

Appendix 5.7-L

**Summer 2003
Waterbirds Survey for the
Cape Wind Energy Project**

**APPENDIX 5.7- L
SUMMER 2003 WATERBIRDS SURVEY
FOR THE
CAPE WIND ENERGY PROJECT
NANTUCKET SOUND**

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EXECUTIVE SUMMARY

As a continuation of a multi-year study to evaluate the abundance and distribution of waterbirds in Nantucket Sound and surrounding areas, six aerial surveys and two boat surveys were conducted between June 16 and August 29, 2003. To provide a coherent account of summer breeders of particular concern in 2003, this report also refers to observations of terns in Spring (from Appendix K) and in Fall (from Appendix M). The aerial surveys used the standardized procedures developed for previous surveys (March 2002 – June 2, 2003) and focused on the same study area that included three alternative sites proposed for installation of wind turbines and the surrounding waters of Nantucket Sound (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 because they are generally frequented by a different avifauna. 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 a total area of about 65 mi² (168 km²) examined per survey. The two boat surveys were conducted on July 31 and August 27, 2003 in the Horseshoe Shoal and inshore waters of Nantucket Sound to complement the aerial surveys and to make observations of bird behavior (Figure 3).

A total of 20 species were observed during the aerial and boat surveys. Eighteen species of waterbirds, totaling 21,684 individuals, were observed during the aerial surveys, 1,603 individuals within the study area transects and an additional 20,081 individuals outside the study area. The most abundant species observed within the study area were Double-crested Cormorants (744; 46.4% of the total birds observed in the study area), Great Black-backed Gull (489; 30.5%), and Common Tern (162; 10.1%). Additional species included small numbers of non-breeding summer-visitors from the Southern Hemisphere: 1 Sooty Shearwater and 15 Wilson's Storm-Petrel. A taxon-based narrative summary of the findings is located in Section 3.4, below.

A small proportion of the individuals observed within the study area were comprised of Federal or Massachusetts endangered, threatened, or candidate species. These were principally three species of terns that are present as summer residents: these included 23 Roseate Terns (a federally-listed endangered species) observed on five of the six aerial surveys, 162 Common Terns (a Massachusetts' species of special concern observed on each survey, and 12 Least Terns (a Massachusetts' species of special concern). In addition, 26 mixed terns (typically flocks that contained both Roseate and Common terns were observed on three of the six aerial surveys. Another species of special concern in Massachusetts, Common Loon, is principally a winter visitor to Nantucket Sound; it was observed in very small numbers on all 6 aerial surveys.

The principal purposes of the two boat surveys (July 31 and August 27) were to study the flight behavior and altitude of the birds, with particular reference to the listed Roseate and Common Terns and to visit Lewis Bay the proposed site where the transmission cable will connect to the mainland.

During the boat and plane surveys, the height at which individual birds were flying was estimated in relation to the height of the plane and the birds' apparent distance from the water. Very few birds (27/944, 2.9%; including 1/181 terns (0.56%)) were observed in the height range of the proposed wind turbine rotors (75 – 417 feet (23 – 127 m)).

The density of terns varied among the three alternative sites from 0.36 to 0.57 individuals/km² (mean density estimated for all six systematic aerial surveys). Larger numbers and higher densities were observed in other parts of the study area, especially along the edges of the Sound.

Overall, fewer birds were observed using the open waters of Nantucket Sound during the summer of 2003, than were observed during other seasons of the year (particularly winter). Of the relatively few birds utilizing the area during the summer, a vast majority flew below the estimated rotor height of the proposed wind turbines. Results of these surveys are similar to the results of surveys conducted by Massachusetts Audubon in the summers of 2002 and 2003.

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 details information about waterbirds utilizing Nantucket Sound during summer 2003. It forms part of a multi-year study that was initiated in summer 2001 and is a continuation of standardized studies that began in March 2002 (and continued to February 2004) at the suggestion of 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 reports are presented as 6 Appendices (5.7-D, 5.7-F, 5.7-G, 5.7-K, 5.7-L, and 5.7-M), of which the most relevant to this report are Appendix 5.7-F (spring/summer 2002) and Appendix 5.7-K (spring 2003).

This report has the following goals:

- To summarize the spatial and temporal distribution of birds during six (6) aerial surveys and two boat surveys (conducted from June 16 – August 29, 2003) within and around three alternative wind park sites identified by the Applicant (see Figure 1). Data from Appendix 5.7-K are used to complete the seasonal account of the terns.
- To extend the findings of earlier studies conducted in winter/spring of 2002 (five flights: March 17 to April 5-Appendix 5.7-D), in the spring/summer 2002 (six flights: May 22 to August 30-Appendix 5.7-F), in the fall 2002/winter 2003 (eleven flights: September 25 to February 21-Appendix 5.7-G) and in the late winter/spring 2003 (March 19 – June 2 - Appendix 5.7-K). Additional surveys were conducted two times per month through February 2004 (Appendix 5.7-M).
- To expand upon material reviewed by Kerlinger and Hatch (Appendix 5.7-A, 2001) in their preliminary risk assessment and to contribute to assessments of the potential for Project impacts to waterbirds that use Nantucket Sound during the summer months. That assessment identified terns as the species of chief concern in summer, specifically the endangered Roseate Tern and the state-listed Common Tern.

The survey methods used are comparable to those used by waterbird biologists who determine population and hunting harvest levels for the MADFW and the USFWS. During the same period as that covered by this report, a parallel series of aerial and boat surveys were conducted by Massachusetts Audubon Society using similar methods (Perkins et al. 2003, Perkins et al. 2004). The present report refers briefly to those findings.

To provide additional context for these surveys, this report includes observations on the distribution of species made while in transit to/from the study area, 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 summer 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. However, 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 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 surveyed of approximately 65 mi² (168 km²) for each survey (Table 1). As shown in 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 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 June 16 and 26, July 9 and 29, and August 20 and 29, 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 which are continuation of studies suggested by avian experts from the USFWS, the MADFW, and the 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 individuals observed flying at altitudes near the plane; these altered their heading to avoid the plane. During the boat surveys, birds that were already aloft were unaffected by the presence of the boat.

*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 Global Positioning System (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 reported to the data recorder in 30-foot (10 meter) increments. Although this methodology was not precise and is not a validated procedure, nevertheless, 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 near this altitude range.

*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. Observations were not generally recorded during the loops between the transect.

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 Surveys

Boat-based observations were made on July 31 and August 27, 2003 to complement the aerial surveys. The July trip was an opportunistic transect between Falmouth and the Cape Wind met tower at the southern edge of Horseshoe Shoal. The August trip first visited Horseshoe Shoal, where few terns were seen, then traveled along shorelines to maximize encounters with flying terns. 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 visits to Horseshoe Shoal (Figure 3) and also to Lewis Bay. The boat traveled at about 10 knots (18.5 km/h) and was on the water for approximately three hours in the July survey and over five hours during the August survey. Observations were recorded principally of flying terns: species, numbers, altitude, direction of flight, and other behaviors.

*The survey team consisted of the captain and an observer (Jeffrey Burm; plus Jeremy Hatch in August). 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 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 about 300 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 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 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 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 20 bird species were observed during the aerial surveys and boat-based surveys conducted from June through August of 2003 (Table 2).

Table 2: Species Observed During Summer 2003 Aerial and Boat Surveys

Common Name	Scientific Name
Common Loon	<i>Gavia immer</i>
Sooty Shearwater	<i>Puffinus griseus</i>
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>
Double-crested Cormorant	<i>Phalacrocorax auritus</i>
Great Blue Heron*	<i>Ardea herodias</i>
Mute Swan*	<i>Cygnus olor</i>
Canada Goose	<i>Branta canadensis</i>
Common Eider	<i>Somateria mollissima</i>
Unknown Scoter	<i>Melanitta sp.</i>
Common Goldeneye	<i>Bucephala clangula</i>
Osprey*	<i>Pandion haliaetus</i>
American Oystercatcher	<i>Haematopus palliatus</i>
Laughing Gull	<i>Larus atricilla</i>
Herring Gull	<i>L. argentatus</i>
Great Black-backed Gull	<i>L. marinus</i>
Unknown Gull	<i>Larus sp.</i>

Common Name	Scientific Name
Roseate Tern	<i>Sterna dougallii</i>
Common Tern	<i>S. hirundo</i>
Least Tern	<i>S. antillarum</i>
Black Tern	<i>Chlidonias niger</i>
Roseate/Common/Black Tern Type	<i>Sterna sp./C. niger</i>
Shorebirds*	

*Seen only outside the study area on the opportunistic flights

For total counts, four 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) cormorants: Double-crested and Great, (2) scoters: Black, Surf, and White-winged; (3) 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; (4) mixed terns: Black, Common and Roseate Terns were pooled when individuals could not be identified readily to species or if flocks included more than one species.

3.1 Aerial Surveys

Six aerial surveys were conducted between June 16 and August 29, 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. Visibility was good on all six surveys. For safety reasons, flights were not conducted in heavy rain and wind.

*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, and Weather Conditions during the Six Summer Waterbird Aerial Surveys in Nantucket Sound, June-August 2003

Survey	Date	Start	Finish	Start Point ¹	High Tide ²	Wind	Temp F	Weather
A29	16-Jun	09:46	13:54	1 North	14:22	NE 12-20 Knots ³	low 60s	Mostly Cloudy
A30	26-Jun	05:06	09:11	1 North	10:40	NNE 0-4 Knots	mid 70s	Clear
A31	9-Jul	08:40	12:56	16 North	08:21	NW 6-9 Knots	high 70s	Clear
A32	29-Jul	07:30	11:56	16 North	13:07	ENE 6-12 Knots	mid 60s	Light Rain
A33	20-Aug	14:19	18:46	16 North	6:37	N 0-4 Knots	high 70s	Clear
A34	29-Aug	07:06	12:04	1 South	13:59	SE 9 knots	mid 70s	Clear

¹ Start Point refers to transect (Fig. 1)

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

³ 1 Knot = 1.85 km/h

3.1.1 Species and Abundances

A total of 13 species (Table 4) were observed within the study area during the six systematic aerial surveys and a total of 18 were observed during all aerial surveys (including the opportunistic extensions outside the study area). 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 observed outside the study area have been broken down to separate birds observed in Nantucket Sound, principally along the edges, from those observed in Vineyard Sound and Buzzards Bay.

Table 4: Numbers of Individuals Recorded in the Study Area During Six Aerial Surveys and Outside the Study Area on the Extended Flights (June-August 2003)

Species	Total Within Study Area	Number of Surveys	Total Outside Study Area		Total
			Nantucket Sound Area	Vineyard Sound/Buzzards Bay Area	
Common Loon	31	6	12	11	53
Sooty Shearwater	1	1	0	0	1
Wilson's Storm-petrel	15	3	0	0	15
Double-crested Cormorant	744	6	3,137	1,234	5,115
Great Blue Heron	0	0	1	0	1
Mute Swan	0	0	55	4	59
Canada Goose	10	1	87	0	97
Common Eider	11	2	105	30	146
Scoter	4	1	0	0	4
Osprey	0	0	3	1	4
American Oystercatcher	1	1	7	2	10
Laughing Gull	0	0	23	25	48
Herring Gull	74	6	367	66	507
Great Black-backed Gull	489	6	2632	97	3,218
Unknown Gull	0	0	231	15	246
Roseate Tern	23	5	31	272	326
Common Tern	162	6	2,799	2402	5,363
Least Tern	12	5	176	8	196
Mixed Terns	26	3	4,839	1,359	6,224
Shorebirds	0	0	50	0	50
Total	1,603		14,555	5,526	21,683

Five species were recorded on all six of the aerial surveys within the study area: Common Loon, Common Tern, Double-crested Cormorant, Great Black-backed and Herring gulls. Roseate and Least terns were observed on five surveys within the study area. These species, excluding Common Loons, are abundant summer residents in the area. Double-crested Cormorants (744, 46.4%) were the most abundant species observed within the study area, followed by Great Black-backed Gulls (489, 30.5%) and Common Terns (162, 10.1%). When including individuals outside the study area and outside Nantucket Sound, Mixed (6,224) and Common (5,363) Terns, Double-crested Cormorants (5,115) and Great Black-back Gulls (3,218) were the most abundant species observed.

3.1.2 Distribution of Waterbirds Within the Study Area

The 5 maps in Attachment 2 summarize the distribution of the major species groups (Loons, Storm-Petrels, Cormorants, Gulls, and Terns) during the summer of 2003 by combining the observations made during the six aerial surveys. These maps include not only the birds recorded during the 6 surveys of the study area, but also various observations in areas outside the study-area obtained on diverse routes by non-standardized methods.

The maps included in Attachment 2 show that the dispersion of some species within the study area was not uniform. For example, cormorants were only found sitting on the rocks at Bishop and Clerks at the northern edge of the study area, or along the shorelines of Fernando's Fetch and Muskeget Island along the southern limit of the study area. Gulls and terns were more evenly distributed with the majority observed in the southern part of the study area and another large cluster southwest of Monomoy.

As shown in Attachment 3, the majority (200, 85.8%) of the 223 terns observed within the study area were outside the Alternative Sites, principally in the southern part of the study area (near Muskeget Island) and west of Monomoy Island. Numbers of terns observed in Alternatives 1, 2 and 3 were low: 12 (5.1%) were observed in Alternative 1, 5 (2.1%) in Alternative 2, and 6 (2.6%) in Alternative 3. All the terns observed within Alternative 1 were Common Terns.

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. The density for the seven major species groups was greater in the outside area, except for storm-petrels, who were greatest in Alternative 3. For cormorants, the density of birds in the outside area was 6.17 per km² and less than 0.1 per km² in Alternative 1. Terns were about 3 times greater outside the three alternatives and were relatively evenly distributed within the three alternatives (Table 5). Gulls were the most dominant species within the three alternatives, with 1.05, 2.55 and 0.89 per km², respectively.

Table 5: Densities (individuals/km²) of Waterbirds Observed within the Study Area During 6 Aerial Surveys, June-August 2003

Species	Alternative 1	Alternative 2	Alternative 3	Outside*	Total Study Area
Loon	0.05	0.00	0.12	0.23	0.18
Storm-Petrel	0.00	0.00	0.24	0.09	0.09
Cormorant	0.05	0.00	0.00	6.17	4.43
Eider	0.00	0.00	0.00	0.09	0.07
Scoter	0.00	0.00	0.00	0.03	0.02
Gull	1.05	2.55	0.89	4.16	3.35
Tern	0.57	0.51	0.36	1.66	1.33

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

The remaining species, including loons, storm-petrels, eiders and scoters were sparsely distributed throughout the survey areas. The densities of these groups were less than 0.5 in all alternatives.

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 bar 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, terns and gulls were more common outside the study area than within the study area. The majority of gulls, terns and cormorants were observed close to Monomoy, Tuckernuck and Nantucket Islands, along the south shore of Cape Cod and the Elizabeth Islands. Canada Geese were found in and around the eastern side of Tuckernuck Island. Other species that were observed in small numbers, principally outside the study area were Great Blue Heron, Mute Swan, Eider, Osprey, Oystercatcher, and shorebirds.

More terns were sighted outside the study area (11,886) than within the study area (223). The largest concentrations were observed along the southern shore of Cape Cod, near Monomoy Island, and near Tuckernuck Island. This distribution is consistent with the 2002 findings (Appendix 5.7-F), however there were many more terns observed in the study area during the 2002 surveys (1,767). Gulls were similarly distributed to terns and were more abundant outside (3,253) the study area than within (563). These two groups of sightings entailed different methods and are not strictly comparable, but they do provide information about the spatial and temporal distribution outside the study area.

3.2 Boat Surveys

Two boat surveys were conducted on July 31 and August 27, 2003 to study the presence and behavior of birds when boats are in the area. Details of the times, dates, tides and weather conditions are summarized in Table 6. During the boat surveys 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 Summer Waterbird Boat Surveys in Nantucket Sound, 2003

Survey	Date	Start	Finish	High Tide ¹	Wind	Temp °F	Weather
B11	31-July	10:00	13:15	18:23	ENE 20 Knots	71-74	Clear
B12	27-August	07:00	13:30	12:35	W 10-15 Knots	64-69	Clear

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

1 knot = 1.85 km/hr

3.2.1 Species and Abundances

A total of 12 species were observed during the boat surveys (Table 7), all of which were also seen on the aerial surveys except for the single Common Goldeneye. The majority of the 1,292 individuals observed were terns (1,110, 85.9%), of which nearly three-quarters were Common Terns. The next most common species were Gulls (Laughing, Herring and Great Black-backed (143, 11.1%)). This is consistent with what was observed during the Summer 2002 surveys, Appendix 5.7-F. Of the 1,292 individuals observed from the boat, 614 (47.5%) were flying. The majority (30, 96.8%) of the thirty-one cormorants observed were sitting on rocks at the mouth of Waquoit Bay.

Table 7: Boat Survey Observations for July 31 and August 27, 2003

Species	Flying	*On water	Total Number
Common Loon	0	1	1
Wilson's Storm-Petrel	1	0	1
Double-crested Cormorant	4	31	35
Common Eider	0	1	1
Common Goldeneye	0	1	1
Laughing Gull	47	87	134
Herring Gull	4	0	4
Great Black-backed Gull	0	5	5
Roseate Tern	1	0	1
Common Tern	519	302	821
Least Tern	3	0	3
Mixed Tern (including Black Terns)	35	250	285
Total	614	678	1,292

* On water also includes birds sitting on rocks and other structures (i.e. buoys, fish weirs)

During the boat surveys, the majority of terns were observed either flying (direct) or foraging (looking down and flying erratically). Many individuals (>200, 18.0%) were observed resting on the rocks at Waquoit Bay (northwest of the study area) and over 400 (35.9%) individuals on the rocks and shoreline in Woods Hole (west of the study area).

3.3 Altitude of Flying Birds

During the aerial surveys the altitude of birds was estimated in relation to the surface of the water and the altitude of the plane (250 ft (75 m)). Within the study area, 1,603 individuals were observed, most of which were on rocks, shorelines, the water surface or flying close to it. Of the 330 individuals observed flying, 26 (7.9%) were flying within the height-range of the proposed turbine-rotors (75-417 feet (23-127 m)) (Table 8). These individuals were Great Black-backed (15) and Herring Gulls (10) flying at various heights up to 300 feet (91 m) and 1 Roseate Tern (0.3%) observed flying at 75 feet (23 m) asl on Hawes Shoal (southwestern portion of the study area). Additional observations of the altitude of flying terns were made in Spring and Fall 2003 and are reported in Appendices 5.7-K and 5.7-M, respectively.

Table 8: Altitude of Flying Waterbirds Observed From the Plane (250 feet asl)

Species	Altitude (Feet)					Total
	<20	20-40	41-60	61-80*	81+**	
Loon	1	0	0	0	0	1
Wilson's Storm-Petrel	6	0	0	0	0	6
Cormorant	7	0	0	0	0	7
Sooty Shearwater	1	0	0	0	0	1
Eider	0	0	0	0	0	0
Gull	82	12	13	4	23	134
Tern	166	9	5	1	0	181
Total	263	21	18	5	23	330

* Three of the five individuals in the 61-80 foot range were at turbine blade height (75+ feet)(1 tern and 2 gulls).

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

During the two boat surveys, the altitude of birds in flight was estimated whenever they were close to the boat. Altitude estimates were made for 614 flying waterbirds (Table 9). Of these, 503 (82%) were flying less than 21 feet (6 m) from the water surface, 107 (17%) were between 21-40 feet, 1 (<1%) were between 41-60 feet, 2 (<1%) were between 61-80 feet, and 1 (<1%) were above 80 feet (24 m). The two Common Terns tabulated flying (downwind) at between 61 and 80 feet were estimated to be flying at 70 feet (21 m) asl and may have been flying at rotor height. The birds flying at rotor height included 1 cormorant that was estimated at 100 feet (30 m) asl along the southern shoreline of Cape Cod.

Table 9: Altitude of Flying Waterbirds Observed From the Boat

Species	Altitude (Feet)					Total
	<21	21-40	41-60	61-80*	80+**	
Wilson's Storm-Petrel	1	0	0	0	0	1
Cormorant	2	1	0	0	1	4
Laughing Gull	45	2	0	0	0	47
Herring Gull	3	1	0	0	0	4
Common Tern	413	103	1	2	0	519
Roseate Tern	1	0	0	0	0	1
Least Tern	3	0	0	0	0	3
Mixed Tern	35	0	0	0	0	35
Total	503	107	1	2	1	614

* The two common terns in the 61-80 foot range were estimated to be at 70 feet asl.

** 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 (about 27/944, or about 3%) were observed in the height range of the prospective turbine rotors (75-417 feet (23-127 m)).

3.4 Numbers, Distribution and Behavior of Species Present

This section combines the results of the systematic aerial surveys conducted between mid-June and late-August 2003 and the boat-based observations in late summer to provide 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 precisely 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 the total numbers of birds present within each area: these are estimated by direct extrapolation in Attachments 3 and 4.

Loons – Common Loon (the only loons observed) were recorded in small numbers on all aerial surveys (total 31 observations). They were distributed very widely over the Sound, with only three observed within the 3 Alternatives (Attachment 2). They occurred singly or in pairs on the water, with one individual observed flying

close to the water's surface. These observations are consistent with concurrent observations by Mass Audubon (Perkins et al. 2004), with observations in the previous year (Appendix 5.7-F), and historical reports (Veit and Petersen, 1993).

Sooty Shearwater – This visitor from the Southern Hemisphere is seen regularly in Massachusetts coastal waters: one individual was recorded in Nantucket Sound during the aerial survey of June 26, 2003.

Wilson's Storm-Petrel – This species was observed in small numbers within the study area on three of the aerial surveys (15 individuals, 12 of them on June 26) and one individual was observed during the boat surveys. They were more abundant in the southern part of the Sound and all flew below about 10 feet (3 m) asl.

Double-crested Cormorant – This species was observed frequently at daytime resting areas along the south shore of Cape Cod, Fernando's Fetch, Bishop & Clerks' Lighthouse, Muskeget and Tuckernuck Islands and on the sandbars west of Monomoy. They were the most abundant species within the study area (744), but only one individual was seen within the alternative sites (Alternative 1). During the boat surveys, 35 individuals were observed.

Common Eider – This species is abundant in winter. During the summer it was seen in small numbers (11 individuals) from the plane on the water near Muskeget Island where small numbers nest.

Scoters – These 3 species are abundant in winter and spring but infrequent in summer. During the first aerial survey, on June 16, 2003, four individuals were observed, on the eastern part of the study area. No scoters were seen within the alternative sites.

Gulls – Two species were widespread (Great Black-backed and Herring gull) and recorded on every flight and during the boat surveys. The Great Black-backed outnumbered the Herring Gulls by approximately 6 to 1, which may reflect local abundance (on Muskeget Island) as well as a more pelagic habit of the larger species. During the aerial surveys, the gulls were more abundant in the southern part of the Sound (Alternative 3) near Muskeget Island and the incidental observations from the plane suggest that more gulls occurred close to shore than over open water. A small number (9) of the flying gulls were seen near the altitude of the plane (250 feet (75 m)). Laughing Gulls were present during the boat surveys (134), but not within the study area during aerial surveys.

Terns – Common and Roseate Terns were observed throughout the summer: records from outside the period of this report are presented in Appendices K and M. Common Terns were first recorded on April 18 during the last of the winter 2003 aerial surveys and were subsequently seen on every flight and boat trip except on April 25, 2003 until November 24. Roseate Terns were first recorded on May 12, 2003 and last seen on September 15, 2003. They were seen on five of the six flights reported here. Only one was observed during the boat surveys. It is possible that Roseate Terns were present on more occasions amongst the terns not identified to species. The tern numbers observed during the 2003 season, including those summarized in this report and those from in Appendices 5.7-K and M, followed a similar trend to the 2002 field surveys and to the findings by Mass Audubon in 2003 (Perkins et al. 2004). The largest numbers of terns were observed within the study area early in the season when the earliest nesters are starting to lay eggs and incubate. Thereafter, very few terns were observed within the study area during the six aerial surveys (Attachment 1) and the majority of these were south of Muskeget Island and west of Monomoy, near their post-breeding locations. Within the study area, 223 individual terns were recorded during the aerial surveys and 7,845 elsewhere within Nantucket Sound. During the boat surveys 18 were seen in the study area and 1,092 elsewhere. Common Terns greatly outnumbered Roseates but many terns could not be identified to species.

A total of twelve Least Terns were observed within the study area during five of the aerial surveys, but were much more common closer to shore where 113 individuals were observed. They were also observed in small numbers (3) on the boat surveys. Black Terns were observed during 3 of the aerial surveys, but few of these were in the study area: most occurred in mixed flocks with Common and Roseate terns, west of Monomoy Island.

Terns occurred throughout the Sound. In the study area they were more commonly seen outside the alternative sites, principally foraging near Muskeget Island. Similar numbers were present within each of the alternative sites (estimated densities of 0.36 to 0.57 individuals/km²). Foraging Terns frequently occurred singly, and also in

flocks that occasionally numbered as many as 35 individual within the study area. Outside the study area large flocks of terns (500 individuals) were observed in Buzzards Bay and near Monomoy Island (up to 350 individuals). Flight altitudes of 736 terns were observed to be within 60 feet (18 m) of the water surface, only 3 individuals were seen above that height: 2 Common Terns at about 70 ft (21 m) and one Roseate at about 75 ft (23 m).

Additional information about terns is presented in the following paragraphs and in the Biological Assessment of the Roseate Tern (Appendix 5.7-H) and the Biological Review of the Common Tern (Appendix 5.7-I).

4.0 DISCUSSION

This report summarizes bird observations during a season dominated by summer residents, principally terns. Brief comparisons are made with concurrent surveys by Mass Audubon.

4.1 Alternative Sites

Overall, within the study area more birds were observed outside of the three alternative sites for the Wind Park. Bird use within the three alternative sites was roughly equal (Table 5). This pattern can best be explained by the congregation of gulls and cormorants at Bishop and Clerks Lighthouse, Muskeget and Monomoy, all of which are resting places. Terns were the third most abundant group of birds with an average density in the study area during the aerial surveys was about 1.33 individuals/km² and estimated densities within the alternative sites were 0.36 to 0.57 individuals/km² (Table 5).

A quantitative comparison of the Cape Wind surveys with the 16 surveys of Horseshoe Shoal by Mass Audubon will appear in Section 5.7. In short, the Mass Audubon surveys conducted from May 15 through July 31, 2003, report the same species and very similar numbers of individuals. They found the largest number of individuals in May, with decreasing numbers thereafter except for a slight increase in late July (Perkins et. al 2004). Mass Audubon reported a majority of terns near Monomoy Island and the south shore of Cape Cod (Perkins et al, 2003), which is what the Cape Wind surveys found. Our results and those of Mass Audubon support the findings by Trull et al (1999) that South Beach and Monomoy Island form an important pre-migratory staging area for Common and Roseate terns. Our combined results show that the Alternative sites were not areas of high usage by terns or other species in summer2003.

4.2 Tern Behavior

Although neither of the survey methods (plane or boat) enables exact measurements of the height at which individual terns were flying, it was estimated that most flew below 40 feet (12 m) asl during the surveys and very few were near the range of the proposed turbine rotor-swept area, 75-416 feet (23 – 127 m). Over 90% of the 134 "traveling" terns observed by Mass Audubon were flying below 70 ft (21 m) asl.

4.5 Conclusion

Nantucket Sound, including Horseshoe Shoal, was used by many fewer birds in the summer of 2003 compared to the, rest of the year when large numbers of seaducks and other species of seabirds are present and migrating through. The average number of birds seen within the study area during the aerial surveys was 267, compared to 7,522 in the spring 2003 aerial surveys and 10,029 in the fall 2002/ winter 2003. Terns were more numerous close to shore than in the offshore parts of Nantucket Sound. Terns were more numerous in the offshore study area early in the season, apparently before breeding, than during and following breeding. Aside from the Roseate and Common Terns, the species found were common birds, and not species that are endangered, threatened, or candidates for such listing

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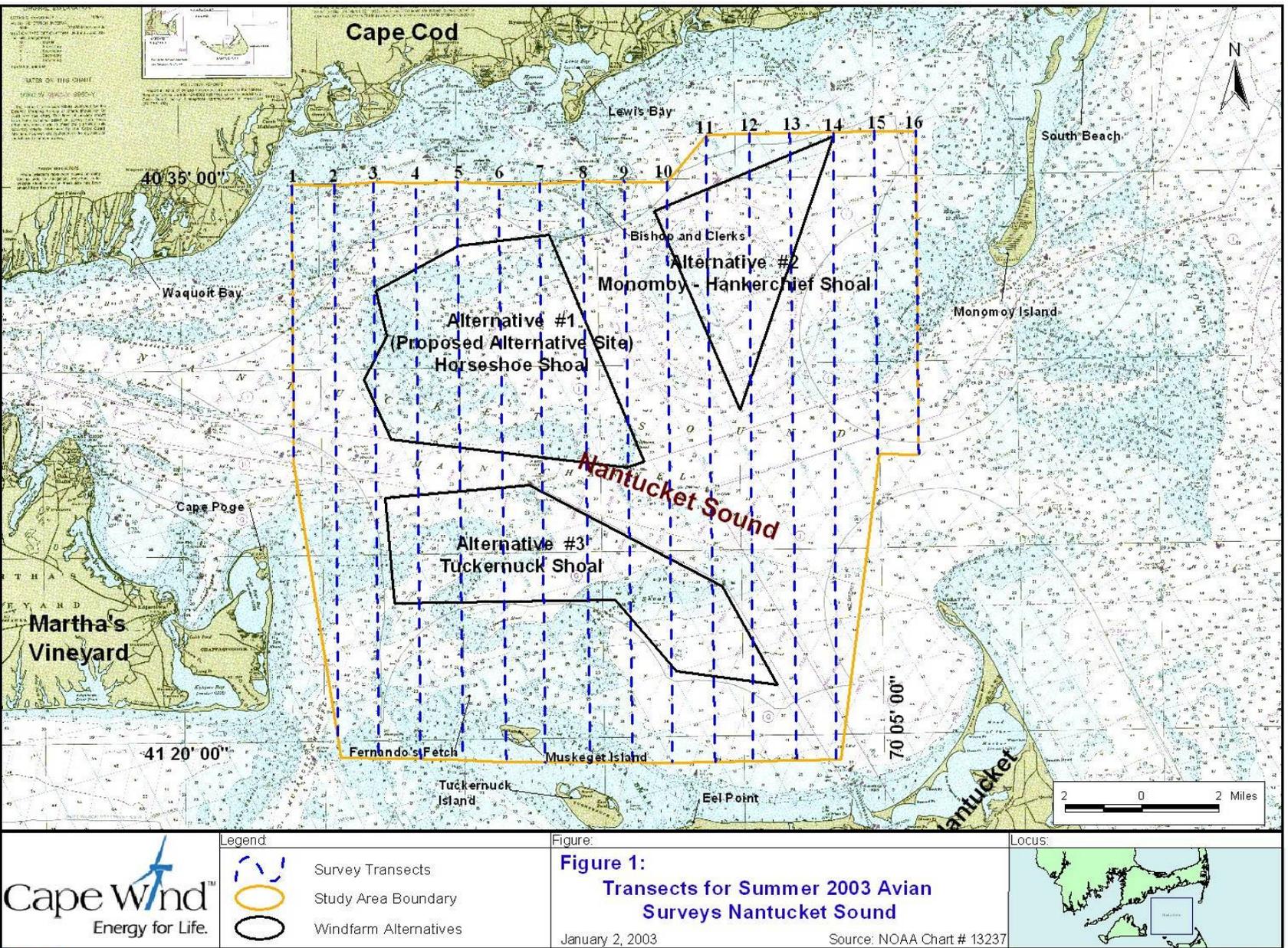
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Figures

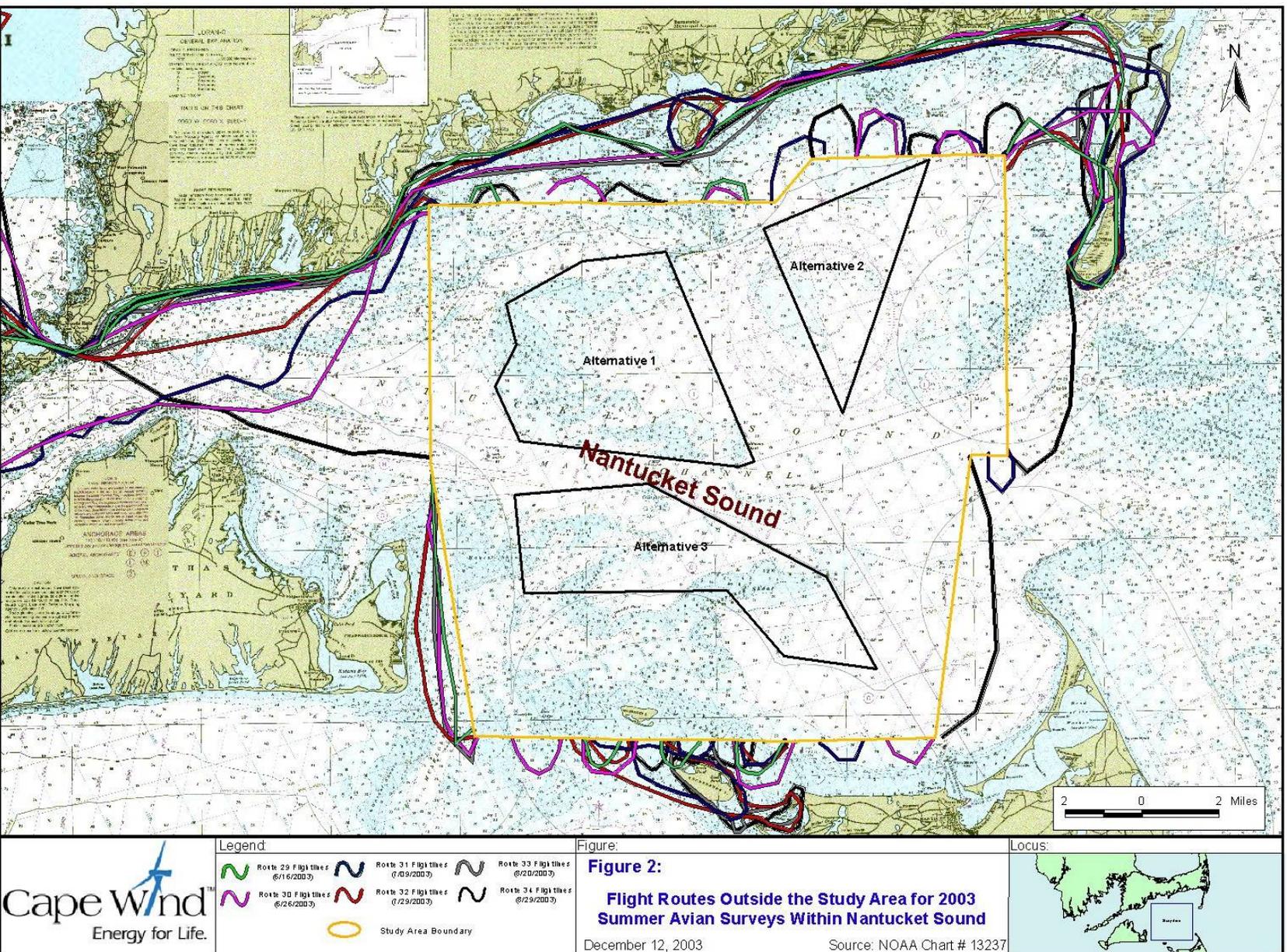
Figure 1: Transects for the Summer 2003 Avian Aerial Surveys Within Nantucket Sound



	<p>Legend</p> <ul style="list-style-type: none">  Survey Transects  Study Area Boundary  Windfarm Alternatives 	<p>Figure:</p> <p>Figure 1: Transects for Summer 2003 Avian Surveys Nantucket Sound</p> <p>January 2, 2003 Source: NOAA Chart # 13237</p>	<p>Locus:</p> 
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Figure 2: Flightlines for the 6 Additional Routes Outside the Study Area During Aerial Surveys in Nantucket Sound June – August 2003.

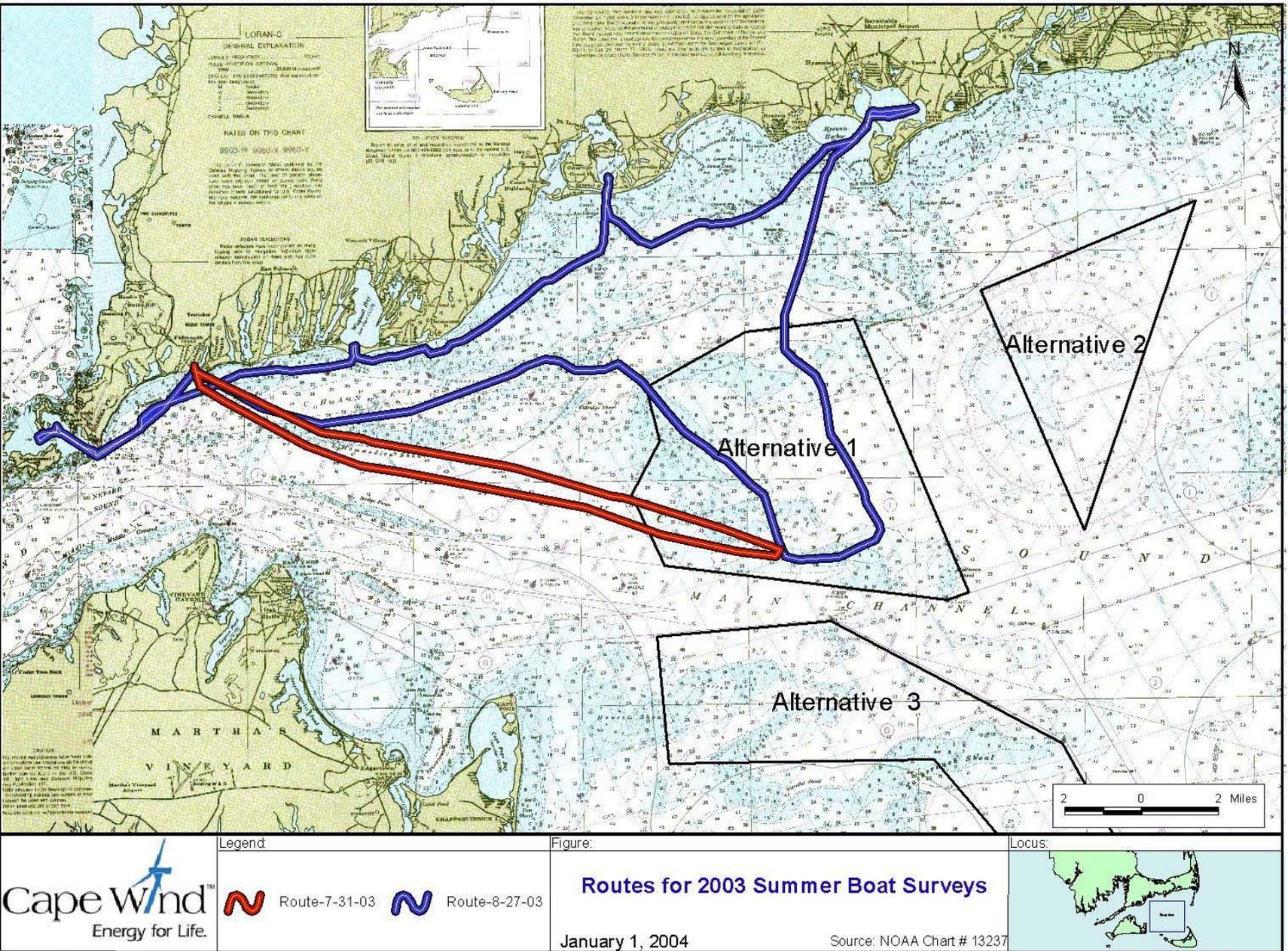


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Figure 3. Routes For Summer 2003 Boat Surveys



ATTACHMENT 1

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

Table A. Numbers of Individuals Observed on Each of the 6 Aerial Surveys within the Study Area in Nantucket Sound, MA, June - August 2003

Species	6/16/2003	6/26/2003	7/9/2003	7/29/2003	8/20/2003	8/29/2003	Total
Common Loon	2	11	5	3	6	4	31
Sooty Shearwater	0	1	0	0	0	0	1
Wilson's Storm-Petrel	2	12	0	1	0	0	15
Double-crested Cormorant	78	216	188	132	55	75	744
Canada Goose	10	0	0	0	0	0	10
Common Eider	6	5	0	0	0	0	11
Scoter sp.	4	0	0	0	0	0	4
American Oystercatcher	0	0	1	0	0	0	1
Herring Gull	11	20	26	7	5	5	74
Great Black-backed Gull	47	319	60	36	6	21	489
Roseate Tern	0	2	4	3	6	8	23
Common Tern	4	16	52	47	19	24	162
Least Tern	2	4	1	0	1	4	12
Mixed Tern Type	0	3	0	22	1	0	26
Total	166	604	342	251	99	141	1603

Table B. Species Totals: Individuals Recorded Outside the Study Area Within Nantucket Sound During Six Aerial Surveys (see Fig. 2) June - August 2003.

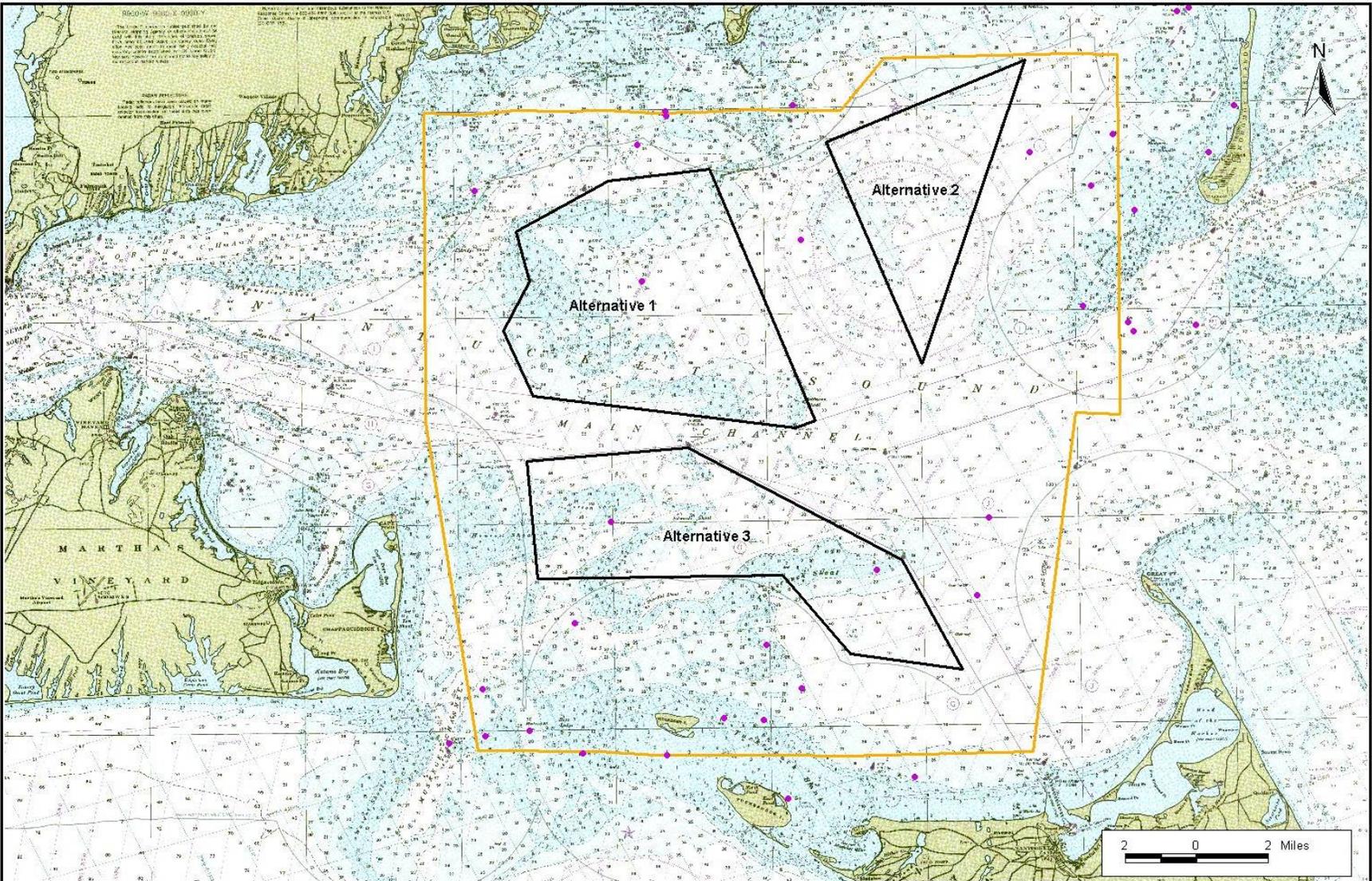
Species	6/16/2003	6/26/2003	7/9/2003	7/29/2003	8/20/2003	8/29/2003	Total
Common Loon	1	2	3	4	0	2	12
Double-crested Cormorant	259	66	434	397	974	1007	3137
Great Blue Heron	0	0	0	1	0	0	1
Mute Swan	0	0	0	0	0	55	55
Canada Goose	0	0	10	0	40	37	87
Common Eider	0	97	8	0	0	0	105
Osprey	0	1	1	1	0	0	3
American Oystercatcher	0	0	0	0	0	7	7
Laughing Gull	0	0	0	0	0	23	23
Herring Gull	19	147	23	98	4	74	365
Great Black-backed Gull	220	33	1070	90	1006	213	2632
Unknown Gull	50	0	25	0	100	56	231
Roseate Tern	3	2	15	2	8	1	31
Common Tern	38	82	373	766	1168	372	2799
Least Tern	5	1	33	71	24	42	176
Mixed Tern Type	2107	0	67	656	555	1454	4839
Shorebirds	0	0	0	0	0	50	50
Total	2701	431	2042	2086	3879	3393	14532

Table C. Species Totals: Individuals Recorded Outside the Study Area and Outside Nantucket Sound; Within Vineyard Sound and Buzzards Bay During Six Aerial Surveys June - August 2003.

Species	6/16/2003	6/26/2003	7/9/2003	7/29/2003	8/20/2003	8/29/2003	Total
Common Loon	0	2	3	4	0	2	11
Double-crested Cormorant	779	9	36	109	206	75	1214
Mute Swan	0	0	0	0	4	0	4
Common Eider	0	0	30	0	0	0	30
Osprey	0	0	0	0	0	1	1
American Oystercatcher	0	0	0	1	0	0	1
Laughing Gull	0	0	0	0	21	4	25
Herring Gull	1	3	7	11	2	42	66
Great Black-backed Gull	2	2	6	0	85	2	97
Unknown Gull	0	0	0	0	15	0	15
Roseate Tern	9	2	26	18	200	17	272
Common Tern	11	115	69	766	1168	372	2501
Least Tern	0	3	2	3	0	0	8
Mixed Tern Type	10	53	139	170	116	871	1359
Total	812	189	318	1082	1817	1386	5604

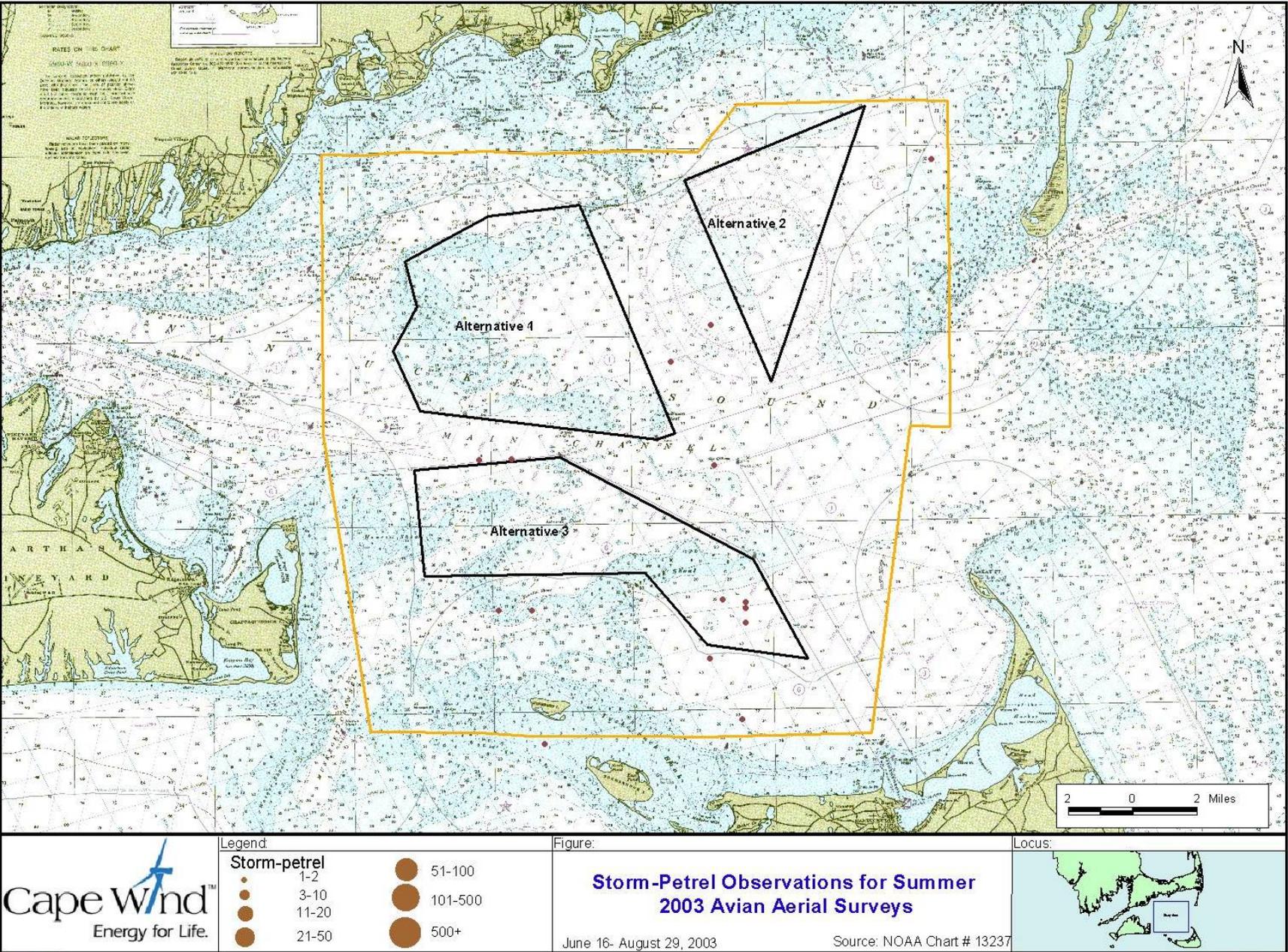
ATTACHMENT 2

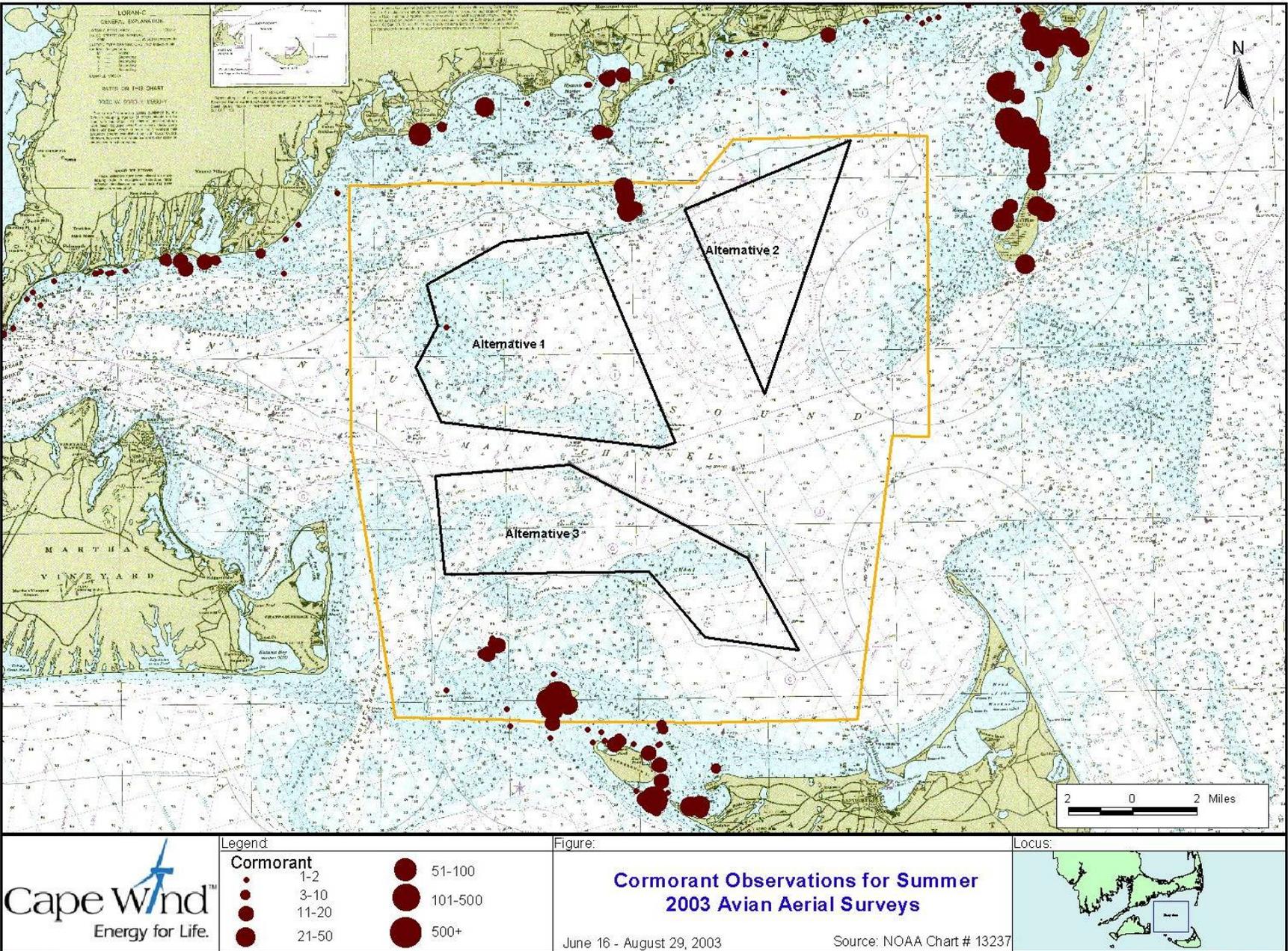
Distribution of Waterbirds in the
Study Area for Aerial
Surveys 29-34 Combined



	Legend Loon		
	1-2 3-10 11-20 21-50	51-100 101-500 500+	
Figure: Loon Observations for Summer 2003 Avian Aerial Surveys June 16 - August 29, 2003		Locus: 	

	Source: NOAA Chart # 13237	
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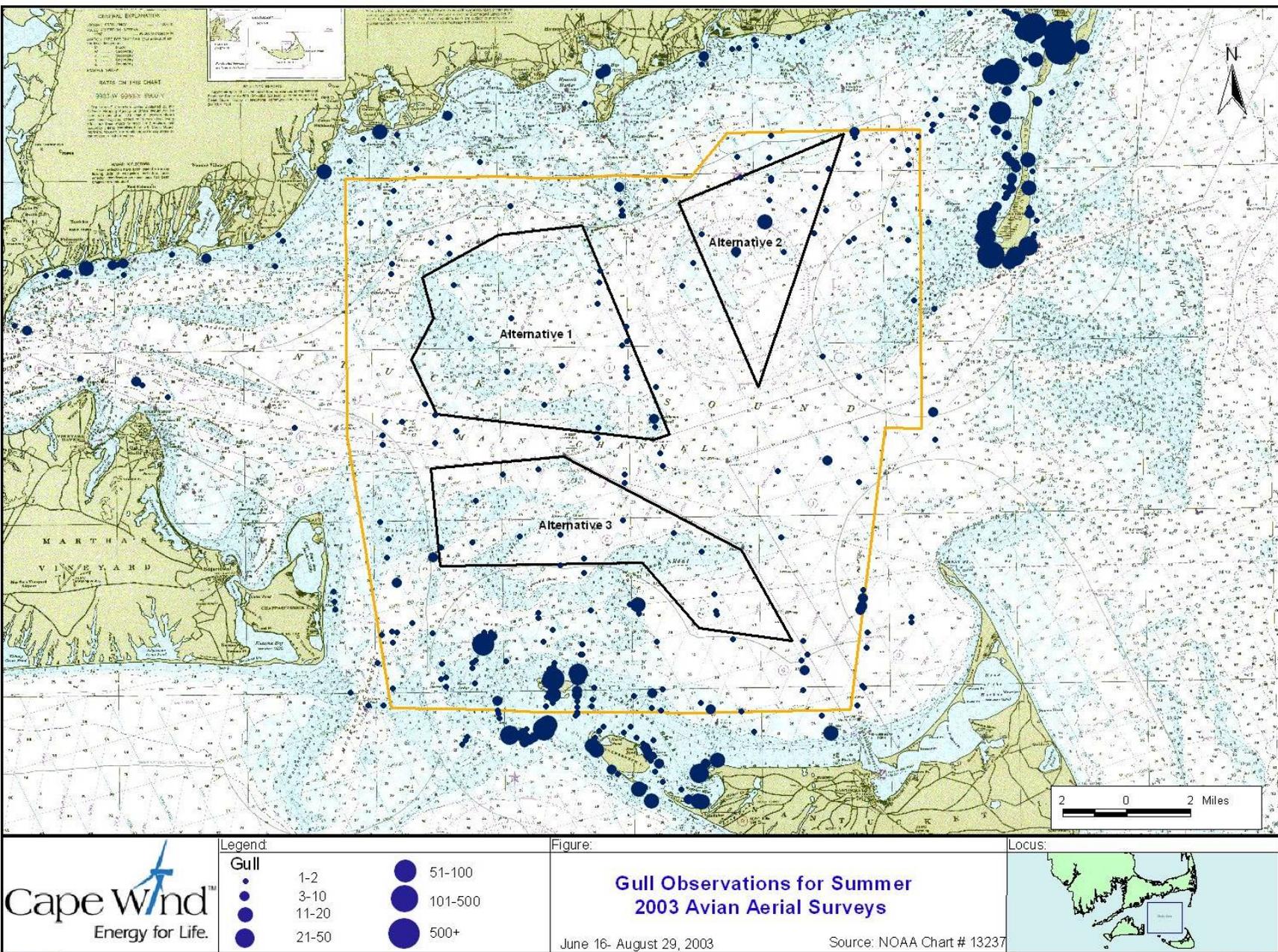


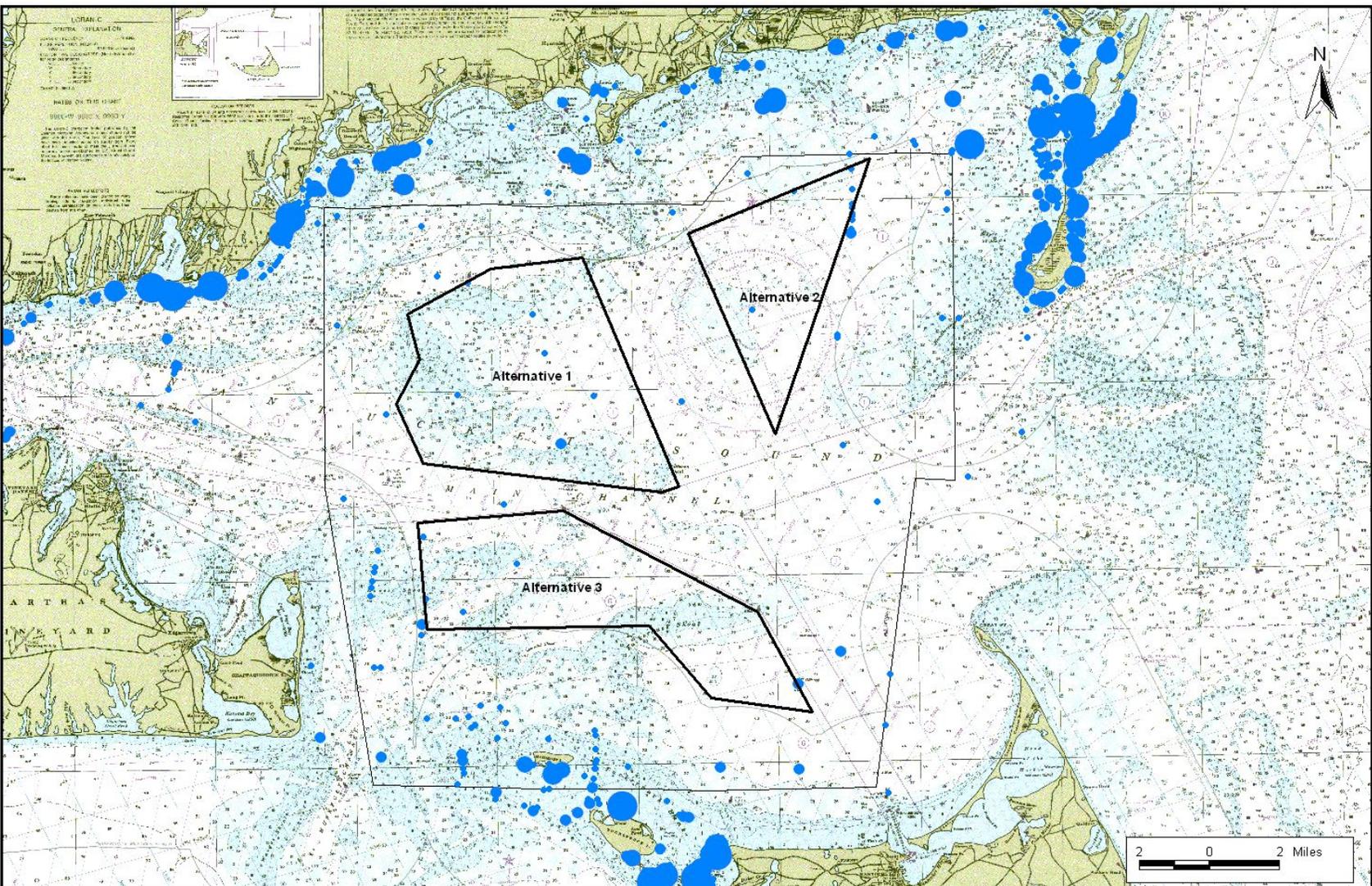


Legend	
Cormorant	
● 1-2	● 51-100
● 3-10	● 101-500
● 11-20	● 500+
● 21-50	

Figure: **Cormorant Observations for Summer 2003 Avian Aerial Surveys**
 June 16 - August 29, 2003 Source: NOAA Chart # 13237







	Legend Tern	1-2 3-10 11-20 21-50	51-100 101-500 500+	Figure: <p style="text-align: center;">Tern Observations for Summer 2003 Avian Aerial Surveys</p> June 16 - August 29, 2003 Source: NOAA Chart # 13237	Locus:
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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 totals and densities for alternative sites and for the area outside of the alternative sites within the study area for the six systematic aerial surveys combined

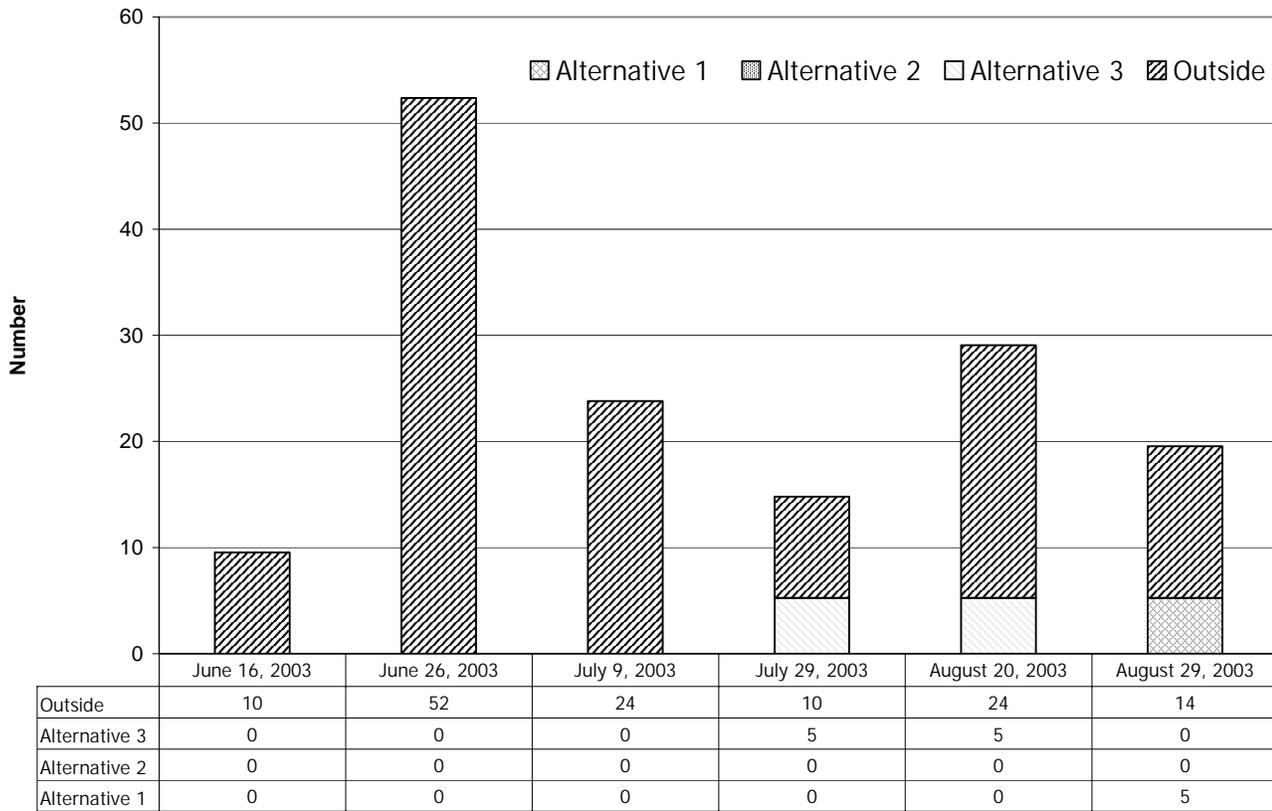
Species	Location	Total Number Observed	Max/Min Number	Density (indivs/km ²)	Estimated* Number Present	Estimated Number Present per Survey
Loon	Alternative 1	1	1/0	0.05	5	1
Loon	Alternative 2	0	0/0	0.00	0	0
Loon	Alternative 3	2	1/0	0.12	11	2
Loon	Outside	28	11/2	0.23	133	22
Loon	Total	31	11/2	0.18	155	26
Storm-petrel	Alternative 1	0	0/0	0.00	0	0
Storm-petrel	Alternative 2	0	0/0	0.00	0	0
Storm-petrel	Alternative 3	4	4/0	0.24	21	4
Storm-petrel	Outside	11	8/0	0.09	52	9
Storm-petrel	Total	15	12/0	0.09	75	13
Eider	Alternative 1	0	0/0	0.00	0	0
Eider	Alternative 2	0	0/0	0.00	0	0
Eider	Alternative 3	0	0/0	0.00	0	0
Eider	Outside	11	6/0	0.09	52	9
Eider	Total	11	6/0	0.07	55	9
Scoter	Alternative 1	0	0/0	0.00	0	0
Scoter	Alternative 2	0	0/0	0.00	0	0
Scoter	Alternative 3	0	0/0	0.00	0	0
Scoter	Outside	4	4/0	0.03	19	3
Scoter	Total	4	4/0	0.02	20	3
Gull	Alternative 1	22	14/1	1.05	116	19
Gull	Alternative 2	25	13/0	2.55	132	22
Gull	Alternative 3	15	4/1	0.89	79	13
Gull	Outside	501	331/9	4.16	2386	398
Gull	Total	563	339/11	3.35	2815	469
Cormorant	Alternative 1	1	1/0	0.05	5	1
Cormorant	Alternative 2	0	0/0	0.00	0	0
Cormorant	Alternative 3	0	0/0	0.00	0	0
Cormorant	Outside	743	215/55	6.17	3538	590
Cormorant	Total	744	215/55	4.43	3720	620
Tern	Alternative 1	12	8/0	0.57	63	11
Tern	Alternative 2	5	5/0	0.51	26	4
Tern	Alternative 3	6	3/0	0.36	32	5
Tern	Outside	200	68/4	1.66	952	159
Tern	Total	223	72/6	1.33	1115	186

*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 Summer 2003
for Aerial Surveys 29-34

Loon



Wilson's Storm Petrel

