

SDJV Project # 102
Final Report to Sea Duck Joint Venture Program
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Project Title: Delineating Breeding Populations and Tracking Night-time Movements of Long-tailed Ducks Wintering in Nantucket Sound

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Project Description: We studied diurnal movements of Long-tailed Duck (*Clangula hyemalis*) (LTDU) in Nantucket Sound (the Sound). The study has tracked instrumented LTDU via Satellite in and around the Sound and track the instrumented ducks to Arctic and sub-Arctic breeding grounds to obtain evidence regarding the relationship of wintering ducks to a recently approved offshore wind energy project and to delineate populations of this important species.

This report describes the results of the three-year study intended to improve understanding of the ecological impact of potential changes in the habitat quality of the Sound including the construction and operation of the wind energy project on Horseshoe Shoal of the Sound.

Objectives: We have used satellite telemetry to track the movements of wintering LTDUs in the waters around Nantucket, and to track the movements of instrumented ducks as they migrate between their wintering grounds and their breeding grounds in the high arctic of Canada. LTDUs typically depart en masse (i.e., “commute”) from the Sound at dawn each day to feeding areas primarily in and around Nantucket Shoals southeast of Nantucket Island, and then return to the Sound at dusk to unknown nocturnal locations. We wanted to determine the relationship of these nocturnal roosting sites to the proposed Cape Wind Energy Project (WEP).

LTDUs have a circumpolar breeding distribution, but which of the possible breeding populations between arctic Alaska, Canada, Greenland, Iceland, Scandinavia, and Siberia are represented in the hundreds of thousands of ducks overwintering in the Sound? Answering this question is of general interest in understanding the ecological impact of changes in the quality of the LTDU wintering habitat of the Sound. Whether this impact is the direct effect of collision mortality at the proposed WEP, or the indirect effects due to loss of habitat or decline in habitat quality, it is difficult to interpret the ecological significance of these effects without accurate definition of the source breeding populations for LTDUs. For example, habitat quality of the wintering range may be a limiting factor for some breeding populations but not others.

To accomplish these objectives we captured and instrumented a total of 32 LTDUs ducks and tracked their movements within Nantucket Sound and to their breeding grounds beginning in winter 2007-08 (nine ducks), winter 2008-2009 (11 ducks), and winter 2009-2010 (12 ducks). Preliminary results are described below.

Preliminary Results: Table 1 presents the outcome for each of the 32 instrumented LTDUs over the three winter study periods. The table lists the last satellite-transmitted location and the fate of each instrumented LTDU along with several other dates of the ducks “life history”. These dates and other column headings are defined below. Please note that the departure and arrival dates should not be viewed as departure or arrival dates in any precise sense of these terms as instrumented ducks were not transmitting continuously:

Column Title	Description
Year	Describes the winter study period in which ducks were instrumented
PTT	The transmitter number provided by Microwave Telemetry
#	The duck number provided by the Argos tracking function. The last two digits correspond to the year the transmitter was surgically implanted in the duck
Date Released	Date on which the instrumented duck was released and began transmitting locations from satellite fixes
Last Nantucket Sound	Date of last signal received from instrumented duck from Nantucket Sound before presumed departure to breeding grounds
Last Stopover Location	Date of last signal received from instrumented from a stopover site on the duck’s journey to its apparent breeding grounds. Instrumented ducks typically spent four to six weeks in the stopover area
First Breeding Location	Date of first signal from an instrumented duck’s presumed breeding location; location was determined after repeated signals were recorded from the same area for at least one month
Last Breeding Location	Date of last signal from general area of breeding; duck may have moved from first location, but remained within general vicinity of the first breeding location
Return Trip	Two dates indicating first satellite-determined locations at points south of breeding location, indicating the instrumented duck is on its return trip to wintering grounds
Nantucket Sound	First satellite fix from Nantucket Sound in second winter
Last Location	Date of last satellite fix from instrumented duck. May represent duck mortality or failure of transmitter.
Comments	Provides further details on transmitter/duck fate.

Table 1. Summary of transmitter fates for Long-tailed Ducks marked in Nantucket Sound, 2007-2010.

Year	PTT	#	Date Released	Last Nantucket Sound	Last Stopover Location	First Breeding Location	Last Breeding Location	Return Trip	Nantucket Sound	Date Last Location	Comments	
2007-08	79633	3307	12/14/07	04/10/08	05/14/08	-	-	-	-	05/20/08	Hudson Bay last location	
	79634	3407	12/14/07	-	-	-	-	-	-	12/19/07	Died; PTT not recovered	
	79635	3507	12/13/07	04/17/08	05/19/08	06/18/08	09/14/08	09/21/08	-	11/20/08	Poor locations after breeding arrival; don't know where it was or when it left; last location near	
	79636	3607	12/14/07	-	-	-	-	-	-	12/31/07	Died; PTT recovered and reused in 2008-2009	
	79637	3707	12/14/07	04/22/08	05/24/08	05/31/08	09/28/08	10/06/08	10/29/08	11/05/08	04/25/09	Wintered in Nantucket Sound for 2nd year
		3707	-	04/25/09	-	-	-	-	-	-	-	Transmitter failed before departure from Sound
	79638	3807	12/13/07	04/22/08	05/16/08	06/15/08	09/21/08	-	-	-	10/14/08	In general area of breeding 6/7/08; Poor last locations - "0"
	79639	3907	12/13/09	-	-	-	-	-	-	-	12/19/09	Died; PTT recovered and reused in 2008-2009
	79640	4007	12/14/07	-	-	-	-	-	-	-	12/20/07	Died; PTT recovered and reused in 2008-2009
	79641	4107	12/13/07	04/08/08	05/13/08	06/19/08	-	-	-	-	07/14/08	Stopped transmitting; apparently healthy
2008-09	79636	3608	12/18/08	04/29/09	05/12/09	06/18/09	-	-	-	08/24/09	Recovered transmitter from 2007-2008 inserted in new bird	
	79639	3908	12/18/08	04/13/09	05/27/09	06/10/09	09/23/09	09/30/09	11/22/09	11/29/09	12/15/09	Recovered transmitter from 2007-2008 inserted in new bird
	79640	4008	12/12/08	-	-	-	-	-	-	01/15/09	Recovered transmitter from inserted in new bird; died 1/15/09 and PTT not recovered	
	79643	4308	12/12/08	-	-	-	-	-	-	12/15/08	Died; PTT not found	
	79644	4408	12/13/08	04/03/09	05/14/09	-	-	-	-	05/29/09	May not have made breeding location	
	89594	9408	12/13/08	-	-	-	-	-	-	12/14/08	Died Tuckernuck; PTT not found	
	89595A	9508A	12/12/08	-	-	-	-	-	-	12/15/08	Died; PTT recovered and re-used immediately	
	89595B	9508B	12/18/08	-	-	-	-	-	-	12/22/08	Recovered transmitter from 89595A; inserted in new bird; died and PTT recovered	
	89597	9708	12/18/08	04/21/09	05/25/09	06/29/09	09/21/09	10/05/09	10/26/09	11/02/09	02/25/10	Last Signal from the Sound
	89598	9808	12/18/08	04/12/09	05/25/09	06/22/09	09/28/09	10/05/09	11/09/09	04/22/10	05/13/10	Left the Sound and last seen in Gulf of St. Lawrence
89599	9908	12/18/08	-	-	-	-	-	-	-	01/12/09	Possible PTT failure; duck apparently healthy	
2009-10	89595	9509	11/22/09	04/07/10	05/24/10	06/08/10	07/20/10	-	-	-	07/20/10	Recovered transmitter from 2008-2009 inserted in new bird
	89596	9609	11/22/09	04/16/10	05/15/10	07/03/10	current	-	-	-	09/04/10	Arrived near breeding location on 6/19/10
	98732	3209	11/22/09	04/18/10	05/17/10	06/08/10	-	-	-	-	07/06/10	Arrived near breeding location on 5/31
	98733	3309	11/22/09	04/06/10	-	-	-	-	-	-	04/15/10	Arrived in staging area and no further signal
	98734	3409	11/22/09	04/10/10	05/16/10	06/21/10	current	-	-	-	09/07/10	Moved north from putative breeding location 7/21/10
	98735	3509	11/22/09	-	-	-	-	-	-	-	11/29/09	Died; PTT recovered and reused in 98735a
	98735a	3510	03/07/10	-	-	-	-	-	-	-	03/29/10	Recovered transmitter inserted in new duck near Cape Cod; died and PTT not recovered
	98736	3609	11/24/09	04/04/09	05/12/09	06/24/10	-	-	-	-	07/15/10	Possible PTT battery failure
	98737	3709	11/24/09	-	-	-	-	-	-	-	11/28/09	Died; PTT recovered and reused in 98737a
	98737a	3710	03/07/10	-	-	-	-	-	-	-	03/11/10	Recovered transmitter inserted in new duck near Cape Cod; died and PTT not recovered
98738	3809	11/24/09	-	-	-	-	-	-	-	01/18/10	Possible PTT failure	
98739	3909	11/24/09	-	-	-	-	-	-	-	01/17/10	Possible PTT failure	

Of the 32 instrumented ducks, 19 ducks transmitted locations for one month or more. Fifteen ducks made it to or near possible breeding locations, and five ducks from the first two winters returned to Nantucket Sound and transmitted location signals for all or a portion of a second winter before apparent battery failure – transmitter operations (i.e., duty cycles) are programmed to allow batteries to last approximately ten months on average. There was high mortality of instrumented ducks, some of which we determined to be the result of predation by gulls of ducks shortly after instrumented ducks were released. LTDUs must come ashore to preen and ducks were vulnerable to gull predation during this time. Changes in release location reduced this predation essentially to zero, but there was still high apparent mortality, much higher than observed in other sea ducks (M. Perry, personal communication). Whenever possible, transmitters were recovered by volunteers on Nantucket and reinserted into new ducks. This transmitter reuse is indicated in Table 1.

A companion study by our partners at the USGS Patuxent lab and funded by the Sea Duck Joint Venture Program instrumented 19 LTDUs in March 2010, including two of our recovered transmitters; only 11 of these instrumented survived more than one month.

Ducks tended to depart Nantucket Sound in the second to third week of April, spend 3-6 weeks in their “stopover” location in the Gulf of St. Lawrence, and arrive in apparent breeding locations in mid-June. Five instrumented ducks continued transmitting long enough to determine that they returned to the Sound in the late fall, and two ducks instrumented in November 2009 continue to transmit signals. We are hopeful that these two ducks will continue transmitting as they return to Nantucket Sound sometime in mid-November of this year. Based on the few ducks with surviving transmitters, LTDUs depart from their breeding grounds in late September and arrive at their Nantucket Sound wintering grounds in November.

The majority of apparent breeding locations were primarily in the Canadian province of Nunavut and Quebec near the coast along Hudson Bay, but some were up to 400 km from the Hudson Bay Coast or further north on the cluster of large islands bordering the Beaufort Sea and Baffin Bay (Figure 1). No detailed analysis of habitat use or gender differences in location has been attempted, yet. Ten surviving ducks instrumented in March 2010 as described above had a similar distribution. Given the size of the potential breeding area of LTDUs the relatively tight clustering of Nantucket Sound ducks is remarkable.

Figure 1: Apparent locations of breeding areas for instrumented LTDUs based on satellite fixes as described in the text. Years ducks were instrumented are color-coded (Yellow = 2007-08, Blue = 2008-2009, and Red = 2009-2010). Closed circles are females and open diamonds are males.



Pattern of Diurnal Winter Movements in Nantucket Sound

Nineteen instrumented LTDUs over the course of three winters provided daytime and nighttime satellite fixes in and around the island of Nantucket. Five of these ducks provided fixes for at least a portion of a second winter and four ducks provided readings for only one month. Maps showing location fixes for winter 2007-08 (five ducks) and winter 2008-09 (six ducks) are reproduced as Appendix A and Appendix B, respectively. Results for ducks instrumented in November 2009 (eight ducks) and three returning ducks instrumented in December 2008 are presented in Figure 2a and Figure 2b, respectively.

The results extend the preliminary conclusions first drawn after winter 2007-2008:

1. None of the 19 instrumented ducks described above were recorded roosting on Horseshoe Shoal, the proposed project area, including the second winter of the five returning ducks. Because transmitters are not on continuously, we can't eliminate the possibility that the instrumented ducks were on Horseshoe Shoal at times when the transmitters were in the "off" portion of the winter season duty cycle. Although the results are not presented here, 19 LTDUs were captured in the vicinity of Cape Cod and Monomoy Island in March 2010 as described previously. Eleven of these ducks transmitted

signals for one month or more. Six of these ducks demonstrated the commuting pattern, and none of these ducks provided satellite fixes in or near Horseshoe Shoal. The remaining five ducks did not commute prior to departure for their breeding areas in mid-April 2010; they remained in the area immediately adjacent to Harwich, Chatham and Monomoy Island

2. Many ducks demonstrated the pattern of diurnal migration so often observed by observers on Nantucket Island, but ducks do not make this journey every night. Some ducks appeared not to migrate but stayed in one area both day and night. Other ducks apparently spent the night on Nantucket Shoals, not returning to the Sound at night.
3. Results suggest that instrumented LTDUs used a broad area of the Sound for nighttime roosting sites, and that the roosting locations changed, i.e., one site was not consistently used, even by individual ducks

Project Status and Plans for the Future: The project achieved its proposed objectives. Our results provided no support for the statement that commuting LTDUs regular roost on Horseshoe Shoal at night or in the daytime. Although, as described above, this does not conclusively demonstrate that LTDUs do not roost or otherwise use Horseshoe Shoal, our results suggest that LTDUs are not at high collision risk with wind turbines within the proposed project area as a result of their commuting behavior.

We have begun discussions with our collaborators to conduct during and post-construction telemetry studies of LTDUs, in particular, and possibly other sea duck species wintering in Nantucket Sound (e.g., White-winged Scoter, Common Eider) to estimate the behavioral impact of construction and operation of the now approved Cape Wind energy project on sea ducks. Particularly with LTDUs, we have an excellent baseline for comparison.

As mentioned above the relatively tight clustering of as many as 25 LTDUs in Canada suggests that LTDUs wintering in Nantucket Sound may form a geographically discrete population. This hypothesis will be further tested by DNA work under the auspices of Michael Sorenson, Biology Department at Boston University.

Figure 2a: Google Earth image of winter locations of six ducks instrumented in November 2009. The approximate location of the proposed Cape Wind energy project is outlined in brown. Different colors correspond to different ducks. Circles are male ducks and squares are female ducks.

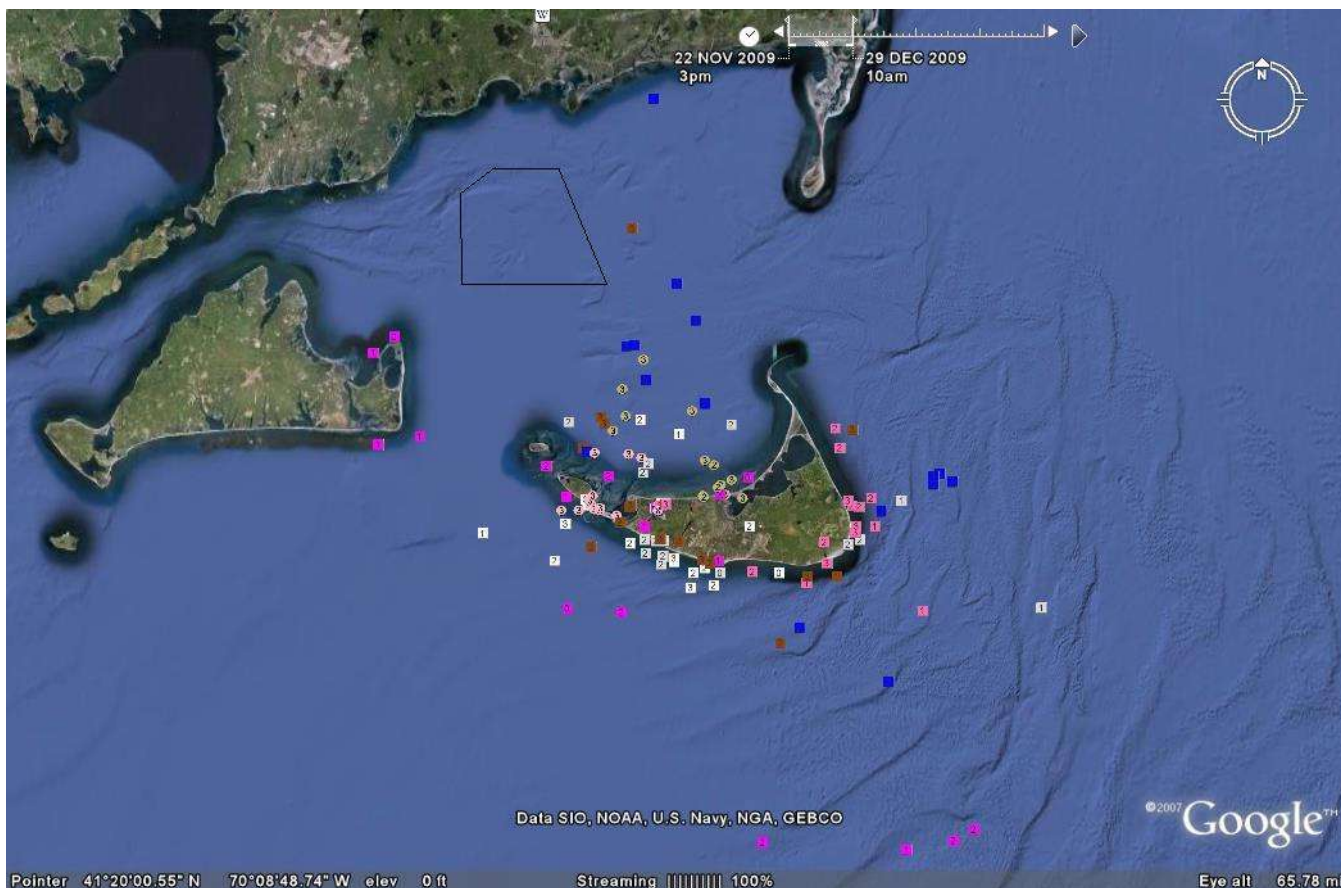
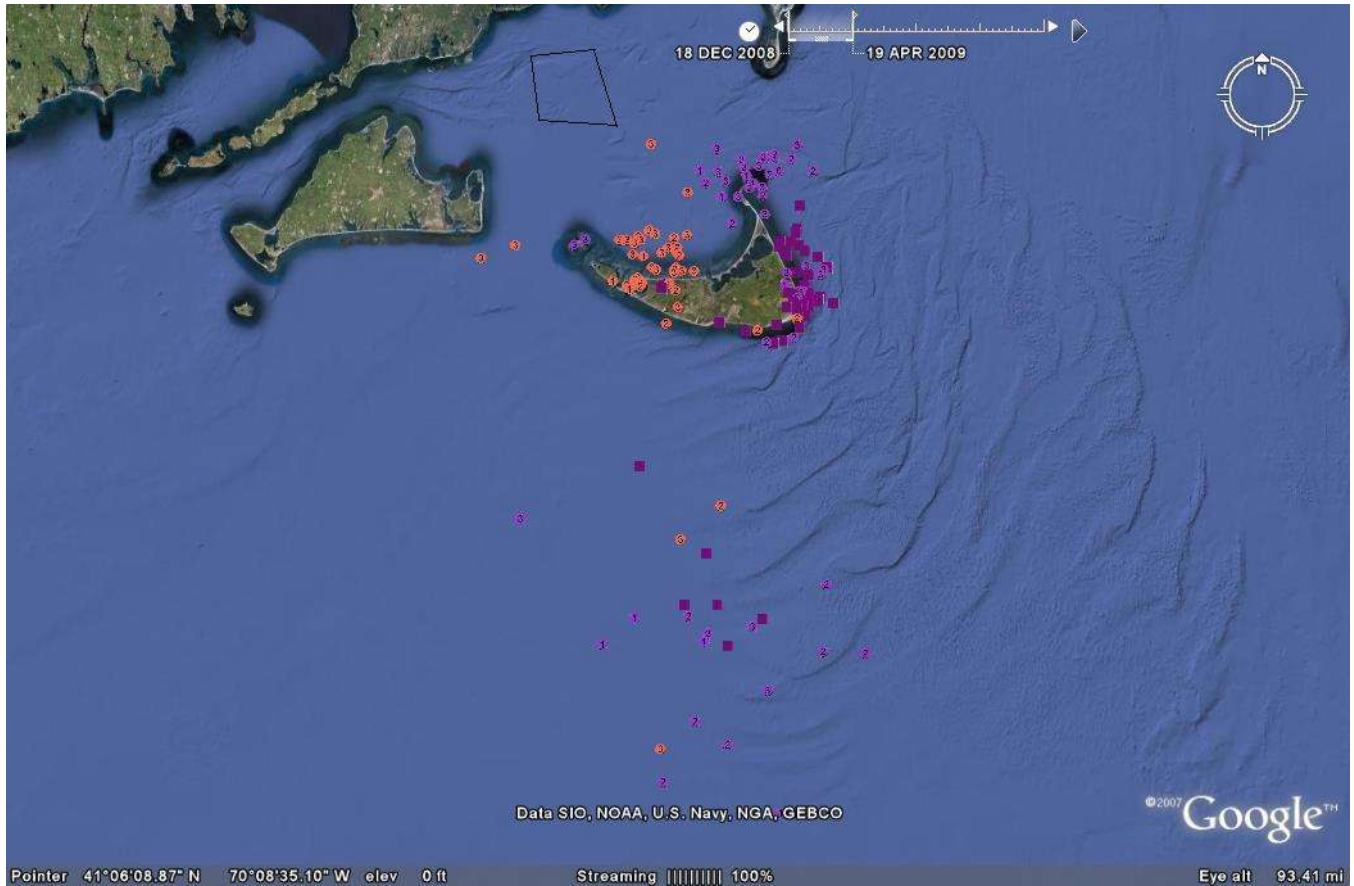
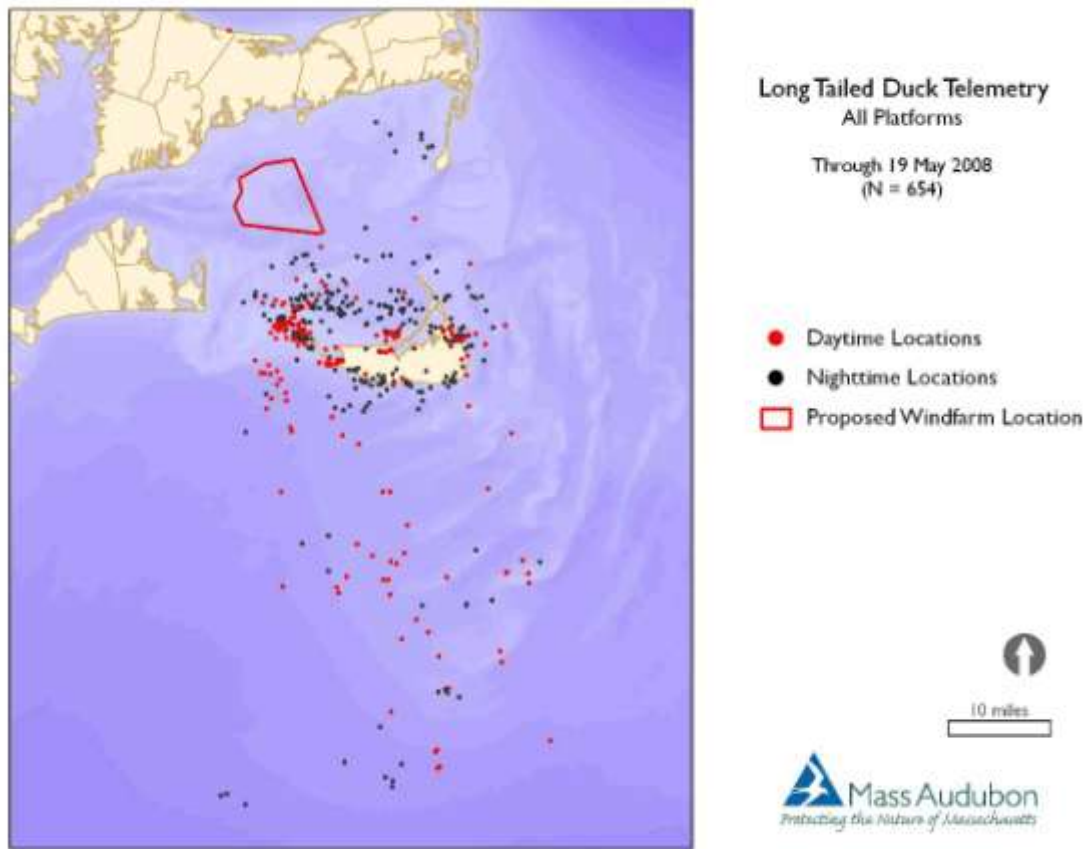


Figure 2b: Google Earth image of winter locations of three ducks instrumented in December 2008 that returned for all or a portion of second winter. The approximate location of the proposed Cape Wind energy project is outlined in brown. Different colors correspond to different ducks. Circles are male ducks and squares are female ducks.



Appendix A: Daytime (red dot) and nighttime (black dot) locations between December 12, 2007 and mid-April 2008 of five instrumented Long-tailed Ducks as interpreted from satellite fixes with respect to Horseshoe Shoal (red outline). The potential error in “true” location of each of the 654 points is a maximum of 1000 m.



Appendix B: Daytime (red dot) and nighttime (black dot) locations between December 12, 2008 and mid-April 2009 of eight instrumented Long-tailed Ducks (including one duck instrumented in December 2007) as interpreted from satellite fixes with respect to Horseshoe Shoal (red outline); two of the ducks only transmitted for one month. The potential error in “true” location of each of the 921 points is a maximum of 1000 m.

