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Recovery of Breeding Bald Eagles on Aberdeen Proving Ground

B. D. Watts
The Center for Conservation Biology, bdwatt@wm.edu

RECOVERY OF BREEDING BALD EAGLES ON ABERDEEN PROVING GROUND, MARYLAND

Bryan D. Watts[1,3]
Elizabeth K. Mojica[1]
John T. Paul[2]
James J. Pottie[2]

[1] Center for Conservation Biology, College of William and Mary, P.O. Box 8795, Williamsburg, Virginia 23187-8795

[2] Directorate of Safety, Health, and Environment, United States Army, Aberdeen Proving Ground, Maryland 21010

[3] Corresponding author: bdwatt@wm.edu

Abstract

We conducted annual aerial surveys (1991-2011) for breeding Bald Eagles (*Haliaeetus leucocephalus*) within Aberdeen Proving Ground (APG), a 350-km^2 military installation located along the northwestern shoreline of the upper Chesapeake Bay in Maryland. The population increased exponentially from 1 pair in 1977 to 58 pairs in 2011 with an average doubling time of 5.8 years. This rate was higher than that documented for the broader Chesapeake Bay and is comparable to the highest reported throughout the species range. Annual population increase was highly variable and exhibited no indication of any systematic decline. A total of 646 chicks were produced from 464 breeding attempts during this period. The population has exhibited tremendous forward momentum such that more than 50% of young produced over the 21-year period were produced in the last 6 years. Average success rate was high (79.8%) and reproductive rates exceeded conservation targets in nearly all years. Due to the expansion of urban development throughout the Chesapeake Bay watershed, APG plays an increasingly important role in the recovery and maintenance of the Chesapeake Bay Bald Eagle population.

Keywords: Bald Eagle, *Haliaeetus leucocephalus*, breeding, Aberdeen Proving Ground, recovery, Department of Defense

Bald Eagles (*Haliaeetus leucocephalus*) have likely bred on the land currently occupied by Aberdeen Proving Ground (APG) for thousands of years. However, no assessment of the population is available prior to the 1930s when the National Audubon Society commissioned a survey of a portion of the Chesapeake Bay that included APG (Tyrrell 1936). In 1936, Tyrrell documented nests on Eagle Point, Robbins Point, lower Little Romney Creek (north of Elm Tree Point), upper Little Romney Creek (near intersection with A-A5 road), and Bear Point. Stewart and Robbins (1958) documented nests on APG in the 1950s. Abbott (unpublished field notes) coordinated Bald Eagle nest surveys from the late 1950s through the mid-1970s and documented additional nests at the mouth of Canal Creek, Reardon Inlet (near Westwood Range), Maxwell Point, Swaderick Creek, Leges Point (near Days Point), north

of Ricketts Point, Gum Point, Skippers Point (on Lauderick Creek), Coopers Creek, Back Creek (near AA-5 road), and three on Spesutie Island (near Locust Point; near Morgan Road; near Sandy Point). Only four of these historic breeding sites had evidence of Bald Eagle use when investigated during the early 1960s (Abbott, unpublished data). By the late 1960s, no occupied Bald Eagle territories were identified for APG.

Following the first rediscovered breeding of Bald Eagles on APG in 1977, the Directorate of Safety, Health and Environment contacted the United States Fish and Wildlife Service to initiate consultation under the Endangered Species Act, Section 7(c)(1). This consultation resulted in studies that lead to the first Bald Eagle management plan in 1986 and subsequent revisions in 1995 and 2009 (Paul 2009). These plans established the need and framework for annual monitoring of the breeding population. Here we provide the results of survey efforts (1991-2011) and discuss changes in the population relative to the breeding population within the tidal reach of the Chesapeake Bay.

Study Area

APG is a 350-km^2 United States Department of Defense military installation located along the northwestern shore of the upper Chesapeake Bay, in southern Harford and eastern Baltimore Counties, Maryland (Figure 1). Since APG's establishment in 1917, the Aberdeen Area has been the site of intensive research and development; large-scale testing of munitions, weapons, and materiel; and a training school for ordnance officers and enlisted specialists. Due to the nature of its mission, APG is primarily forested and has extensive undeveloped shorelines. The property is embedded within the Upper Chesapeake Bay Bald Eagle Concentration Area, one of several areas within the Chesapeake Bay where Bald Eagles from along the Atlantic Coast converge (Watts et al. 2007). Throughout the Bay such concentration areas have formed within low salinity, tidal-fresh waters where prey availability is high (Watts et al. 2006). For the resident breeding population, brood provisioning and chick growth tend to be high in these areas (Markham and Watts 2008) leading to high breeding densities, high breeding success, and high productivity (Watts et al. 2006).

Methods

Aerial helicopter surveys have been used to survey the entire study area for breeding eagles (1991-2011). Typically four to six surveys have been conducted between mid-January and late May to document nests, breeding activity, and productivity. Detected nests were plotted on topographic maps and given unique codes as names. Each nest was examined to determine its condition and status. Notes from field observations were interpreted by the authors to determine activity status according to national standards. We considered a breeding territory to be occupied if a pair of birds were observed in association with the nest and there was evidence of recent nest maintenance (e.g., well-formed cup, fresh lining, structural maintenance). We considered nests to be active if we observed a bird in an incubating posture or if we detected eggs or young in the nest (Postupalsky 1974). The number of eaglets was recorded for each nest. Due to the number of flights, we have confidence that nesting activity was well documented.

We defined breeding success as the percentage of occupied nests that contained ≥1 young, reproductive rate as the number of young per occupied nest, and average brood size as the number of young per successful nest. We expressed population growth rate using the

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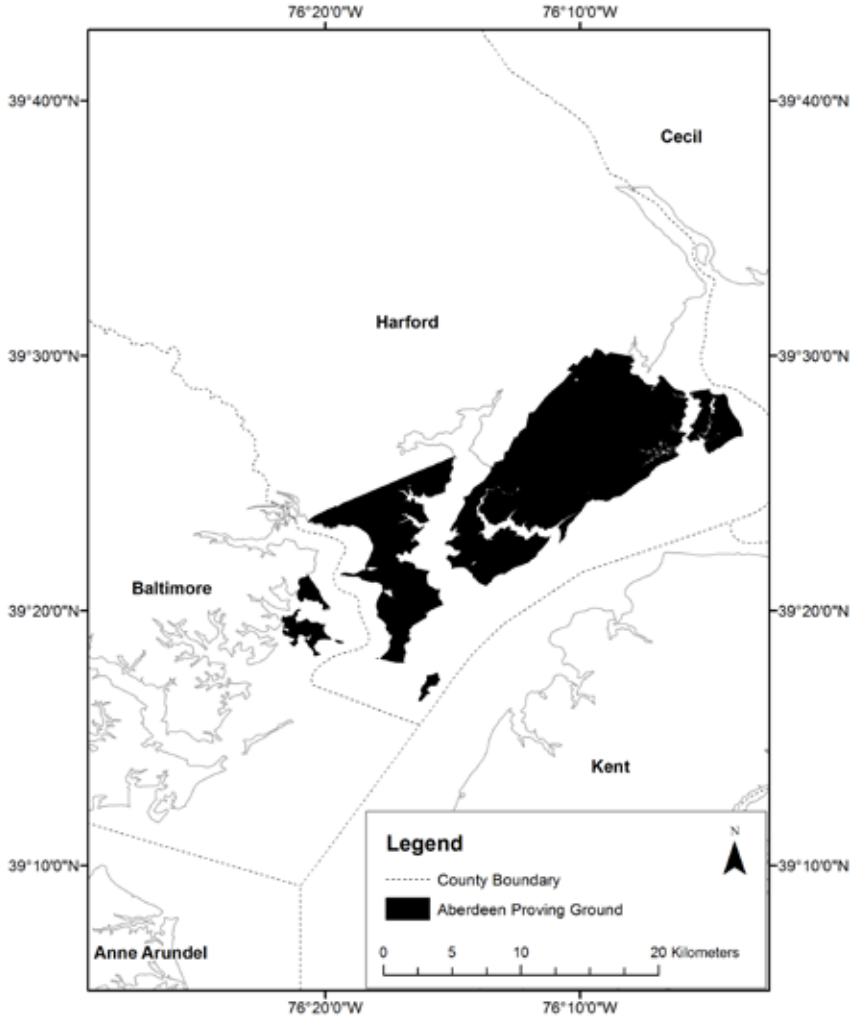

Figure 1. Aberdeen Proving Ground, Baltimore and Harford Counties, Maryland.

average time (in years) required for the population to double in size (t_{double}), the intrinsic rate of increase (r), and the average annual percent increase over the study period. We calculated average doubling time using the growth equation $N_t = N_0 e^{rt}$, where N_t is the population size in 2011, N_0 is the population size in 1977, e is the base of the natural logarithm, ^{r} is the intrinsic rate of increase, and ^{t} is the time interval between population estimates. With this configuration, $t_{double} = \ln(2)/r$. We calculated average annual percent increase as $(N_{t+1}-N_t)/N_t \times 100$.

Results

Between 1977 and 2011, the Bald Eagle breeding population on APG increased from 1 pair to 58 pairs. During this period, the population grew exponentially with an average doubling time of 5.8 years. Intrinsic rate of increase (r) was 0.119. Average annual increase was 13.1$\pm$ 4.23% (mean $\pm$ S.E.). The annual population increase, as expressed by a percentage, was highly variable over the study period and ranged from a low of -20.6% (2005-2006) to a high of 57.9% (1998-1999). There is no indication over the survey period that this rate has shown any directional change ($R^2 = 0.042$, $F[1,17] = 0.75$, $p = 0.395$).

During the study period, we documented 464 breeding attempts (i.e., active nests) that produced 646 young (Table 1). Average annualized rates were 79.8 $\pm$ 3.48%, 1.39 $\pm$ 0.06%, and 1.6 $\pm$ 0.05% for breeding success, reproductive rate, and brood size, respectively. The population has exhibited tremendous forward momentum such that more than 50% of young produced over the 21-year period have been produced in the 6 years since 2005.

Survey information between 1991 and 2011 indicates that the breeding population on APG has exceeded the goal of 1.1 chicks/breeding attempt set by the Chesapeake Bay Bald Eagle Recovery Plan (Byrd et al. 1990) every year except 1997 and 1998 (Table 1). During 1997 and 1998, recorded reproductive rate was higher than that suggested for maintenance but lower than the recovery goal. For the 11-year period 1991-2001, reproductive rates for APG were virtually identical to those recorded for the broader Chesapeake Bay. The average number of chicks per active nest was 1.4 $\pm$ 0.05 (mean $\pm$ S.E.) and 1.4 $\pm$ 0.09 for the Chesapeake Bay and APG respectively. The average number of chicks per successful nest (average brood size) was 1.8 $\pm$ 0.03 and 1.6 $\pm$ 0.05 for the Chesapeake Bay and APG respectively. These rates are not statistically distinguishable (for both comparisons, df = 19, F-statistic < 3.2, $P > 0.05$).

Discussion

The recovery of the Bald Eagle breeding population on APG has been dramatic. Population growth rate has been faster (doubling time of 5.8 vs 8.2 years) than that documented for the tidal reach of the larger Chesapeake Bay (Watts et al. 2008). The rate is comparable to other low-salinity reaches of the Bay that represent some of the fastest growing regions throughout the species range (Watts et al. 2006). With the exception of locations that have been developed, virtually all of the breeding territories documented during the 1930s, 1940s and 1950s have now been re-occupied. No specific estimates of the APG Bald Eagle population are available prior to the onset of the DDT era. However, given the tremendous forward momentum currently exhibited by the breeding population, it seems likely that Bald Eagles will reach nesting carrying capacity within the installation in a relatively short period of time.

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Table 1. Bald Eagle population size and productivity within Aberdeen Proving Ground, Maryland (1991-2011).

(Note: The 1998 survey was incomplete. Occupied Nest = pair of birds and evidence of recent nest maintenance; Active Nest = eggs or young in the nest; Successful Nest = number of nests that produced at least one young; Successful Nest/Occupied Nest = breeding success; Young/Occupied Nest = reproductive rate; Young/Successful Nest = average brood size.)

Year	Occupied Nests	Active Nests	Successful Nests	Young	Successful /Occupied[a]	Successful /Active[a]	Young /Occupied[a]	Young /Active[a]	Young /Successful[a]
1991	5	5	4[b]	5	100	100	1.25	1.25	1.25
1992	5	5	4	8	80	80	1.6	1.6	2
1993	9	8	7	11	77.8	87.5	1.22	1.38	1.57
1994	10	9	7	10	70	77.8	1	1.11	1.43
1995	13	13	10[d]	18	100	100	1.8	1.8	1.8
1996	16	16	14[b]	23	93.3	93.3	1.53	1.53	1.64
1997	16	13	5[c]	9	35.7	45.5	0.64	0.82	1.8
1998	8	8	5	6	71.4	71.4	0.86	0.86	1.2
1999	19	19	11[c]	20	64.7	64.7	1.18	1.18	1.82
2000	19	13	10	18	52.6	76.9	0.95	1.38	1.8
2001	20	20	19	32	95	95	1.6	1.6	1.68
2002	19	18	12[d]	20	80	85.7	1.33	1.43	1.67
2003	24	23	23	35	95.8	100	1.46	1.52	1.52
2004	29	27	22	32	75.9	81.5	1.1	1.19	1.45
2005	35	35	29	41	82.9	82.9	1.17	1.17	1.41
2006	29	29	28[b]	41	100	100	1.46	1.46	1.46
2007	31	31	27	42	87.1	87.1	1.35	1.35	1.56
2008	44	37	33	61	75	89.2	1.39	1.65	1.85
2009	46	37	35	69	76.1	94.6	1.5	1.86	1.97
2010	44	41	36	60	81.8	87.8	1.36	1.46	1.67
2011	58	57	45[c]	85	80.4	81.8	1.52	1.55	1.98
TOTAL	499	464	386	646	–	–	–	–	–
AVERAGE	–	–	–	–	79.8 ± 3.48	84.7 ± 13.4	1.39 ± 0.06	1.38 ± 0.27	1.60 ± 0.05

[a] Based on nests with known outcome
[b] Final outcome of 1 nest not determined and not included in totals
[c] Final outcome of 2 nests not determined and not included in totals
[d] Final outcome of <5 nests not determined and not included in totals

A reproductive rate of 0.7 chicks/breeding attempt has been suggested to represent the threshold for population maintenance for Bald Eagles (Sprunt et al. 1973). Buehler et al. (1991a) estimated that 1.0 chicks/successful nest (equivalent to brood size) was required for sustaining breeding populations in the Bay. A reproductive rate of 1.1 chicks/breeding attempt was set as the recovery goal for the Chesapeake Bay population (Byrd et al. 1990). With the exception of 1997 and 1998, the APG population has met or exceeded the productivity target outlined in the recovery plan in every year that a survey has been conducted. The broader Chesapeake Bay reached this threshold in 1985 and has exceeded the target in all subsequent years (Watts et al. 2008). The reproductive rate documented by Tyrrell in 1936 was nearly 1.5 chicks/breeding attempt. The APG population has approached or achieved this rate in the years after 2005.

APG plays an increasingly important role in the recovery and maintenance of the Chesapeake Bay Bald Eagle population. The availability of mature trees suitable for nesting within 1 km of water has become the dominant limiting factor for Bald Eagles in the region. Human activity is the best predictor of eagle distribution within the tidal portion of the Bay. Indicators of human activity such as housing and road density, shoreline use, and boating activity have been related to nest distribution (Watts et al. 1994), shoreline use (Buehler et al. 1991b, Watts and Whalen 1997), and the likelihood of nest abandonment (Therres et al. 1993) or recolonization (B. D. Watts, Center for Conservation Biology, unpublished data). Since Bald Eagles began their most dramatic decline in the 1950s, the human population within the tidal reach of the Bay has increased by more than 50% (United States Department of Commerce 2010). A preliminary review of development occurring around eagle nests in the lower Chesapeake Bay shows that development had occurred in 55% of shoreline areas by the late 1980s (Byrd et al. 1990). Extensive undeveloped shorelines and associated uplands on APG have allowed the property to become a significant stronghold for the breeding population.

APG will continue to serve as an important Bald Eagle breeding location for the foreseeable future. APG has been actively working to restore the Bald Eagle population within the installation since the early 1980s. The Army has adopted environmental stewardship as one of its missions and it is clear that without federal ownership of this land and the demand for the ongoing mission, the upper Bay would support considerably less habitat for breeding eagles. The current Bald Eagle management plan (Paul 2009) provides broad directives to protect significant eagle habitat and outlines specific measures to reduce disturbance within known nesting, foraging, and roosting sites. Management efforts continue that are designed to mesh the needs of eagles with other military missions.

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