



Breeding Bird Monitoring

Mid-Atlantic Network 2013 Summary Report

Natural Resource Data Series NPS/MIDN/NRDS—2014/736



ON THE COVER

Pileated Woodpecker (*Dryocopus pileatus*)

Photograph by: Bill Tucker

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List of Acronyms

APCO: Appomattox Court House National Historical Park
BCI: Bird Community Index
BCR: Bird Conservation Region
BOWA: Booker T. Washington National Monument
FRSP: Fredericksburg and Spotsylvania National Military Park
GRTS: Generalized Random Tessellation Stratified Design
I&M: Inventory and Monitoring
MIDN: Mid-Atlantic Network
NABCI: North American Bird Conservation Initiative
NB: National Battlefield
NBP: National Battlefield Park
NER: NPS Northeast Region
NHP: National Historical Park
NM: National Monument
NMP: National Military Park
NP: National Park
NPS: National Park Service
PETE: Petersburg National Battlefield
PIF: Partners in Flight
RICH: Richmond National Battlefield Park
SE: Standard Error
USGS: U.S. Geological Survey
VAFO: Valley Forge National Historical Park

Introduction

As part of the Natural Resource Challenge (NPS 1999), the Mid-Atlantic Network (MIDN) has been tasked with monitoring “vital signs,” a suite of physical, chemical, or biological elements or processes that represent the overall health or condition of the network parks’ natural resources. Breeding birds have been selected as one of the Mid-Atlantic Network’s vital signs because they are highly visible, are a reliable indicator of ecological integrity, and face numerous population threats in the region (Comiskey and Callahan 2008).

The Mid-Atlantic Network began pilot testing a volunteer breeding bird monitoring program in 2009 at three network parks and later expanded to include six network parks (Figure 1). Four parks fall in the Piedmont Bird Conservation Region (BCR) and two fall just adjacent to the Piedmont BCR in the Southeastern Coastal Plain BCR. Developed by the North American Bird Conservation Initiative (NABCI), BCRs are ecologically distinct units designed to help focus conservation efforts for specific bird communities. The Mid-Atlantic Network consists of 10 park units across Pennsylvania and Virginia. In the future, the network hopes to expand monitoring efforts to the remaining parks within the network.

The two primary objectives for the monitoring protocol are to:

1. Determine annual changes and long-term trends in species composition and relative abundance.
2. Improve our understanding of the relationship between breeding birds, habitats, and park management.

This report summarizes monitoring data collected in 2009-2013. We provide park and region-wide abundance metrics for all species, and take note of the spatial distribution of species of conservation concern identified on a continental and regional scale (for the Piedmont/Southeastern Coastal Plain region). We also provide a community-wide assessment of species composition (a “Bird Community Index” or BCI) that informs on ecosystem integrity by evaluating the relative composition of different guilds in the overall bird community.

Park-specific resource briefs, which may be used as outreach material, can be downloaded from the Mid-Atlantic Network’s bird protocol website:

<http://science.nature.nps.gov/im/units/midn/monitor/birds.cfm>

Readers should treat results as provisional, as metrics may be confounded by variability in detection probability. A more comprehensive analysis that accounts for such variability will be included as we acquire more data.

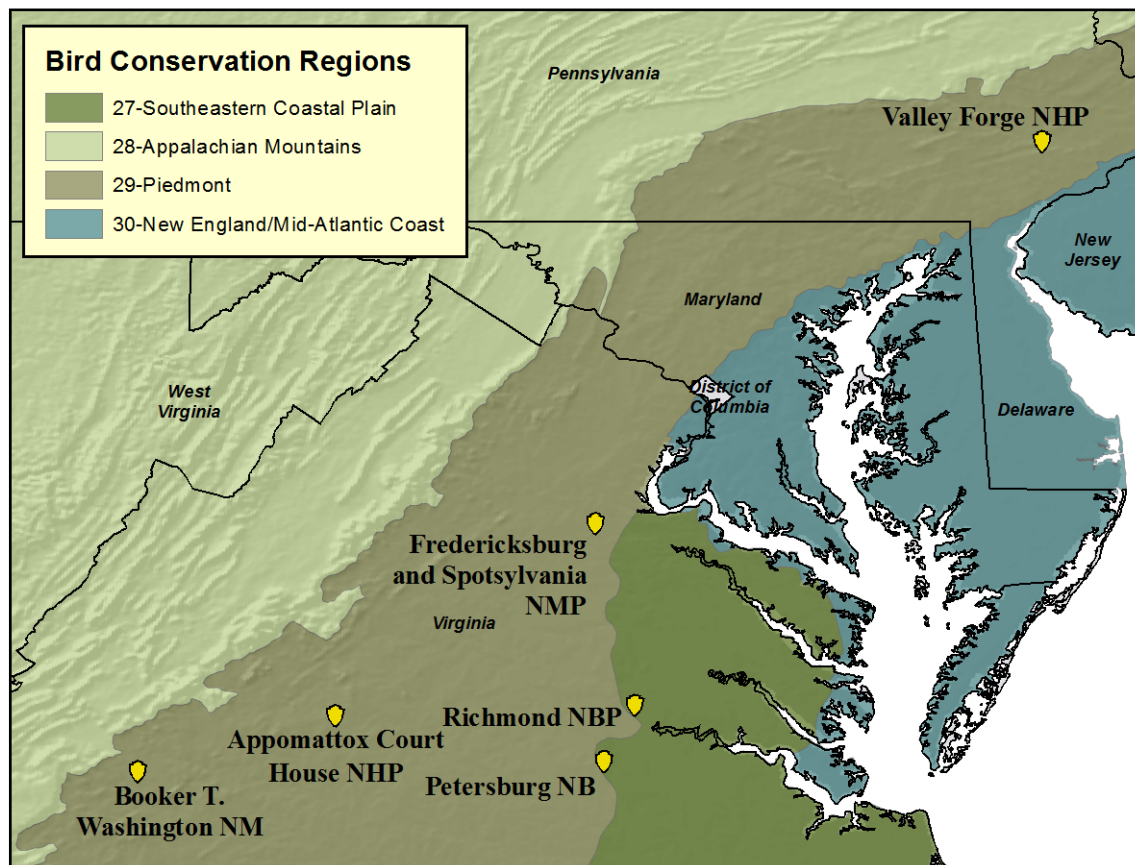


Figure 1. Mid-Atlantic Network parks implementing bird monitoring in 2009-2013 and their associated Bird Conservation Region (BCR). Appomattox Court House NHP and Petersburg NB did not participate in 2013.

Methods

Study Area

Pilot testing for the bird monitoring program began in 2009 at Booker T. Washington National Monument (BOWA), Fredericksburg and Spotsylvania National Military Park (FRSP), and Valley Forge National Historical Park (VAFO). Since then, monitoring efforts have expanded to Appomattox Court House National Historical Park (APCO), Petersburg National Battlefield (PETE), and Richmond National Battlefield Park (RICH). Appomattox Court House NHP and Petersburg NB did not participate in 2013.

Sample Design

Monitoring stations were selected by overlaying a 250 m grid on park maps. The grid is the same used for selecting vegetation monitoring plots (Comiskey et al. 2009), but offset by 125 m. This allows for point count stations to be co-located with vegetation monitoring plots, but avoids trampling vegetation monitoring plots. Stations that were selected were within forest and grassland habitat types and were at least 15 m from hiking trails and secondary and tertiary roads (park roads), and 50 m from primary roads, park boundaries, and buildings which are frequented by visitors and may influence bird behavior.

BOWA is the smallest park in the network and has a good volunteer base, so all potential stations could be sampled. VAFO is a large contiguous park with more possible sampling locations than available volunteers. Therefore, stations at this park were randomly selected using the Generalized Random Tesselation Stratified (GRTS) algorithm (Stevens and Olsen 2004). APCO, like VAFO, is a large contiguous park, but due to severe limitations in available volunteers and the difficulty of accessing points in dense thickets, a GRTS sample was not possible. Therefore, only stations that were easily accessible were sampled at this park. FRSP, PETE, and RICH contain several discrete units separated over large areas. To maximize volunteer time, resource managers at those parks selected a unit of management concern for monitoring (Table 2).

While the parks within the network are primarily forested, many also contain large areas managed as grasslands. Resource managers were interested in long-term trends for both of these habitat types. Therefore, each point count station was categorized as either grassland or forest based on vegetation maps available for each park (Patterson 2008, Taverna and Patterson 2008, and Podniesinski et al. 2005). Edge buffers between habitat types were not applied because analysis is on the overall characterization of each habitat type rather than a comparison between types (Ralph et al. 1995).

Surveys

Skilled volunteers with approximately 3-5 years of birding experience in the region were recruited by the parks. All volunteers attended a training session lead by the project lead prior to the field season. Point counts were conducted at stations between May 25 and July 15, 2013. Volunteers visited each station at least once during the season. During each station survey, volunteers recorded all birds detected, including flyovers, in a ten-minute interval along with the minute the bird was first detected, whether the bird was within or beyond 50 m, the type of detection (visual, auditory, both), and the location of the detection. New species detected outside

the formal count (i.e. walking between stations or detected right after count ended) were recorded as incidentals.

Data were transcribed to paper datasheets, entered into the U.S. Geological Survey (USGS) point-count database (<http://www.pwrc.usgs.gov/point/>), and later verified by the project lead.

Metrics

We present total number of species, total detections, relative abundance, and percent occurrence summaries for the region and each park. In the past, we provided density estimates which incorporated variation in detectability relative to distance. These density estimates are not being presented in this report because we believe they will be more accurate and meaningful after additional data have been collected and a thorough analysis of factors affecting detectability can be conducted. Because 75-100 detections per species are typically required for such analysis (Buckland et al. 2001), data will be fully analyzed and presented every 5-10 years. Hence, until such analyses are completed, results should be treated as preliminary since variation in detectability is not accounted for in the current data summaries.

Number of Species

All detections, including flyovers and incidentals, were included in species counts. Here, the goal is to document the total diversity of species across all parks, so including incidental encounters is not problematic.

Species of conservation concern were also noted. Partners in Flight (PIF), a cooperative effort to address the conservation of birds, produced a list of species of conservation concern in their North American Landbird Conservation Plan (Rich et al. 2004). They define two sets of species of concern, “Watchlist” species that face immediate threats due to habitat alteration, declining populations, small population size, and limited distributions, and “Stewardship” species that are representative species of avifaunal biomes that may or may not be in immediate danger. These lists have been developed at the continental and regional scale. We identified both continental and regional (e.g. Piedmont and Southeastern Coastal Plain BCRs) Watchlist and Stewardship species detected across the parks.

Detections

Total raw detection counts included unknowns, flyovers and incidentals. Additionally, we summed detections across visits when presenting total raw detection counts, which may result in double-counted individuals. Total detection counts for individual species, however, did not include flyovers or incidentals and used maximum detection counts per species for each station if multiple visits were made.

Relative Abundance

Relative abundance was calculated by dividing the total detections by the number of monitoring stations surveyed. Because flyovers and incidentals are not strictly indicative of individuals using the survey area, they were removed from calculations of relative abundance. Additionally, in assessing the relative abundance of a particular species, using the sum of individuals across repeat visits may lead to upward-biased results (e.g. inflating abundance estimates by double-counting the same individual bird across multiple visits). To avoid this potential bias, we calculated relative abundance using the maximum count of detections per species across repeat visits (if applicable).

Percent Occurrence

Percent occurrence was calculated by dividing the total number of stations a species was detected in by the total number of stations surveyed. As with relative abundance, flyovers and incidentals were removed in calculations of percent occurrence, however, multiple visits to a site were not problematic as they provide a more complete picture of the bird community at the station location. Hence all visits were used to calculate percent occurrence.

Avian Integrity Scorecards

Avian guilds, or groups of species occupying similar ecological niches, are diverse and can be utilized for assessing response to environmental changes and ecosystem stressors. These guilds can be defined based on foraging behavior and substrate, nesting substrate, migratory distance, and various other life history traits. Changes in ecological condition can variably impact avian guilds, resulting in alterations to the bird community as a whole (Severinghaus 1981, Verner 1984). Bird community assessments, or “indices” (BCIs), yield a quantitative metric that can be used to define the ecological integrity of a sampled area based on the avian community present. BCIs assume that changes in habitat quality or extent, upon which a specific guild is dependent, result in corresponding changes in the representation of that guild within the overall bird community. Within the BCI, guilds are ranked based on specialization, with specialist guilds receiving higher weight over generalist guilds. This ability to use the bird community to reflect ecological condition, particularly in urban areas where impacts can be multi-faceted, provides a valuable and informative indicator for monitoring programs.

BCI scores and ratings are based on ecological criteria. However, due to cultural landscape objectives within the park and surrounding land use conditions, parks may not ever attain “high ecological integrity”. However, shifts in ecological integrity over time may be indicative of stressors. Additionally, a management scorecard could be developed by park and MIDN staff that would reflect progress towards avian and ecological management goals for individual parks.

BCIs are designed to represent major habitat types, as bird communities shift markedly by ecosystem. Two major habitat types dominate the parks in the Mid-Atlantic Network; forest and grassland. O’Connell et al. (2003) developed a combined forest integrity index for the Piedmont and Southeastern Coastal Plain ecoregions that can be applied to the points that fall in forested areas. For grassland bird communities, however, we are still exploring metrics for assessment.

Avian Scorecard Methods

For forest BCI analysis, data from grassland stations, incidentals, flyovers, and unknown species were removed. Only members of the following families were used in BCI analyses: Passeriformes, Columbiformes, Apodiformes, Piciformes, and Cuculiformes. Furthermore, only bird species that were included in the original development of these indices were considered (O’Connell et al. 2003, Coppedge et al. 2006).

If a station was visited more than once, detections for that station were aggregated. Forest integrity estimates based on O’Connell et al. (2003) are built from percent guild representation rather than counts of individuals, so multiple visits provide a more complete picture of the community and not an upward biased BCI score (e.g. from double-counted individuals).

Often, ecological integrity reports aggregate individual integrity metrics to create indices of overall ecosystem scores (Karr 1991, O’Connell et al. 2003). However, some believe that these indices may rely on a subjective understanding of the relative importance of each individual metric in estimating overall ecosystem integrity and that, by aggregating metrics, individual ecosystem components which may need attention are obscured (Faccio et al. 2010). Therefore, we summarized the data in both manners: across each individual guild and as an aggregated score.

Calculating BCI scores

All species detected at forested stations were assigned to appropriate guilds that were defined by O’Connell et al. (2003) and shown to respond most strongly to changing forest structure (Appendix A). Proportional guild representation was then calculated for each station. For example, if 2 of 10 species detected at a station were forest interior species, then that station had 20% forest interior species. That guild percentage was then assigned a rank score of 1, 2, 3, or 4 (Table 1) using thresholds derived by O’Connell et al. (2003) for the Piedmont and Southeastern Coastal Plain. This was done for each guild and a final BCI score for a station is then calculated as follows:

$$V1 = \frac{\sum \text{Structural Guild Ranks}}{4}$$

$$V2 = \frac{\sum \text{Functional Guild Ranks}}{4}$$

$$V3 = \frac{\sum \text{Compositional Guild Ranks}}{4}$$

$$BCI = \frac{V1 + V2 + V3}{9}$$

This final BCI score which ranges from 0.25 – 1.00 can then be then assigned a rank that falls on the Humanistic to Naturalistic scale of 1 to 4 (Table 1). Thus for each station, we derive individual guild rank scores and an aggregate rank score. Station aggregate scores are then averaged to provide scores for each park and the region.

Table 1. Rank scores by percent guild representation for forested sites based on O’Connell et al. (2003). See details on these guild assignments in Appendix A.

Guild		Percent Guild Representation			
		Rank = 1 Humanistic	Rank = 2 Moderately Disturbed	Rank = 3 Largely Intact	Rank = 4 Naturalistic
Structural Guilds	Forest Interior	0 -10.0	10.1 - 20.0	20.1 - 28.0	28.1 - 100
	Pine Associated	0	0.1 - 2.0	2.1 - 5.0	5.1 - 100
	Urban/Suburban	60.1 - 100	47.1 - 60.0	20.1 - 47.0	0 - 20.0
Functional Guilds	Bark Prober	0 - 9.0	9.1 - 16.0	16.1 - 20.0	20.1 - 100
	Upper Canopy Forager	0 - 4.0	4.1 - 12.0	12.1 - 18.0	18.1 - 100
	Ground Forager	0	0.1 - 3.0	3.1 - 7.0	7.1 - 100
Compositional Guilds	Single Brooded	0 - 16.0	16.1 - 34.0	34.1 - 46.0	46.1 - 100
	Nest Predator/Brood Parasite	23.1 -100	16.1 - 23.0	0.1 - 16.0	0
	Exotic	11.1-100	1.1 - 11.0	0.1 - 1.0	0
Final BCI Score		0.250-0.460	0.461-0.600	0.601-0.730	0.731-1.00

Results and Discussion

Region-wide

A total of 372 point counts were conducted by 27 volunteers at 206 stations in 2013 (Table 2). Of the stations, 140 were in forested habitat and 66 were in grassland habitat.

Table 2. Number of monitoring stations at four Mid-Atlantic Network parks in 2013 by habitat type, total number of surveys conducted, and total number of volunteers surveying.

Park	Park Unit	Park Code	Number of Stations			Total Surveys	Average Surveys/Station	Volunteers
			Forest	Grassland	Total			
Booker T. Washington National Monument (NM)		BOWA	11	4	15	39	2.60	2
Fredericksburg and Spotsylvania National Military Park (NMP)	Spotsylvania Battlefield	FRSP	51	8	59	89	1.51	6
Richmond National Battlefield Park (NBP)	Malvern Hill/Cold Harbor	RICH	41	15	56	64	1.14	10
Valley Forge National Historical Park (NHP)		VAFO	37	39	76	180	2.37	10
Total			140	66	206	372	1.81	27

Across the four parks, 5,123 individual birds were detected encompassing 95 species, with an additional 385 individuals and 3 additional species detected as flyovers. Within forested habitats 91 species were detected, while 77 species were detected in grassland habitats. Valley Forge NHP had the greatest number of detections and number of species (Table 3), but it also had the greatest number of stations and surveys conducted (Table 2).

Table 3. Total number of detections and number of species detected in 2013 at bird monitoring stations in four Mid-Atlantic Network parks.

Park	Raw Detections*	Number of Species			Total
		Forest	Grassland	Species of Concern	
BOWA	656	51	39	25	59
FRSP	1012	52	35	25	58
RICH	591	60	45	25	68
VAFO	2864	57	61	23	69

*Raw detections are raw unadjusted counts including flyovers, incidentals, and possible double-counted individuals.

European Starlings had the highest relative abundance ($\bar{x} = 0.89$ birds/station ± 0.26 SE) and the greatest number of detections ($n = 183$) across the region. This species, however, typically occurs in large flocks and hence had highly variable counts and were only detected at 14.56% of stations. The Tufted Titmouse had the second highest relative abundance ($\bar{x} = 0.84$ birds/station ± 0.07 SE), the second highest number of detections ($n=173$), and was the most prevalent species occurring at 57.28% of stations surveyed in 2013 (Table 4).

A total of 33 species of concern as identified by Partners in Flight (PIF) were detected across the four parks, including 18 watchlist species and 15 stewardship species (Table 5). Three stewardship species, the Carolina Chickadee, the Carolina Wren, and Red-bellied Woodpecker, were among the 10 most abundant of the birds detected (Table 4). The Wood Thrush, a watchlist species, was the 9th most abundant species.

The average BCI for forested stations across the parks was 0.70 ± 0.01 , giving the region a rating of “largely intact” (Table 6). The pine associated guild had the lowest rating, ranked “moderately disturbed.” The remaining guilds were either rated as “largely intact” or “naturalistic.”

Table 4. Number of detections, mean and standard error of abundance (birds/station), and the number and percentage of stations individual species were detected at during the 2013 breeding bird monitoring season at four Mid-Atlantic Network parks. Detections do not include flyovers or incidentals and uses maximum detection counts per species for each station if multiple visits were made.

Species	Detections	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)
European Starling ¹	183	0.89 $\pm$ 0.26	14.56
Tufted Titmouse	173	0.84 $\pm$ 0.07	57.28
Blue Jay	157	0.76 $\pm$ 0.07	47.57
Red-bellied Woodpecker†	146	0.71 $\pm$ 0.05	56.31
Carolina Chickadee†	135	0.66 $\pm$ 0.07	40.78
Red-winged Blackbird	130	0.63 $\pm$ 0.13	17.48
Red-eyed Vireo	125	0.61 $\pm$ 0.05	48.54
American Robin	124	0.60 $\pm$ 0.06	38.83
Wood Thrush*	119	0.58 $\pm$ 0.06	39.32
Carolina Wren†	117	0.57 $\pm$ 0.05	46.12
American Crow	102	0.50 $\pm$ 0.07	30.10
Eastern Wood-Pewee*	102	0.50 $\pm$ 0.04	43.69
Northern Cardinal	99	0.48 $\pm$ 0.05	39.32
Field Sparrow*	97	0.47 $\pm$ 0.07	24.76
Indigo Bunting†	88	0.43 $\pm$ 0.06	29.13
Eastern Meadowlark*	81	0.39 $\pm$ 0.08	17.96
Ovenbird	78	0.38 $\pm$ 0.05	27.67
Acadian Flycatcher†	73	0.35 $\pm$ 0.04	29.13
Song Sparrow	73	0.35 $\pm$ 0.05	20.87
Mourning Dove	71	0.34 $\pm$ 0.05	27.18
White-breasted Nuthatch	69	0.33 $\pm$ 0.04	26.70
Common Yellowthroat	66	0.32 $\pm$ 0.04	25.24
American Goldfinch	64	0.31 $\pm$ 0.05	21.84
Downy Woodpecker†	58	0.28 $\pm$ 0.04	24.76
Gray Catbird	54	0.26 $\pm$ 0.05	16.50
Eastern Towhee*	53	0.26 $\pm$ 0.04	17.96
Chipping Sparrow	48	0.23 $\pm$ 0.04	17.48
Northern Mockingbird	46	0.22 $\pm$ 0.04	15.53
Baltimore Oriole*	44	0.21 $\pm$ 0.04	15.53
Canada Goose	42	0.20 $\pm$ 0.15	1.46
Great Crested Flycatcher	41	0.20 $\pm$ 0.03	16.50
Pileated Woodpecker†	38	0.18 $\pm$ 0.03	16.99
Cedar Waxwing	35	0.17 $\pm$ 0.06	7.28
Blue-gray Gnatcatcher	34	0.17 $\pm$ 0.03	13.11
Eastern Bluebird	32	0.16 $\pm$ 0.03	12.14
Scarlet Tanager	31	0.15 $\pm$ 0.03	14.56
Brown-headed Cowbird	29	0.14 $\pm$ 0.03	10.68
Northern Flicker*	28	0.14 $\pm$ 0.03	12.62
Eastern Kingbird*	27	0.13 $\pm$ 0.03	8.74

Table 4. Number of detections, mean and standard error of abundance (birds/station), and the number and percentage of stations individual species were detected at during the 2013 breeding bird monitoring season at four Mid-Atlantic Network parks (continued).

Species	Detections	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)
Yellow-billed Cuckoo*	25	0.12 $\pm$ 0.02	12.14
Orchard Oriole†	24	0.12 $\pm$ 0.03	8.74
Chimney Swift*	21	0.10 $\pm$ 0.04	4.85
Summer Tanager†	20	0.10 $\pm$ 0.02	9.71
Eastern Phoebe	19	0.09 $\pm$ 0.02	8.74
Barn Swallow	17	0.08 $\pm$ 0.02	6.80
Common Grackle	16	0.08 $\pm$ 0.03	4.85
House Wren	15	0.07 $\pm$ 0.02	5.83
Tree Swallow	13	0.06 $\pm$ 0.02	4.37
Blue Grosbeak†	12	0.06 $\pm$ 0.02	3.40
Pine Warbler†	12	0.06 $\pm$ 0.02	5.83
Red-tailed Hawk	12	0.06 $\pm$ 0.02	4.37
Yellow-breasted Chat	11	0.05 $\pm$ 0.02	4.37
Yellow-throated Vireo†	11	0.05 $\pm$ 0.02	5.34
Hairy Woodpecker	10	0.05 $\pm$ 0.02	4.37
Yellow Warbler	8	0.04 $\pm$ 0.02	2.91
Killdeer	7	0.03 $\pm$ 0.02	0.97
Mallard	7	0.03 $\pm$ 0.02	1.46
Prairie Warbler*	7	0.03 $\pm$ 0.01	2.91
Warbling Vireo	7	0.03 $\pm$ 0.01	3.40
White-eyed Vireo†	7	0.03 $\pm$ 0.01	3.40
Brown Thrasher*	6	0.03 $\pm$ 0.01	2.91
Brown-headed Nuthatch*	6	0.03 $\pm$ 0.02	1.46
Great Horned Owl	5	0.02 $\pm$ 0.01	1.46
House Finch	5	0.02 $\pm$ 0.01	1.94
Northern Bobwhite*	5	0.02 $\pm$ 0.01	2.43
Turkey Vulture	5	0.02 $\pm$ 0.02	1.46
American Kestrel	4	0.02 $\pm$ 0.01	1.46
Ruby-throated Hummingbird	4	0.02 $\pm$ 0.01	1.46
Wild Turkey	4	0.02 $\pm$ 0.01	1.94
Grasshopper Sparrow*	3	0.01 $\pm$ 0.01	0.97
Louisiana Waterthrush	3	0.01 $\pm$ 0.01	1.46
Northern Parula†	3	0.01 $\pm$ 0.01	0.97
Red-headed Woodpecker*	3	0.01 $\pm$ 0.01	1.46
Belted Kingfisher	2	0.01 $\pm$ 0.01	0.49
Bobolink	2	0.01 $\pm$ 0.01	0.97
Cooper's Hawk	2	0.01 $\pm$ 0.01	0.97
Great Blue Heron	2	0.01 $\pm$ 0.01	0.97
Philadelphia Vireo	2	0.01 $\pm$ 0.01	0.97
Red-shouldered Hawk†	2	0.01 $\pm$ 0.01	0.97

Table 4. Number of detections, mean and standard error of abundance (birds/station), and the number and percentage of stations individual species were detected at during the 2013 breeding bird monitoring season at four Mid-Atlantic Network parks (continued).

Species	Detections	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)
Willow Flycatcher*	2	0.01 $\pm$ 0.01	0.49
Yellow-throated Warbler	2	0.01 $\pm$ 0.01	0.49
American Coot	1	0.00 $\pm$ 0.00	0.49
Black-and-white Warbler	1	0.00 $\pm$ 0.00	0.49
Broad-winged Hawk*	1	0.00 $\pm$ 0.00	0.49
Green Heron	1	0.00 $\pm$ 0.00	0.49
Horned Lark	1	0.00 $\pm$ 0.00	0.49
House Sparrow	1	0.00 $\pm$ 0.00	0.49
unid. Buteo Hawk	1	0.00 $\pm$ 0.00	0.49
White-throated Sparrow	1	0.00 $\pm$ 0.00	0.49
Worm-eating Warbler*	1	0.00 $\pm$ 0.00	0.49
Yellow-rumped Warbler	1	0.00 $\pm$ 0.00	0.49

*Partners in Flight Watchlist species, †Partners in Flight Stewardship species, ‡Exotic species

Table 5. Bird species detected in the four Mid-Atlantic Network parks during the 2013 breeding bird monitoring season and patterns of occurrence during 2009-2013. Closed circles indicate species that were detected in a station while open circles indicate species that were only detected as flyovers or incidentals.

Species	BOWA	FRSP	RICH	VAFO	Region				
					2009	2010	2011	2012	2013
Acadian Flycatcher†	●	●	●	●	●	●	●	●	●
American Coot				●		●			●
American Crow	●	●	●	●	●	●	●	●	●
American Goldfinch	●	●	●	●	●	●	●	●	●
American Kestrel				●	●	●	●	●	●
American Redstart						●	●	●	
American Robin	●	●	●	●	●	●	●	●	●
Bald Eagle						○			
Baltimore Oriole*		●		●	●	●	●	●	●
Bank Swallow						●	○	○	
Barn Swallow	●		●	●	●	●	●	●	●
Barred Owl					●		●		
Belted Kingfisher	○		●	○	●	●	●	●	●
Black Vulture	○			○	●	●	●	●	○
Black-and-white Warbler		●					●	●	●
Black-billed Cuckoo*						○	●	●	
Blackpoll Warbler						●			
Blue Grosbeak†	●	●	●	○	●	●	●	●	●
Blue Jay	●	●	●	●	●	●	●	●	●
Blue-gray Gnatcatcher	●	●	●	●	●	●	●	●	●
Blue-headed Vireo							●	●	
Blue-winged Warbler*					●	●			
Bobolink			●				●		●
Broad-winged Hawk*	●						○		●
Brown Creeper							●		
Brown Thrasher*	●	●	○		●	●	●	●	●
Brown-headed Cowbird	●	●	●	●	●	●	●	●	●
Brown-headed Nuthatch*	●							●	●
Canada Goose		○		●	●	●	●	●	●
Canada Warbler					●				
Carolina Chickadee†	●	●	●	●	●	●	●	●	●
Carolina Wren†	●	●	●	●	●	●	●	●	●
Cedar Waxwing	●	●	●	●	●	●	●	●	●
Chimney Swift*			○	●	●	●	●	●	●
Chipping Sparrow	●	●	●	●	●	●	●	●	●
Common Grackle	●		●	●	●	●	●	●	●
Common Merganser								○	
Common Peafowl					○				

Table 5. Bird species detected in the four Mid-Atlantic Network parks during the 2013 breeding bird monitoring season and patterns of occurrence during 2009-2013 (continued).

Species	BOWA	FRSP	RICH	VAFO	Region				
					2009	2010	2011	2012	2013
Common Raven	○								○
Common Yellowthroat	●	●	●	●	●	●	●	●	●
Cooper's Hawk				●	○		○		●
Double-crested Cormorant							●		
Downy Woodpecker†	●	●	●	●	●	●	●	●	●
Eastern Bluebird	●	●	●	●	●	●	●	●	●
Eastern Kingbird*	●			●	●	●	●	●	●
Eastern Meadowlark*	●	●		●	●	●	●	●	●
Eastern Phoebe	●	●	●	●	●	●	●	●	●
Eastern Screech-Owl						●			
Eastern Towhee*	●	●		●	●	●	●	●	●
Eastern Wood-Pewee*	●	●	●	●	●	●	●	●	●
European Starling ¹	●		●	●	●	●	●	●	●
Field Sparrow*	●	●	●	●	●	●	●	●	●
Fish Crow						●	○	○	
Grasshopper Sparrow*	●		●		●	●	●	●	●
Gray Catbird		●	●	●	●	●	●	●	●
Great Blue Heron	○	○	●	●	●	●	●	●	●
Great Crested Flycatcher	●	●	●	●	●	●	●	●	●
Great Horned Owl		●	●					●	●
Green Heron				●		●	○	○	●
Hairy Woodpecker	●	●	●	●	●	●	●	●	●
Hooded Warbler†		○			●	●	●		○
Horned Lark			●				●		●
House Finch	●		●	●	●	●	●	●	●
House Sparrow			●					●	●
House Wren				●	●	●	●	●	●
Indigo Bunting†	●	●	●	●	●	●	●	●	●
Kentucky Warbler*						●	●	●	
Killdeer			●		●	●	●	●	●
Least Flycatcher							●		
Lesser Yellowlegs						●			
Louisiana Waterthrush	○	●			●	●	●	●	●
Mallard				●	●	●	●	●	●
Marsh Wren								●	
Mourning Dove	●	●	●	●	●	●	●	●	●
Mute Swan							○		
Nashville Warbler							●		

Table 5. Bird species detected in the four Mid-Atlantic Network parks during the 2013 breeding bird monitoring season and patterns of occurrence during 2009-2013 (continued).

Species	BOWA	FRSP	RICH	VAFO	Region				
					2009	2010	2011	2012	2013
Northern Bobwhite*		○	●			●	●	●	●
Northern Cardinal	●	●	●	●	●	●	●	●	●
Northern Flicker*	●	●	●	●	●	●	●	●	●
Northern Mockingbird	●	●	●	●	●	●	●	●	●
Northern Parula†	●			●	●	●	●	●	●
Northern Rough-winged Swallow					○	●	●	●	
Orchard Oriole†			●	●	●	●	●	●	●
Osprey						●		○	
Ovenbird	●	●	●		●	●	●	●	●
Palm Warbler						●	●		
Philadelphia Vireo		●							●
Pileated Woodpecker†	●	●	●	●	●	●	●	●	●
Pine Warbler†	●	●	●	●	●	●	●	●	●
Prairie Warbler*	●	●	●		●	●	●	●	●
Purple Martin†					○		○	●	
Red-bellied Woodpecker†	●	●	●	●	●	●	●	●	●
Red-eyed Vireo	●	●	●	●	●	●	●	●	●
Red-headed Woodpecker*			●			●	●	●	●
Red-shouldered Hawk†	○	●	●		●	●	●	●	●
Red-tailed Hawk		●	●	●	●	●	●	●	●
Red-winged Blackbird	●		●	●	●	●	●	●	●
Rock Pigeon				○		○	○	○	○
Rose-breasted Grosbeak							●		
Ruby-throated Hummingbird	●		●	○		●	●	●	●
Scarlet Tanager	●	●	●	●	●	●	●	●	●
Sharp-shinned Hawk				○		●			○
Song Sparrow				●	●	●	●	●	●
Summer Tanager†	●	●	●		●	●	●	●	●
Swainson's Thrush							●		
Tree Swallow			●	●	●	●	●	●	●
Tufted Titmouse	●	●	●	●	●	●	●	●	●
Turkey Vulture	○	○	●	●	●	●	●	●	●
Veery					●	●			
Warbling Vireo				●	●	●	●	●	●
White-breasted Nuthatch	●	●	●	●	●	●	●	●	●
White-eyed Vireo†			●		●	●	●	●	●
White-throated Sparrow			●						●
Wild Turkey	●		●		●	●	●	●	●

Table 5. Bird species detected in the four Mid-Atlantic Network parks during the 2013 breeding bird monitoring season and patterns of occurrence during 2009-2013 (continued).

Species	BOWA	FRSP	RICH	VAFO	Region				
					2009	2010	2011	2012	2013
Willow Flycatcher*				●	●	●	●	●	●
Wood Duck				○		●	●	○	○
Wood Thrush*	●	●	●	●	●	●	●	●	●
Worm-eating Warbler*		●			●	●	●	●	●
Yellow Warbler				●	●	●	●	●	●
Yellow-bellied Flycatcher		○							○
Yellow-billed Cuckoo*	●	●	●	●	●	●	●	●	●
Yellow-breasted Chat		●	●		●	●	●	●	●
Yellow-rumped Warbler			●						●
Yellow-throated Vireo†		●	●	●	●	●	●	●	●
Yellow-throated Warbler			●		●	●	●	●	●

*Partners in Flight Watchlist species, †Partners in Flight Stewardship species, ¹Exotic species

Table 6. Regional avian forest guild summary and Bird Community Index (BCI) score for 2013. Values indicate the average percent guild membership at monitoring locations across four parks in the Mid-Atlantic Network. Total BCI scores range from 0-1 with 1 being having the highest integrity. Ranks are derived from O'Connell et al. (2003). See details on these guild assignments in Appendix A.

Guild		Percent	Rank
Structural	Forest Interior	31.01	Naturalistic
	Pine Associated	0.97	Moderately Disturbed
	Urban/Suburban	39.23	Largely Intact
Functional	Bark Prober	21.46	Naturalistic
	Ground Forager	4.59	Largely Intact
	Upper Canopy Forager	14.79	Largely Intact
Compositional	Nest Predator/Brood Parasite	14.91	Largely Intact
	Single Brooded	50.03	Naturalistic
	Exotic	0.15	Largely Intact
Total BCI Score		0.70	Largely Intact

Booker T. Washington National Monument

A total of 15 bird monitoring stations were surveyed at Booker T. Washington NM, including 11 stations in forested habitats and 4 in grassland habitats (Figure 2). Two volunteer birders from the local birding community conducted an average of 2.6 surveys per station, producing a total of 39 surveys for the season (Table 2).

Between May and July, 656 birds of 59 species were detected throughout the park. Forested habitat had slightly higher species richness than grassland habitat with 51 species in forested habitats and 39 in grassland habitats (Table 3).

A few species were detected this year that were not in previous monitoring years including the Belted Kingfisher, Broad-winged Hawk, and Common Raven. The American Crow had the highest relative abundance averaging 2.33 birds / station, and tied with the Blue Jay and Tufted Titmouse for most prevalent species occurring in 73.33% of the stations surveyed (Table 7).

Volunteers detected 25 species considered to be of conservation concern by Partners in Flight (PIF). PIF distinguishes species of concern facing immediate threats as "watchlist" species. "Stewardship" species are representative of avifaunal biomes that may or may not be in immediate danger. Within the park, 13 watchlist species and 12 stewardship species were detected. Four species of concern, including 2 watchlist species (Eastern Meadowlark and Wood Thrush) and 2 stewardship species (Carolina Chickadee and Indigo Bunting), were among the 10 most abundant species (Table 7).

Avian guilds, or groups of species occupying similar ecological niches, can be utilized for assessing responses to environmental changes and ecosystem stressors via bird community assessments, or "indices" (BCIs). Based on a BCI developed for the Piedmont/Coastal Plain region (O'Connell et al. 2003), forested stations surveyed in the park maintained their ecological rank of "naturalistic," the highest rank available in the metric (Table 8). All other guilds maintained their rank with the exception of the pine associated and exotic guilds, which were one rank lower than in the previous year.

A Resource Brief for Booker T. Washington NM, which may be used as outreach material, can be downloaded as a PDF from the NPS Data Store located on the Integrated Resource Management Application (IRMA) Portal at the following website address:

<https://irma.nps.gov/App/Reference/Profile/2217607>

Table 7. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Booker T. Washington NM. Closed circles indicate species that were detected at a station while open circles indicate species that were only detected as flyovers or incidentals.

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
American Crow	2.33 $\pm$ 0.51	73.33	●	●	●	●	●
Eastern Meadowlark*	1.33 $\pm$ 0.74	33.33	●	●	●	●	●
Blue Jay	1.13 $\pm$ 0.26	73.33	●	●	●	●	●
Carolina Chickadee†	1.13 $\pm$ 0.38	53.33	●	●	●	●	●
Tufted Titmouse	1.13 $\pm$ 0.22	73.33	●	●	●	●	●
Blue-gray Gnatcatcher	1.07 $\pm$ 0.25	60.00	●	●	●	●	●
Indigo Bunting†	1.07 $\pm$ 0.27	66.67	●	●	●	●	●
American Goldfinch	0.93 $\pm$ 0.25	53.33	●	●	●	●	●
Chipping Sparrow	0.93 $\pm$ 0.25	53.33	●	●	●	●	●
Wood Thrush*	0.93 $\pm$ 0.21	66.67	●	●	●	●	●
Northern Cardinal	0.87 $\pm$ 0.24	60.00	●	●	●	●	●
Red-eyed Vireo	0.87 $\pm$ 0.19	73.33	●	●	●	●	●
Carolina Wren†	0.80 $\pm$ 0.20	60.00	●	●	●	●	●
Eastern Wood-Pewee*	0.80 $\pm$ 0.17	66.67	●	●	●	●	●
European Starling ¹	0.80 $\pm$ 0.67	13.33	○		●		●
Ovenbird	0.80 $\pm$ 0.24	53.33	●	●	●	●	●
Cedar Waxwing	0.73 $\pm$ 0.54	20.00	●	●	○	●	●
Acadian Flycatcher†	0.67 $\pm$ 0.29	33.33	●	●	●	●	●
Field Sparrow*	0.67 $\pm$ 0.21	46.67	●	●	●	●	●
White-breasted Nuthatch	0.67 $\pm$ 0.29	40.00	●	●	●	●	●
Downy Woodpecker†	0.60 $\pm$ 0.24	40.00	●	●	●	●	●
Eastern Bluebird	0.53 $\pm$ 0.24	33.33	●	●	●	●	●
Eastern Phoebe	0.53 $\pm$ 0.13	53.33	●	●	●	●	●
Mourning Dove	0.53 $\pm$ 0.13	53.33	●	●	●	●	●
Brown-headed Cowbird	0.47 $\pm$ 0.22	26.67	●	●	●	●	●
Eastern Towhee*	0.47 $\pm$ 0.22	26.67	●	●	●	●	●
Brown-headed Nuthatch*	0.40 $\pm$ 0.24	20.00				●	●
Scarlet Tanager	0.40 $\pm$ 0.13	40.00	●	●	●	●	●
Red-bellied Woodpecker†	0.33 $\pm$ 0.13	33.33	●	●	●	●	●
Great Crested Flycatcher	0.27 $\pm$ 0.15	20.00	●	○	●	●	●
Northern Flicker*	0.27 $\pm$ 0.15	20.00	●	●		●	●
Northern Mockingbird	0.27 $\pm$ 0.12	26.67	●	●	●	●	●
Eastern Kingbird*	0.20 $\pm$ 0.14	13.33		●	●	●	●
Pine Warbler†	0.20 $\pm$ 0.11	20.00	●	●	●	●	●
Red-winged Blackbird	0.20 $\pm$ 0.14	13.33			●	●	●
American Robin	0.13 $\pm$ 0.09	13.33	●	●	●	●	●
Barn Swallow	0.13 $\pm$ 0.09	13.33	○	●	●	●	●

Table 7. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Booker T. Washington NM (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
Common Grackle	0.13 $\pm$ 0.09	13.33		●	●	●	●
Grasshopper Sparrow*	0.13 $\pm$ 0.13	6.67	●	●	●	●	●
Ruby-throated Hummingbird	0.13 $\pm$ 0.13	6.67		●	●		●
Wild Turkey	0.13 $\pm$ 0.09	13.33				●	●
Blue Grosbeak†	0.07 $\pm$ 0.07	6.67		●	●	●	●
Broad-winged Hawk*	0.07 $\pm$ 0.07	6.67					●
Brown Thrasher*	0.07 $\pm$ 0.07	6.67	●		●	●	●
Common Yellowthroat	0.07 $\pm$ 0.07	6.67	●	●	●	●	●
Hairy Woodpecker	0.07 $\pm$ 0.07	6.67	○	●			●
House Finch	0.07 $\pm$ 0.07	6.67			●		●
Northern Parula†	0.07 $\pm$ 0.07	6.67	●	○	●	●	●
Pileated Woodpecker†	0.07 $\pm$ 0.07	6.67	●	●	●	●	●
Prairie Warbler*	0.07 $\pm$ 0.07	6.67	○	●	●	●	●
Summer Tanager†	0.07 $\pm$ 0.07	6.67	●	●		●	●
Yellow-billed Cuckoo*	0.07 $\pm$ 0.07	6.67	●	●	●	●	●
Belted Kingfisher	0.00 $\pm$ 0.00	0.00					○
Black Vulture	0.00 $\pm$ 0.00	0.00		○		●	○
Common Raven	0.00 $\pm$ 0.00	0.00					○
Great Blue Heron	0.00 $\pm$ 0.00	0.00	●	●	●	○	○
Louisiana Waterthrush	0.00 $\pm$ 0.00	0.00	●	●	●	●	○
Red-shouldered Hawk†	0.00 $\pm$ 0.00	0.00	●	●	○	●	○
Turkey Vulture	0.00 $\pm$ 0.00	0.00	●	●		●	○
American Redstart				●			
Baltimore Oriole*				●		●	
Barred Owl					●		
Blackpoll Warbler				●			
Canada Warbler			●				
Chimney Swift*					●	○	
Gray Catbird						●	
Killdeer			●	●		●	
Northern Rough-winged Swallow			○	●	●		
Orchard Oriole†				○	●		
Red-tailed Hawk			●	○			
Song Sparrow						●	
White-eyed Vireo†				○			
Worm-eating Warbler*				●			
Yellow-throated Vireo†			●	●	●	●	

*Partners in Flight Watchlist species, †Partners in Flight Stewardship species, †Exotic species

Table 8. Avian forest guild summary and Bird Community Index (BCI) score for 2009-2013 at Booker T. Washington NM. Values indicate the average percent guild membership at monitoring locations. Total BCI scores range from 0-1 with 1 having the highest integrity. Ranks are derived from O'Connell et al. (2003). See details on these guild assignments in Appendix A.

		2009 (n=41)		2010 (n=31)		2011 (n=41)		2012 (n=34)		2013 (n=26)	
Guild		Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
Structural	Forest Interior	34.93	Naturalistic	43.05	Naturalistic	37.48	Naturalistic	35.60	Naturalistic	33.69	Naturalistic
	Pine Associated	0.00	Humanistic	1.42	Moderately Disturbed	0.38	Moderately Disturbed	2.08	Largely Intact	1.89	Moderately Disturbed
	Urban/Suburban	43.59	Largely Intact	29.08	Largely Intact	33.57	Largely Intact	34.18	Largely Intact	39.66	Largely Intact
Functional	Bark Prober	16.73	Largely Intact	18.91	Largely Intact	19.44	Largely Intact	16.80	Largely Intact	17.16	Largely Intact
	Ground Forager	6.48	Largely Intact	6.80	Largely Intact	5.52	Largely Intact	6.57	Largely Intact	4.98	Largely Intact
	Upper Canopy Forager	17.32	Largely Intact	25.27	Naturalistic	23.84	Naturalistic	22.78	Naturalistic	20.42	Naturalistic
Compositional	Nest Predator/ Brood Parasite	18.30	Moderately Disturbed	11.88	Largely Intact	12.68	Largely Intact	12.69	Largely Intact	13.69	Largely Intact
	Single Brooded	45.78	Largely Intact	56.65	Naturalistic	52.83	Naturalistic	51.42	Naturalistic	48.46	Naturalistic
	Exotic	0.00	Naturalistic	0.00	Naturalistic	0.00	Naturalistic	0.00	Naturalistic	0.87	Largely Intact
Total BCI Score		0.72	Largely Intact	0.83	Naturalistic	0.83	Naturalistic	0.86	Naturalistic	0.81	Naturalistic

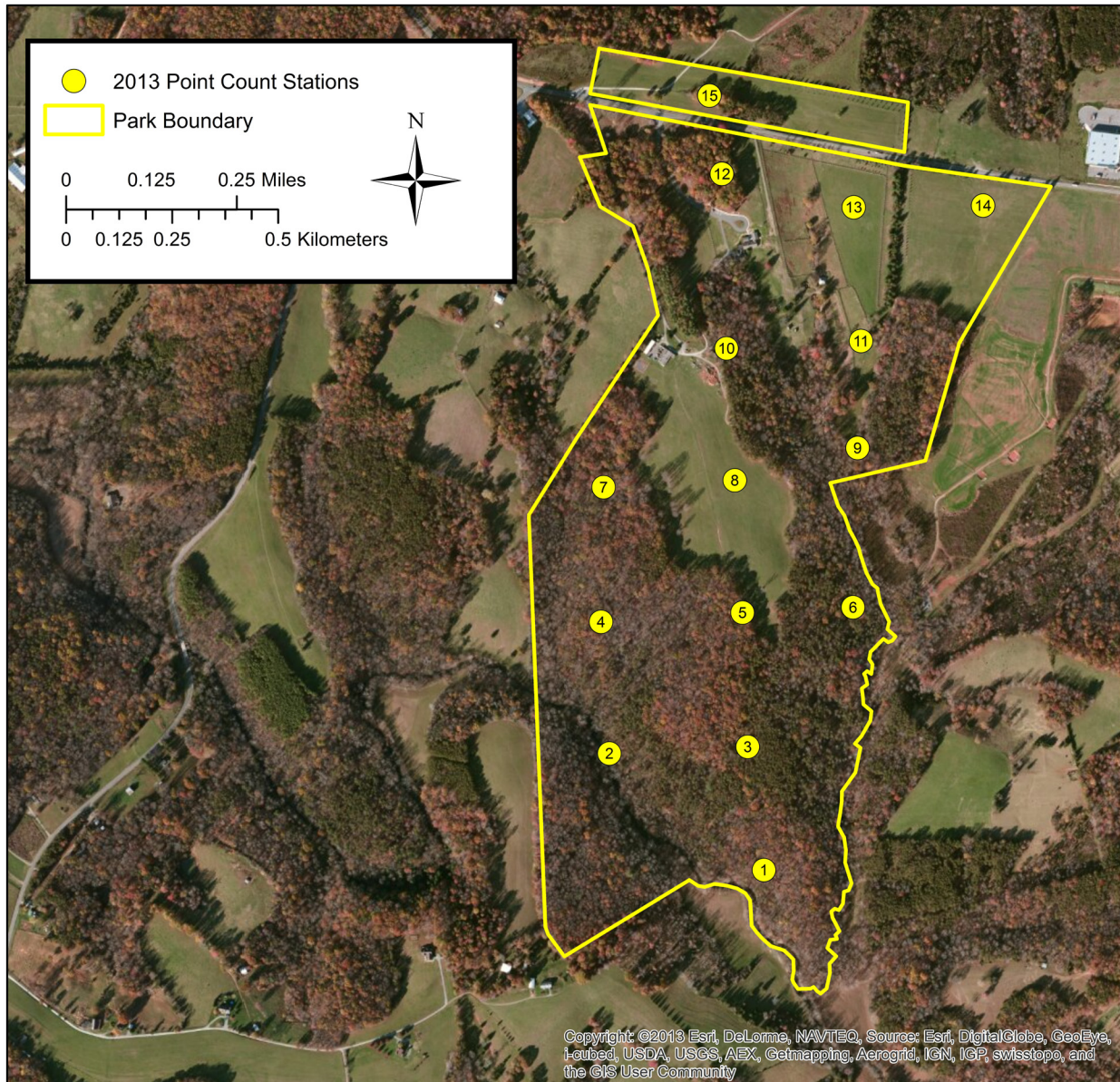


Figure 2. Bird monitoring stations sampled at Booker T. Washington NM in 2013.

Fredericksburg and Spotsylvania National Military Park

A total of 59 bird monitoring stations were surveyed at the Spotsylvania Battlefield unit of Fredericksburg and Spotsylvania NMP, including 51 stations in forested habitats and 8 stations in grassland habitats (Figure 3). Six volunteer birders from the local birding community conducted an average of 1.51 surveys per station, producing a total of 89 surveys for the season (Table 2).

Between May and July, 1,012 birds of 58 species were detected throughout the unit. Forested habitat had slightly higher species richness than grassland habitat with 52 species in forested habitats and 35 in grassland habitats (Table 3).

A few species were detected this year that were not in previous years including the Great Horned Owl, Northern Mockingbird, and Philadelphia Vireo. The Tufted Titmouse was the most numerous species averaging 1.25 birds / station and was also the most prevalent, occurring at 71.19% of the stations surveyed (Table 9).

Volunteers detected 25 species considered to be of conservation concern by Partners in Flight (PIF). PIF distinguishes species of concern facing immediate threats as "watchlist" species. "Stewardship" species are representative of avifaunal biomes that may or may not be in immediate danger. Within the unit, 12 watchlist species and 13 stewardship species were detected. Six species of concern, including 2 watchlist species (Eastern Wood-Pewee and Wood Thrush) and 4 stewardship species (Acadian Flycatcher, Carolina Chickadee, Carolina Wren, and Red-bellied Woodpecker), were among the 10 most abundant species (Table 9).

Avian guilds, or groups of species occupying similar ecological niches, can be utilized for assessing responses to environmental changes and ecosystem stressors via bird community assessments, or "indices" (BCIs). Based on a BCI developed for the Piedmont/Coastal Plain region (O'Connell et al. 2003), forested stations surveyed in the unit maintained their ecological rank of "naturalistic," the highest rank available in the metric. All other guilds maintained their rank with the exception of the ground forager and upper canopy forager guilds, which were one rank lower than in the previous year (Table 10).

A Resource Brief for Fredericksburg and Spotsylvania NMP, which may be used as outreach material, can be downloaded as a PDF from the NPS Data Store located on the Integrated Resource Management Application (IRMA) Portal at the following website address:

<https://irma.nps.gov/App/Reference/Profile/2217609>

Table 9. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Spotsylvania Battlefield, Fredericksburg and Spotsylvania NMP. Closed circles indicate species that were detected in a station while open circles indicate species that were only detected as flyovers or incidentals.

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
Tufted Titmouse	1.25 $\pm$ 0.15	71.19	●	●	●	●	●
Wood Thrush*	1.03 $\pm$ 0.12	67.80	●	●	●	●	●
Ovenbird	0.83 $\pm$ 0.12	54.24	●	●	●	●	●
Carolina Chickadee†	0.73 $\pm$ 0.13	49.15	●	●	●	●	●
Red-eyed Vireo	0.73 $\pm$ 0.09	59.32	●	●	●	●	●
Blue Jay	0.69 $\pm$ 0.12	45.76	●	●	●	●	●
Red-bellied Woodpecker†	0.68 $\pm$ 0.09	55.93	●	●	●	●	●
Acadian Flycatcher†	0.64 $\pm$ 0.08	55.93	●	●	●	●	●
Eastern Wood-Pewee*	0.61 $\pm$ 0.08	55.93	●	●	●	●	●
Carolina Wren†	0.56 $\pm$ 0.09	47.46	●	●	●	●	●
American Crow	0.46 $\pm$ 0.09	37.29	●	●	●	●	●
Northern Cardinal	0.44 $\pm$ 0.08	38.98	●	●	●	●	●
Downy Woodpecker†	0.41 $\pm$ 0.07	37.29	●	●	●	●	●
White-breasted Nuthatch	0.39 $\pm$ 0.08	33.90	●	●	●	●	●
Mourning Dove	0.37 $\pm$ 0.11	27.12	●	●	●	●	●
Indigo Bunting†	0.32 $\pm$ 0.07	27.12	●	●	●	●	●
Common Yellowthroat	0.31 $\pm$ 0.08	23.73	●	●	●	●	●
Pileated Woodpecker†	0.27 $\pm$ 0.07	23.73	●	●	●	●	●
Yellow-billed Cuckoo*	0.27 $\pm$ 0.06	27.12	●	●	●	●	●
Scarlet Tanager	0.22 $\pm$ 0.05	22.03	●	●	●	●	●
American Goldfinch	0.20 $\pm$ 0.07	15.25	●	●	●	●	●
Field Sparrow*	0.20 $\pm$ 0.07	13.56	●	●	●	●	●
Great Crested Flycatcher	0.19 $\pm$ 0.07	15.25	●	●	●	●	●
Brown-headed Cowbird	0.17 $\pm$ 0.06	13.56	●	●	●	●	●
Chipping Sparrow	0.17 $\pm$ 0.06	13.56	●	●	●	●	●
Blue-gray Gnatcatcher	0.15 $\pm$ 0.05	15.25	●	●	●	●	●
Eastern Towhee*	0.15 $\pm$ 0.05	15.25	●	●	●	●	●
Summer Tanager†	0.15 $\pm$ 0.05	15.25	●	●	●	●	●
American Robin	0.12 $\pm$ 0.04	11.86	●	●	●	●	●
Eastern Bluebird	0.10 $\pm$ 0.05	8.47	●	●	○	●	●
Eastern Meadowlark*	0.10 $\pm$ 0.08	3.39				○	●
Hairy Woodpecker	0.10 $\pm$ 0.05	8.47	●	●	●	●	●
Yellow-throated Vireo†	0.10 $\pm$ 0.04	10.17	●	●	●	●	●
Brown Thrasher*	0.08 $\pm$ 0.04	8.47	●	●	●	●	●
Yellow-breasted Chat	0.08 $\pm$ 0.04	8.47	●	●	●	●	●
Great Horned Owl	0.07 $\pm$ 0.05	3.39					●

Table 9. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Spotsylvania Battlefield, Fredericksburg and Spotsylvania NMP (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
Louisiana Waterthrush	0.05 $\pm$ 0.03	5.08		●	●	●	●
Northern Flicker*	0.05 $\pm$ 0.03	5.08	●	●	●	●	●
Philadelphia Vireo	0.03 $\pm$ 0.02	3.39					●
Pine Warbler†	0.03 $\pm$ 0.02	3.39	●	●	●	●	●
Prairie Warbler*	0.03 $\pm$ 0.02	3.39	●	●	●	●	●
Red-tailed Hawk	0.03 $\pm$ 0.02	3.39		●	●	●	●
Baltimore Oriole*	0.02 $\pm$ 0.02	1.69		●			●
Black-and-white Warbler	0.02 $\pm$ 0.02	1.69				●	●
Blue Grosbeak†	0.02 $\pm$ 0.02	1.69	●	●	●	●	●
Cedar Waxwing	0.02 $\pm$ 0.02	1.69				○	●
Eastern Phoebe	0.02 $\pm$ 0.02	1.69	●	●	●	○	●
Gray Catbird	0.02 $\pm$ 0.02	1.69	●	●		●	●
Northern Mockingbird	0.02 $\pm$ 0.02	1.69					●
Red-shouldered Hawk†	0.02 $\pm$ 0.02	1.69	●	●	○	●	●
Worm-eating Warbler*	0.02 $\pm$ 0.02	1.69	●	●	●	●	●
Canada Goose	0.00 $\pm$ 0.00	0.00		●		○	○
Great Blue Heron	0.00 $\pm$ 0.00	0.00	○	○	○	○	○
Hooded Warbler†	0.00 $\pm$ 0.00	0.00	●		●		○
Northern Bobwhite*	0.00 $\pm$ 0.00	0.00				○	○
Turkey Vulture	0.00 $\pm$ 0.00	0.00	○	○	○	○	○
Yellow-bellied Flycatcher	0.00 $\pm$ 0.00	0.00					○
Barn Swallow				○			
Barred Owl			●		●		
Belted Kingfisher				●			
Black Vulture						○	
Brown Creeper					●		
Chimney Swift*			●		○	○	
Common Grackle			●	●			
Common Peafowl			○				
Eastern Kingbird*			●	●		●	
Fish Crow				●	○		
Grasshopper Sparrow*			●				
Green Heron				●			
House Wren			○				
Kentucky Warbler*				●	●	●	
Marsh Wren						●	
Northern Parula†			●	●	●	●	

Table 9. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Spotsylvania Battlefield, Fredericksburg and Spotsylvania NMP (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
Orchard Oriole†			●	●	●	●	
Palm Warbler				●			
Purple Martin†			○			○	
Red-headed Woodpecker*						●	
Ruby-throated Hummingbird				●	●	●	
Sharp-shinned Hawk				●			
Song Sparrow			●	●		○	
Tree Swallow			○			○	
Veery				●			
White-eyed Vireo†				●	●	●	
Wild Turkey			●				
Willow Flycatcher*					●		

*Partners in Flight Watchlist species, †Partners in Flight Stewardship species, ¹Exotic species

Table 10. Avian forest guild summary and Bird Community Index (BCI) score at Spotsylvania Battlefield, Fredericksburg and Spotsylvania NMP for 2009-2013. Values indicate the average percent guild membership at monitoring locations. Total BCI scores range from 0-1 with 1 having the highest integrity. Ranks are derived from O'Connell et al. (2003). See details on these guild assignments in Appendix A.

	Guild	2009 (n=95)		2010 (n=86)		2011 (n=65)		2012 (n=81)		2013 (n=74)	
		Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
Structural	Forest Interior	40.58	Naturalistic	36.10	Naturalistic	44.13	Naturalistic	43.33	Naturalistic	39.83	Naturalistic
	Pine Associated	0.92	Moderately Disturbed	0.42	Moderately Disturbed	1.20	Moderately Disturbed	0.40	Moderately Disturbed	0.37	Moderately Disturbed
	Urban/Suburban	28.21	Largely Intact	33.57	Largely Intact	24.90	Largely Intact	27.40	Largely Intact	31.16	Largely Intact
Functional	Bark Prober	18.98	Largely Intact	20.98	Naturalistic	21.94	Naturalistic	24.43	Naturalistic	24.28	Naturalistic
	Ground Forager	7.49	Naturalistic	5.88	Largely Intact	10.49	Naturalistic	7.80	Naturalistic	6.80	Largely Intact
	Upper Canopy Forager	23.42	Naturalistic	23.37	Naturalistic	19.04	Naturalistic	21.36	Naturalistic	15.51	Largely Intact
Compositional	Nest Predator/ Brood Parasite	9.97	Largely Intact	15.72	Largely Intact	12.54	Largely Intact	11.32	Largely Intact	13.68	Largely Intact
	Single Brooded	59.70	Naturalistic	56.06	Naturalistic	64.75	Naturalistic	62.19	Naturalistic	58.08	Naturalistic
	Exotic	0.00	Naturalistic	0.00	Naturalistic	0.00	Naturalistic	0.00	Naturalistic	0.00	Naturalistic
Total BCI Score		0.86	Naturalistic	0.86	Naturalistic	0.89	Naturalistic	0.89	Naturalistic	0.83	Naturalistic

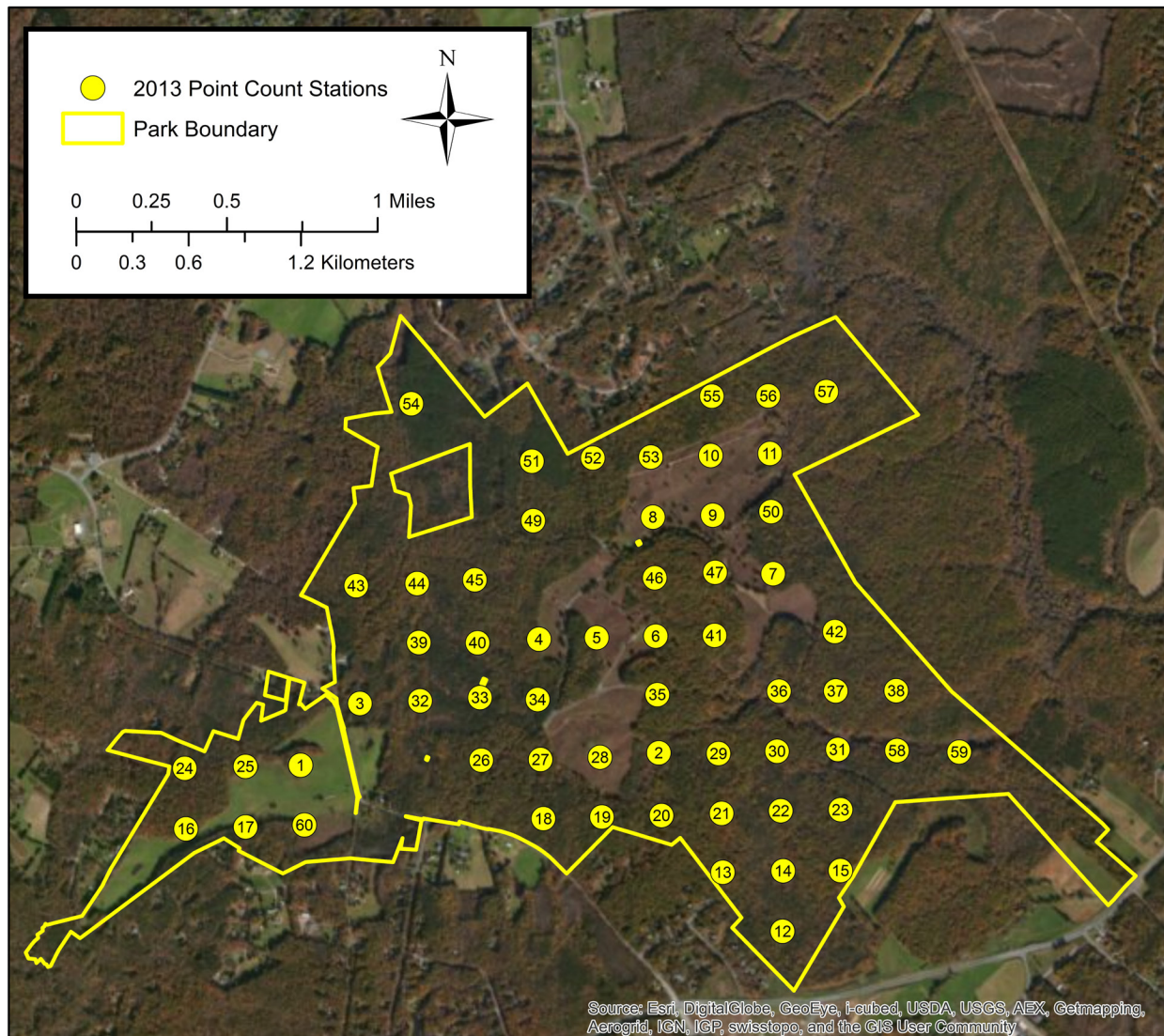


Figure 3. Bird monitoring stations surveyed at Spotsylvania Battlefield, Fredericksburg and Spotsylvania NMP in 2013.

Richmond National Battlefield Park

A total of 56 sampling stations were surveyed at the Malvern Hill and Cold Harbor units of Richmond NBP during the park's fourth season of breeding bird monitoring, including 41 stations in forested habitats and 15 stations in grassland habitats (Figures 4 and 5). Ten volunteers from the local birding community conducted an average of 1.14 surveys per station, producing a total of 64 surveys for the season (Table 2).

Between May and July, 591 birds of 68 species were detected throughout the units (Table 3). Forested habitat had slightly higher species richness than grassland habitat with 60 species occurring in forested habitats and 45 in grassland habitats. The Indigo Bunting had the highest relative abundance, averaging 0.57 birds / station. The Red-eyed Vireo was the most prevalent species, occurring at 42.86% of the stations surveyed (Table 11).

Volunteers detected 25 species considered to be of conservation concern by Partners in Flight (PIF). PIF distinguishes species of concern facing immediate threats as "watchlist" species. "Stewardship" species are representative of avifaunal biomes that may or may not be in immediate danger. Within the units, 11 watchlist species and 14 stewardship species were detected. Six species of concern, including 1 watchlist species (Eastern Wood-Pee-wee) and 5 stewardship species (Acadian Flycatcher, Carolina Chickadee, Carolina Wren, Indigo Bunting, Red-bellied Woodpecker), were among the 10 most abundant species observed (Table 11).

Avian guilds, or groups of species occupying similar ecological niches, can be utilized for assessing responses to environmental changes and ecosystem stressors via bird community assessments, or "indices" (BCIs). Based on a BCI developed for the Piedmont/Coastal Plain region (O'Connell et al. 2003), forested stations surveyed in Malvern Hill and Cold Harbor this year received a ranking of "Naturalistic," which is higher than in 2012 and the same as 2011. Rankings, when broken out by guild, were also higher in 6 out of 9 categories (Table 12). These results, however, are preliminary, and yearly changes may be influenced by both natural and observer variation. Until more data is collected, these initial trends should be treated with caution.

A Resource Brief for Richmond NBP, which may be used as outreach material, can be downloaded as a PDF from the NPS Data Store located on the Integrated Resource Management Application (IRMA) Portal at the following website address:

<https://irma.nps.gov/App/Reference/Profile/2217610>

Table 11. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2010-2013 at Malvern Hill and Cold Harbor, Richmond NBP. Closed circles indicate species detected in a station while open circles indicate species that were only detected as flyovers or incidentals.

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected			
			2010	2011	2012	2013
Indigo Bunting†	0.57 ± 0.15	32.14	●	●	●	●
Red-eyed Vireo	0.54 ± 0.10	42.86	●	●	●	●
Red-bellied Woodpecker†	0.50 ± 0.10	39.29	●	●	●	●
Carolina Wren†	0.46 ± 0.08	41.07	●	●	●	●
Northern Cardinal	0.46 ± 0.09	37.50	●	●	●	●
Acadian Flycatcher†	0.43 ± 0.08	37.50	●	●	●	●
Common Yellowthroat	0.43 ± 0.11	30.36	●	●	●	●
Eastern Wood-Pewee*	0.43 ± 0.08	37.50	●	●	●	●
Carolina Chickadee†	0.41 ± 0.09	30.36	●	●	●	●
Tufted Titmouse	0.39 ± 0.07	39.29	●	●	●	●
Mourning Dove	0.36 ± 0.07	33.93	●	●	●	●
Ovenbird	0.30 ± 0.06	30.36	●	●	●	●
American Crow	0.25 ± 0.07	21.43	●	●	●	●
Pileated Woodpecker†	0.25 ± 0.06	25.00	●	●	●	●
Chipping Sparrow	0.23 ± 0.08	17.86	●	●	●	●
Eastern Bluebird	0.20 ± 0.07	14.29	●	●	●	●
Blue Grosbeak†	0.18 ± 0.08	8.93		●	●	●
Summer Tanager†	0.18 ± 0.05	17.86	●		●	●
American Robin	0.16 ± 0.06	14.29	●	●	●	●
Blue Jay	0.13 ± 0.05	10.71	●	●	●	●
Downy Woodpecker†	0.13 ± 0.04	12.50	●	●	●	●
Killdeer	0.13 ± 0.09	3.57			●	●
White-eyed Vireo†	0.13 ± 0.04	12.50	●	●	●	●
American Goldfinch	0.11 ± 0.04	10.71	○	○	●	●
Blue-gray Gnatcatcher	0.11 ± 0.04	10.71	●	●	●	●
Brown-headed Cowbird	0.11 ± 0.05	8.93	●	○		●
Pine Warbler†	0.11 ± 0.04	10.71	●	●	●	●
White-breasted Nuthatch	0.11 ± 0.05	8.93	●		●	●
Wood Thrush*	0.11 ± 0.04	10.71	●	●	●	●
Yellow-breasted Chat	0.11 ± 0.06	7.14		●	●	●
Field Sparrow*	0.09 ± 0.05	7.14	●	●	●	●
Great Crested Flycatcher	0.09 ± 0.04	8.93	●	●	●	●
Northern Bobwhite*	0.09 ± 0.04	8.93	●	●	●	●
Yellow-billed Cuckoo*	0.09 ± 0.04	8.93	●	●		●
Northern Flicker*	0.07 ± 0.03	7.14	●		●	●
Northern Mockingbird	0.07 ± 0.03	7.14		●	●	●
Prairie Warbler*	0.07 ± 0.04	5.36		●	●	●

Table 11. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2010-2013 at Malvern Hill and Cold Harbor, Richmond NBP (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected			
			2010	2011	2012	2013
Yellow-throated Vireo†	0.07 ± 0.03	7.14	●	●		●
Common Grackle	0.05 ± 0.04	3.57	○	○	○	●
Eastern Phoebe	0.05 ± 0.03	5.36		●	●	●
Red-headed Woodpecker*	0.05 ± 0.03	5.36	●	●	●	●
Turkey Vulture	0.05 ± 0.05	1.79	●	○	●	●
Belted Kingfisher	0.04 ± 0.04	1.79	●			●
Bobolink	0.04 ± 0.03	3.57				●
Cedar Waxwing	0.04 ± 0.03	3.57				●
Hairy Woodpecker	0.04 ± 0.03	3.57	●		●	●
House Finch	0.04 ± 0.04	1.79			○	●
Ruby-throated Hummingbird	0.04 ± 0.03	3.57	○		●	●
Wild Turkey	0.04 ± 0.03	3.57	●	●	●	●
Yellow-throated Warbler	0.04 ± 0.04	1.79	●		●	●
Barn Swallow	0.02 ± 0.02	1.79		○	○	●
European Starling ¹	0.02 ± 0.02	1.79	●		○	●
Grasshopper Sparrow*	0.02 ± 0.02	1.79				●
Gray Catbird	0.02 ± 0.02	1.79	●			●
Great Blue Heron	0.02 ± 0.02	1.79	●	○	●	●
Great Horned Owl	0.02 ± 0.02	1.79			●	●
Horned Lark	0.02 ± 0.02	1.79				●
House Sparrow	0.02 ± 0.02	1.79				●
Orchard Oriole†	0.02 ± 0.02	1.79		●	●	●
Red-shouldered Hawk†	0.02 ± 0.02	1.79	●	●	●	●
Red-tailed Hawk	0.02 ± 0.02	1.79	○	●		●
Red-winged Blackbird	0.02 ± 0.02	1.79	●	○		●
Scarlet Tanager	0.02 ± 0.02	1.79	●	●	●	●
Tree Swallow	0.02 ± 0.02	1.79		○	○	●
White-throated Sparrow	0.02 ± 0.02	1.79				●
Yellow-rumped Warbler	0.02 ± 0.02	1.79				●
Bald Eagle			○			
Black Vulture				●	●	
Blue-headed Vireo				●		
Brown Thrasher*			●		●	○
Canada Goose			●	○	●	
Chimney Swift*			●	○	●	○
Eastern Meadowlark*				○	○	
Hooded Warbler†			●			

Table 11. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2010-2013 at Malvern Hill and Cold Harbor, Richmond NBP (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected			
			2010	2011	2012	2013
Kentucky Warbler*			●			
Lesser Yellowlegs			●			
Louisiana Waterthrush			●		●	
Mallard			●			
Northern Parula†				●		
Osprey			●		○	
Purple Martin†				○		
Wood Duck			●	○		

*Partners in Flight Watchlist species, †Partners in Flight Stewardship species, ¹Exotic species

Table 12. Avian forest guild summary and Bird Community Index (BCI) score for 2010-2013 at Malvern Hill and Cold Harbor, Richmond NBP. Values indicate the average percent guild membership at monitoring locations. Total BCI scores range from 0-1 with 1 having the highest integrity. Ranks are derived from O'Connell et al. (2003). See details on these guild assignments in Appendix A.

		2010 (n=22)		2011 (n=15)		2012 (n=26)		2013 (n=44)	
Guild		Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
Structural	Forest Interior	30.73	Naturalistic	25.63	Largely Intact	16.37	Moderately Disturbed	25.30	Largely Intact
	Pine Associated	0.58	Moderately Disturbed	2.08	Largely Intact	2.24	Largely Intact	2.22	Largely Intact
	Urban/Suburban	40.61	Largely Intact	27.83	Largely Intact	63.22	Humanistic	39.83	Largely Intact
Functional	Bark Prober	23.58	Naturalistic	25.16	Naturalistic	16.62	Largely Intact	21.22	Naturalistic
	Ground Forager	6.70	Largely Intact	6.26	Largely Intact	3.29	Largely Intact	5.86	Largely Intact
	Upper Canopy Forager	15.99	Largely Intact	24.99	Naturalistic	5.61	Moderately Disturbed	13.65	Largely Intact
Compositional	Nest Predator/Brood Parasite	24.89	Humanistic	15.13	Largely Intact	27.03	Humanistic	14.03	Largely Intact
	Single Brooded	44.28	Largely Intact	47.35	Naturalistic	28.54	Moderately Disturbed	50.11	Naturalistic
	Exotic	5.26	Moderately Disturbed	0.00	Naturalistic	0.00	Naturalistic	0.27	Largely Intact
Total BCI Score		0.69	Largely Intact	0.86	Naturalistic	0.58	Moderately Disturbed	0.81	Naturalistic

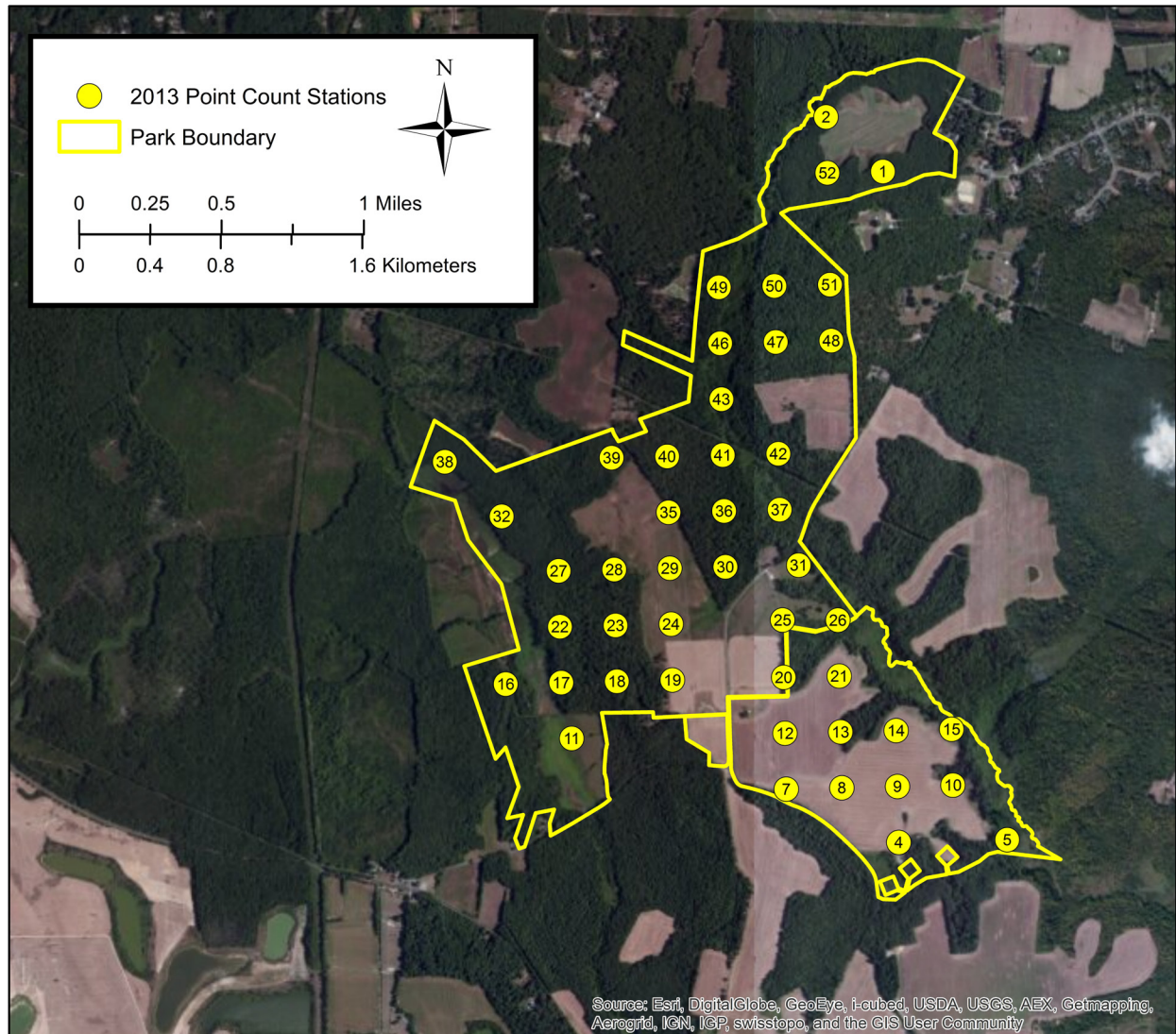


Figure 4. Bird monitoring stations surveyed at Malvern Hill, Richmond NBP in 2013.

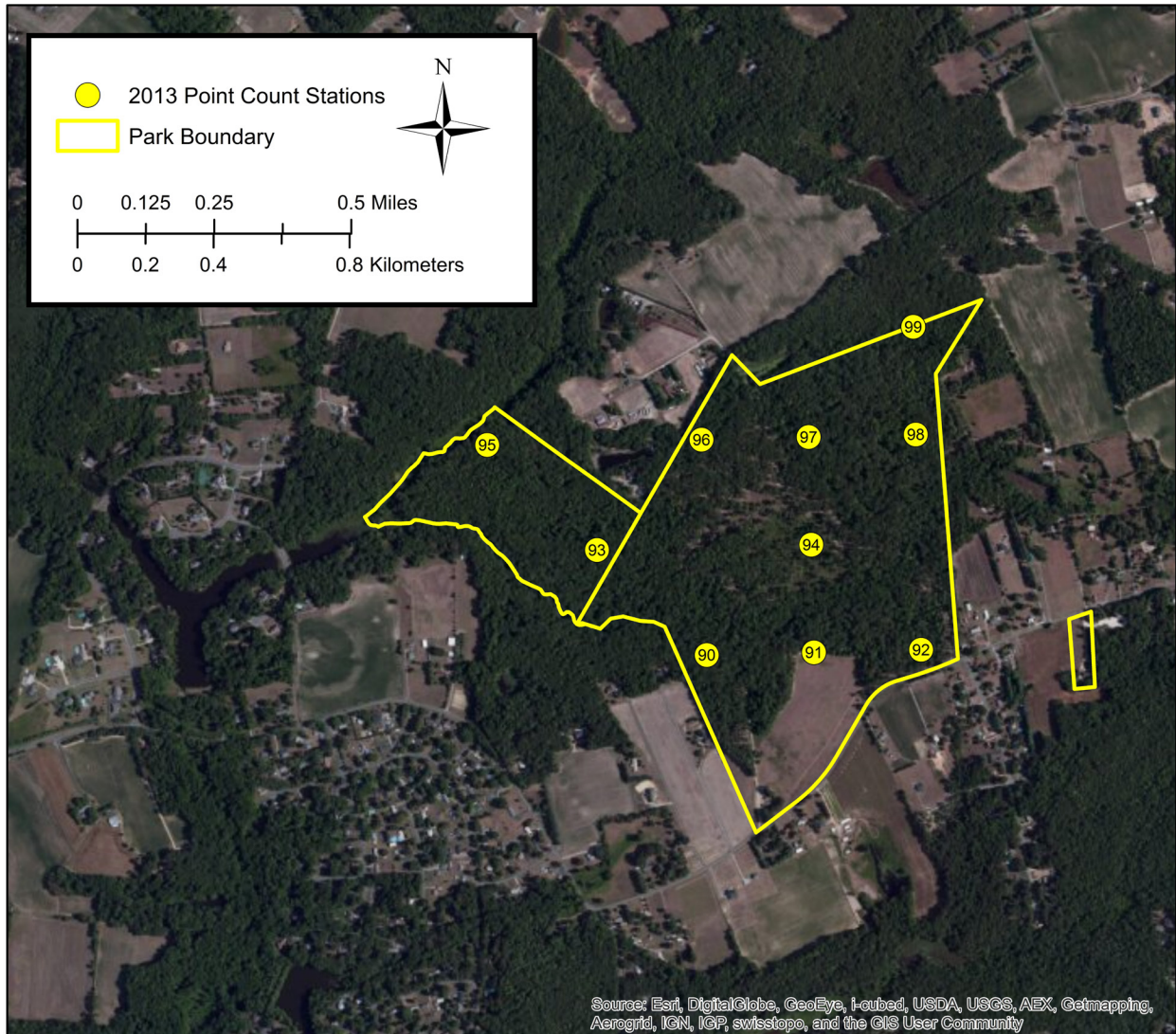


Figure 5. Bird monitoring stations surveyed at Cold Harbor, Richmond NBP in 2013.

Valley Forge National Historical Park

A total of 76 stations were surveyed at Valley Forge NHP during the park's fifth season of breeding bird monitoring, including 37 stations in forested habitats and 39 stations in grassland habitats (Figure 6). Ten volunteer birders from the local birding community conducted an average of 2.37 surveys per station, producing a total of 180 surveys for the season (Table 2).

Between May and July, a total of 2,864 birds of 69 species were detected throughout the park. The number of species was similar across habitat types with 57 different species detected at forested stations, versus 61 species detected at grassland stations (Table 3).

Two species were detected this year that were not in previous years including the Ruby-throated Hummingbird and Pine Warbler. The European Starling was the most abundant species, averaging 2.24 birds per station, while the American Robin was the most prevalent species, occurring at 82.89% of stations surveyed (Table 13).

Volunteers detected 23 species considered to be of conservation concern by Partners in Flight (PIF). PIF distinguishes species of concern facing immediate threats as "watchlist" species. "Stewardship" species are representative of avifaunal biomes that may or may not be in immediate danger. Within the park, 11 watchlist species and 12 stewardship species were detected. Four species of concern, including two watchlist species (Eastern Meadowlark and Field Sparrow) and 2 stewardship species (Carolina Chickadee and Red-bellied Woodpecker), were among the 10 most abundant species (Table 13).

Avian guilds, or groups of species occupying similar ecological niches, can be utilized for assessing response to environmental changes and ecosystem stressors via bird community assessments, or "indices" (BCIs). Based on a BCI developed for the Piedmont/Coastal Plain region (O'Connell et al. 2003), forested stations surveyed at the park this year received the second highest ranking of "largely intact," which is consistent with the 2009-2012 rankings for the park (Table 14). All guild ranks remained consistent with last year's rankings with the exception of the Bark Prober and Ground Forager guilds, which decreased one rank from last year, and the Pine Associated guild which increased one rank from previous years.

A Resource Brief for Valley Forge NHP, which may be used as outreach material, can be downloaded as a PDF from the NPS Data Store located on the Integrated Resource Management Application (IRMA) Portal at the following website address:

<https://irma.nps.gov/App/Reference/Profile/2217611>

Table 13. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Valley Forge NHP. Closed circles indicate species that were detected in a station while open circles indicate species that were only detected as flyovers or incidentals.

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
European Starling ¹	2.24 $\pm$ 0.66	35.53	●	●	●	●	●
Red-winged Blackbird	1.66 $\pm$ 0.32	43.42	●	●	●	●	●
American Robin	1.39 $\pm$ 0.11	82.89	●	●	●	●	●
Blue Jay	1.21 $\pm$ 0.11	71.05	●	●	●	●	●
Red-bellied Woodpecker†	0.96 $\pm$ 0.08	73.68	●	●	●	●	●
Song Sparrow	0.96 $\pm$ 0.12	56.58	●	●	●	●	●
Field Sparrow*	0.92 $\pm$ 0.15	42.11	●	●	●	●	●
Tufted Titmouse	0.79 $\pm$ 0.10	56.58	●	●	●	●	●
Eastern Meadowlark*	0.72 $\pm$ 0.14	39.47	●	●	●	●	●
Carolina Chickadee†	0.68 $\pm$ 0.14	39.47	●	●	●	●	●
Gray Catbird	0.68 $\pm$ 0.11	42.11	●	●	●	●	●
Carolina Wren†	0.61 $\pm$ 0.09	46.05	●	●	●	●	●
Baltimore Oriole*	0.57 $\pm$ 0.10	40.79	●	●	●	●	●
Canada Goose	0.55 $\pm$ 0.41	3.95	●	●	●	●	●
Red-eyed Vireo	0.51 $\pm$ 0.08	39.47	●	●	●	●	●
Wood Thrush*	0.50 $\pm$ 0.09	32.89	●	●	●	●	●
Eastern Towhee*	0.49 $\pm$ 0.10	31.58	●	●	●	●	●
Northern Mockingbird	0.49 $\pm$ 0.09	30.26	●	●	●	●	●
Northern Cardinal	0.45 $\pm$ 0.08	36.84	●	●	●	●	●
American Goldfinch	0.42 $\pm$ 0.08	28.95	●	●	●	●	●
Eastern Wood-Pewee*	0.39 $\pm$ 0.07	34.21	●	●	●	●	●
White-breasted Nuthatch	0.39 $\pm$ 0.07	31.58	●	●	●	●	●
American Crow	0.34 $\pm$ 0.08	22.37	●	●	●	●	●
Eastern Kingbird*	0.32 $\pm$ 0.08	21.05	●	●	●	●	●
Common Yellowthroat	0.30 $\pm$ 0.06	26.32	●	●	●	●	●
Orchard Oriole†	0.30 $\pm$ 0.07	22.37	●	●	●	●	●
Cedar Waxwing	0.28 $\pm$ 0.13	11.84		●	●	●	●
Chimney Swift*	0.28 $\pm$ 0.10	13.16	●	●	●	●	●
Great Crested Flycatcher	0.28 $\pm$ 0.06	22.37	●	●	●	●	●
Indigo Bunting†	0.28 $\pm$ 0.07	21.05	●	●	●	●	●
Mourning Dove	0.28 $\pm$ 0.08	17.11	●	●	●	●	●
Downy Woodpecker†	0.24 $\pm$ 0.06	21.05	●	●	●	●	●
Northern Flicker*	0.22 $\pm$ 0.05	21.05	●	●	●	●	●
House Wren	0.20 $\pm$ 0.06	15.79	●	●	●	●	●
Barn Swallow	0.18 $\pm$ 0.06	14.47	●	●	●	●	●
Tree Swallow	0.16 $\pm$ 0.06	10.53	●	●	●	●	●
Chipping Sparrow	0.14 $\pm$ 0.04	13.16	●	●	●	●	●

Table 13. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Valley Forge NHP (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
Common Grackle	0.14 $\pm$ 0.06	7.89	●	●	●	●	●
Scarlet Tanager	0.14 $\pm$ 0.04	13.16	●	●	●	●	●
Red-tailed Hawk	0.12 $\pm$ 0.05	7.89	●	●	●	●	●
Yellow Warbler	0.11 $\pm$ 0.04	7.89	●	●	●	●	●
Eastern Bluebird	0.09 $\pm$ 0.03	9.21	●	●	●	●	●
Eastern Phoebe	0.09 $\pm$ 0.04	7.89	●	●	●	●	●
Mallard	0.09 $\pm$ 0.06	3.95	●	●	●	●	●
Pileated Woodpecker†	0.09 $\pm$ 0.04	7.89		●	●	●	●
Warbling Vireo	0.09 $\pm$ 0.03	9.21	●	●	●	●	●
Brown-headed Cowbird	0.08 $\pm$ 0.04	6.58	●	●	●	●	●
American Kestrel	0.05 $\pm$ 0.03	3.95	●	●	●	●	●
Blue-gray Gnatcatcher	0.04 $\pm$ 0.02	3.95	●	●	●	●	●
Yellow-billed Cuckoo*	0.04 $\pm$ 0.02	3.95		●	●	●	●
Cooper's Hawk	0.03 $\pm$ 0.02	2.63	○		○		●
House Finch	0.03 $\pm$ 0.02	2.63	●	●	●	●	●
Northern Parula†	0.03 $\pm$ 0.03	1.32			●		●
Turkey Vulture	0.03 $\pm$ 0.02	2.63	●	●	●	●	●
Willow Flycatcher*	0.03 $\pm$ 0.03	1.32	●	●	●	●	●
Acadian Flycatcher†	0.01 $\pm$ 0.01	1.32		●			●
American Coot	0.01 $\pm$ 0.01	1.32		●			●
Great Blue Heron	0.01 $\pm$ 0.01	1.32	●	●	○	●	●
Green Heron	0.01 $\pm$ 0.01	1.32			○		●
Hairy Woodpecker	0.01 $\pm$ 0.01	1.32	●	●	●	●	●
Pine Warbler†	0.01 $\pm$ 0.01	1.32					●
Yellow-throated Vireo†	0.01 $\pm$ 0.01	1.32				●	●
Belted Kingfisher	0.00 $\pm$ 0.00	0.00	●	●	●	●	○
Black Vulture	0.00 $\pm$ 0.00	0.00	●	●	●	○	○
Blue Grosbeak†	0.00 $\pm$ 0.00	0.00					○
Rock Pigeon	0.00 $\pm$ 0.00	0.00		○	○	○	○
Ruby-throated Hummingbird	0.00 $\pm$ 0.00	0.00					○
Sharp-shinned Hawk	0.00 $\pm$ 0.00	0.00		○			○
Wood Duck	0.00 $\pm$ 0.00	0.00		○	●	○	○
American Redstart				●	●	●	
Bank Swallow				●	○	○	
Black-billed Cuckoo*				○	●	●	
Blue-winged Warbler*			●	●			
Bobolink					●		

Table 13. Summary statistics for point count surveys conducted in 2013 and patterns of bird occurrence during 2009-2013 at Valley Forge NHP (continued).

Species	Abundance ($\bar{x} \pm SE$)	Occurrence (% stations)	Detected				
			2009	2010	2011	2012	2013
Broad-winged Hawk*					○		
Brown Thrasher*			●	●	●		
Common Merganser						○	
Double-crested Cormorant					●		
Eastern Screech-Owl				●			
Fish Crow				●			
Grasshopper Sparrow*					●	●	
House Sparrow						●	
Killdeer				●			
Louisiana Waterthrush					●		
Mute Swan					○		
Northern Rough-winged Swallow					●	●	
Ovenbird			●	●	●	●	
Prairie Warbler*					●	●	
Rose-breasted Grosbeak					●		
Veery			●	●			
White-eyed Vireo†			●	●			
Yellow-throated Warbler			●				

*Partners in Flight Watchlist species, †Partners in Flight Stewardship species, †Exotic species

Table 14. Avian forest guild summary and Bird Community Index (BCI) score for 2009-2013 at Valley Forge NHP. Values indicate the average percent guild membership at monitoring locations. Total BCI scores range from 0-1 with 1 having the highest integrity. Ranks are derived from O'Connell et al. (2003). See details on these guild assignments in Appendix A.

		2009 (n=38)		2010 (n=47)		2011 (n=88)		2012 (n=69)		2013 (n=87)	
Guild		Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Percent	Rank
Structural	Forest Interior	23.00	Largely Intact	23.21	Largely Intact	23.13	Largely Intact	23.70	Largely Intact	24.38	Largely Intact
	Pine Associated	0.00	Humanistic	0.00	Humanistic	0.00	Humanistic	0.00	Humanistic	0.14	Moderately Disturbed
	Urban/Suburban	50.27	Moderately Disturbed	51.55	Moderately Disturbed	48.08	Moderately Disturbed	52.01	Moderately Disturbed	49.56	Moderately Disturbed
Functional	Bark Prober	17.12	Largely Intact	20.57	Naturalistic	20.04	Naturalistic	20.74	Naturalistic	19.13	Largely Intact
	Ground Forager	0.36	Moderately Disturbed	0.47	Moderately Disturbed	0.57	Moderately Disturbed	1.09	Moderately Disturbed	0.00	Humanistic
	Upper Canopy Forager	15.99	Largely Intact	11.52	Moderately Disturbed	15.39	Largely Intact	13.53	Largely Intact	13.38	Largely Intact
Compositional	Nest Predator/ Brood Parasite	23.24	Humanistic	20.70	Moderately Disturbed	16.87	Moderately Disturbed	21.73	Moderately Disturbed	17.93	Moderately Disturbed
	Single Brooded	39.46	Largely Intact	38.44	Largely Intact	40.34	Largely Intact	38.96	Largely Intact	39.30	Largely Intact
	Exotic	0.00	Naturalistic	0.35	Largely Intact	0.69	Largely Intact	0.00	Naturalistic	0.00	Naturalistic
Total BCI Score		0.61	Largely Intact	0.61	Largely Intact	0.64	Largely Intact	0.67	Largely Intact	0.64	Largely Intact

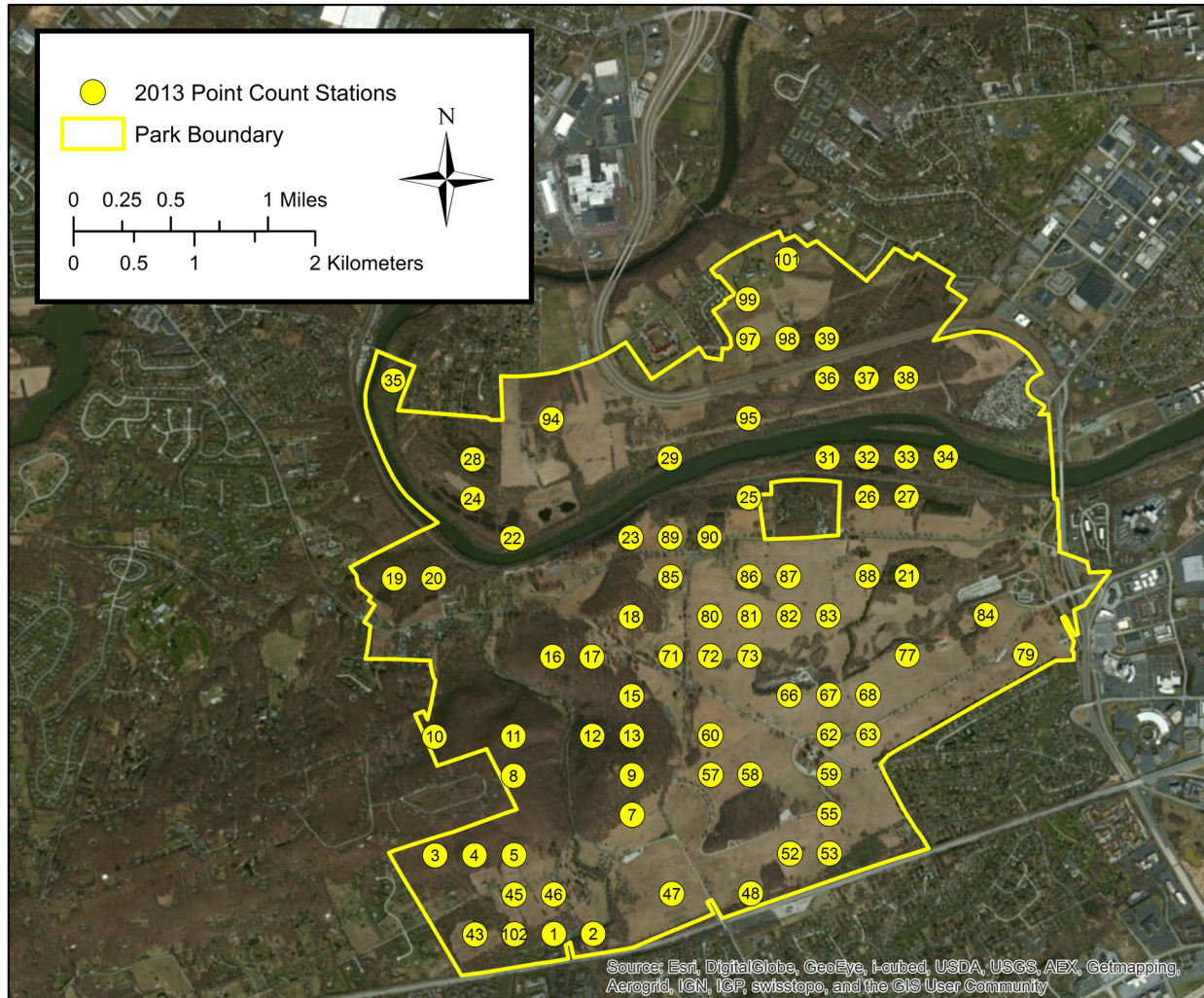


Figure 6. Bird monitoring stations surveyed at Valley Forge NHP in 2013.

Literature Cited

- Buckland, S. T. 1987. On the variable circular plot method of estimating animal density. *Biometrics* 43:363-384.
- Comiskey, J. A. and K. K. Callahan. 2008. Mid-Atlantic Network vital signs monitoring plan. Natural Resource Report NPS/MIDN/NRR—2008/071. National Park Service, Fort Collins, Colorado.
- Comiskey, J. A., J. P. Schmit, and G. Tierney. 2009. Mid-Atlantic Network forest vegetation monitoring protocol. Natural Resource Report NPS/ MIDN/NRR—2009/119. National Park Service, Fort Collins, Colorado.
- Faccio, S., B. R. Mitchell, and P. S. Pooler. 2010. Breeding landbird monitoring protocol: Northeast Temperate Network. Natural Resource Report NPS/NETN/NRR—2010/198. National Park Service, Fort Collins, Colorado.
- Goodwin, S. E. and W. G. Shriver. 2010. Avian monitoring in the National Capital Region Network: 2007 – 2009. Natural Resource Draft Technical Report. National Park Service, Fort Collins, Colorado.
- Karr, J. R. 1991. Biological integrity - a long-neglected aspect of water-resource management. *Ecological Applications* 1:66-84.
- National Park Service (NPS). 1999. Natural Resource Challenge: The National Park Service's action plan for preserving natural resources. National Park Service, Washington, D.C.
- O'Connell, T. J., R. P. Brooks, M. J. Lanzone, and J. A. Bishop. 2003. A bird community index for the Mid-Atlantic Piedmont and Coastal Plain. Final Report to the USGS Patuxent Wildlife Research Center. Report No. 2003-02, Penn State Cooperative Wetlands Center, University Park, Pennsylvania.
- Patterson, K. D. 2008. Vegetation classification and mapping at Booker T. Washington National Monument, Virginia. Technical Report NPS/ NER/NRTR—2008/100, National Park Service, Philadelphia, Pennsylvania.
- Podniesinski, G. S., L. A. Sneddon, J. Lundgren, H. Devine, B. Slocumb, and F. Koch. 2005b. Vegetation classification and mapping of Valley Forge National Historical Park. Technical Report NPS/NER/NRTR—2005/028, National Park Service, Philadelphia, Pennsylvania.
- Ralph, C. J., S. Droege, and J. R. Sauer. 1995. Managing and monitoring birds using point counts: standards and applications. USDA Forest Service Gen. Tech. Rep. PSW-GTR-149, Albany, California.
- Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Inigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, and T. C. Will. 2004.

Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, New York.

Severinghaus, W. D. 1981. Guild theory development as a mechanism for assessing Environmental impact. *Environmental Management* 5:187-190.

Taverna, K. and K. D. Patterson. 2008. Vegetation classification and mapping at Fredericksburg and Spotsylvania National Military Park. Technical Report NPS/NER/NRTR—2008/126, National Park Service, Philadelphia, Pennsylvania.

Verner, J. 1984. The guild concept applied to management of bird populations. *Environmental Management* 8:1-13.

Appendix A. Forested guild assignments

Several guild categories were considered in the development of the forested guild BCI and ultimately, only a subset of these guilds was found to be responsive to forest structure change (O’Connell et al. 2003). For that reason, some of the guild categories below do not cover the guild a species belongs to. For example, Acadian Flycatchers are aerial salliers under the functional guild category. As this guild is not part of the final structure of the BCI, this space is left blank.

Species	Guild		
	Structural	Functional	Compositional
Acadian Flycatcher	forest interior		single brood
American Crow	urban/suburban		nest predator/brood parasite
American Goldfinch	urban/suburban		
American Redstart	forest interior		single brood
American Robin	urban/suburban		
Bachmans Sparrow	pine associated		
Baltimore Oriole		upper canopy forager	single brood
Black-and-White Warbler	forest interior	bark prober	single brood
Black-billed Cuckoo			single brood
Black-capped Chickadee		bark prober	single brood
Black-throated Green Warbler		upper canopy forager	single brood
Blue Jay	urban/suburban		nest predator/brood parasite
Blue-gray Gnatcatcher		upper canopy forager	
Boat-tailed Grackle			nest predator/brood parasite
Bobolink			single brood
Brown Thrasher			single brood
Brown-headed Nuthatch	pine associated		single brood
Carolina Chickadee		bark prober	single brood
Carolina Wren	urban/suburban		
Cedar Waxwing	urban/suburban		
Cerulean Warbler	forest interior	upper canopy forager	single brood
Chimney Swift	urban/suburban		single brood
Chipping Sparrow	urban/suburban		
Common Grackle	urban/suburban		nest predator/brood parasite; single brood
Downy Woodpecker	urban/suburban	bark prober	
Eastern Kingbird			single brood
Eastern Towhee	forest interior		
Eastern Wood-Pewee	forest interior		single brood
Eurasian Collared Dove	urban/suburban		exotic
European Starling	urban/suburban		nest predator/brood parasite; exotic
Fish Crow			nest predator/brood parasite; single brood
Gray Catbird	urban/suburban		
Great Crested Flycatcher			single brood
Hairy Woodpecker	forest interior	bark prober	single brood

Species	Guild		
	Structural	Functional	Compositional
Hooded Warbler	forest interior		
House Finch	urban/suburban		exotic
House Sparrow	urban/suburban		nest predator/brood parasite; exotic
Kentucky Warbler	forest interior	ground forager	single brood
Loggerhead Shrike			nest predator/brood parasite
Louisiana Waterthrush	forest interior	ground forager	single brood
Mourning Dove	urban/suburban		
Northern Cardinal	urban/suburban		
Northern Flicker		ground forager	single brood
Northern Mockingbird	urban/suburban		
Northern Parula	forest interior	upper canopy forager	single brood
Northern Rough-winged Swallow			single brood
Orchard Oriole			single brood
Ovenbird	forest interior	ground forager	single brood
Pileated Woodpecker	forest interior	bark prober	single brood
Pine Warbler	pine associated	bark prober	
Prairie Warbler			single brood
Purple Martin	urban/suburban		single brood
Red-bellied Woodpecker	urban/suburban		nest predator/brood parasite
Red-cockaded Woodpecker	pine associated	bark prober	single brood
Red-eyed Vireo		upper canopy forager	single brood
Red-headed Woodpecker			nest predator/brood parasite
Rock Dove/Pigeon	urban/suburban		exotic
Rose-Breasted Grosbeak	forest interior	upper canopy forager	
Ruby-throated Hummingbird	urban/suburban		
Scarlet Tanager	forest interior	upper canopy forager	single brood
Song Sparrow	urban/suburban		
Summer Tanager		upper canopy forager	single brood
Swainsons Warbler	forest interior	ground forager	single brood
Tree Swallow			single brood
Tufted Titmouse		bark prober	
Veery	forest interior		single brood
Warbling Vireo		upper canopy forager	
White-breasted Nuthatch	forest interior	bark prober	single brood
Willow Flycatcher			single brood
Wood Thrush	forest interior		single brood
Worm-eating Warbler	forest interior		single brood
Yellow Warbler			single brood
Yellow-billed Cuckoo		upper canopy forager	single brood
Yellow-throated Vireo	forest interior	upper canopy forager	single brood
Yellow-throated Warbler			single brood

Guild Descriptions

Individual guilds are broadly categorized as “specialist” or “generalist” based on their relationship to specific elements of ecosystem structure, function, and composition (O’Connell 2003). A specialist can be a species with a narrow range of habitat tolerances, while a generalist can be a species with a wide range of habitat tolerances. For our purposes, specialist guilds may be thought of as “guilds indicative of a high-integrity condition” while generalist guilds are “guilds indicative of a low-integrity condition.”

Structural Guilds

Species guilds based on nesting and/or foraging habitat requirements:

Forest Interior (Specialist)

This guild includes species that require large blocks of interior forest. Few to none of the species in this guild are typically supported in small forest fragments (<10ha; Robbins et al. 1989, Freemark and Collins 1992) and numbers typically decline with increasing human disturbance (O’Connell 2003, Glennon and Porter 2005).

Examples include the Ovenbird, Louisiana Waterthrush, Yellow-throated Warbler, and Eastern Wood Peewee.

Pine Associated (Specialist)

This guild is comprised of species that require pine forest or plantations for foraging and nesting. The proportion of pine associated guild species is typically low compared to other species, but is positively correlated with habitat quality.

Examples include the Pine Warbler, Brown-headed Nuthatch, and Red-Cockaded Woodpecker.

Urban/Suburban (Generalist)

These are species that typically occur in human dominated environments. They nest and forage in a wide range of habitats and many prefer edges. Exotic species fall in this guild and hence large proportions of these species are indicative of poor-quality habitat.

Northern Mockingbird, House Finch, Gray Catbird, and Song Sparrow are all examples of Urban/Suburban guild species.

Functional Guilds

Species guilds based on foraging habit:

Bark Prober (Specialist)

Insectivorous species that primarily forage via bark probing fall in this guild. They require standing snags, large diameter coarse woody debris (CWD), and/or mature trees with deeply furrowed or flaking bark which provide substrates that support abundant insect populations. Increasing proportions of these guilds indicate higher forest integrity.

Examples include the woodpeckers, nuthatches, and chickadees.

Upper Canopy Forager (Specialist)

This guild includes species that forage high in the forest canopy. These species are typically restricted to mature forests and many are considered forest interior obligates. The majority of the species in this guild are insectivorous warblers. Like the Forest Interior guild the proportion of species in this guild increases with forest integrity.

Examples of species in this guild are the Baltimore Oriole, Black-throated Green Warbler, Blue-gray Gnatcatcher, and Cerulean Warbler.

Ground Forager (Specialist)

Species that primarily forage by gleaning insects from the ground fall into this guild. They include specialized insectivores that pick insects from the leaf litter or directly from the ground. Like species in the Pine Associated guild, numbers of these species are low and hence detections are difficult to rare, but higher proportions of these species are indicative of good forest integrity.

The Kentucky Warbler, Louisiana Waterthrush, Northern Flicker, and Swainsons Warbler are examples of species form this guild.

Compositional Guilds

Species guilds based on factors that are not functional or structural (e.g. interspecific dynamics, breeding phenology):

Single-brooded (Specialist)

This guild is comprised of species that typically raise only one brood per breeding season. Many single-brooded species are restricted to interior forest habitat, and are absent from smaller forest fragments due to increased competition and higher rates of predation and nest parasitism associated with edge habitats (Freemark and Collins 1992). Hence, proportional species richness for this guild increases with forest integrity.

Species in this guild include Red-eyed Vireos, Tree Swallows, Yellow-billed Cuckoos, and Wood Thrush.

Nest Predator / Brood Parasite (Generalist)

This guild includes species that are nest predators or brood parasites. Nest predators and brood parasites have been shown to negatively affect the distribution, abundance, and nest success of other bird species, particularly neotropical migrants (Wilcove 1985, Robinson et al. 1993), and these effects increase significantly in fragmented and edge habitats (Robinson et al. 1995). Hence high proportions of species in this guild are indicative of poor forest integrity.

Many of the Corvids fall into this guild along with European Starlings, Red-bellied Woodpeckers, and Red-headed Woodpeckers.

Exotic (Generalist)

This guild is comprised of species that are not native to the study region. Typically edge-loving, generalists, species in this guild are indicative of poor forest integrity. Additionally, species in this guild often disrupt natural communities and compete with native species for nesting sites.

Species such as the House Finch, Rock Dove, and European Starling fall in this guild.

Literature Cited

- Freemark, K. and B. Collins. 1992. Landscape ecology of birds breeding in temperate forest fragments. Pages 443-454 *in* Hagan, J. M. III, Johnston D. W., editors. Ecology and Conservation of Neotropical Migrant Landbirds. Smithsonian Institution Press, Washington D.C.
- Glennon, M. J. and W. F. Porter. 2005. Effects of land use management on biotic integrity: An investigation of bird communities. *Biological Conservation* 126:499-511.
- O'Connell, T. J., R. P. Brooks, M. J. Lanzone, and J. A. Bishop. 2003. A bird community index for the Mid-Atlantic Piedmont and Coastal Plain. Final Report to the USGS Patuxent Wildlife Research Center. Report No. 2003-02, Penn State Cooperative Wetlands Center, University Park, Pennsylvania.
- Robinson, S. K., J. A. Grybowski, S. I. Rothstein, M. C. Brittingham, L. J. Petit, and F. R. Thompson III. 1993. Management implications of cowbird parasitism for Neotropical 124 migrant songbirds. Pages 93-102 *in* D. M. Finch and P. W. Stangel, editors. Status and management of Neotropical migratory birds. General technical report RM-229. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado.
- Robinson, S. K., F. R. Thompson III, T. M. Donovan, D. Whitehead, and J. Faaborg. 1995. Regional forest fragmentation and the nesting success of migratory birds. *Science* 267:1987-1990.
- Wilcove, D. S. 1985. Nest predation in forest tracts and the decline of migratory songbirds. *Ecology* 66:1211-1314.

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