

**Appendix 5.7-F**

**Spring and Summer 2002  
Waterbirds Survey for the  
Cape Wind Energy Project**

---

**APPENDIX 5.7-F  
SPRING AND SUMMER 2002 WATERBIRDS SURVEY  
FOR THE  
CAPE WIND ENERGY PROJECT  
NANTUCKET SOUND**

*Prepared for:*

Cape Wind Associates  
75 Arlington Street  
Boston, Massachusetts 02116

*Prepared by:*

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

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

and

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

**ESS Project No. E159**

**October 24, 2003**

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
EXECUTIVE SUMMARY .....	I
1.0 INTRODUCTION.....	1
2.0 METHODS.....	1
2.1 Location of Study Area and Alternative Sites .....	1
*2.2 Aerial Surveys .....	2
2.3 Boat Surveys.....	3
*2.4 Comparison of Survey Methods.....	4
3.0 RESULTS .....	4
3.1 Aerial Surveys .....	5
3.2 Boat Surveys.....	7
3.4 Altitude of Flying Birds .....	10
4.0 DISCUSSION.....	11
5.0 LITERATURE CITED.....	13

### TABLES

Table 1	Aerial Survey Coverage and Percentage of each Alternative Site Flown
Table 2	Species Observed During Spring/Summer 2002 Aerial and Boat Surveys
Table 3	Summary of Dates, Times, and Weather Conditions during the Six Spring/Summer Waterbird Aerial Surveys in Nantucket Sound, May-August 2002
Table 4	Numbers of Individuals Recorded in the Study Area During Six Aerial Surveys and elsewhere during 4 extended flights (May-August 2002)
Table 5	Densities (individuals/km <sup>2</sup> ) of waterbirds observed in the study area during 6 aerial surveys, May-August 2002
Table 6	Summary of Dates, Times, and Weather Conditions During the Seven Spring/Summer Waterbird Boat Surveys in Nantucket Sound, 2002
Table 7	Species Totals: Individuals Recorded during Seven Boat Surveys and 13 Days of Ground-Truthing for the Radar
Table 8A	Species Totals: Individuals Recorded by Date During Seven Boat Surveys
Table 8B	Species Totals: Individuals Recorded by Date during 13 Days of Ground-Truthing for the Radar
Table 9	Boat Survey Waterbird Observations for May 1-August 22, 2002 and Observations during Ground-Truthing for Radar (May 10-September 30, 2002)
Table 10	Altitude of Flying Terns Observed from the Boats: Numbers of Terns Observed

### FIGURES

Figure 1	Transects for the Spring/Summer 2002 Aerial Surveys in Nantucket Sound
Figure 2	Flightlines for the Routes Outside the Study Area during the 2002 Spring/Summer Aerial Surveys in Nantucket Sound
Figure 3	Routes For Spring Summer Boat Surveys 2-7

## **ATTACHMENT**

- Attachment 1 Numbers of Individuals Observed on each of the 6 Aerial Surveys within the Study Area in Nantucket Sound, MA, May-August 2002
- Attachment 2 Species Densities for all Aerial Surveys Combined
- 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
- Attachment 4 Estimated numbers of Summer Birds for Aerial Surveys 6-11

## **EXECUTIVE SUMMARY**

Bird use of the open waters of Nantucket Sound in late spring and summer was assessed by means of six aerial and seven boat surveys from May to August, 2002. These surveys occurred during conditions of good visibility and moderate winds. The principal purpose of the six aerial surveys (May 22-August 30) was to measure bird densities (birds per unit area) in the Project Area and the surrounding vicinity in a standardized manner, using protocols established during the 2002 winter surveys. The surveys covered a study area in the center of the Sound that included the proposed site for the Wind Park (Alternative 1) and two alternative sites (Alternatives 2 and 3) as well as surrounding waters (Fig. 1) but excluded most of the immediate inshore waters, less than 1.2 miles (2 km) from land, because they generally have different avifauna. The study area totaled about 322 mi<sup>2</sup> (834 km<sup>2</sup>) and encompassed approximately 58% of Nantucket Sound. The total distance flown for each of the aerial surveys was approximately 258 linear miles (415 km). The surveys were conducted at an altitude of approximately 250 feet (75 m). Birds were counted and identified over a distance of 656 feet (200 m) on each side of the transect (a total of 1,312 feet/400 m) resulting in a total area of approximately 65 mi<sup>2</sup> (168 km<sup>2</sup>) for each survey. Additional information was obtained during the flights, while approaching, and returning from, the study area. These opportunistic records cannot be quantitatively compared to the transects because data collection was not standardized for measuring densities.

The principal purpose of the seven boat surveys (May 1-August 22) was to study the flight behavior and altitude of the birds, with particular reference to the listed Roseate and Common Terns. The first boat survey systematically covered about half of the transects in the study area. Subsequent surveys traveled between known areas where terns foraged, rested, or roosted. Additional boat-based observations of birds were made on nine days (May 10 to June 6) in the course of ground-truthing targets for the spring radar survey based on Horseshoe Shoal and on four days (September 5 to 30) for the fall radar survey based at Cape Poge.

A total of 25 species were observed during the aerial and boat surveys. Eighteen species of waterbirds, 9187 individuals, were observed during the aerial surveys: 2856 individuals within the study area transects and an additional 6,331 individuals outside the study area. Some species (loons, gannets, scoters and eiders) were principally wintering waterbirds that were rarely seen in the Sound after the first survey. The most abundant species observed were the Common and Roseate Terns forming 59% of the total birds observed in the study area, and the Great Black-backed and Herring Gulls comprising 14% of the total birds observed in the study area. Additional species included small numbers of non-breeding summer-visitors from the Southern Hemisphere: Sooty Shearwater and Wilson's Storm-Petrel. A taxon-based narrative summary of the findings is located in Section 4, below.

The distribution of terns among the three alternative sites ranged from 3.57-to 5.36-individuals/km<sup>2</sup> (mean density estimated for all six systematic aerial surveys). Larger numbers were observed in other parts of the study area and along the edges of the Sound.

Altitude estimates of 1,779 flying terns were made during the boat surveys; of these, 1,732 were within approximately 60 feet (18 m) of the water surface and most flew below 40 feet (12 m). The highest-flying terns observed were 30 individuals at 110 feet (34 m). For all flying seabirds, the great majority were observed close to the water surface, below about 33 feet (10 m), but during the aerial surveys small numbers of gulls and gannets were observed near the altitude of the plane (75 meters). The proposed turbine rotor-swept area will be between 75 and 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.

In summary, relatively few birds used the open waters of Nantucket Sound during the summer of 2002 compared to the larger numbers present in winter. The average number of birds seen within the study area during the aerial surveys was 476, compared to 15,455 in the winter 2002 aerial surveys. Terns were rarely observed flying at altitudes within the range swept by turbine rotors of the size proposed.

## **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 presents observations of waterbirds in Nantucket Sound during the period May - September 2002, within and adjacent to three alternative sites for the wind park proposed by Cape Wind Associates, LLC (Cape Wind or the Applicant). It comprises part of the year-round data gathering mandated by the USACE for inclusion in the DEIS. The preliminary avian risk assessment (Appendix 5.7-A) identified terns as the species of chief concern in summer, specifically the endangered Roseate Tern and the state-listed Common Tern. That assessment also concluded that little quantitative information is available on bird use of Nantucket Sound.

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

This report has two principal goals: (1) it summarizes the information gathered in 6 aerial surveys (May 22 – August 30, 2002) on the spatial and temporal distribution of birds in the study area including the three alternative wind park sites and surrounding areas; and (2) it summarizes the information gathered in twenty boat-based surveys (May 1 September 30, 2002) used for characterizing bird behavior, especially altitude of flight. The boat surveys included thirteen trips that were principally intended to identify birds recorded on the radar screens during the radar surveys in May and September 2002 (referred to herein as “ground-truthing”), see Appendix 5.7-J. As summer-visitors of particular concern, the Roseate and Common Terns received particular attention and, for completeness, tern data from two flights, in mid April and late September 2002 are included here although the flights are reported in Appendix 5.7-D and 5.7-G.

This report accompanies reports of wintering birds (Appendix 5.7-D and Appendix 5.7-G) and will refer briefly to two other studies of terns in Nantucket Sound that used similar methods: one in 2001 (Hatch 2001), and the other by Massachusetts Audubon Society, in 2002 (Perkins et al. 2003). Additional surveys will be conducted two times per month through February 2004 and the results from these additional surveys will be presented in future reports.

\*The survey methods used are comparable to those employed by waterbird biologists who determine population and harvest levels for the MADFW and the USFWS. These methods include both aerial and boat surveys, but they have not previously been employed systematically in the open waters of Nantucket Sound. The information provided in this study significantly expands upon the quantitative material reviewed by Kerlinger and Hatch (2001) in their preliminary risk assessment and will contribute to assessments of the potential for Project impacts to waterbirds that use Nantucket Sound during the summer. Specifically, the data on numbers and distribution will contribute to evaluation of bird-use of the proposed and alternative sites and to the evaluation of potential impacts of the proposed project. The behavioral information is relevant to possible impacts including disturbance and collisions.

## **2.0 METHODS**

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

\*The same study area has been used in all surveys included in this report and in reports for other seasons. The area of Nantucket Sound is approximately 560 mi<sup>2</sup> (1,450 km<sup>2</sup>) of which the study area comprises approximately 322 mi<sup>2</sup> (834 km<sup>2</sup>) (about 58% of Nantucket Sound) and includes the three alternative sites for the proposed Wind Park and surrounding areas, as shown in Figure 1. With the exception of a small area near Muskeget Island, this study area excludes waters within 1.2 miles (2 km) of land. Areas close to shore commonly have a different avifaunal community from the principal areas of concern. The small portion of the survey area within

1.2 miles (2 km) of land (near Muskeget Island at the southern edge of the study area) totaled about 5 mi<sup>2</sup> (13 km<sup>2</sup>). This area was included in the study area due to its proximity to Alternative 2 and because Muskeget Island extends into Nantucket Sound. The three alternative sites are identified as:

- 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 survey area of approximately 65 mi<sup>2</sup> (168 km<sup>2</sup>) 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 <sup>2</sup> /mi <sup>2</sup> )	Kilometers <sup>2</sup> /Miles <sup>2</sup> Surveyed	% Area Surveyed
1	110 km <sup>2</sup> (42.5 mi <sup>2</sup> )	21.0 km <sup>2</sup> (8.1 mi <sup>2</sup> )	19%
2	52 km <sup>2</sup> (20.1 mi <sup>2</sup> )	9.8 km <sup>2</sup> (3.8 mi <sup>2</sup> )	19%
3	89 km <sup>2</sup> (34.4 mi <sup>2</sup> )	16.8 km <sup>2</sup> (6.5 mi <sup>2</sup> )	19%
OUTSIDE	582 km <sup>2</sup> (224.7 mi <sup>2</sup> )	120.4 km <sup>2</sup> (46.5 mi <sup>2</sup> )	21%
TOTAL	834 km <sup>2</sup> (322.0 mi <sup>2</sup> )	168.0 km <sup>2</sup> (64.9 mi <sup>2</sup> )	20%

**\*2.2 Aerial Surveys**

\*The goal of the aerial surveys within the study area was to measure bird densities (numbers per unit area), using standardized protocols developed previously for the 2002 winter bird survey 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.

Plane altitude was selected as a compromise between covering as much area as possible, being able to identify and count the birds seen, and putting as few as possible of them to flight before counting. Six aerial surveys (May 22, June 24, July 25, August 6, August 26, and August 30, 2002) were flown in a Cessna-206 floatplane at 250 feet (75 m) above sea level (asl) at an airspeed of 90 knots (167 km/h). 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 varying weather, but were restricted to conditions of good visibility and moderate winds (< 30 knots (56 km/h)) for safety reasons. Flights were also varied in their starting point and direction of flight.

On four of the days, the flights were extended to additional areas, principally along the shores (Figure 2). These sections of flights were sometimes flown at higher altitudes and provide information on birds sighted, but the only data used for calculating densities for strict comparisons were collected along the transects of the study area.

\*Two observers were employed, one on each side of the plane. To identify outer transect boundaries, an aluminum rod was attached perpendicular to the wing strut on each side of the plane. The placement of these rods was determined with a clinometer to measure the calculated angle and the distances were verified by flying over the airport at 250 feet (75 m) using pre-measured 200-meter (656 feet) markers on the ground. The area visible between the float on the plane and the aluminum rod provided each observer with a 200-meter (656 foot) transect width within which all birds were counted. Additional sightings beyond the transect were recorded incidentally but were not used for densities.

\*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, activity and time of sighting. The data recorder was responsible for entering the data conveyed by the observers. 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.

### **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.

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 (Attachment 2).

### **2.3 Boat Surveys**

A systematic boat survey was initiated on May 1, 2002 along the same transects as the aerial surveys to complement those surveys with additional information on bird behavior. The survey vessel used (the Minuteman, from Patriot Party Boats) was a 40-foot (12.2 m) trawler with a freeboard of 5 feet (1.5 m). The survey team consisted of the captain, a data recorder, and two observers (Jeremy Hatch and Jeffrey Burm) positioned on opposite sides of the boat, on the foredeck when conditions permitted, observing from a height of about 11 feet (3.4 m) above sea level. Seven of the 16 transects were covered on May 1 (transects 1, 2, 3, 4, 7, 8, and 9), but the survey was not completed due to high winds and rough seas on subsequent days. Experience on this first boat survey indicated that such surveys are not an effective way to examine the natural movements of seabirds in Nantucket Sound because many of them, principally seaducks, were strongly affected by the vessel. Almost all the seaducks within sight flew up when the boat approached. Typically these birds flew close to the water surface and did not fly great distances but it was rarely possible to see where each flock landed.

Unlike seaducks, terns were almost unaffected by the survey vessel. Since these birds were the principal focus of the summer work, the subsequent boat journeys (June 19, July 1, July 26, August 1, August 15, and August 22, 2002) were made without following the predetermined transects. The survey vessel (the TG, from Patriot Party Boats) was a 29-foot (8.8 m) Hawk 29 Bass boat, with a freeboard of 3 feet (0.9 m). Observations were made from a height of about 7 feet (2.1 m) above the water while going to areas where terns were known to forage or

rest. Observations on species, number, behavior, and altitude were recorded. On each boat survey, Horseshoe Shoal was visited to record observations of birds present. The routes for boat surveys 2-7 are shown in Figure 3.

Additional boat-based observations (May 10, May 17, May 20, May 24, May 28, June 3, June 4, and June 6, 2002) of bird behavior were gathered during the ground-truthing for the spring radar studies. These operations were designed to identify targets (often flying birds) from the boat that had been located on the radar screen, located on a jack-up barge at the southern edge of Horseshoe Shoal (see Fig.1). Boat-based observations of bird behavior were also conducted in the fall of 2002 (September 5, September 13, September 18, and September 30) during the ground truthing of the fall land-based radar studies. The land-based radar study was conducted with radars located at Cape Poge, Martha's Vineyard (see Fig.1). The ground-truthing boat-based observations were conducted near Cape Poge and targets were also identified from beside the radar. The observations from both the spring and fall ground truthing are included in the characterization of flight altitudes. The radar studies are presented in Appendix 5.7-E, and Geo-Marine Radar Report – Appendix 5.7-J).

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" (and no portable instruments are available for use with small moving targets). The height above sea level for birds within 300 feet (100m) of the boat was estimated, using bird size, wave height, and the boat (and other vessels nearby) as benchmarks and placing each estimate into a 20-foot interval. Observations from the jack-up barge and from the bluff were easier because the observer was on a stable site at a known height above sea level. In practice, few birds were observed at altitudes near the rotor-swept zone so that the imprecision does not weaken the conclusion that most birds were flying well below.

#### **\*Data Compilation for Boat 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 attributes. Observer sightings were also recorded on an audiotape to provide independent recordings and backup for each observer.

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

#### **\*2.4 Comparison of Survey Methods**

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

\*Two advantages of the aerial surveys over the boat surveys included the ability to survey a larger area in a given time period and at the height chosen (250 feet (75 m)), most birds within the transect could be seen before the presence of the airplane disturbed them. However, the ability to distinguish and count similar species, especially large numbers in mixed flocks (such as wintering seaducks), was reduced due to plane speed. At higher altitudes, the chances increased of missing small birds such as Storm-Petrels.

### **3.0 RESULTS**

During the six aerial surveys and 20 boat-based surveys conducted during May through September of 2002, a total of 25 species were observed (Table 2).

**Table 2**  
**Species Observed During Spring/Summer 2002 Aerial and Boat Surveys**

Common Name	Scientific Name
Red-throated Loon	<i>Gavia stellata</i>
Common Loon	<i>G. immer</i>
Sooty Shearwater	<i>Puffinus griseus</i>
Wilson's Storm-Petrel	<i>Oceanites oceanicus</i>
Northern Gannet	<i>Morus bassanus</i>
Double-crested Cormorant	<i>Phalacrocorax auritus</i>
Common Eider	<i>Somateria mollissima</i>
Long-tailed Duck	<i>Clangula hyemalis</i>
Black Scoter	<i>Melanitta nigra</i>
White-winged Scoter	<i>M. fusca</i>
Surf Scoter	<i>M. perspicillata</i>
Goldeneye	<i>Bucephala sp.</i>
Osprey	<i>Pandion haliaetus</i>
Red Knot	<i>Calidris canutus</i>
Sandpiper	<i>Calidris sp.</i>
Laughing Gull	<i>Larus atricilla</i>
Ring-billed Gull	<i>L. delawarensis</i>
Herring Gull	<i>L. argentatus</i>
Great Black-backed Gull	<i>L. marinus</i>
Unknown Gull	<i>Larus unknown</i>
Roseate Tern	<i>Sterna dougallii</i>
Common Tern	<i>S. hirundo</i>
Least Tern	<i>S. antillarum</i>
Roseate/Common Tern Type	<i>Sterna sp.</i>
Dovekie	<i>Alle alle</i>
Razorbill	<i>Alca torda</i>
Swallow	<i>Hirundinidae sp.</i>

### 3.1 Aerial Surveys

Six aerial surveys were conducted between May 22 and August 30, 2002. Details of the times, dates, tide, and weather conditions are provided in Table 3. Weather varied from survey to survey and included different wind conditions, tides, and cloud cover. Only one day had extensive cloud cover and there was no precipitation.

**Table 3**  
**Summary of Dates, Times, and Weather Conditions during the Six Spring/Summer Waterbird Aerial Surveys in Nantucket Sound, May-August 2002**

Survey <sup>1</sup>	Date	Start	Finish	Start Point <sup>2</sup>	High Tide <sup>3</sup>	Wind	Temp F	Weather
A6	22-May	05:15	09:45	16 South	8:51	NNW 8 Knots	52	Sunny
A7	24-Jun	09:40	14:17	1 South	12:24	NW 11-16 Knots	mid 60s	Sunny
A8	25-Jul	07:00	11:20	16 North	13:43	NW 25 Knots	low 70s	Sunny
A9	6-Aug	14:50	19:30	16 North	10:46	NW 20-35 Knots	70s	Sunny
A10	26-Aug	06:30	10:41	2 South	15:08	NE 3-7 Knots	70s	Clear
A11	30-Aug	16:15	19:10	2 North	17:55	NE 10 knots	low 70s	Overcast

<sup>1</sup> Surveys A1 – A5 were the flights flown during the late winter/spring 2002 surveys from March 17 – April 15, 2002.

<sup>2</sup> Start Point refers to transect (Fig. 1)

<sup>3</sup> High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts ([www.harbertides.com](http://www.harbertides.com))

### Species and Abundances

A total of 18 species of waterbirds were identified during the six aerial surveys of the study area. Table 4 summarizes the total numbers recorded and the numbers found on each survey are presented in Attachment 1. Table 4 also includes the numbers observed during other sections of the flights, principally around the edges of

the Sound, outside the transects of the study area. The tracks for these flights are shown in Figure 2. Two groups of related species were pooled as follows: the three species of scoters observed (Black, Surf, and White-winged) were pooled as "scoters"; and the two species of loons observed (Common and Red-throated) were pooled as "loons." Common Loons greatly outnumbered Red-throated Loons but species was not always recorded because it is sometimes difficult to differentiate between them. Terns were separated by species when possible, but there were many instances where differentiating between Common and Roseate Terns was difficult including when they were in mixed flocks. When this occurred, these two species were pooled together and labeled as "Common/Roseate Type" as presented in Table 4.

**Table 4  
 Numbers of Individuals Recorded in the Study Area During Six Aerial Surveys and elsewhere during  
 4 extended flights (May-August 2002)**

Species	Within Study Area	# Surveys	Outside Study Area	Total
Loon: Common and Red-throated	83	3	0	83
Wilson's Storm-Petrel	13	4	1	14
Northern Gannet	89	1	0	89
Double-crested Cormorant	293	5	1,347	1,640
Common Eider	181	3	0	181
Scoter: Black, White-winged, and Surf	18	2	4	22
Goldeneye	1	1	1	2
Laughing Gull	2	1	12	14
Ring-billed Gull	1	1	0	1
Herring Gull	158	6	194	352
Great Black-backed Gull	249	6	887	1,136
Unknown Gull	0	0	808	808
Roseate Tern	113	6	96	209
Common Tern	1,016	6	1,283	2,299
Least Tern	68	2	106	174
Common/Roseate Tern Type	570	5	1,592	2,162
Razorbill	1	1	0	1
Total	2,856		6,331	9,187

Most of the loons (77/83), gannets (89/89), and seaducks (Eider and Scoters) (109/203) were seen on the first flight (May 22) and presumably represented lingering winter-visitors or transients. Small numbers subsequently seen most likely included injured birds, immature non-breeders, or members of the small local breeding population (of Eiders). The Sound is not an important molting site for scoters.

The only species recorded on all six of the aerial surveys within the study area were Common and Roseate terns and Great Black-backed and Herring gulls. The Double-crested Cormorant appeared on five surveys within the study area. These five species are abundant summer residents in the area. The Cormorants were more abundant in the late summer, reflecting the pattern of post-breeding dispersal characteristic of this species. Another summer resident along the shores of the Sound, the Least Tern, was recorded on only two systematic surveys: it is generally confined to waters close to shore. Many unknown gulls were observed outside the study area on Monomoy Island and Great Point, Nantucket in late August. Only one species of non-breeding summer-visitor, Wilson's Storm-Petrel, was seen with any regularity (on four surveys). The remaining species occurred in very small numbers.

**Bird Distribution**

The distribution of sightings of the most common species observed during the aerial surveys is shown on eight maps in Attachment 2. These maps include not only the birds recorded during the 6 aerial surveys with systematic transects of the study area but also various observations in other areas obtained by the four flights on diverse routes that had non-standardized methods.

More terns were sighted outside the study area (3,077) than within the study area (1,767). The largest concentrations were observed along the southern shore of Cape Cod, near Monomoy Island, and near Tuckernuck Island. These two groups of sightings entailed different methods and are not rigorously comparable,

however the larger numbers outside the study area were obtained in fewer flights (4) than those within the study area (6 flights).

As shown in Attachment 3, the majority of the 1,767 terns observed within the study area (1,545) were seen outside the 3 Alternative Sites (principally because flocks tended to rest on the sandbar Fernando's Fetch near Muskeget). Terns in Alternatives 1, 2 and 3 were relatively evenly distributed: 97 were observed in Alternative 1, 35 were observed in Alternative 2, and 90 were observed in Alternative 3. The terns observed within Alternative 1 were comprised of 79 Common Terns, 15 Roseate Terns, 2 Roseate/Common Type terns, and 1 Least Tern.

The numbers of waterbirds within the study area are summarized, as estimated densities, in Table 5, which includes species (and groups of related species) for which >10 individuals were recorded. These densities are averaged over the six systematic aerial surveys. The estimated numbers present in each alternative site (density in samples x area) are shown in Attachment 3. The only species present in all three alternative sites with numbers >1 / sq km were terns.

**Table 5**  
**Densities (individuals/km<sup>2</sup>) of waterbirds observed in the study area during 6 aerial surveys**

Species	Alternative 1	Alternative 2	Alternative 3	Outside	Total Study Area
Loon	0.67	1.33	0.54	0.39	0.49
Storm-Petrel	0.00	0.00	0.06	0.10	0.08
Gannet	0.05	1.22	0.00	0.63	0.53
Cormorant	0.00	0.00	0.06	2.43	1.74
Eider	0.00	0.00	0.00	1.50	1.08
Scoter	0.00	0.00	0.00	0.15	0.11
Gull	0.48	2.86	0.42	3.03	2.44
Tern	4.62	3.57	5.36	12.83	10.52

The numbers in each part of the study area on each survey, estimated by extrapolating observed densities to the entire areas, are summarized in Attachment 4. These bar graphs show the spatial distribution (with the largest numbers outside the alternative areas), and the temporal changes for the most common species or species group observed during each aerial survey.

### **3.2 Boat Surveys**

Seven boat surveys were conducted between May 1 and August 22, 2002. Details of the times, dates, tide, and weather conditions are summarized in Table 6. As previously described, the first boat survey (May 1) followed the systematic transects, while the others were conducted opportunistically to study the behavior of terns and other birds. Experience during the first survey showed that presence of the survey boat strongly affected behavior of seaducks and to a lesser extent loons and gannets, but not terns. Accordingly, the subsequent surveys focused on terns because these are the species of chief concern due to their protected status. Additional boat-based observations occurred during ground-truthing for the radar surveys. In spring, boat-based observations occurred on nine days from May 10 – June 6, 2002 while the radar was located on Horseshoe Shoal, and in fall on four days from September 5 to 30, 2002 when the radar was on Cape Poge, Martha's Vineyard.

**Table 6**  
**Summary of Dates, Times, and Weather Conditions During the Seven Spring/Summer Waterbird Boat Surveys in Nantucket Sound, 2002**

Survey	Date	Start	Finish	High Tide*	Wind	Temp °F	Weather
B1	1-May	06:35	17:30	18:23	12-23 MPH	48	Clear
B2	19-Jun	07:20	13:00	07:30	10-18 MPH	70	Clear
B3	1-Jul	07:00	11:30	05:16	13-17 MPH	65	Clear
B4	26-Jul	06:20	11:15	14:24	11-17 MPH	66	Cloudy
B5	1-Aug	14:30	20:00	18:40	5-10 MPH	80	Clear
B6	15-Aug	15:30	20:00	18:21	7-18 MPH	75	Overcast
B7	22-Aug	15:00	19:30	12:39	10-13 MPH	75	Clear

\* High Tide data for Cape Poge, Chappaquiddick Island, Massachusetts ([www.harbertides.com](http://www.harbertides.com))

**Species and Abundances**

During the boat surveys 22 species, including four species of landbirds, were observed (Table 7). The species and numbers observed on the individual surveys are shown in Tables 8A and 8B. The landbirds observed included 2 Swallows, one seen near Wasque, Martha’s Vineyard on August 15, 2002 and the other near Cape Poge on September 5, 2002; 6 Sandpipers and 1 Red Knot on September 13, 2002 observed flying low over the water near Cape Poge; and 7 Ospreys observed singly within 1 mile (2 km) of the south shore of Cape Cod on August 15 and 22, 2002.

The first boat survey was conducted on May 1, 2002 three weeks before the first summer aerial survey and before the end of the seaduck migration (although many of these birds had left). Substantial numbers of seaducks were recorded on May 1 but none on subsequent boat surveys. Similarly, the other winter birds (gannets and loons) were rarely observed after the May 1 survey. Gulls were not reported on every boat survey, otherwise their occurrences resembled the aerial surveys. Terns were the most abundant group observed during the boat surveys. The species lists for the boat and aerial surveys are very similar and show no important differences. Three species seen only from the boat, all in very small numbers, included two lingering winter birds (Long-tailed Duck and Dovekie) and one summer visitor (Sooty Shearwater).

**Table 7  
Species Totals: Individuals Recorded during Seven Boat Surveys and 13 Days of Ground-Truthing for the Radar**

Species	May 1 Survey	Surveys 2-7 (Jun 19-Aug 22)	Number of Surveys where Species was Observed	Ground-truthing	Total
Loon: Common and Red-throated	48	0	1	27	75
Sooty Shearwater	0	1	1	7	8
Wilson’s Storm-Petrel	0	11	4	3	14
Northern Gannet	139	0	1	57	196
Double-crested Cormorant	2	115	5	22	139
Long-tailed Duck	18	0	1	0	18
Scoter: Black, White-winged, and Surf	872	0	1	95	967
Goldeneye	0	1	1	0	1
Osprey	0	7	2	0	7
Red Knot	0	0	0	1	1
Sandpipers	0	0	0	6	6
Laughing Gull	0	0	0	8	8
Herring Gull	24	3	2	13	40
Great Black-backed Gull	118	6	3	18	142
Roseate Tern	7	190	6	8	205
Common Tern	156	542	7	488	1,186
Least Tern	0	112	4	0	112
Common/Roseate Tern Type	0	1,380	4	122	1,502
Dovekie	2	0	1	0	2
Swallow	0	1	1	1	2
<b>Total</b>	<b>1,386</b>	<b>2,369</b>		<b>876</b>	<b>4,631</b>

**Table 8A**  
**Species Totals: Individuals Recorded by Date During Seven Boat Surveys**

Species	May 1	Jun 19	Jul 1	Jul 26	Aug 1	Aug 15	Aug 22	Total
Loon: Common, Red-throated	48	0	0	0	0	0	0	48
Sooty Shearwater	0	0	0	0	0	0	1	1
Wilson's Storm-Petrel	0	6	0	2	2	1	0	11
Northern Gannet	139	0	0	0	0	0	0	139
Double-crested Cormorant	2	0	0	4	6	54	51	117
Long-tailed Duck	18	0	0	0	0	0	0	18
Scoter: Black, White-winged, Surf	872	0	0	0	0	0	0	872
Goldeneye	0	0	0	0	1	0	0	1
Osprey	0	0	0	0	0	2	5	7
Red Knot	0	0	0	0	0	0	0	0
Sandpipers	0	0	0	0	0	0	0	0
Laughing Gull	0	0	0	0	0	0	0	0
Herring Gull	24	0	0	0	3	0	0	27
Great Black-backed Gull	118	0	0	4	2	0	0	124
Roseate Tern	7	2	0	129	47	8	4	197
Common Tern	156	12	15	117	174	158	66	698
Least Tern	0	51	0	0	5	4	52	112
Common/Roseate Tern	0	100	0	60	464	756	0	1,380
Dovekie	2	0	0	0	0	0	0	2
Swallow	0	0	0	0	0	1	0	1
Total	1,386	171	15	316	704	984	179	3,755

**Table 8B**  
**Species Totals: Individuals Recorded by Date during 13 Days of Ground-Truthing for the Radar**

Species	May 10	May 17	May 20	May 24	May 28	May 29	Jun 3	Jun 4	Jun 6	Sep 5	Sep 13	Sep 18	Sep 30	Total
Loon: Common and Red-throated	1	11	7	0	0	0	5	2	0	0	1	0	0	27
Sooty Shearwater	0	0	0	1	0	0	0	5	1	0	0	0	0	7
Wilson's Storm-Petrel	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Northern Gannet	18	30	4	2	0	0	2	0	1	0	0	0	0	57
Double-crested Cormorant	0	0	0	0	0	0	1	0	2	1	7	2	9	22
Long-tailed Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scoter: Black, White-winged, and Surf	4	17	4	0	0	0	0	0	0	1	14	12	43	95
Goldeneye	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osprey	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Knot	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Sandpipers	0	0	0	0	0	0	0	0	0	0	6	0	0	6
Laughing Gull	0	0	0	0	0	0	0	0	0	0	8	0	0	8
Herring Gull	0	4	0	0	0	0	0	0	0	0	5	4	0	13
Great Black-backed Gull	0	1	0	0	1	0	1	0	0	0	11	2	2	18
Roseate Tern	1	0	2	4	0	0	0	0	0	1	0	0	0	8
Common Tern	40	75	68	114	1	2	11	21	22	18	93	23	0	488
Least Tern	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common/Roseate Tern Type	0	0	0	0	0	0	0	0	111	11	0	0	0	122
Dovekie	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Swallow	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Total	64	138	85	121	2	2	20	28	140	33	146	43	54	876

**Bird Behavior**

During the aerial surveys, the number of terns recorded in each observation ranged from 1 to 201. The most frequent observation was of single terns (187/322 observations) and more than half the individuals recorded

Copyright © ESS Group, Inc., 2003

were observed with 20 or fewer others. Flocks varied widely in their cohesiveness and individual spacing (see Section 4.0, Discussion, below).

For many of the boat-based observations, bird behavior was categorized as flying, on the water, or resting (generally meaning on shore or on the sandbar known as Fernando's Fetch, but also including small numbers on navigation buoys). These observations are summarized in Table 9. Unfortunately, they are not overly informative for certain species because, as noted earlier, the boat had such marked effects on the birds, especially scoters, which often took off before they were clearly visible to the observers.

**Table 9  
Boat Survey Waterbird Observations for May 1-August 22, 2002 and Observations during Ground-Truthing for Radar (May 10-September 30, 2002)**

Species	Boat Observations			Ground-truthing Observations		
	Flying	On water	Resting	Flying	On water	Resting
Red-throated Loon	1	3	0	0	0	0
Common Loon	18	26	0	19	8	0
Sooty Shearwater	1	0	0	7	0	0
Wilson's Storm-Petrel	11	0	0	3	0	0
Northern Gannet	105	34	0	23	34	0
Double-crested Cormorant	6	10	101	19	0	3
Long-tailed Duck	3	15	0	0	0	0
Black Scoter	142	2	0	0	0	0
Surf Scoter	69	79	0	16	2	0
White-winged Scoter	33	173	0	67	4	0
Unknown Scoter	192	182	0	6	0	0
Goldeneye	0	1	0	0	0	0
Laughing Gull	0	0	0	8	0	0
Herring Gull	17	10	0	12	1	0
Great Black-backed Gull	74	50	0	15	3	0
Roseate Tern	167	0	30	8	0	0
Common Tern	582	0	116	461	0	27
Least Tern	62	0	50	0	0	0
Common-Roseate Tern Type	377	0	1003	122	0	0

The boat trips included several visits to an exposed shoal about 2 miles (3 km) northwest of Muskeget Island, unofficially named "Fernando's Fetch". This ephemeral sandbar was about the size of a football field in August 2002 and served as a resting spot for all three species of terns, two gulls, and Double-crested cormorants. It also served as a favored haulout site for large numbers (100-300) of gray seals (*Halichoerus grypus*).

During the boat surveys, the majority of terns were observed either flying (direct) or foraging (looking down and flying erratically). However, some were observed resting on the rocks at Waquoit Bay or on "Fernando's Fetch". During a visit to the southern part of the study area late in the day (after sunset) on August 15, 2002, all flying terns were heading towards Fernando's Fetch and it was concluded that terns (and other species) roosted there (i.e. spent the night). The total numbers of terns observed roosting on the sandbar were estimated at about one thousand with additional individuals flying in that direction.

### **3.4 Altitude of Flying Birds**

When possible during the seven boat surveys and spring/fall ground-truthing, the altitude of birds in flight were estimated, usually whenever they were close to the boat. Altitude estimates were made for 1779 flying terns. Of the terns observed flying, 1,732 were within approximately 60 feet (18 m) of the water surface and 47 were above 60 feet (18 m) (Table 10). These included terns flying towards their overnight roost on Fernando's Fetch. Another flock of terns observed flying above 80 feet (24 m) was estimated to be flying at 110 feet (33 m). They were flying in a southeasterly direction about 1 mile (2 km) off of Cape Poge on September 13, 2002.

**Table 10**  
**Altitude of Flying Terns Observed from the Boats: Numbers of Terns Observed**

Species	Altitude (Feet)					Total
	<20	21-40	41-60	61-80	80+	
Roseate Tern	173	2	0	0	0	175
Common Tern	865	103	28	17	30	1043
Least Tern	61	1	0	0	0	62
Common-Roseate Tern Type	471	28	0	0	0	499
Total	1,570	134	28	17	30	1779

From the plane, all terns were observed close to the water, where altitudes were impossible to estimate with precision, but most were < 50 feet (15 m) asl. Small numbers of flying gulls and gannets were observed above 65 feet (2 m) (and thus in the potential rotor-swept zone) and some were observed flying as high as the plane 250 feet (75 m). The only other species that was observed above 50 feet (15 m) were 2 Double-crested cormorants estimated flying at 90 feet (27 m).

#### **4.0 DISCUSSION**

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

This section combines the systematic aerial surveys and the boat and ground-truthing observations conducted from May to September 2002, 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 the alternative sites. The boat-based observations provide additional information on occurrences as well as behavior.

Loons – Loons were observed frequently from both the boat and the plane until May 22, following the peak in numbers in early April (See Appendix 5.7-D). Common Loons were more numerous than Red-throated. Most of the loons observed after May 22 were Common Loons and were not in breeding plumage; they may have included some injured birds. No loons were observed in the month of August. However, one individual was seen on September 13, which probably was an early migrant flying south through the project area. A total of 83 individuals were observed during the aerial surveys, primarily on May 22. During the boat/ground-truthing surveys 75 individuals were observed. Loons were distributed very widely over the Sound, and evenly within each of the alternative sites. They occurred singly or in small parties on the water, rarely flying. The observed occurrences are consistent with historical reports (Veit and Petersen, 1993).

Sooty Shearwater – This visitor from the southern hemisphere is seen regularly in Massachusetts coastal waters and was recorded in Nantucket Sound on four of the surveys: three times during the boat-based ground-truthing and one time during the boat survey (total 8 individuals, all flying below 50 feet (15 m) asl). Shearwaters were not observed during the aerial surveys.

Wilson's Storm-Petrel – This species was observed in small numbers within the study area on most days (June 6 –Aug 26), during both aerial (13 individuals) and boat/ground-truthing observations (14 individuals). They were widely distributed but generally more abundant in the eastern part of the Sound, all flying below about 10 feet (3 m) asl.

Northern Gannet – This species was observed principally in May, from both the boat and plane surveys. The last individual was seen in early June. A total of 89 individuals were recorded during the aerial surveys and 196 individuals were recorded during the boat surveys/ground-truthing. Aerial surveys indicated that they were more abundant in the eastern part of the Sound. The peak of northward migration for this species is in April. Some individuals were observed on the water, many were flying, and some were near the altitude of the plane (250 feet (75 m)).

Double-crested Cormorant – This species was observed frequently at daytime resting areas on Fernando's Fetch, Bishop & Clerks' Lighthouse, and on the sandbars west of Monomoy. They were abundant in August, which is consistent with the post-breeding dispersal characteristic of this species. Only one individual was seen within the

alternative sites (Alternative 3), while 292 were seen outside the alternative sites within the study area during the aerial surveys (total 293).

Common Eider – This species is abundant in winter. During the summer it was seen in small numbers only from the plane and on the water near Muskeget Island, in areas inaccessible to the boat. Small numbers of Eiders nest on this island. None were seen from the plane within the alternative sites, but were observed outside of the alternative sites within the study area.

Long-tailed Duck – Most of the abundant winter residents had left by the end of April and the only observation of this species was of 18 individuals during the first boat survey (May 1).

Scoters – During the first boat survey, on May 1, scoters were still numerous (872 observed), although most had left on migration. Very small numbers were observed on three subsequent boat surveys and three aerial flight surveys. These individuals could have been lingering migrants, but the two seen from the plane on June 24 are likely to have been injured, although no evidence of this was apparent. The seven individuals observed on August 30 could have been molting. No scoters were seen within the alternative sites. Seventy (70) Surf and White-winged Scoters observed in September during the ground-truthing near Cape Poge for the fall radar survey may have been early migrants.

Gulls – Two species were widespread (Great Black-backed and Herring gull) and recorded on every flight and several boat/ground-truthing surveys. The Great Black-backed outnumbered the Herring Gulls by approximately 2 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 northeastern part of the Sound (Alternative 2) and the incidental observations from the plane suggest that many more gulls occurred close to shore than over open water. A small number of the flying gulls were seen near the altitude of the plane (250 feet (75 m)). Laughing Gulls appeared in August (seen on 1 flight) and in September during the fall ground-truthing surveys. A single Ring-billed Gull was observed on July 25, 2002.

Terns – Common and Roseate Terns were observed throughout the summer. Common Terns were first recorded (13 individuals) on April 18 during the last of the winter 2002 boat surveys and were subsequently seen on every flight and boat trip except on September 30. Roseate Terns were identified on all six flights and during 10 of the boat/ground-truthing trips, and may have been present on more occasions amongst the terns not identified to species. The Least Tern was observed within the study area during the aerial surveys on two of the flights in August and also occurred close to shore. They were also observed on four of the boat surveys. Within the study area, 1767 individual terns were recorded during the aerial surveys and 3,005 were seen during the boat/ground-truthing surveys. Common Terns greatly outnumbered Roseates but many terns could not be identified to species. Terns occurred throughout the Sound, and in the study area were more commonly seen outside the alternative sites, principally because many roosted on the sandbar Fernando's Fetch. Similar numbers were present within each of the alternative sites (estimated densities of 3.57 to 5.36 individuals/km<sup>2</sup>). Foraging Terns frequently occurred singly, and also in flocks that occasionally numbered as many as 200. Flight altitudes of 1,732 terns were observed to be within 60 feet (18 m) of the water surface. Three flocks were observed above 60 feet (18 m), 2 flocks (17 individuals) were estimated at 80 feet (24 m) and 1 flock (30 individuals) at 110 feet (33 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).

### **Species of Special Concern**

Common and Roseate terns are the species of primary concern during the summer months within the open waters of Nantucket Sound (no Piping Plovers were encountered). Typically, the peaks of Roseate activity follow the Commons by a few days and Roseates depart earlier in fall but both species are combined in this broad summary. Both species breed in two large colonies in northern Buzzards Bay (about 25 miles (40 km) northwest of Horseshoe Shoal) and there is a very large colony of Common Terns on North Monomoy (about 16 miles (26 km) east of Horseshoe Shoal). Most eggs are laid from May 10 to May 30, most chicks are fed at the colonies throughout June, and most fledglings leave between June 25 and July 20. By August 5, in typical years, only

scattered individuals are still tending young at the colonies, but some post-breeding birds may be present. In exceptional years, such as 1972 the year of an early Hurricane (Agnes) which led to near-total re-nesting, fledging may be delayed by weeks. Timing of breeding is typically later in smaller colonies and where predation leads to relaying. After breeding, the terns disperse widely, with large numbers gathering at a staging area on South Beach, near Chatham. The six spring/summer aerial surveys (May 22 to August 30) covered the period from incubation through post-breeding dispersal. During this time there were no strong temporal patterns of tern numbers in the study area, but observations suggest that fewer use the area when feeding chicks at the colony. The information from the boat surveys, including one in the pre-nesting stage (May 1), also supports this conclusion. Observations of resting birds at the edges of the Sound (Waquoit Bay- to the north of the study area, and Fernando's Fetch- to the south of the study area) suggest that larger numbers occur early and late in the season but these are dwarfed by the numbers at the colonies and at the post-breeding roost, respectively.

### **Alternative Sites**

The three alternative sites for the Wind Park were used about equally by small numbers of birds with more individuals generally present in other parts of the study area. This pattern resulted in part from numerous terns, gulls and cormorants using Fernando's Fetch as a resting site. Terns were the most abundant: their average density in the study area during the aerial surveys was about 10.52 individuals/km<sup>2</sup> and estimated densities within the alternative sites were 3.57 to 5.36 individuals/km<sup>2</sup> (Table 5). During the breeding season of 2001, Hatch (2001) found that few terns flew over or beyond Alternative 1 to forage. Mass Audubon found few terns in Alternative 1 during their 2002 aerial and boat surveys (Perkins et al, 2003). Mass Audubon conducted their surveys after the breeding season, suggesting that terns rarely forage within Alternative 1 after individuals leave the nesting colonies. Mass Audubon also observed the majority of terns near Monomoy Island and the south shore of Cape Cod (Perkins et al, 2003). This supports 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.

### **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, 75-417 feet (23 – 127 m). The surveys were all conducted when winds were moderate.

The information available from the aerial surveys on flocking behavior is of limited value for characterizing the way terns forage because their behavior is very variable. Sometimes feeding flocks persist (as at an upwelling), but often the terns' distribution fluctuates from moment to moment in response to shifts of available prey. When foraging over predatory fish that drive the terns' prey to the surface, the tern flock may be at one moment dispersed over a wide area (much larger than the transect observed from the plane) and at the next moment aggregated rapidly at a transient abundance of prey. Both of these types of flock-feeding were evident during the surveys, as well as individuals apparently foraging alone. Flock-feeding over predatory fish was probably more prevalent in areas frequented by sport fishermen than elsewhere, but there are no data to substantiate this impression. Many fishermen use the fishing terns to locate the predatory fish, and appear to be moderately successful in this endeavor.

### **Conclusion**

During the summer of 2002, the open waters of Nantucket Sound were used by relatively few birds compared to the larger numbers present in winter. The average number of birds seen within the study area during the aerial surveys was 476, compared to 15,455 in the winter 2002 aerial surveys. Terns were rarely observed flying at altitudes within the range swept by turbine rotors of the size proposed.

## **5.0 LITERATURE CITED**

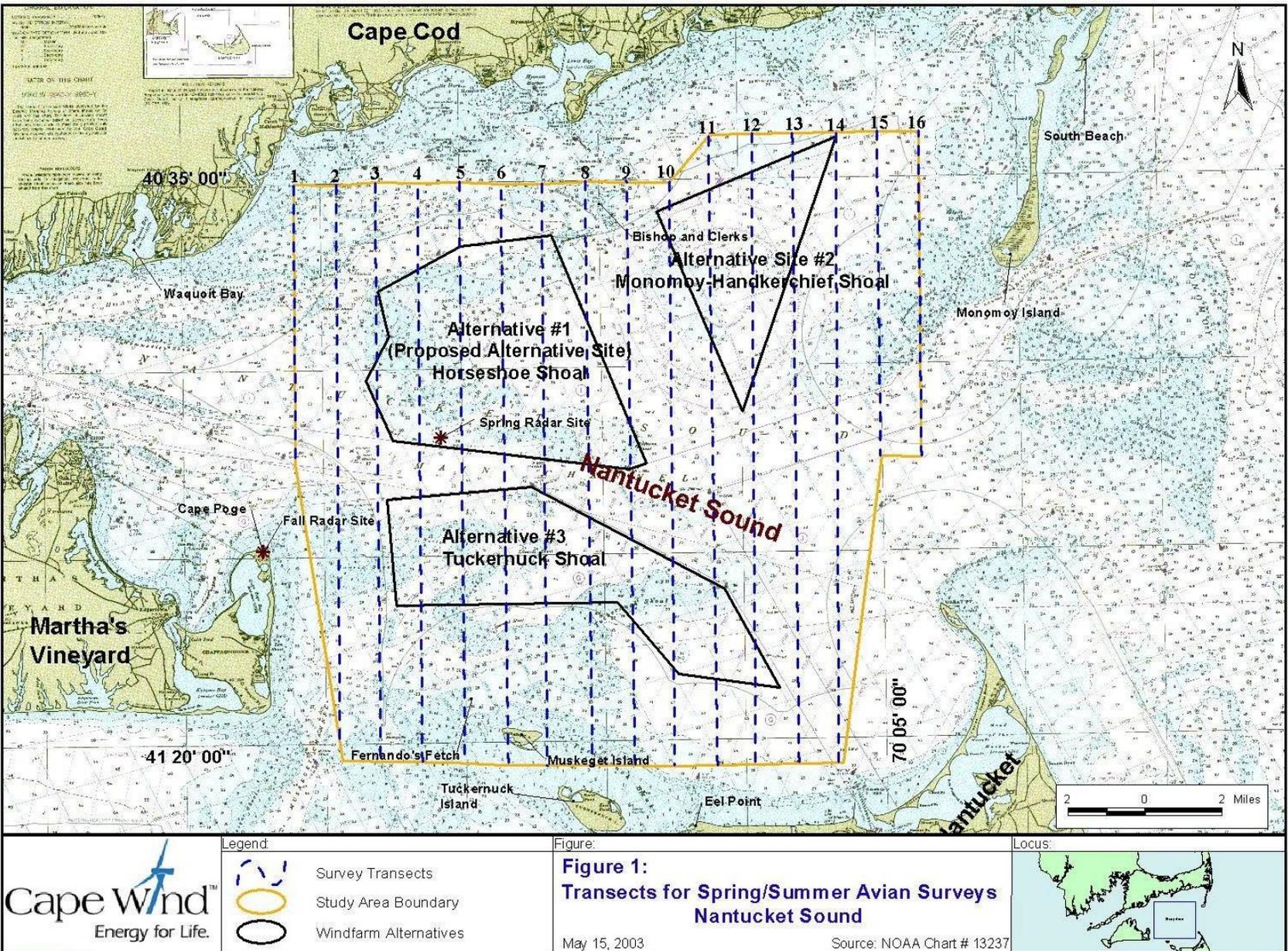
Hatch, J.J. 2001. Terns (*Aves: Sterninae*) and the Cape Wind Project in Nantucket Sound. A report to Cape Wind Associates and Environmental Science Services.

- Kerlinger, P., and J.J. Hatch. 2001. Preliminary avian risk assessment for the Cape Wind Energy Project. November 2001. Report prepared for Cape Wind Associates, LLC and Environmental Science Services, Inc.
- Perkins, S., A. Jones, and T. Allison. 2003. Survey of tern activity within Nantucket Sound, Massachusetts, during pre-migratory fall staging. Final report for Massachusetts Technology Collaborative, 8 January 2003. from Mass. Audubon Soc.
- Trull, P., S. Hecker, M.J.Watson & I.C.T.Nisbet. 1999. Staging of Roseate Terns *Sterna dougallii* in post-breeding period around Cape Cod, Massachusetts, USA. *Atlantic Seabirds* 1: 145-158.
- Veit, R.R., and W.R. Petersen. 1993. *Birds of Massachusetts*. Massachusetts Audubon Society, Lincoln, MA.

Figures

---

Figure 1 Transects for the Spring/Summer 2002 Aerial Surveys in Nantucket Sound



	<p><b>Legend:</b></p> <ul style="list-style-type: none"> <li> Survey Transects</li> <li> Study Area Boundary</li> <li> Windfarm Alternatives</li> </ul>	<p><b>Figure:</b>  <b>Figure 1:</b>  <b>Transects for Spring/Summer Avian Surveys</b>  <b>Nantucket Sound</b></p> <p>May 15, 2003</p> <p>Source: NOAA Chart # 13237</p>	<p><b>Locus:</b></p>
--	---	---	----------------------



**Figure 2 - Flightlines for the Routes Outside the Study Area during the 2002 Spring/Summer Aerial Surveys in Nantucket Sound**

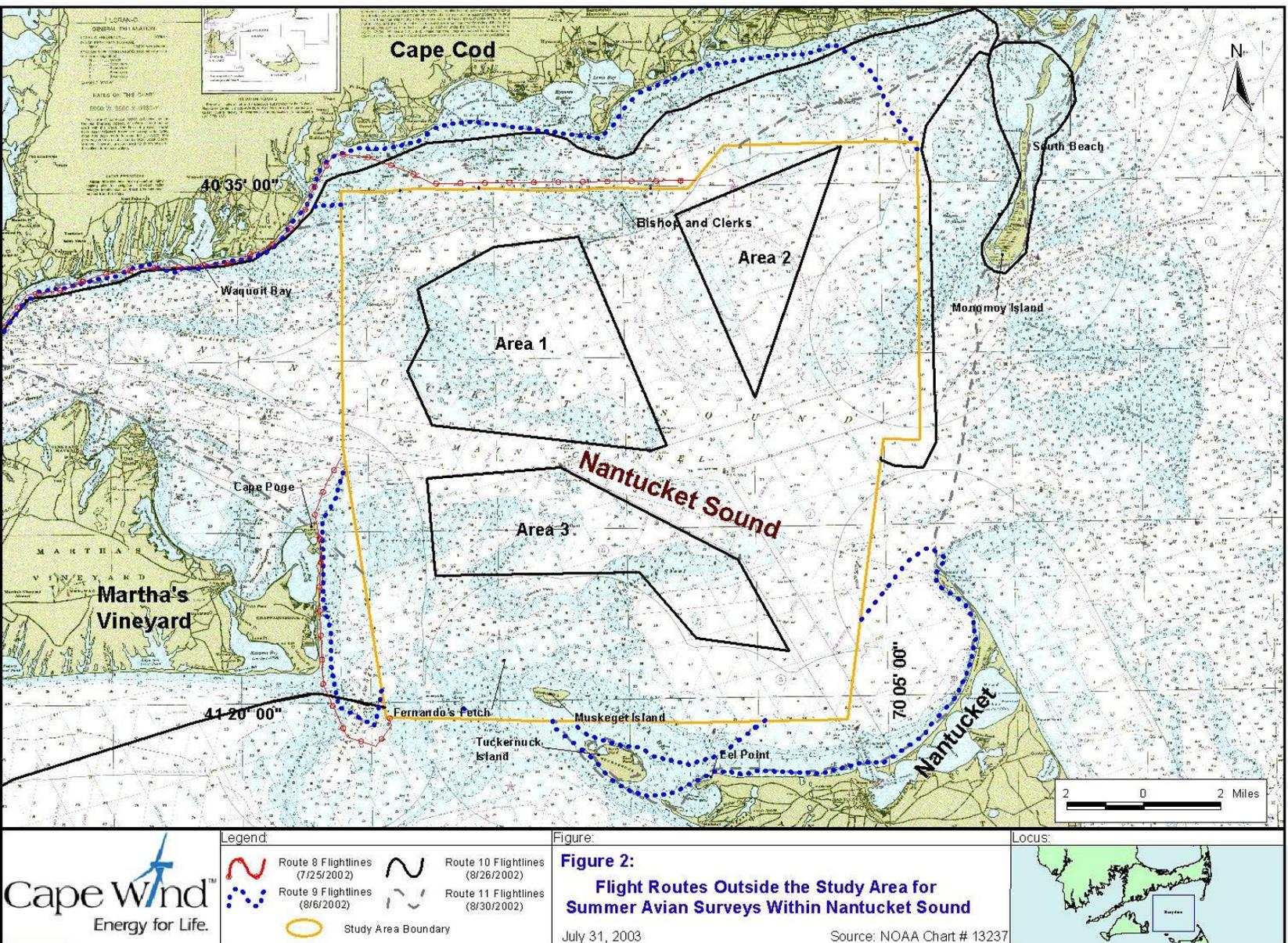
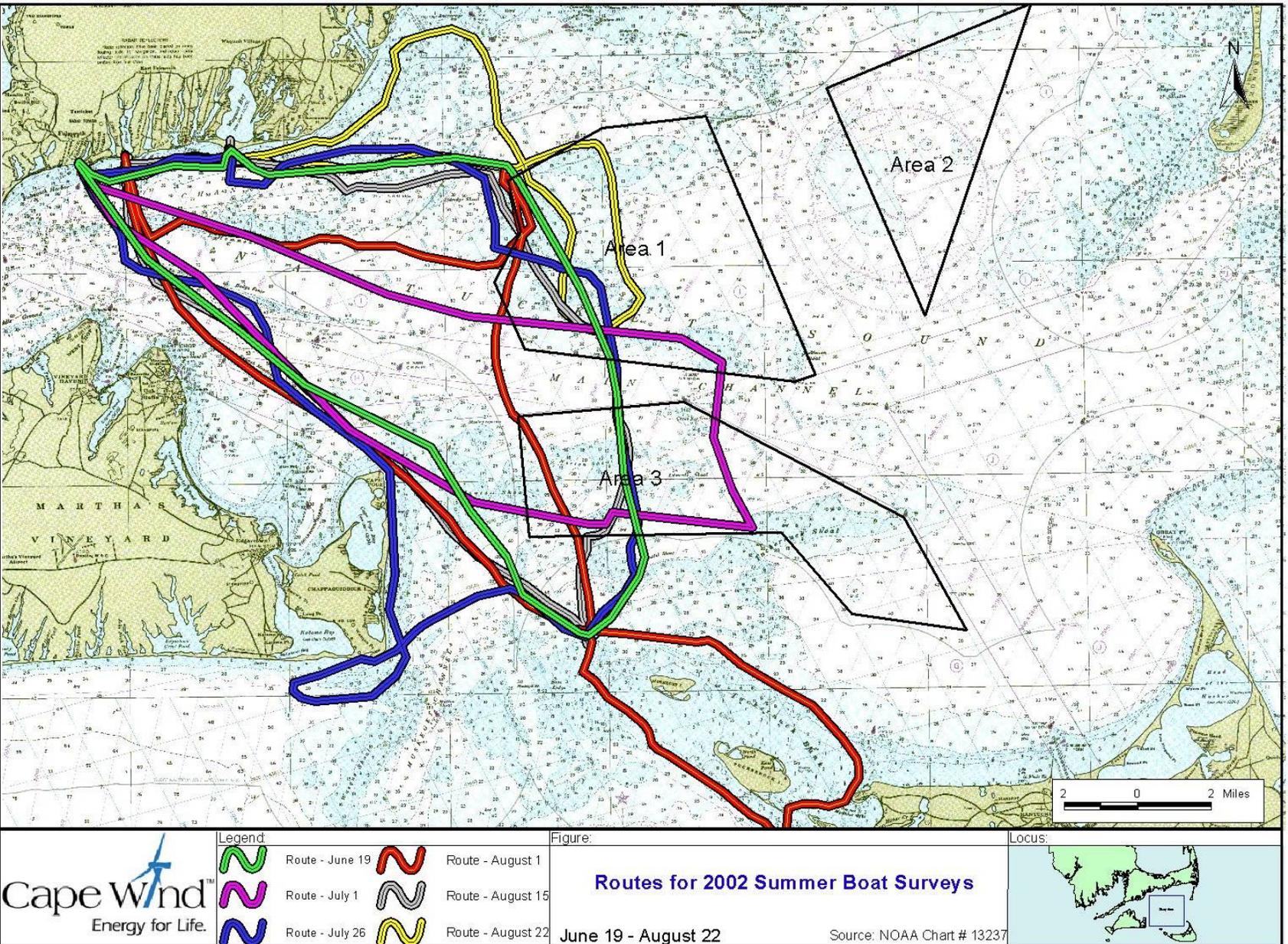


Figure 3. Routes For Spring Summer Boat Surveys 2-7



ATTACHMENT 1

Numbers of Individuals Observed  
On Each of the 6 Aerial Surveys  
In Nantucket Sound, MA,  
May - August 2002

**Numbers of Individuals Observed on Each of the 6 Aerial Surveys within the Study Area  
in Nantucket Sound, MA, May - August 2002**

Species	5/22/2002	6/24/2002	7/25/2002	8/6/2002	8/26/2002	8/30/2002	Total
Loon (2)	77	2	4	0	0	0	83
Wilson's Storm-Petrel	0	1	5	1	6	0	13
Gannet	89	0	0	0	0	0	89
Cormorant	1	41	0	83	52	116	293
Eider	100	0	0	30	0	51	181
Scoter (3)	9	2	0	0	0	7	18
Goldeneye	0	0	1	0	0	0	1
Laughing Gull	0	0	0	0	2	0	2
Ring-billed Gull	0	0	1	0	0	0	1
Herring Gull	22	5	15	67	47	2	158
Great Black-backed Gull	114	29	53	4	36	13	249
Unknown Gull	0	0	0	0	0	0	0
Roseate Tern	16	12	15	23	31	16	113
Common Tern	209	38	253	252	202	62	1,016
Least Tern	0	0	0	67	0	1	68
Common/Roseate Tern Type	0	7	1	76	172	314	570
Razorbill	0	1	0	0	0	0	1
<b>Total</b>	<b>637</b>	<b>138</b>	<b>348</b>	<b>603</b>	<b>548</b>	<b>582</b>	<b>2,856</b>

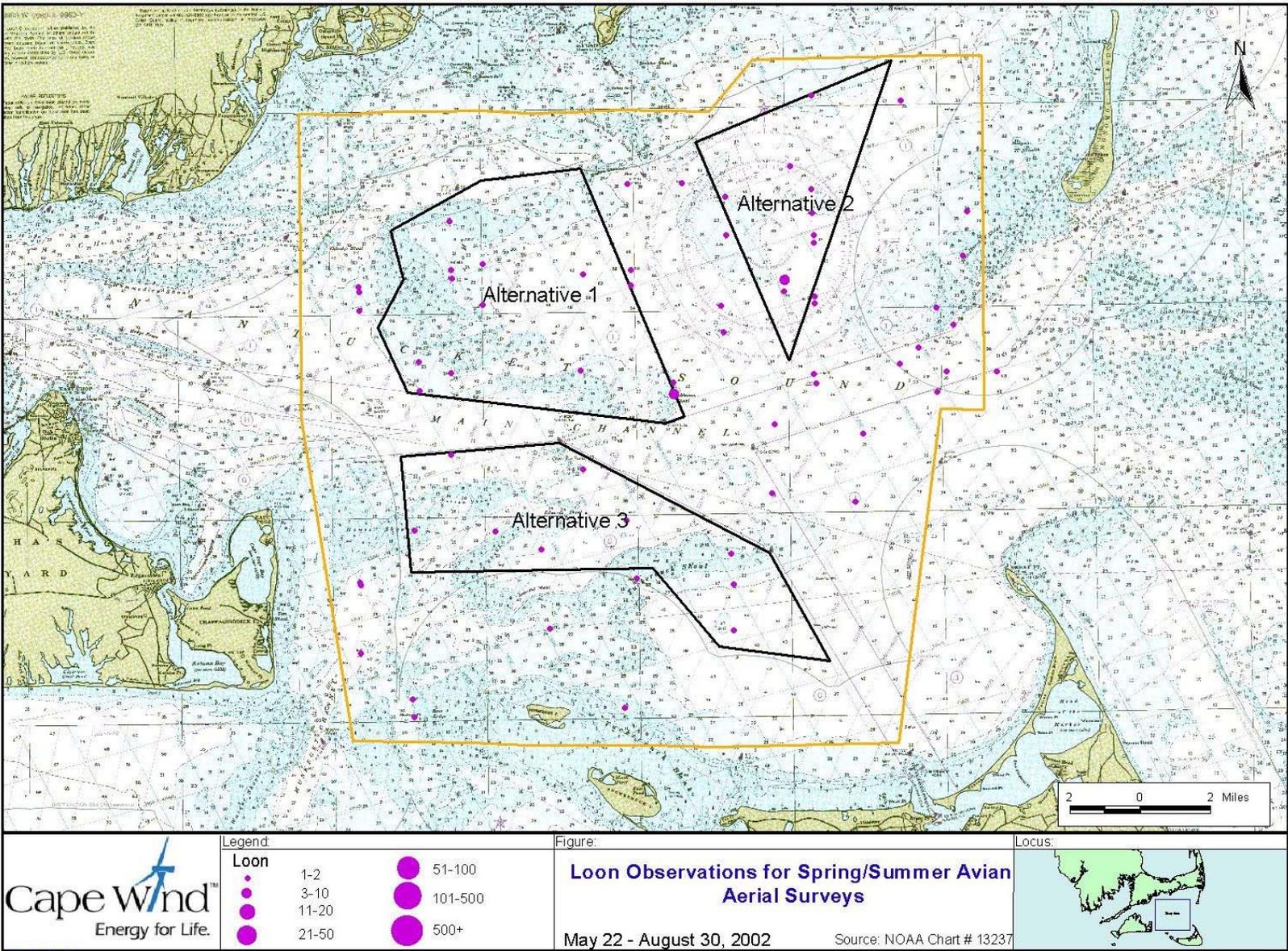
**Numbers of Individuals Observed on Each of the 6 Aerial Surveys outside of the Study Area in  
Nantucket Sound, MA, May - August 2002**

Species	5/22/2002	6/24/2002	7/25/2002	8/6/2002	8/26/2002	8/30/2002	Total
Loon (2)	0	0	0	0	0	0	0
Wilson's Storm-Petrel	0	0	0	0	1	0	1
Gannet	0	0	0	0	0	0	0
Cormorant	0	0	2	6	710	629	1,347
Eider	0	0	0	0	0	0	0
Scoter (3)	0	0	0	0	0	4	4
Goldeneye	0	0	0	1	0	0	1
Laughing Gull	0	0	0	0	0	12	12
Ring-billed Gull	0	0	0	0	0	0	0
Herring Gull	0	0	0	64	6	124	194
Great Black-backed Gull	0	0	1	236	26	624	887
Unknown Gull	0	0	0	40	464	304	808
Roseate Tern	0	15	29	6	10	36	96
Common Tern	0	76	97	504	254	352	1,283
Least Tern	0	0	0	84	20	2	106
Common/Roseate Tern Type	0	0	114	86	419	973	1,592
Razorbill	0	0	0	0	0	0	0
<b>Total</b>	<b>0</b>	<b>91</b>	<b>243</b>	<b>1,027</b>	<b>1,910</b>	<b>3,060</b>	<b>6,331</b>

ATTACHMENT 2

Species densities for all Aerial  
Surveys Combined

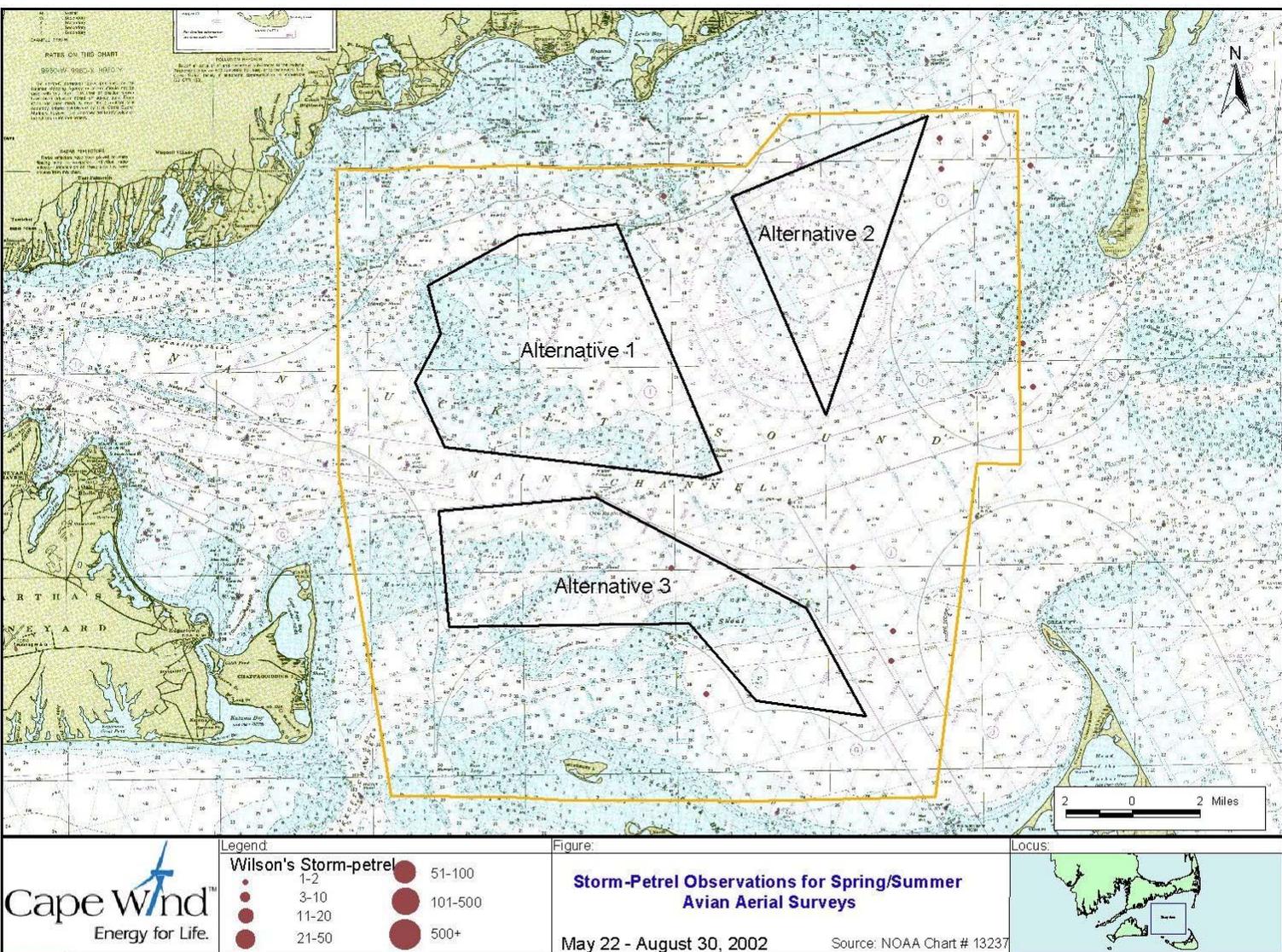
---

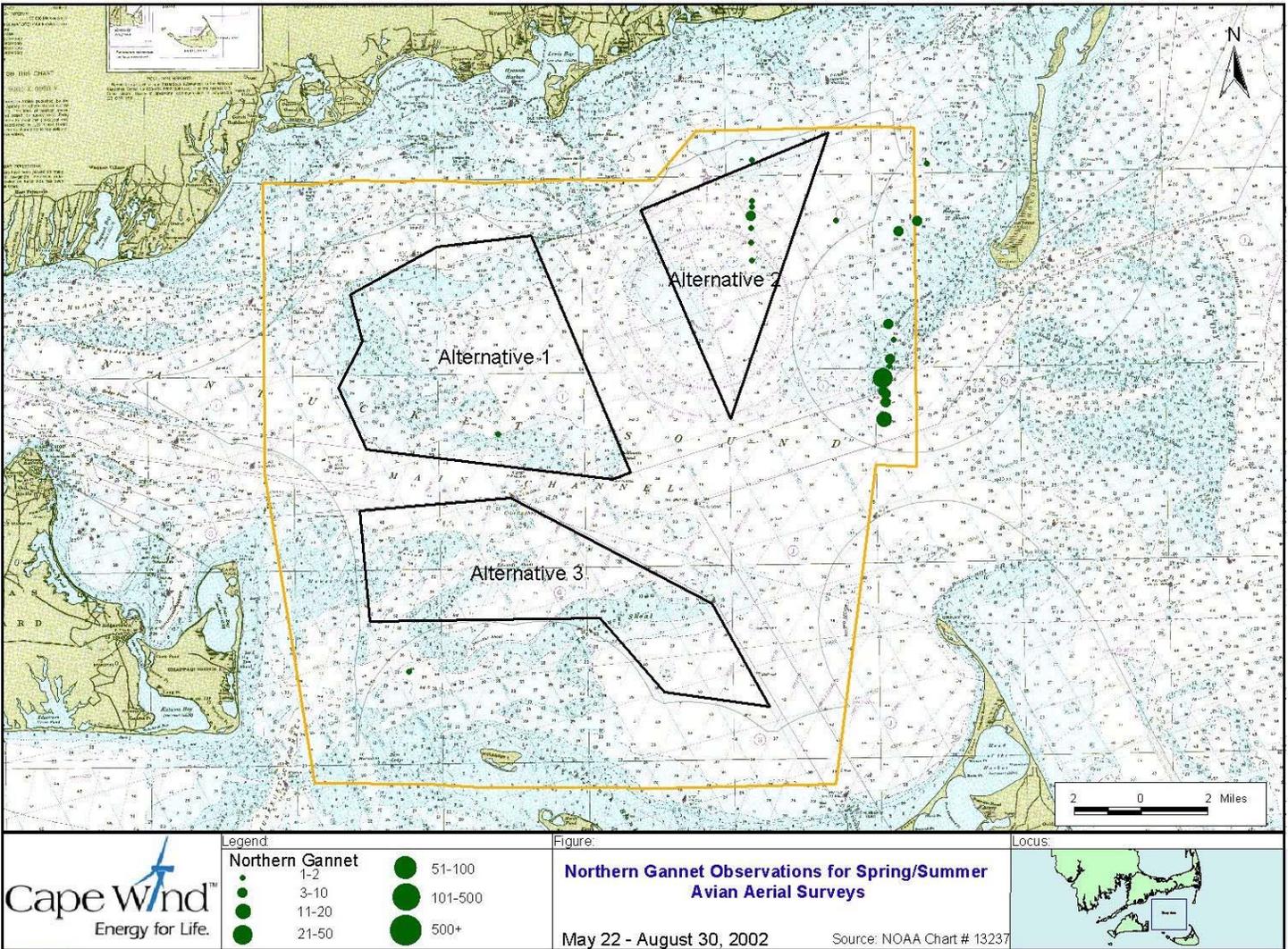


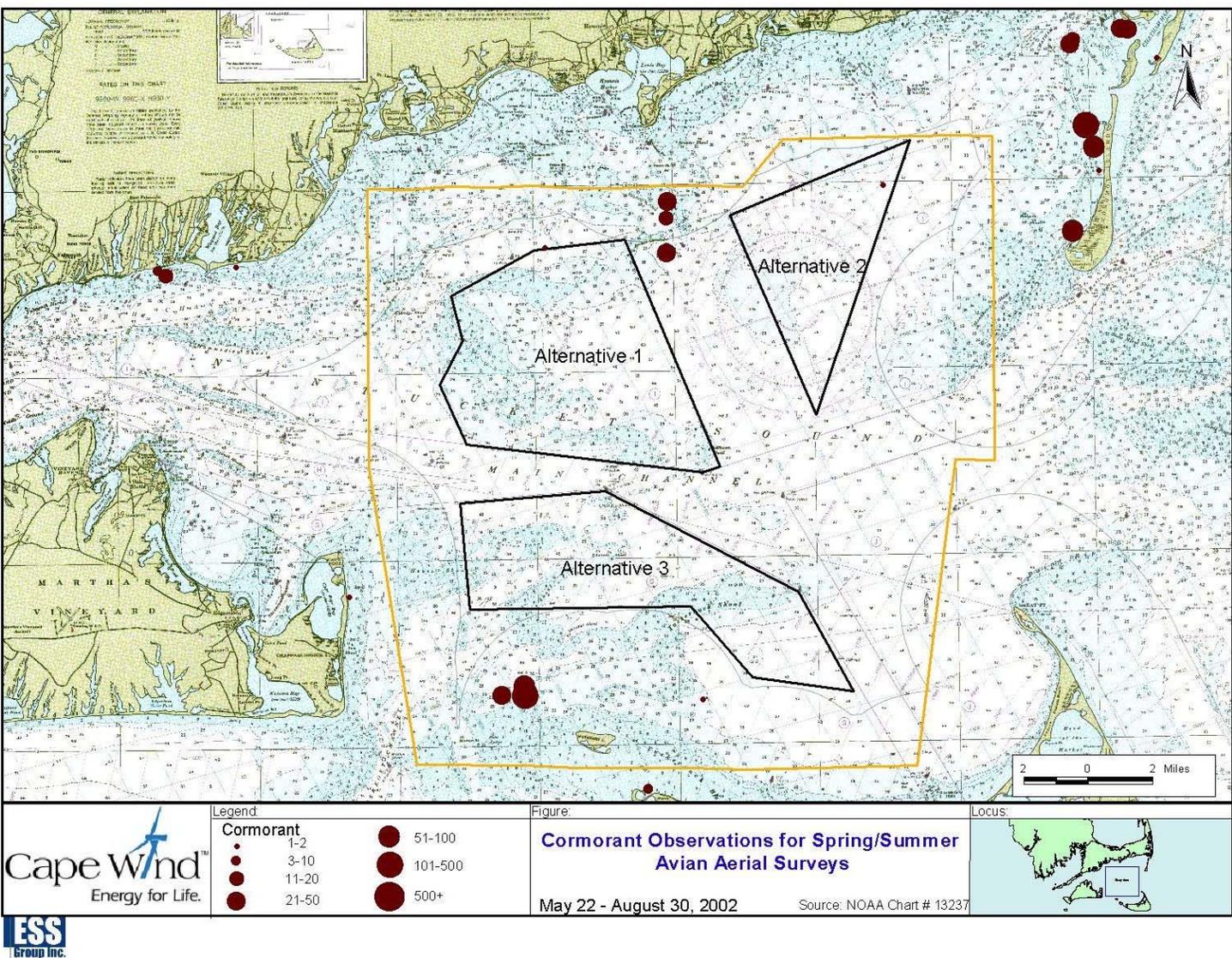
Legend	
Loon	
● (smallest)	1-2
● (small)	3-10
● (medium)	11-20
● (large)	21-50
● (medium)	51-100
● (large)	101-500
● (largest)	500+

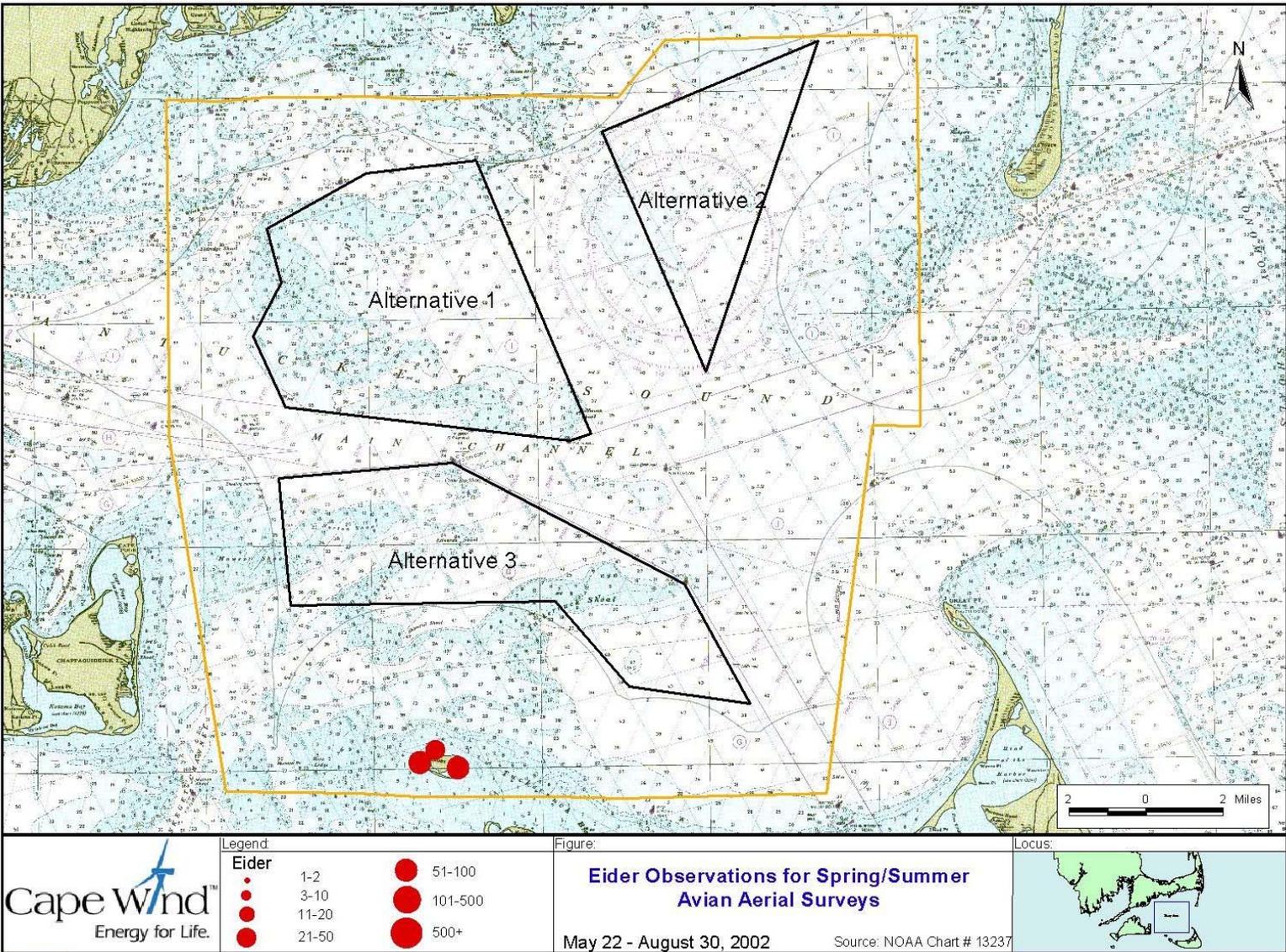
Figure:  
**Loon Observations for Spring/Summer Avian Aerial Surveys**  
 May 22 - August 30, 2002

Locus:  
  
 Source: NOAA Chart # 13237





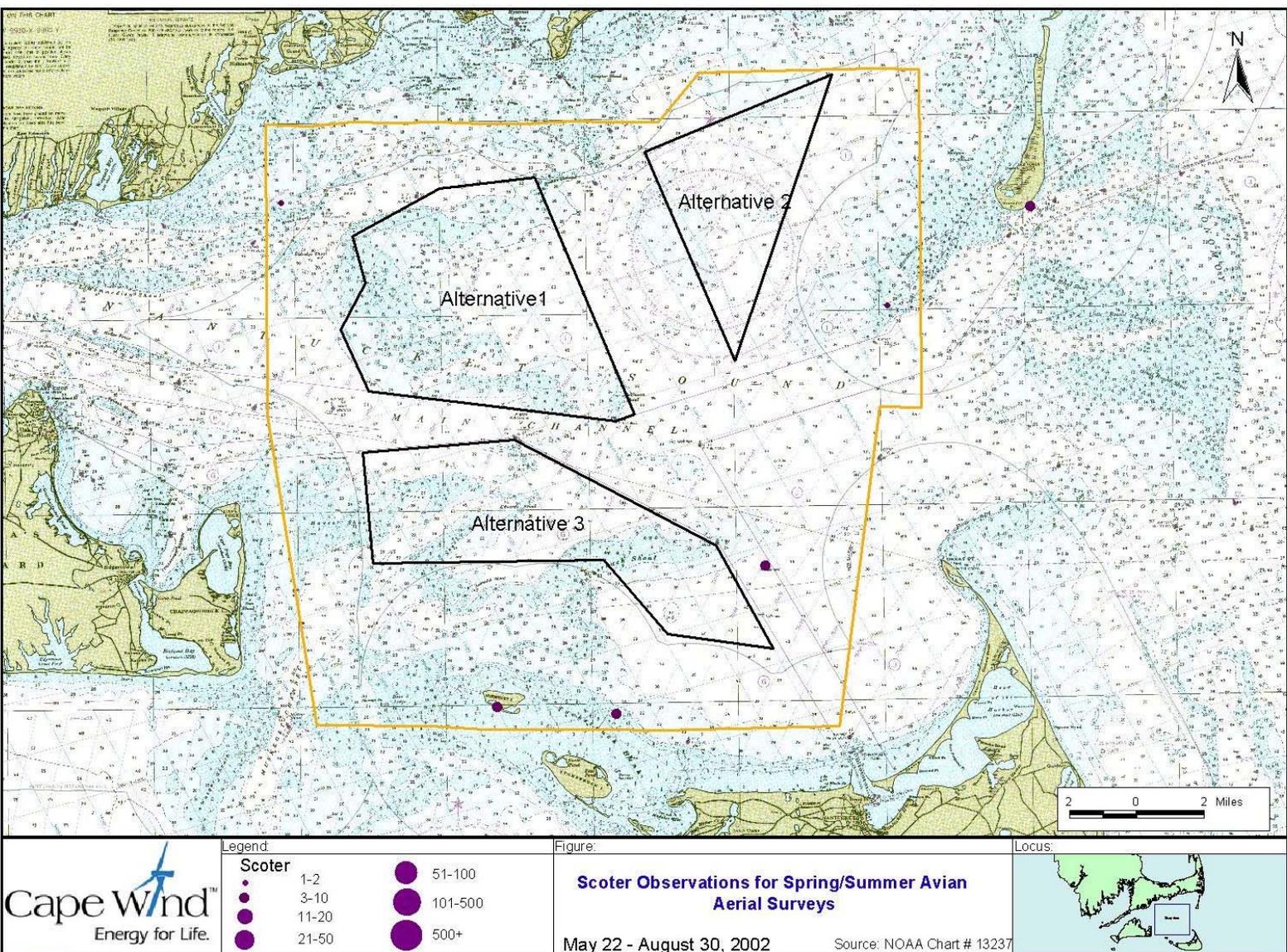


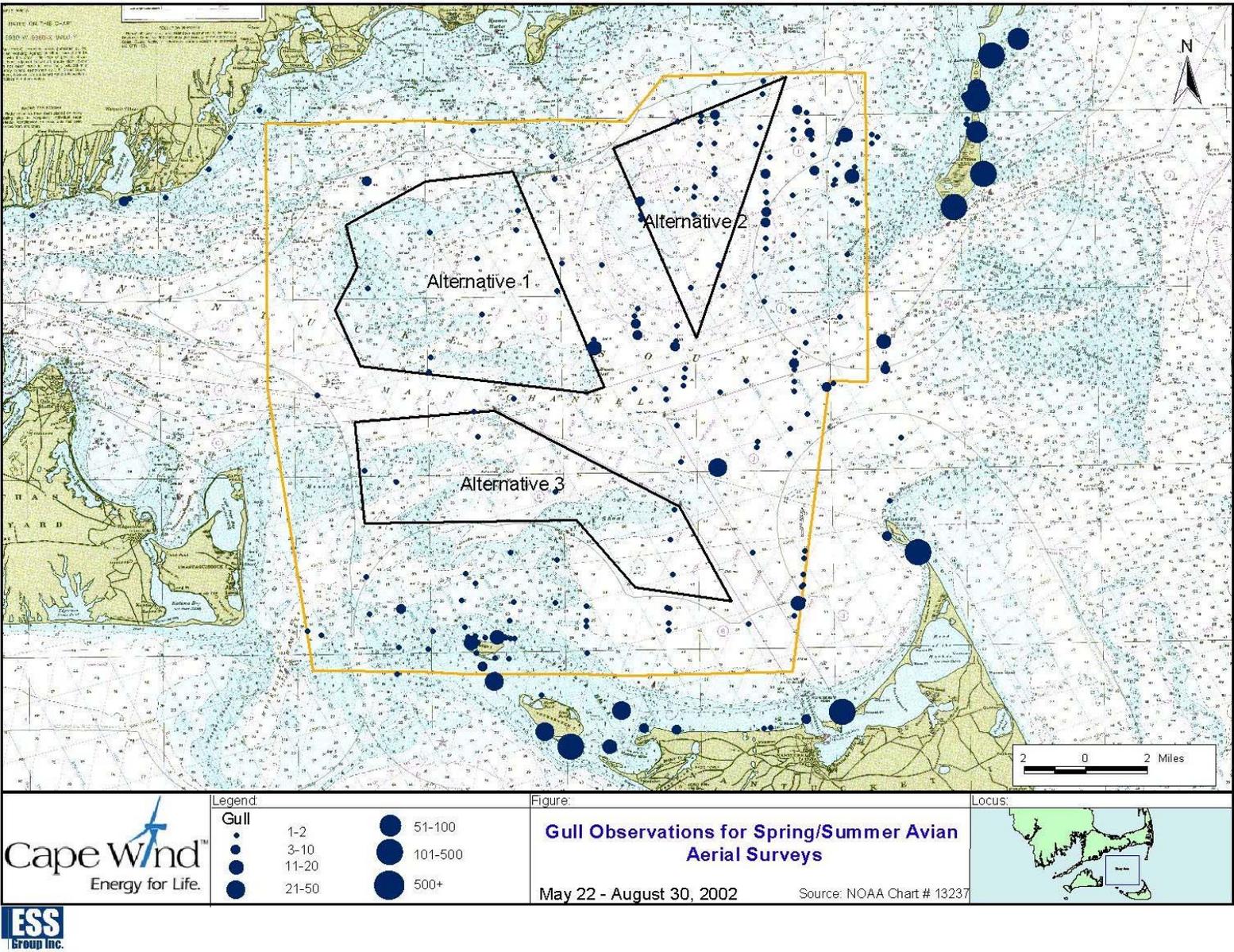


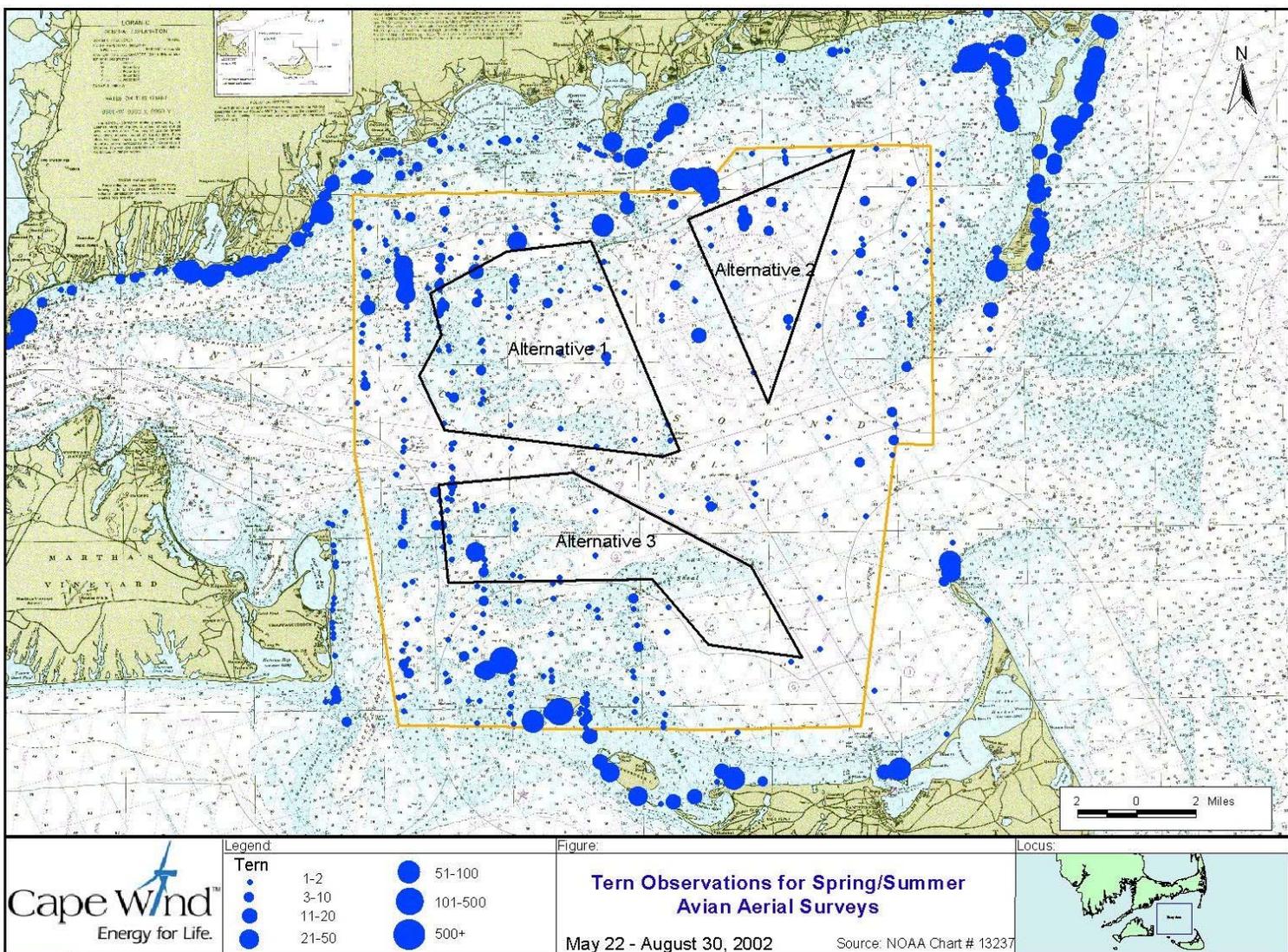
Legend	
<span style="color: red;">•</span>	Eider
<span style="color: red;">•</span>	1-2
<span style="color: red;">•</span>	3-10
<span style="color: red;">•</span>	11-20
<span style="color: red;">•</span>	21-50
<span style="color: red;">●</span>	51-100
<span style="color: red;">●</span>	101-500
<span style="color: red;">●</span>	500+

Figure:  
**Eider Observations for Spring/Summer Avian Aerial Surveys**  
 May 22 - August 30, 2002 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 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/km2)	Estimated* Number Present	Estimated Number Present per Survey
Loon	Alternative 1	14	14/0	0.67	74	12
Loon	Alternative 2	13	13/0	1.33	68	11
Loon	Alternative 3	9	9/0	0.54	47	8
Loon	Outside	47	41/0	0.39	224	37
Loon	Total	83	77/0	0.49	415	69
Storm-Petrel	Alternative 1	0	0/0	0	0	0
Storm-Petrel	Alternative 2	0	0/0	0	0	0
Storm-Petrel	Alternative 3	1	1/0	0.06	5	1
Storm-Petrel	Outside	12	5/0	0.10	57	10
Storm-Petrel	Total	13	6/0	0.08	65	11
Gannet	Alternative 1	1	1/0	0.05	5	1
Gannet	Alternative 2	12	12/0	1.22	63	11
Gannet	Alternative 3	0	0/0	0.00	0	0
Gannet	Outside	76	76/0	0.63	362	60
Gannet	Total	89	89/0	0.53	445	74
Cormorant	Alternative 1	0	0/0	0	0	0
Cormorant	Alternative 2	0	0/0	0	0	0
Cormorant	Alternative 3	1	1/0	0.06	5	1
Cormorant	Outside	292	116/0	2.43	1390	232
Cormorant	Total	293	116/0	1.74	1465	244
Eider	Alternative 1	0	0/0	0	0	0
Eider	Alternative 2	0	0/0	0	0	0
Eider	Alternative 3	0	0/0	0	0	0
Eider	Outside	181	100/0	1.50	862	144
Eider	Total	181	100/0	1.08	905	151
Scoter	Alternative 1	0	0/0	0	0	0
Scoter	Alternative 2	0	0/0	0	0	0
Scoter	Alternative 3	0	0/0	0	0	0
Scoter	Outside	18	18/0	0.15	86	14
Scoter	Total	18	18/0	0.11	90	15
Goldeneye	Alternative 1	0	0/0	0	0	0
Goldeneye	Alternative 2	0	0/0	0	0	0
Goldeneye	Alternative 3	0	0/0	0	0	0
Goldeneye	Outside	1	1/0	0.01	5	1
Goldeneye	Total	1	1/0	0.01	5	1
Gull	Alternative 1	10	9/0	0.48	53	9
Gull	Alternative 2	28	14/0	2.86	147	25
Gull	Alternative 3	7	4/0	0.42	37	6

Species	Location	Total Number Observed	Max/Min Number	Density (indivs/km2)	Estimated* Number Present	Estimated Number Present per Survey
Gull	Outside	365	102/15	3.03	1738	290
Gull	Total	410	136/15	2.44	2050	342
Tern	Alternative 1	97	52/0	4.62	511	85
Tern	Alternative 2	35	23/0	3.57	184	31
Tern	Alternative 3	90	48/0	5.36	474	79
Tern	Outside	1545	383/41	12.83	7357	1226
Tern	Total	1767	418/55	10.52	8835	1473
Razorbill	Alternative 1	0	0/0	0	0	0
Razorbill	Alternative 2	0	0/0	0	0	0
Razorbill	Alternative 3	0	0/0	0	0	0
Razorbill	Outside	1	1/0	0.01	5	1
Razorbill	Total	1	1/0	0.01	5	1

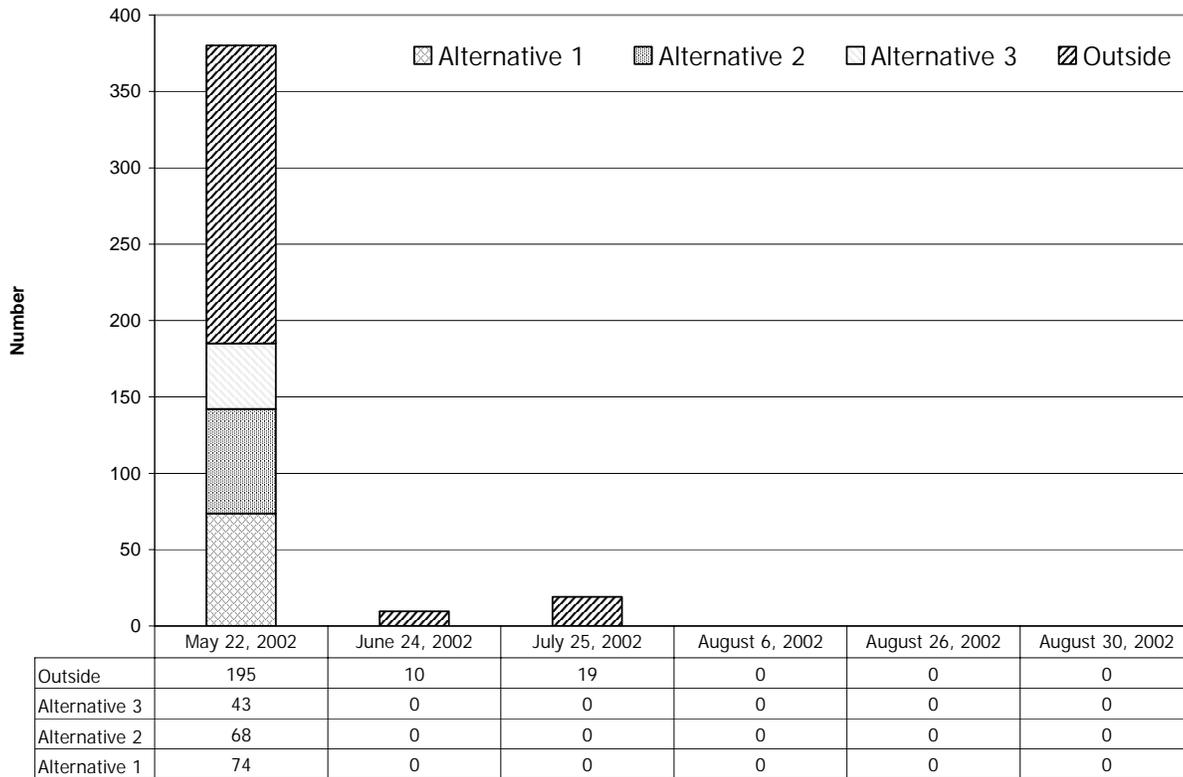
\*Estimated Number Present is calculated by dividing the total number observed by fraction of area surveyed flown.

ATTACHMENT 4

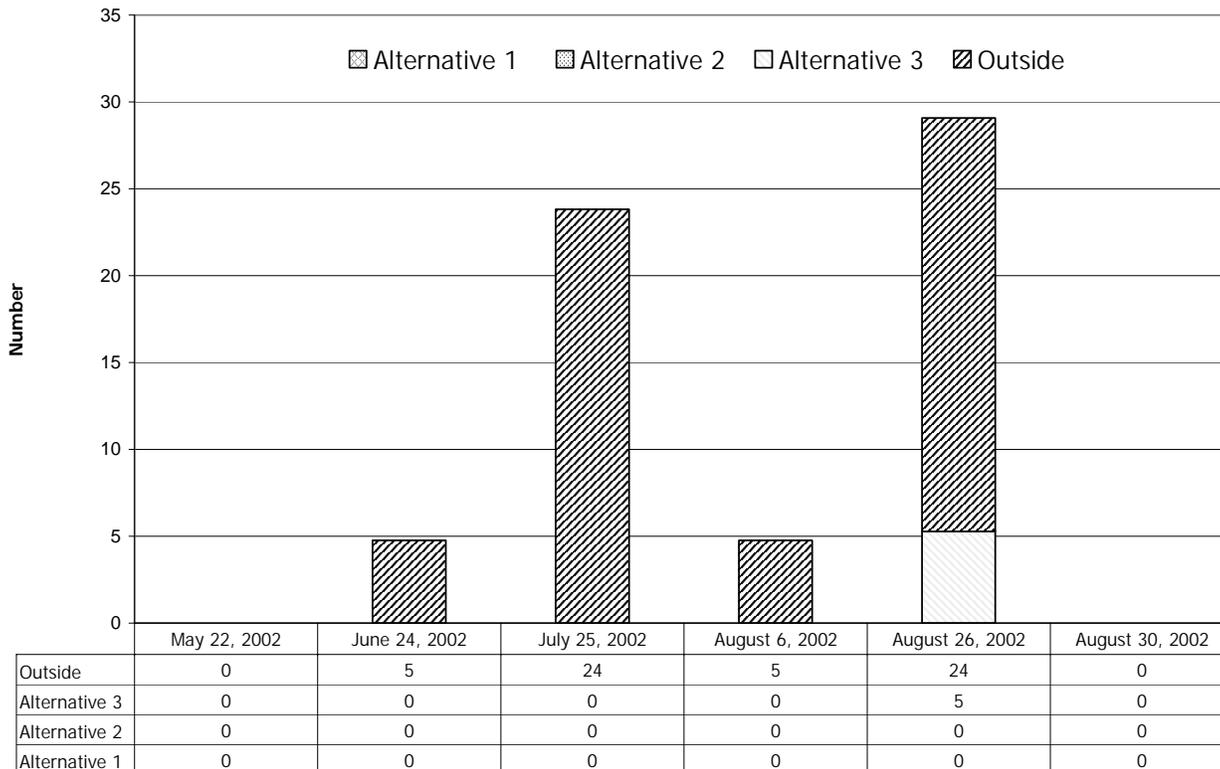
Estimated Numbers Summer  
Birds for Aerial Surveys 6-11

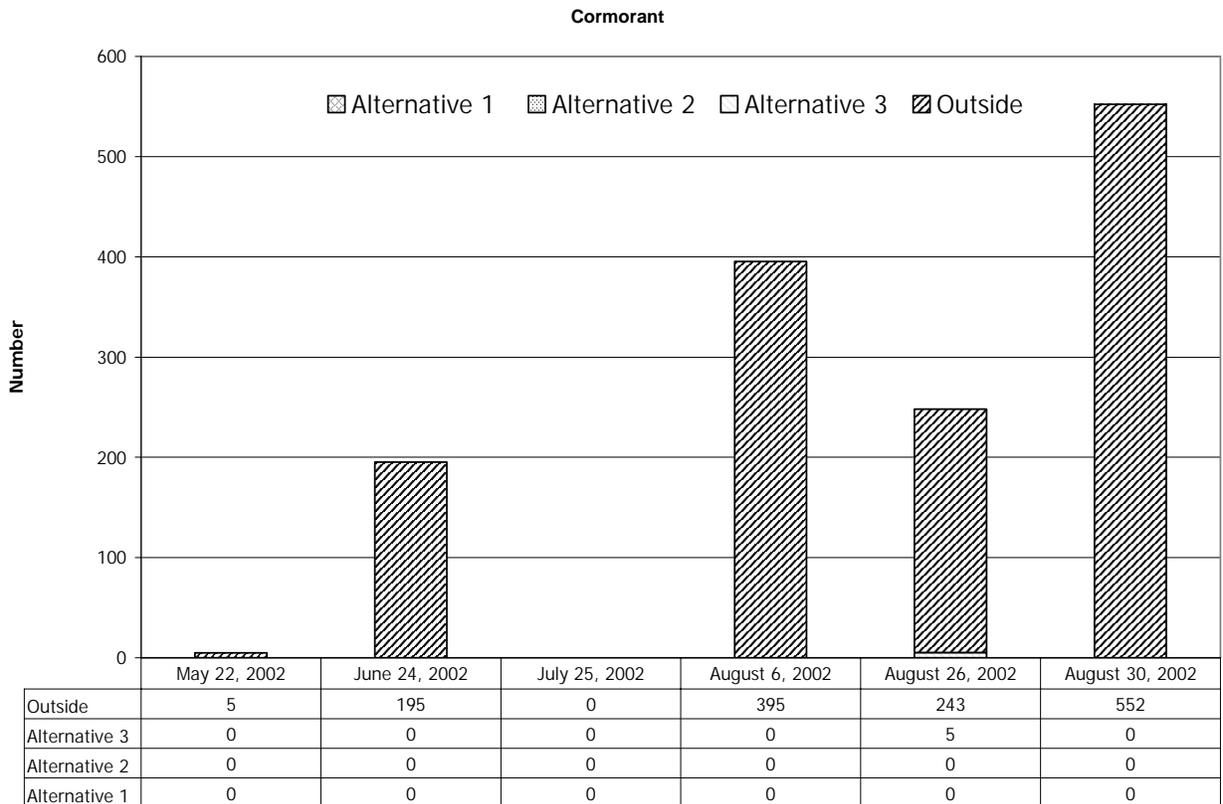
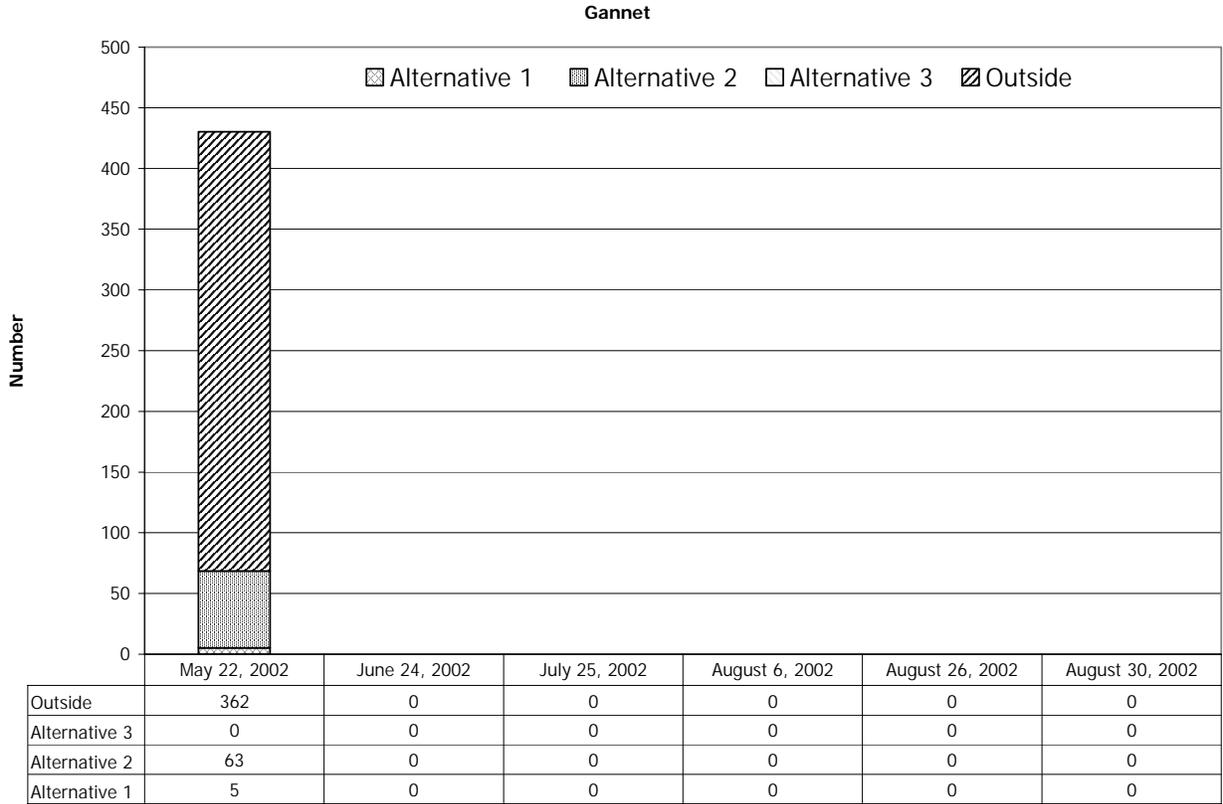
---

**Loon**

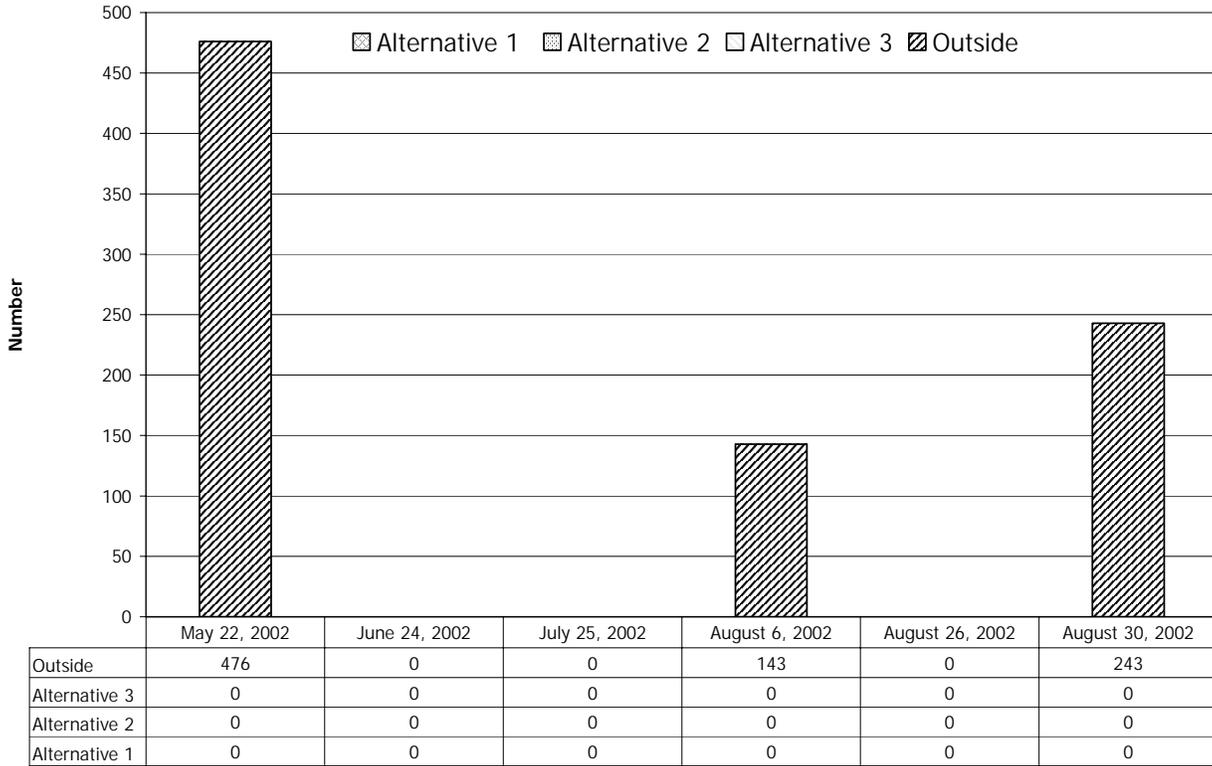


**Wilson's Storm-Petrel**





**Eider**



**Scoter**

