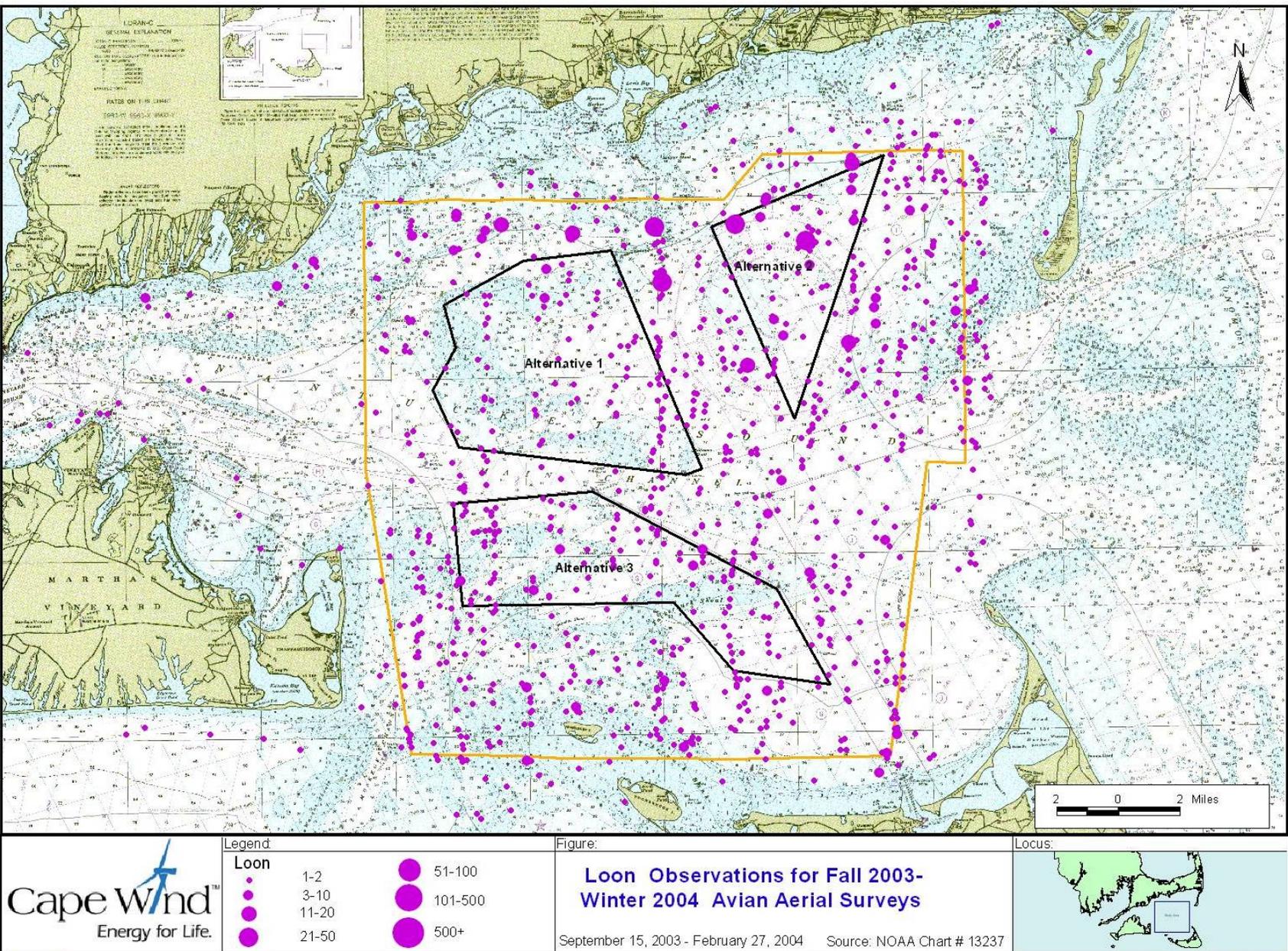
Species	15-Sep-03	22-Sep-03	17-Oct-03	31-Oct-03	19-Nov-03	24-Nov-03	5-Dec-03	14-Dec-03	9-Jan-04	2-Feb-04	20-Feb-04	27-Feb-04	Totals
Loon (2): Red-throated and Common	0	4	18	6	13	19	21	16	4	1	23	2	127
Grebe	0	0	0	4	1	0	0	8	0	0	0	0	13
Northern Gannet	1	0	1	0	46	10	9	1	0	0	1	0	69
Cormorant (2) Great and Double-crested	253	2344	256	14	0	0	1	0	0	0	0	0	2,868
Snowy Egret	1	0	0	0	0	0	0	0	0	0	0	0	1
Mute Swan	0	0	0	1	0	0	0	0	0	0	0	0	1
Canada Goose	28	0	0	0	0	0	0	0	0	0	0	0	28
Brant	0	0	0	0	30	0	0	0	0	0	0	0	30
Common Eider	0	0	467	172	853	1226	631	1692	3140	1321	1873	534	11909
Long-tailed Duck	0	0	0	0	64	39	419	4	108	1073	609	187	2503
Scoter (3): Black, Surf and White-winged	0	59	391	86	544	564	882	412	775	0	77	26	3816
Common Goldeneye	0	0	0	0	3	0	0	106	30	2	0	3	144
Bufflehead	0	0	0	0	0	0	0	1	0	24	10	30	65
Red-breasted Merganser	1	0	0	0	123	56	157	250	43	29	41	120	820
Osprey	1	0	0	0	0	0	0	0	0	0	0	0	1
Shorebird	50	80	520	0	0	0	0	0	0	0	0	0	650
Jaeger	0	0	0	0	0	0	0	1	0	0	0	0	1
Laughing Gull	49	38	8	4	0	0	0	0	0	0	0	0	99
Bonaparte's Gull	0	0	0	0	27	94	212	30	6	0	0	0	369
Herring Gull	43	61	37	13	10	6	44	8	13	1	8	0	244
Great Black-backed Gull	90	21	56	25	7	10	2	8	37	3	9	1	269
Black-legged Kittiwake	0	0	0	0	5	1	1	3	9	2	0	0	21
Unknown Gull	140	1011	0	0	0	0	50	220	0	1	0	0	1422
Roseate Tern	11	0	0	0	0	0	0	0	0	0	0	0	11
Common Tern	1276	759	0	0	11	0	0	0	0	0	0	0	2046
Least Tern	0	221	0	0	0	0	0	0	0	0	0	0	221
Black Tern	0	0	0	1	0	0	0	0	0	0	0	0	1
Unknown Tern	788	196	0	0	0	0	0	0	0	0	0	0	984
Razorbill	0	0	0	0	2	0	10	6	14	52	31	9	124
<b>Total</b>	<b>2,732</b>	<b>4,794</b>	<b>1,754</b>	<b>326</b>	<b>1,739</b>	<b>2,025</b>	<b>2,439</b>	<b>2,766</b>	<b>4,179</b>	<b>2,509</b>	<b>2,682</b>	<b>912</b>	<b>28,857</b>

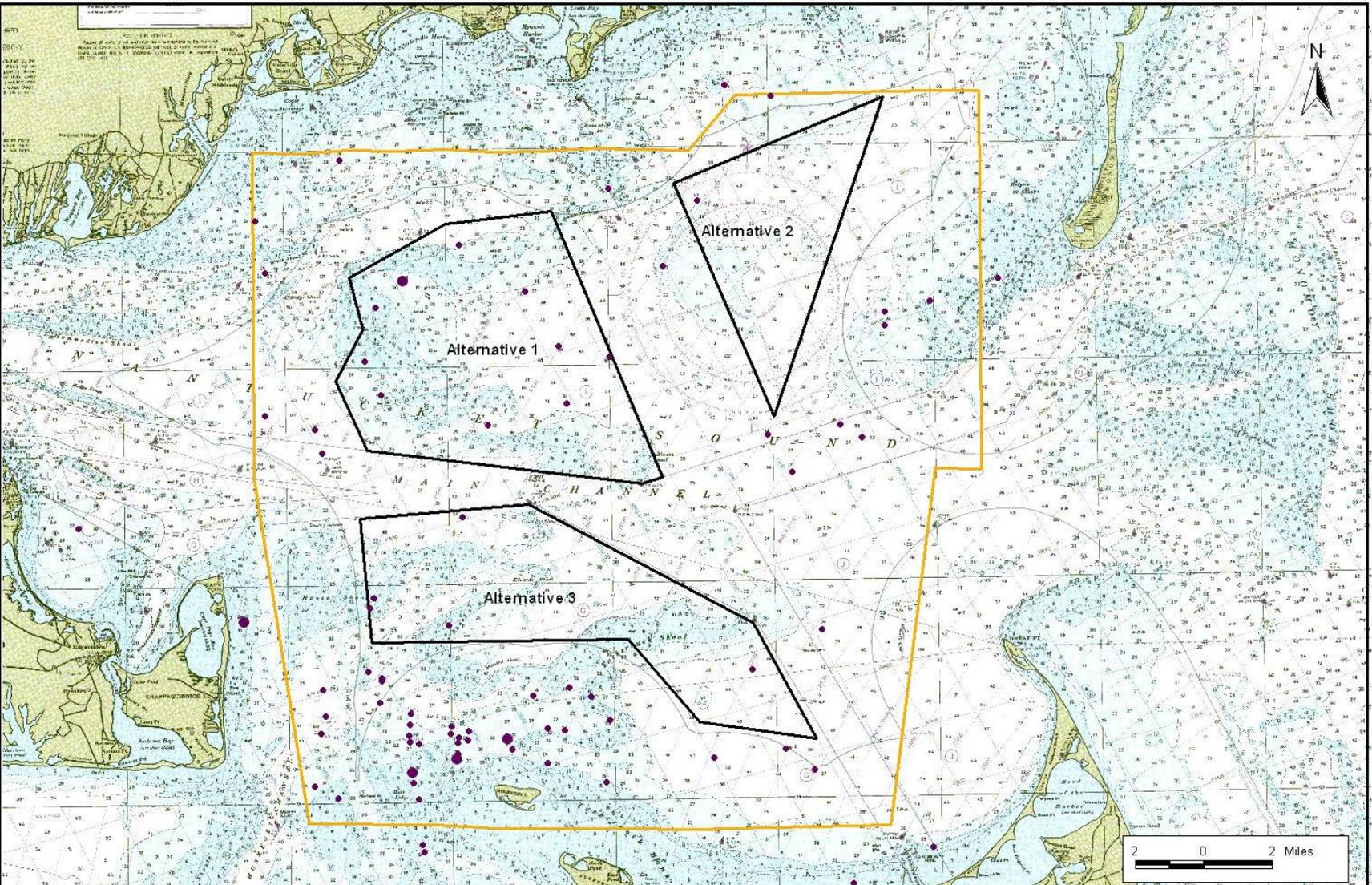
**Table C: Species Totals: Individuals Recorded Outside the Study Area Within Vineyard Sound and Buzzards Bay During Twelve Aerial Surveys**

Species	15-Sep-03	22-Sep-03	17-Oct-03	31-Oct-03	19-Nov-03	24-Nov-03	5-Dec-03	14-Dec-03	9-Jan-04	2-Feb-04	20-Feb-04	27-Feb-04	Totals
Loon (2): Red-throated and Common	0	1	3	5	0	0	22	4	6	44	1	0	86
Grebe (2): Horned abd Red-necked	1	0	0	0	0	0	0	1	0	12	0	0	14
Northern Gannet	0	0	0	0	0	0	33	19	0	0	0	0	52
Cormorant (2) Great and Double-crested	105	132	69	153	150	38	51	12	7	4	0	28	749
Great Blue Heron	0	0	0	0	1	0	0	0	0	0	0	0	1
Snowy Egret	0	1	0	0	0	0	0	0	0	0	0	0	1
Mute Swan	0	0	0	0	0	0	0	0	0	0	0	0	0
Canada Goose	0	0	0	0	0	0	0	0	0	10	0	0	10
Brant	0	0	30	30	0	0	0	60	0	0	0	0	120
American Black Duck	0	0	0	0	0	0	2	3	0	0	39	0	44
Common Eider	0	0	10	353	52	125	4295	143	6518	61379	514	1,405	74,794
Long-tailed Duck	0	0	0	6	4	19	9	109	5	54	7	9	222
Scoter (3): Black, Surf and White-winged	0	0	46	15	132	123	570	152	54	6855	150	0	8,097
Common Goldeneye	0	0	0	0	0	0	5	6	0	45	0	20	76
Bufflehead	0	0	0	0	0	0	0	25	115	197	88	12	437
Red-breasted Merganser	0	0	0	0	30	0	0	9	13	344	0	83	479
Laughing Gull	70	51	0	0	4	0	0	0	0	0	0	0	125
Bonaparte's Gull	0	0	0	0	0	60	18	38	8	0	0	0	124
Herring Gull	4	24	16	22	45	7	7	57	24	13	13	2	234
Great Black-backed Gull	10	6	4	0	1	1	51	33	3	2	5	20	136
Black-legged Kittiwake	0	0	0	0	0	0	1	0	2	1	0	0	4
Unknown Gull	50	25	150	20	0	0	1	32	302	0	0	0	580
Roseate Tern	2	0	0	0	0	0	0	0	0	0	0	0	2
Common Tern	417	2582	24	0	17	0	0	0	0	0	0	0	3,040
Black Tern	0	1	0	0	0	0	0	0	0	0	0	0	1
Unknown Tern	258	1724	0	0	0	0	0	0	0	0	0	0	1,982
Dovekie	0	0	0	0	0	0	0	1	0	10	0	0	11
Razorbill	0	0	0	4	0	0	2	0	6	31	0	0	43
Tree Swallows	0	100	0	0	0	0	0	0	0	0	0	0	100
<b>Total</b>	<b>917</b>	<b>4,647</b>	<b>352</b>	<b>608</b>	<b>436</b>	<b>373</b>	<b>5,067</b>	<b>704</b>	<b>7,063</b>	<b>69,001</b>	<b>817</b>	<b>1,579</b>	<b>91,564</b>

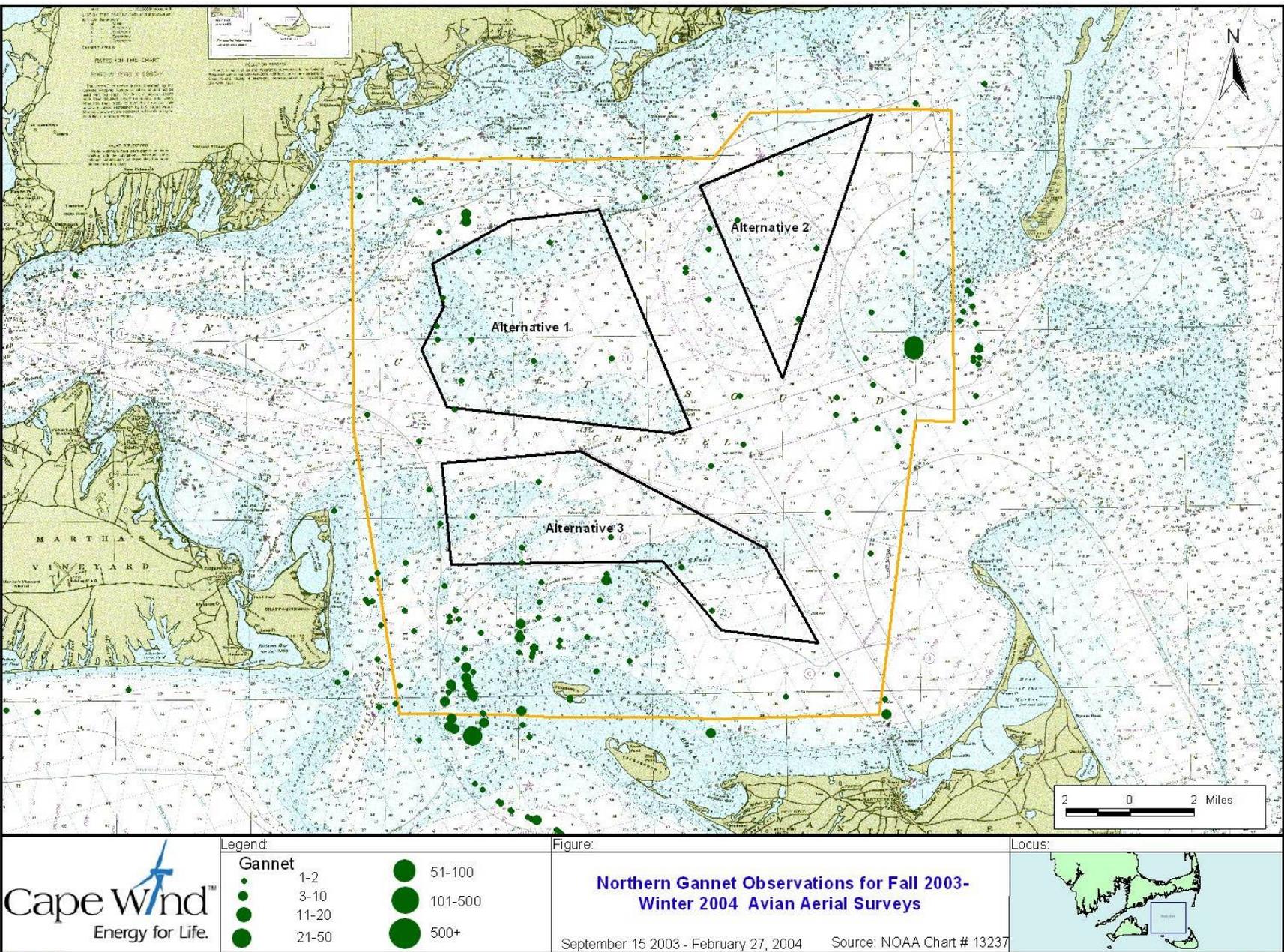
## ATTACHMENT 2

Distribution of Waterbirds in the  
Study Area for Aerial Surveys  
35-46 Combined





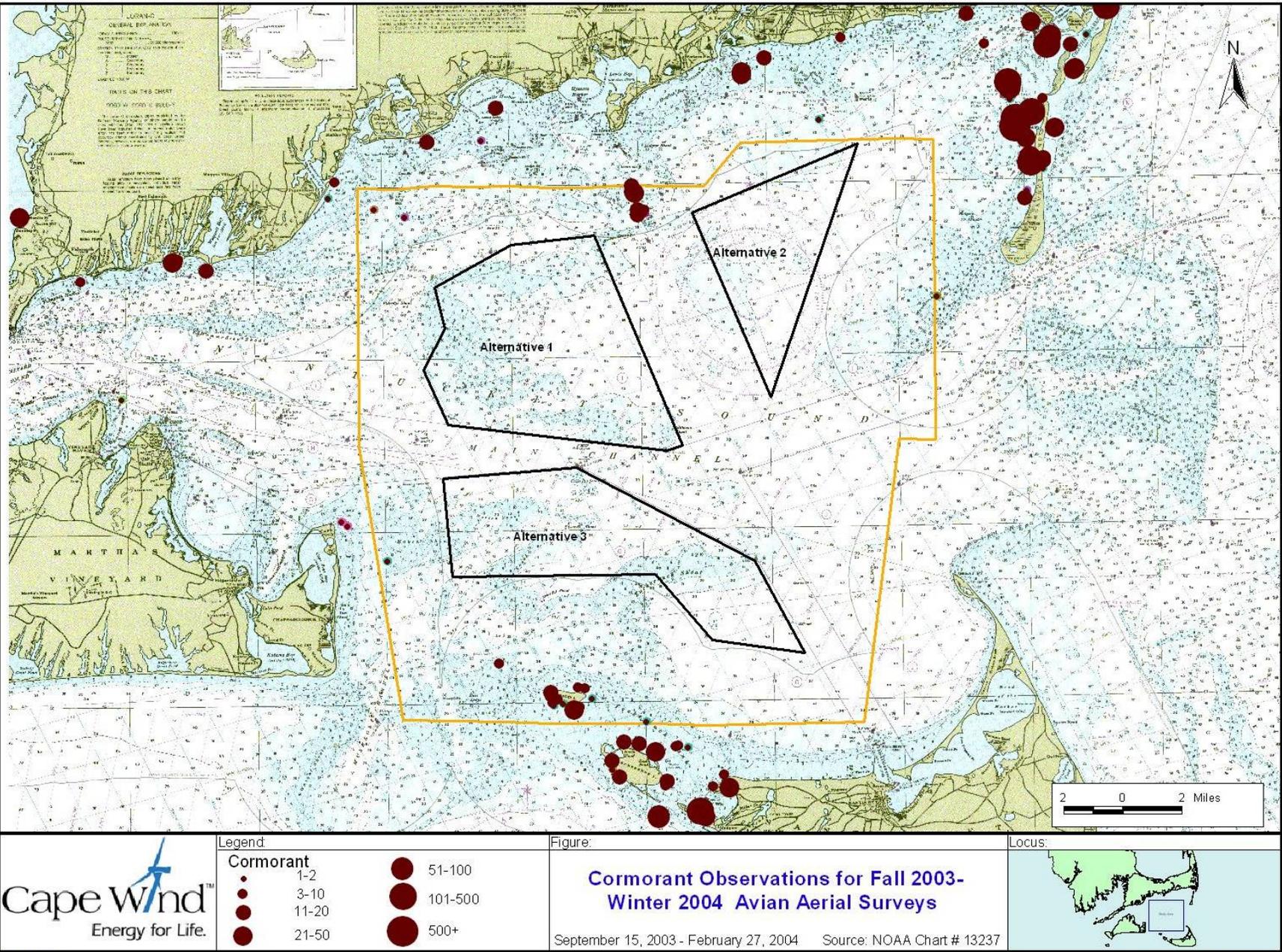
	<b>Legend:</b> <b>Grebe</b> 1-2 3-10 11-20 21-50	51-100 101-500 500+	<b>Figure:</b> <b>Grebe Observations for Fall 2003-                  Winter 2004 Avian Aerial Surveys</b> September 12, 2003 - February 27, 2004 Source: NOAA Chart # 13273	<b>Locus:</b> 

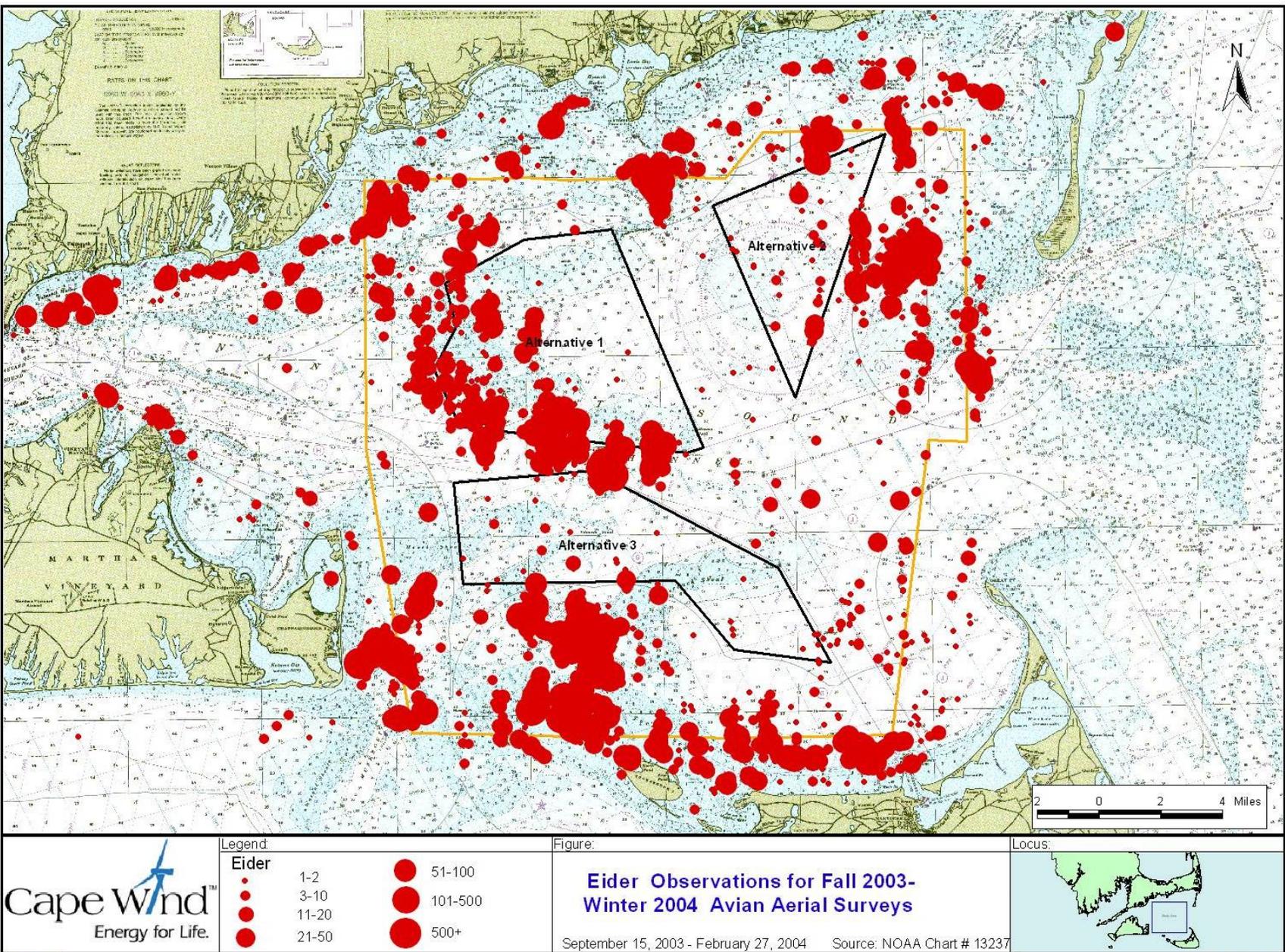


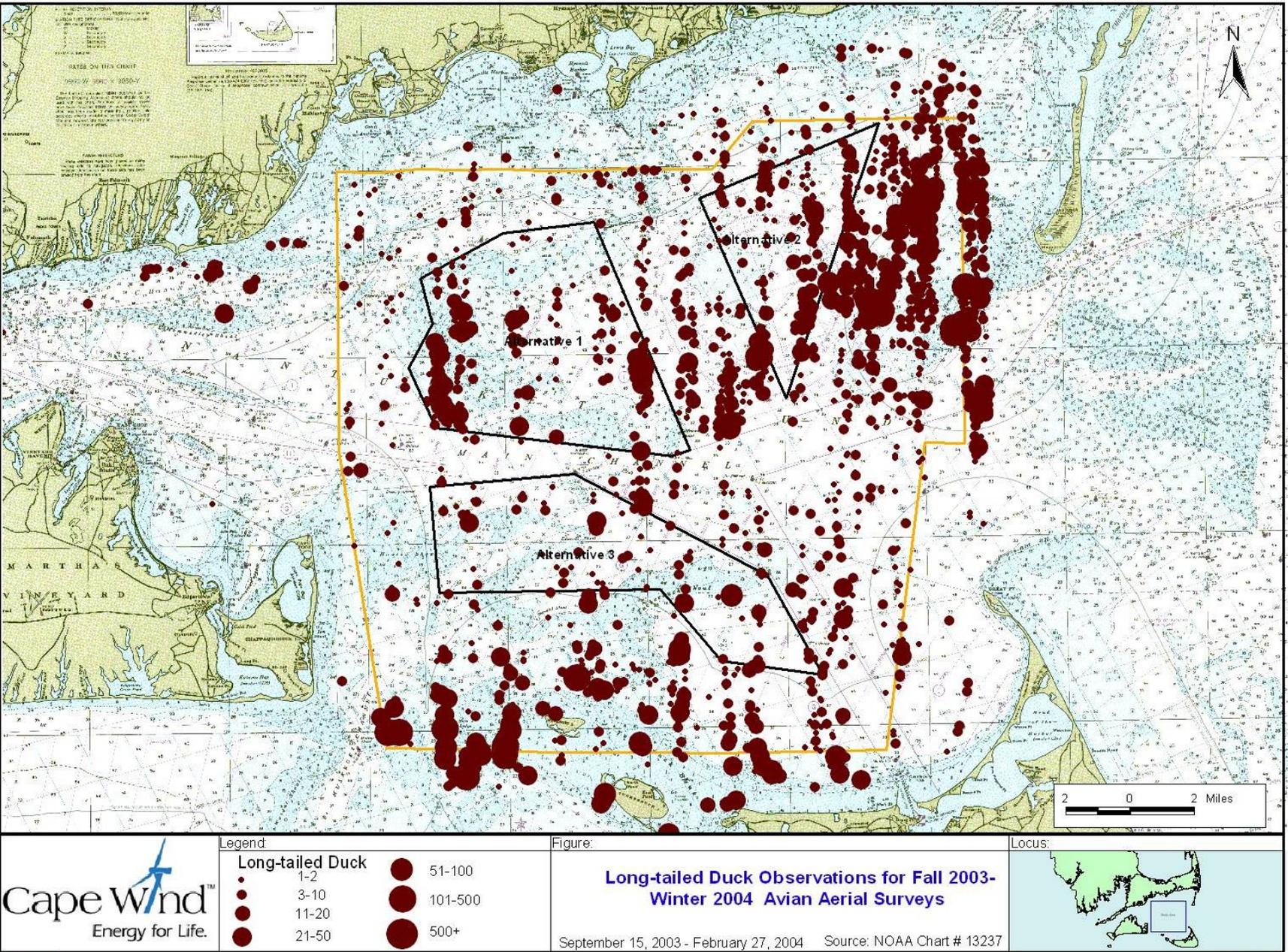
Legend	
<b>Gannet</b>	
● 1-2	● 51-100
● 3-10	● 101-500
● 11-20	● 500+
● 21-50	

Figure:  
**Northern Gannet Observations for Fall 2003-  
 Winter 2004 Avian Aerial Surveys**  
 September 15 2003 - February 27, 2004 Source: NOAA Chart # 13237





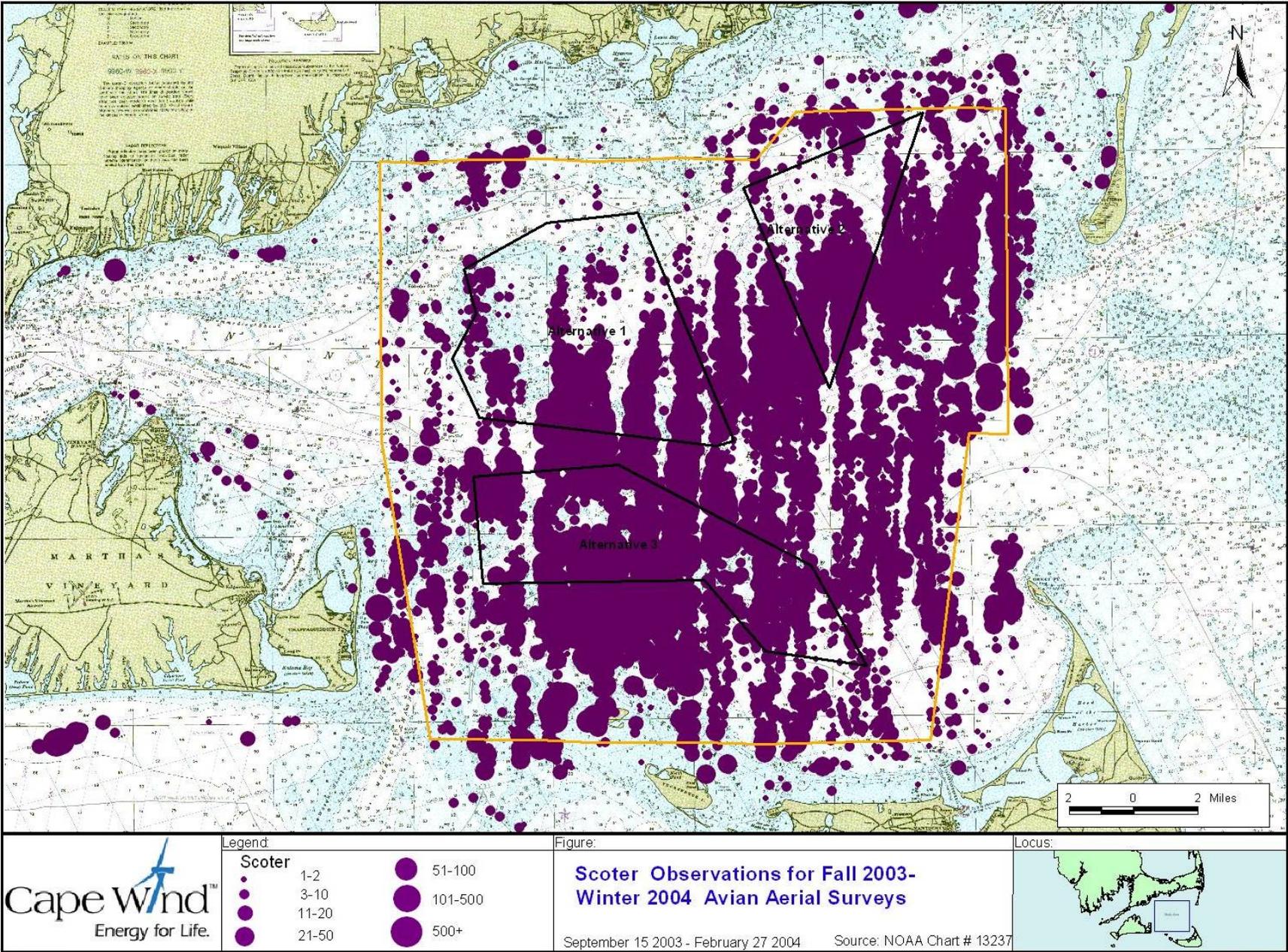




Legend	
●	Long-tailed Duck
●	1-2
●	3-10
●	11-20
●	21-50
●	51-100
●	101-500
●	500+

Figure:  
**Long-tailed Duck Observations for Fall 2003-  
 Winter 2004 Avian Aerial Surveys**  
 September 15, 2003 - February 27, 2004 Source: NOAA Chart # 13237

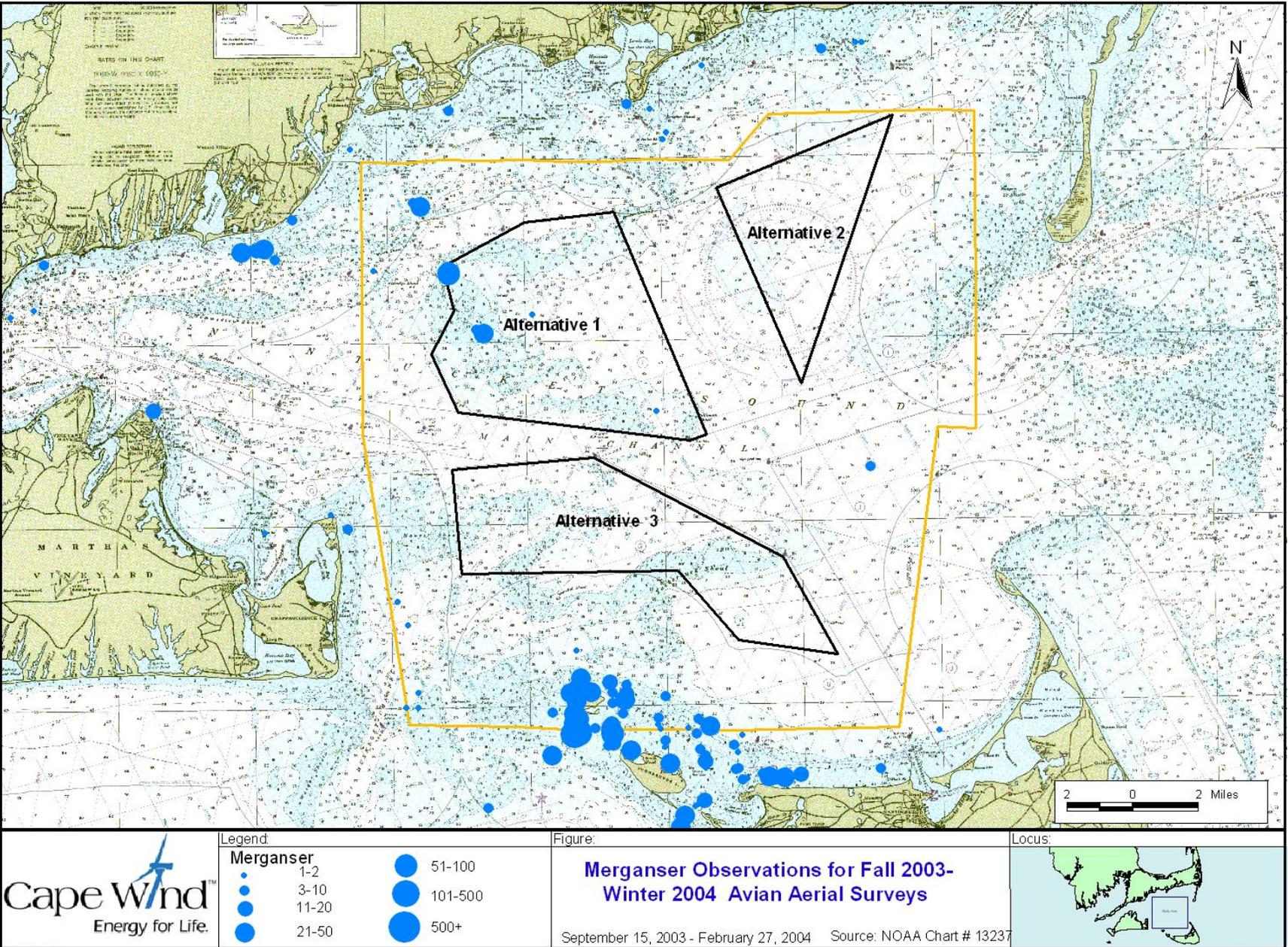


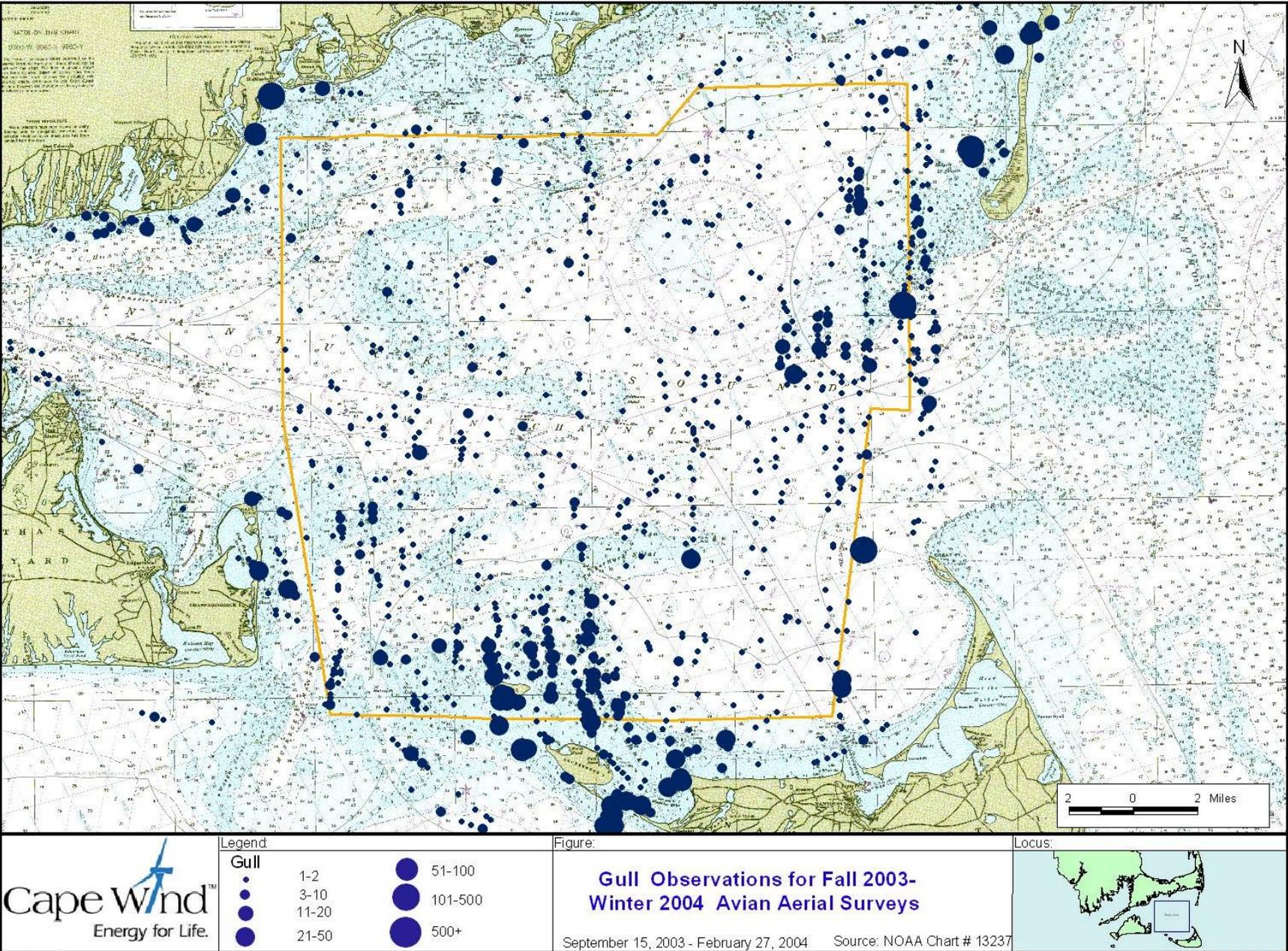


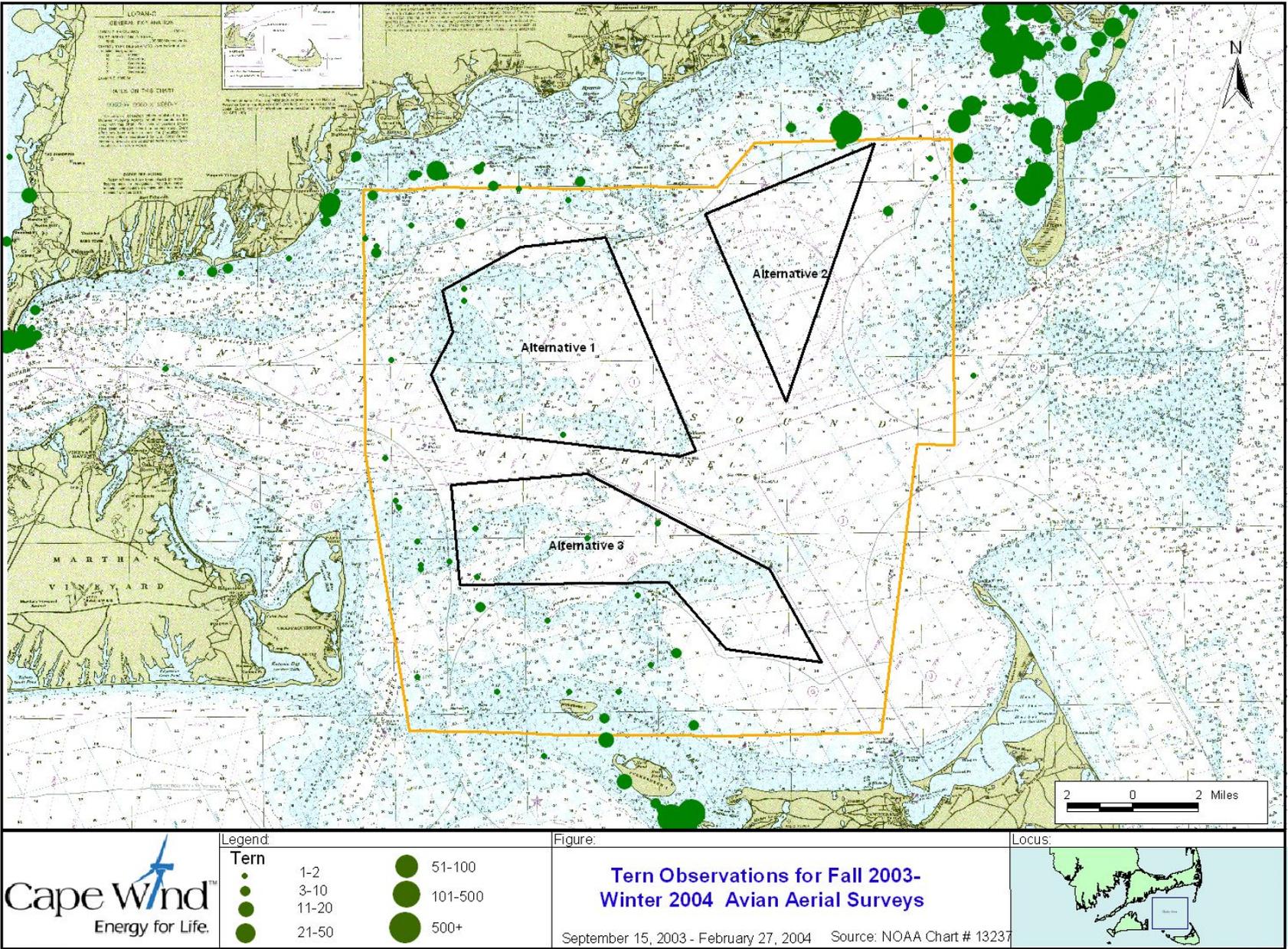
Legend	
Scoter	
● 1-2	● 51-100
● 3-10	● 101-500
● 11-20	● 500+
● 21-50	

Figure: **Scoter Observations for Fall 2003-  
 Winter 2004 Avian Aerial Surveys**  
 September 15 2003 - February 27 2004 Source: NOAA Chart # 13237





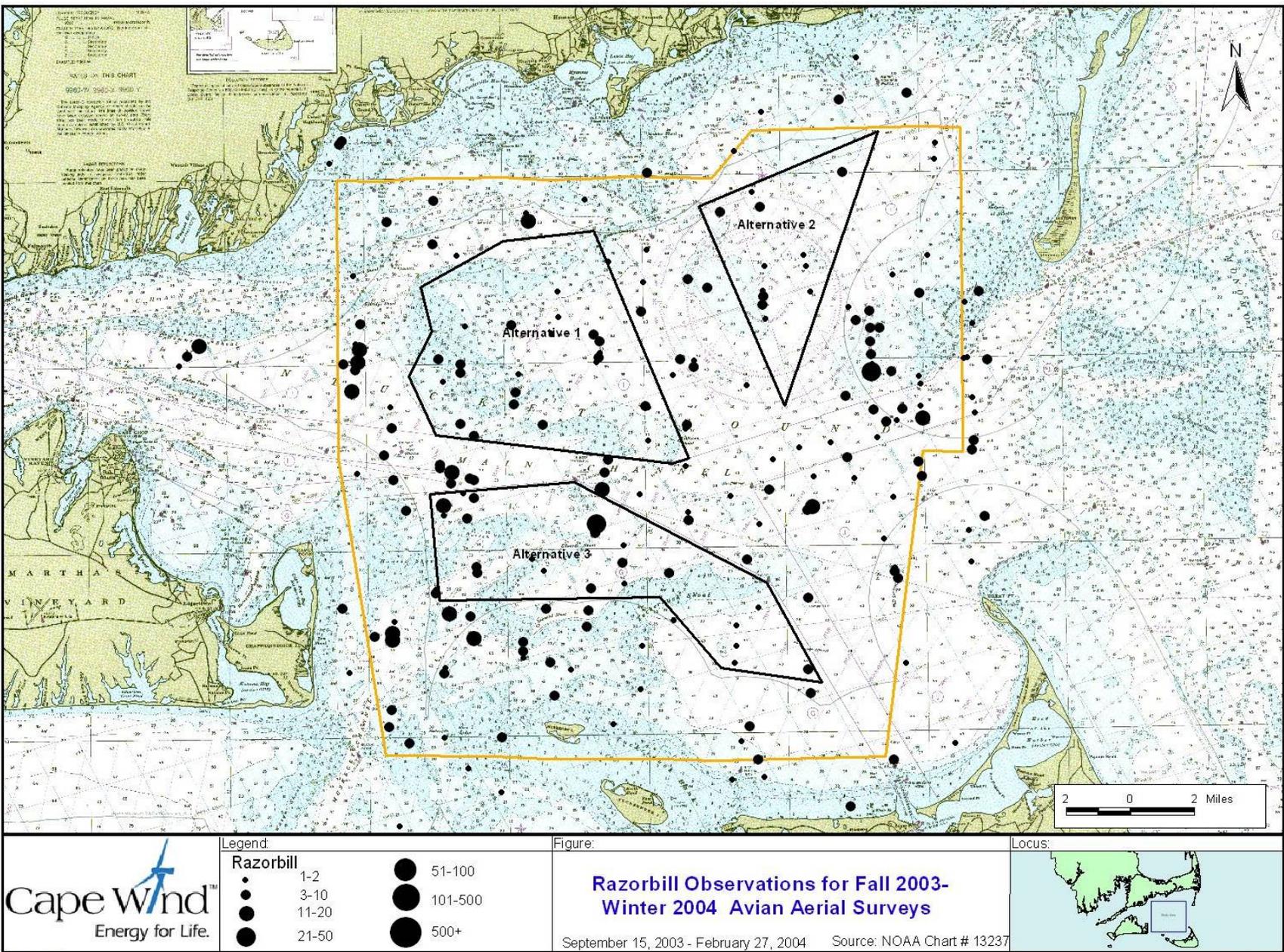




Legend	
<b>Tern</b>	
	1-2
	3-10
	11-20
	21-50
	51-100
	101-500
	500+

Figure:  
**Tern Observations for Fall 2003-  
 Winter 2004 Avian Aerial Surveys**  
 September 15, 2003 - February 27, 2004 Source: NOAA Chart # 13237





Legend	
<b>Razorbill</b>	
● 1-2	● 51-100
● 3-10	● 101-500
● 11-20	● 500+
● 21-50	

Figure:  
**Razorbill Observations for Fall 2003-  
 Winter 2004 Avian Aerial Surveys**  
 September 15, 2003 - February 27, 2004 Source: NOAA Chart # 13237

Locus:



## ATTACHMENT 3

Species Totals and Densities for  
Alternative Sites and for the Area  
Outside of the Alternative Sites  
Within the Study Area for Twelve  
Aerial Surveys Combined

**Species Totals and Densities By Site Alternatives For All 12 Aerial Surveys Combined**

Species	Location	Total Number Observed	Max/Min Number	Density (indivs/km2)	Estimated* Number Present	Estimated Number Present per Survey
Loon	Alternative 1	88	19/0	4.19	463	39
Loon	Alternative 2	132	49/0	13.47	695	58
Loon	Alternative 3	129	33/0	7.68	679	57
Loon	Outside	911	29/3	7.57	4338	362
Loon	Total	1260		7.50	6300	525
Grebe	Alternative 1	14	4/0	0.67	74	6
Grebe	Alternative 2	1	1/0	0.10	5	0
Grebe	Alternative 3	5	1/0	0.30	26	2
Grebe	Outside	71	22/1	0.59	338	28
Grebe	Total	91		0.54	455	38
Gannet	Alternative 1	11	8/0	0.52	58	5
Gannet	Alternative 2	3	1/0	0.31	16	1
Gannet	Alternative 3	9	7/0	0.54	47	4
Gannet	Outside	283	137/0	2.35	1348	112
Gannet	Total	306		1.82	1530	128
Cormorant	Alternative 1	0	0/0	0.00	0	0
Cormorant	Alternative 2	0	0/0	0.00	0	0
Cormorant	Alternative 3	0	0/0	0.00	0	0
Cormorant	Outside	103	30/0	0.86	490	41
Cormorant	Total	103		0.61	515	43
Eider	Alternative 1	3347	713/0	159.38	17616	1468
Eider	Alternative 2	257	173/0	26.22	1353	113
Eider	Alternative 3	666	502/0	39.64	3505	292
Eider	Outside	38362	13047/0	318.62	182676	15223
Eider	Total	42632		253.76	213160	17763
Long-tailed Duck	Alternative 1	1379	504/0	65.67	7258	605
Long-tailed Duck	Alternative 2	761	334/0	77.65	4005	334
Long-tailed Duck	Alternative 3	444	110/0	26.43	2337	195
Long-tailed Duck	Outside	9955	1675/0	82.68	47405	3950
Long-tailed Duck	Total	12539		74.64	62695	5225
Scoter	Alternative 1	9216	2230/0	438.86	48505	4042
Scoter	Alternative 2	7277	1705/0	742.55	38300	3192
Scoter	Alternative 3	16186	3414/0	963.45	85189	7099
Scoter	Outside	63504	12593/2	527.44	302400	25200
Scoter	Total	96183		572.52	480915	40076
Merganser	Alternative 1	115	106/0	5.48	605	50
Merganser	Alternative 2	0	0/0	0.00	0	0
Merganser	Alternative 3	0	0/0	0.00	0	0
Merganser	Outside	937	300/0	7.78	4462	372
Merganser	Total	1052		6.26	5260	438
Gull	Alternative 1	61	18/0	2.90	321	27
Gull	Alternative 2	31	7/0	3.16	163	14
Gull	Alternative 3	119	45/0	7.08	626	52
Gull	Outside	1926	484/10	16.00	9171	764
Gull	Total	2137		12.72	10685	890
Tern	Alternative 1	3	2/0	0.14	16	1

Species	Location	Total Number Observed	Max/Min Number	Density (indivs/km <sup>2</sup> )	Estimated* Number Present	Estimated Number Present per Survey
Tern	Alternative 2	0	0/0	0.00	0	0
Tern	Alternative 3	4	2/0	0.24	21	2
Tern	Outside	136	72/0	1.13	648	54
Tern	Total	143		0.85	715	60
Razorbill	Alternative 1	80	33/0	3.81	421	35
Razorbill	Alternative 2	32	10/0	3.27	168	14
Razorbill	Alternative 3	115	65/0	6.85	605	50
Razorbill	Outside	592	152/0	4.92	2819	235
Razorbill	Total	819		4.88	4095	341

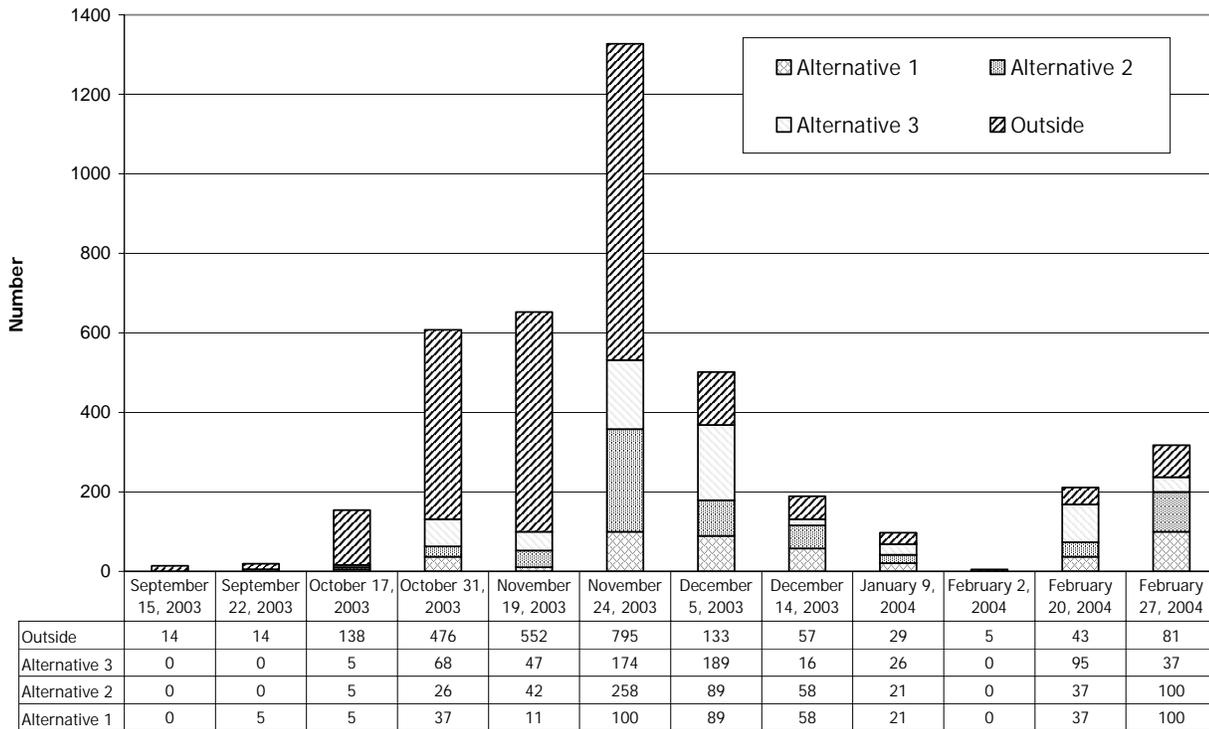
\*The individual maxima do not sum to the Total given because maxima do not necessarily coincide.

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

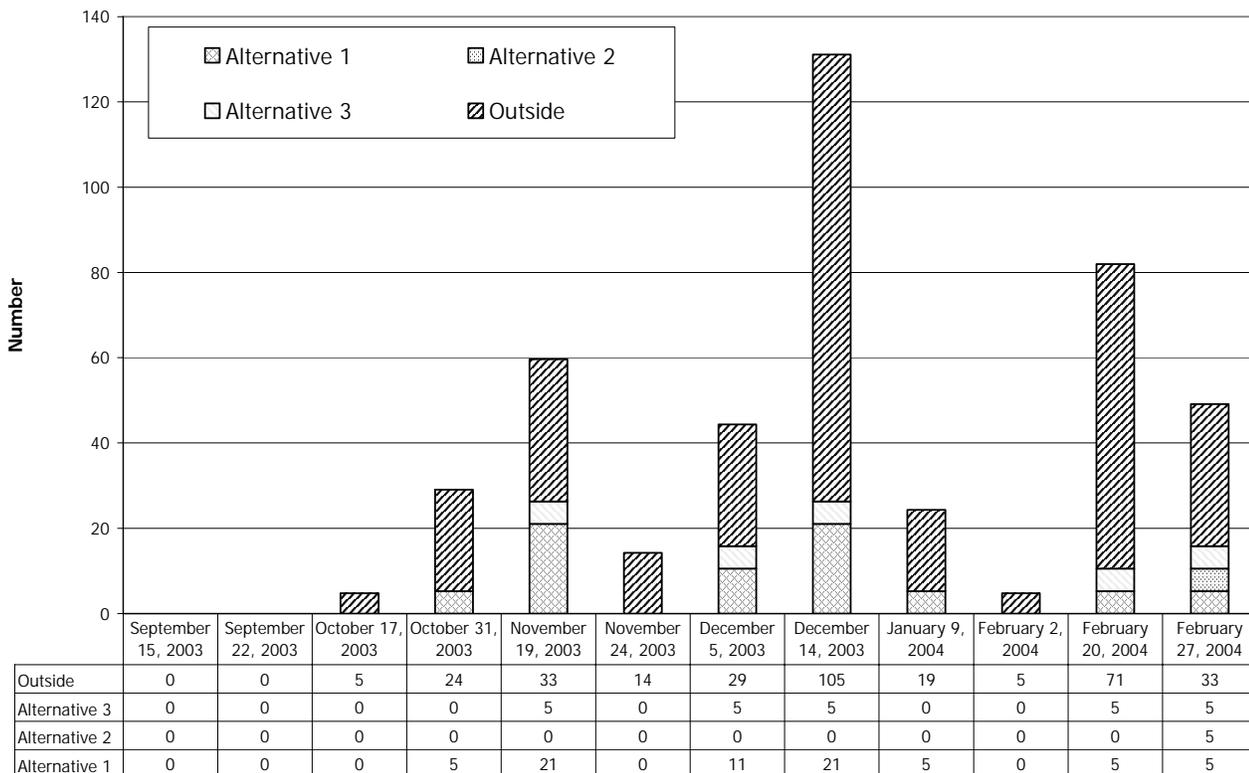
ATTACHMENT 4

Estimated Numbers of Waterbirds  
In the Study Area during  
Fall 2003/Winter 2004 for  
Aerial Surveys 35-47

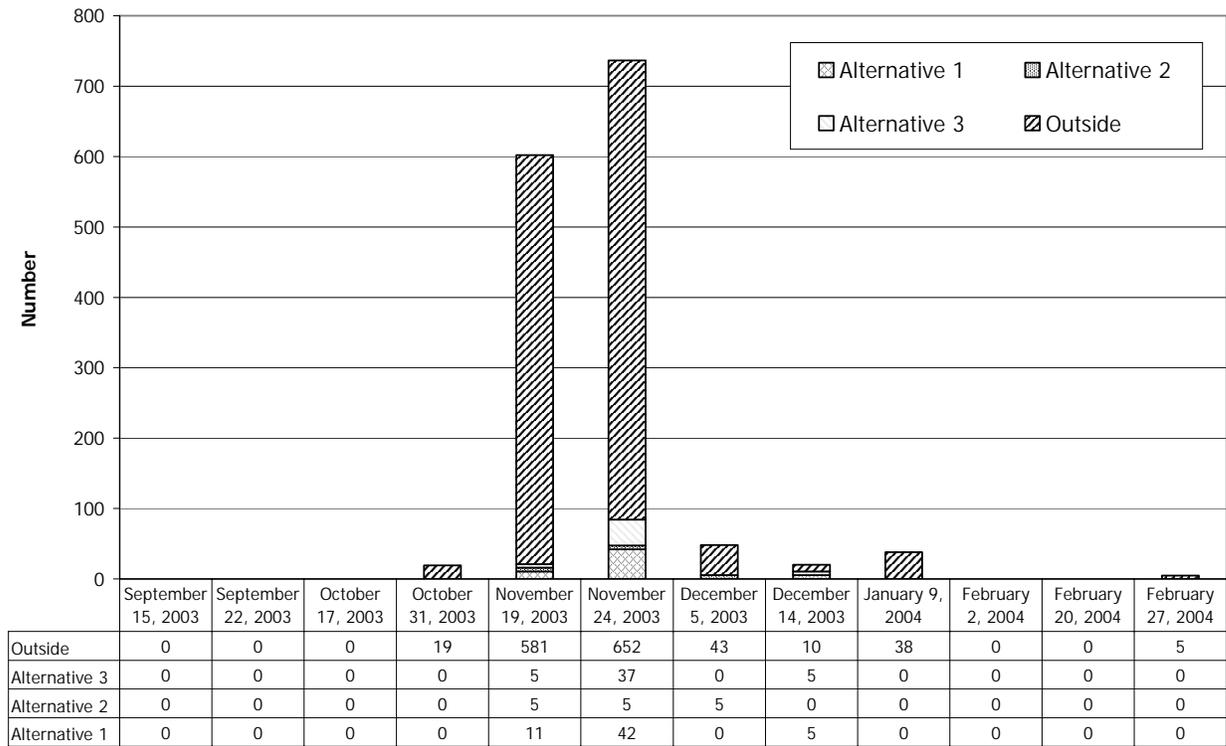
**Loon**



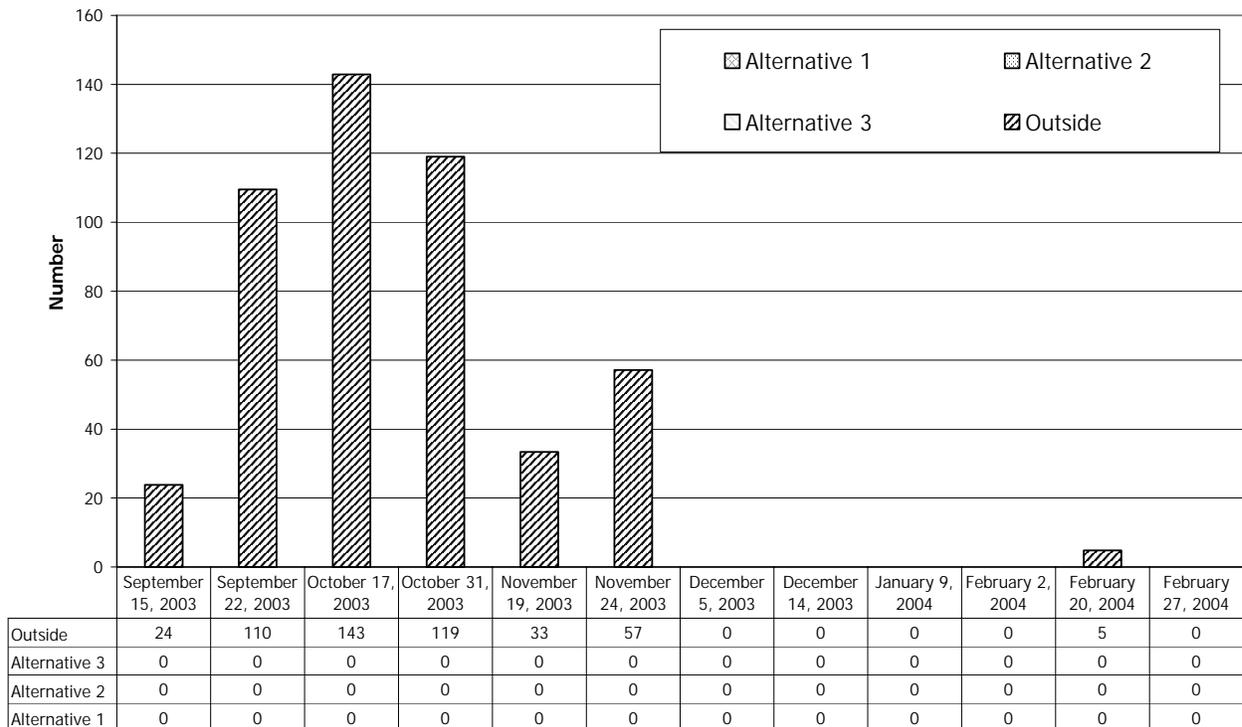
**Grebe**



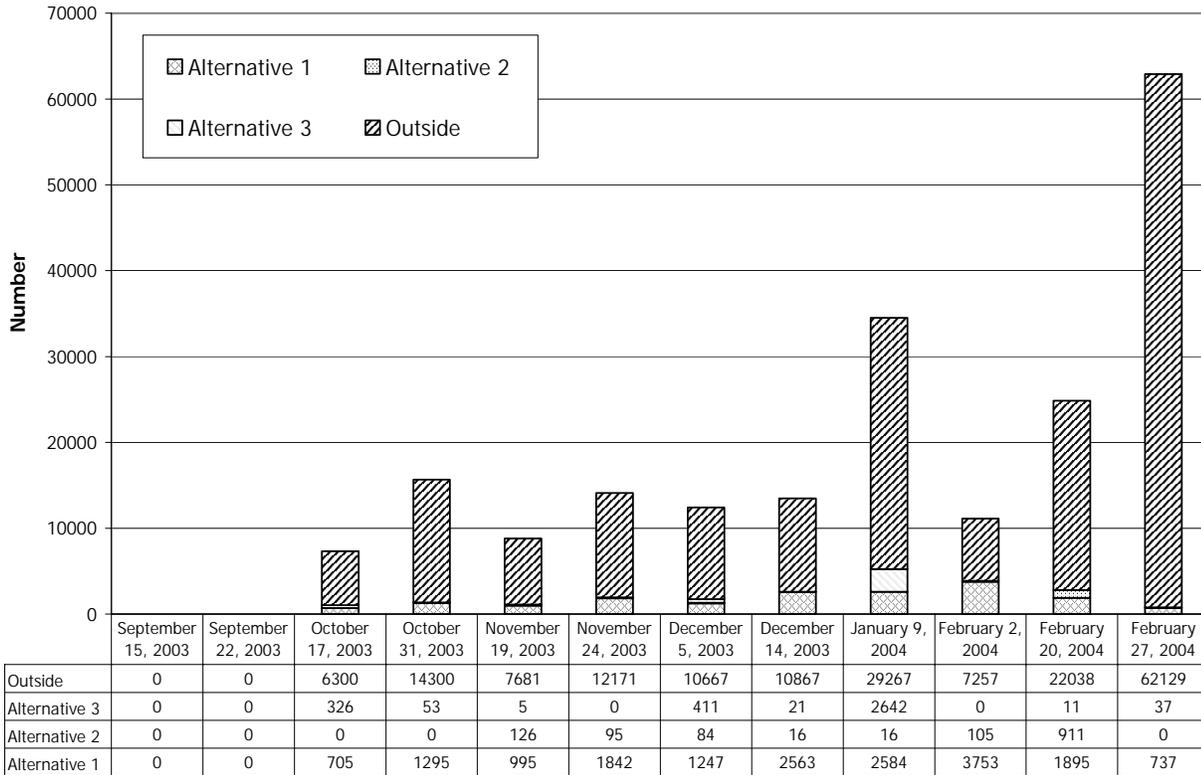
**Gannet**



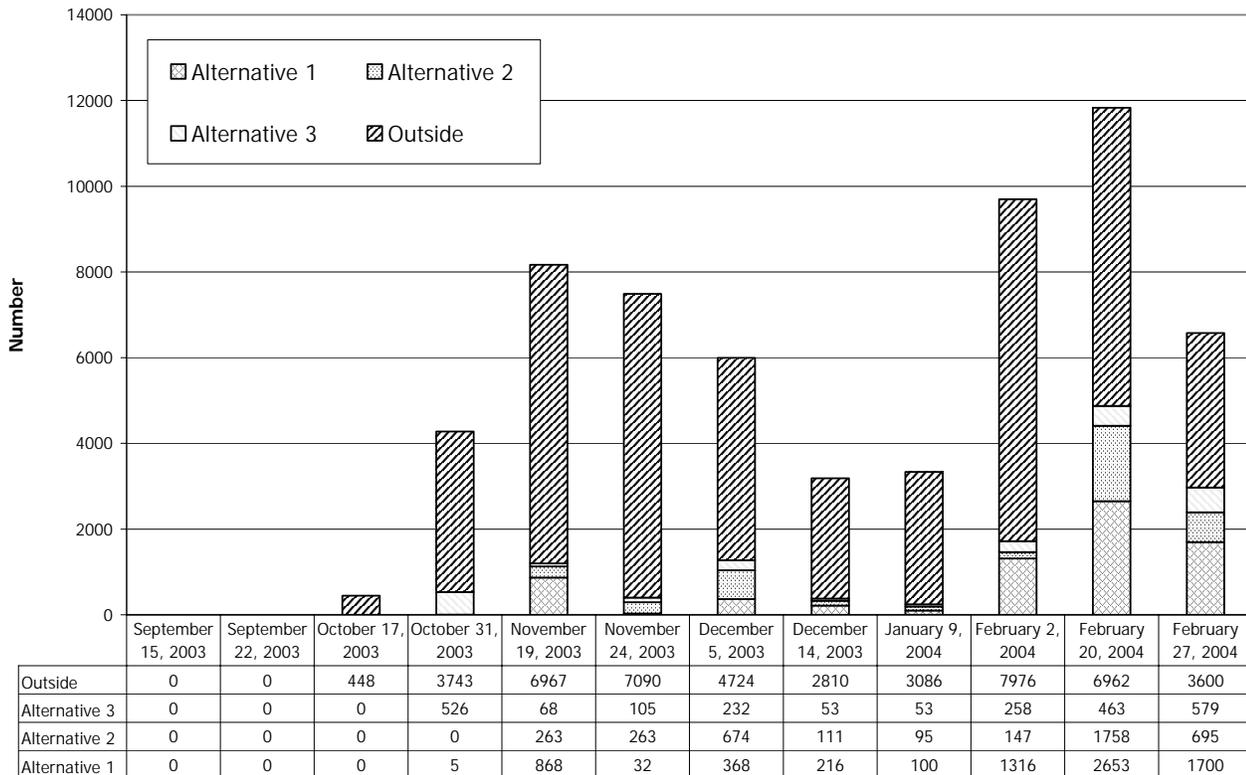
**Cormorant**

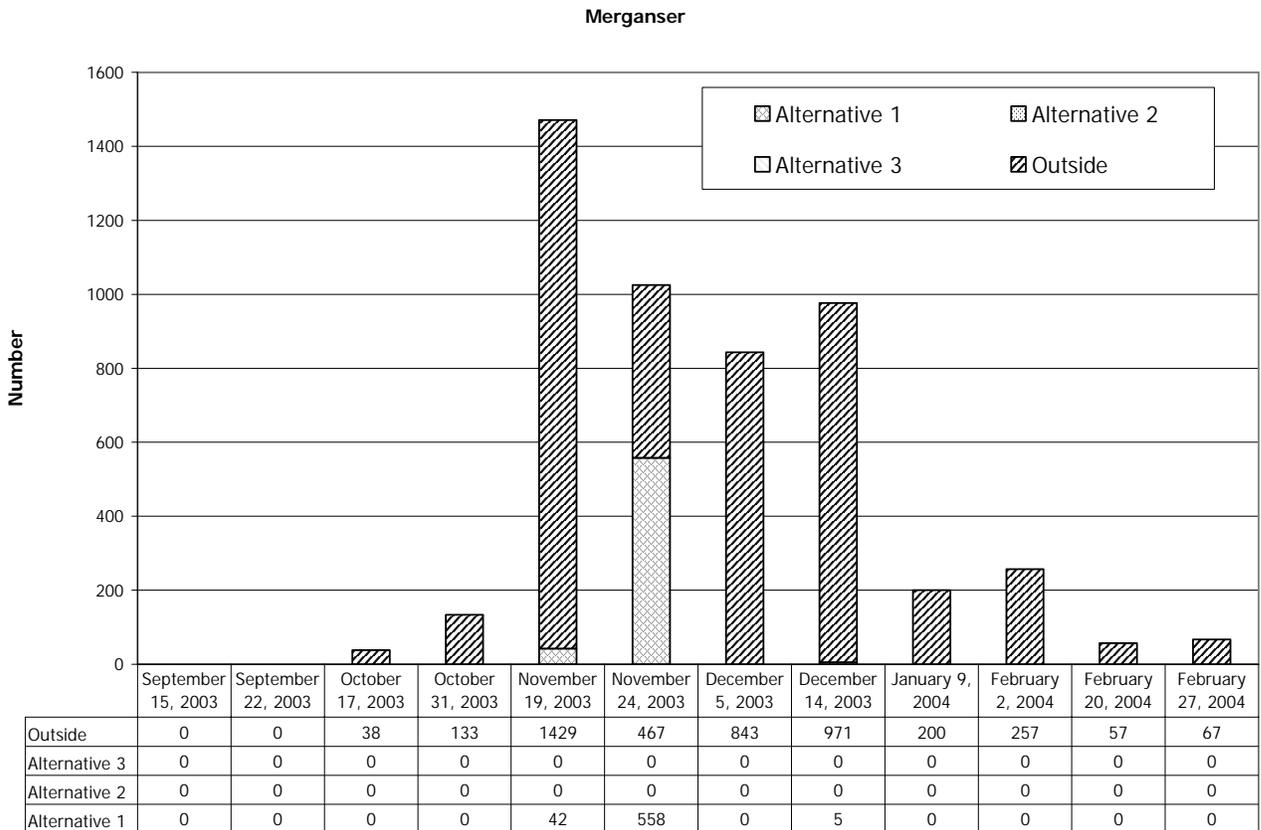
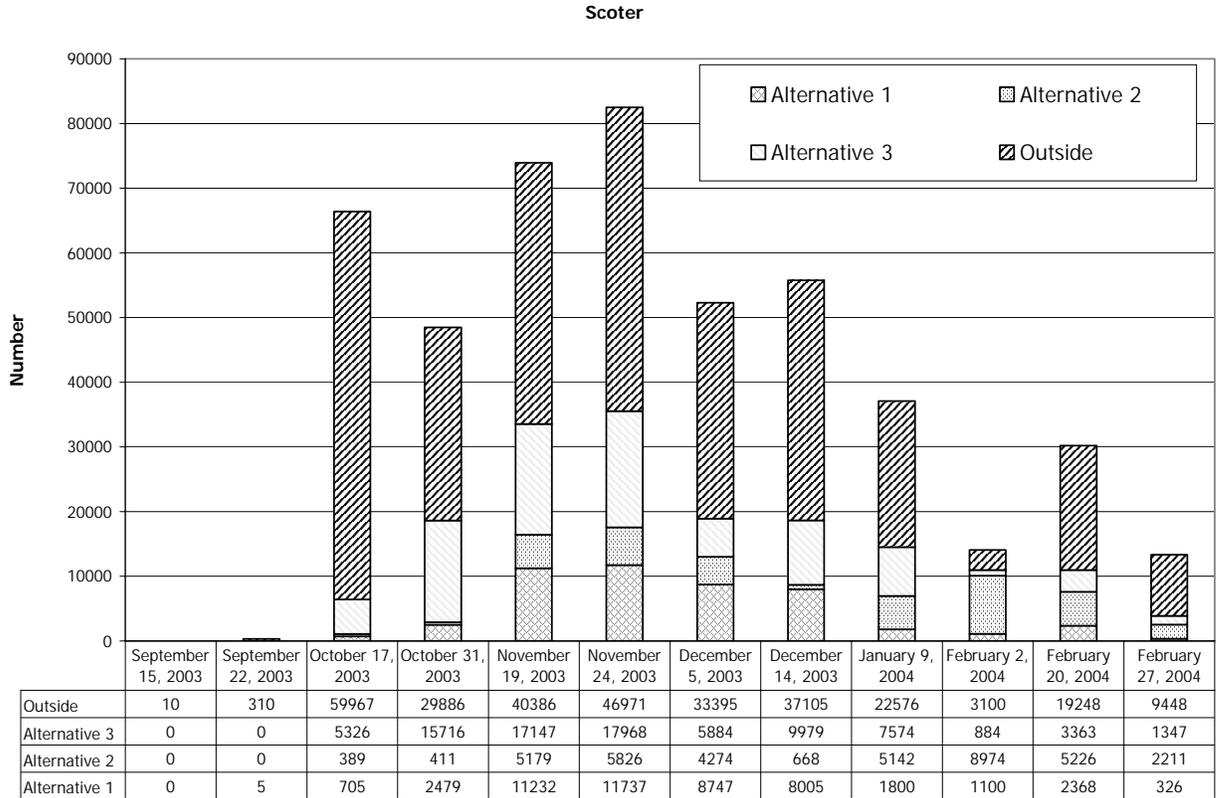


**Eider**

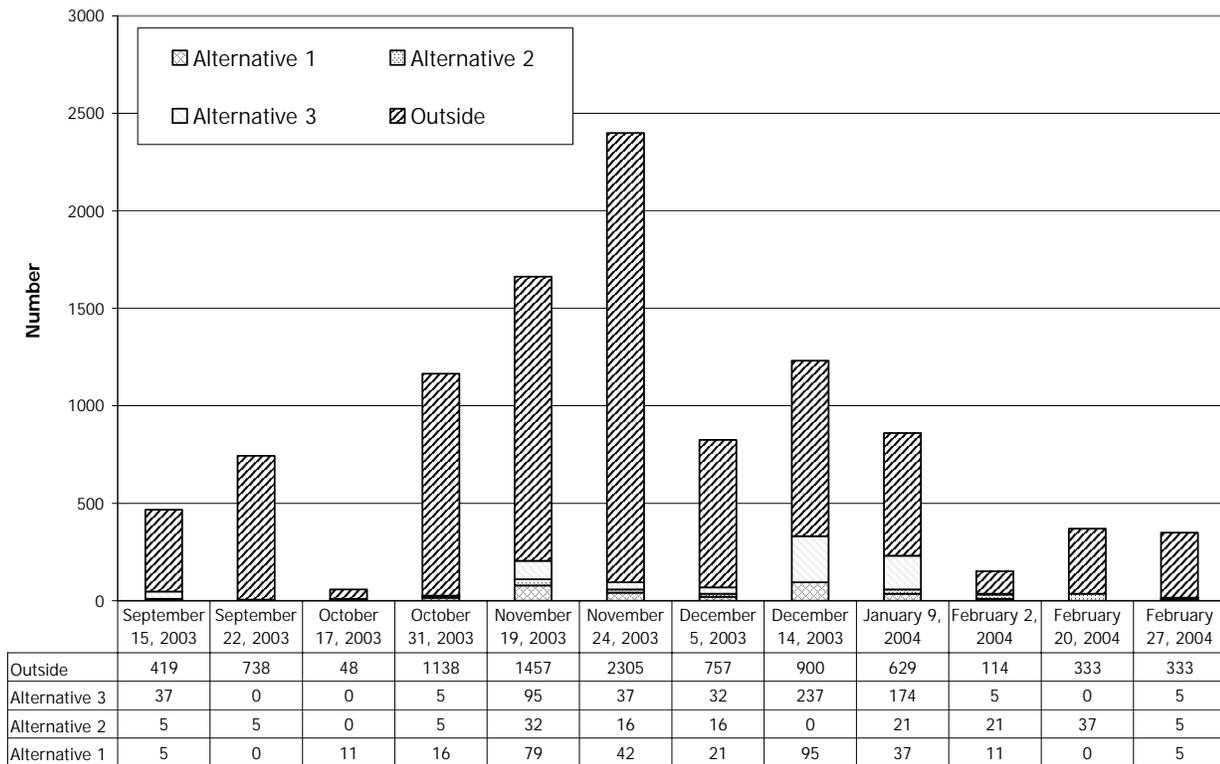


**Long-tailed Duck**





**Gull**



**Terns**

