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Natural Resource Stewardship and Science

Breeding Bird Monitoring

Fredericksburg and Spotsylvania National Military Park
2014–2019 Summary Report

Natural Resource Data Series NPS/MIDN/NRDS—2020/1276



ON THE COVER
Sunrise over the Spotsylvania unit of Fredericksburg and Spotsylvania National Military Park
By Mark J. Johnson, NPS

Breeding Bird Monitoring

Fredericksburg and Spotsylvania National Military Park 2014–2019 Summary Report

Natural Resource Data Series NPS/MIDN/NRDS—2020/1276

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U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Contents

Page

Figures....iv

Tables....vi

Executive Summary....vii

Acknowledgments....viii

List of Acronyms....ix

Introduction....1

Methods....3

Monitoring....3

Metrics....3

Results....4

Number of Species....4

Relative Abundance....5

Percent Occurrence....7

Species of Concern....9

Ecological Integrity Metrics....10

Survey Effort....11

Survey Effort Maps....13

Literature Cited....19

Appendix A....21

Figures

Page

Figure 1. Mid-Atlantic Network parks and their associated Bird Conservation Region (BCR). 2

Figure 2. Species Richness detected at breeding bird monitoring points at Fredericksburg and Spotsylvania National Military Park for the years 2009–2019. 4

Figure 3. Mean ± SE number of individuals detected at breeding bird monitoring points at Fredericksburg and Spotsylvania National Military Park for the years 2009–2019. 5

Figure 4. Ten most abundant species detected across all monitoring points during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 6

Figure 5. Ten most abundant species detected at forested points during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 6

Figure 6. Ten most abundant species detected at grassland points during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 7

Figure 7. Ten species with the highest percent occurrence of monitoring points detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 8

Figure 8. Ten species with the highest percent occurrence of forested monitoring points detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 8

Figure 9. Ten species with the highest percent occurrence of grassland monitoring points detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 9

Figure 10. Mean abundance of species of regional concern detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. 10

Figure 11. Percent occurrence of species of regional concern detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019 10

Figure 12. Bird Community Index (BCI) for forest points monitored at Fredericksburg and Spotsylvania National Military Park for the years 2009–2019. 11

Figure 13. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2014 13

Figures (continued)

Page

Figure 14. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2015.....14

Figure 15. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2016.....15

Figure 16. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2017.....16

Figure 17. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2018.....17

Figure 18. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2019.....18

Tables

Page

Table 1. Number of volunteer participants at all participating parks in the Mid-Atlantic Network Breeding Bird Monitoring Program for 2009–2019. 12

Table 2. Summary of breeding bird monitoring volunteer survey effort for Fredericksburg and Spotsylvania National Military Park for all years. 12

Table A1. Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). 21

Table A2. Percent occurrence for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). 26

Executive Summary

The Mid-Atlantic Network (MIDN) of the National Park Service's Inventory and Monitoring Division (IMD) was established to serve 10 national parks in Pennsylvania and Virginia. The MIDN breeding bird protocol is administered by Mid-Atlantic Network staff in cooperation with the Natural Resource Management (NRM) staff of each participating park and utilizes citizen scientists to aid in data collection.

The primary objectives of this protocol are to determine the status and long-term trends in breeding bird species composition, relative abundance, and occupancy, and to evaluate changes in bird populations relative to park management regimes. Protocol procedures were developed to meet protocol objectives, address resource management needs, and provide opportunities for citizen scientists to contribute significantly to their local park and the Mid-Atlantic Network as a whole.

This report summarizes the data collected from 2009 through 2019, with a focus on 2014 through 2019, for Fredericksburg and Spotsylvania National Military Park. Detailed results for 2009 through 2013 can be found in previous publications by the MIDN. This report contains metrics on survey effort, species richness, abundance, occupancy, and the integrity of the forest bird community, as measured by a forest Bird Conservation Index (BCI).

Acknowledgments

We extend thanks to the Region 1 bird monitoring working group for helping with the development of reporting metrics for this report. Jim Comiskey, Jeb Wofford, and Nathan Dammeyer provided valuable editorial comments. We would also like to thank our park resource managers and staff, including Kristen Allen, Tim Blumenschine, Amy Ruhe, Kate Jensen, Gregg Kneipp, and Timbo Sims for their continued support for the implementation of the Mid-Atlantic Network breeding bird monitoring program. Finally, the Mid-Atlantic Network's breeding bird monitoring program at Fredericksburg and Spotsylvania National Military Park would not be successful without the help of numerous volunteers. We sincerely thank our dedicated volunteers for performing the often difficult field work to gather the data summarized in this report:

- Beverly Arnold
- Andrew Dolby
- Donna Finnegan
- Blake Gostelow
- Wayne Heideman
- Michael Lott
- Paul Nasca
- Chris Ochman
- John Reifenberg
- Kevin Reifenberg
- Matt Roland
- David Steinberger
- Marty Wright

List of Acronyms

BCI: Bird Community Index

BCR: Bird Conservation Region

BOWA: Booker T. Washington National Monument

FRSP: Fredericksburg and Spotsylvania National Military Park

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

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 consists of 10 park units across Pennsylvania and Virginia. In 2009, MIDN began pilot testing a volunteer breeding bird monitoring program at three network parks and now has five participating parks (Figure 1). In the future, the network hopes to expand monitoring efforts to the remaining parks within the network (Johnson and Wakamiya 2018).

The majority of participating parks, including Booker T. Washington National Monument (BOWA), Fredericksburg and Spotsylvania National Military Park (FRSP), and Valley Forge National Historical Park (VAFO) fall within the Piedmont Bird Conservation Region (BCR) (Figure 1). Richmond National Battlefield Park (RICH) falls in the far southwestern portion of the New England/Mid-Atlantic Coast BCR. Petersburg National Battlefield (PETE) is in the northern portion of 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 (USNABCI Committee 2000).

The primary objectives for the monitoring protocol are to:

1. Estimate status and long-term trends in species composition, occupancy, and other indices of abundance for breeding bird populations within MIDN parks.
2. Estimate status and trends in measures of biotic integrity (Bird Community Indices) for breeding bird communities within MIDN parks.
3. Evaluate changes in bird populations in forest and grassland habitats relative to park management regimes.

This report summarizes monitoring data collected from 2009 through 2019 at Fredericksburg and Spotsylvania National Military Park, with a specific focus on the years 2014 through 2019. Detailed results for 2009 through 2013 can be found in the annual reports published for those years (Goodwin and Wakamiya 2011, Wakamiya 2012a, Wakamiya 2012b, Johnson 2014a, Johnson 2014b).

We provide park abundance and occurrence metrics for all species detected during breeding bird monitoring. We also provide a community-wide assessment of species composition (a "Bird Community Index" or BCI) in forested areas. The BCI informs on ecosystem integrity by evaluating the relative composition of different guilds in the overall bird community.

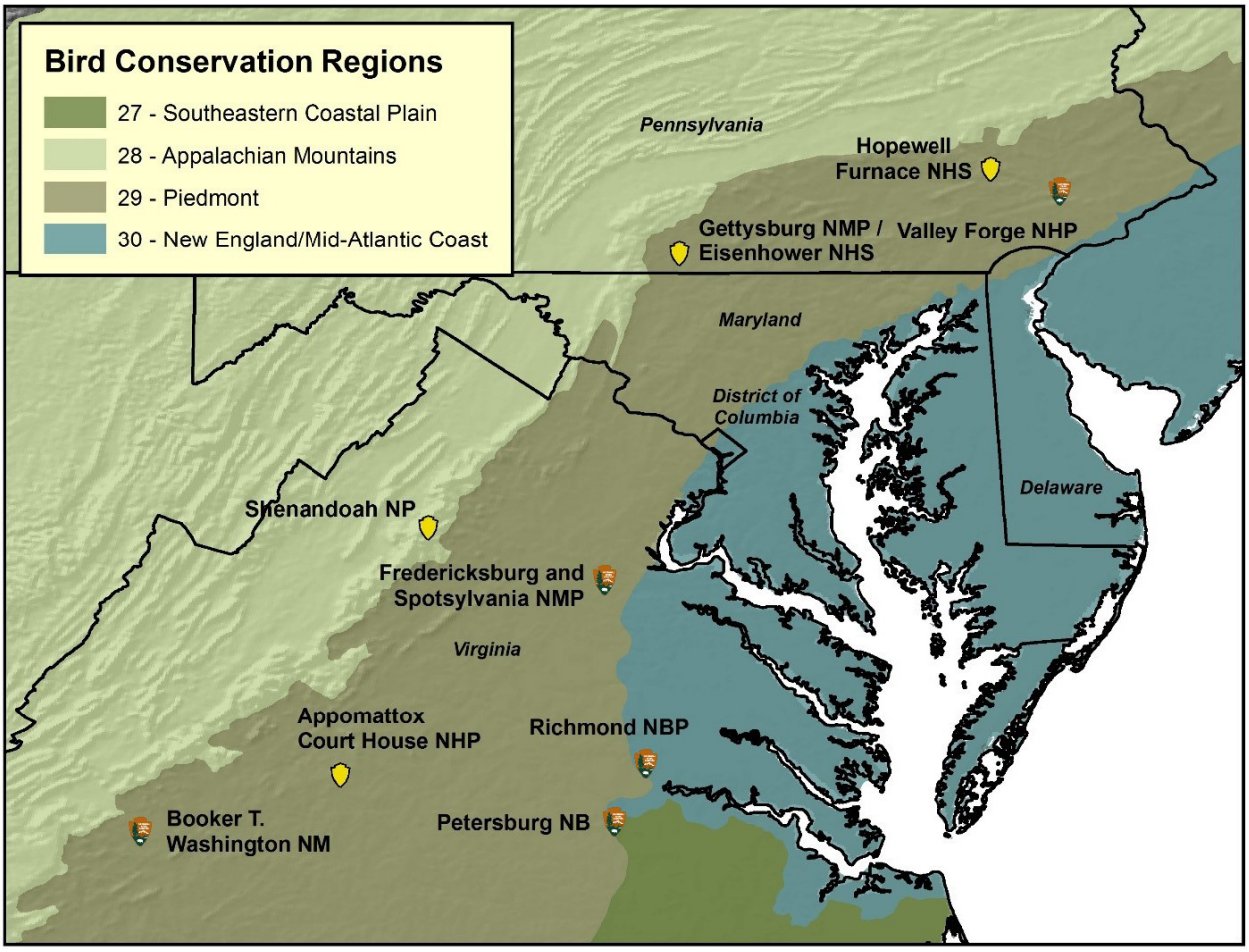


Figure 1. Mid-Atlantic Network parks and their associated Bird Conservation Region (BCR). Parks not yet participating in the breeding bird monitoring program are shown with a yellow icon.

Methods

Monitoring

Monitoring efforts following the procedures outlined by the MIDN breeding bird protocol were conducted at Fredericksburg and Spotsylvania National Military Park (FRSP) for the years 2009–2019. Skilled volunteers with approximately 3–5 years of experience in the region identifying birds visually and by ear were recruited by each participating park's natural resource management staff. All volunteers attended a training session lead by the protocol lead to learn protocol and safety procedures prior to each field season. Point counts were conducted between May 25 and July 15 at 59 point count stations (51 forest, 8 grassland) for years 2009 to 2015. For years 2016 through 2019, a randomly selected subset of those point was sampled (36 total, 28 forest, 8 grassland). A power analysis of the data pointed to a need for more repeat visits to points, which led to the change in the sampling scheme (Shriver and Ladin 2016). For a summary of survey effort see Table 2 below. During a point count, the distance from the observer to a bird of interest is estimated using two distance bands (<50m and ≥50m). For this report, we summarize all observations regardless of their distance band. For specific details regarding the point count procedures, please reference the MIDN breeding bird protocol narrative (Johnson and Wakamiya 2018) and standard operating procedures available on the MIDN website: https://www.nps.gov/im/midn/breeding-birds.htm.

Metrics

We present survey effort, population, and community metrics for Fredericksburg and Spotsylvania National Military Park (FRSP) for multiple years and for other participating parks within the network to allow for comparisons across years and within the network. A brief summary is provided above the results for each metric. For more detailed information regarding these metrics, please reference Standard Operating Procedure 10: Data Analysis and Reporting available at the link above.

Readers should treat results as preliminary, as metrics may be affected by variability in detection probability. A more comprehensive analysis that accounts for such variability and addresses long terms trends will be included as we acquire more data.

Results

Number of Species

This metric provides the total number of species observed, or species richness, and the mean number of species detected at each monitoring point. All detections, including flyovers (birds detected flying over the habitat within the point count radius) and incidentals (birds detected outside the time of survey), are included in these species counts. The species richness and mean number of individuals detected at each point are shown below (Figures 2 and 3).

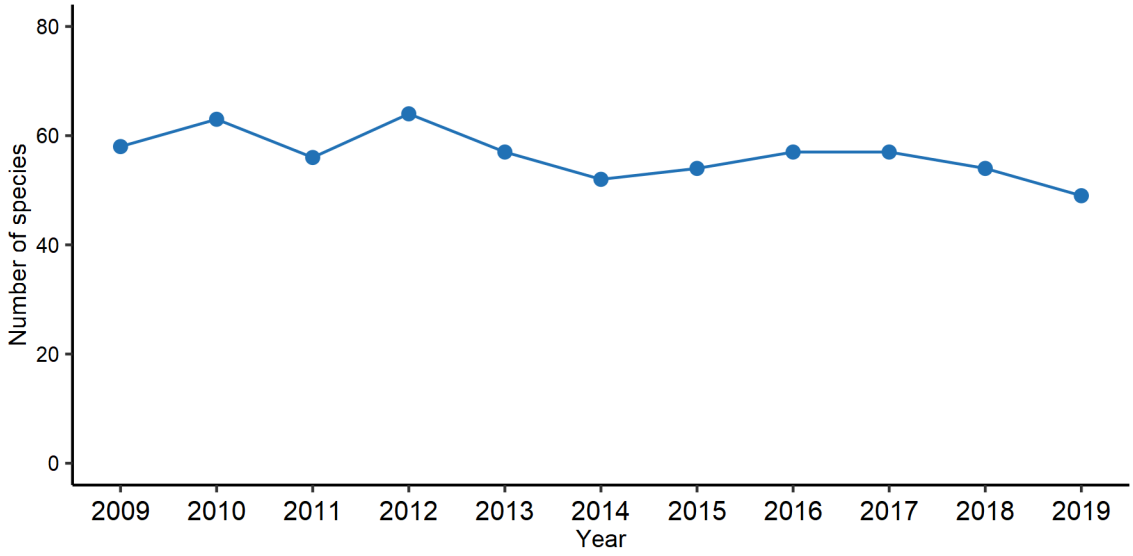


Figure 2. Species Richness detected at breeding bird monitoring points at Fredericksburg and Spotsylvania National Military Park for the years 2009–2019.

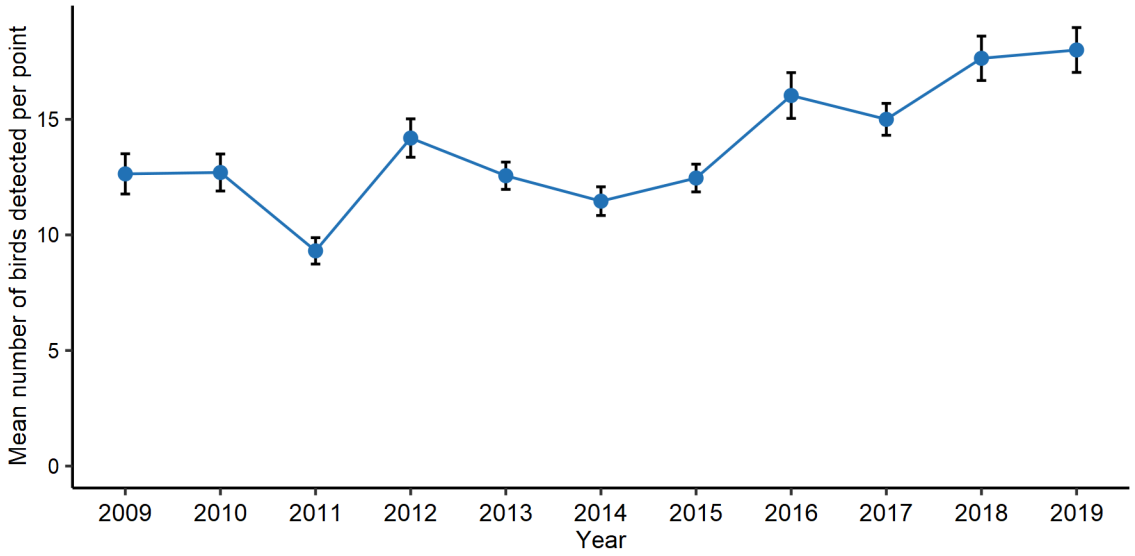


Figure 3. Mean ± SE number of individuals detected at breeding bird monitoring points at Fredericksburg and Spotsylvania National Military Park for the years 2009–2019. The mean was calculated based on the maximum number of detections at each point.

Relative Abundance

Relative abundance is calculated by dividing the total detections of a species by the number of monitoring points surveyed, not including flyovers and incidentals. The maximum number of detections per species across repeat visits are used in this calculation to avoid upward-biased results (e.g. inflating abundance estimates by double-counting the same individual bird across multiple visits). The ten most abundant species documented at all monitoring points, forest points, and grassland points are shown below (Figures 4–6). Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the years 2014–2019 are provided in Appendix Table A1.

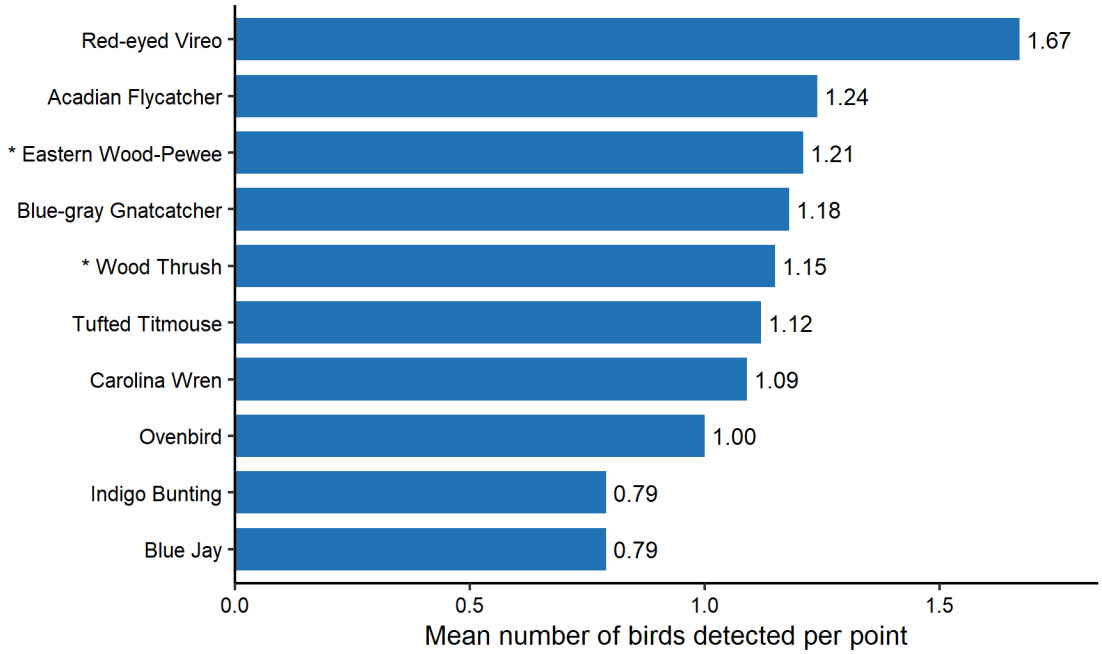


Figure 4. Ten most abundant species detected across all monitoring points during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. The mean was calculated based on the maximum number of detections at each point. *Species of regional concern.

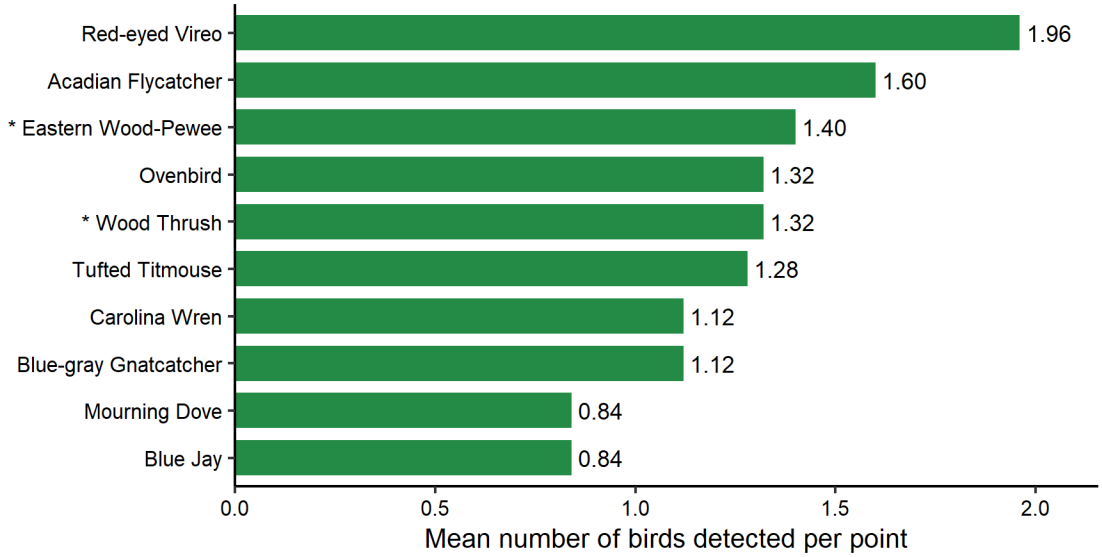


Figure 5. Ten most abundant species detected at forested points during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. The mean was calculated based on the maximum number of detections at each point. *Species of regional concern.

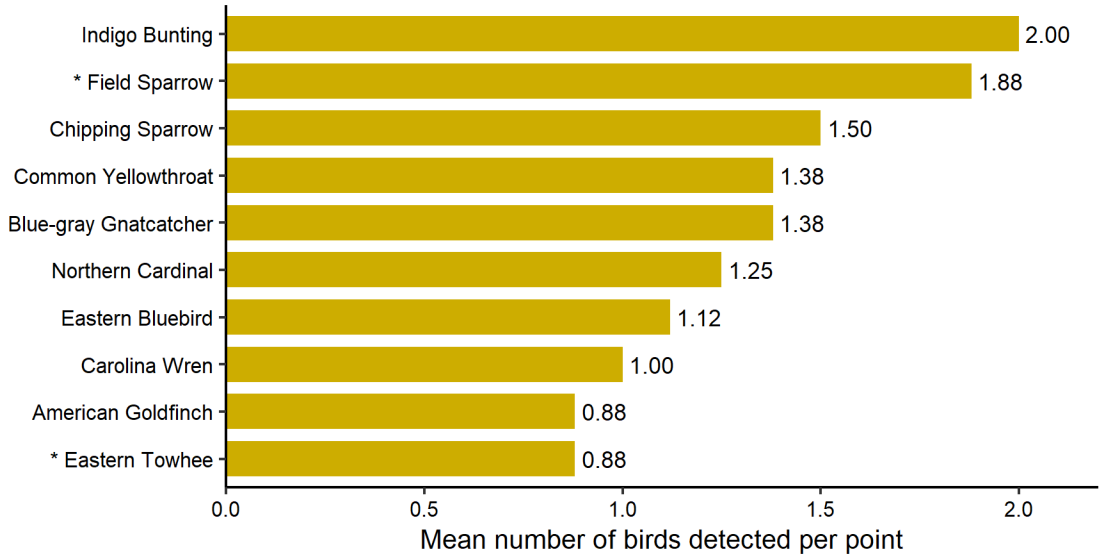


Figure 6. Ten most abundant species detected at grassland points during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. The mean was calculated based on the maximum number of detections at each point. *Species of regional concern.

Percent Occurrence

To calculate percent occurrence, the total number of monitoring points at which a species is detected is divided by the total number of points surveyed. As with relative abundance, flyovers and incidentals are removed from the calculation. Percent occurrence across all points surveyed, forested points, and grassland points are shown below (Figures 7–9). Percent occurrence for all species observed at Fredericksburg and Spotsylvania National Military Park for the years 2014–2019 is provided in Appendix Table A2.

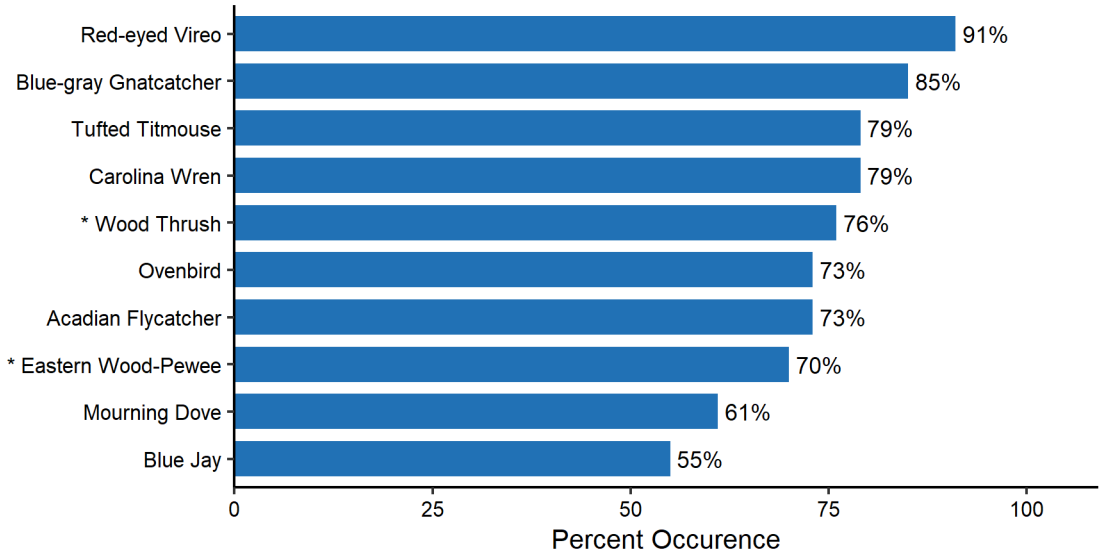


Figure 7. Ten species with the highest percent occurrence of monitoring points detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. *Species of regional concern.

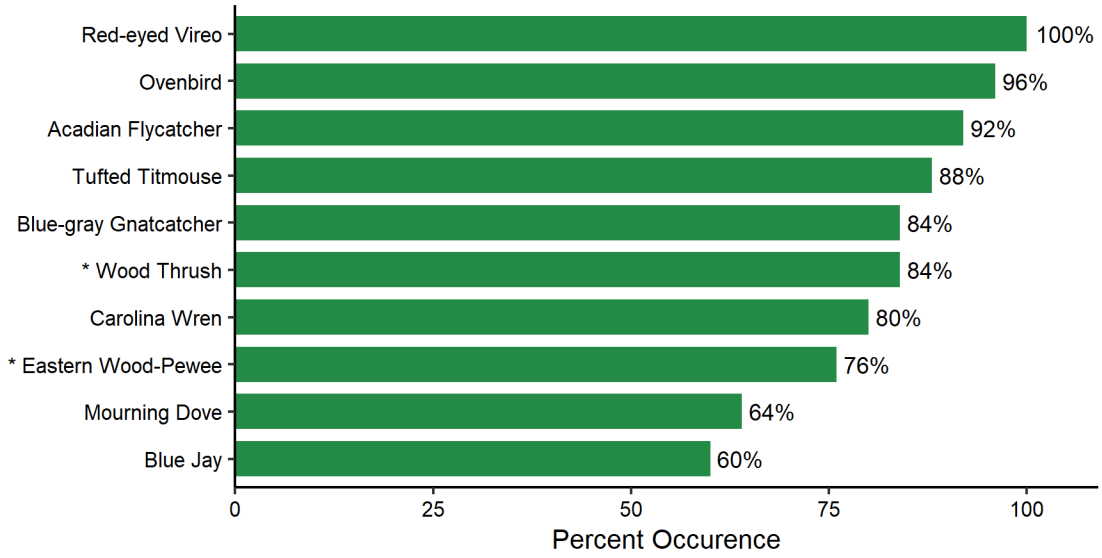


Figure 8. Ten species with the highest percent occurrence of forested monitoring points detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. *Species of regional concern.

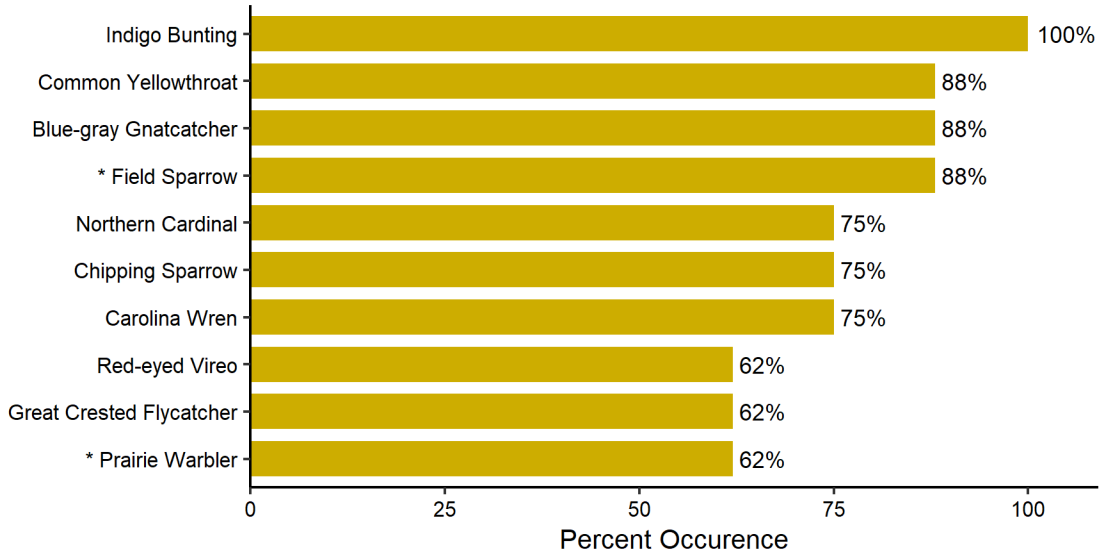


Figure 9. Ten species with the highest percent occurrence of grassland monitoring points detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019. *Species of regional concern.

Species of Concern

Partners in Flight (PIF), a multi-organizational effort to address the conservation of birds, produced a list of species considered important at the regional scale in the PIF North American Landbird Conservation Plan (Rosenberg et al. 2016). These species either face a high level of regional threats to their population or moderate regional threats combined with moderate or large regional population declines. The abundance and percent occurrence of regional species of concern documented at FRSP are shown below (Figures 10 and 11).

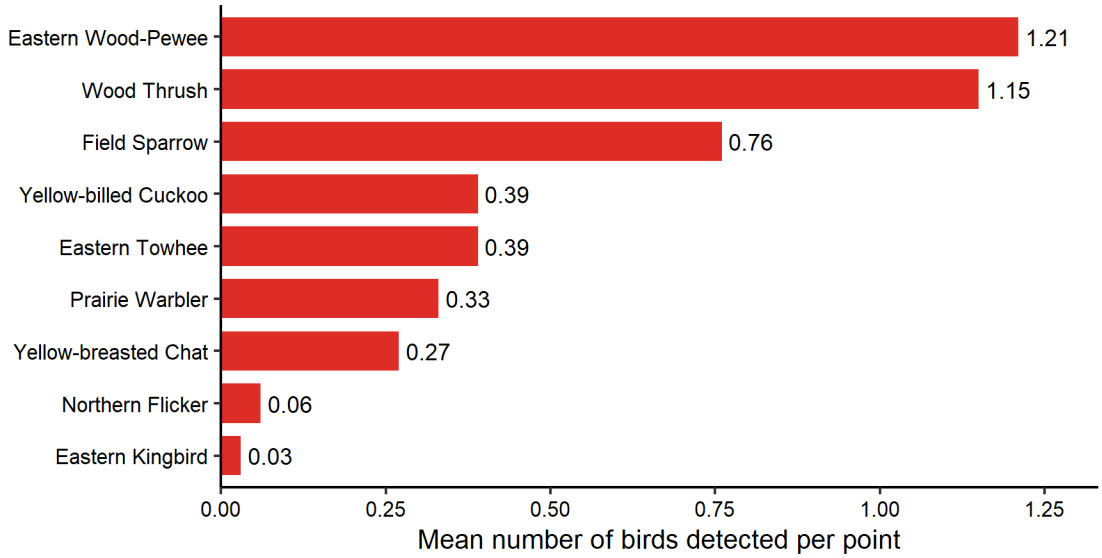


Figure 10. Mean abundance of species of regional concern detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019.

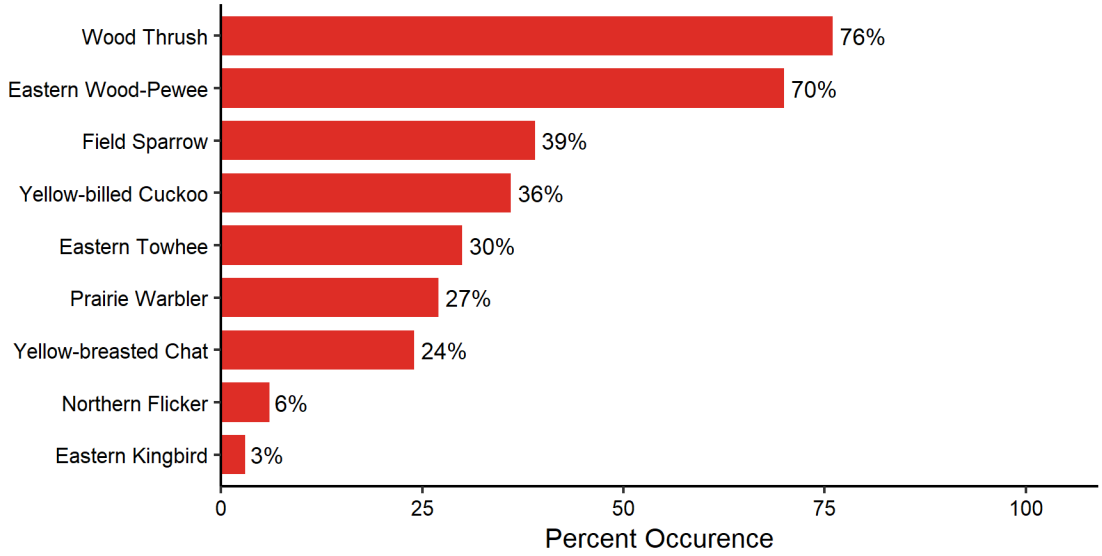


Figure 11. Percent occurrence of species of regional concern detected during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park for the year 2019.

Ecological Integrity Metrics

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 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. Within the BCI presented below (Figure 12), avian guilds are ranked based on specialization, with specialist guilds receiving higher weight over generalist guilds. BCI scores

and ratings are based on ecological criteria. O'Connell et al. (1998, 2000) developed a combined forest integrity index that can be applied to the MIDN points located in forested areas.

For forest BCI analysis, data from grassland points, incidentals, flyovers, and unknown species are removed. Only members of the following taxonomic Orders are used in BCI analyses: Passeriformes, Columbiformes, Apodiformes, Piciformes, and Cuculiformes. Furthermore, only bird species that were included in the original development of these indices are considered (O'Connell et al. 1998, 2000). If a point is visited more than once, detections for that point are aggregated. Forest integrity estimates based on O'Connell et al. (1998, 2000) 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). For more detailed information regarding the calculation of the forest BCI, please reference Standard Operating Procedure 10: Data Analysis and Reporting.

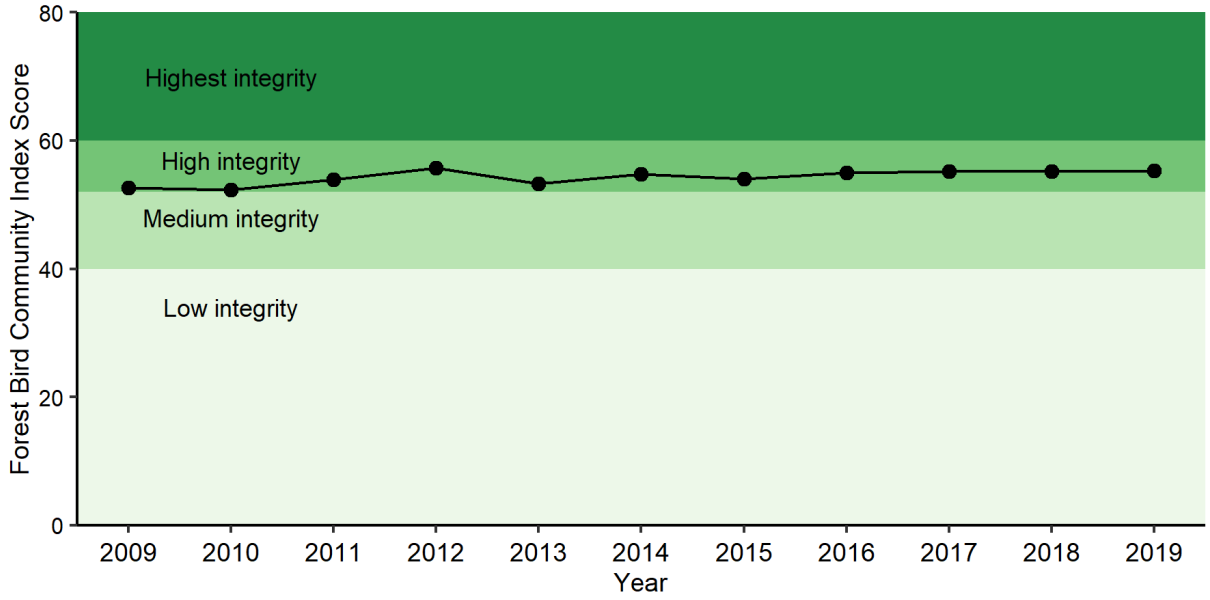


Figure 12. Bird Community Index (BCI) for forest points monitored at Fredericksburg and Spotsylvania National Military Park for the years 2009–2019. The points on the graph denote the mean BCI for points monitored during each year for the selected visits.

Survey Effort

The following tables and figures summarize the number of volunteers participating across the network (Table 1), the number of points surveyed (Table 2), and mean number of surveys per point (Tables 2). Maps are also included that display the locations of points surveyed each year and the number of surveys conducted at each point (Figures 13–18).

Table 1. Number of volunteer participants at all participating parks in the Mid-Atlantic Network Breeding Bird Monitoring Program for 2009–2019.

Year	BOWA	FRSP	PETE	RICH	VAFO	Total
2009	3	8	–	–	12	23
2010	4	9	–	5	14	40
2011	6	8	2	3	13	37
2012	4	8	1	6	11	36
2013	2	7	–	9	10	28
2014	1	7	–	7	12	27
2015	1	7	–	12	12	32
2016	1	6	2	11	14	34
2017	1	6	2	10	15	34
2018	2	5	1	8	11	27
2019	1	4	–	9	10	24

Table 2. Summary of breeding bird monitoring volunteer survey effort for Fredericksburg and Spotsylvania National Military Park for all years. SE refers to the standard error around the calculated mean.

Year	Points Surveyed	Number of Surveys	Mean visits per point	SE
2009	59	116	1.97	0.11
2010	56	103	1.84	0.11
2011	59	77	1.31	0.06
2012	58	98	1.69	0.10
2013	59	89	1.51	0.07
2014	59	89	1.51	0.07
2015	59	99	1.68	0.10
2016	37	75	2.03	0.03
2017	33	62	1.88	0.09
2018	33	78	2.36	0.09
2019	33	66	2.00	0.00

Survey Effort Maps

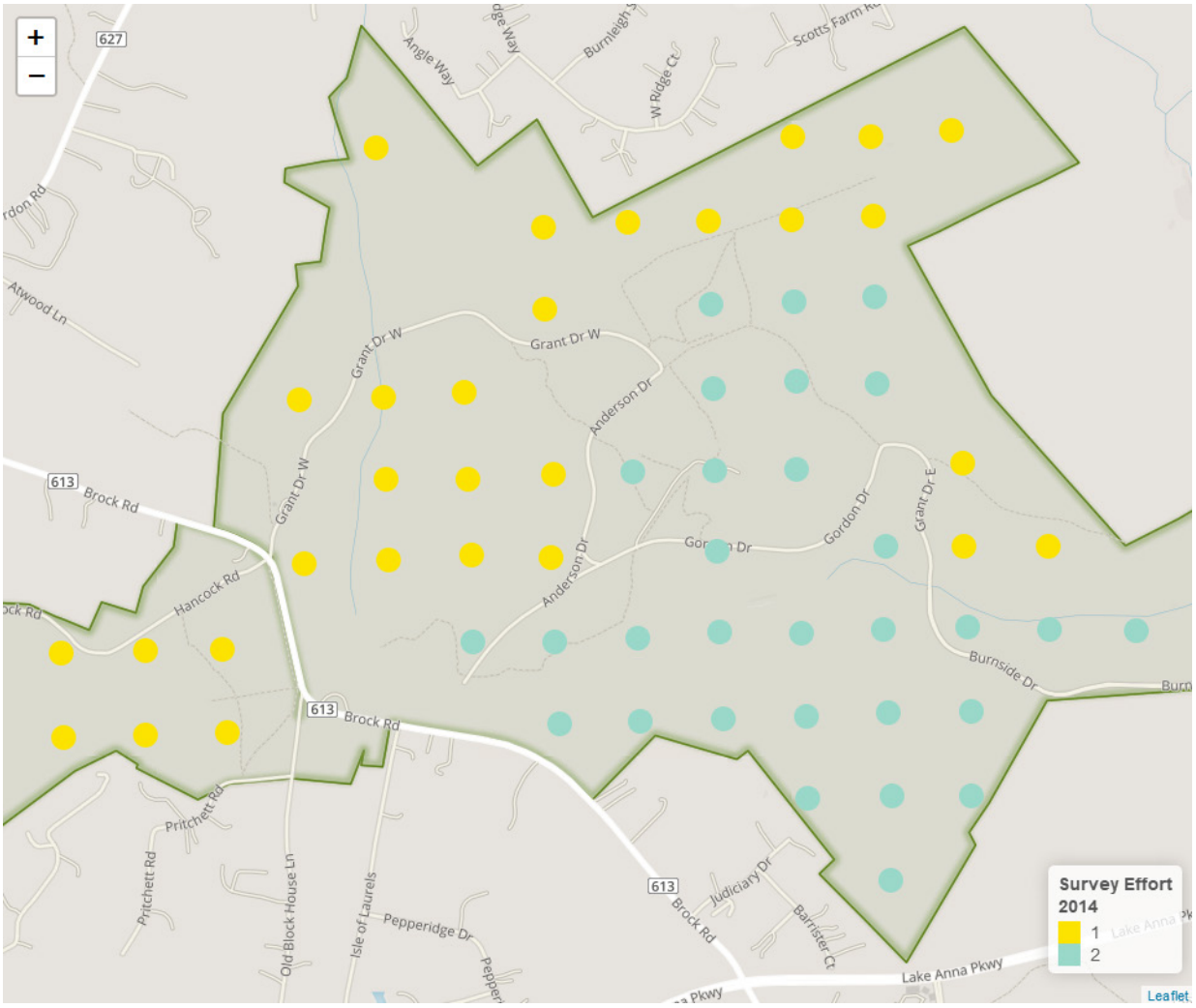


Figure 13. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2014.

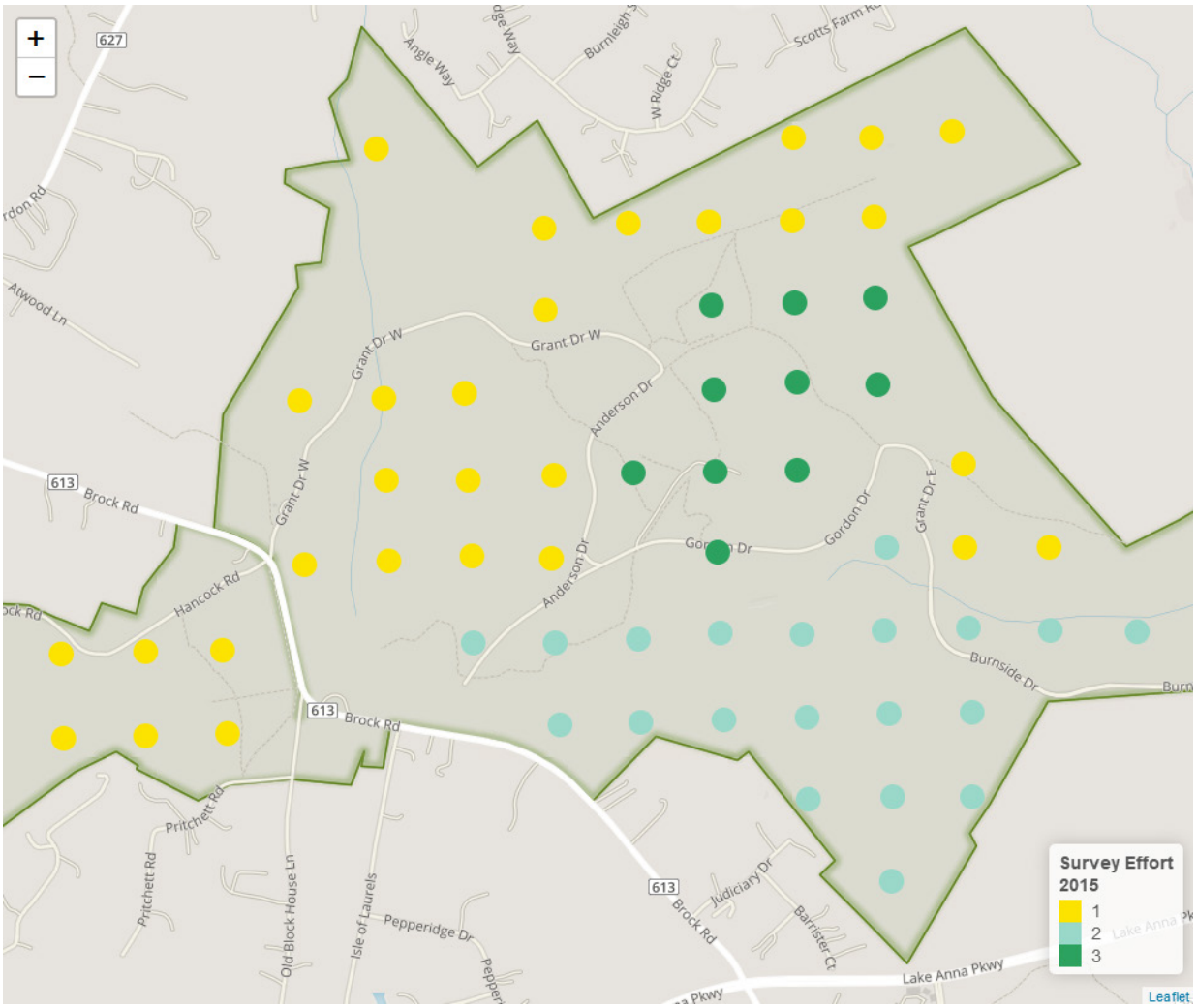


Figure 14. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2015.

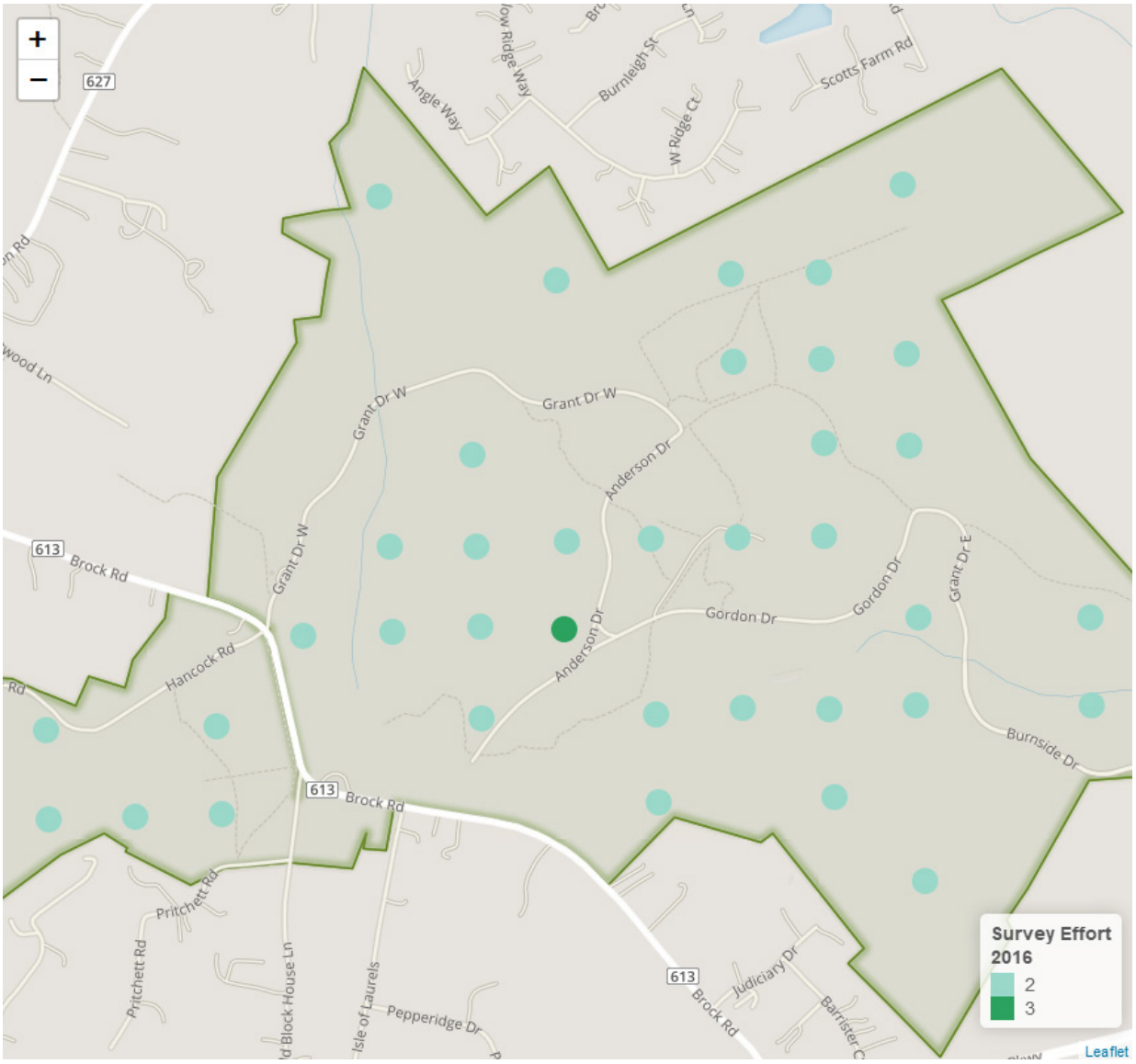


Figure 15. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2016.

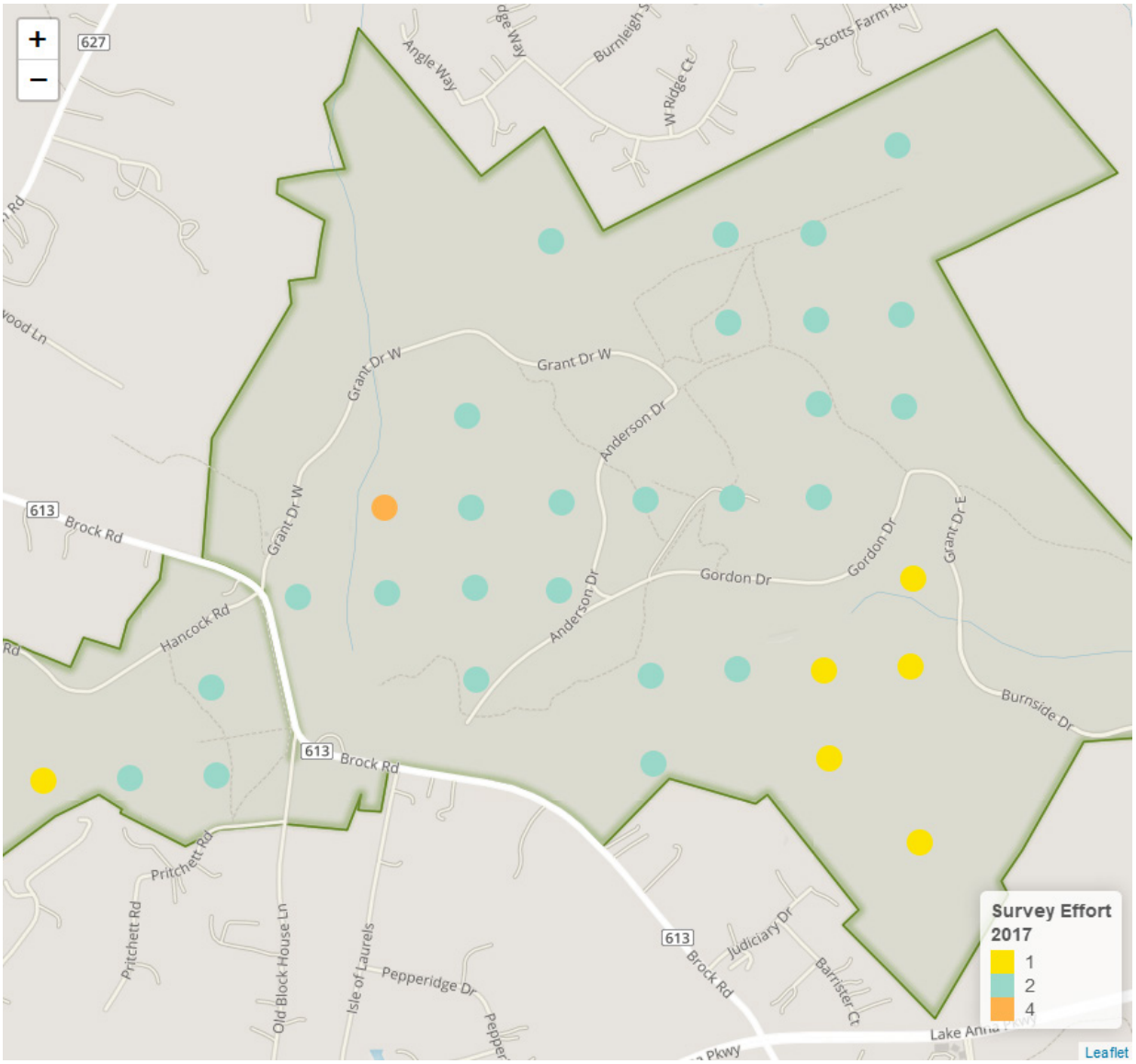


Figure 16. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2017.

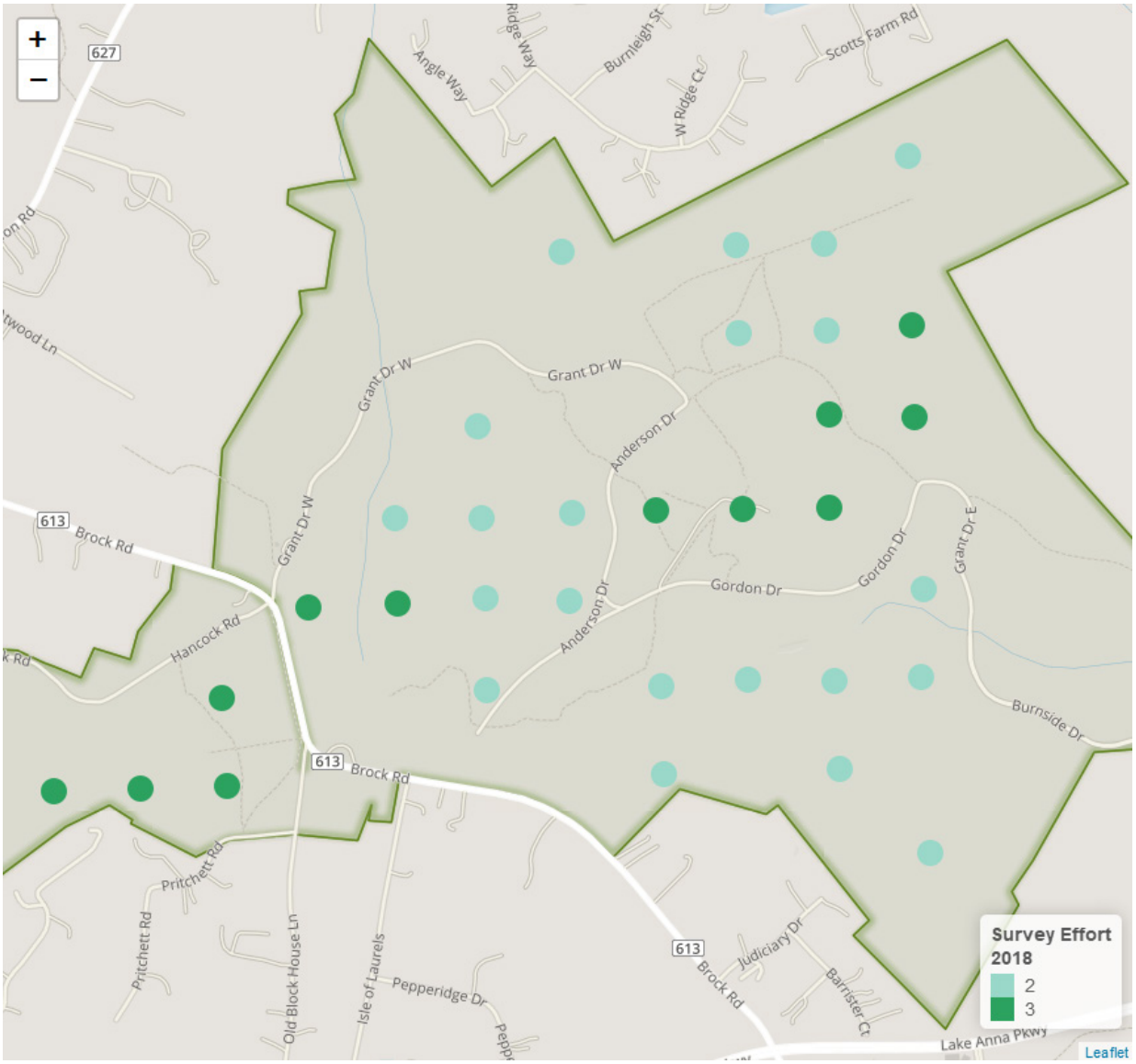


Figure 17. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2018.

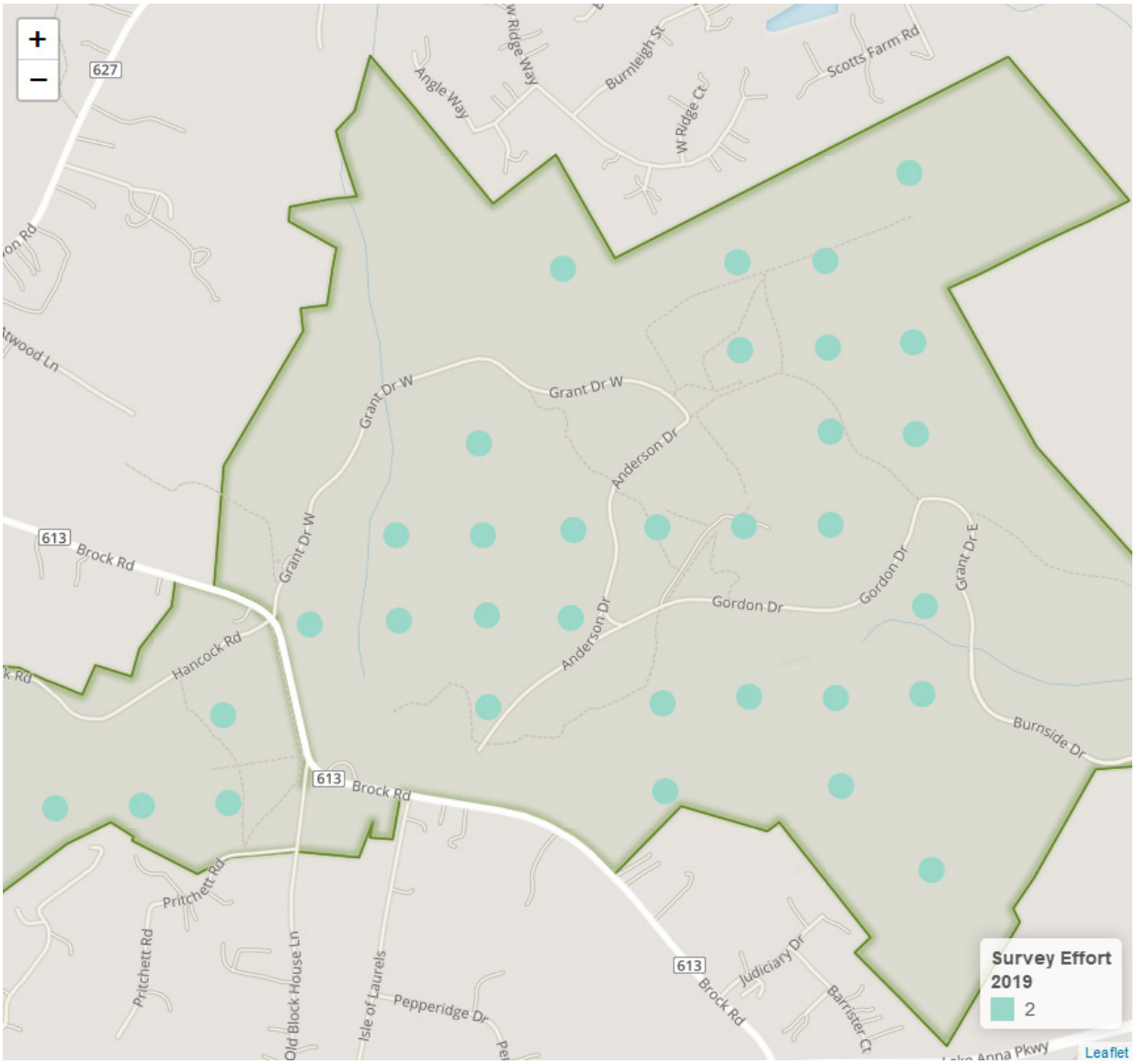


Figure 18. Map of breeding bird monitoring points and the number of visits to each point (Survey Effort) for Fredericksburg and Spotsylvania National Military Park for the year 2019.

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Appendix A

Relative Abundance

Table A1. Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). The means presented were calculated based on the maximum number of detections at each point. *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Acadian Flycatcher	*Empidonax virescens*	0.71±0.09	0.64±0.10	0.78±0.13	0.85±0.12	1.00±0.15	1.24±0.18
American Coot	*Fulica americana*	0	0.02±0.02	0	0	0	0
American Crow	*Corvus brachyrhynchos*	0.42±0.09	0.37±0.10	0.73±0.17	0.61±0.14	0.61±0.11	0.55±0.12
American Goldfinch	*Spinus tristis*	0.03±0.03	0.08±0.05	0.65±0.19	0.48±0.16	0.36±0.12	0.27±0.12
American Robin	*Turdus migratorius*	0.10±0.05	0.20±0.06	0.03±0.03	0.18±0.08	0.18±0.08	0
* American Woodcock	*Scolopax minor*	0	0	0	0.03±0.03	0	0
Baltimore Oriole	*Icterus galbula*	0.02±0.02	0	0.03±0.03	0	0	0
Barred Owl	*Strix varia*	0	0	0	0	0.03±0.03	0
* Belted Kingfisher	*Megaceryle alcyon*	0.02±0.02	0	0	0	0	0
Black-and-white Warbler	*Mniotilta varia*	0	0	0	0	0.03±0.03	0
Blue Grosbeak	*Passerina caerulea*	0.03±0.02	0.05±0.04	0.16±0.08	0.09±0.07	0.18±0.07	0.15±0.08
Blue Jay	*Cyanocitta cristata*	0.44±0.09	0.27±0.06	0.68±0.15	0.36±0.10	0.85±0.16	0.79±0.18
Blue-gray Gnatcatcher	*Polioptila caerulea*	0.31±0.07	0.27±0.08	0.59±0.10	0.42±0.09	1.03±0.13	1.18±0.13
* Broad-winged Hawk	*Buteo platypterus*	0	0	0	0.03±0.03	0	0
Brown Creeper	*Certhia americana*	0	0	0	0	0	0
Brown Thrasher	*Toxostoma rufum*	0.03±0.02	0	0	0.12±0.07	0.03±0.03	0

Table A1 (continued). Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). The means presented were calculated based on the maximum number of detections at each point. *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Brown-headed Cowbird	*Molothrus ater*	0.05±0.03	0.05±0.04	0.08±0.05	0.12±0.06	0.39±0.09	0.24±0.09
Canada Goose	*Branta canadensis*	0	0.03±0.02	0	0	0	0
Carolina Chickadee	*Poecile carolinensis*	0.42±0.09	0.64±0.12	0.46±0.13	0.55±0.14	0.85±0.20	0.36±0.13
Carolina Wren	*Thryothorus ludovicianus*	0.29±0.07	0.20±0.06	0.46±0.12	0.67±0.11	0.97±0.10	1.09±0.15
Cedar Waxwing	*Bombycilla cedrorum*	0.02±0.02	0.03±0.03	0.08±0.08	0.15±0.12	0	0.18±0.15
* Chimney Swift	*Chaetura pelagica*	0.02±0.02	0	0	0	0	0
Chipping Sparrow	*Spizella passerina*	0.08±0.04	0.19±0.07	0.35±0.10	0.18±0.08	0.52±0.20	0.48±0.17
Common Grackle	*Quiscalus quiscula*	0	0.03±0.03	0.08±0.05	0	0	0.06±0.04
Common Raven	*Corvus corax*	0.02±0.02	0.02±0.02	0	0	0	0
Common Yellowthroat	*Geothlypis trichas*	0.20±0.07	0.24±0.08	0.51±0.14	0.45±0.12	0.61±0.14	0.42±0.13
Downy Woodpecker	*Dryobates pubescens*	0.27±0.06	0.36±0.07	0.59±0.09	0.45±0.10	0.88±0.15	0.30±0.08
Eastern Bluebird	*Sialia sialis*	0.08±0.04	0	0.11±0.08	0.24±0.13	0.27±0.10	0.45±0.19
* Eastern Kingbird	*Tyrannus tyrannus*	0	0.07±0.03	0.05±0.04	0.06±0.04	0	0.03±0.03
* Eastern Meadowlark	*Sturnella magna*	0	0	0	0	0	0
Eastern Phoebe	*Sayornis phoebe*	0.05±0.03	0.05±0.03	0.03±0.03	0.03±0.03	0.03±0.03	0.03±0.03
* Eastern Towhee	*Pipilo erythrophthalmus*	0.05±0.03	0.08±0.04	0.32±0.12	0.15±0.08	0.24±0.09	0.39±0.12
* Eastern Wood-Pewee	*Contopus virens*	0.78±0.09	0.76±0.10	0.78±0.12	0.91±0.14	1.30±0.10	1.21±0.18
* Field Sparrow	*Spizella pusilla*	0.19±0.07	0.20±0.07	0.81±0.20	0.79±0.21	0.58±0.15	0.76±0.18
Fish Crow	*Corvus ossifragus*	0	0	0	0	0	0

Table A1 (continued). Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). The means presented were calculated based on the maximum number of detections at each point. *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
* Grasshopper Sparrow	*Ammodramus savannarum*	0	0.02±0.02	0	0	0	0
Gray Catbird	*Dumetella carolinensis*	0	0.02±0.02	0.03±0.03	0.03±0.03	0	0
Great Crested Flycatcher	*Myiarchus crinitus*	0.17±0.06	0.08±0.04	0.19±0.07	0.30±0.09	0.36±0.09	0.45±0.12
Great Horned Owl	*Bubo virginianus*	0	0	0	0	0	0
* Green Heron	*Butorides virescens*	0	0	0	0	0	0
Hairy Woodpecker	*Dryobates villosus*	0.07±0.03	0.20±0.08	0.11±0.05	0.06±0.04	0.18±0.08	0.06±0.04
Hooded Warbler	*Setophaga citrina*	0	0.05±0.04	0	0.06±0.04	0	0
House Finch	*Haemorhous mexicanus*	0	0.02±0.02	0.03±0.03	0	0	0
House Wren	*Troglodytes aedon*	0	0	0	0.03±0.03	0	0
Indigo Bunting	*Passerina cyanea*	0.25±0.07	0.36±0.10	0.70±0.15	0.70±0.17	0.73±0.18	0.79±0.16
* Kentucky Warbler	*Geothlypis formosa*	0.02±0.02	0	0	0	0	0
Louisiana Waterthrush	*Parkesia motacilla*	0.05±0.04	0	0	0.03±0.03	0.12±0.06	0.06±0.04
Marsh Wren	*Cistothorus palustris*	0	0	0	0	0	0
Mourning Dove	*Zenaida macroura*	0.44±0.08	0.73±0.07	0.89±0.12	0.52±0.10	1.12±0.14	0.76±0.12
* Northern Bobwhite	*Colinus virginianus*	0	0.02±0.02	0	0.09±0.05	0	0
Northern Cardinal	*Cardinalis cardinalis*	0.49±0.08	0.54±0.10	0.57±0.10	0.45±0.12	0.79±0.14	0.73±0.15
* Northern Flicker	*Colaptes auratus*	0.14±0.04	0.15±0.07	0.14±0.06	0.06±0.04	0.09±0.05	0.06±0.04
Northern Mockingbird	*Mimus polyglottos*	0	0	0	0.09±0.05	0.03±0.03	0
Northern Parula	*Setophaga americana*	0	0.03±0.02	0	0	0.03±0.03	0.15±0.06

Table A1 (continued). Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). The means presented were calculated based on the maximum number of detections at each point. *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	0	0	0.08±0.08	0	0	0
Orchard Oriole	*Icterus spurius*	0	0	0	0.06±0.06	0	0
Ovenbird	*Seiurus aurocapilla*	0.97±0.11	0.73±0.10	1.00±0.15	0.76±0.14	1.06±0.17	1.00±0.14
Palm Warbler	*Setophaga palmarum*	0	0	0	0	0	0
Philadelphia Vireo	*Vireo philadelphicus*	0	0	0	0	0	0
Pileated Woodpecker	*Dryocopus pileatus*	0.08±0.04	0.12±0.05	0.43±0.13	0.24±0.08	0.33±0.09	0.36±0.09
Pine Warbler	*Setophaga pinus*	0.03±0.02	0.03±0.02	0.08±0.05	0.09±0.07	0.24±0.11	0.06±0.06
* Prairie Warbler	*Setophaga discolor*	0.03±0.02	0	0.16±0.06	0.15±0.08	0.03±0.03	0.33±0.10
Purple Martin	*Progne subis*	0	0	0	0	0	0.12±0.12
Red-bellied Woodpecker	*Melanerpes carolinus*	0.68±0.08	0.54±0.08	0.27±0.08	0.58±0.12	0.88±0.13	0.76±0.14
Red-eyed Vireo	*Vireo olivaceus*	0.80±0.10	0.80±0.11	1.14±0.12	1.48±0.15	1.85±0.17	1.67±0.19
Red-headed Woodpecker	*Melanerpes erythrocephalus*	0	0	0	0	0.03±0.03	0
Red-shouldered Hawk	*Buteo lineatus*	0.02±0.02	0.02±0.02	0	0	0	0
Red-tailed Hawk	*Buteo jamaicensis*	0.02±0.02	0	0.03±0.03	0	0	0
Red-winged Blackbird	*Agelaius phoeniceus*	0	0.03±0.03	0	0	0.06±0.06	0
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	0	0	0.03±0.03	0	0	0
Ruby-throated Hummingbird	*Archilochus colubris*	0	0	0.03±0.03	0.03±0.03	0.09±0.07	0
Scarlet Tanager	*Piranga olivacea*	0.39±0.08	0.58±0.09	0.68±0.11	0.76±0.13	0.79±0.10	0.55±0.12
Sharp-shinned Hawk	*Accipiter striatus*	0	0	0	0	0	0

Table A1 (continued). Relative abundance for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). The means presented were calculated based on the maximum number of detections at each point. *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Song Sparrow	*Melospiza melodia*	0	0	0.03±0.03	0	0	0
Summer Tanager	*Piranga rubra*	0.03±0.02	0.12±0.04	0.22±0.07	0.33±0.09	0.39±0.11	0.21±0.08
Tufted Titmouse	*Baeolophus bicolor*	0.92±0.11	1.07±0.15	1.19±0.16	1.24±0.14	1.67±0.22	1.12±0.14
Turkey Vulture	*Cathartes aura*	0	0.02±0.02	0	0	0	0
Veery	*Catharus fuscescens*	0	0	0	0	0	0
White-breasted Nuthatch	*Sitta carolinensis*	0.34±0.07	0.42±0.07	0.59±0.11	0.67±0.09	0.88±0.11	0.52±0.11
White-eyed Vireo	*Vireo griseus*	0.02±0.02	0	0	0	0.03±0.03	0.06±0.04
Wild Turkey	*Meleagris gallopavo*	0	0	0	0.03±0.03	0	0.09±0.09
Willow Flycatcher	*Empidonax traillii*	0	0	0	0	0	0
* Wood Thrush	*Hylocichla mustelina*	1.12±0.13	1.46±0.13	1.19±0.19	0.97±0.17	1.30±0.13	1.15±0.16
Worm-eating Warbler	*Helmitheros vermivorum*	0	0	0.03±0.03	0.06±0.04	0.06±0.04	0
* Yellow-billed Cuckoo	*Coccyzus americanus*	0.49±0.08	0.66±0.10	0.54±0.11	0.82±0.11	0.85±0.13	0.39±0.10
* Yellow-breasted Chat	*Icteria virens*	0.02±0.02	0.05±0.03	0.19±0.09	0.12±0.06	0.12±0.06	0.27±0.09
Yellow-throated Vireo	*Vireo flavifrons*	0.07±0.03	0.25±0.06	0.16±0.06	0.12±0.06	0.15±0.08	0.42±0.09

Percent Occurrence

Table A2. Percent occurrence for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Acadian Flycatcher	*Empidonax virescens*	58	47	57	67	73	73
American Coot	*Fulica americana*	0	2	0	0	0	0
American Crow	*Corvus brachyrhynchos*	34	25	43	42	52	45
American Goldfinch	*Spinus tristis*	2	5	32	36	27	18
American Robin	*Turdus migratorius*	8	19	3	15	15	0
* American Woodcock	*Scolopax minor*	0	0	0	3	0	0
Baltimore Oriole	*Icterus galbula*	2	0	3	0	0	0
Barred Owl	*Strix varia*	0	0	0	0	3	0
* Belted Kingfisher	*Megaceryle alcyon*	2	0	0	0	0	0
Black-and-white Warbler	*Mniotilta varia*	0	0	0	0	3	0
Blue Grosbeak	*Passerina caerulea*	3	3	11	6	18	12
Blue Jay	*Cyanocitta cristata*	34	25	49	30	61	55
Blue-gray Gnatcatcher	*Polioptila caerulea*	29	19	54	42	76	85
* Broad-winged Hawk	*Buteo platypterus*	0	0	0	3	0	0
Brown Creeper	*Certhia americana*	0	0	0	0	0	0
Brown Thrasher	*Toxostoma rufum*	3	0	0	9	3	0
Brown-headed Cowbird	*Molothrus ater*	5	3	8	12	39	21
Canada Goose	*Branta canadensis*	0	3	0	0	0	0

Table A2 (continued). Percent occurrence for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Carolina Chickadee	*Poecile carolinensis*	34	44	30	42	42	24
Carolina Wren	*Thryothorus ludovicianus*	25	19	35	58	82	79
Cedar Waxwing	*Bombycilla cedrorum*	2	2	3	6	0	6
* Chimney Swift	*Chaetura pelagica*	2	0	0	0	0	0
Chipping Sparrow	*Spizella passerina*	8	12	27	15	30	27
Common Grackle	*Quiscalus quiscula*	0	2	8	0	0	6
Common Raven	*Corvus corax*	2	2	0	0	0	0
Common Yellowthroat	*Geothlypis trichas*	14	15	32	36	42	30
Downy Woodpecker	*Dryobates pubescens*	27	32	57	42	61	30
Eastern Bluebird	*Sialia sialis*	8	0	5	12	21	21
* Eastern Kingbird	*Tyrannus tyrannus*	0	7	5	6	0	3
* Eastern Meadowlark	*Sturnella magna*	0	0	0	0	0	0
Eastern Phoebe	*Sayornis phoebe*	5	5	3	3	3	3
* Eastern Towhee	*Pipilo erythrophthalmus*	5	8	22	12	21	30
* Eastern Wood-Pewee	*Contopus virens*	63	59	62	64	94	70
* Field Sparrow	*Spizella pusilla*	12	15	41	42	36	39
Fish Crow	*Corvus ossifragus*	0	0	0	0	0	0
* Grasshopper Sparrow	*Ammodramus savannarum*	0	2	0	0	0	0
Gray Catbird	*Dumetella carolinensis*	0	2	3	3	0	0
Great Crested Flycatcher	*Myiarchus crinitus*	14	8	19	27	36	36

Table A2 (continued). Percent occurrence for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Great Horned Owl	*Bubo virginianus*	0	0	0	0	0	0
* Green Heron	*Butorides virescens*	0	0	0	0	0	0
Hairy Woodpecker	*Dryobates villosus*	7	12	11	6	15	6
Hooded Warbler	*Setophaga citrina*	0	3	0	6	0	0
House Finch	*Haemorhous mexicanus*	0	2	3	0	0	0
House Wren	*Troglodytes aedon*	0	0	0	3	0	0
Indigo Bunting	*Passerina cyanea*	22	24	43	45	42	48
* Kentucky Warbler	*Geothlypis formosa*	2	0	0	0	0	0
Louisiana Waterthrush	*Parkesia motacilla*	3	0	0	3	12	6
Marsh Wren	*Cistothorus palustris*	0	0	0	0	0	0
Mourning Dove	*Zenaida macroura*	39	69	68	48	79	61
* Northern Bobwhite	*Colinus virginianus*	0	2	0	9	0	0
Northern Cardinal	*Cardinalis cardinalis*	44	41	51	33	58	48
* Northern Flicker	*Colaptes auratus*	14	10	14	6	9	6
Northern Mockingbird	*Mimus polyglottos*	0	0	0	9	3	0
Northern Parula	*Setophaga americana*	0	3	0	0	3	15
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	0	0	3	0	0	0
Orchard Oriole	*Icterus spurius*	0	0	0	3	0	0
Ovenbird	*Seiurus aurocapilla*	66	56	65	58	61	73
Palm Warbler	*Setophaga palmarum*	0	0	0	0	0	0

Table A2 (continued). Percent occurrence for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
Philadelphia Vireo	*Vireo philadelphicus*	0	0	0	0	0	0
Pileated Woodpecker	*Dryocopus pileatus*	8	10	32	24	30	36
Pine Warbler	*Setophaga pinus*	3	3	8	6	18	3
* Prairie Warbler	*Setophaga discolor*	3	0	16	12	3	27
Purple Martin	*Progne subis*	0	0	0	0	0	3
Red-bellied Woodpecker	*Melanerpes carolinus*	59	47	24	48	70	55
Red-eyed Vireo	*Vireo olivaceus*	61	58	81	88	94	91
Red-headed Woodpecker	*Melanerpes erythrocephalus*	0	0	0	0	3	0
Red-shouldered Hawk	*Buteo lineatus*	2	2	0	0	0	0
Red-tailed Hawk	*Buteo jamaicensis*	2	0	3	0	0	0
Red-winged Blackbird	*Agelaius phoeniceus*	0	2	0	0	3	0
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	0	0	3	0	0	0
Ruby-throated Hummingbird	*Archilochus colubris*	0	0	3	3	6	0
Scarlet Tanager	*Piranga olivacea*	36	46	59	61	70	45
Sharp-shinned Hawk	*Accipiter striatus*	0	0	0	0	0	0
Song Sparrow	*Melospiza melodia*	0	0	3	0	0	0
Summer Tanager	*Piranga rubra*	3	12	22	30	33	18
Tufted Titmouse	*Baeolophus bicolor*	64	61	81	82	91	79
Turkey Vulture	*Cathartes aura*	0	2	0	0	0	0
Veery	*Catharus fuscescens*	0	0	0	0	0	0

Table A2 (continued). Percent occurrence for all species observed during breeding bird monitoring at Fredericksburg and Spotsylvania National Military Park (2014–2019). *Species of regional concern.

Common Name	Scientific Name	2014	2015	2016	2017	2018	2019
White-breasted Nuthatch	*Sitta carolinensis*	31	39	51	64	73	45
White-eyed Vireo	*Vireo griseus*	2	0	0	0	3	6
Wild Turkey	*Meleagris gallopavo*	0	0	0	3	0	3
Willow Flycatcher	*Empidonax traillii*	0	0	0	0	0	0
* Wood Thrush	*Hylocichla mustelina*	71	83	65	61	88	76
Worm-eating Warbler	*Helmitheros vermivorum*	0	0	3	6	6	0
* Yellow-billed Cuckoo	*Coccyzus americanus*	44	53	49	70	67	36
* Yellow-breasted Chat	*Icteria virens*	2	5	14	12	12	24
Yellow-throated Vireo	*Vireo flavifrons*	7	24	16	12	12	42

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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