3.0 AVIAN AERIAL SURVEYS

This chapter describes the avian aerial survey conducted for the NJDEP Baseline Studies Project on 16 April 2008. Survey design, methodology, results, and conclusions are presented. After review of the survey results, the NJDEP peer review committee determined that avian aerial surveys would be discontinued for the remainder of the project.

3.1 SURVEY DESIGN

The avian aerial survey design was based primarily on recommendations made by Camphuysen et al. (2004). A strip transect survey sampling design was selected to collect avian data. Transect lines were spaced 2 NM (2.3 miles [mi]) apart and orientated perpendicular to the coastline. The 34 transect lines were divided (even or odd numbered) and scheduled to be flown during separate morning and afternoon sessions (i.e., half in the morning and half in the afternoon). This design provided comparable spatial and temporal coverage of the entire Study Area.

3.2 SURVEY METHODOLOGY

On the day of the survey, a coin toss determined whether the surveys started at the north or south end of the survey area. Another coin toss determined whether the odd or even numbered survey transects were flown in the morning. After a mid-day break, the remaining transects were flown.

The survey aircraft was a twin-engine Cessna Skymaster 337. Surveys were flown at approximately 76.2 m (250 ft) altitude at a speed of approximately 220 kilometers per hour (kph; 110 kts per hour [hr]). Two avian biologists/observers conducted the avian strip transect surveys. A third scientist observer was responsible for ensuring the operational status of computer that was connected to the plane's GPS to accurately record transect sighting coordinates and transect start and end times. The data acquisition computer was interfaced with the aircraft GPS system. Automated data acquisition included the time, date, latitude, longitude, speed, and heading of the aircraft, and GPS signal strength; data were collected at 10-s intervals.

The two avian biologists were stationed at each of the back side windows; the other (third) scientist observer was stationed in the front seat next to the pilot. Avian observers recorded: transect number; transect start/end times (to the nearest second); transect side; identity (lowest practical taxon [four-letter standard code]; number of individuals (approximate number for flocks); distance bin (based on perpendicular distance from the aircraft's heading) and behavior (flying, foraging, etc.) with a digital voice recorder. The three distance bins were: A = 44 to163 m (144 to 535 ft); B = 164 to 432 m (538 to 1417 ft); and C = 433 to 1,000 m (1420 to 3281 ft). The declination in the degrees from the horizon were 60° to 25° for Bin A, 25° to 10° for Bin B, and 10° to 4° for Bin C for an aircraft flying at 76 m (250 ft) above mean sea level (AMSL). Prior to initiating the survey the biologists used an inclinometer to mark these bin lines on the aircraft window to aid in sorting observations into these distance bins. The avian biologists completed QA/QC protocols (see New Jersey Department of Environmental Protection Quality Assurance Work Plan Revision III; Geo-marine, Inc [GMI] 2008a) prior to take-off and after landing.

The avian aerial survey was conducted on 16 April 2008. Flying conditions during the survey were nearly perfect. Skies were clear, wind speeds were low (0 to 5 miles per hour [mph]), and the BSS ranged from 0 to 1. All 34 proposed transects were flown on 16 April (**Figure 3-1**). Transects were flown in an alternating pattern to provide data on temporal variation. The aerial survey was initiated at 8:52:13 AM Eastern Daylight Time (EDT) on Transect 1 (south end of the Study Area; see **Figure 3-1**). The morning flight ended at Transect 33 at 12:27:35 PM EDT. The afternoon flight started on Transect 2 at 2:12:32 PM EDT and ended at Transect 34 at 5:51:50 PM EDT. The total survey effort for the avian aerial survey was 7:04:54 hrs. The width of the strip transect was 0.956 km^2 (0.369 square miles [mi^2]). The total length of all transects flown was 1,098 km (593 NM [681.9 mi]) and the area surveyed was 1,050 km^2 (405.4 mi^2).

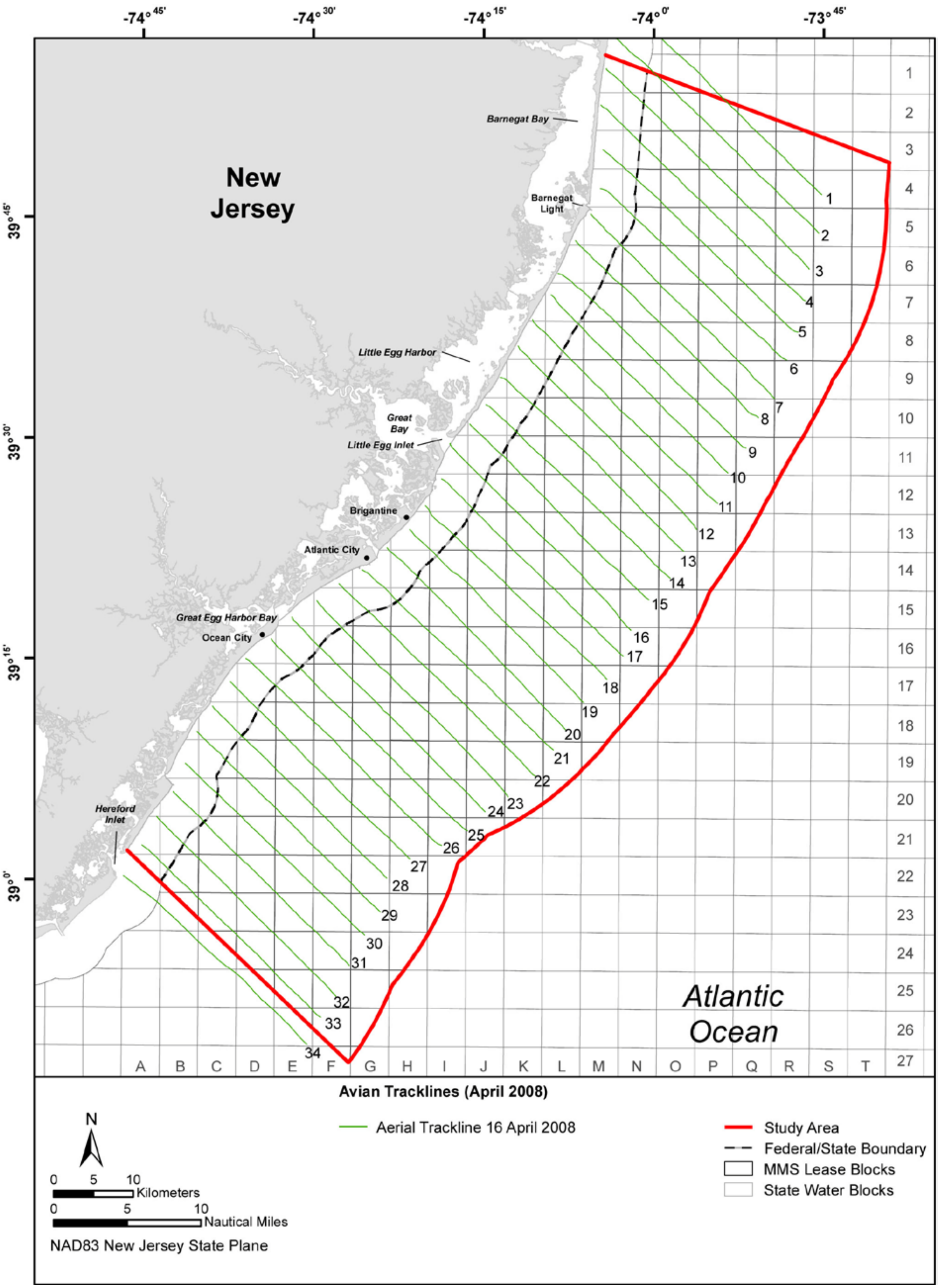

Figure 3-1. Avian aerial survey tracklines for 16 April 2008.

Transect data were transcribed from the digital voice recorders into an Excel spreadsheet. The voice recordings were not audible on one of the two recorders. An attempt was made to reduce background noise; however, the recording was still not audible. Only data from the audible recorder (half of the observed data) were analyzed.

3.3 SURVEY RESULTS AND CONCLUSIONS

Ten avian species were identified during the aerial survey ten in the morning and eight in the afternoon (**Table 3-1**). Five categories were used to designate birds that could not be identified to species. No federal or state-classified bird species were observed.

Table 3-1. Avian species observed during the 16 April 2008 aerial survey.

Family Common Name	Full-Day Survey	Morning	Afternoon
Anatidae (sea ducks)			
Surf Scoter	X		X
Black Scoter	X	X	
Scoter (unknown)	X	X	
Gaviidae (loons)			
Red-throated Loon	X	X	X
Common Loon	X	X	X
Loon (unknown)	X	X	X
Sulidae (gannets)			
Northern Gannet	X	X	X
Laridae (gulls, terns)			
Bonaparte's Gull	X	X	
Laughing Gull	X	X	X
Herring Gull	X	X	X
Great Black-backed Gull	X	X	X
Gull, small (unknown)	X	X	
Gull (unknown)	X	X	
Forster's Tern	X	X	
Unidentified			
Passerine	X	X	

Northern Gannet, Red-throated Loon, and Common Loon were the most abundant species detected during the aerial survey (**Table 3-2**). Temporal variation in abundance occurred between the morning and afternoon surveys; more birds were detected in the morning (332) than in the afternoon (199; **Table 3-2**). The primary differences between morning and afternoon counts were decreased numbers of Red-throated Loon and Common Loon. Many variables affect bird activity and behavior. For example, differences in morning and afternoon abundance may have resulted from decreased visibility from glare because of the clear weather conditions and/or increased diving activity (e.g., loons).

The total number of birds detected per transect (T) varied from 9 to 31 during the morning survey and from 1 to 43 during the afternoon (**Tables 3-3** and **3-4**). The highest number of individuals were detected on transects 25 and 27 in the morning and on transect 28 in the afternoon. More birds were detected in the northern half of the Study Area during the morning, with 177 birds present on the morning northern transects (odd-numbered transects 19 through 33) compared to 155 on the morning southern transects (odd-numbered transects 1 through 17). During the afternoon, the number of individuals on the northern half (even-numbered transects 20 through 34) of the Study Area was 108 and the southern half (even-numbered transects 2 through 18) had 91 individuals.

Table 3-2. Abundance[1] and percent numerical composition of birds observed during the 16 April 2008 aerial survey.

Family Common Name	Morning		Afternoon	
	Number	% Composition	Number	% Composition
Anatidae (sea ducks)				
Surf Scoter			15	7.5
Black Scoter	1	0.3		
Scoter (unknown)	1	0.3		
Gaviidae (loons)				
Red-throated Loon	67	20.2	18	9.1
Common Loon	59	17.8	9	4.5
Loon (unknown)	11	3.3	3	1.5
Sulidae (gannets)				
Northern Gannet	152	45.8	138	69.4
Laridae (gulls, terns)				
Bonaparte's Gull	2	0.6	3	1.5
Laughing Gull	2	0.6		
Herring Gull	25	7.5	5	2.5
Great Black-backed Gull	4	1.2	8	4.0
Gull, small (unknown)	1	0.3		
Gull, large (unknown)	3	0.9		
Forster's Tern	3	0.9		
Unidentified				
Passerine	1	0.3		
TOTAL	**332**		**199**	

[1] Total number of birds counted

During the 16 April 2008 avian aerial survey a total of 531 birds were detected. In contrast the average daily number of birds observed during the April offshore ship surveys (09, 10, 12 to 14 April) was 2,322. In April, offshore ship surveys had a total of 14.67 birds/km^2 compared to 0.50 birds/km^2 the 16 April aerial survey (**Table 3-5**). Offshore ship and aerial survey data were compared to determine if differences existed in species diversity and the detection of species.

As expected, April avian species diversity was higher during the four-day offshore ship survey than the one-day aerial survey because of the difference in survey effort. The number/km^2 for scoters, small gulls, and small terns were noticeably lower on the aerial survey than on the April offshore ship surveys. It is possible that the scoters observed on the offshore ship survey had migrated away from the Study Area prior to the aerial survey or that the dark-bodied scoters could not be distinguished during the aerial survey. Small gull and tern species (e.g., laughing gull, common tern) that are resident in the Study Area beginning in April may also occur as migrants throughout the spring. Small gulls and terns resting on the water at moderate distances from the ship can be difficult to see during the offshore survey, and unless they are flying, would be easy to miss on an aerial survey. Another possible explanation for the lower bird numbers for the aerial survey was the difference in weather conditions; the weather on 16 April (BSS of 0 to 1) was unusual for New Jersey coastal and offshore waters in April and differed from the weather for the offshore surveys (GMI 2008b).

Table 3-3. Morning avian species abundance[1] by transect during the 16 April 2008 aerial survey.

Family Common Name	Transect Number																
	T1	**T3**	**T5**	**T7**	**T9**	**T11**	**T13**	**T15**	**T17**	**T19**	**T21**	**T23**	**T25**	**T27**	**T29**	**T31**	**T33**
Anatidae (sea ducks)																	
Surf Scoter																	
Black Scoter						1											
Scoter (unknown)											1						
Gaviidae (loons)																	
Red-throated Loon	1	1	1	1		19	3	6	5	3		2	9	1	3	6	6
Common Loon	1	2	9	5	4		4	1	1	2	8	1	1	8	4	5	3
Loon (unknown)				1	1	1	1	1	1			1		2		1	1
Sulidae (gannets)																	
Northern Gannet	4	10	8	5	4	6	3	15	10	6	4	17	15	19	14	5	7
Laridae (gulls, terns)																	
Bonaparte's Gull						1					1						
Laughing Gull													1		1		
Herring Gull	3	3	2	2				1		2			4	1	3	3	1
Great Black-backed Gull		1										1	1				
Gull, small (unknown)		1															
Gull, large (unknown)				1											1		1
Forster's Tern		2	1														
Unidentified																	
Passerine																	
TOTAL	**9**	**20**	**21**	**15**	**9**	**28**	**12**	**24**	**17**	**13**	**14**	**22**	**31**	**31**	**26**	**21**	**19**

[1] number of individuals counted
T = Transect

Table 3-4. Afternoon avian species abundance[1] by transect during the 16 April 2008 aerial survey.

Family Common Name	Transect Number																
	T2	**T4**	**T6**	**T8**	**T10**	**T12**	**T14**	**T16**	**T18**	**T20**	**T22**	**T24**	**T26**	**T28**	**T30**	**T32**	**T34**
Anatidae (sea ducks)																	
Surf Scoter				15													
Black Scoter																	
Scoter (unknown)																	
Gaviidae (loons)																	
Red-throated Loon	1	1		1	2	1		1	1	1	1	3		2		1	2
Common Loon		2	1				1		2			1	2				
Loon (unknown)	2					1											
Sulidae (gannets)																	
Northern Gannet	5	2	7	9	5	6	15	8			2	13	10	37	8	6	5
Laridae (gulls, terns)																	
Bonaparte's Gull														3			
Laughing Gull																	
Herring Gull		1											2			2	
Great Black-backed Gull			1									1	2	1		3	
Gull, small (unknown)																	
Gull (unknown)																	
Forster's Tern																	
Unidentified																	
Passerine																	
TOTAL	**8**	**6**	**9**	**25**	**7**	**8**	**16**	**9**	**3**	**1**	**3**	**18**	**16**	**43**	**8**	**12**	**7**

[1] number of individuals counted
T = Transect

Table 3-5. Avian abundance and number of individuals per km^2 during the April 2008 offshore ship and aerial surveys.

Family Common Name	April Offshore Ship[1]		April Aerial	
	Number	No./km^2	Number	No./km^2
Anatidae (geese, ducks)				
Atlantic Brant	54	0.07		
Canada Goose	4	0.01		
Snow Goose	10	0.01		
American Black Duck	96	0.12		
Northern Pintail	25	0.03		
Green-winged Teal	1	*		
Duck (dabbling)	34	0.04		
Scaup (unknown), Lesser Scaup, Greater Scaup	4	0.01		
Duck (diving)	6	0.01		
Surf Scoter	2,408	3.04	15	0.01
Black Scoter	484	0.61	1	*
White-winged Scoter	8	0.01		
Scoter (dark-winged)	1,650	2.08		
Scoter (unknown)	1,425	1.80	1	*
Long-tailed Duck	3	*		
Bufflehead	2	*		
Red-breasted Merganser	19	0.02		
Duck (unknown)	102	1.02		
Gaviidae (loons)				
Red-throated Loon	564	0.71	85	0.08
Common Loon	271	0.34	68	0.06
Loon (unknown)	20	0.03	14	0.01
Podicipedidae (grebes)				
Horned Grebe	2	*		
Sulidae (gannets)				
Northern Gannet	2,793	3.53	290	0.28
Phalacrocoracidae (cormorants)				
Double-crested Cormorant	296	0.37		
Ardeidae (herons)				
Great Blue Heron	18	0.02		
Accipitridae (hawks, eagles)				
Osprey	4	0.01		
Laridae (gulls, terns)				
Little Gull	1	*		
Bonaparte’s Gull	391	0.49	5	*
Laughing Gull	74	0.09	2	*
Ring-billed Gull	5	0.01		
Herring Gull	386	0.49	30	0.03
Lesser Black-backed Gull	1	*		
Great Black-backed Gull	101	0.13	12	0.01
Gull, large (unknown)	179	0.23	3	*
Royal Tern	1	*		
Common Tern	2	*		
Forster's Tern	108	0.14	3	*
Tern, small (unknown)	3	*		
Gull, small/tern	33	0.04	1	*

Table 3-5 (*continued*). Avian abundance and average number of individuals per on-effort hour during the April 2008 offshore ship and aerial surveys.

Family Common Name	April Offshore Ship[1]		April Aerial	
	Number	No./km^2	Number	No./km^2
Alcidae (auks)				
Dovekie	2	*		
Razorbill	4	0.01		
Unidentified				
Non-passerine[2]	11	0.02		
Passerine[3]	5	0.01	1	*
Unknown				
TOTAL	**11,610**	**14.67**	**531**	**0.50**

* <0.01 birds/km^2
[1] GMI 2008b
[2] Represents vultures and other non-water bird, non-passerine spp.
[3] Represents passerine spp. recorded over land, on shore, offshore, and/or on the survey vessel
Avg. = Average
No. = Number

Avian aerial surveys were initially scheduled for three separate occasions: once each in spring 2008, fall 2008, and spring 2009. After the April survey the efficacy of such limited surveying was discussed by the committee members, and the pros and cons of conducting aerial surveys were compared. Benefits consisted of better detection of peak activity (if conducted during peak activity) and a “snapshot” collection of avian data over the whole day. The negatives consisted of limited detection of small and darker-colored birds, the temporal variation of migration, the small number of planned surveys (considering the limited data already gathered), the safety of flying at low altitudes, and the cost involved. A vote was taken and it was decided to discontinue aerial surveys and instead increase radar validation surveys.

3.4 SUPPLEMENTAL AVIAN AERIAL SURVEY DATA

Avian aerial surveys were conducted offshore from northern New Jersey to just south of mouth of Chesapeake Bay, Virginia in 2001, 2002, and 2003 by the USFWS Chesapeake Bay Field Office (Forsell, D., pers. comm., 14 May 2010). The avian aerial surveys were conducted during two winters and one spring from 21 December 2001 through 08 March 2003. The aerial survey transects were flown perpendicular to shore from the coast to 22.2 km (12 NM) offshore. The aerial survey sample width was 120 m (393.7 ft). Birds were identified to the lowest identifiable taxa (i.e., species, guild, unidentified) and density maps (birds/km^2) were made for guilds and/or species.

All USFWS 2001-2003 avian aerial survey offshore data within the NJDEP EBS Study Area off the New Jersey was combined and density data was calculated for scoters (Black Scoter, Surf Scoter, White-winged Scoter, unidentified scoter), Northern Gannet, Common Loon, Red-throated Loon, and large Gulls (Herring Gull, Great Black-backed Gull, Lesser Black-backed Gull, large gull [unidentified]). Aerial survey density figures are presented in **Appendix N** and avian shipboard-small boat survey density figures are provided in **Appendix M**.

A general comparison was made between the avian densities of 2001-2003 USFWS avian aerial survey data and the 2007-2009 avian shipboard-small boat survey data collected during this study. In general, large density differences were not discernable between sitting and all behavior birds during the avian shipboard-small boat survey and therefore general comparisons were made with available data.

Scoter density during the aerial surveys was concentrated primarily along the coast in three areas, north and south of Barnegat Light, off of Little Egg Inlet, and south of Ocean City. In contrast, scoter density during the avian shipboard-small boat surveys conducted for this study was primarily along the coast from north of Little Egg Inlet south to Ocean City (**Figures N-1 and M-521**). The highest areas of Northern Gannet abundance were farther offshore during the avian aerial surveys than during the avian shipboard-small boat surveys (**Figures N-2 and M-522**). Common Loon density was similar between the aerial and avian shipboard-small boat surveys (**Figures N-3 and M-530**) Red-throated Loon density during the aerial surveys was highest in the vicinity of Barnegat Light and more concentrated within state waters. In contrast, during the avian shipboard-small boat surveys Red-throated Loon were present mostly outside of state waters (**Figures N-4 and M-130**). During the aerial surveys large gulls were more evenly distributed along all of the New Jersey coastline than during the avian shipboard-small boat surveys (**Figures N-5 and M-525** [Herring Gull, the most abundant large gull]).

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