2011

Eagle Nest, Roost and Foraging Area Monitoring at Exelon's Conowingo and Muddy Run Reservoirs

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EAGLE NEST, ROOST, AND FORAGING AREA MONITORING AT EXELON'S CONOWINGO AND MUDDY RUN RESERVOIRS

Final report submitted to the Exelon Corporation

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September 2011

Recommended Citation:

Mojica, E.K., B.J. Paxton, and B.D. Watts. 2011. Eagle Nest, Roost and Foraging Area Monitoring at Exelon's Conowingo and Muddy Run Reservoirs. Final Report. Center for Conservation Biology Technical Report Series, CCBTR-11-15. College of William and Mary & Virginia Commonwealth University, Williamsburg, VA. 23 pp.

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Executive Summary

The upper Chesapeake Bay region is an important area for both breeding and non-breeding Bald Eagles. The resident breeding population in the Bay has fully recovered since the declines of the 1960s and is estimated at over 2,000 breeding pairs. The population has experienced exponential growth since the mid-1990s with an average doubling time of 8.2 years (Watts et al. 2008). The Chesapeake Bay is a convergence zone for non-breeding eagles attracting thousands of eagles from multiple populations along the Atlantic Coast. Eagles congregate along the lower Susquehanna River attracted by forested shoreline habitat and abundant food resources. This study seeks to assess Bald Eagle use of the lower Susquehanna River to inform the Federal Energy Regulatory Commission in the relicensing of the Conowingo Hydroelectric Project and the Muddy Run Pumped Storage Project.

A survey of the breeding population was conducted using a standard 2-flight survey approach with fixed-wing aircraft. The survey conducted in the Spring of 2010 documented 12 breeding territories, 11 of which were actively breeding. Reproductive rates were 1.25 chicks/occupied territory and 1.36 chicks/active nest.

Communal roosts and high-use shorelines were delineated using satellite transmitter data collected from Bald Eagles in the Chesapeake Bay during 2008-2011. The roosts were monitored on the ground during a summer and winter sampling period to assess their use by eagles. Use in summer was significantly greater than in winter. The ground observations were then compared to transmitter data to determine if a relationship could be formed where transmitter data could remotely estimate roost use. A relationship between the two types of roost data was found for the summer sampling period but not the winter sampling period. Shoreline use was mapped in 100 m segments for the study area using transmitter data. Both shoreline and roost use varied by season.

Background

The waters of the lower Susquehanna River support several power generating stations including Exelon Corporation's Muddy Run Hydroelectric Station, Peach Bottom Atomic Power Plant, and Conowingo Hydroelectric Station. This section of the Susquehanna is rich in birdlife with over 200 species documented in the area. The Lower Susquehanna Gorge was identified in 2002 as a candidate for recognition as an Important Bird Area (PA Audubon). The first Bald Eagle Sanctuary was established in 1936 to protect an active eagle nest on Mt Johnson Island, across from the Peach Bottom Nuclear Plant (Abbott 1959).

Bald Eagles from populations along the Atlantic coast congregate in the upper Chesapeake Bay and lower Susquehanna River with some of the largest numbers concentrating around the lower portion of the Susquehanna River (Buehler et al 1987, Buehler et al 1991, Watts et al 2007). Eagle populations have grown exponentially in the Chesapeake Bay resulting in a large increase in the number of eagles foraging and roosting around the Conowingo reservoir and dam system (Watts et al 2007, Watts et al 2008). Satellite telemetry data from an ongoing study of eagles at Aberdeen Proving Ground has revealed significant use of Conowingo by eagles in the upper Bay (Watts and Mojica *in press*). This telemetry data was used to delineate communal roosts and key foraging areas. Ground work was needed to determine the relationship between use of communal roosts and foraging areas by birds with transmitters and the broader eagle population using the study area.

Identification of communal roosts and foraging areas is important for successful eagle management under the USFWS's National Eagle Management Guidelines. Though the Bald Eagle was removed from the federal Endangered Species List in 2007, it remains protected by the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) and Migratory Bird Treaty Act (16 U.S.C. 703-712). Bald Eagles are listed as state threatened in Pennsylvania and are on the state watch list in Maryland.

Objectives

The objectives of the project were:

1. To use aerial surveying to document the status, distribution and productivity of nesting Bald Eagles
2. To delineate eagle roosts and foraging areas using satellite telemetry data.
3. To monitor eagle roosts and foraging areas with ground surveys.

Study Area

All forested components of the Conowingo and Muddy Run reservoir systems were included in the study of nesting, roosting, and foraging Bald Eagles. The study area covered all shoreline from US 40 at the mouth of the Susquehanna to PA Route 372 at the north end of the Conowingo Reservoir and Muddy Run Reservoir (approximately 50 miles of shoreline).

Methods

Nesting and Productivity Surveys

All major waterways and tributaries associated with the study area were surveyed for breeding Bald Eagles. In March 2010, a high-wing Cessna 172 aircraft was used to systematically overfly the land surface, at an altitude of approximately 100 m above tree canopy, to detect eagle nests. Flights were flown to systematically move between the shoreline and a distance of approximately 1.5 km inland to cover the most probable breeding locations for Bald Eagles. Detected nests were plotted on 7.5 min topographic maps, assigned a unique numeric code, and plotted in ArcGIS 10.0. Each nest was examined to determine its structural condition, the type and condition of nest tree, and the condition of the surrounding landscape. Following national conventions (USFWS 2009), a breeding territory was considered "occupied" if a pair of birds was observed in association with the nest and there was evidence of recent nest maintenance (e.g., well-formed cup, fresh lining, and structural maintenance). Nests were considered "active" if a bird was observed in an incubating posture or if eggs or young were detected in the nest. A "productive" nest has young present until fledging age (11-14 weeks old). All active Bald Eagle nests were rechecked in May 2010 for productivity. All eaglets were counted and aged by sight.

Eagle Roost and Foraging Areas

Delineation

GPS telemetry data were compiled from 67 Bald Eagles tagged in the Chesapeake Bay during August 2007 – February 2010 (Watts and Mojica 2009). Thirty-nine of these eagles roosted in the study area with a total of 1,864 GPS locations included in the analysis. A nearest neighbor clustering script in Crimestat III (Levine 2004) was used to delineate the roost boundaries with a minimum convex polygon (MCP; see example Figure 1). This analysis searched for spatially clustered GPS locations which indicated communal roosts (Watts and Mojica *in press*). Seasonal use and variation was evaluated.

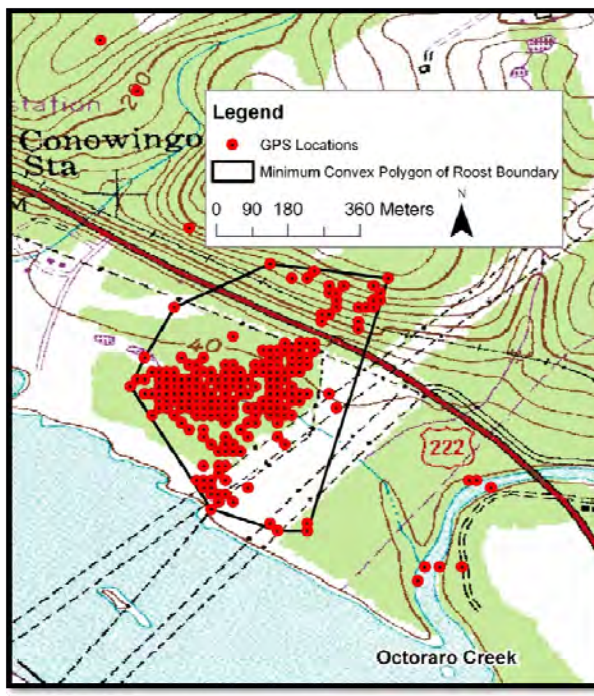


Figure 1. A Minimum Convex Polygon was drawn around roost locations recorded by GPS-transmitters. The polygon represents the boundary of the communal roost. The roost in the figure is Roost 1 located downstream of Conowingo Dam along Rt. 222.

We identified foraging areas using GPS telemetry data filtered to include only locations collected during daylight hours. The shoreline within the study area was delineated into 100m segments and all GPS locations within 200m of the shoreline were associated with the closest shoreline segment. Use per segment was classified in ArcGIS 10.0 using the Jenks method of classifying natural breaks in data values (Jenks 1967).

Monitoring

Roost Surveys: Communal roosts were identified from existing satellite data and a subset of 12 roosts was selected for surveying based on ground access and year-round use by eagles. Ten weekly surveys were completed during each of the sampling periods: July-October 2010 and January-March 2011. One observer counted and aged eagles as they entered the roost at dusk or exited at dawn (Figure 4). Dawn surveys began 45 minutes before civil twilight and ended 30 minutes after sunrise. Dusk surveys began 2 hours before civil twilight and ended when it became too dark to see (approximately civil twilight).

Ground observations of eagles using communal roosts were compared to existing satellite data to determine the relationship between the data for evaluating roost use by transmittered and non-transmittered eagles. The observation sampling period July-October 2010 was compared to GPS telemetry data from July-October 2008-2010. The observation sampling period January-March 2011 was compared to GPS telemetry data from January-March 2008-2011. The date range in the GPS telemetry data was expanded to include multiple years to increase the sample size for the analysis.

Shoreline Surveys: We planned to survey a subset of the shoreline each week to assess the overall eagle population using the Conowingo dam and reservoir system. Because of limited safe access to observation points, the data could not be collected in its entirety and is inadequate for comparison to GPS telemetry data.

Results

Nesting and Productivity Surveys

Twelve occupied breeding territories were documented in the study area during spring 2010 (Figure 2). Eleven nests were active and these produced 15 eagle nestlings (Table 1). Reproductive rates were 1.25 chicks/occupied territory and 1.36 chicks/active nest.

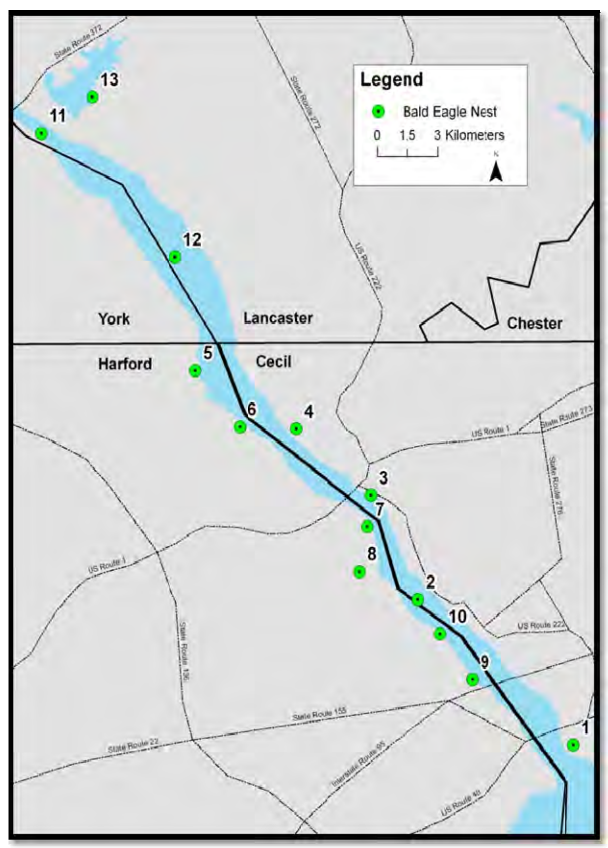


Figure 2. Bald Eagle nests located in 2010 along the Susquehanna River in Pennsylvania and Maryland.

Table 1. Eagle nests surveyed on the lower Susquehanna River in 2010. Coordinates for nests are listed in Appendix A.

Nest	Tree	Quad	Location	Occup.	Active	Prod.
1	Cell tower	Havre de Grace	Perryville Substation	Y	Y	2
2	Hardwood tree	Aberdeen	Robert Island	Y	N	0
3	Electrical tower	Conowingo Dam	Conowingo Dam	Y	Y	0
4	Oak tree	Conowingo Dam	Pilot Station	N	N	0
5	Oak tree	Conowingo Dam	N of Broad Creek	Y	Y	2
6	Beech tree	Conowingo Dam	Gazebo House	Y	Y	0
7	Oak tree	Conowingo Dam	S of Conowingo Dam	Y	Y	1
8	Hardwood tree	Conowingo Dam	Buck Branch	Y	Y	2
9	Poplar tree	Havre de Grace	Susquehanna SP	Y	Y	2
10	Sycamore tree	Aberdeen	Lapidum	Y	Y	2
11	Beech tree	Holtwood	Upper Bear Island	Y	Y	0
12	Electrical tower	Holtwood	Fulton Power Plant	Y	Y	1
13	Hardwood	Holtwood	Muddy Run	Y	Y	3[a]

[a] Productivity data for this nest provided by D. Gross, Pennsylvania Game Department.

Eagle Roost and Foraging Areas

Delineation

Nineteen communal roosts were identified in the study area (Figure 3). They ranged from high-use roosts near Conowingo Dam and Muddy Run Reservoir, to smaller low-use roosts scattered on the river shoreline. Foraging areas were delineated along shorelines of Muddy Run Reservoir, Conowingo Reservoir, and the lower Susquehanna River. Coordinates for roosts are listed in Appendix B.

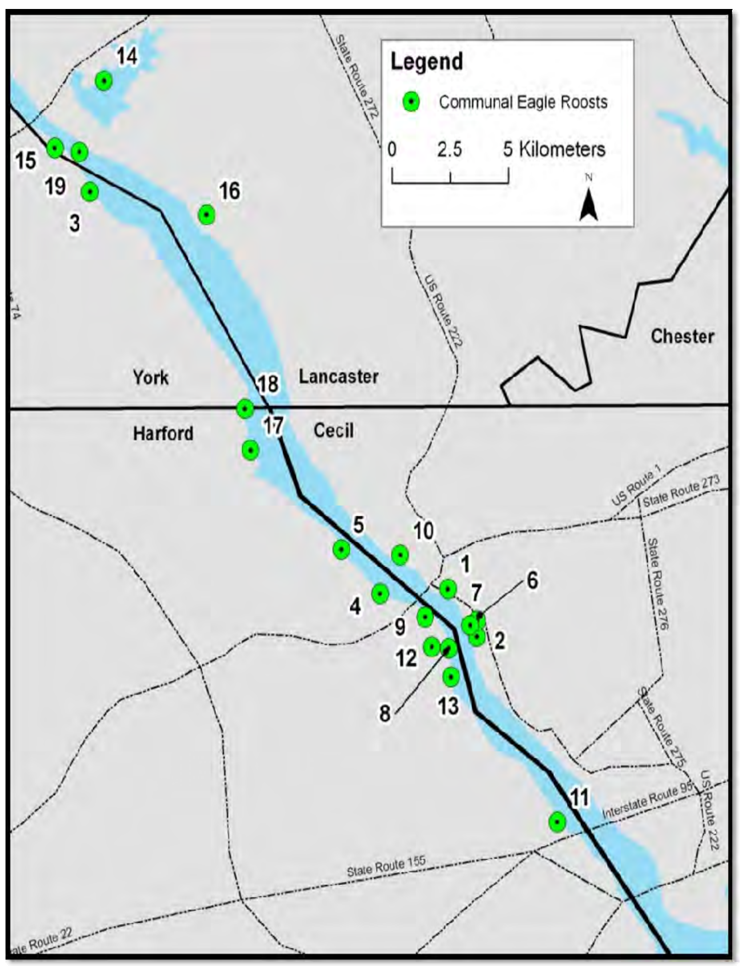
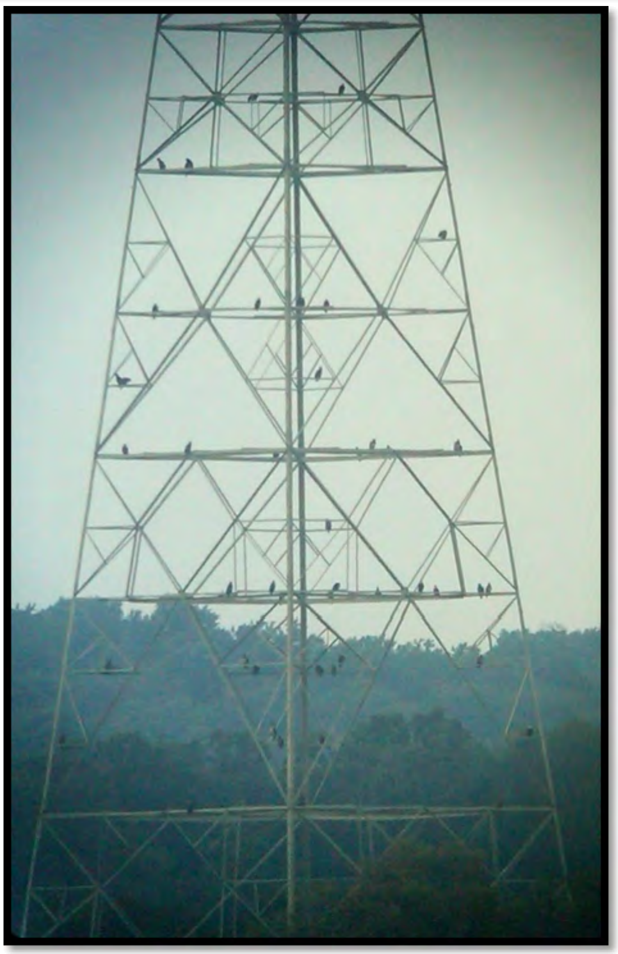


Figure 3. Bald Eagle communal roosts delineated on the lower Susquehanna River.

Figure 4. Left: Adult Bald Eagle fitted with transmitter in January 2008 in Harford Co, MD. Photographed at Conowingo Dam by Robert Lin in December 2008. Bottom left: Transmission tower adjacent to roost 14 on Muddy Run Reservoir with 47 roosting Bald Eagles. Bottom right: Surveyors Beth Dzula (top) at Susquehannock State Park and Libby Mojica (bottom) at Muddy Run Reservoir.



Monitoring

Roosts: Roost use varied between seasons with visitation during July-October greater than in January-March ($F_{(1,18)} = 45.3531$, $p < 0.0001$, $R^2_{Adj} = 0.70$). A total of 1,250 eagles were counted in communal roosts during the July-October 2010 sampling period (Table 2) and 294 eagles during the January-March 2011 period (Table 3).

Table 2. Number of individual eagles observed during July - October in each of the surveyed roosts.

Roost	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Total Observations
1	98	82	52	47	39	105	26	19	49	82	**599**
2&7[a]	4	6	8	3	2	3	6	6	7	7	**52**
3	8	0	6	1	0	0	2	4	0	0	**21**
4	5	1	2	3	3	0	8	---[b]	0	16	**38**
5	0	2	2	2	1	0	4	---[b]	6	3	**20**
9	2	4	2	5	0	1	3	7	0	7	**31**
10	3	1	1	1	2	3	2	---[b]	3	0	**16**
11	14	17	36	6	8	9	6	8	7	7	**118**
14	62	31	30	20	8	18	43	37	13	11	**273**
15	2	0	3	2	0	2	1	0	0	11	**21**
17	4	0	2	1	2	0	0	---[b]	1	0	**10**
19	13	2	12	0	4	4	6	7	3	0	**51**
Total	**215**	**146**	**156**	**91**	**69**	**145**	**107**	**88**	**89**	**144**	**1250**

[a] Roosts 2 and 7 were surveyed jointly because close proximity of the roosts made separation of observations between roosts difficult.

[b] Four roost surveys were cancelled during an extensive weather system in week 8.

Table 3. Number of individual eagles observed during January-March in each of the surveyed roosts.

Roost	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Total Observations
1	13	3	0	0	0	10	3	0	2	0	**31**
2&7[a]	0	3	4	0	7	6	4	3	9	5	**41**
3	1	4	3	1	2	1	2	3	6	3	**26**
4	4	3	1	3	3	0	0	0	0	1	**15**
5	0	4	0	5	1	1	0	0	2	1	**14**
9	18	4	3	6	2	4	4	0	1	0	**42**
10	5	1	5	6	2	6	0	7	5	6	**43**
11	3	1	0	4	0	0	3	2	2	2	**17**
14	3	5	3	4	2	1	5	4	0	4	**31**
15	1	2	0	0	0	3	5	2	0	2	**15**
17	0	4	0	---[b]	3	0	0	0	0	0	**7**
19	0	1	2	1	0	2	1	1	1	3	**12**
Total	**48**	**35**	**21**	**30**	**22**	**34**	**27**	**22**	**28**	**27**	**294**

[a] Roosts 2 and 7 were surveyed jointly because close proximity of the roosts made separation of observations between roosts difficult.

[b] One roost survey was cancelled during a snow storm in week 4.

Comparison of visual observations to the GPS telemetry data was different between sampling periods. For the July-October period, the number of GPS data points per month predicted the number of eagles in the roost per day ($F_{(1,10)} = 47.2079$, $p < 0.0001$, $R^2_{Adj} = 0.81$; Figure 5). Using the formula in Figure 5, future GPS telemetry data can be used to estimate the total number of eagles using a roost during the summer period. There was no relationship between observational and GPS telemetry data during the January through March period ($F_{(1,10)} = 0.0043$, $p = 0.9488$, $R^2_{Adj} = -0.09$).

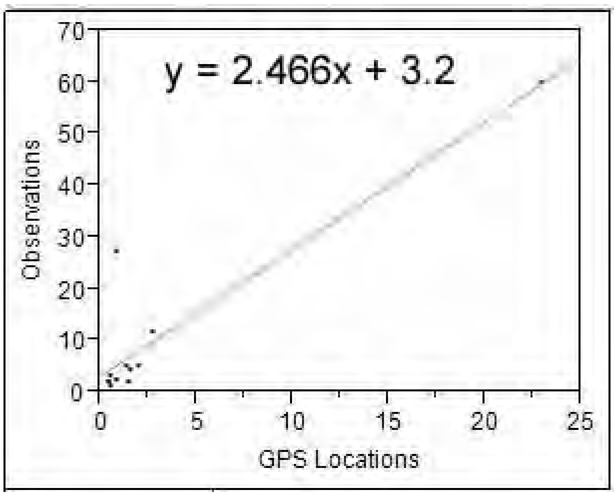


Figure 5. The number of observed eagles using a communal roost (y) can be estimated by multiplying the number of GPS data points per month (x) for a roost by 2.466 and adding 3.2.

Shoreline Use: Shoreline use varied between sampling periods in summer and winter (Figures 6-10). Shoreline use was high at communal roosts where eagles often loaf during the day. Summer shoreline usage was concentrated on the shoreline at Peters Creek, shoreline downstream of the Peach Bottom discharge, shoreline below Bald Friar on the north shore of Conowingo Reservoir, shoreline at roost 9 (Fisherman's Park), shoreline at roost 1 and the north side of the outfall of Conowingo Dam, shoreline at roost 7, shoreline on Sterret Island, shoreline at roost 11 near Lapidum boat ramp, and on Garrett Island. Winter shoreline usage concentrated around Roost 3 near the discharge of the Muddy Run powerhouse, Mount Johnson Island, shoreline downstream of the Peach Bottom's discharge, shoreline at roost 18, shoreline at roost 10, shoreline at roost 9 (Fisherman's Park), shoreline at roost 1 and the north side of the outfall of Conowingo Dam, and shoreline of roosts 2 and 7.

Figure 6. Use of shoreline by Bald Eagles in summer (a) and winter (b) from Rt 372 to Peach Bottom Nuclear Plant.

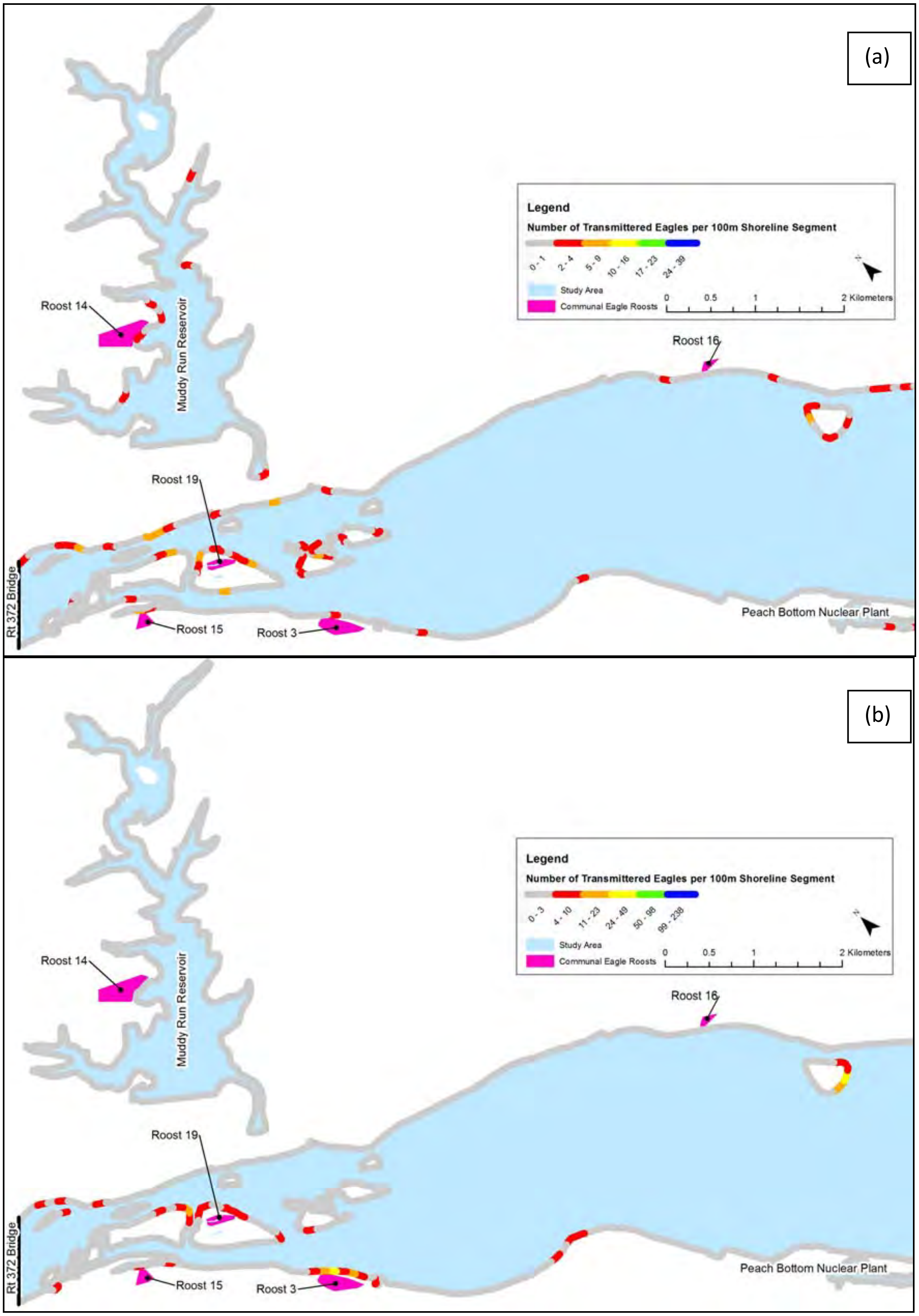


Figure 7. Use of shoreline by Bald Eagles in summer (a) and winter (b) from Peach Bottom Nuclear Plant to roost 5.

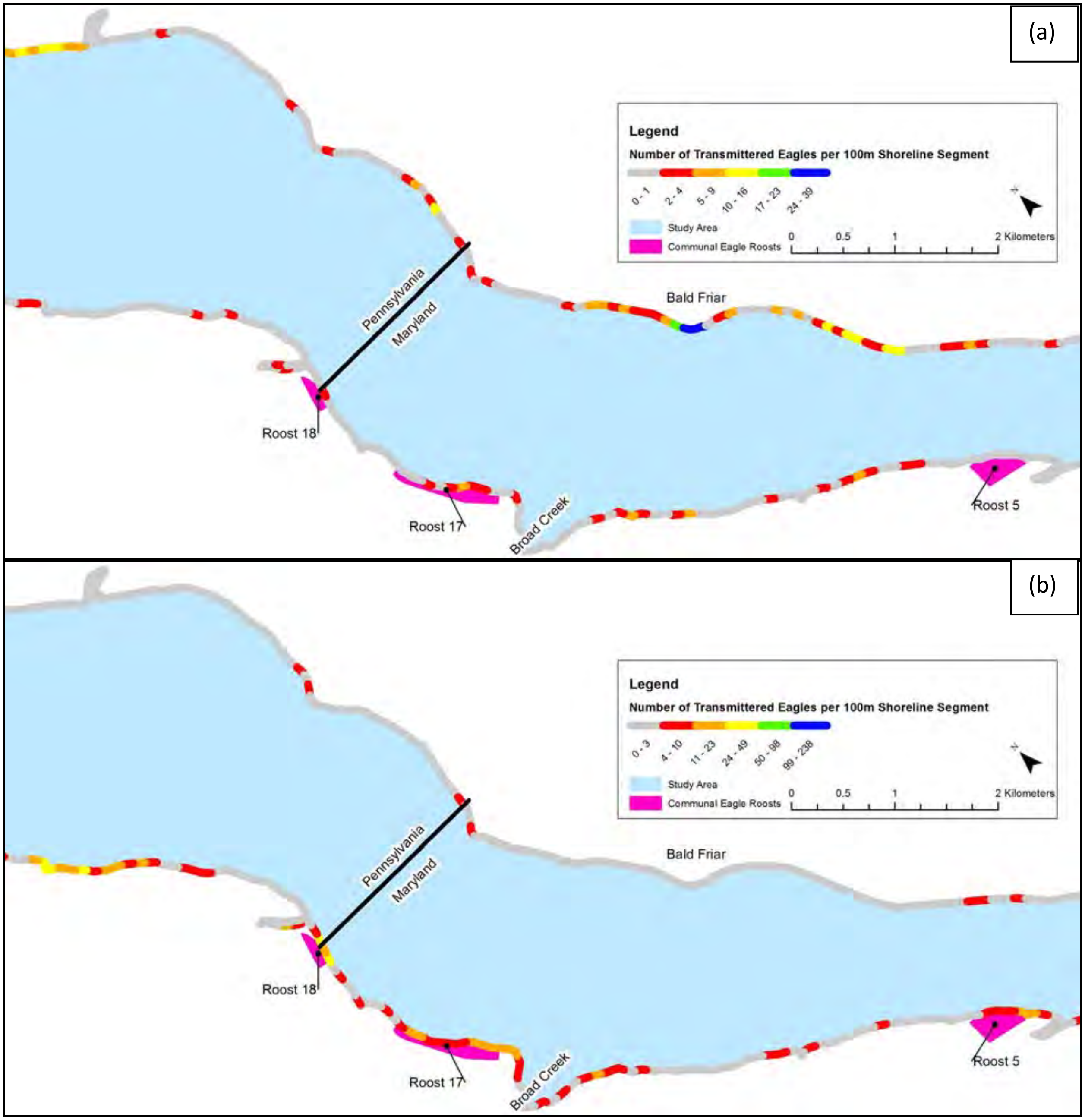


Figure 8. Use of shoreline by Bald Eagles in summer (a) and winter (b) from roost 5 to Susquehanna State Park.

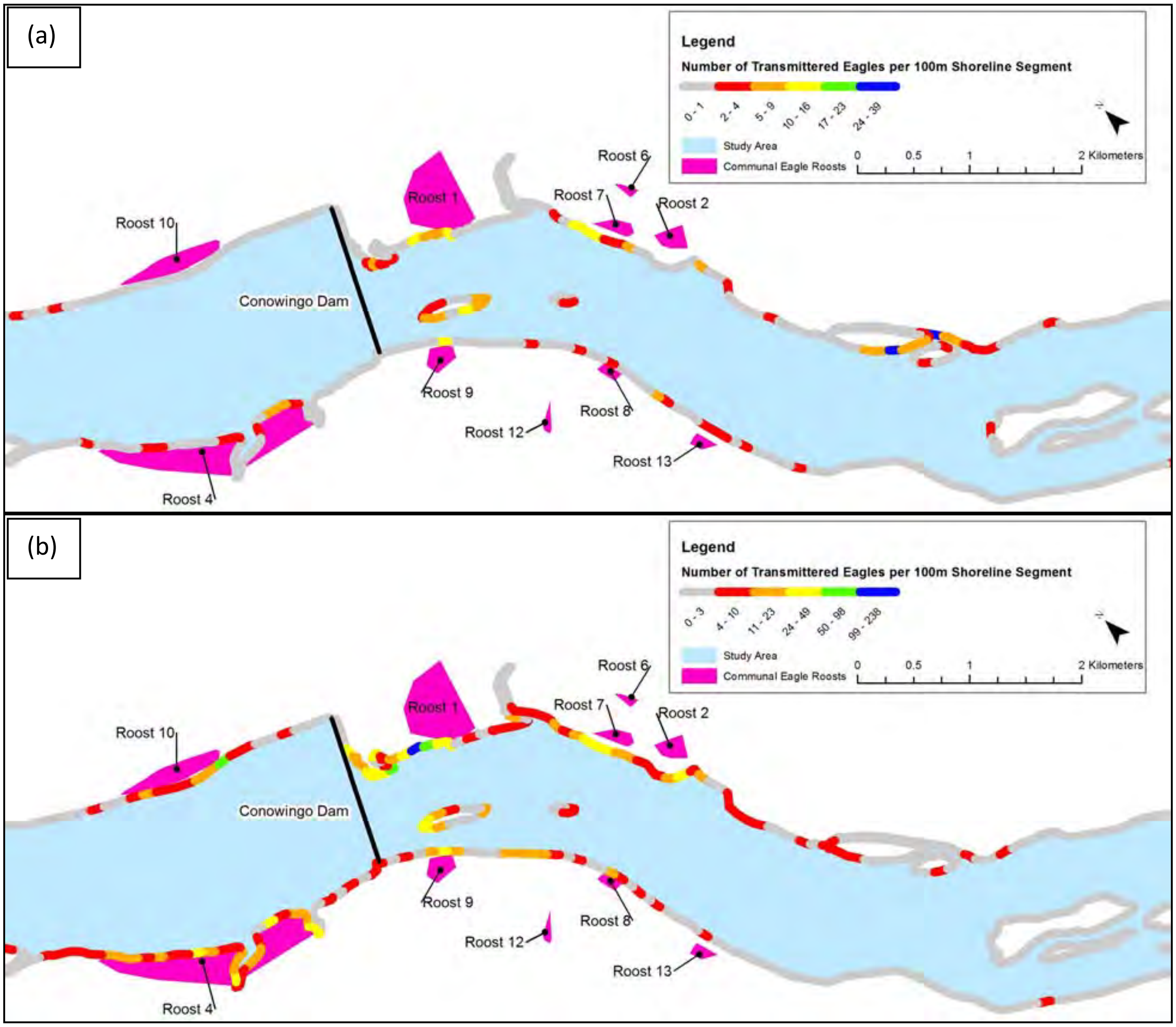
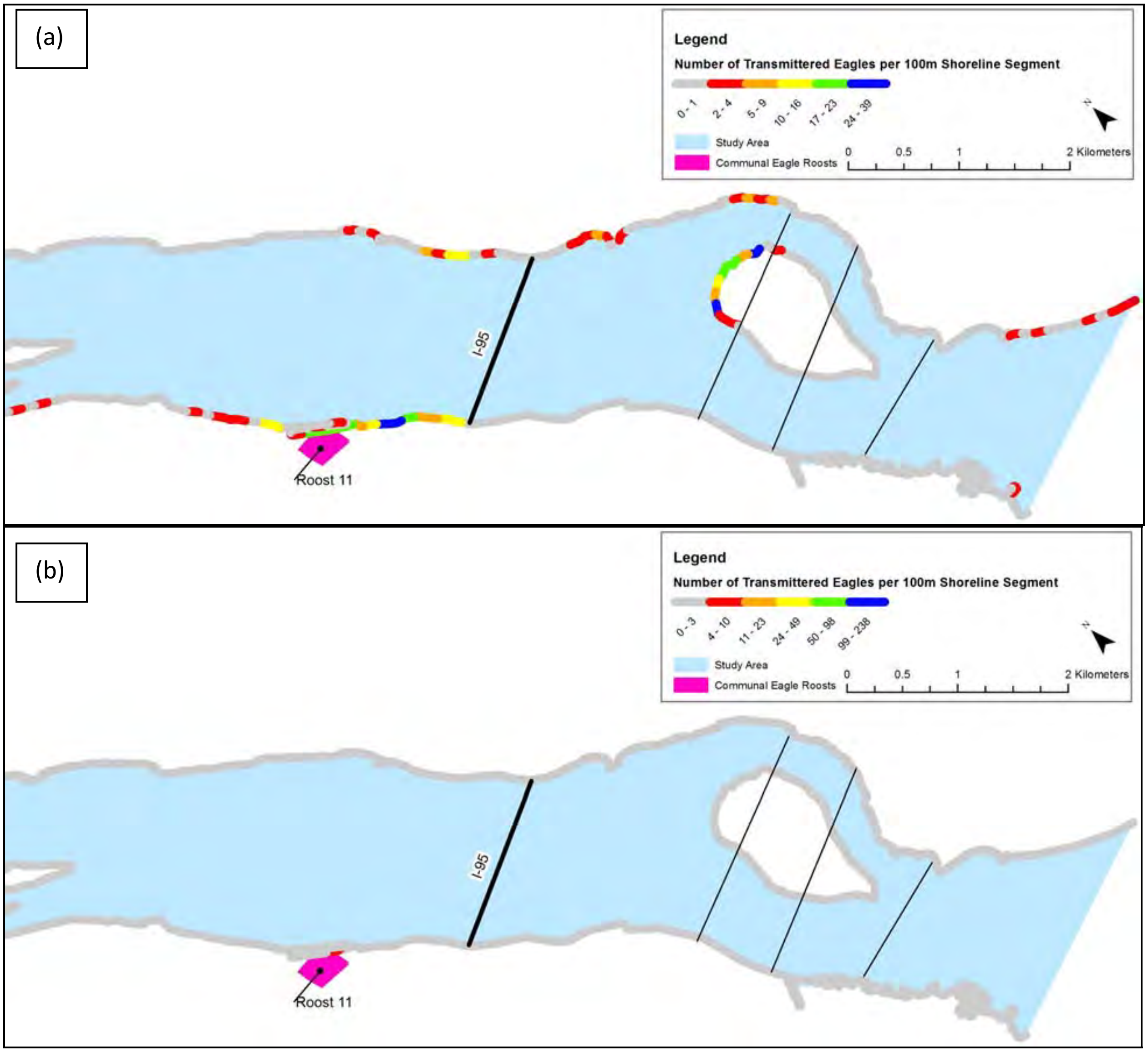


Figure 9. Use of shoreline by Bald Eagles in summer (a) and winter (b) from Susquehanna State Park to the mouth of the Susquehanna River.



Discussion

The lower Susquehanna River in the upper Chesapeake Bay is an important breeding, foraging, and roosting area for Bald Eagles. The forested shoreline along the Conowingo Reservoir, Muddy Run Reservoir, and the lower Susquehanna River provide habitat that supports 12 pairs of breeding Bald Eagles and thousands of non-breeding Bald Eagles each year from multiple populations along the Atlantic Coast. We found nest productivity was above population maintenance levels for the species and similar to recent reproductive rates for the Chesapeake Bay (Watts et al 2008).

Shoreline along the Muddy Run Reservoir, Conowingo Reservoir, and Susquehanna River were used with varying frequency for perching, roosting, and foraging. Nineteen communal roosts were found in the study area demonstrating the area's concentrated use by eagles. These roosts provide an important role for the species by facilitating social interaction between individuals and providing shelter in inclement weather (Watts and Mojica *in press*). Because Bald Eagles are opportunistic foragers, roost use in a given night or season can depend on the availability of nearby food resources. The variation in water levels (and resulting stunned fish) related to power generation at Holtwood Dam, Muddy Run Reservoir, and Conowingo Dam likely affected the frequency and geographic distribution of roost use in our study area. The forest in and around Roost 1 at the Conowingo Dam is the most important in the study area for foraging and roosting Bald Eagles. This area was consistent used by large numbers of eagles year-round.

Communal roosts and foraging areas are protected under the Bald and Golden Eagle Protection Act (Eagle Act) (16 U.S.C. 668-668d) under the working definition of the "disturb" clause. Alternatives should be sought for actions that may either alter the physical structure of roost and foraging sites or cause disturbances that impact the ability of individuals to use these areas. Introduction of new disturbances like boat ramps, aircraft corridors, and explosives should be avoided in consultation with the U.S. Fish and Wildlife Service and state wildlife agency (USFWS 2007).

Acknowledgements

Many individuals contributed to the success of this project. D. Poppel, K. Smith, and B. Simpson facilitated project coordination and safety. C. Koppie was an observer during the productivity flight and provided nest locations and insight on eagle behavior in the study area. Ground surveys were conducted by F. Smith, L. Smith, M. Odell, A. Odell, Z. Millen, B. Dzula, M. Wilson, J. Baylor, D. Cockerham, S. Underwood, and J. Pignatelli. Contracting and finances at William and Mary were handled by C. Corbett, E. Lawler, G. Sciole, K. Boothe, B. Willard, and M. Roberts. Housing during field work was provided by the Roberts family. J. Reed piloted the plane for the surveys. Nest coordinates were coordinated with D. Gross at the Pennsylvania Game Department and G. Therres at the Maryland Department of Natural Resources. This project was funded by the Exelon Corporation as part of the relicensing process through the Federal Energy Regulatory Commission.

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Appendix A. Bald Eagle nest coordinates in WGS 1984.

Nest	Tree	Quad	Location	Latitude	Longitude
1	Cell tower	Havre de Grace	Perryville Substation	39.55776	-76.07447
2	Hardwood tree	Aberdeen	Robert Island	39.61716	-76.14355
3	Electrical tower	Conowingo Dam	Conowingo Dam	39.65979	-76.16452
4	Oak tree	Conowingo Dam	Pilot Station	39.68692	-76.19777
5	Oak tree	Conowingo Dam	N of Broad Creek	39.71076	-76.24259
6	Beech tree	Conowingo Dam	Gazebo House	39.68768	-76.22283
7	Oak tree	Conowingo Dam	S of Conowingo Dam	39.64688	-76.16607
8	Hardwood tree	Conowingo Dam	Buck Branch	39.62858	-76.16959
9	Poplar tree	Havre de Grace	Susquehanna SP	39.58456	-76.11948
10	Sycamore tree	Aberdeen	Lapidum	39.60310	-76.13372
11	Beech tree	Holtwood	Upper Bear Island	39.80755	-76.31106
12	Electrical tower	Holtwood	Fulton Power Plant	39.75708	-76.25157
13	Hardwood tree	Holtwood	Muddy Run	39.82247	-76.28828[a]

[a]Coordinates for this nest provided by D. Gross, Pennsylvania Game Department.

Appendix B. Mid-point coordinates for Bald Eagle communal roosts. Coordinates are in WGS 1984.

Roost	Latitude	Longitude
1	39.66217	-76.16338
2	39.64643	-76.15228
3	39.79283	-76.30243
4	39.66064	-76.18978
5	39.67518	-76.20484
6	39.65178	-76.15210
7	39.65023	-76.15480
8	39.64256	-76.16318
9	39.65288	-76.17223
10	39.67328	-76.18185
11	39.58558	-76.12101
12	39.64316	-76.16975
13	39.63322	-76.16224
14	39.82925	-76.29698
15	39.80718	-76.31599
16	39.78512	-76.25716
17	39.70784	-76.24005
18	39.72146	-76.24227
19	39.80587	-76.30643

Appendix C. Weekly roost count data for individual eagle roosts monitored during July-October 2010. In week 8, an extensive weather system forced cancellation of surveys at 4 roosts.

Roost	Week	Date	Observation Period	Juvenile	Adult	Unknown Age	Total
1	1	7/28/2010	Morning	63	35	0	98
	2	8/4/2010	Evening	57	25	0	82
	3	8/12/2010	Morning	13	6	33	52
	4	8/19/2010	Evening	41	6	0	47
	5	8/26/2010	Morning	8	1	30	39
	6	9/2/2010	Evening	81	24	0	105
	7	9/9/2010	Evening	22	4	0	26
	8	9/16/2010	Morning	8	2	9	19
	9	9/22/2010	Evening	32	17	0	49
	10	10/7/2010	Evening	56	26	0	82
2&7	1	7/28/2010	Morning	1	1	2	4
	2	8/4/2010	Evening	4	2	0	6
	3	8/12/2010	Morning	4	3	1	8
	4	8/19/2010	Evening	2	1	0	3
	5	8/26/2010	Morning	2	0	0	2
	6	9/2/2010	Evening	0	3	0	3
	7	9/9/2010	Evening	5	1	0	6
	8	9/16/2010	Morning	6	0	0	6
	9	9/22/2010	Evening	3	4	0	7
	10	10/7/2010	Evening	2	5	0	7
3	1	7/27/2010	Evening	1	6	1	8
	2	8/3/2010	Morning	0	0	0	0
	3	8/13/2010	Evening	2	4	0	6
	4	8/19/2010	Morning	0	0	1	1
	5	8/25/2010	Evening	0	0	0	0
	6	9/2/2010	Morning	0	0	0	0
	7	9/8/2010	Morning	2	0	0	2
	8	9/15/2010	Evening	3	1	0	4
	9	9/23/2010	Morning	0	2	0	0
	10	10/6/2010	Evening	0	0	0	0
4	1	7/28/2010	Morning	1	4	0	5
	2	8/5/2010	Morning	0	0	1	1
	3	8/11/2010	Evening	0	2	0	2
	4	8/20/2010	Morning	1	2	0	3
	5	8/26/2010	Evening	3	0	0	3
	6	9/1/2010	Evening	0	0	0	0
	7	9/9/2010	Morning	2	6	0	8
	8	9/16/2010		---	---	---	---
	9	9/23/2010	Evening	0	0	0	0
	10	10/7/2010	Morning	2	12	2	16
5	1	7/28/2010	Morning	0	0	0	0
	2	8/5/2010	Morning	1	1	0	2
	3	8/12/2010	Morning	0	2	0	2

Roost	Week	Date	Observation Period	Juvenile	Adult	Unknown Age	Total
	4	8/20/2010	Morning	0	2	0	2
	5	8/26/2010	Evening	0	1	0	1
	6	9/1/2010	Evening	0	0	0	0
	7	9/9/2010	Morning	2	1	1	4
	8	9/16/2010		---	---	---	---
	9	9/23/2010	Evening	3	2	1	6
	10	10/7/2010	Morning	1	2	0	3
9	1	7/28/2010	Morning	0	2	0	2
	2	8/4/2010	Evening	1	3	0	4
	3	8/12/2010	Morning	0	2	0	2
	4	8/19/2010	Evening	4	1	0	5
	5	8/26/2010	Morning	0	0	0	0
	6	9/2/2010	Evening	1	0	0	1
	7	9/9/2010	Evening	0	3	0	3
	8	9/16/2010	Morning	6	0	1	7
	9	9/22/2010	Evening	0	0	0	0
	10	10/7/2010	Evening	2	5	0	7
10	1	7/28/2010	Morning	0	0	3	3
	2	8/5/2010	Morning	0	1	0	1
	3	8/12/2010	Morning	1	0	0	1
	4	8/20/2010	Morning	0	0	1	1
	5	8/26/2010	Evening	0	0	2	2
	6	9/1/2010	Evening	0	0	3	3
	7	9/9/2010	Morning	1	1	0	2
	8	9/16/2010		---	---	---	---
	9	9/23/2010	Evening	1	2	0	3
	10	10/7/2010	Morning	0	0	0	0
11	1	7/31/2010	Morning	6	6	2	14
	2	8/8/2010	Evening	5	11	1	17
	3	8/14/2010	Morning	16	15	5	36
	4	8/22/2010	Evening	2	4	0	6
	5	8/26/2010	Morning	4	4	0	8
	6	9/2/2010	Evening	5	4	0	9
	7	9/9/2010	Evening	3	3	0	6
	8	9/16/2010	Morning	2	2	4	8
	9	9/22/2010	Evening	4	2	1	7
	10	10/7/2010	Evening	2	5	0	7
14	1	7/27/2010	Evening	49	12	1	62
	2	8/5/2010	Morning	20	8	3	31
	3	8/11/2010	Evening	23	7	0	30
	4	8/20/2010	Morning	2	2	16	20
	5	8/25/2010	Evening	5	3	0	8
	6	9/2/2010	Morning	1	1	16	18
14	7	9/8/2010	Evening	37	6	0	43
	8	9/15/2010	Evening	35	2	0	37
	9	9/23/2010	Morning	9	4	0	13
	10	10/6/2010	Evening	8	3	0	11
15	1	7/27/2010	Evening	0	1	1	2

Roost	Week	Date	Observation Period	Juvenile	Adult	Unknown Age	Total
	2	8/3/2010	Morning	0	0	0	0
	3	8/13/2010	Evening	1	2	0	3
	4	8/19/2010	Morning	1	1	0	2
	5	8/25/2010	Evening	0	0	0	0
	6	9/2/2010	Morning	2	0	0	2
	7	9/8/2010	Evening	0	1	0	1
	8	9/15/2010	Evening	0	0	0	0
	9	9/23/2010	Morning	0	0	0	0
	10	10/6/2010	Evening	8	3	0	11
17	1	7/31/2010	Evening	1	3	0	4
	2	8/8/2010	Evening	0	0	0	0
	3	8/14/2010	Morning	1	1	0	2
	4	8/21/2010	Morning	0	1	0	1
	5	8/26/2010	Evening	1	1	0	2
	6	9/1/2010	Evening	0	0	0	0
	7	9/9/2010	Morning	0	0	0	0
	8	9/16/2010		---	---	---	---
	9	9/23/2010	Evening	1	0	0	1
	10	10/7/2010	Morning	0	0	0	0
19	1	7/27/2010	Evening	9	4	0	13
	2	8/3/2010	Morning	0	0	2	2
	3	8/13/2010	Evening	8	4	0	12
	4	8/19/2010	Morning	0	0	0	0
	5	8/25/2010	Evening	1	3	0	4
	6	9/2/2010	Morning	2	2	0	4
	7	9/8/2010	Evening	4	2	0	6
	8	9/15/2010	Evening	3	4	0	7
	9	9/23/2010	Morning	2	1	0	3
	10	10/6/2010	Evening	0	0	0	0

Appendix D. Weekly roost count data for individual eagle roosts monitored during January-March 2011. In week 4, a snow storm prevented completion of a survey at roost 17.

Roost	Week	DATE	Observation Period	Juvenile	Adult	Unknown Age	Total
1	1	1/8/2011	EVENING	5	8	0	13
	2	1/15/2011	MORNING	1	2	0	3
	3	1/22/2011	MORNING	0	0	0	0
	4	1/29/2011	MORNING	0	0	0	0
	5	2/4/2011	EVENING	0	0	0	0
	6	2/12/2011	MORNING	4	6	0	10
	7	2/20/2011	EVENING	2	1	0	3
	8	2/26/2011	MORNING	0	0	0	0
	9	3/5/2011	EVENING	2	0	0	2
	10	3/13/2011	MORNING	0	0	0	0
2&7	1	1/8/2011	EVENING	0	0	0	0
	2	1/15/2011	MORNING	1	2	0	3
	3	1/22/2011	MORNING	2	2	0	4
	4	1/29/2011	MORNING	0	0	0	0
	5	2/4/2011	EVENING	3	4	0	7
	6	2/11/2011	MORNING	2	4	0	6
	7	2/20/2011	EVENING	1	3	0	4
	8	2/26/2011	MORNING	1	2	0	3
	9	3/5/2011	EVENING	2	7	0	9
	10	3/13/2011	MORNING	1	4	0	5
3	1	1/11/2011	MORNING	0	1	0	1
	2	1/21/2011	EVENING	1	3	0	4
	3	1/28/2011	MORNING	0	2	1	3
	4	2/4/2011	EVENING	1	0	0	1
	5	2/9/2011	MORNING	1	1	0	2
	6	2/18/2011	EVENING	0	1	0	1
	7	2/26/2011	MORNING	1	0	1	2
	8	3/7/2011	EVENING	1	1	1	3
	9	3/13/2011	MORNING	2	2	2	6
	10	3/20/2011	EVENING	1	0	2	3
4	1	1/9/2011	MORNING	1	3	0	4
	2	1/15/2011	EVENING	0	3	0	3
	3	1/19/2011	EVENING	0	1	0	1
	4	1/29/2011	EVENING	1	2	0	3
	5	2/6/2011	MORNING	0	3	0	3

Roost	Week	DATE	Observation Period	Juvenile	Adult	Unknown Age	Total
	6	2/12/2011	EVENING	0	0	0	0
	7	2/20/2011	MORNING	0	0	0	0
	8	2/26/2011	EVENING	0	0	0	0
	9	3/5/2011	MORNING	0	0	0	0
	10	3/12/2011	EVENING	0	1	0	1
5	1	1/9/2011	MORNING	0	0	0	0
	2	1/15/2011	EVENING	2	2	0	4
	3	1/19/2011	EVENING	0	0	0	0
	4	1/29/2011	EVENING	2	3	0	5
	5	2/6/2011	MORNING	1	0	0	1
	6	2/12/2011	EVENING	1	0	0	1
	7	2/20/2011	MORNING	0	0	0	0
	8	2/26/2011	EVENING	0	0	0	0
	9	3/5/2011	MORNING	0	2	0	2
	10	3/12/2011	EVENING	0	1	0	1
9	1	1/8/2011	EVENING	6	12	0	18
	2	1/15/2011	MORNING	1	3	0	4
	3	1/22/2011	MORNING	0	3	0	3
	4	1/29/2011	MORNING	1	5	0	6
	5	2/4/2011	EVENING	0	2	0	2
	6	2/12/2011	MORNING	1	3	0	4
	7	2/20/2011	EVENING	2	2	0	4
	8	2/26/2011	MORNING	0	0	0	0
	9	3/5/2011	EVENING	0	1	0	1
	10	3/13/2011	MORNING	0	0	0	0
10	1	1/9/2011	MORNING	3	2	0	5
	2	1/15/2011	EVENING	1	0	0	1
	3	1/19/2011	EVENING	2	3	0	5
	4	1/29/2011	EVENING	2	4	0	6
	5	2/6/2011	MORNING	0	2	0	2
	6	2/13/2011	EVENING	2	4	0	6
	7	2/20/2011	MORNING	0	0	0	0
	8	2/26/2011	EVENING	3	4	0	7
	9	3/5/2011	MORNING	4	1	0	5
	10	3/12/2011	EVENING	4	2	0	6
11	1	1/9/2011	EVENING	3	0	0	3
	2	1/16/2011	MORNING	1	0	0	1
	3	1/20/2011	EVENING	0	0	0	0
	4	1/30/2011	MORNING	1	3	0	4
	5	2/7/2011	EVENING	0	0	0	0

Roost	Week	DATE	Observation Period	Juvenile	Adult	Unknown Age	Total
	6	2/13/2011	MORNING	0	0	0	0
	7	2/19/2011	EVENING	1	2	0	3
	8	2/27/2011	MORNING	0	2	0	2
	9	3/6/2011	EVENING	0	2	0	2
	10	3/12/2011	MORNING	1	1	0	2
14	1	1/14/2011	EVENING	0	3	0	3
	2	1/22/2011	MORNING	0	5	0	5
	3	1/30/2011	EVENING	1	2	0	3
	4	2/4/2011	MORNING	1	1	2	4
	5	2/10/2011	EVENING	0	2	0	2
	6	2/18/2011	MORNING	0	0	1	1
	7	2/26/2011	EVENING	2	3	0	5
	8	3/4/2011	MORNING	2	2	0	4
	9	3/11/2011	EVENING	0	0	0	0
	10	22-Mar	MORNING	2	1	1	4
15	1	1/10/2011	MORNING	0	1	0	1
	2	1/19/2011	EVENING	0	2	0	2
	3	1/29/2011	MORNING	0	0	0	0
	4	2/3/2011	EVENING	0	0	0	0
	5	2/11/2011	MORNING	0	0	0	0
	6	2/19/2011	EVENING	1	2	0	3
	7	2/27/2011	MORNING	1	2	2	5
	8	3/3/2011	EVENING	1	1	0	2
	9	3/10/2011	MORNING	0	0	0	0
	10	3/18/2011	EVENING	0	2	0	2
17	1	1/9/2011	EVENING	0	0	0	0
	2	1/16/2011	MORNING	1	3	0	4
	3	1/22/2011	EVENING	0	0	0	0
	4			---	---	---	---
	5	2/7/2011	EVENING	0	3	0	3
	6	2/12/2011	MORNING	0	0	0	0
	7	2/18/2011	EVENING	0	0	0	0
	8	2/27/2011	MORNING	0	0	0	0
	9	3/6/2011	EVENING	0	0	0	0
	10	3/11/2011	MORNING	0	0	0	0
19	1	1/10/2011	MORNING	0	0	0	0
	2	1/19/2011	EVENING	0	1	0	1
	3	1/29/2011	MORNING	0	2	0	2
	4	2/3/2011	EVENING	0	1	0	1
	5	2/11/2011	MORNING	0	0	0	0
	6	2/19/2011	EVENING	1	1	0	2

Roost	Week	DATE	Observation Period	Juvenile	Adult	Unknown Age	Total
	7	2/27/2011	MORNING	0	1	0	1
	8	3/3/2011	EVENING	0	1	0	1
	9	3/10/2011	MORNING	1	0	0	1
	10	3/19/2011	EVENING	2	1	0	3