

Appendix 5.7-K

**Six Surveys of Waterbirds
in Nantucket Sound:
March 19 – June 2, 2003 for
the Cape Wind Energy Project**

APPENDIX 5.7-K
SIX SURVEYS OF WATERBIRDS IN NANTUCKET SOUND: March 19 –June 2, 2003
FOR THE
CAPE WIND ENERGY PROJECT

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- Attachment 2 Distribution of Waterbirds in the Study Area for Aerial Surveys 23-28 Combined.
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EXECUTIVE SUMMARY

Six aerial surveys and one boat survey were conducted between March 19 and June 2, 2003 to evaluate the abundance and distribution of waterbirds in Nantucket Sound and surrounding areas and to supplement previous surveys. The aerial surveys used the same standardized procedures as the previous surveys (March 2002 – February 2003) and focused on the same study area that included the three alternative sites within Nantucket Sound proposed for installation of wind turbines and the surrounding waters (Figure 1). The preferred site for the turbines is Alternative 1 (Figure 1). The aerial surveys were conducted by day in fair weather along 16 north/south transects in a study area of about 322 mi² (834 km²) that encompassed about 58% of Nantucket Sound. The study area excluded most of the immediate 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 mi² (168 km²) examined per survey. The boat survey was conducted on April 24, 2003 in the Horseshoe Shoal area of Nantucket Sound to complement the aerial surveys and to make observations of bird behavior. An additional aerial survey outside Nantucket Sound was flown on April 14, 2003.

A total of twenty-six (26) species of birds were observed during the aerial and boat surveys. Common Eiders, Long-tailed Ducks, and three species of scoters (black, surf and white-winged) accounted for the majority (~90%) of 45,133 individuals observed within the study area and 21,157 observed elsewhere in Nantucket Sound. A small proportion of the total individuals observed during these surveys were comprised of listed species (those on the Federal or Massachusetts lists of endangered, threatened, or candidate species). These included 94 Roseate Terns (a federally-listed endangered species) observed on the last two aerial surveys on May 12 and June 2 and 320 Common Terns (a Massachusetts's species of special concern and summer resident) first observed on April 18 (within Nantucket Sound) and observed on each survey thereafter. In addition, 304 mixed terns (typically flocks that contained both roseate and common terns) were observed on the last two aerial surveys. Common Loons, another species of special concern in Massachusetts, were observed on all 6 aerial surveys, peaking on April 23 and were relatively evenly distributed throughout the study area. Seaduck numbers peaked on March 25, whereas loons and gannets peaked on April 23. Gull and tern numbers increased as summer approached.

The densities of seaducks (the most common species) varied greatly among the alternative sites. Eider densities were greatest outside the three alternative sites with densities approximately 10, 6, and nearly 40 times those in Alternatives 1, 2, and 3, respectively. Long-tailed Duck densities were greatest in Alternative 2 with densities approximately 1.7, 4.7 and 2 times those in Alternative 1, Alternative 3, and outside of the alternative sites, respectively. Scoter densities were highest in Alternative 2 (same as the winter 2002), with densities over 5 and almost 4 times those in Alternatives 1 and 3, respectively. Razorbill densities within each of the Alternatives were at least two times those observed outside the alternative sites. Gulls, loons, and Northern Gannets were more evenly distributed but most common in Alternative 3. Tern densities were greatest in Alternative 1 with densities 2.2, 2.1 and 2.1 times those in Alternative 2, Alternative 3, and outside of the alternative sites, respectively.

In summary, excluding terns, the highest densities of waterbirds observed during the late winter/spring 2003 surveys occurred either in Alternative 2, Alternative 3 or outside of the three Alternatives. This is consistent with what was found in previous field studies.

Although neither of the survey methods (plane nor boat) enabled exact measurements of the height at which individual birds were flying, bird altitudes were estimated in relation to the height of the plane and the birds apparent distance from the water. Based on these characteristics, very few birds (154/5,251) were 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.

This report forms part of a series describing the waterbirds utilizing Nantucket Sound and is a 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). Information about the types and numbers of birds that occurred in Nantucket Sound and nearby areas during six (6) aerial surveys and one boat survey conducted from March 19 – June 2, 2003 is described in this report. The surveys focused on the areas within and around the three alternative wind park sites identified by the Applicant (Alternatives 1, 2, and 3). These surveys were conducted to corroborate the findings of the earlier studies in the winter/spring of 2002 (five flights: March 17 to April 5) (Appendix 5.7-D) and in the fall 2002/winter 2003 (eleven flights: September 25 to February 21) (Appendix 5.7-G). 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. The principal goal of these studies is to extend the quantitative material reviewed by Kerlinger and Hatch (Appendix 5.7-A, 2001) in their preliminary risk assessment and to assess the potential for Project impacts to waterbirds that use Nantucket Sound during the winter and the spring migration. 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.

To provide additional context for these surveys, this report includes observations on the distribution of species while in transit to/from the study area, principally in near-shore areas of the Sound and the findings of an aerial survey of waterbirds conducted outside Nantucket Sound, including Nantucket Shoals, flown on April 14, 2003 when many wintering birds remained.

2.0 METHODS

2.1 Location of Study Area and Alternative Sites

*The same area examined in all previous surveys was used for the late winter/spring 2003 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. A small portion of the study area, approximately 5 mi² (13 km²), was within 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 area due to its proximity to Alternative 2 and because Muskeget Island extends into Nantucket Sound. 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 area of each Alternative Site and that portion of the study area surrounding them are summarized in Table 1. The same areas examined in all prior surveys were examined for this study. The three alternative sites are:

- Alternative #1-Horseshoe Shoal, the Proposed Site for the Wind Park;
- Alternative #2-named Monomoy-Handkerchief Shoal, an area in the northeast part of the Sound; and
- Alternative #3-named 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 surveyed 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	Study Area (km ² /mi ²)	Kilometers ² /Miles ² 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

Six systematic aerial surveys of the study area were flown on March 17 and 24, April 18 and 23, May 12, and June 2, 2003. 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.

*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 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 day, at different tides and in various weather conditions (as discussed in Section 3.1), 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 foot) markers on the ground. The area visible between the float on the plane and the 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 GPS point. Each observer's sightings were also recorded on independent audiotapes linked directly to each headset to provide a recording as backup for each observer.

*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. 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 there are 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 six 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.

Outside Nantucket Sound

In addition to the opportunistic routes identified above, one systematic survey of areas outside of Nantucket Sound, including Nantucket Shoals, was conducted on April 14, 2003, when most wintering species were still present. This survey used the same methodology and observations methods as the systematic aerial surveys of the study area. Sixteen pre-determined transects (Figure 3) were flown: north/south in the area south of Martha's Vineyard and Nantucket and east/west in the area east of Nantucket and Monomoy Island. The extent of the survey was limited to the southeast due to national security reasons. For reasons of weather, the survey was not flown until April 14, 2003, however, most wintering species were present on that day.

The total distance flown for the aerial survey outside Nantucket Sound was approximately 386 linear miles (621 km (Figure 3). The north/south flightlines were defined in the north by landfall or the boundary with Nantucket Sound, and in the south by the US/International waters boundary or if there were no birds for a total of 4 minutes. East/west flightlines were defined by landfall and the Nantucket Sound boundary in the west, and US/International waters on the east. The US/International waters line could not be crossed in an aircraft because of increased government security.

Data Compilation for Aerial Surveys

*During the aerial surveys, as observations were made, the data were relayed verbally to the recorder, who entered a GPS point, species type, number, and activity into a database using a Trimble GeoExplorer 3C GPS unit. This GPS unit contains a data dictionary with preloaded attributes. Observer sightings were also recorded on 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 Survey

One boat survey was conducted on April 24, 2003 to complement the aerial surveys and to make observations of bird behavior. 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 and included seven transects over Horseshoe

Shoal (Figure 4). The boat traveled at about 10 knots (18.5 km/h) and was on the water for approximately seven hours. Specific attention was paid 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. Sea conditions were calm with little wind in the morning, increasing up to about 10 knots (18.5 km/h) with 1-2 foot swells in the afternoon.

*The survey team consisted of the captain and an observer (Jeffrey Burm). The captain was responsible for keeping the boat on course, while the observer recorded bird species, number of species, activity (i.e. foraging or flying), and altitude into a Global Positioning System (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 feet (6 m) interval. In practice, few birds were observed at altitudes near the rotor-swept zone.

Data Compilation

*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 the 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 aerial and boat surveys provided different information regarding avian use of Nantucket Sound. From the plane, the height chosen (250 ft (75 m)) provided abundance and density estimates via counts of birds within the transects that could 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 disturbed 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 26 bird species were observed during the aerial and boat surveys conducted between March and June 2003 (Table 2).

**Table 2
 Species Observed During the Late Winter/ Spring 2003 Aerial and Boat Surveys**

Common Name	Scientific Name
Red-throated Loon	<i>Gavia stellata</i>
Common Loon	<i>Gavia immer</i>
Grebe	<i>Podiceps sp.</i>
Wilson's Storm Petrel	<i>Oceanites oceanicus</i>
Northern Gannet	<i>Morus bassanus</i>
Great Cormorant	<i>Phalacrocorax carbo</i>
Double-crested Cormorant	<i>Phalacrocorax auritus</i>
Greater Scaup	<i>Aythya marila</i>

Common Name	Scientific Name
Common Eider	<i>Somateria mollissima</i>
Long-tailed Duck	<i>Clangula hyemalis</i>
Black Scoter	<i>Melanitta nigra</i>
Surf Scoter	<i>Melanitta perspicillata</i>
White-winged Scoter	<i>Melanitta fusca</i>
Goldeneye	<i>Bucephala sp.</i>
Bufflehead	<i>Bucephala albeola</i>
Red-breasted Merganser	<i>Mergus serrator</i>
Osprey	<i>Pandion haliaetus</i>
Oystercatcher	<i>Haematopus palliatus</i>
Bonaparte's Gull	<i>Larus delawarensis</i>
Herring Gull	<i>Larus argentatus</i>
Great Black-backed Gull	<i>Larus marinus</i>
Roseate Tern	<i>Sterna dougallii</i>
Common Tern	<i>Sterna hirundo</i>
Least Tern	<i>Sterna antillarum</i>
Dovekie	<i>Alle alle</i>
Razorbill	<i>Alca torda</i>

For total counts, eight groups of related species were often pooled together because of biological similarities and difficulties of identification under the conditions of the surveys, as follows: (1) loons: Common Loons greatly outnumbered Red-throated Loons but species could not always be determined; (2) grebes: Horned and Red-necked Grebes are the species commonly observed offshore within Nantucket Sound, but they were frequently not distinguishable; (3) cormorants: Double-crested and Great, (4) Common eiders: the large numbers of Common Eiders recorded might have included a very few King Eider (*Somateria spectabilis*) but none were identified; (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: Common and Roseate Terns were pooled when individuals could not be identified readily to species or if flocks were mixed with both 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 in the area (Veit and Petersen, 1993).

3.1 Aerial Surveys

Six aerial surveys were conducted between March 17 and June 2, 2003. 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 good visibility on all six surveys. Flights in heavy rain and wind were not conducted for safety reasons.

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 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 direct extrapolations were made from the observed densities to calculate numbers for the wider areas of interest. Extensive data are presented numerically and graphically in four Attachments. Maps showing the locations of sightings for each species of interest are presented in Attachment 2. All 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 Six Waterbird Aerial Surveys in Nantucket Sound, March - June 2003

Survey	Date	Start	Finish	Start Point ¹	High Tide ²	Wind	Temp F	Weather
A23	17-Mar-03	14:40	19:00	1 North	12:31	NNE 8-18 Knots	mid 60s	Clear
A24	24-Mar-03	4:18	18:28	16 South	17:02	NNE 6-15 Knots	high50s	Clear

Survey	Date	Start	Finish	Start Point ¹	High Tide ²	Wind	Temp F	Weather
A25	18-Apr-03	14:25	18:40	16 South	14:01	NW 10 Knots	mid 50s	Clear
A26	23-Apr-03	13:15	17:50	16 North	6:01	0-5 Knots	low 50s	Hazy
A27	12-May-03	6:15	10:49	16 North	9:09	0-2 Knots	low 30s	Clear
A28	2-Jun-03	15:49	20:00	16 North	14:38	NW 6-16 knots	low to mid 50s	Bright/clear

¹ Start Point refers to Figure 1.

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

3.1.1 Species and Abundances

A total of 22 species (Table 4) were observed during the six systematic aerial surveys conducted within the study area and a total of 26 were observed during all aerial surveys (including the opportunistic extension of the systematic aerial surveys conducted outside of the survey area and the aerial survey conducted outside of Nantucket Sound). Table 4 summarizes the total numbers recorded within and outside the study area and Attachment 1 provides the numbers recorded during each survey. The numbers presented from outside the study area during the opportunistic extension of these surveys have been broken down 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 area.

Within the study area, seaducks accounted for approximately 90% of all 45,133 birds observed during the aerial surveys conducted between March and June, 2003 (Table 4). These seaducks included scoters (13,591), eiders (21,993) and Long-tailed Ducks (4,863). The proportions of the three groups (30%:49%:11%) differed from earlier winters. The Winter 2002 surveys (Appendix 5.7-D) had proportions of 53%:26%:14% and the Fall 2002/Winter 2003 surveys (Appendix 5.7-G) had proportions of 50%:23%:21%. During the two previous surveys, scoters were the most abundant species; however, during this survey eiders were the most observed species.

Table 4
Numbers of Individuals Recorded in the Study Area During Aerial Surveys and Outside the Study Area on the Extended Flights March – June, 2003

Species	Total Within Study Area	Surveys	Total Outside Study Area		Total
			Nantucket Sound Area	Vineyard Sound/Buzzards Bay Area	
Loon (2): Common, Red-throated	1,753	6	65	18	1,836
Grebe (2): Horned and red-necked	124	6	4	0	128
Wilson's Storm Petrel	1	1	1	0	2
Northern Gannet	473	6	367	26	866
Cormorant (2): Great, Double-crested	114	5	205	286	605
Greater Scaup	14	1	0	0	14
Common Eider	21,993	5	14,950	5,760	42,703
Long-tailed Duck	4,863	4	543	2	5,408
Scoter (3): Black, White-winged, Surf	13,591	6	3,987	8,722	26,300
Goldeneye	0	0	3	0	3
Bufflehead	0	0	20	0	20
Redbreasted Merganser	166	4	91	5	262
Osprey	0	0	0	2	2
Oystercatcher	0	0	1	0	1
Herring Gull	111	6	259	18	388
Great Black-backed Gull	180	6	121	15	316
Unknown Gull	31	2	217	25	273
Roseate Tern	94	2	8	62	164
Common Tern	320	4	164	198	682
Least Tern	3	2	63	1	67
Mixed Tern	304	2	70	16	390
Dovekie	5	2	0	0	5
Razorbill	993	4	18	29	1,040
Total	45,133		21,157	15,185	81,475

Loons were less common than seaducks in the study area, totaling 1,753 sightings and peaking in abundance in late March through April. Less than 1,000 individual gannets, terns and razorbills were observed within the study area during these aerial surveys (Table 4).

Outside the study area during the extended flights, seaducks again predominated and there were relatively larger numbers of cormorants, gulls, and inshore ducks compared to those observed within the study area (Table 4). It should be noted that the study area was sampled with 16 systematic flightlines (repeated survey lines) whereas the surrounding areas were sampled over 6 different routes, so the absolute numbers are not comparable.

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 Gannets, Cormorants, Eiders, Long-tailed Ducks, Scoters, Mergansers, Gulls, Terns, and Razorbills) within the study area by combining the observations during the six aerial surveys.

The maps show that the dispersion of some species within the study area was not uniform. There were locations within the study area that had much greater numbers of several species and other areas that had much lower numbers. For example, the largest numbers of eiders were consistently 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. This is strikingly similar to the distribution documented during the winter 2002 surveys (Appendix 5.7-D) and the fall 2002/winter 2003 surveys (Appendix 5.7-G). Long-tailed Ducks were found in largest numbers west of Monomoy, and in the southern section of the study area near Tuckernuck Island.

The scoter pattern was not as distinct, but numbers were greatest in the eastern and southern portions of the study area. Other species, like loons and razorbills, were spread more evenly over a much larger area without distinct clusters. Gannets were present in larger numbers in this late winter/spring 2003 survey compared to the 2002 late winter/spring study. Grebes and mergansers were more abundant in the southern part of the study area.

The three numerically dominant species groups (scoters, eiders, and Long-tailed Ducks) were not evenly distributed within the study area (Table 5, also see Attachment 2). Density (individuals per km²) was measured by adding individuals from the six aerial surveys and dividing by square kilometers flown within each of the alternatives and outside areas surrounding the three alternatives. The "outside area" is defined as the zone within the study area and outside the alternatives. For scoters, the density of birds in Alternative 2 was greater than within any of the other two sites and the "outside area". The density within Alternative 2 was more than 5 times that observed in Alternative 1 and more than 3 times that of Alternative 3 and the "outside area". Alternative 3 had the second highest density of the three alternative areas. For eiders, the density outside of the three alternative sites was much greater than any of the Alternatives. The "outside area" hosted about 177 birds per km² vs. 4 to 27 per km² in the three alternative sites. For Long-tailed Ducks the density was greatest in Alternative 2 (58/km²).

Table 5
Densities (individuals/km²) of Waterbirds Observed within the Study Area During Aerial Surveys

Species	Alternative 1	Alternative 2	Alternative 3	Outside Area*	Total Area Density
Loons	14.33	8.16	14.76	9.34	10.43
Grebe	0.52	0.31	1.13	0.76	0.74
Gannet	4.62	0.71	6.01	2.23	2.82
Cormorants	0.0	0.0	0.18	0.92	0.68
Eider	17.67	27.76	4.52	176.69	130.91
Long-tailed Duck	34.86	59.69	12.62	27.69	28.95
Scoters	51.24	268.78	71.37	72.11	80.90
Merganser	0.1	0.0	0.0	1.36	0.99
Gulls	2.29	0.51	2.74	1.85	1.92
Tern	7.86	3.67	3.81	3.79	4.29
Razorbill	9.71	10.51	8.87	4.46	5.91

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

The remaining species, including loons, grebes, gannets, cormorants, mergansers, gulls, razorbills, terns, and the others were thinly spaced throughout the survey areas. The densities of these groups ranged from a high of 14.7 loons per km² in Alternative 3 to a low of 0 cormorants per km² in Alternatives 1 and 2 and 0 mergansers per km² in Alternatives 2 and 3. These species were also not distributed evenly. For species such as gulls, the densities in Alternatives 1 and 3, for example, were more than five times the density in Alternative 2. Gannet densities in Alternatives 1 and 3 were more than six times the density of Alternative 2. Tern density ranged from 3.6 to 7.9 individual per km². Alternative 1 had the highest density of terns (7.9 km²) and was almost two times that of the other two alternatives and the "outside" area. Among the other species (including loons, grebes, cormorants, mergansers, and razorbills), differences in densities were less evident.

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). Cormorants and gulls were more common outside the study area than within the study area. The majority of gulls and cormorants were observed close to Monomoy Island, along the south shore of Cape Cod and the Elizabeth Islands. Numbers of eiders observed were similar within and outside the study area and they were primarily observed between Gay Head on Martha's Vineyard and Noman's Land, in areas that are not shown on the distribution maps. On March 19, 2003, about 5,500 eiders were observed outside the study area, approximately 3 miles south of Monomoy Island. Other notable observations from outside the Nantucket Sound study area include large flocks (up to 3,000 individuals) of mixed scoters southwest of Martha's Vineyard, off Gay Head and Squibnocket.

3.1.4 Distribution of Waterbirds Outside Nantucket Sound During April 14, 2003 Survey

During the systematic aerial survey conducted outside Nantucket Sound on April 14, 2003 (Table 6), a total of 17 species and 15,825 individuals were observed. The only species observed that was not seen on the aerial surveys flown within Nantucket Sound during this season was the Bonaparte's Gull. Over 85% of the observed individuals were scoters (5,935), eiders (4,895) and Long-tailed ducks (2,850). Loons (891) and Razorbills (607) were also frequently observed.

Table 6
Numbers of Individuals and Density on the Survey Conducted Outside Nantucket Sound, April 14, 2003

SPECIES	Number of Individuals	Density Individuals/km²
Red-throated Loon	64	0.26
Common Loon	802	3.23
Mixed Loons	25	0.10
Grebe	19	0.07
Gannet	301	1.21
Cormorant	111	0.45
Eiders	4,895	19.74
Long-tailed Duck	2,850	11.49
Black Scoter	617	2.49
Surf Scoter	1,488	6.00
White-winged Scoter	311	1.25
Scoters Mixed	3,519	14.19
Red-breasted Merganser	78	0.32
Bonaparte's Gull	9	0.04
Herring Gull	87	0.35
Great Black-backed Gull	25	0.10

SPECIES	Number of Individuals	Density Individuals/km ²
Common Terns	6	0.02
Dovekie	11	0.04
Razorbill	607	2.45
Total	15,825	

3.2 Boat Survey

One boat survey was conducted on April 25, 2003 to study the presence and behavior of birds when boats are in the area. Details of the time, date, tide and weather condition are summarized in Table 7. During the boat survey, Horseshoe Shoal was visited and observations were made on species present, as well as their numbers, altitude, direction of flight, and other behaviors (Figure 4).

Table 7
Summary of Date, Time, and Weather Condition during the Waterbird Boat Survey in Nantucket Sound, April 25, 2003

Survey	Date	Start	Finish	High Tide ¹	Wind	Temp °F	Weather
B10	25-Apr	7:10	8:15	13:24	SW 3-10 Knots	40s	Sunny

¹ High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts (www.harbertides.com)

3.2.1 Species and Abundances

A total of 12 species were observed during the boat survey (Table 8), all of which were also seen on the aerial surveys. The majority of the 1,877 individuals observed were scoters (1,392), of which nearly half were Surf Scoters. The next most common species was Common Eiders (155). This is consistent with what was observed during the Fall 2002/Winter 2003 surveys, Appendix 5.7-G. Of the 1,877 individuals observed from the boat, 1572 were flying. This is primarily a result of seaducks flying away after being disturbed by the boat and is not reflective of their behavior in the absence of this disturbance. For example, during aerial surveys, seaducks were rarely disturbed by the plane and most were observed on the water. Common loons and Red-throated Loons exhibited different behaviors toward the boat with Common Loons more frequently observed on the water and Red-throated Loons more frequently observed flying during the boat surveys. This suggests that Common Loons may be more tolerant of boat traffic than Red-throated Loons.

Table 8
Boat Survey Observations for April 25, 2003

Species	Flying	On water	Total Number
Red-throated Loon	37	0	37
Common Loon	7	48	55
Northern Gannet	90	42	132
Double-crested Cormorant	1	11	12
Common Eider	137	18	155
Long-tailed Duck	64	2	66
Black Scoter	221	0	221
Surf Scoter	465	175	640
White-winged Scoter	92	0	92
Unknown Scoter	439	0	439
Great Black-backed Gull	13	7	20
Herring Gull	4	0	4
Razorbill	2	2	4
Total	1,572	305	1,877

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 ft). More than 45,133 individuals were observed, most of which were on the water surface or flying close to it. Of the 3,679 individuals observed flying, 130 (3.5%) were flying within the range of the rotors (75-417 feet (23-127 m)) (Table 9). Fifty-one (1.4%) of these individuals were Great Black-backed

and Herring Gulls flying at various heights up to 250 feet (76 m) and 16 were Northern Gannets (0.43%) observed flying at rotor height and up to about 220 feet (67 m) asl. Fifty-two individuals (1.4%) were terns observed flying at rotor height on the June 2, 2003 survey, of which, a flock of 50 mixed terns were at about 150 feet (46 m) asl. All the terns observed flying at rotor height were close to Monomoy Island outside the three alternatives.

**Table 9
Altitude of Flying Waterbirds Observed From the Plane (250 feet asl)**

Species	Altitude (Feet)					Total
	<20	21-40	41-60	61-80*	80+**	
Loon	82	3	0	1	3	89
Grebe	4	0	0	0	1	5
Cormorant	15	0	0	0	0	15
Gannet	217	14	6	5	12	254
Eider	764	0	4	0	0	768
Long-tailed Duck	393	0	0	0	0	393
Scoter	1,158	1	1	2	1	1,163
Merganser	71	0	0	0	0	71
Gull	90	7	19	4	48	168
Tern	656	7	6	0	52	721
Razorbill	29	0	0	0	3	32
Total	3,479	32	36	12	120	3,679

* Ten of the twelve individuals in the 61-80 foot range were at turbine blade height (75+ feet)(1 loon, 4 gannets, 2 scoters and 3 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 1,572 flying waterbirds (Table 10), 100% of the birds observed flying. Of these, 1,417 (90%) were flying less than 21 feet (6 m) from the water surface, 53 (3%) were between 21-40 feet, 75 (5%) were between 41-60 feet, 11 (<1%) were between 61-80 feet, and 16 (1%) were above 80 feet (24 m). Eight of the 11 species observed flying between 61 and 80 feet and all of the species observed flying above 80 feet were within the proposed rotor height. The birds flying at rotor height included 11 gulls (seven on Horseshoe Shoal) and 10 gannets (all on Horseshoe Shoal). The only other species observed flying at rotor height were loons (1), scoters (1) and cormorants (1). Many of the low-flying individuals, especially seaducks, had been flushed by the boat.

**Table 10
Altitude of Flying Waterbirds Observed From the Boat**

Species	Altitude (Feet)					Total
	<21	21-40	41-60	61-80*	80+**	
Loon	25	16	1	1	1	44
Eider	119	18	0	0	0	137
Long-tailed Duck	64	0	0	0	0	64
Scoter	1,199	15	2	0	1	1217
Gull	0	0	5	5	7	17
Razorbill	2	0	0	0	0	2
Gannet	8	4	67	5	6	90
Cormorant	0	0	0	0	1	1
Total	1,417	53	75	11	16	1,572

* Eight of the eleven individuals in the 61-80 foot range were at turbine blade height (75+ feet)(4 gannet, and 4 gulls).

** All of the individuals in the 80+ foot range were within turbine blade height.

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

This report principally summarizes bird observations during seasons dominated by winter residents and spring migrants, with small extensions to summer residents.

4.1 Numbers, Distribution and Behavior of Species Present

This section combines the results of the systematic aerial and boat surveys conducted between March and June 2003 and provides a composite summary and interpretation of the numbers and distribution of each group of birds. The aerial surveys provide quantitative data for the study area, including 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. The numbers reported from the aerial surveys are based on surveying 20% of the area through gridline transects and include the number of birds that were observed/recorded within these transects. These numbers are not meant to represent the total numbers of birds present within each area. The total number present for the most numerous species are estimated in Attachments 3 and 4.

Loons – Loons were observed during all six systematic aerial surveys. Their numbers were highest in late March and late April. These peaks likely reflect the use of Nantucket Sound as a staging area during migration. This is consistent with the trend observed in 2002 (See Appendix 5.7-D and Appendix 5.7-G). A total of 1,753 individuals were observed within the study area during the systematic aerial surveys; however, of the 1,753 sightings, 1,124 occurred outside of the three alternative sites. Another 83 were observed during the additional flightlines outside the study area. A total of 92 individuals were observed during the boat survey. An additional 891 individuals were observed during the aerial survey conducted outside Nantucket Sound on April 14, 2003. Loons occurred singly or in small parties on the water, rarely flying. Of those observed flying, only five individuals were flying within the height range of the rotors. The observed occurrences are consistent with historical reports (Veit and Petersen, 1993).

Grebes – Two species of grebes (horned and red-necked) occur as winter residents within Nantucket Sound. A total of 124 individuals were observed within the study area and were seen during all six of the aerial surveys. However, the majority of the individuals observed (91) were outside the three alternative sites, with most individuals found in the southern part of the study area. They occurred singly or in small flocks on the water, rarely flying. None were observed during the boat survey. Only 4 individuals were observed during the additional flightlines outside the study area. During the survey outside Nantucket Sound on April 14, 2003, 19 individuals were observed. Of those grebes observed flying, only one was flying within the height range of the rotors.

Wilson's Storm-Petrel – Only one individual was observed, during the June 2, 2003 aerial survey. Storm-Petrels are pelagic summer visitors that are occasionally observed flying close to the water's surface.

Northern Gannet – This species was observed on all six systematic aerial surveys with peak numbers in late April. Of the 473 observed within the study area, 416 were seen during 2 surveys in late April and early May, reflecting the northward migration of this species. This is consistent with observations from the winter 2002 surveys (See Appendix 5.7-D). Aerial surveys showed gannets to be more abundant in the southern and eastern parts of the Sound (Attachment 2). There was one large flock of about 300 individuals observed just north of the study area on April 18, 2003. Gannets were observed both on the water and flying, with a total of 26/344 individuals observed flying at rotor height. There were also 393 observed during the additional flightlines and 301 observed outside Nantucket Sound on April 14, 2003. During the boat survey 132 individuals were observed.

Cormorant – Double-crested Cormorants were observed in small numbers within the study area. Great Cormorants may have been present but mistaken for the smaller double-crested cormorant during the early surveys. Of the 114 observed within the study area, 94 were observed on the last aerial survey flown on June 2, 2003. This is consistent with the winter 2002 aerial survey observations. Most cormorants were observed outside the alternative sites. Within the alternative sites, none were seen within Alternative Sites 1 or 2, and only 3 individuals were observed within Alternative Site 3.

This species was observed at daytime resting areas on Bishop & Clerks' Lighthouse and the sandbars near Muskeget Island. They were also frequently observed (491 individuals) on the additional flightlines along the shoreline south of Cape Cod and along the Elizabeth Islands. A large flock of about 200 individuals was observed on the Weepecket Islands, a known cormorant nesting area, on April 18, 2003. Only 12 individuals were observed on the boat survey. During the April 14, 2003 aerial survey outside Nantucket Sound, 111 individuals were recorded. Only one individual was observed flying within the height range of the rotors.

Common Eider – This species is abundant in winter. Eiders were the most abundant species within Nantucket Sound, with a total of 21,993 individuals recorded during aerial transects in the study area. They were observed on five of the six systematic aerial surveys, the boat survey, the additional flightlines surveys, and the April 14 aerial survey outside Nantucket Sound. Eiders were abundant during the first two aerial surveys with their numbers declining in April. This is consistent with past survey results (See Appendices 5.7-D and 5.7-F). Eiders reached their peak in late March with a total of 13,790 observed within the study area. A total of 155 individuals were observed on the boat survey with the majority observed flying and some observed on the water's surface. The majority of the eiders seen within the study area were observed outside the three alternatives in the southern section of Nantucket Sound (177/km²). There were also considerable numbers found in Alternative 1 (18/km²) and Alternative 2 (28/km²). Few individuals were observed in Alternative 3 (4.5/km²). An additional 20,710 were observed outside the study area on the additional flightlines. On the April 14, 2003 aerial survey, 4,895 individuals were observed, when large flocks were seen to the west of Martha's Vineyard and south of Cuttyhunk. Flock sizes recorded within transects ranged from 1 to 3,000 individuals. None of the eiders observed flying were flying within the height range of the rotors.

Long-tailed Duck – This species is abundant in the winter. It was seen on the first four aerial surveys conducted within the study area. Long-tailed Ducks numbers peaked in late-March and none were observed after April 23, 2003, suggesting that migrants leave Nantucket Sound and surrounding waters between these dates. A total of 4,863 individuals were observed within the study area during the systematic aerial surveys. They were more common outside the three alternative sites, with the greatest concentrations in the eastern section of the study area near Monomoy Island. The lowest densities occurred in Alternative 3 (12.6/km²). Flock sizes ranged from 1 to 300 individuals. A total of 66 individuals were observed during the boat survey. There were also 545 individuals observed on the additional flightlines and 2,850 observed on the April 14, 2003 aerial survey. None of the long-tailed ducks observed flying were flying within the height range of the rotors.

Long-tailed ducks are commonly believed to fly between night roosts in Nantucket Sound and daytime feeding areas in the ocean south of Nantucket and Tuckernuck Islands. Several attempts were made during the aerial surveys to investigate these movements but all were unsuccessful, perhaps because the birds start moving before sunrise and after sunset.

Scoters – Scoters were the second most abundant species group observed within Nantucket Sound, with a total 13,591 individuals observed within the study area and an additional 12,709 observed outside of the study area on the additional flightlines. An additional 5,935 individuals were observed on the April 14, 2003 aerial survey. Scoter numbers peaked in late March with a total of 5,438 individuals seen on the March 24, 2003 flight. Thereafter, fewer were observed (only 595 on May 12 by which date most had left). The few individuals that were observed as late as June could have been lingering migrants or injured individuals, but no evidence of this was found. A total of 1,392 individuals were observed on the boat survey. Scoters were seen throughout the study area with the highest density in Alternative 2 (269/km²) and they were more common in the eastern part of the study area (Attachment 2). Alternative 1 had the lowest density (51.2/km²). There were also large numbers of scoters observed southwest of Martha's Vineyard in flocks numbering up to 3,000 individuals. Of those observed flying, only four individuals were flying within the height range of the rotors.

Mergansers – Red-breasted Mergansers were seen on four of the six systematic aerial surveys and were also observed on some of the extended flightlines outside the study area. Of the 166 individuals observed within the study area, only two individuals were recorded within Alternative 1, the rest were observed near Muskeget and Tuckernuck Islands. They were also observed outside the study area, close to Monomoy Island. An additional 78 individuals were observed on the aerial survey outside Nantucket Sound (April 14, 2003), but all were within 2 miles of the shoreline. No mergansers were observed during the boat survey conducted on Horseshoe Shoal and none were observed flying within the height range of the rotors.

Gulls – Within the study area, the Great Black-backed gull was the most common gull observed during the aerial surveys (180 individuals) and the boat survey (20 individuals). They were observed on all six systematic aerial surveys within the study area. Herring gulls were also observed on all six systematic aerial surveys (111 individuals) and 4 individuals were also observed on the boat survey. During the survey conducted outside Nantucket Sound on April 14, 2003, herring gulls were more common (87) than great black-backed gulls (25). There were also nine Bonaparte's Gulls observed during the survey conducted outside Nantucket Sound.

During the flights, the gulls were more abundant in the southwestern part of the Sound (Alternative 3) and off Monomoy Island, and the incidental observations from the plane suggest that many more gulls occurred close to the shore than over the open water. Of the gulls observed flying, 62 were within the height range of the rotors.

Terns – Terns are abundant in Nantucket Sound during the spring and summer (see Appendix 5.7-F) but are generally absent from the Nantucket Sound area between late October and April (Veit and Petersen 1993). Small numbers of Common terns were observed within the study area in April and numbers started to increase in May. The first Common terns were seen on April 14, 2003 during the survey conducted outside Nantucket Sound. They were first seen within the study area on April 18, 2003. Tern numbers increased rapidly in subsequent surveys later in the spring and three species (Common, Least and Roseate) were seen in May. A total of 320 Common, 94 Roseate, 3 Least, and 304 mixed terns were observed within the study area. Tern density within the study area ranged from 3.7 to 7.9 individual per km². Alternative 1 had the highest density of terns (7.9 km²) and was almost two times that of the other two alternatives and the "outside" area. Fifty-two mixed terns (one flock included 50 individuals) were observed flying within the height range of the rotors. All of the terns observed flying at rotor height were close to Monomoy Island, outside the three alternatives.

Razorbill – This species is fairly common during winter in Nantucket Sound. Razorbills were observed on the aerial surveys from March through April, which is consistent with the Winter 2002 survey observations (see Appendix 5.7-D). A total of 993 individuals were observed within the study area during the systematic aerial surveys with Alternative 2 having the highest density (10.5/km²). This species was relatively evenly distributed in small numbers throughout the rest of the study area. A few individuals (47) were observed outside the study area on the additional flightlines and 607 individuals were observed on April 14, 2003 during the survey conducted outside Nantucket Sound. Only 4 individuals were observed during the boat survey. Of those razorbills observed flying, only 3 were flying within the height range of the rotors.

Other Species – Seven additional species were observed during the surveys (Table 2), but in such low numbers that they do not comprise important components of the Nantucket Sound avian community.

4.2 Conclusion

The surveys conducted between March and June 2003, like those in winter/spring 2002 and fall/winter 2002/2003, 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. The most notable differences from prior surveys (March 2002-April 2002 (Appendix 5.7-D) and September 2002-February 2003 (Appendix 5.7-G)) were that eiders were the most abundant species and the density of terns was greatest in Alternative 1. Prior to these surveys, scoters were consistently the most abundant species when they are present in or migrating through the area. Many scoters may have left the area when Nantucket Sound froze in February 2003 while eiders remained in the area.

Although tern density was greatest in Alternative 1, there were more terns in the vicinity of Alternatives 2 and 3 (Attachment 2). During the summer of 2002 field investigations, terns were relatively evenly distributed throughout the three alternatives and had the highest density outside the three alternatives (near Monomoy Island and the southern part of the study area (Appendix 5.7-F). This is consistent with what was found by Perkins et al. (2003).

Aside from the Roseate and Common Terns, the species found were mostly common birds, and not species that are endangered, threatened, or candidates for such listing. A total of 94 Roseate and 304 mixed terns were

observed during two aerial surveys and 320 Common terns were observed on three aerial surveys. The mixed terns were typically flocks that contained both roseate and common terns.

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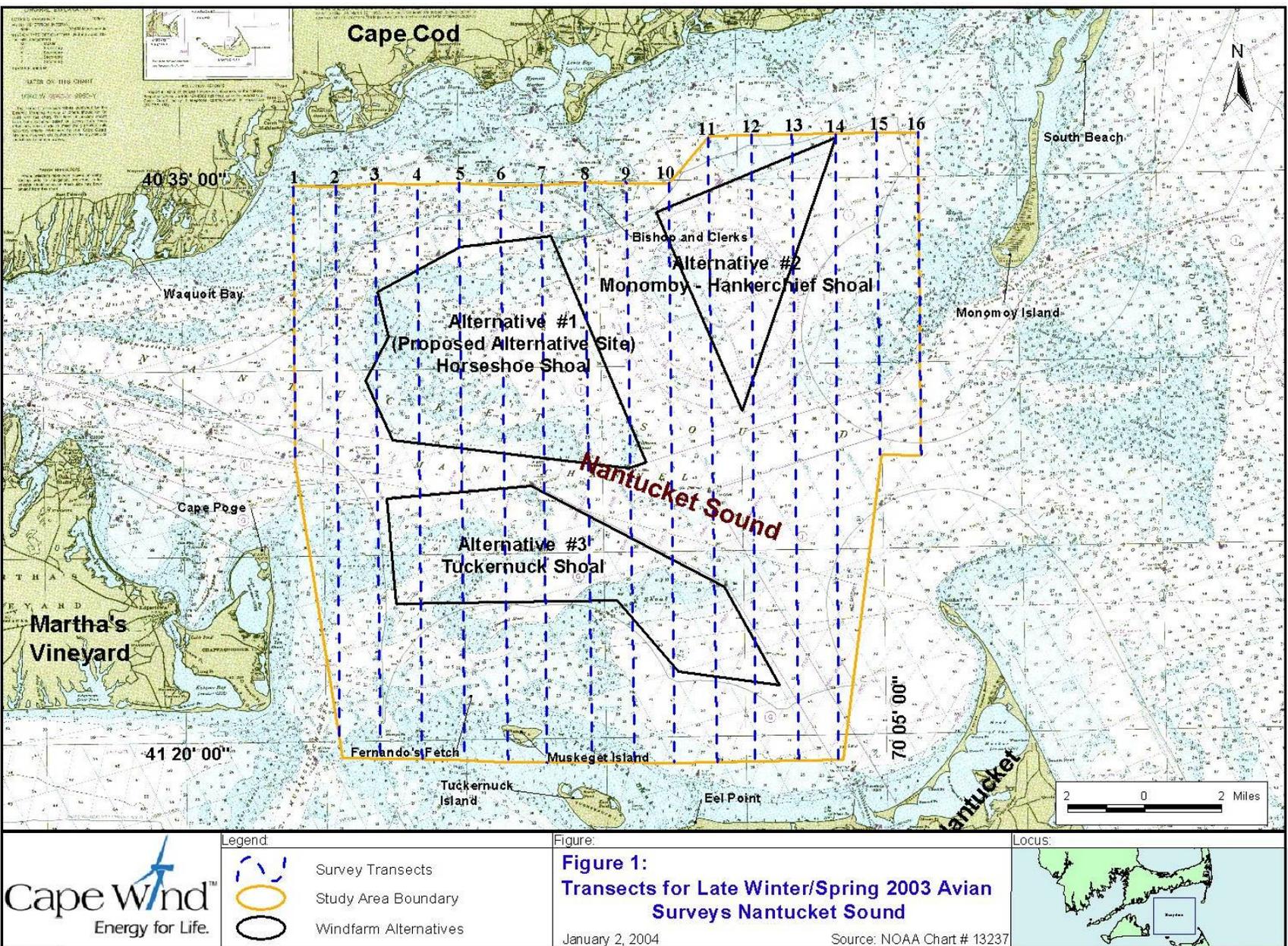
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Figures

Figure 1 - Transects for Late Winter/Spring 2003 Avian Aerial Surveys Within Nantucket Sound



**Figure 2 - Flightlines For the 6 Additional Routes Outside of the Study Area During Aerial Surveys
 March – June 2003.**

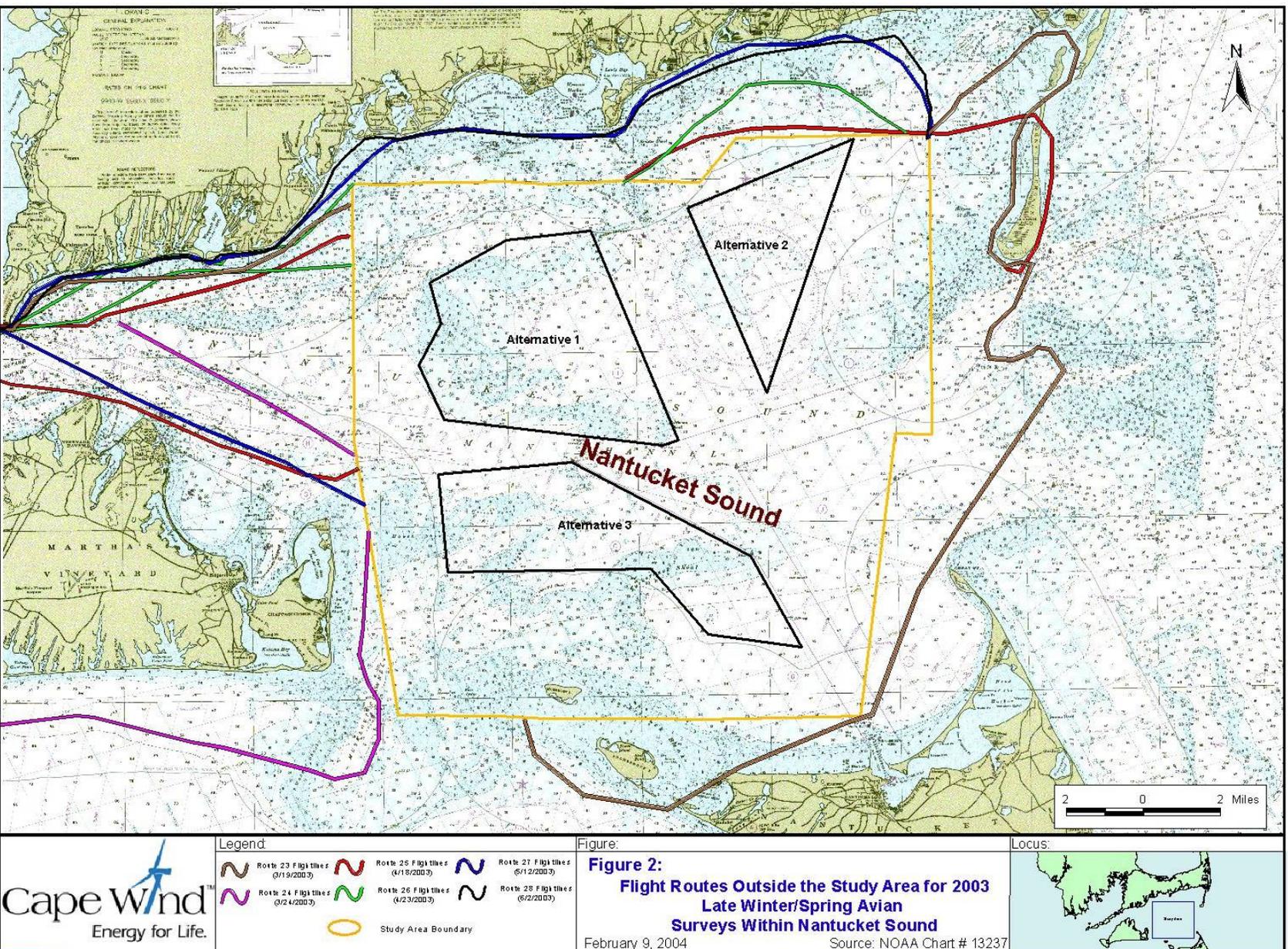


Figure 3 - Transects for April 14, 2003 Avian Survey Outside Nantucket Sound

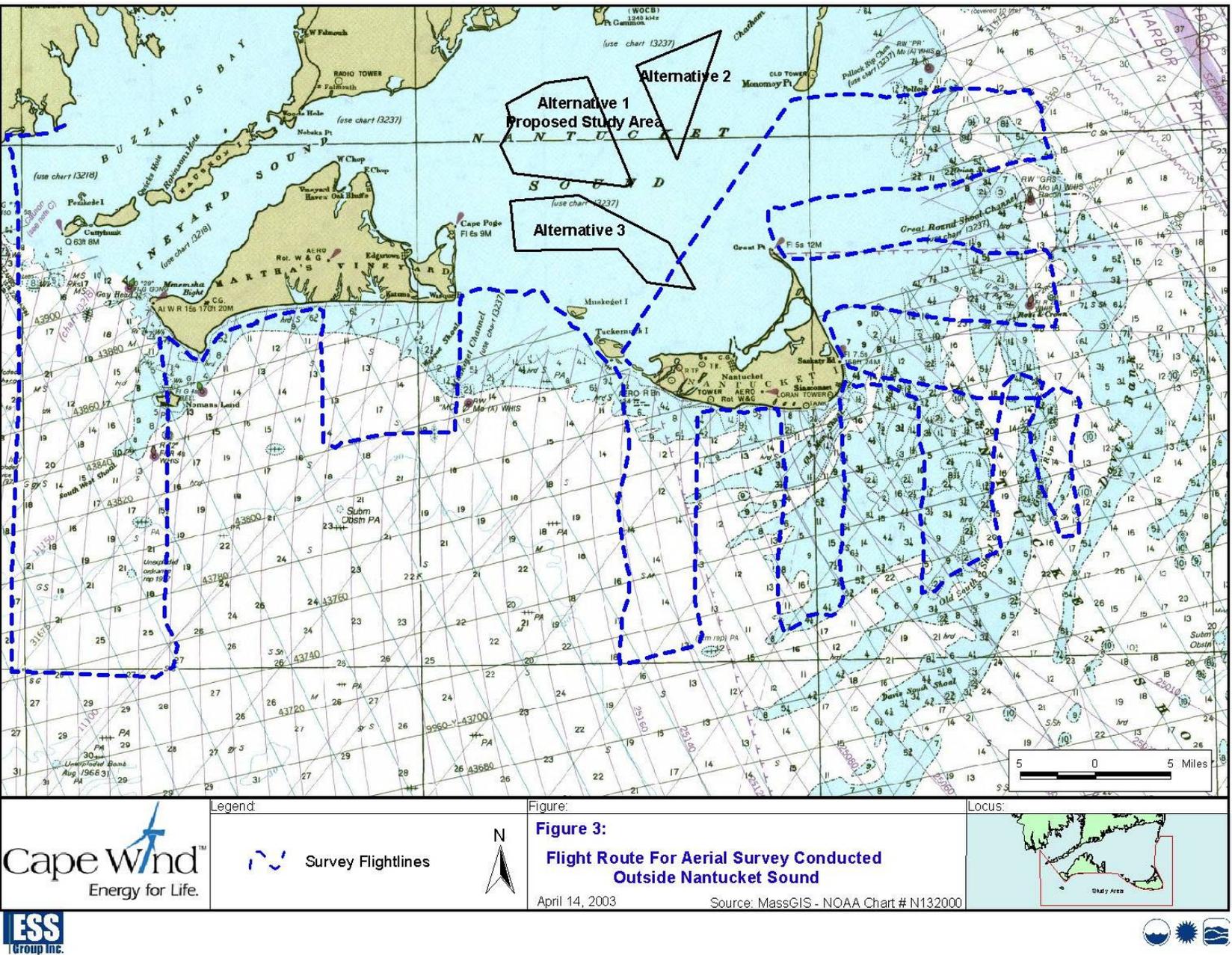
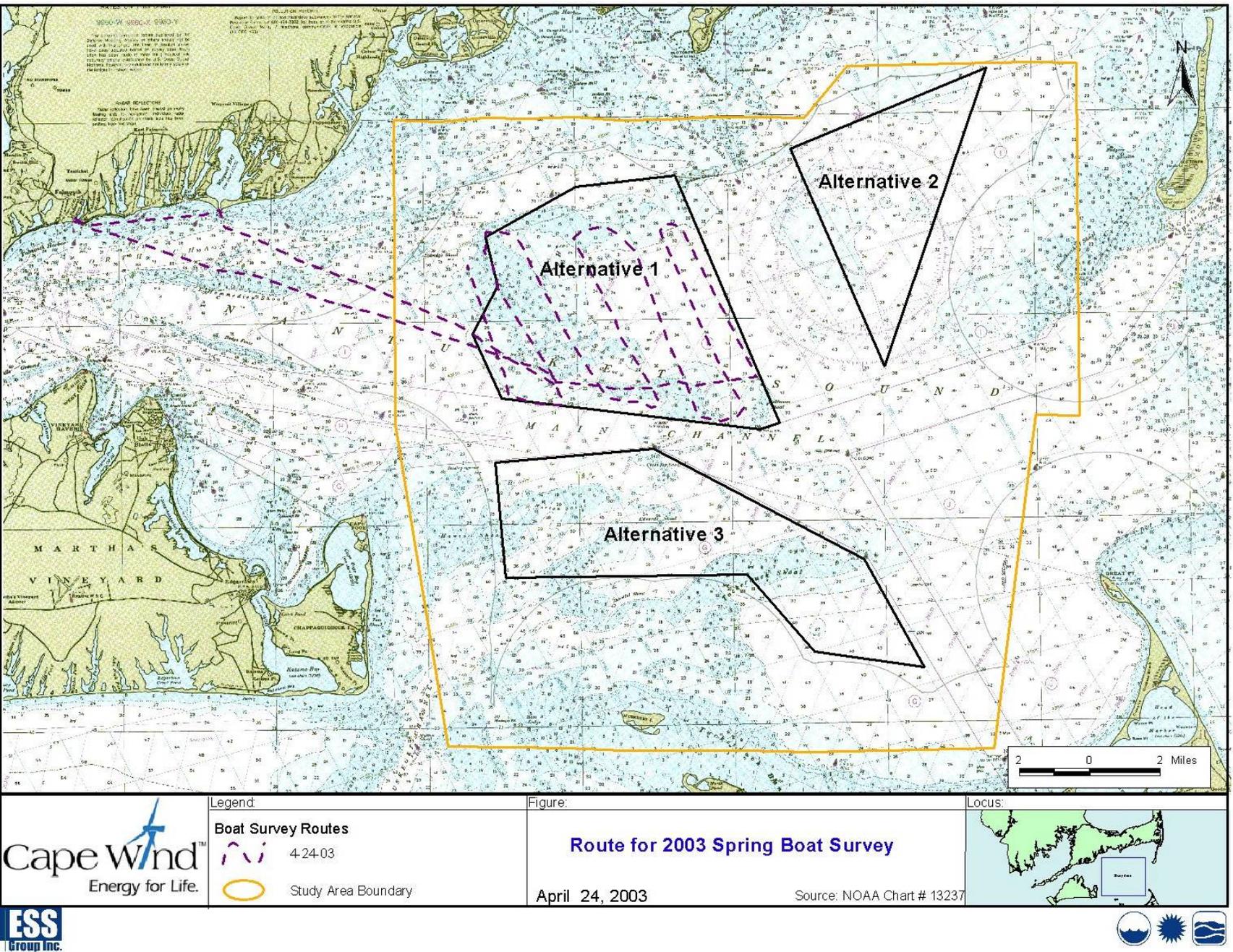


Figure 4. Routes For Boat Survey, April 24, 2003.



ATTACHMENT 1

Numbers of Individuals Observed
On Each of the 6 Aerial Surveys
In Nantucket Sound, MA,
March - June 2003

Table A. Species Totals: Individuals Recorded Within the Study Area During Six Systematic Aerial Surveys

Species	March 19, 2003	March 24, 2003	April 18, 2003	April 23, 2003	May 12, 2003	June 2, 2003	Totals
Loon (2): Red-throated and Common	119	495	253	649	187	50	1,753
Grebe	18	57	24	18	5	2	124
Wilson's Storm Petrel	0	0	0	0	0	1	1
Northern Gannet	5	6	43	295	121	3	473
Cormorant (2) Great and Double-crested	2	0	8	9	1	94	114
Greater Scaup	0	0	0	0	0	14	14
Common Eider	5,687	13,790	1,900	610	6	0	21,993
Long-tailed Duck	1,664	2,870	267	62	0	0	4,863
Scoter (3): Black, Surf and White-winged	2,693	5,438	2,317	2540	595	8	13,591
Goldeneye	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0
Red-breasted Merganser	43	80	20	23	0	0	166
Osprey	0	0	0	0	0	0	0
Oystercatcher	0	0	0	0	0	0	0
Herring Gull	17	25	1	32	9	27	111
Great Black-backed Gull	15	6	17	32	69	41	180
Unknown Gull	1	0	0	0	0	30	31
Roseate Tern	0	0	0	0	81	13	94
Common Tern	0	0	2	15	246	57	320
Least Tern	0	0	0	0	2	1	3
Mixed Tern	0	0	0	0	197	107	304
Dovekie	3	0	2	0	0	0	5
Razorbill	117	433	173	270	0	0	993
Total	10,382	23,202	5,027	4,555	1,519	448	45,133

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

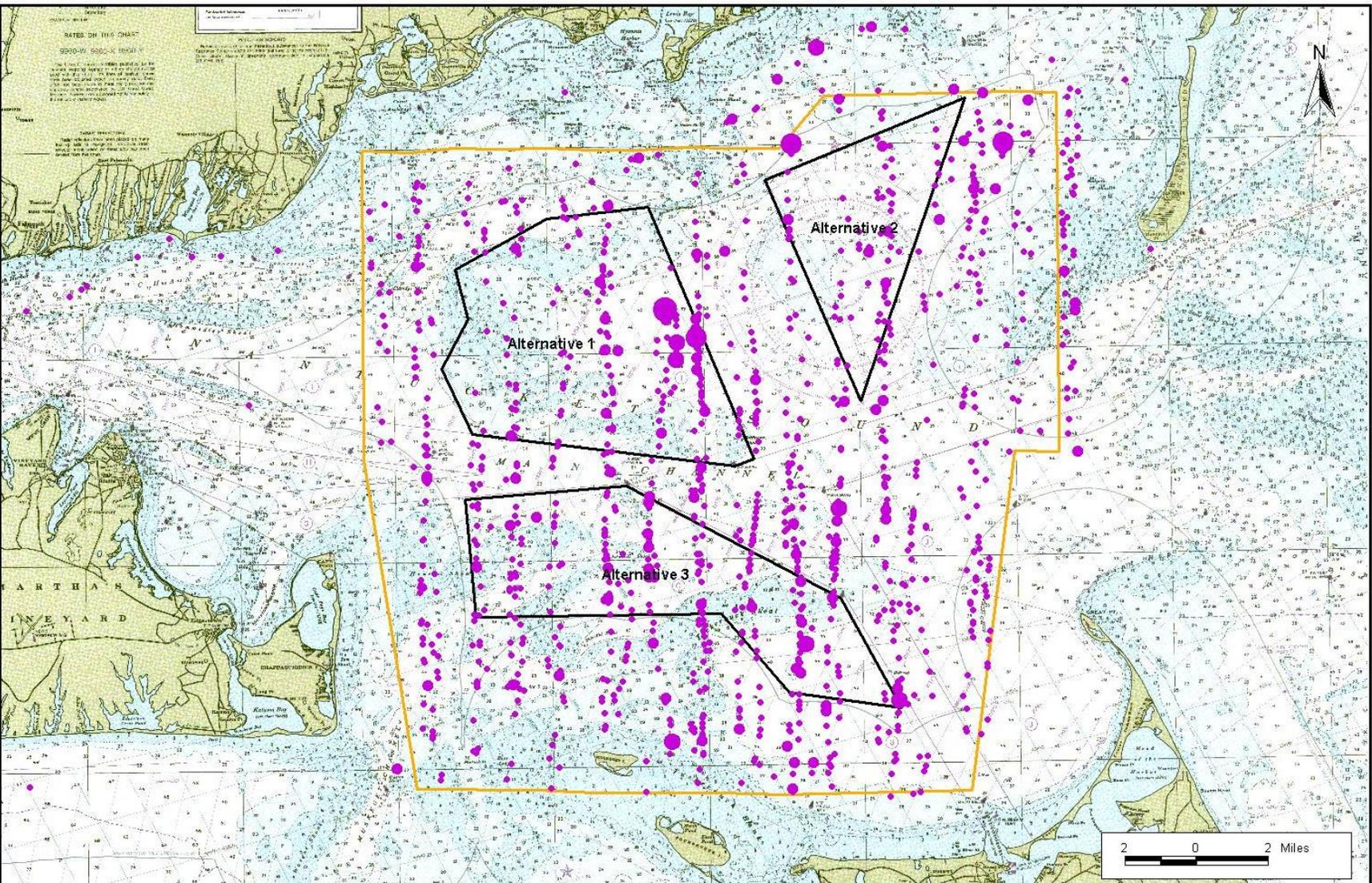
Species	March 19, 2003	March 24, 2003	April 18, 2003	April 23, 2003	May 12, 2003	June 2, 2003	Totals
Loon (2): Red-throated and Common	1	1	19	41	3	0	65
Grebe	1	0	2	0	1	0	4
Wilson's Storm Petrel	0	0	0	0	0	1	1
Northern Gannet	0	30	311	21	5	0	367
Cormorant (2) Great and Double-crested	0	0	20	41	61	83	205
Greater Scaup	0	0	0	0	0	0	0
Common Eider	6,993	7,700	22	233	2	0	14,950
Long-tailed Duck	434	105	4	0	0	0	543
Scoter (3): Black, Surf and White-winged	2	3,800	108	71	6	0	3,987
Goldeneye	1	0	2	0	0	0	3
Bufflehead	20	0	0	0	0	0	20
Red-breasted Merganser	75	0	3	5	6	2	91
Osprey	0	0	0	0	0	0	0
Oystercatcher	0	0	0	1	0	0	1
Herring Gull	172	0	3	1	30	53	259
Great Black-backed Gull	0	0	11	2	59	49	121
Unknown Gull	172	0	0	0	25	20	217
Roseate Tern	0	0	0	0	7	1	8
Common Tern	0	0	2	96	30	36	164
Least Tern	0	0	0	0	49	14	63
Mixed Tern	0	0	0	0	60	10	70
Dovekie	0	0	0	0	0	0	0
Razorbill	6	0	6	5	1	0	18
Total	7,877	11,636	513	517	345	269	21,157

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

Species	March 19, 2003	March 24, 2003	April 18, 2003	April 23, 2003	May 12, 2003	June 2, 2003	Totals
Loon (2): Red-throated and Common	0	3	0	9	6	0	18
Grebe	0	0	0	0	0	0	0
Wilson's Storm Petrel	0	0	0	0	0	0	0
Northern Gannet	0	15	3	8	0	0	26
Cormorant (2) Great and Double-crested	2	0	232	2	49	1	286
Greater Scaup	0	0	0	0	0	0	0
Common Eider	110	5,526	28	35	61	0	5,760
Long-tailed Duck	0	0	0	2	0	0	2
Scoter (3): Black, Surf and White-winged	0	8,521	10	191	0	0	8,722
Goldeneye	0	0	0	0	0	0	0
Bufflehead	0	0	0	0	0	0	0
Red-breasted Merganser	3	0	0	0	2	0	5
Osprey	0	0	2	0	0	0	2
Oystercatcher	0	0	0	0	0	0	0
Herring Gull	1	0	0	0	17	0	18
Great Black-backed Gull	0	0	4	3	4	4	15
Unknown Gull	0	0	0	0	25	0	25
Roseate Tern	0	0	0	0	52	10	62
Common Tern	0	0	0	0	45	153	198
Least Tern	0	0	0	0	0	1	1
Mixed Tern	0	0	0	0	16	0	16
Dovekie	0	0	0	0	0	0	0
Razorbill	0	27	0	2	0	0	29
Total	116	14,092	279	252	277	169	15,185

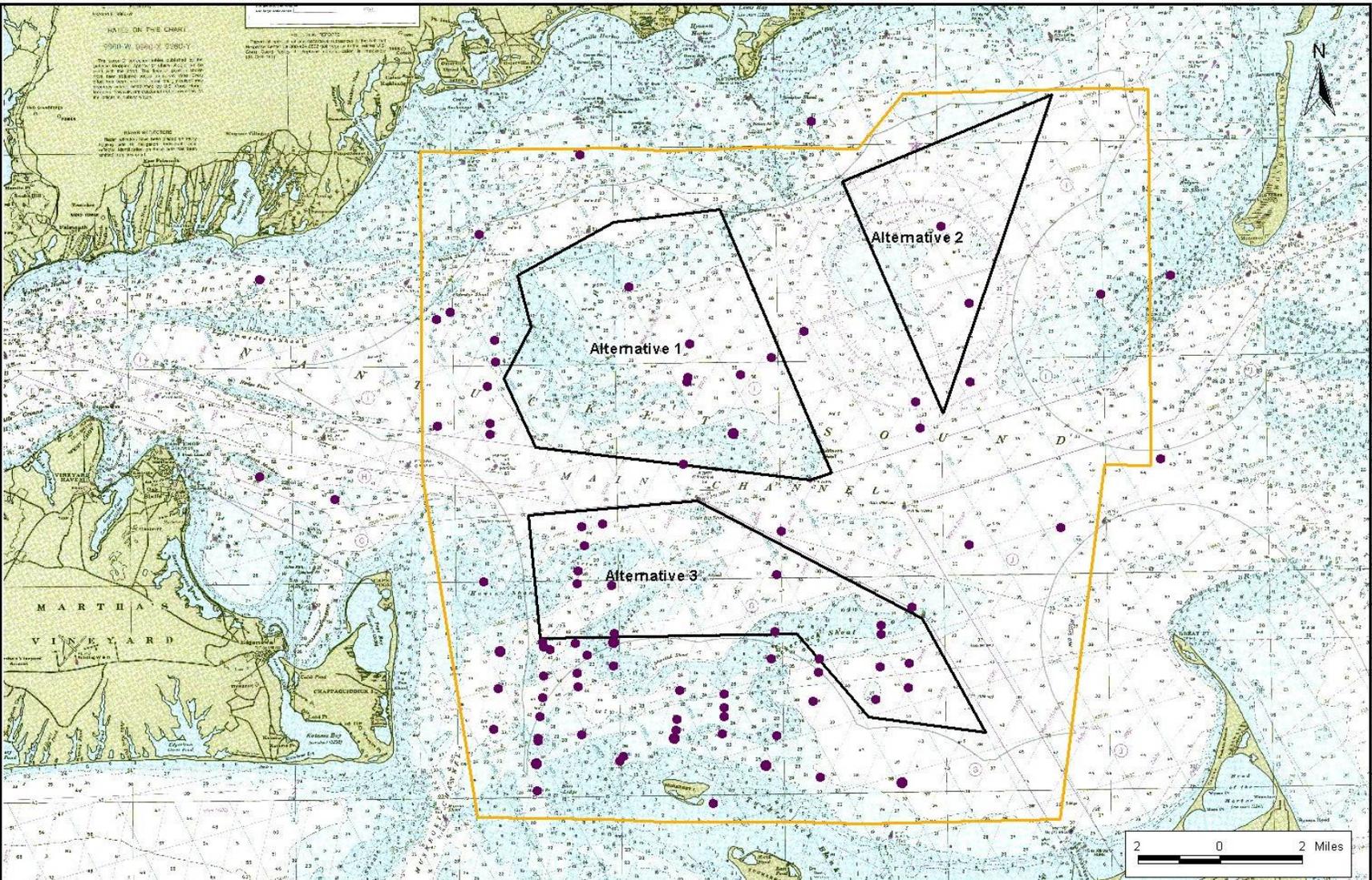
ATTACHMENT 2

Distribution of Waterbirds in the
Study Area for Aerial
Surveys 23-28 Combined



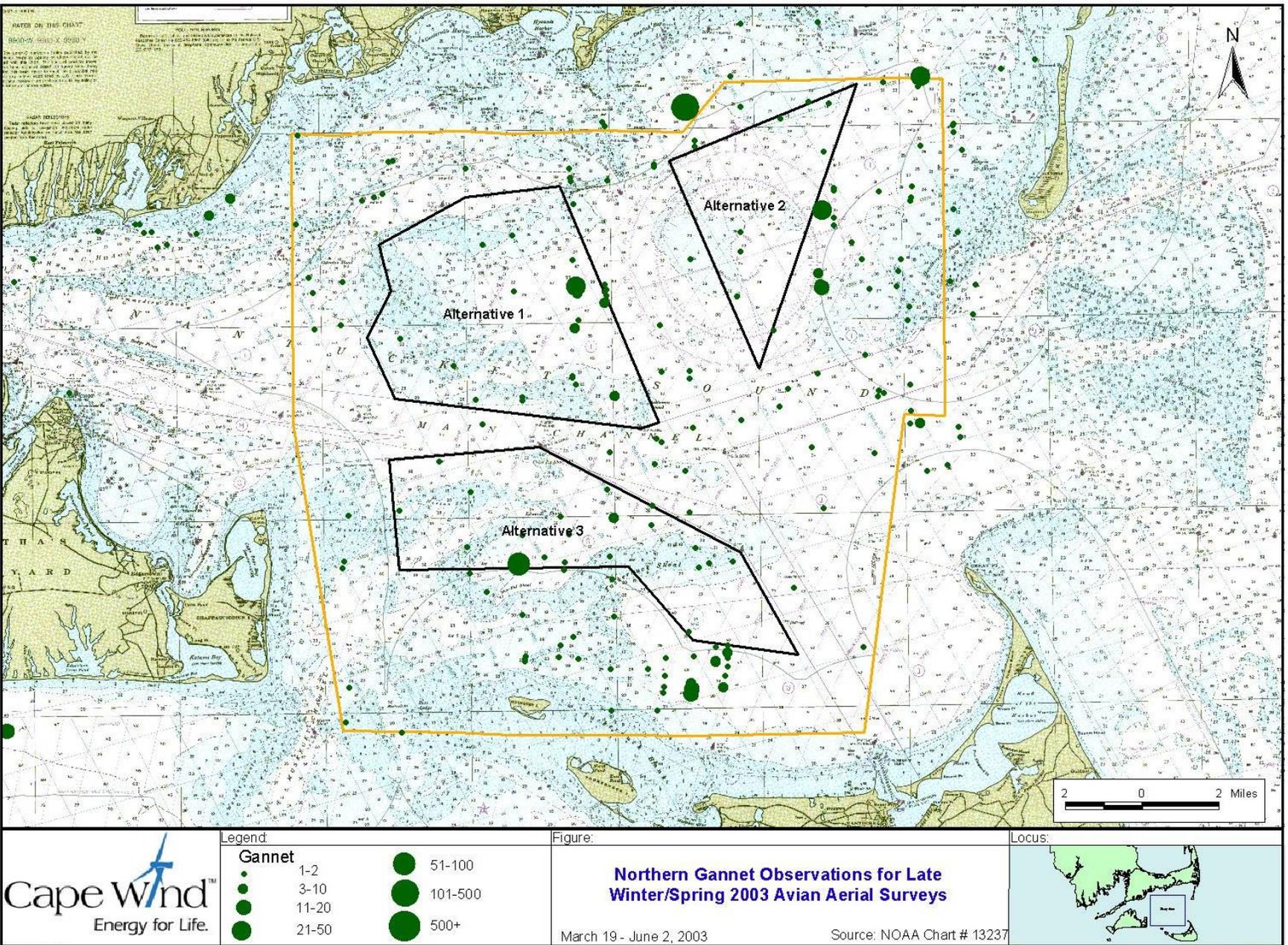
	Legend Loon	1-2 3-10 11-20 21-50	51-100 101-500 500+	Figure: Loon Observations for Late Winter/Spring 2003 Avian Aerial Surveys	Locus:
	March 19 - June 2, 2003	Source: NOAA Chart # 13237			

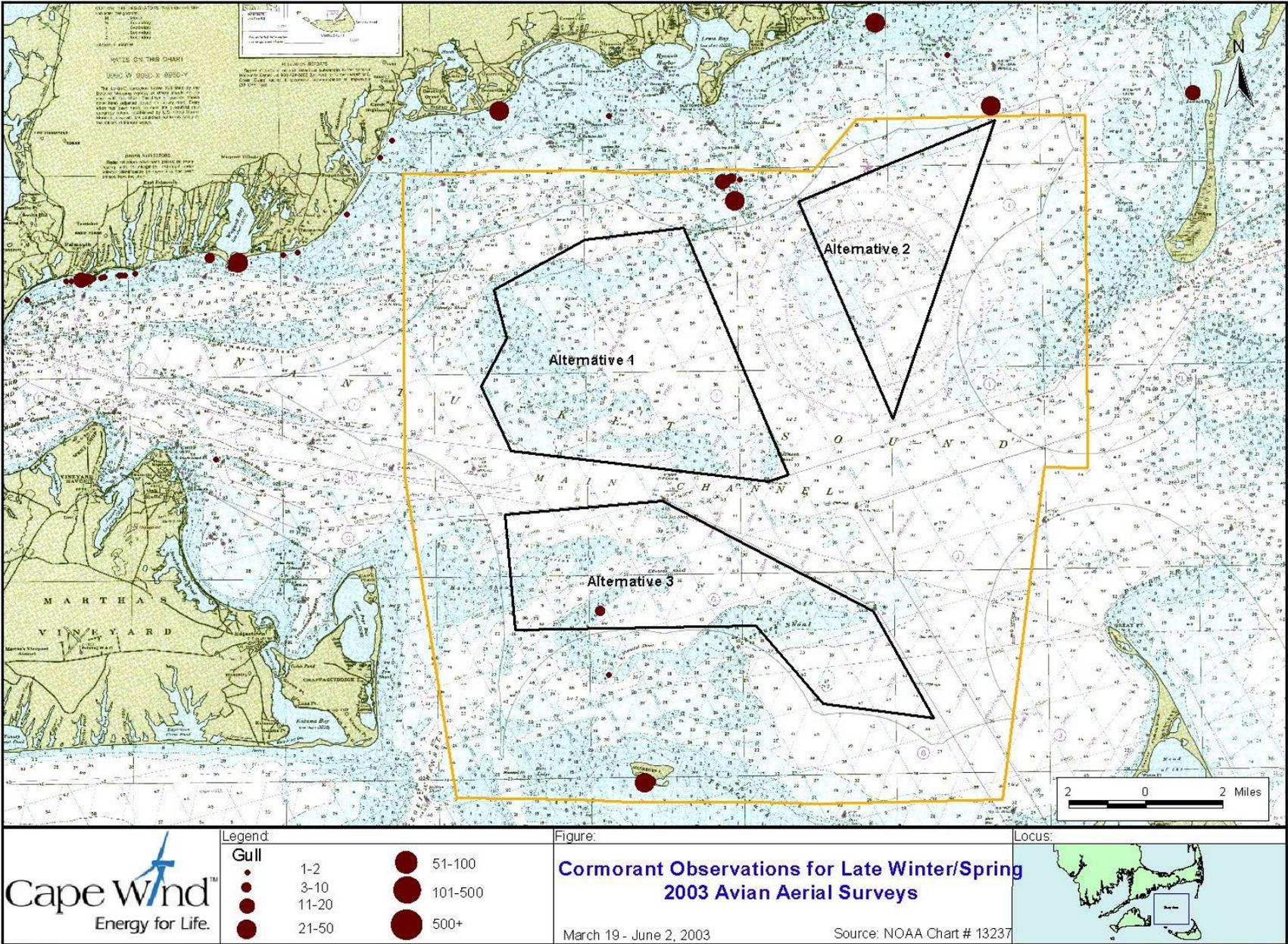
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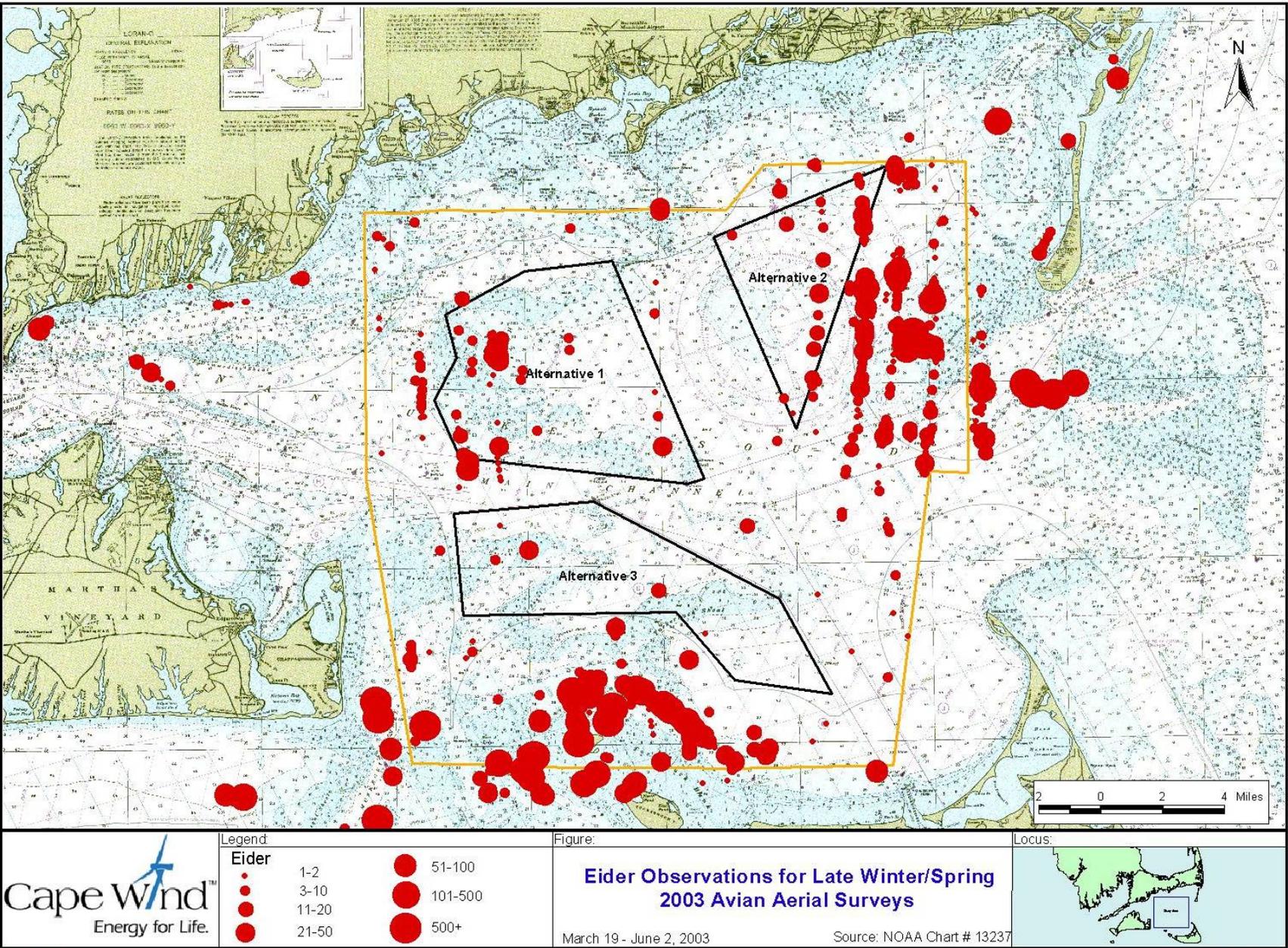


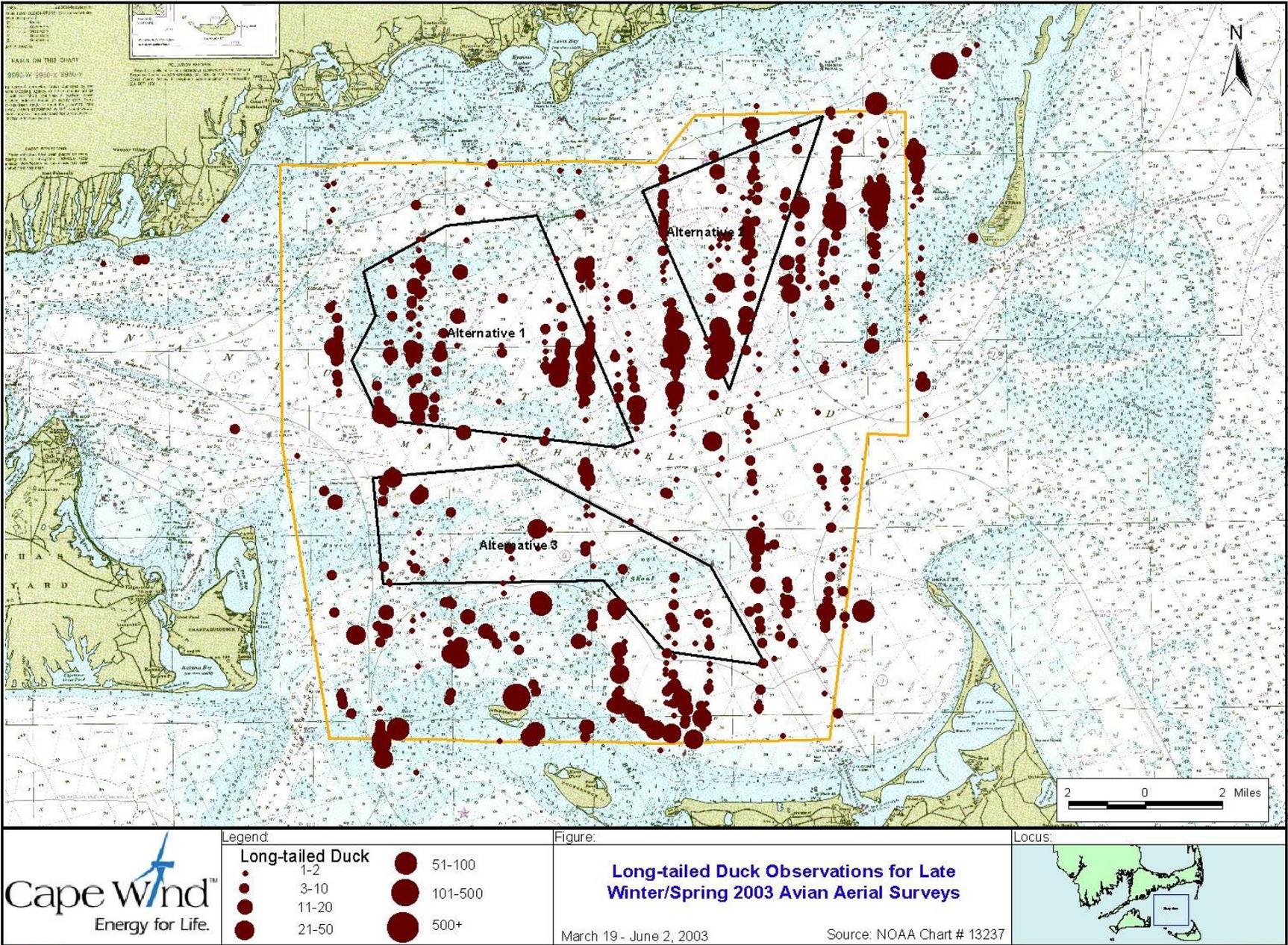
	Legend Grebe 1-2 3-10 11-20 21-50 51-100 101-500 500+	Figure: Grebe Observations for Late Winter/Spring 2003 Avian Aerial Surveys March 19 - June 2, 2003	Locus:
	Source: NOAA Chart # 13237		





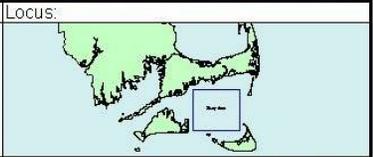


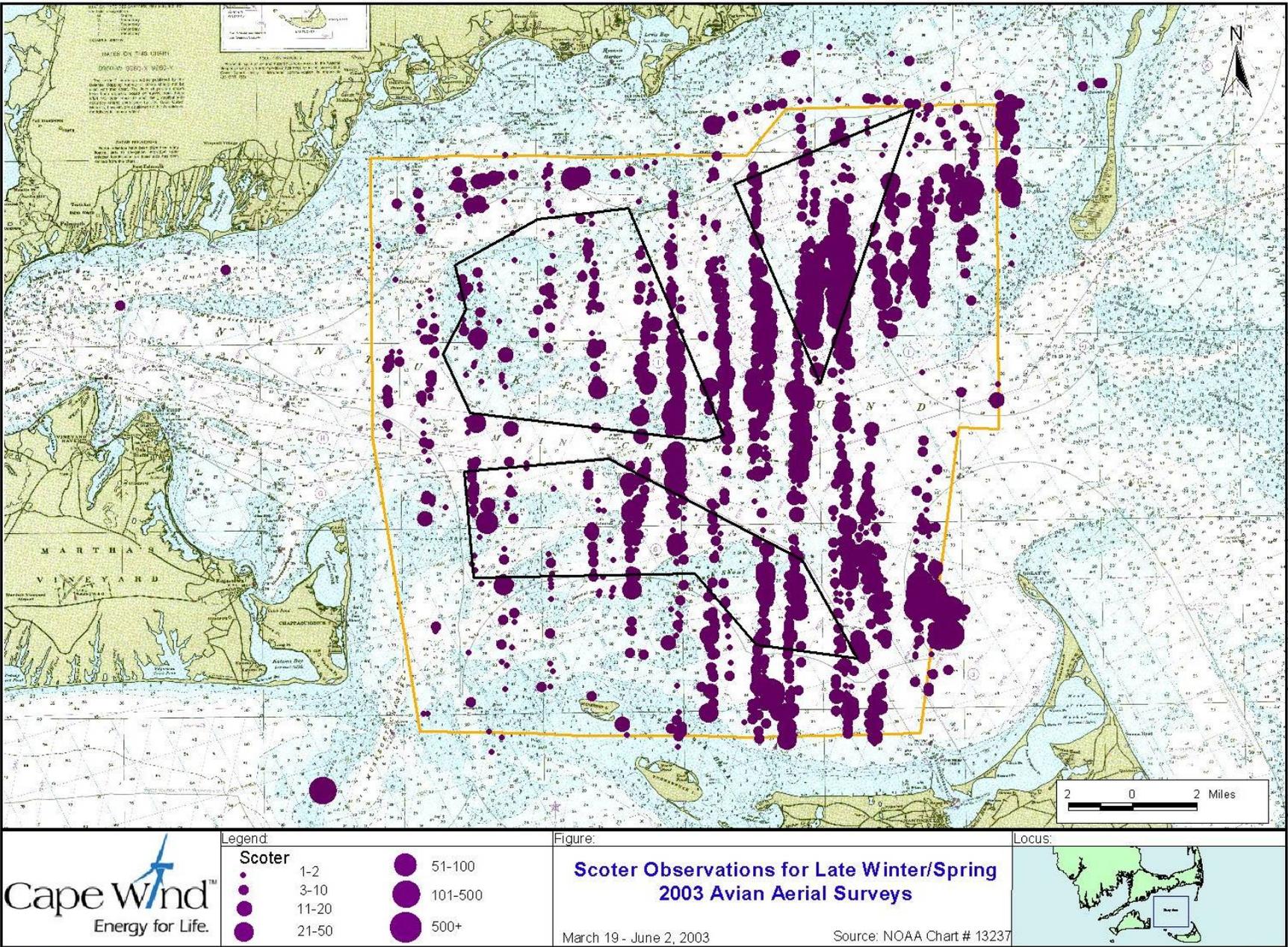




Legend:	
●	Long-tailed Duck
●	1-2
●	3-10
●	11-20
●	21-50
●	51-100
●	101-500
●	500+

Figure:
Long-tailed Duck Observations for Late Winter/Spring 2003 Avian Aerial Surveys
 March 19 - June 2, 2003
 Source: NOAA Chart # 13237





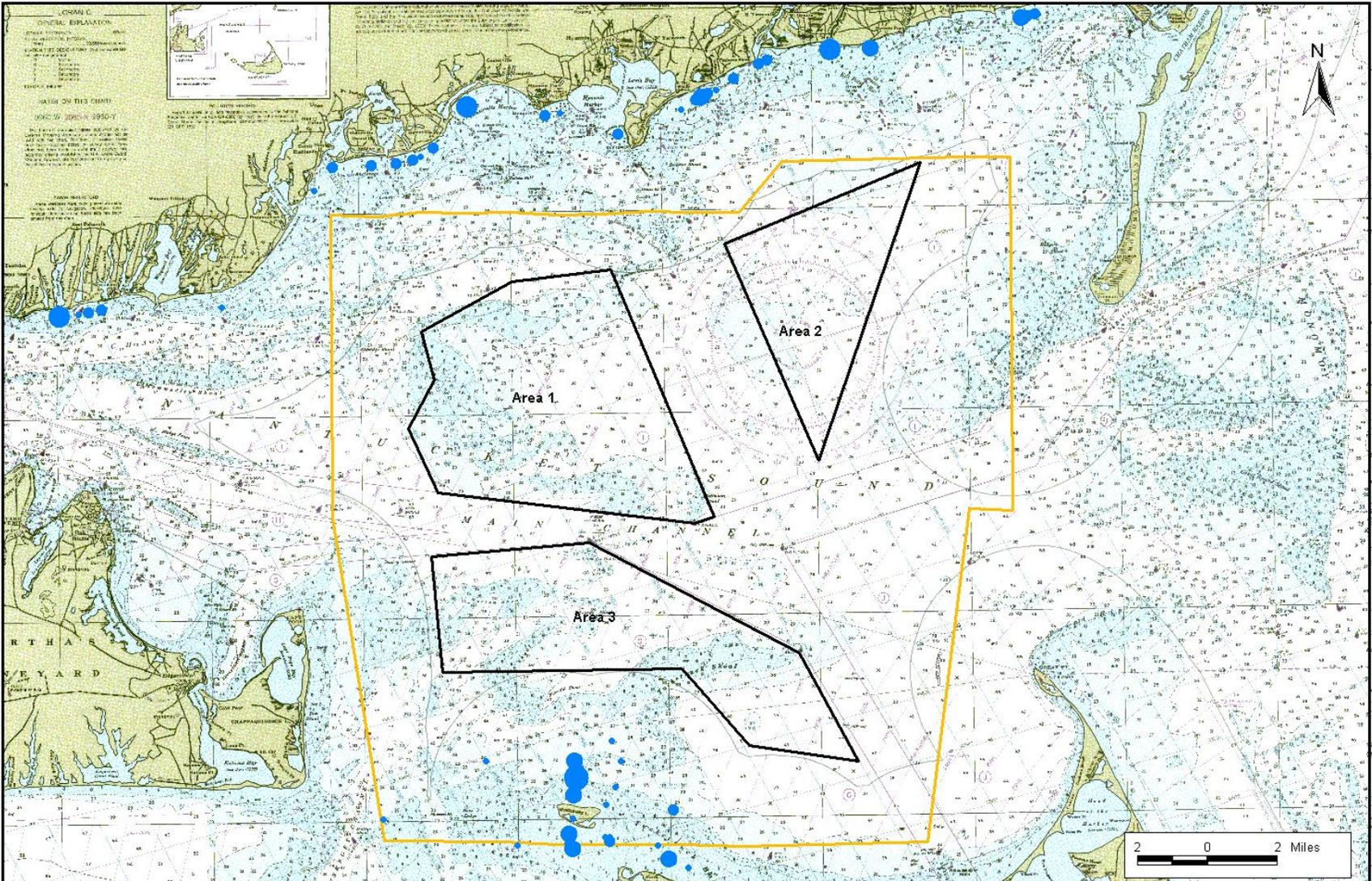
Cape Wind™
 Energy for Life.

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

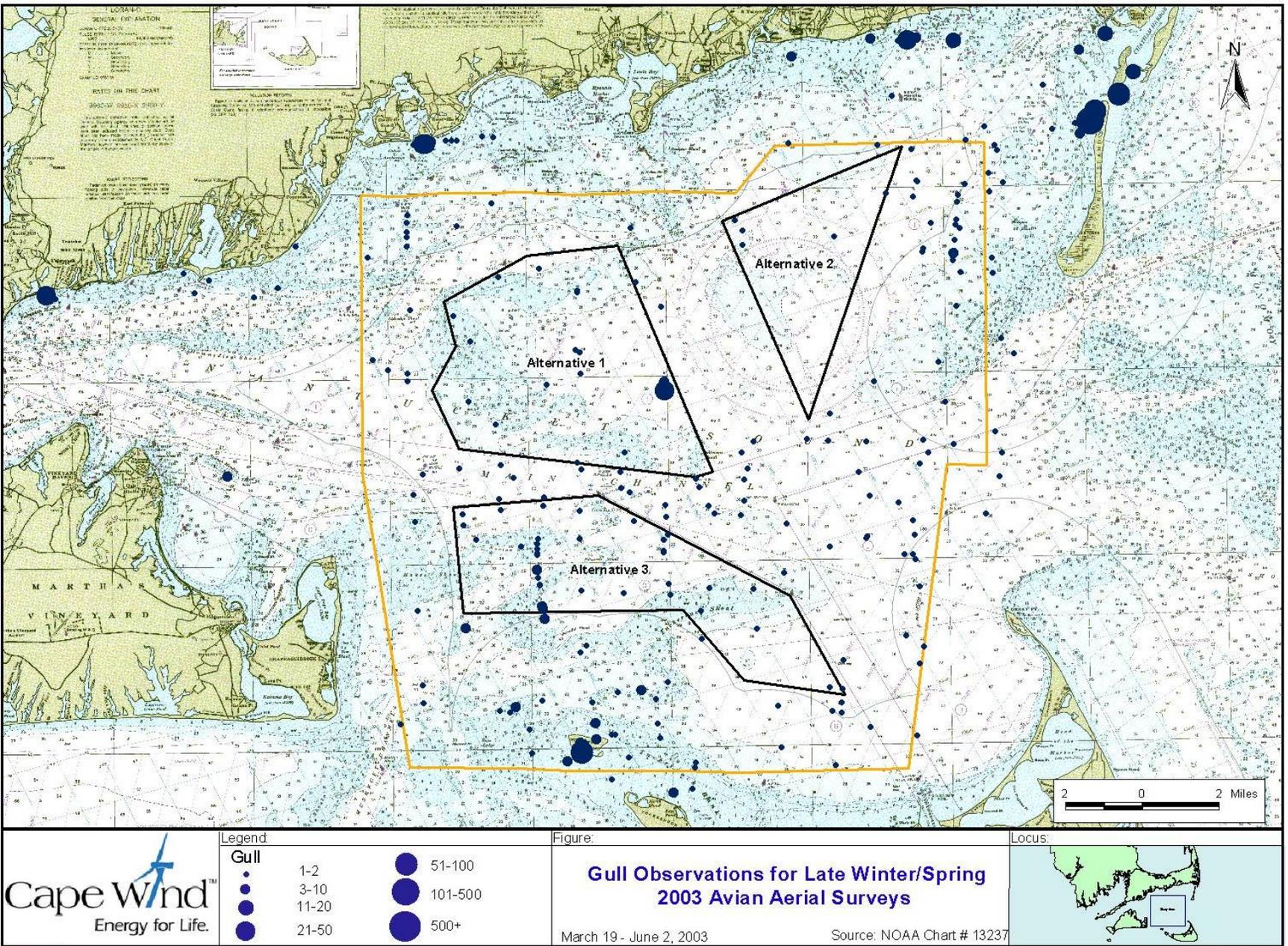
Figure:
**Scoter Observations for Late Winter/Spring
 2003 Avian Aerial Surveys**
 March 19 - June 2, 2003 Source: NOAA Chart # 13237

Locus:





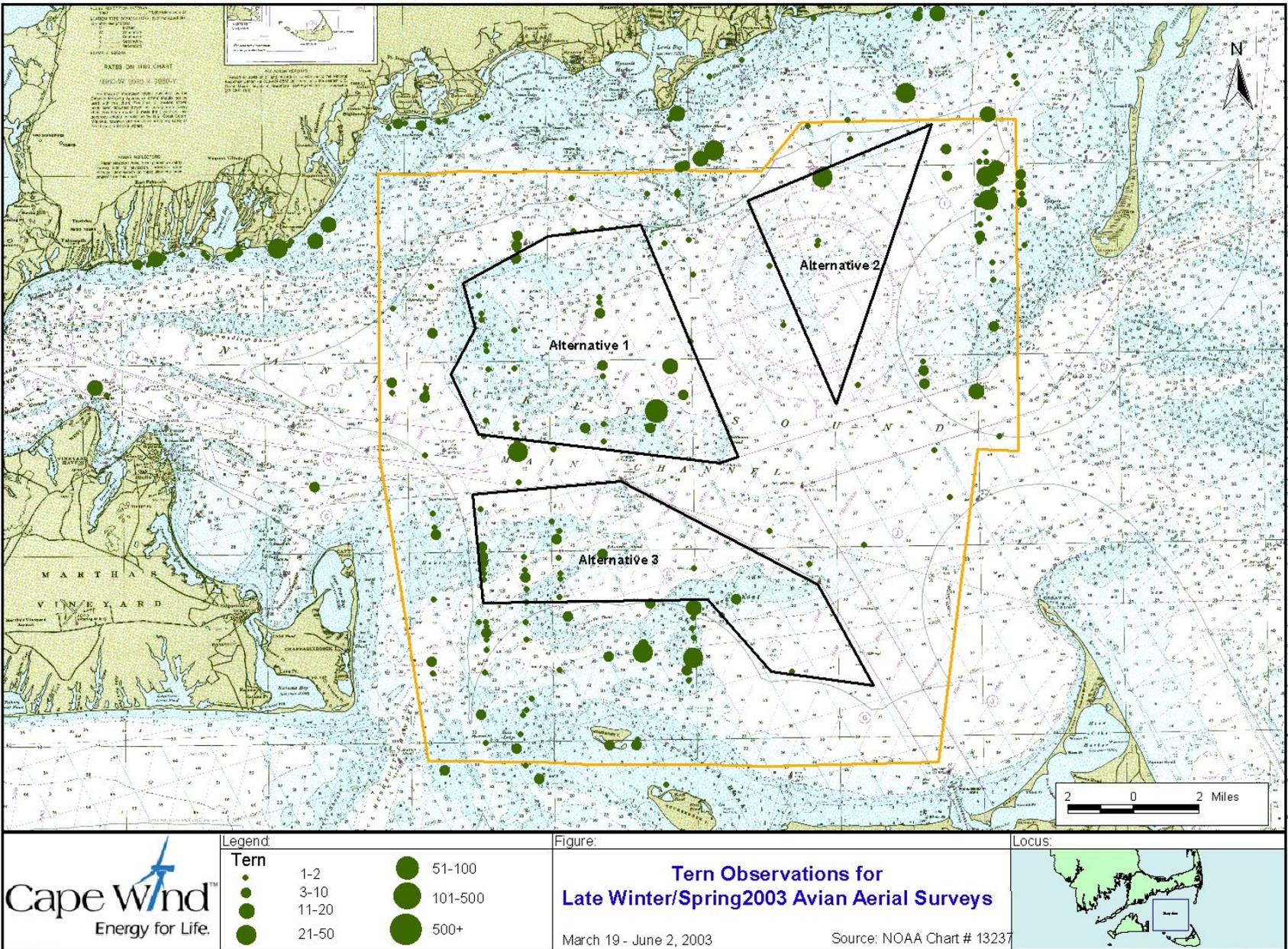
	Legend Merganser		1-2 3-10 11-20 21-50	51-100 101-500 500+	Figure: Merganser Observations for Late Winter/Spring 2003 Avian Aerial Surveys March 19 - June 2, 2003	Locus:
	Source: NOAA Chart # 13237					

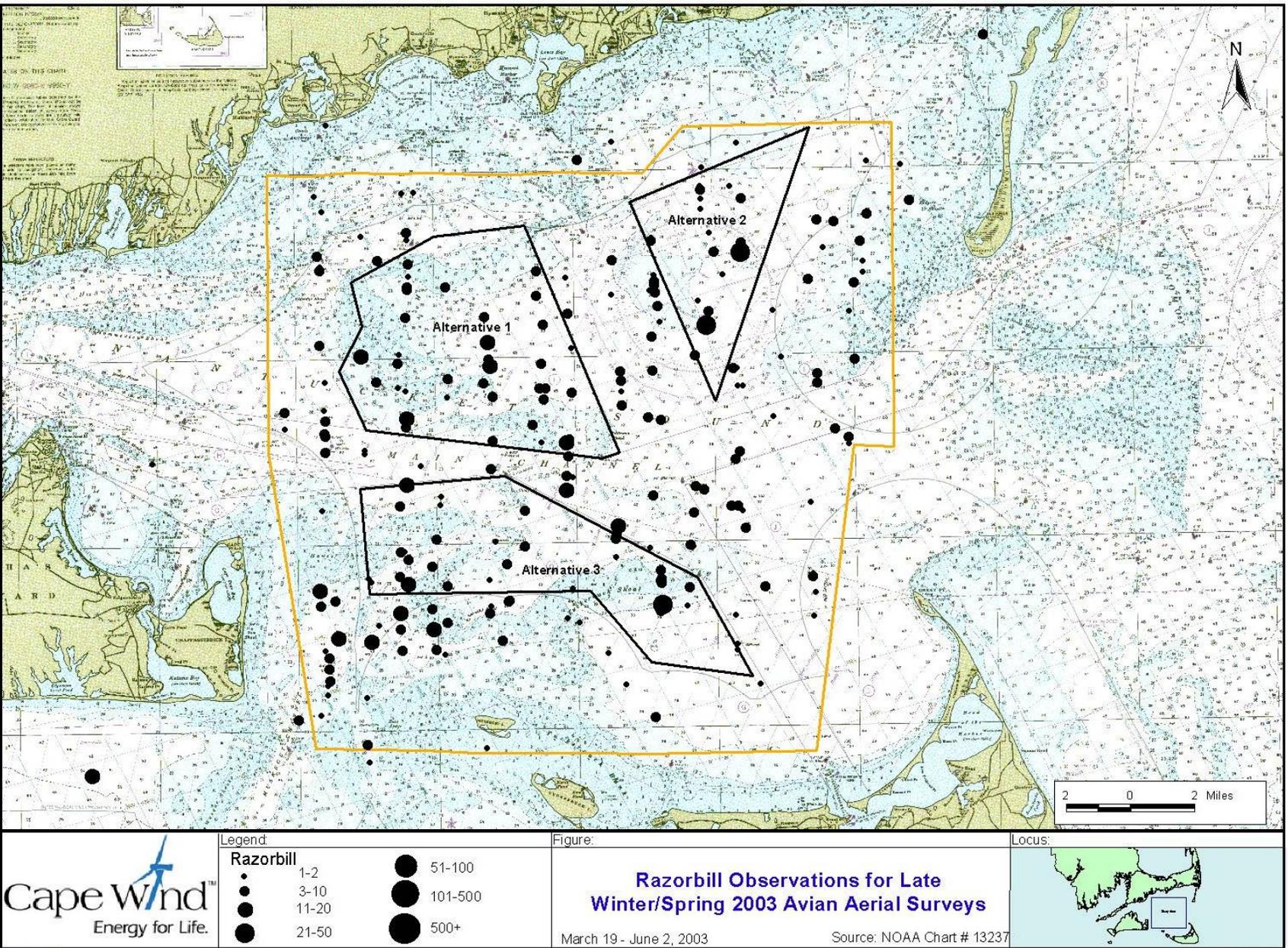


Legend	
Gull	
	1-2
	3-10
	11-20
	21-50
	51-100
	101-500
	500+

Figure:
**Gull Observations for Late Winter/Spring
 2003 Avian Aerial Surveys**
 March 19 - June 2, 2003
 Source: NOAA Chart # 13237







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

Figure:
Razorbill Observations for Late Winter/Spring 2003 Avian Aerial Surveys
 March 19 - June 2, 2003 Source: NOAA Chart # 13237



ATTACHMENT 3

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

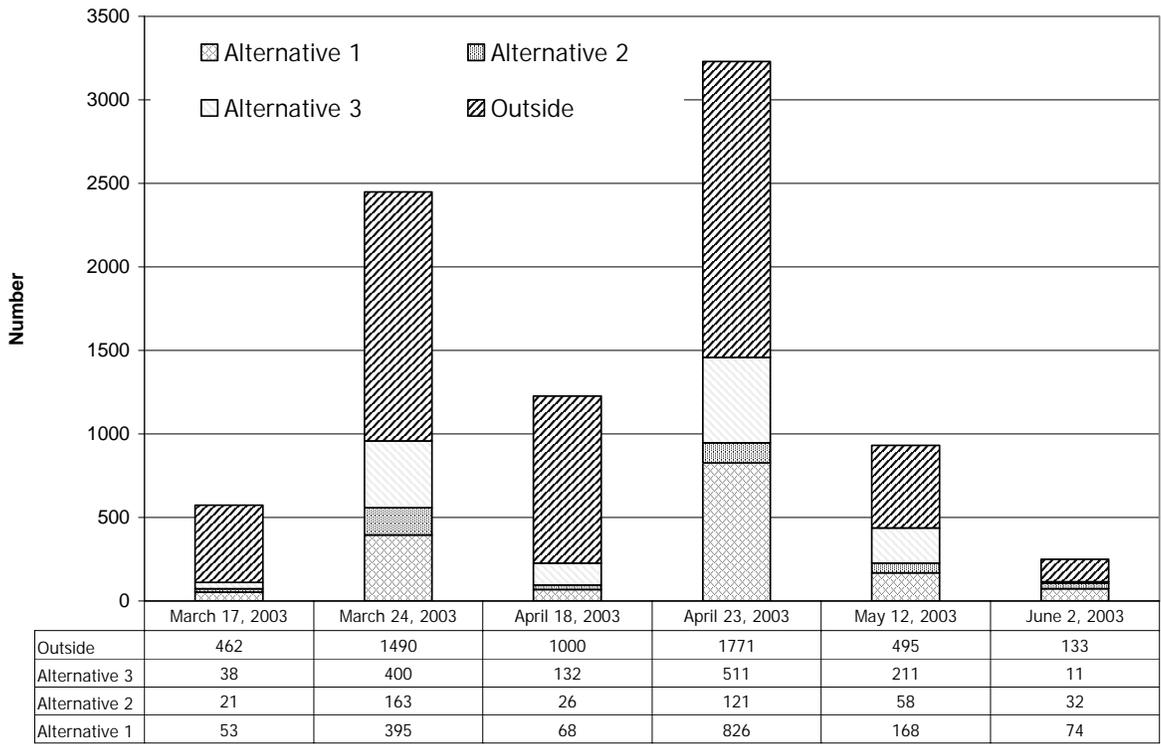
Species	Location	Total Number Observed	Max/Min Number	Density (indivs/km ²)	Estimated* Number Present	Estimated Number Present per Survey
Loon	Alternative 1	301	157/10	14.33	1584	264
Loon	Alternative 2	80	31/4	8.16	421	70
Loon	Alternative 3	248	97/2	14.76	1305	218
Loon	Outside	1124	372/28	9.34	5352	892
Loon	Total	1753	649/50	10.43	8765	1461
Grebe	Alternative 1	11	4/0	0.52	58	10
Grebe	Alternative 2	3	2/0	0.31	16	3
Grebe	Alternative 3	19	9/0	1.13	100	17
Grebe	Outside	91	47/2	0.76	433	72
Grebe	Total	124	57/2	0.74	620	103
Gannett	Alternative 1	97	89/0	4.62	511	85
Gannett	Alternative 2	7	3/0	0.71	37	6
Gannett	Alternative 3	101	83/0	6.01	532	89
Gannett	Outside	268	197/3	2.23	1276	213
Gannett	Total	473	295/3	2.82	2365	394
Cormorant	Alternative 1	0	0/0	0.00	0	0
Cormorant	Alternative 2	0	0/0	0.00	0	0
Cormorant	Alternative 3	3	3/0	0.18	16	3
Cormorant	Outside	111	91/0	0.92	529	88
Cormorant	Total	114	94/0	0.68	570	95
Eider	Alternative 1	371	201/0	17.67	1953	325
Eider	Alternative 2	272	271/0	27.76	1432	239
Eider	Alternative 3	76	57/0	4.52	400	67
Eider	Outside	21274	13300/0	176.69	101305	16884
Eider	Total	21993	13790/0	130.91	109965	18328
Long-Tailed Duck	Alternative 1	732	450/0	34.86	3853	642
Long-Tailed Duck	Alternative 2	585	285/0	59.69	3079	513
Long-Tailed Duck	Alternative 3	212	120/0	12.62	1116	186
Long-Tailed Duck	Outside	3334	2019/0	27.69	15876	2646
Long-Tailed Duck	Total	4863	2870/0	28.95	24315	4053
Scoter	Alternative 1	1076	508/1	51.24	5663	944
Scoter	Alternative 2	2634	1018/4	268.78	13863	2311
Scoter	Alternative 3	1199	596/0	71.37	6311	1052
Scoter	Outside	8682	3316/2	72.11	41343	6890
Scoter	Total	13591	5438/8	80.90	67955	11326
Merganser	Alternative 1	2	0/0	0.10	11	2
Merganser	Alternative 2	0	0/0	0.00	0	0
Merganser	Alternative 3	0	0/0	0.00	0	0
Merganser	Outside	164	130/0	1.36	781	130
Merganser	Total	166	130/0	0.99	830	138
Gull	Alternative 1	48	36/0	2.29	253	42
Gull	Alternative 2	5	3/0	0.51	26	4
Gull	Alternative 3	46	27/2	2.74	242	40
Gull	Outside	223	63/16	1.85	1062	177
Gull	Total	322	98/18	1.92	1610	268
Tern	Alternative 1	165	165/0	7.86	868	145
Tern	Alternative 2	36	364/0	3.67	189	32
Tern	Alternative 3	64	47/0	3.81	337	56
Tern	Outside	456	278/0	3.79	2171	362
Tern	Total	721	278/0	4.29	3605	601
Razorbill	Alternative 1	204	94/0	9.71	1074	179
Razorbill	Alternative 2	103	85/0	10.51	542	90
Razorbill	Alternative 3	149	88/0	8.87	784	131
Razorbill	Outside	537	212/0	4.46	2557	426
Razorbill	Total	993	433/0	5.91	4965	828

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

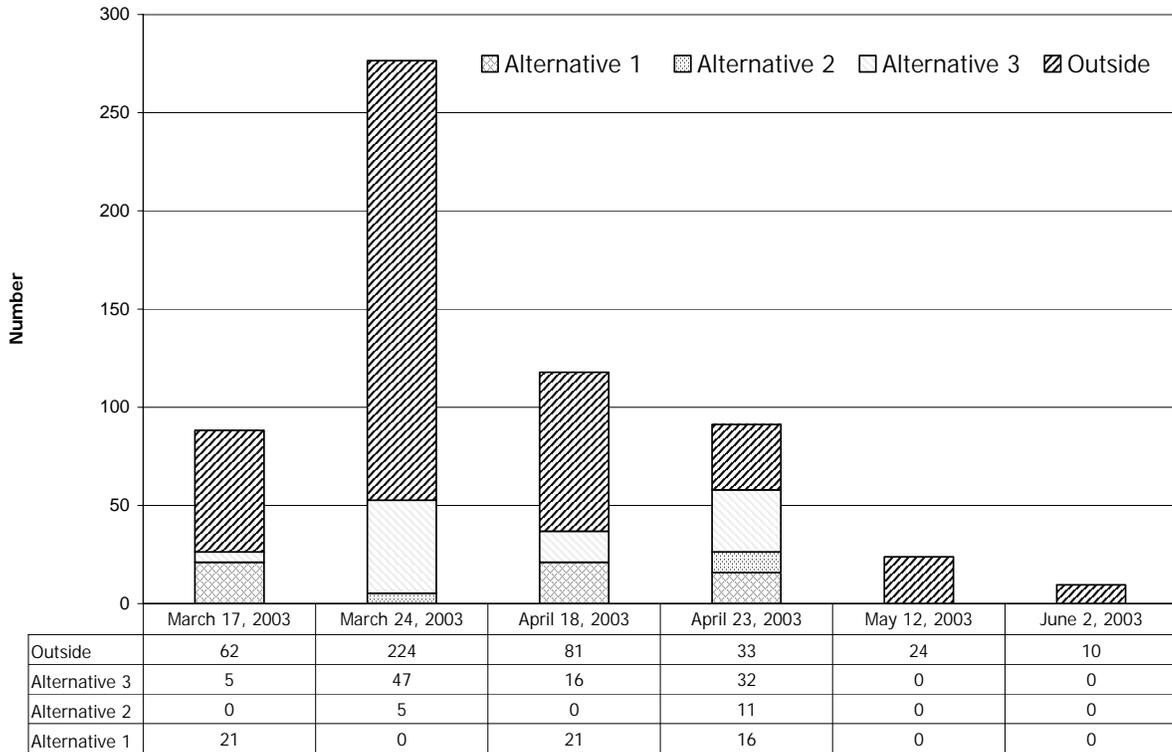
ATTACHMENT 4

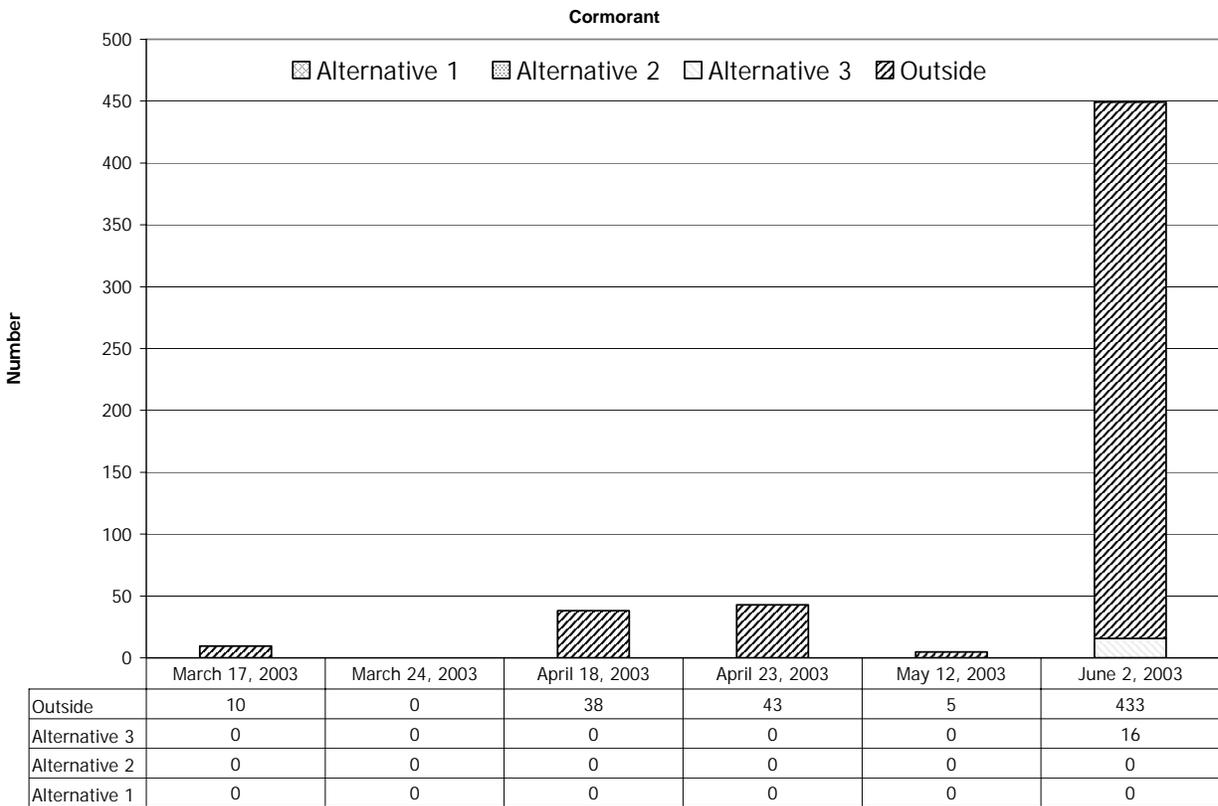
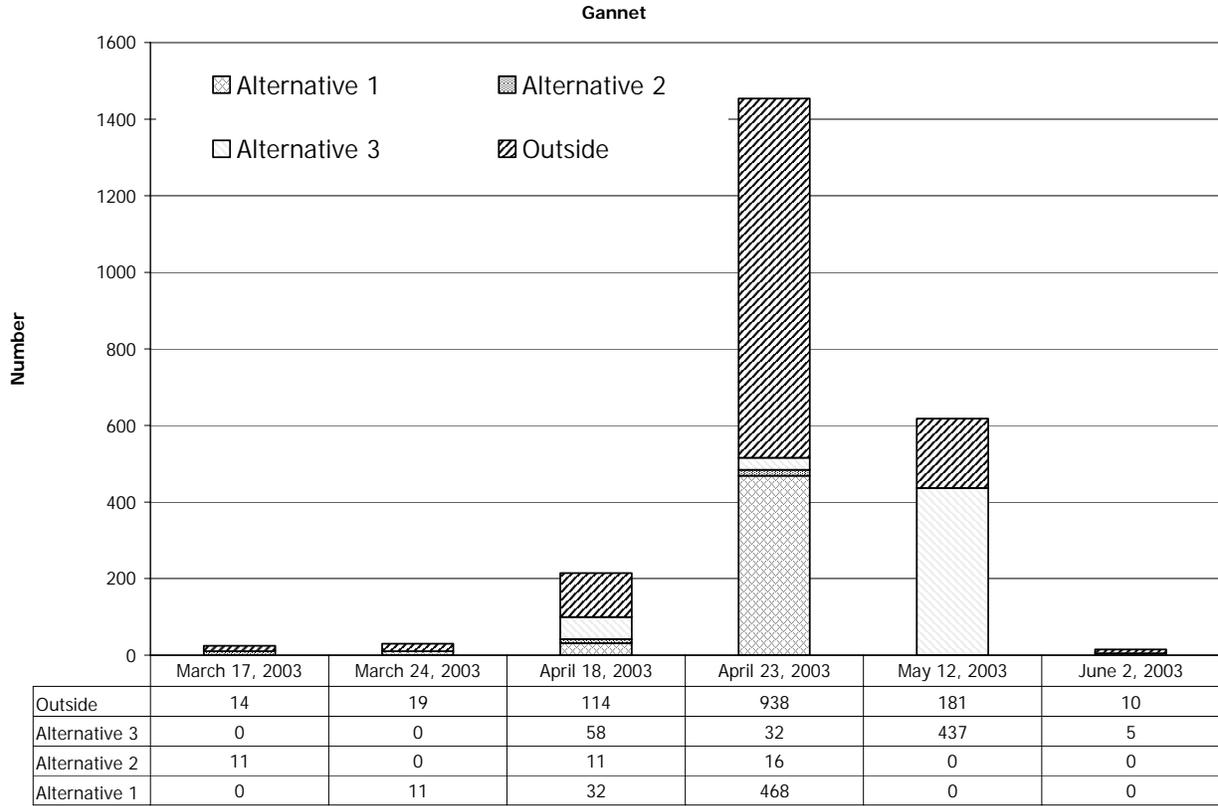
Estimated Numbers of
Waterbirds in the Study Area
during Late Winter – Spring 2003
for Aerial Surveys 23-28

Loon

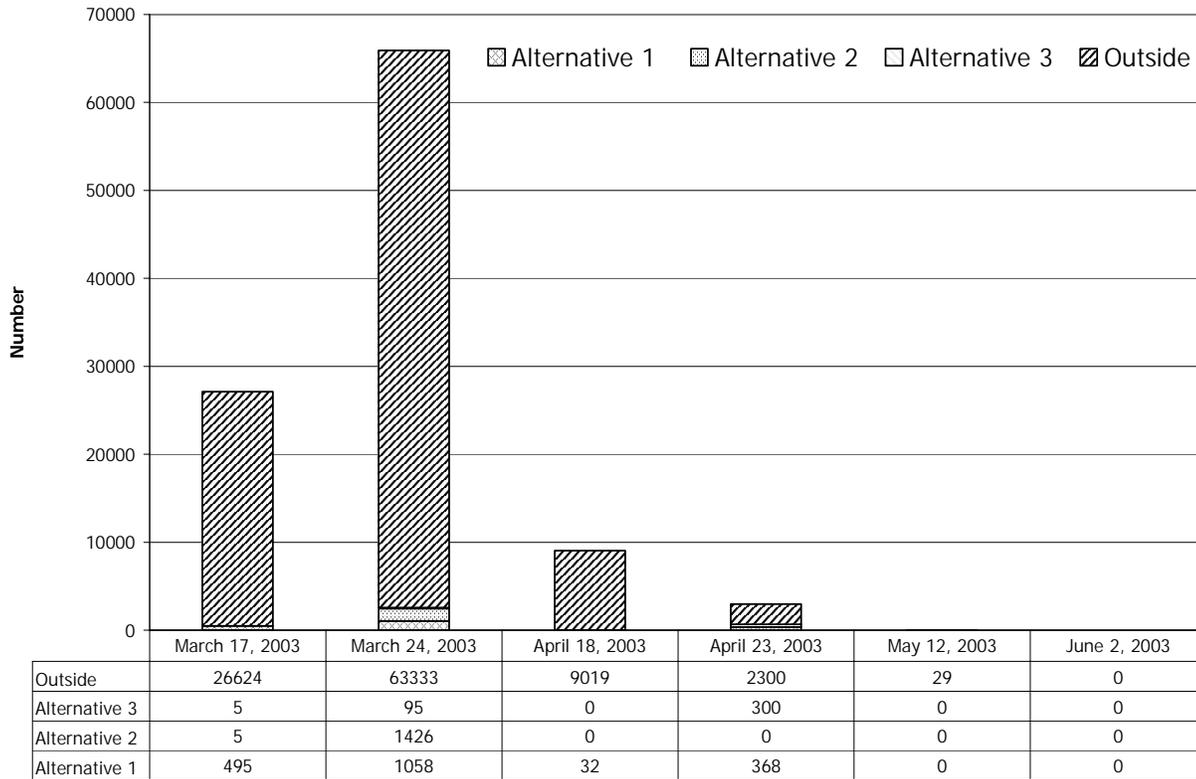


Grebe





Eider



Scoter

