National Park Service
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Natural Resource Stewardship and Science

Forest Bird Monitoring in the National Capital Region Network

Summary Report 2007–2017

Natural Resource Report NPS/NCRN/NRR—2021/2292



ON THE COVER
NCRN bird monitoring at Rock Creek Park
NPS/Nortrup photo.

Forest Bird Monitoring in the National Capital Region Network

Summary Report 2007–2017

Natural Resource Report NPS/NCRN/NRR—2021/2292

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Executive Summary

This report presents 11 years of data from forest bird monitoring efforts in the National Capital Region Network (NCRN). Forest bird monitoring began in 2007 and was implemented annually at 385 (initial) and 410 (current) sampling points within the 13 parks of the NCRN that include Antietam National Battlefield (ANTI), Catoctin Mountain Park (CATO), Chesapeake and Ohio Canal National Historical Park (CHOH), George Washington Memorial Parkway (GWMP), Harpers Ferry National Historical Park (HAFE), Manassas National Battlefield Park (MANA), Monocacy National Battlefield (MONO), National Capital Parks–East (NACE; including Greenbelt/Baltimore Washington Parkway [GREE] and Fort Washington/Piscataway Park [PISC/FOWA]), Prince William Forest Park (PRWI), Rock Creek Park (ROCR), and Wolf Trap National Park for the Performing Arts (WOTR). The objectives of this monitoring program are to: (1) document distributions of forest-breeding bird species including mean occupancy, abundance, and density, (2) use bird community indices to assess ecosystem-level dynamics at both park and regional levels, (3) detect annual variation in species abundance with special attention paid to species of conservation concern, and (4) provide data that will allow the assessment of the importance of habitat quality for long-term trends in bird abundance, density, and community dynamics. Throughout the report, we refer to bird species using a four-letter code designated by the American Ornithological Society (Chesser et al. 2019) and now maintained by the Institute of Bird Populations (https://www.birdpop.org/pages/birdSpeciesCodes.php). These "alpha" codes are presented with common and scientific names, along with conservation status in the Glossary.

After completing a five-year report (Ladin and Shriver 2013), we are continuing to follow standard operating procedures (Dawson and Efford 2013). We document results on annual probability of site occupancy and abundance along with associated variances for all forest-breeding species detected in the NCRN from 2007 to 2017 at regional and park unit scales. The parks within the NCRN boast a high diversity of forest-breeding birds, and provide important habitat for species of both continental and regional conservation concern. In addition to supporting common forest-breeding species, NCRN parks provide important breeding habitat for many species of conservation concern. For example, Cerulean Warblers (*Setophaga cerulea*), Rusty Blackbirds (*Euphagus carolinus*), Red-headed Woodpeckers (*Melanerpes erythrocephalus*), Olive-sided Flycatchers (*Contopus cooperi*), Henslow's Sparrows (*Centronyx henslowii*), Chimney Swifts (*Chaetura pelagica*), and Wood Thrushes (*Hylocichla mustelina*) are all Partners in Flight watch list species of continental concern (Panjabi et al. 2017) that have been detected within the NCRN. These species should be given special consideration during planning and management within the NCRN.

Based on a guild analysis using bird community assemblages, we calculated a bird community index (BCI) to evaluate habitat integrity within NCRN as a region and within each park (O'Connell et al. 2003). We were able to detect variation in BCI among park units and years. Within the NCRN there is a considerable range in BCI scores among park units, with larger forested parks (i.e., Catoctin Mountain Park and Prince William Forest Park) having the highest forest habitat integrity and smaller parks in more urban settings (i.e., Wolf Trap National Park for the Performing Arts) having a lower habitat integrity.

We include additional analyses (methods described in most up-to-date protocol SOPs, available at https://irma.nps.gov/DataStore/Reference/Profile/2170024) for each species including those of continental concern to estimate abundance using the 'unmarked' package (Fiske et al. 2011), implemented using the statistical software program R (R Core Team 2017). These corrected abundance estimates can be on the order of three times greater than estimates calculated from raw point count data. Hence, improving the accuracy of estimates of population sizes and trends, particularly for species of conservation concern, will improve the way monitoring data can inform the development, prioritization, and implementation of management objectives and goals within National Parks.

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List of Acronyms and Terms

List of region and park 4-letter codes within the National Capital Region Network

NCRN:	National Capital Region Network
ANTI:	Antietam National Battlefield
CATO:	Catoctin Mountain Park
CHOH:	Chesapeake and Ohio Canal National Historical Park
GWMP:	George Washington Memorial Parkway
GREE:	Greenbelt Park
HAFE:	Harpers Ferry National Historical Park
MANA:	Manassas National Battlefield Park
MONO:	Monocacy National Battlefield Park
NACE:	National Capital Parks-East
PISC/FOWA:	Piscataway Park/Fort Washington
PRWI:	Prince William Forest Park
ROCR:	Rock Creek Park
WOTR:	Wolf Trap National Park for the Performing Arts

List of abbreviations or acronyms of terms

NPS:	National Park Service
BCI:	Bird Community Index
PIF:	Partners in Flight
IUCN:	International Union for Conservation of Nature
LC:	Least Concern
NT:	Near Threatened
VU:	Vulnerable
Yel-d:	In decline
Yel-r:	Restricted range
CBSD:	Common Birds in Steep Decline
GOF:	Goodness-of-fit

Introduction

The 13 national parks of the National Capital Region Network (NCRN) host a diverse array of bird species across varied habitats (Table 1 shows all birds detected during monitoring). Urban settings dominate some of the parks in the National Capital Region Network including: National Capital Parks-East (D.C. portions), Greenbelt/Baltimore Washington Parkway, and Fort Washington/Piscataway Park, Rock Creek Park, Wolf Trap National Park for the Performing Arts, and the George Washington Memorial Parkway (Figure 1). Alternatively, parks embedded in more rural areas include Catoctin Mountain Park, Harpers Ferry National Historical Park, Prince William Forest Park, and parts of the C&O Canal (Figure 1); these parks tend to support more forest interior specialist species. The battlefield parks of Antietam National Battlefield, Manassas National Battlefield Park, and Monocacy National Battlefield provide suitable habitat for both grassland and forest species. Collectively, these relatively small cultural parks located within a human dominated landscape, support a diverse bird community.

All monitoring points are part of the holistic NCRN forest monitoring sampling frame and are specifically located within forested habitats. The forest-breeding bird protocol was first published in 2006 to establish monitoring methods for this vital sign (Dawson and Efford 2013). Avian species abundance and composition are assessed using point counts at monitoring sites distributed randomly throughout the region (Dawson and Efford 2013). In 2007, the protocol was successfully implemented, and repeated annually between 2008 and 2017. This report summarizes the results at both a regional and park unit level for forest-breeding birds over the first 11 years of implementation.

The majority of parks in the NCRN are located in the greater Washington, D.C. metro area, where some of the most rapid development in the U.S. occurs. As the areas surrounding national parks are subsumed for human activity, these protected parks are increasingly important for local and regional bird conservation. Twenty-two forest bird species of both regional and continental conservation concern have been detected in the NCRN parks, including Blue-winged Warblers (*Vermivora pinus*), Cerulean Warblers, Kentucky Warblers (*Geothlypis formosa*), Olive-sided Flycatchers, Prothonotary Warblers (*Protonotaria citrea*), Red-headed Woodpeckers, Least Flycatchers (*Empidonax minimus*), Wood Thrushes, and Worm-eating Warblers (*Helmitheros vermivorus*).

For these reasons, birds were selected as one of 21 "vital signs" monitored in the NCRN (National Park Service 2005). Vital signs are indicators of the state of natural resources in the parks and are network specific. The forest-breeding bird vital sign focuses on estimating the forest bird species composition and abundance and tracking changes in these metrics over time. Additionally, taxonomic information at count locations can be used to calculate a Bird Community Index (BCI) (O'Connell et al. 1998, O'Connell et al. 2003) that can aid in using the bird community monitoring data to assess bird community dynamics in relation to overall condition of the forest (Ladin et al. 2016). This is a useful data analysis tool which quantifies the condition of avian communities based on habitat use by particular guilds. Sites are rated based on proportional species representation in specialist or generalist guilds, with more poorly rated sites having a higher proportion of generalist guilds, indicative of lower avian community integrity. Lower BCI ratings are associated with higher

negative human impacts (O'Connell et al. 2000, Glennon and Porter 2005), or increased degree of urban landcover (Ladin et al. 2016). Here, we present results that can be assessed each subsequent monitoring year in order to track trends in BCI over time.

Table 1. List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Acadian Flycatcher	ACFL	*Empidonax virescens*	–	LC
Alder Flycatcher	ALFL	*Empidonax alnorum*	–	LC
American Bittern	AMBI	*Botaurus lentiginosus*	–	LC
American Crow	AMCR	*Corvus brachyrhynchos*	–	LC
American Goldfinch	AMGO	*Spinus tristis*	–	LC
American Kestrel	AMKE	*Falco sparverius*	–	LC
American Redstart	AMRE	*Setophaga ruticilla*	–	LC
American Robin	AMRO	*Turdus migratorius*	–	LC
American Woodcock[a]	**AMWO**	***Scolopax minor***	**Watch List - Yel-d**	**LC**
Bald Eagle	BAEA	*Haliaeetus leucocephalus*	–	LC
Baltimore Oriole	BAOR	*Icterus galbula*	–	LC
Bank Swallow[a]	**BANS**	***Riparia riparia***	**CBSD**	**LC**
Barn Swallow	BARS	*Hirundo rustica*	–	LC
Barred Owl	BADO	*Strix varia*	–	LC
Bay-breasted Warbler[b]	BBWA	*Setophaga castanea*	–	LC
Belted Kingfisher	BEKI	*Megaceryle alcyon*	–	LC
Black Vulture	BLVU	*Coragyps atratus*	–	LC
Black-and-white Warbler	BAWW	*Mniotilta varia*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Black-billed Cuckoo[a]	**BBCU**	***Coccyzus erythropthalmus***	**Watch List - Yel-d**	**LC**
Black-capped Chickadee	BCCH	*Poecile atricapillus*	–	LC
Black-crowned Night-Heron	BCNH	*Nycticorax nycticorax*	–	LC
Black-throated Blue Warbler	BTBW	*Setophaga caerulescens*	–	LC
Black-throated Green Warbler	BTNW	*Setophaga virens*	–	LC
Blackburnian Warbler	BLBW	*Setophaga fusca*	–	LC
Blackpoll Warbler[a,b]	**BLPW**	***Setophaga striata***	**CBSD**	**LC**
Blue Grosbeak	BLGR	*Passerina caerulea*	–	LC
Blue Jay	BLJA	*Cyanocitta cristata*	–	LC
Blue-gray Gnatcatcher	BGGN	*Polioptila caerulea*	–	LC
Blue-headed Vireo	BHVI	*Vireo solitarius*	–	LC
Blue-winged Warbler	BWWA	*Vermivora cyanoptera*	–	LC
Broad-winged Hawk	BWHA	*Buteo platypterus*	–	LC
Brown Creeper	BRCR	*Certhia americana*	–	LC
Brown Thrasher	BRTH	*Toxostoma rufum*	–	LC
Brown-headed Cowbird	BHCO	*Molothrus ater*	–	LC
Canada Goose	CANG	*Branta canadensis*	–	LC
Canada Warbler[a,b]	**CAWA**	***Cardellina canadensis***	**Watch List - Yel-d**	**LC**
Cape May Warbler[a,b]	**CMWA**	***Setophaga tigrina***	**Watch List - Yel-d**	**LC**
Carolina Chickadee	CACH	*Poecile carolinensis*	–	LC
Carolina Wren	CARW	*Thryothorus ludovicianus*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Cedar Waxwing	CEDW	Bombycilla cedrorum	–	LC
Cerulean Warbler[a]	**CERW**	**Setophaga cerulea**	**Watch List - Yel-d**	**VU**
Chestnut-sided Warbler	CSWA	Setophaga pensylvanica	–	LC
Chimney Swift[a]	**CHSW**	**Chaetura pelagica**	**Watch List - Yel-d**	**NT**
Chipping Sparrow	CHSP	Spizella passerina	–	LC
Chuck-will's-widow[a]	**CWWI**	**Antrostomus carolinensis**	**CBSD**	**LC**
Cliff Swallow	CLSW	Petrochelidon pyrrhonota	–	LC
Common Grackle[a]	**COGR**	***Quiscalus quiscula***	**CBSD**	**LC**
Common Merganser	COME	*Mergus merganser*	–	LC
Common Nighthawk[a]	**CONI**	***Chordeiles minor***	**CBSD**	**LC**
Common Raven	CORA	*Corvus corax*	–	LC
Common Yellowthroat	COYE	*Geothlypis trichas*	–	LC
Cooper's Hawk	COHA	*Accipiter cooperii*	–	LC
Double-crested Cormorant	DCCO	*Phalacrocorax auritus*	–	LC
Downy Woodpecker	DOWO	*Dryobates pubescens*	–	LC
Eastern Bluebird	EABL	*Sialia sialis*	–	LC
Eastern Kingbird	EAKI	*Tyrannus tyrannus*	–	LC
Eastern Meadowlark[a]	**EAME**	***Sturnella magna***	**CBSD**	**LC**
Eastern Phoebe	EAPH	*Sayornis phoebe*	–	LC
Eastern Screech-Owl	EASO	*Megascops asio*	–	LC
Eastern Towhee	EATO	*Pipilo erythrophthalmus*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Eastern Wood-Pewee	EAWP	*Contopus virens*	–	LC
European Starling	EUST	*Sturnus vulgaris*	–	LC
Field Sparrow[a]	**FISP**	***Spizella pusilla***	**CBSD**	**LC**
Fish Crow	FICR	*Corvus ossifragus*	–	LC
Golden-crowned Kinglet	GCKI	*Regulus satrapa*	–	LC
Grasshopper Sparrow[a]	**GRSP**	***Ammodramus savannarum***	**CBSD**	**LC**
Gray Catbird	GRCA	*Dumetella carolinensis*	–	LC
Gray-cheeked Thrush[b]	GCTH	*Catharus minimus*	–	LC
Great Blue Heron	GBHE	*Ardea herodias*	–	LC
Great Crested Flycatcher	GCFL	*Myiarchus crinitus*	–	LC
Great Egret	GREG	*Ardea alba*	–	LC
Great Horned Owl	GHOW	*Bubo virginianus*	–	LC
Green Heron[a]	**GRHE**	***Butorides virescens***	**CBSD**	**LC**
Hairy Woodpecker	HAWO	*Dryobates villosus*	–	LC
Henslow's Sparrow[a]	**HESP**	***Centronyx henslowii***	**Watch List - Yel-r**	**NT**
Hermit Thrush	HETH	*Catharus guttatus*	–	LC
Herring Gull[a]	**HERG**	***Larus argentatus***	**CBSD**	**LC**
Hooded Merganser	HOME	*Lophodytes cucullatus*	–	LC
Hooded Warbler	HOWA	*Setophaga citrina*	–	LC
House Finch	HOFI	*Haemorhous mexicanus*	–	LC
House Sparrow	HOSP	*Passer domesticus*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
House Wren	HOWR	*Troglodytes aedon*	–	LC
Indigo Bunting	INBU	*Passerina cyanea*	–	LC
Kentucky Warbler[a]	**KEWA**	***Geothlypis formosa***	**Watch List - Yel-d**	**LC**
Killdeer	KILL	*Charadrius vociferus*	–	LC
Laughing Gull	LAGU	*Leucophaeus atricilla*	–	LC
Least Flycatcher[a]	**LEFL**	***Empidonax minimus***	**CBSD**	**LC**
Louisiana Waterthrush	LOWA	*Parkesia motacilla*	–	LC
Magnolia Warbler	MAWA	*Setophaga magnolia*	–	LC
Mallard	MALL	*Anas platyrhynchos*	–	LC
Marsh Wren	MAWR	*Cistothorus palustris*	–	LC
Mourning Dove	MODO	*Zenaida macroura*	–	LC
Mourning Warbler[b]	MOWA	*Geothlypis philadelphia*	–	LC
Nashville Warbler[b]	NAWA	*Oreothlypis ruficapilla*	–	LC
Northern Bobwhite[a]	**NOBO**	***Colinus virginianus***	**CBSD**	**NT**
Northern Cardinal	NOCA	*Cardinalis cardinalis*	–	LC
Northern Flicker	NOFL	*Colaptes auratus*	–	LC
Northern Mockingbird	NOMO	*Mimus polyglottos*	–	LC
Northern Parula	NOPA	*Setophaga americana*	–	LC
Northern Rough-winged Swallow	NRWS	*Stelgidopteryx serripennis*	–	LC
Northern Saw-whet Owl	NSWO	*Aegolius acadicus*	–	LC
Northern Waterthrush[b]	NOWA	*Parkesia noveboracensis*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Olive-sided Flycatcher[a]	**OSFL**	***Contopus cooperi***	**Watch List - Yel-d**	**NT**
Orchard Oriole	OROR	*Icterus spurius*	–	LC
Osprey	OSPR	*Pandion haliaetus*	–	LC
Ovenbird	OVEN	*Seiurus aurocapilla*	–	LC
Palm Warbler	PAWA	*Setophaga palmarum*	–	LC
Philadelphia Vireo	PHVI	*Vireo philadelphicus*	–	LC
Pileated Woodpecker	PIWO	*Dryocopus pileatus*	–	LC
Pine Warbler	PIWA	*Setophaga pinus*	–	LC
Prairie Warbler[a]	**PRAW**	***Setophaga discolor***	**Watch List - Yel-d**	**LC**
Prothonotary Warbler[a]	**PROW**	***Protonotaria citrea***	**Watch List - Yel-d**	**LC**
Purple Martin	PUMA	*Progne subis*	–	LC
Red-bellied Woodpecker	RBWO	*Melanerpes carolinus*	–	LC
Red-breasted Nuthatch	RBNU	*Sitta canadensis*	–	LC
Red-eyed Vireo	REVI	*Vireo olivaceus*	–	LC
Red-headed Woodpecker[a]	**RHWO**	***Melanerpes erythrocephalus***	**Watch List - Yel-d**	**NT**
Red-shouldered Hawk	RSHA	*Buteo lineatus*	–	LC
Red-tailed Hawk	RTHA	*Buteo jamaicensis*	–	LC
Red-winged Blackbird	RWBL	*Agelaius phoeniceus*	–	LC
Ring-billed Gull	RBGU	*Larus delawarensis*	–	LC
Rock Pigeon	ROPI	*Columba livia*	–	LC
Rose-breasted Grosbeak	RBGR	*Pheucticus ludovicianus*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Ruby-crowned Kinglet	RCKI	*Regulus calendula*	–	LC
Ruby-throated Hummingbird	RTHU	*Archilochus colubris*	–	LC
Rusty Blackbird[a]	**RUBL**	***Euphagus carolinus***	**CBSD**	**VU**
Savannah Sparrow	SAVS	*Passerculus sandwichensis*	–	LC
Scarlet Tanager	SCTA	*Piranga olivacea*	–	LC
Sharp-shinned Hawk	SSHA	*Accipiter striatus*	–	LC
Snowy Egret	SNEG	*Egretta thula*	–	LC
Song Sparrow	SOSP	*Melospiza melodia*	–	LC
Spotted Sandpiper	SPSA	*Actitis macularius*	–	LC
Summer Tanager	SUTA	*Piranga rubra*	–	LC
Swainson's Thrush[b]	SWTH	*Catharus ustulatus*	–	LC
Swamp Sparrow	SWSP	*Melospiza georgiana*	–	LC
Tennessee Warbler[b]	TEWA	*Leiothlypis peregrina*	–	LC
Tree Swallow	TRES	*Tachycineta bicolor*	–	LC
Tufted Titmouse	TUTI	*Baeolophus bicolor*	–	LC
Turkey Vulture	TUVU	*Cathartes aura*	–	LC
Veery	VEER	*Catharus fuscescens*	–	LC
Warbling Vireo	WAVI	*Vireo gilvus*	–	LC
White-breasted Nuthatch	WBNU	*Sitta carolinensis*	–	LC
White-eyed Vireo	WEVI	*Vireo griseus*	–	LC
White-throated Sparrow	WTSP	*Zonotrichia albicollis*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

Table 1 (continued). List of 157 species detected within National Capital Region Network park units during implementation of the NCRN monitoring protocol. Four-letter American Ornithological Society alpha codes are shown. Species of continental conservation concern as designated by Partners in Flight species are labeled with a table note ([a]) and are also in bold and gray-highlighted rows, and categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	Continental Concern	IUCN Red List Category
Wild Turkey	WITU	*Meleagris gallopavo*	–	LC
Willow Flycatcher	WIFL	*Empidonax traillii*	–	LC
Winter Wren	WIWR	*Troglodytes hiemalis*	–	LC
Wood Duck	WODU	*Aix sponsa*	–	LC
Wood Thrush[a]	**WOTH**	***Hylocichla mustelina***	**Watch List - Yel-d**	**NT**
Worm-eating Warbler	WEWA	*Helmitheros vermivorum*	–	LC
Yellow Warbler	YEWA	*Setophaga petechia*	–	LC
Yellow-bellied Flycatcher	YBFL	*Empidonax flaviventris*	–	LC
Yellow-billed Cuckoo[a]	**YBCU**	***Coccyzus americanus***	**CBSD**	**LC**
Yellow-breasted Chat	YBCH	*Icteria virens*	–	LC
Yellow-rumped Warbler	YRWA	*Setophaga coronata*	–	LC
Yellow-throated Vireo	YTVI	*Vireo flavifrons*	–	LC
Yellow-throated Warbler	YTWA	*Setophaga dominica*	–	LC

[a] Species of continental conservation concern as designated by Partners in Flight species (also in bold and gray-highlighted rows)

[b] Indicates non-breeding migrants

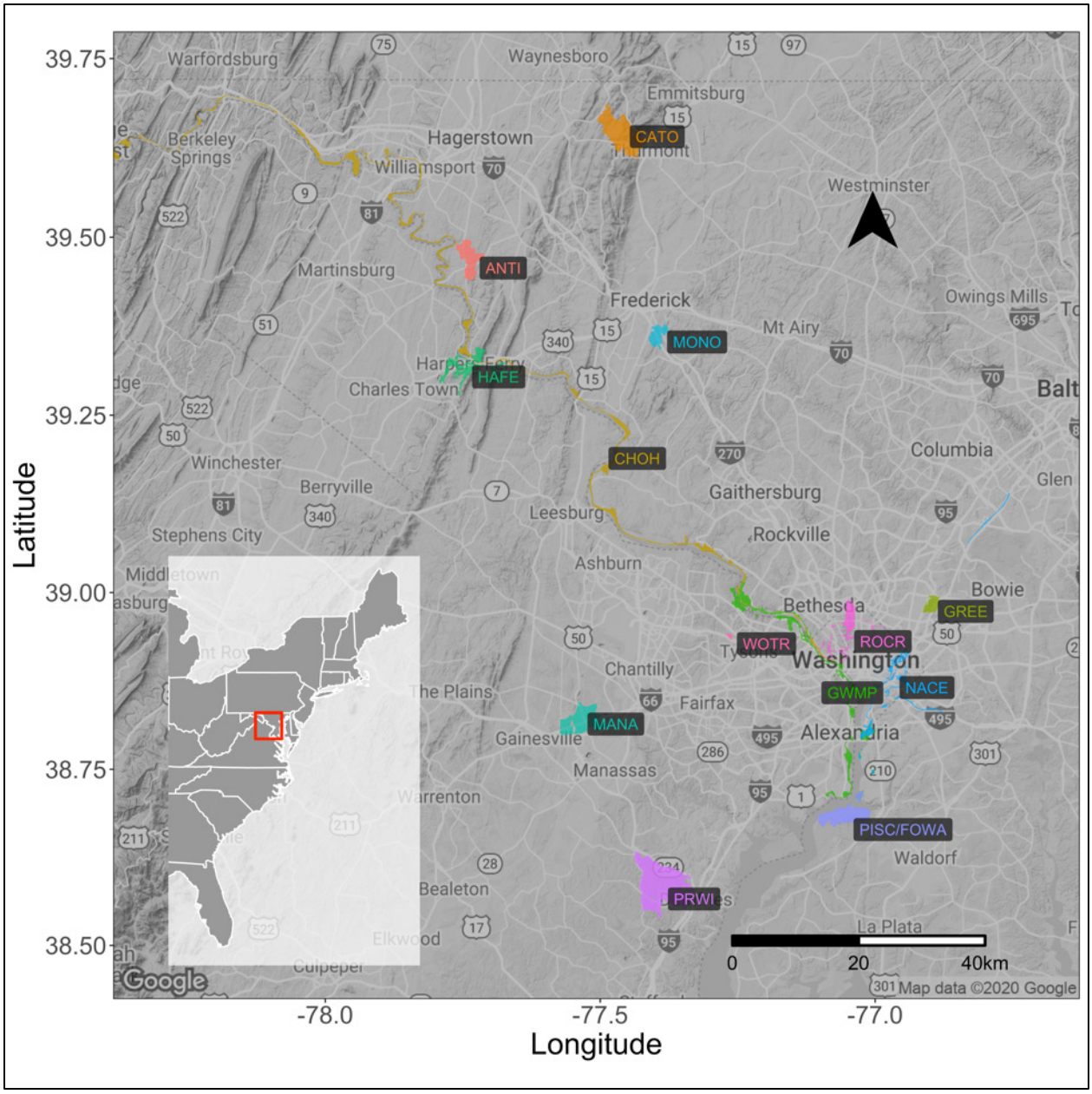


Figure 1. Study area map showing 13 park units within the National Capital Region Network. Park units include: Antietam National Battlefield (ANTI), Catoctin Mountain Park (CATO), Chesapeake and Ohio Canal National Historical Park (CHOH), George Washington Memorial Parkway (GWMP), Harpers Ferry National Historical Park (HAFE), Manassas National Battlefield Park (MANA), Monocacy National Battlefield (MONO), National Capital Parks–East (NACE; including Greenbelt/Baltimore Washington Parkway [GREE] and Fort Washington/Piscataway Park [PISC/FOWA]), Prince William Forest Park (PRWI), Rock Creek Park (ROCR), and Wolf Trap National Park for the Performing Arts (WOTR).

Methods

Monitoring Locations

Forest bird monitoring points were selected following a generalized random tessellation stratified (GRTS) design (Stevens and Olsen 2004) to produce a coverage for the region that is both probabilistic and spatially balanced. This point selection method is also used for vegetation monitoring, and many bird monitoring locations are co-located with vegetation monitoring points. Occasionally, some points were suitable for monitoring birds, but not vegetation, and in those cases, there is no overlap. For further detail on point selection, see the NCRN forest vegetation monitoring protocol (Schmit et al. 2014).

For the 2007 season, many of the bird monitoring points had not yet been visited and ground-truthed, and some points had to be discarded. Points were discarded if they were not in forested areas or if they were inaccessible or not accessible in a timely manner (i.e., if a point fell on an island). In 2007, 400 points were visited, and 33 were discarded. The total number monitored in 2007 was 367 (Table 2), just below the goal of 384 samples (Dawson and Efford 2013). In the 2008 season, additional points were added, bringing the total to 385, all of which were monitored in 2009-2013 (Table 2). Another 25 points were subsequently added in ANTI, MONO, and WOTR, parks that were previously underrepresented. Currently, there are a total of 410 locations being sampled annually. Occasionally, monitoring locations are not visited due to unavoidable circumstances.

Table 2. Count of monitoring points sampled each year within each park from 2007 to 2017 in the National Capital Region Network.

Name	4-letter Code	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
National Capital Region Network	NCRN	367	385	385	385	385	385	385	410	410	410	410
Antietam National Battlefield	ANTI	6	6	6	6	6	6	6	14	14	14	14
Catoctin Mountain Park	CATO	45	45	45	45	45	45	45	45	45	45	45
Chesapeake and Ohio Canal National Historical Park	CHOH	84	91	91	91	91	91	91	91	91	92	91
Greenbelt Park	GREE	7	7	7	7	7	7	7	7	7	7	7
George Washington Memorial Parkway	GWMP	18	20	20	20	20	20	20	20	20	20	20
Harpers Ferry National Historical Park	HAFE	18	20	20	20	20	20	20	20	20	20	20
Manassas National Battlefield Park	MANA	23	24	24	24	24	24	24	24	24	23	24
Monocacy National Battlefield	MONO	2	3	3	3	3	3	3	15	15	15	15
National Capital Parks-East, DC portion	NACE	8	9	9	9	9	9	9	9	9	9	9
Piscataway-Fort Washington	PISC/ FOWA	13	13	13	13	13	13	13	13	13	13	13
Prince William Forest Park	PRWI	128	132	132	132	132	132	132	132	132	132	132
Rock Creek Park	ROCR	14	14	14	14	14	14	14	14	14	14	14
Wolf Trap National Park for the Performing Arts	WOTR	1	1	1	1	1	1	1	6	6	6	6

Field Methods

Each point was surveyed twice each breeding season (7 May - 29 July) by a skilled observer between 20 minutes before and five hours after dawn. An individual observer never visited the same point twice within a given season. Each observer conducted a 10-minute point count, and recorded every bird detected within 100 m. This includes birds flying over the point count area, which are recorded as “flyovers”. Observers also recorded the sex of a bird where discernible, how the bird was detected (visual observation or auditory detection) and if the bird was within 50 m or between 50 and 100 m. The ten-minute count was divided into four equal intervals of 2.5 minutes, and observers also

recorded which interval the first detection of a bird was noted to facilitate calculations of density and detection probability (Farnsworth et al. 2002). Starting in 2008, observers also recorded which species were detected within the first 3 minutes so these data could be compared with Breeding Bird Survey data (Pardiek et al. 2019).

Data Analysis

Species Richness

For each of the 13 parks we used the total number of species detected each year as an estimate of species richness. For this analysis, we included all detections (i.e., flyovers and all distance bands 0-100 m).

Species of Conservation Concern

We calculated the proportion of points where species of conservation concern, as defined by Partners in Flight (PIF), were detected at park and region levels. We included detections from within both 0-50 m and 50-100 m distance bands. The PIF program is a cooperative effort among government agencies, non-governmental organizations, and private individuals to help species at risk and to identify species of conservation concern in the region (Panjabi et al. 2017). PIF watch list species are those species most vulnerable at a continental scale and include categories: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD).

Site Occupancy

We analyzed point count data using the 'unmarked' (Fiske et al. 2011) package in statistical software program R (version 3.1.3; R Core Team 2017). We first converted raw count data to binomial detections (i.e., 0 or 1) for each visit to estimate probability of site occupancy. We fit models using the *occu()* function (MacKenzie et al. 2002) which assumes population closure during the duration of surveys. We fit the following models: Null, Observer, Ordinal Day, Observer+Ordinal Day, Observer+Ordinal Day+Time of Day, and Observer+Ordinal Day+Wind speed on the detection process to account for known observer, seasonal, and survey conditions that can affect detection. We fit separate models for each species within each park unit that had adequate data (i.e., > 50 total detections), and we included Year as a fixed-effect variable, to get annual estimates of the probability of site occupancy. We subsequently used corrected Akaike's information criterion (AICc; Akaike 1974, Hurvich and Tsai 1989) with delta AICc values ≤ 2 as a criterion to compare models predicting annual site occupancy for each species within each park unit. We then calculated the detection probability from each model using the equation: $1 - [(1 - p_1) \times (1 - p_2) \times \ldots (1 - p_n)]$ where $p_1 \ldots p_n$ are the detection probabilities associated with the model covariates. For each model run, we evaluated the goodness-of-fit (GOF) using the *mb.gof.test()* function within the 'AICcmodavg' package (Mazerolle 2017), which computes a model-fit statistic, c-hat. Subsequently, we only included results from models with c-hat values ranging between 0.2–4.0, to remove any models with either underdispersion or overdispersion (Mazerolle 2017). All GOF test results for top-performing model are included in Appendix C. We then calculated the linear trend in annual occupancy across years (2007-2017) for each species (see Appendix A for trends in annual occupancy estimates in each NCRN park). Significant trends were determined using linear models that regressed mean annual occupancy against year with $\alpha = 0.10$. When visualizing model-

estimated annual probability of site occupancy, we additionally included mean (± SE) naïve probability of site occupancy, which we computed the mean and SE for the number of points occupied per year at a given park unit using the raw maximum count (converted to presence/absence; i.e., 0 or 1) from both visits divided by the total number of surveyed points.

Abundance Estimation

Abundance estimates based on raw counts of individuals that do not account for detection probabilities of the individuals counted, may lead to biased population estimates (Royle 2004), and have been shown to underestimate population sizes (Royle et al. 2007, Kéry 2008). We estimated the annual abundance (mean number of birds per sampling location) within each park. Our analysis included data with detections from within a 0-100 m distance band, and analyzed count data from two repeated visits using N-mixture models with the *pcount*() function (Royle 2004, Chandler et al. 2011) with Observer and Ordinal Day as detection covariates and the park as a site-level covariate in the R package 'unmarked' (Fiske et al. 2011). These models can be used to estimate true unobserved abundance as: $N_{it} \sim Pois(\lambda_{it})$, where N is the unobserved true abundance at site i, at time t, which is a function of the Poisson distribution in which the mean is equal to the variance, with a mean of λ at site i, at time t. The above model is then nested within and influences the model describing the detection process: $y_{ijt} \sim Binom(N_{it}, p_{ijt})$, where y_{ijt} is the observed abundance at site i, during visit j, at time t which is a function of a binomial random variable with the parameters N_{it} (true abundance at site i, at time t) and p_{ijt} (detection probability, p at site i, during visit j, at time t) (Royle 2004, Kéry 2008). Similar to methods for fitting occupancy models (see above), we fit separate models for each species within each park unit that had adequate data (i.e., > 50 total detections), and we included Year as a fixed-effect variable, to get annual estimates mean abundance at a given point. We used a model selection approach that included fitting the following models: Null (Poisson), Null (Negative Binomial), Observer (Poisson), Observer (Negative Binomial), Observer+Ordinal Day (Poisson), and Observer+Ordinal Day (Negative Binomial). We included year as a site-level covariate in all models. We then calculated the detection probability from each model using the equation $1 - [(1 - p_1) \times (1 - p_2) \times \ldots (1 - p_n)]$ where $p_1 \ldots p_n$ are the detection probabilities associated with model covariates. Then, we used the 'AICmodavg' package (Mazarolle 2017) to compare models using AICc model selection (Akaike 1974, Hurvich and Tsai 1989). We used predicted estimates of abundance (mean number of birds at a given monitoring location) from the top-performing model with delta AICc values ≤ 2 to compute the mean population density (birds per ha) for each year. Similar to modelling occupancy, for each abundance model run, we evaluated the GOF using the *Nmix.gof.test()* function within the 'AICcmodavg' package (Mazerolle 2017), which computes a model-fit statistic, c-hat. Subsequently, we only included results from models with c-hat values ranging between 0.2–4.0, to remove any models with either underdispersion or overdispersion (Mazerolle 2017). All GOF test results for top-performing model are included in Appendix C.

Population Density

To calculate the population density (birds per ha) for each species, we divided the estimated mean number of birds per monitoring location (means and SEs) by 3.14 ha, which is the area of a circular point count point with a radius of 100 m. This number could then be multiplied by a given area (e.g.,

forest habitat within a park) to get a park-level estimate of total individuals within a park. When visualizing annual mean species density, based on abundance model estimates, we additionally included mean (± SE) annual naïve density estimates, which were computed by taking the mean and SE for the raw maximum count from both visits among points per year at a given park unit.

Bird Community Index

We used the point count data from each point to assess the bird community integrity following O'Connell et al. (2003) and used the scoring and guild assignments from O'Connell et al. (1998) for the Appalachian bird conservation region (BCR). Scores for each point were then averaged to estimate annual mean bird community index (BCI) scores per park and region. BCI scores can be used to compare overall habitat integrity among parks and years. The integrity of sampling units is ranked accordingly: highest integrity (60.1-77.0), high integrity (52.1-60.0), medium integrity (40.1-52.0), and low integrity (20.0-40.0) (O'Connell et al. 1998). The National Capital Region has parks within the Appalachian, the Piedmont, and the Coastal Plain BCRs. However, here we use the Appalachian guild assignment and BCI scoring framework described in O'Connell et al. (1998) to evaluate NCRN parks. We chose the Appalachian BCR guild assignments as representative for the NCRN region since it contained the most similar list of species compared to the species detected

Results

Species Richness

Species richness varied among parks in the NCRN and among years (Figure 2, Table 3). The C&O Canal hosted the greatest forest-breeding bird species richness for all ten sampling years and Wolf Trap supported the fewest (Figure 2). Monitoring location-level species richness for each year is presented for the entire network and for each park unit in Appendix D.

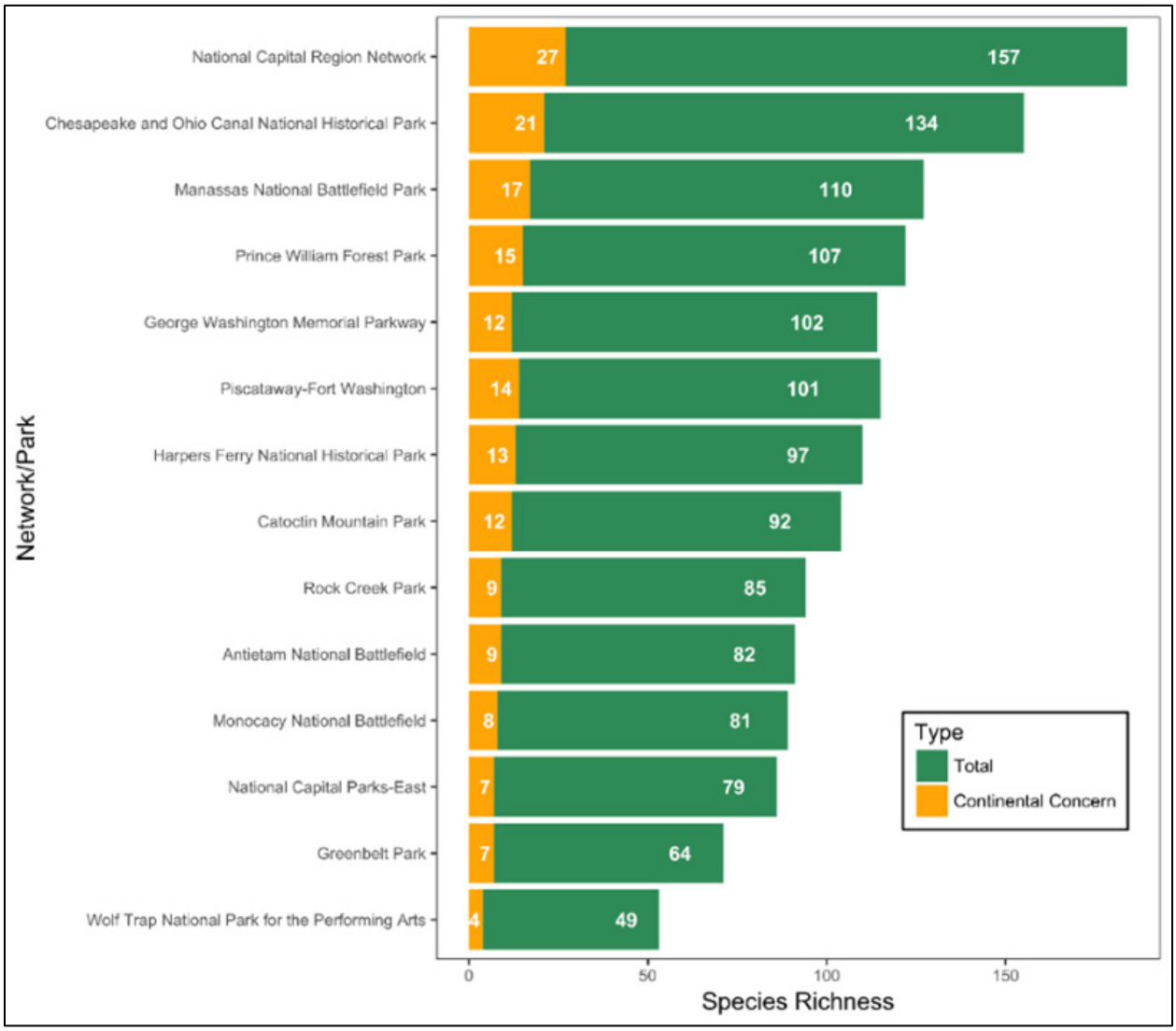


Figure 2. Network-wide and park-level numbers of unique species detected from 2007 to 2017 within the National Capital Region Network. Green bars indicate counts of the total number of unique species, and yellow bars are overlaid to indicate total number of unique Partners in Flight watch list species (Continental Concern).

Table 3. Network-wide and park-level counts of unique species per year in the National Capital Region Network.

Name	4-letter Code	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
National Capital Region Network	NCRN	111	112	102	119	112	110	111	116	110	107	113
Antietam National Battlefield	ANTI	46	47	35	42	44	35	44	53	49	51	48
Catoctin Mountain Park	CATO	59	44	41	51	49	51	56	51	46	47	46
Chesapeake and Ohio Canal National Historical Park	CHOH	94	85	74	89	92	88	93	87	82	79	91
Greenbelt Park	GREE	29	38	31	32	31	32	31	34	28	21	33
George Washington Memorial Parkway	GWMP	55	57	55	65	53	56	57	52	50	47	49
Harpers Ferry National Historical Park	HAFE	49	63	55	51	51	55	59	53	47	51	48
Manassas National Battlefield Park	MANA	59	60	56	64	61	62	64	71	53	64	65
Monocacy National Battlefield	MONO	27	22	28	22	31	30	21	59	50	44	54
National Capital Parks-East, D.C. portion	NACE	40	43	34	38	40	41	45	42	34	37	48
Piscataway/Fort Washington	PISC/ FOWA	56	59	57	54	55	53	54	59	53	50	57
Prince William Forest Park	PRWI	65	68	64	66	65	70	61	63	59	60	60
Rock Creek Park	ROCR	54	44	41	50	53	44	36	39	38	39	40
Wolf Trap National Park for the Performing Arts	WOTR	7	8	9	9	9	12	21	30	31	28	30

Species of Conservation Concern

We detected 27 species designated by Partners in Flight (PIF) as species of conservation concern (Table 4). Of these species, 12 were categorized as declining (Yel-d), Henslow's sparrow (*Centronyx henslowii*) was designated as having restricted range (Yel-r), and 14 species were designated as a common bird in steep decline (CBSD) based on PIF Watch List criteria (Panjabi et al. 2017). Additionally, species of continental concern belonged to multiple IUCN Red List categories (see Table 4). Nineteen species were identified as Least Concern (LC), and six species were identified as Near Threatened (NT). Additionally, the Cerulean Warbler (*Setophaga cerulea*) and Rusty Blackbird (*Euphagus carolinus*) were categorized as Vulnerable (VU) according to the IUCN Red List. The proportions of monitoring locations where at least one PIF species of conservation concern were detected differed among park units and years, and overwhelmingly, park units across years had a high proportion (i.e., > 0.5) of monitoring locations where species of conservation concern were detected (Table 5).

Table 4. List of 27 Partners in Flight (PIF) species of continental concern detected within the National Capital Region Network of national parks between 2007 to 2017. PIF categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	PIF category	IUCN Red List category
American Woodcock	AMWO	*Scolopax minor*	Watch List - Yel-d	LC
Bank Swallow	BANS	*Riparia riparia*	CBSD	LC
Black-billed Cuckoo	BBCU	*Coccyzus erythropthalmus*	Watch List - Yel-d	LC
Blackpoll Warbler	BLPW	*Setophaga striata*	CBSD	LC
Canada Warbler	CAWA	*Cardellina canadensis*	Watch List - Yel-d	LC
Cape May Warbler	CMWA	*Setophaga tigrina*	Watch List - Yel-d	LC
Cerulean Warbler	CERW	*Setophaga cerulea*	Watch List - Yel-d	VU
Chimney Swift	CHSW	*Chaetura pelagica*	Watch List - Yel-d	NT
Chuck-will's-widow	CWWI	*Antrostomus carolinensis*	CBSD	LC
Common Grackle	COGR	*Quiscalus quiscula*	CBSD	LC
Common Nighthawk	CONI	*Chordeiles minor*	CBSD	LC
Eastern Meadowlark	EAME	*Sturnella magna*	CBSD	LC
Field Sparrow	FISP	*Spizella pusilla*	CBSD	LC
Grasshopper Sparrow	GRSP	*Ammodramus savannarum*	CBSD	LC
Green Heron	GRHE	*Butorides virescens*	CBSD	LC

Table 4 (continued). List of 27 Partners in Flight (PIF) species of continental concern detected within the National Capital Region Network of national parks between 2007 to 2017. PIF categories for Watch List species include: declining (Yel-d), restricted range (Yel-r), and Common Bird in Steep Decline (CBSD). IUCN Red List Categories shown: Least Concern (LC), Near Threatened (NT), Vulnerable (VU).

Common Name	4-letter Alpha Code	Scientific Name	PIF category	IUCN Red List category
Henslow's Sparrow	HESP	*Centronyx henslowii*	Watch List - Yel-r	NT
Herring Gull	HERG	*Larus argentatus*	CBSD	LC
Kentucky Warbler	KEWA	*Geothlypis formosa*	Watch List - Yel-d	LC
Least Flycatcher	LEFL	*Empidonax minimus*	CBSD	LC
Northern Bobwhite	NOBO	*Colinus virginianus*	CBSD	NT
Olive-sided Flycatcher	OSFL	*Contopus cooperi*	Watch List - Yel-d	NT
Prairie Warbler	PRAW	*Setophaga discolor*	Watch List - Yel-d	LC
Prothonotary Warbler	PROW	*Protonotaria citrea*	Watch List - Yel-d	LC
Red-headed Woodpecker	RHWO	*Melanerpes erythrocephalus*	Watch List - Yel-d	NT
Rusty Blackbird	RUBL	*Euphagus carolinus*	CBSD	VU
Wood Thrush	WOTH	*Hylocichla mustelina*	Watch List - Yel-d	NT
Yellow-billed Cuckoo	YBCU	*Coccyzus americanus*	CBSD	LC

Table 5. Network-wide and park-level proportions of monitoring locations containing species of continental concern as designated by the Partners in Flight watch list in the National Capital Region Network.

Name	4-letter Code	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
National Capital Region Network	NCRN	0.84	0.8	0.74	0.9	0.83	0.75	0.83	0.85	0.74	0.76	0.77
Antietam National Battlefield	ANTI	1	0.83	1	0.83	1	1	1	1	0.93	0.93	0.93
Catoctin Mountain Park	CATO	0.98	0.78	0.76	0.93	0.93	0.8	0.93	0.84	0.78	0.87	0.89
Chesapeake and Ohio Canal National Historical Park	CHOH	0.9	0.88	0.71	0.88	0.91	0.69	0.81	0.91	0.8	0.8	0.8
George Washington Memorial Parkway	GWMP	0.67	0.75	0.7	0.9	0.8	0.5	0.7	0.8	0.7	0.8	0.65
Greenbelt Park	GREE	0.57	0.86	0.43	0.57	0.43	0.43	0.57	0.71	0.57	0.57	0.71
Harpers Ferry National Historical Park	HAFE	1	0.95	0.8	0.9	0.9	0.8	1	0.9	0.85	0.9	0.65
Manassas National Battlefield Park	MANA	0.74	0.88	0.83	0.92	0.83	0.79	0.83	1	0.83	0.83	0.88
Monocacy National Battlefield	MONO	1	1	0.67	1	0.67	0.67	0.33	0.93	0.87	0.87	0.8
National Capital Parks-East, D.C. portion	NACE	0.75	0.67	0.67	1	0.78	0.44	0.78	1	0.67	0.67	0.67
Piscataway-Fort Washington	PISC FOWA	0.85	0.92	0.85	1	0.92	0.77	0.85	0.69	0.77	0.77	1
Prince William Forest Park	PRWI	0.78	0.71	0.74	0.92	0.75	0.83	0.83	0.8	0.68	0.68	0.74
Rock Creek Park	ROCR	1	0.93	0.79	0.86	0.93	0.79	0.64	0.86	0.5	0.71	0.64
Wolf Trap National Park for the Performing Arts	WOTR	0	0	0	1	0	1	1	0	0.33	0.17	0.17

Site Occupancy

We modeled the mean annual probability of site occupancy and tested for significant trends of 63 species within the National Capital Region (Figure 3 and Appendix A), where we had adequate data and suitable model GOFs. We found that overwhelmingly at the network-wide level, trends in species occupancy were stable (86%), and that 3% of species had increasing trends in site occupancy that included the Eastern Meadowlark (*Sturnella magna*) and the Red-bellied Woodpecker (*Melanerpes carolinus*). However, 11% of species were found to have negative trends in occupancy and included the Eastern Towhee (*Pipilo erythrophthalmus*), Gray Catbird (*Dumetella carolinensis*), Hairy Woodpecker (*Dryobates villosus*), House Wren (*Troglodytes aedon*), Ovenbird (*Seiurus aurocapilla*), Song Sparrow (*Melospiza melodia*), and the Worm-eating Warbler. Notably, all other PIF Watch List species that had data suitable for modeling showed stable trends in the probability of site occupancy (Appendix A). Additionally, variance estimates around linear trends (shown as mean ± SE) in the probability of occupancy differed among species. Species having adequate raw count data (> 50 detections across all years) that we were able to model, led to reduced SE, in general (Appendix A). Covariates and GOF statistics included within each of the top-performing models for each species within each park unit are shown in Appendix C.

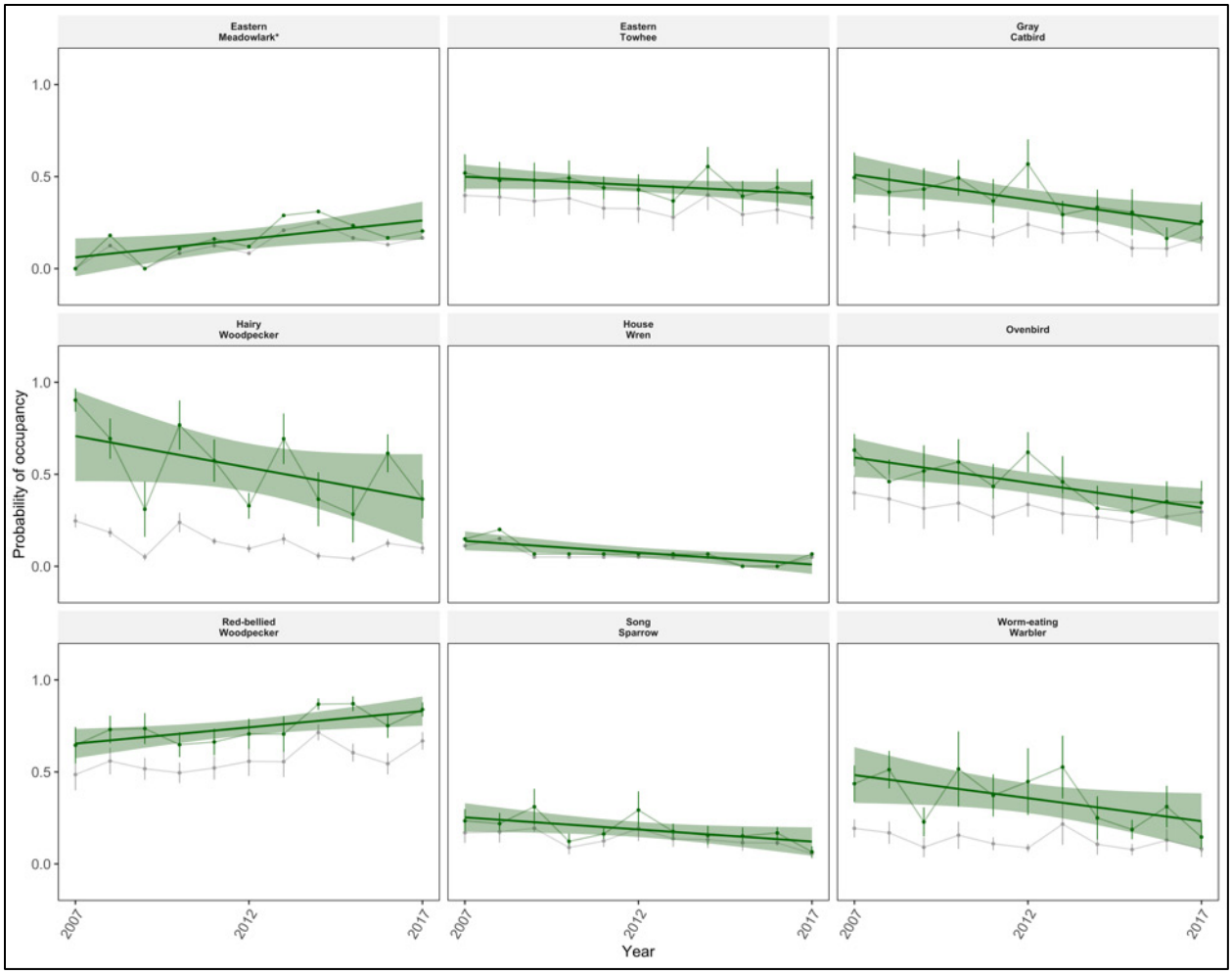


Figure 3. Species with Significant Trends in Annual Occupancy in the National Capital Region Network. All significant trends are indicated by linear models with SE. Gray and green points, lines, and error bars, indicate naïve and model estimates, respectively. Partners in Flight watch list species are indicated by asterisk.

Population Density

We successfully fit abundance models and calculated population density for 67 unique species that had adequate data and reasonable model GOF results (Figure 4 and Appendix C). We found that the majority of species had linear trends in population density (birds per ha) that were stable (76%; Appendix B). Additionally, we found only 1 species (1%), the Eastern Meadowlark, had an increasing trend. Of the species modeled, we found 22% to have declining trends which included the Baltimore Oriole (*Icterus galbula*), Black-and-white Warbler (*Mniotilta varia*), Common Grackle (*Quiscalus quiscula*), Eastern Phoebe (*Sayornis phoebe*), Eastern Wood-pewee (*Contopus virens*), Great Crested Flycatcher (*Myiarchus crinitus*), House Sparrow (*Passer domesticus*), House Wren, Indigo Bunting (*Passerina cyanea*), Northern Cardinal (*Cardinalis cardinalis*), Ovenbird, Pileated Woodpecker (*Dryocopus pileatus*), Pine Warbler (*Setophaga pinus*), Red-eyed Vireo (*Vireo olivaceus*). Variance estimates, as indicated by errorbars (SE), generally varied among species.

Covariates included within each of the top-performing models for each species within each park unit are shown in Appendix C.

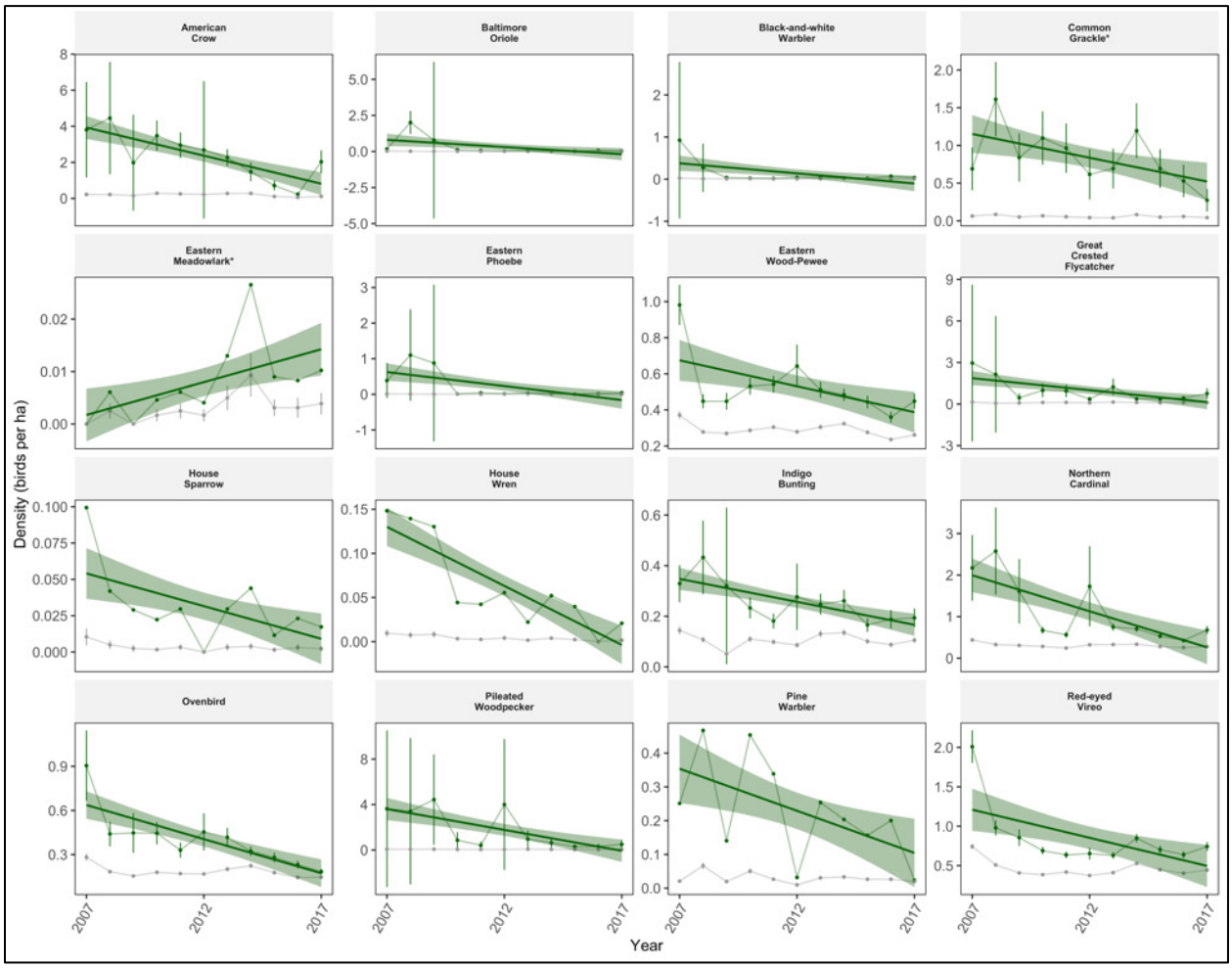


Figure 4. Species with Significant Trends in Annual Density in the National Capital Region Network. All significant trends are indicated by linear models with SE. Gray and green points, lines, and error bars, indicate naïve and model estimates, respectively. Partners in Flight watch list species are indicated by asterisk.

Bird Community Index

The trend in network wide annual BCI (mean ± SE) was very stable and ranged between 50.5 ± 0.34 in 2012 and 52.3 ± 0.36 in 2017. However, BCI varied among parks and among years within parks (Figure 5). Overall, annual BCI scores fell within the medium integrity range for the NCRN reflecting the diversity of parks within the network. The BCI scores are ranked as follows: highest integrity (60.1-77.0), high integrity (52.1-60.0), medium integrity (40.1-52.0), and low integrity (20.0-40.0) (O'Connell et al. 1998). In the NCRN, Prince William Forest Park and Catoctin Mountain Park exhibited high integrity BCI scores (Figure 5). The majority of the thirteen parks fall into the medium integrity range. While Wolf Trap had the greatest within-park unit variation among years with low integrity BCI from 2009 to 2011, when more sampling points were added to annual

surveys, the score increased with a significant positive trend ($P < 0.1$) reaching the medium integrity range (Figure 5). This highlights an important aspect of how the sampling effort within parks can influence the species detected, and subsequently the computed BCI score. We found a declining trend in BCI score within Harpers Ferry that is of interest, and closer evaluation of changes in community composition at the park-level and at the monitoring locations would be warranted. Otherwise, all other parks exhibited stable trends in BCI suggesting that bird communities as represented by relative dynamics among functional guilds are stable. This also suggests that bird community responses to underlying changes in the vegetation community dynamics over the past 11 years are relatively stable. However, given demonstrated time lag-effects of bird community responses to changes in vegetation (Knick et al. 2017, Whytock et al. 2018), these results should be conservatively interpreted, particularly in light of other contributing factors (e.g., climate change), that are not directly examined here.

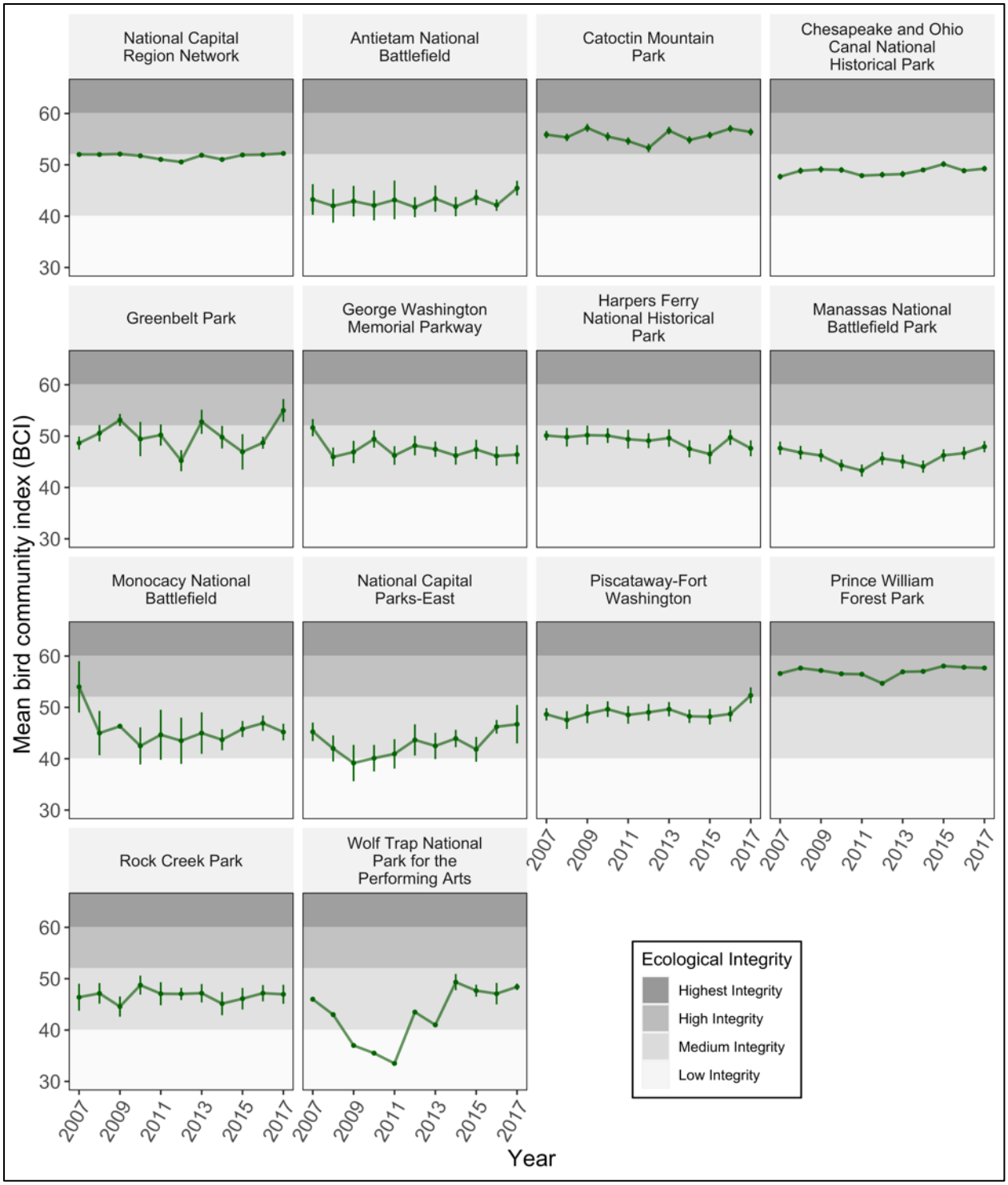


Figure 5. Network-wide (NCRN) and park-level annual bird community index (BCI) scores (mean ± SE) in the National Capital Region Network. Shaded gray areas in panel backgrounds indicate categories of ecological Integrity that range from Low (light gray) to Highest (dark gray) integrity.

Summary

This report presents the first 11 years of data (2007–2017) and analyses from the forest bird monitoring protocol in the National Capital Region Network. Occupancy and population density metrics were summarized at the network and individual park levels, including species of continental conservation concern (Table 4). After 11 years of data collection, it is clear that NCRN parks are both supporting and maintaining populations of species by providing critical breeding habitat. These parks are also important for species of continental concern that are declining rapidly across their ranges, such as the Chimney Swift and Cerulean Warbler. Our analyses of point count data to estimate species occupancy and abundance, while accounting for imperfect detection have been updated and standardized using the statistical software R to streamline future analysis, reporting, and inference for park biologists. Within this report, we have also included species-based and park-based 1-page resource brief-style summaries to enable the rapid assessment of broad patterns (Appendix A).

Here we present a broad overview of results that are informative at the park unit-level as to the percentages of declining, increasing, or stable trends for species occupancy and density. These results while informative at park unit and regional scales to describe overarching patterns, may be limited in their use for exploring species-level trends more explicitly. Since our goal was to fit models of occupancy and abundance that account for imperfect detection, and make broad comparisons among species, we used a standardized approach for fitting models and the inclusion of model covariates (see Methods). We are aware that modeling species occupancy and abundance can be improved with more focus and modeling of species on a case-by-case basis. This work remains important, and forthcoming research should incorporate more detailed exploration of such models. Additionally, future analyses can explore models that incorporate ancillary data within park units that would likely further highlight how forest bird populations and community dynamics are related to changes in vegetation, and other factors.

The continued use of a biological condition index as a method of rapid assessment of avian integrity across the region shows just how stable bird communities are within NCRN parks. These results are comforting given the rate of anthropogenic change outside of park units. Future studies should look to compare more closely trends of forest-breeding species both within and outside of NCRN parks to better assess the influence of changes in species populations within national parks. Additionally, our updated results within this report corroborate the findings from Ladin and Shriver (2016) which demonstrated how even when parks are surrounded by increasingly urbanized areas, they can provide critical breeding habitat for both common and conservation priority species. Overall, among these 11 years of data, there was little variation in the average score at each park.

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Appendix A. Trends in Estimated Probability of Site Occupancy

Trends in estimated probability of site occupancy for each species in each park per year in the National Capital Region Network between 2007 and 2017 are shown in Figures A1–A13.

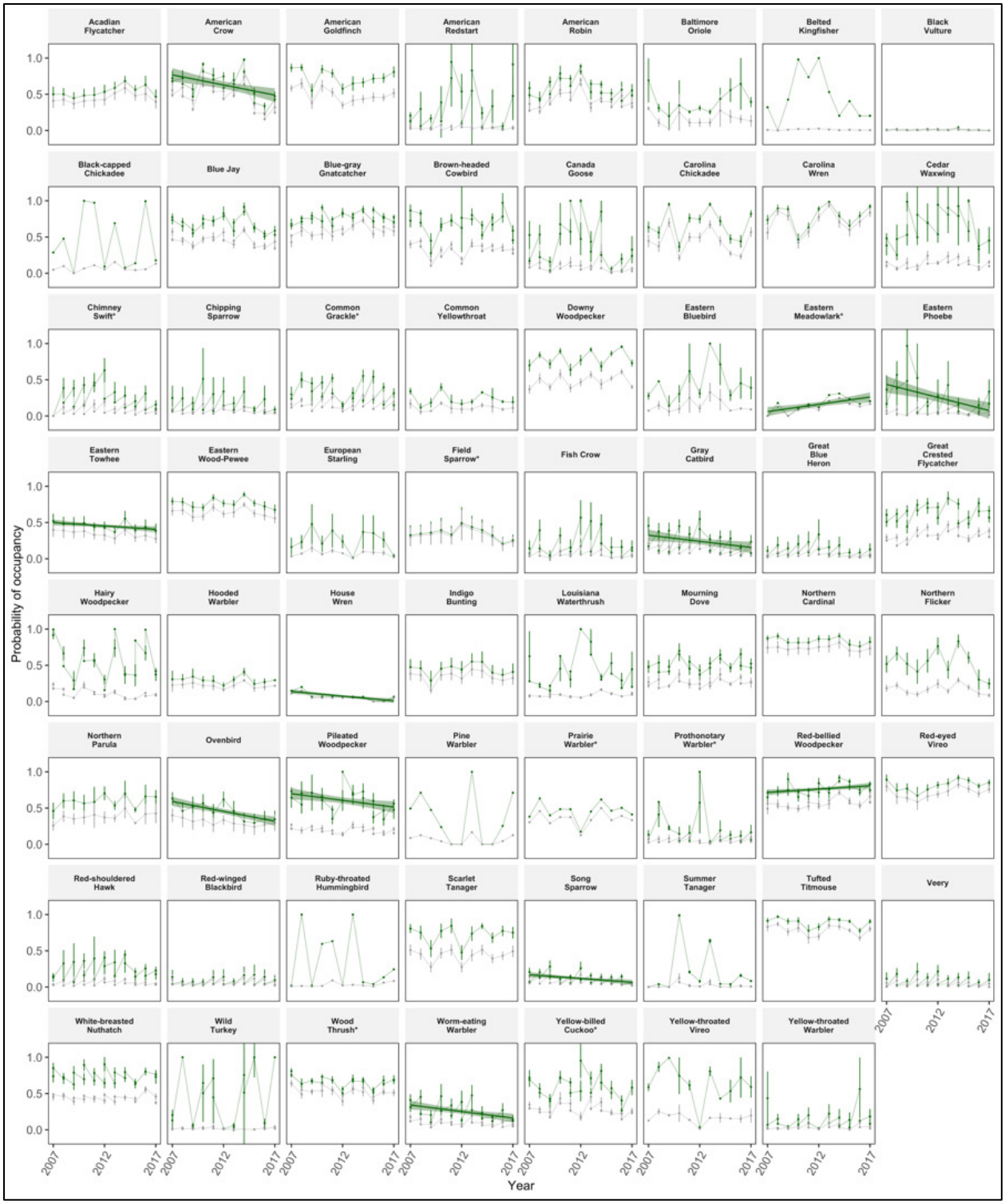


Figure A-1. Trends in Annual Occupancy – National Capital Region (3% increasing, 83% stable, and 14% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

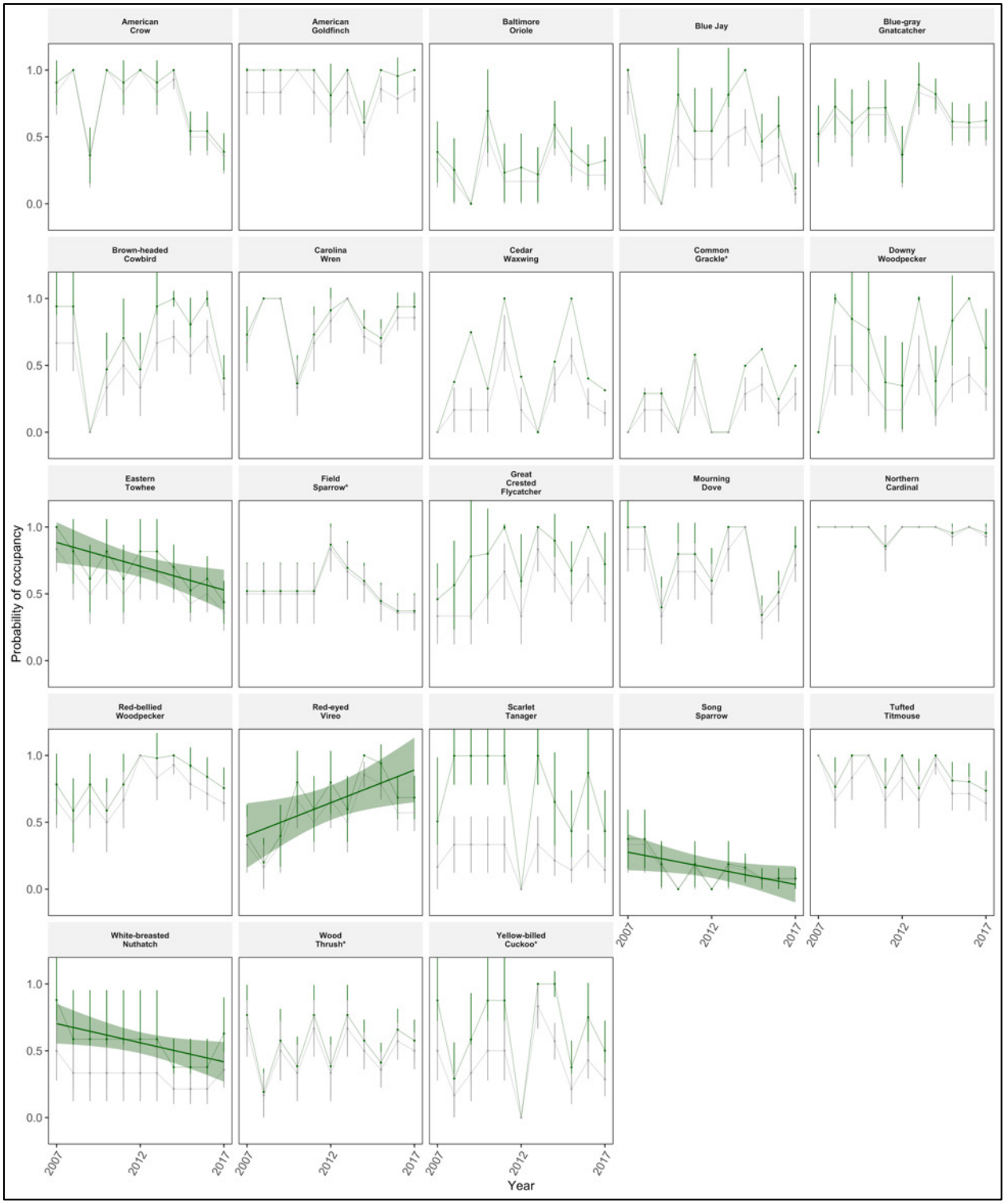


Figure A-2. Trends in Annual Occupancy – Antietam National Battlefield (4% increasing, 83% stable, and 12% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

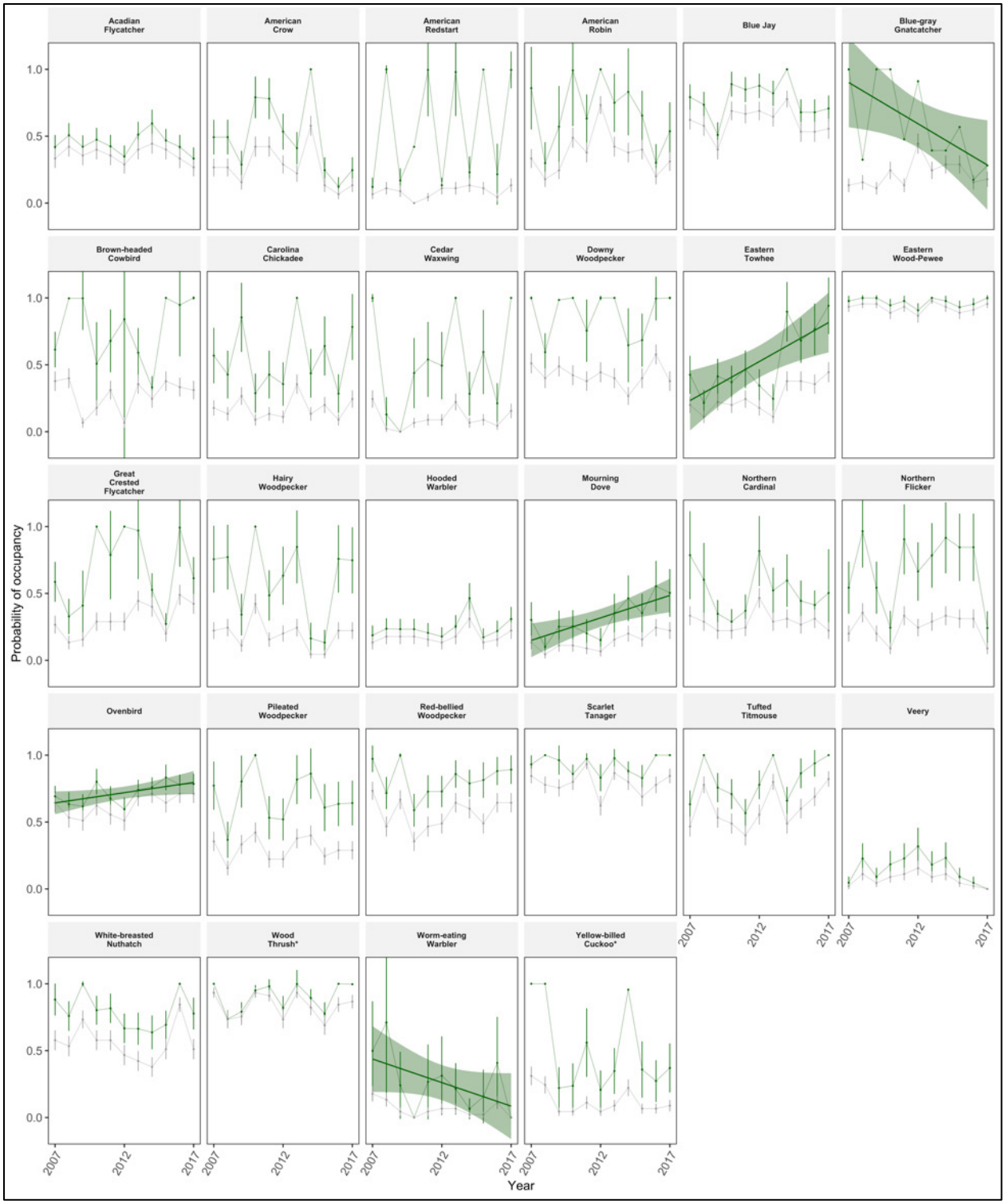


Figure A-3. Trends in Annual Occupancy – Catoctin Mountain Park (11% increasing, 82% stable, and 7% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

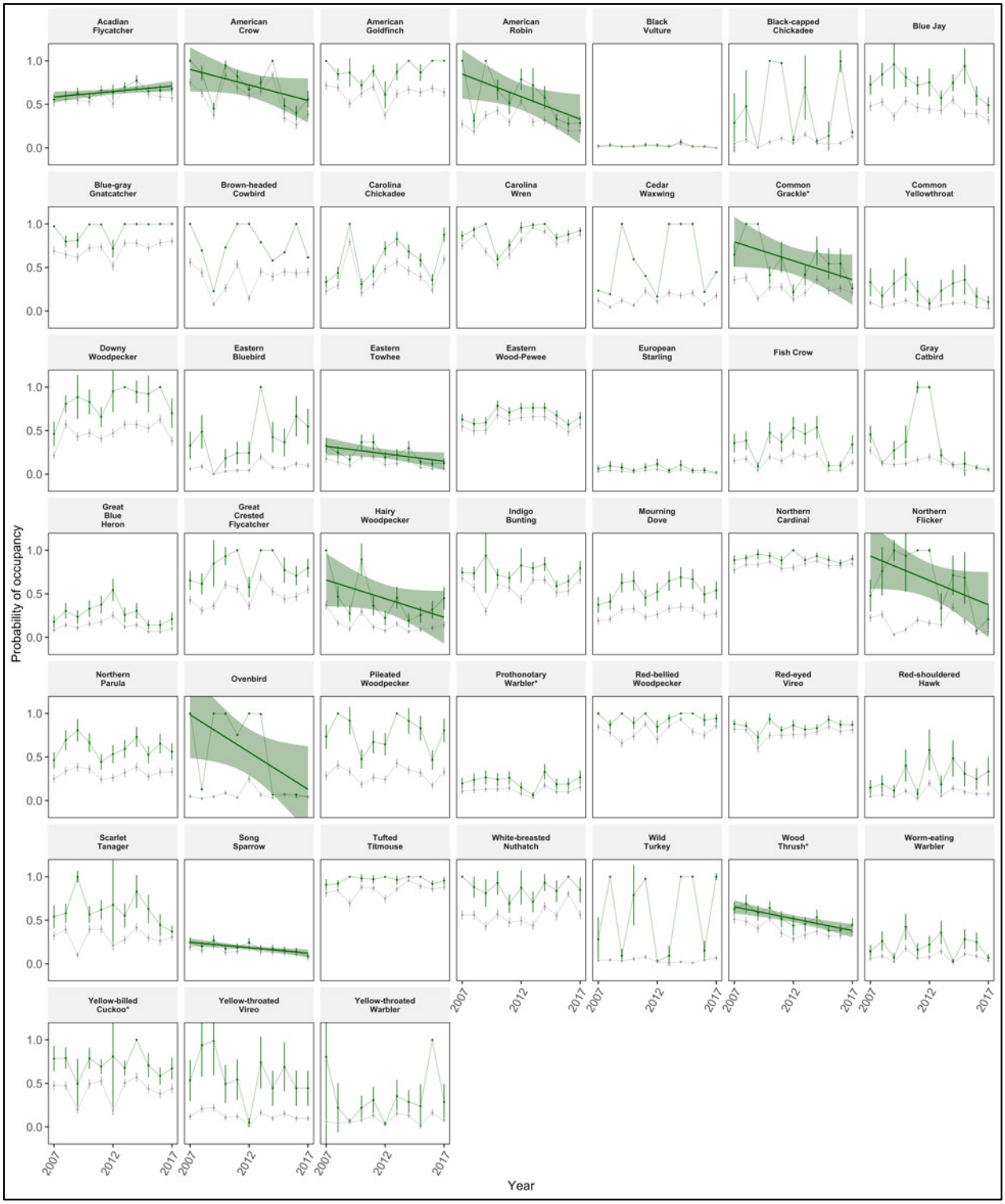


Figure A-4. Trends in Annual Occupancy – C&O Canal National Historical Park (2% increasing, 78% stable, and 20% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

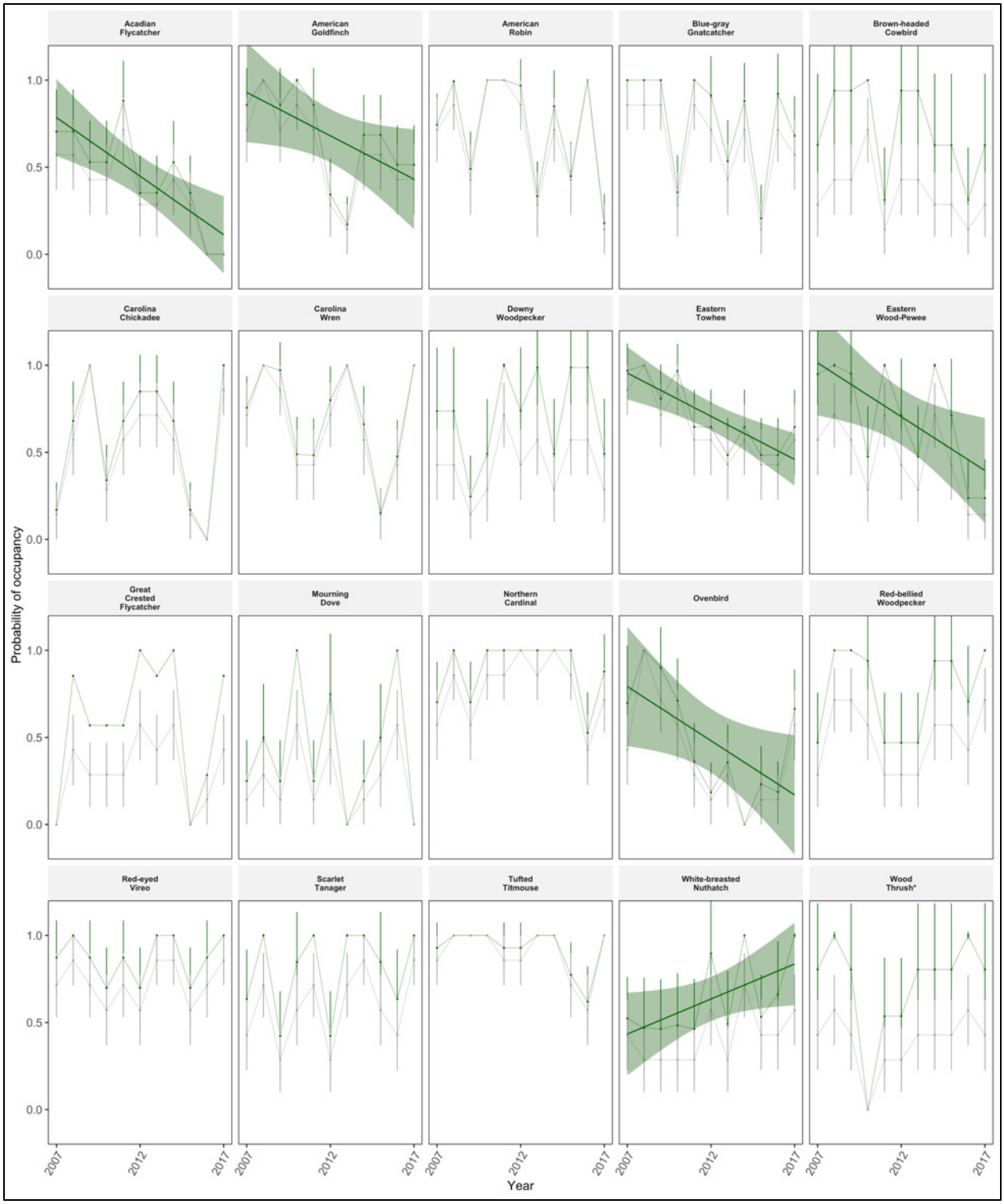


Figure A-5. Trends in Annual Occupancy – Greenbelt National Park (5% increasing, 70% stable, and 25% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

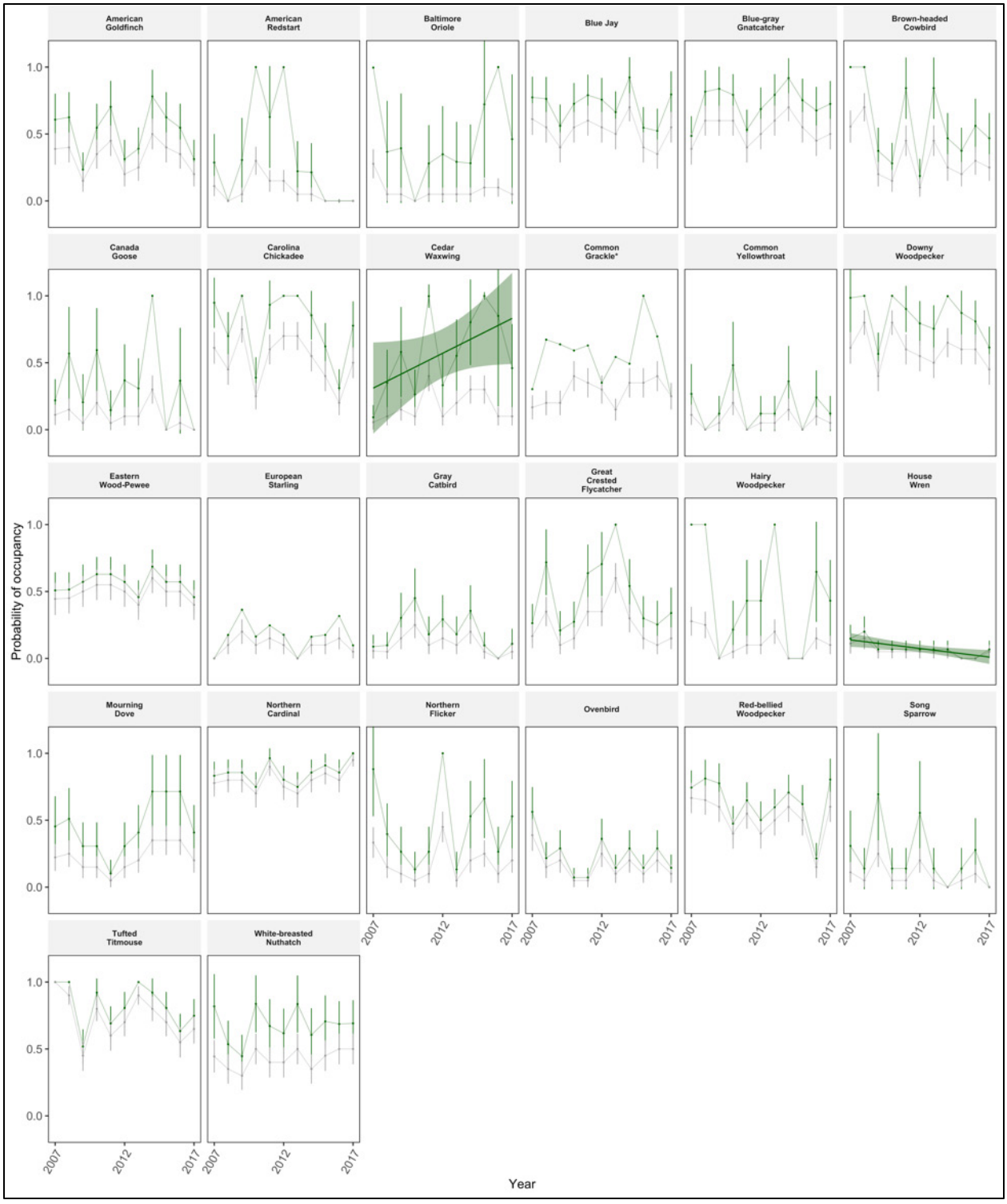


Figure A-6. Trends in Annual Occupancy – George Washington Memorial Parkway (4% increasing, 92% stable, and 4% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

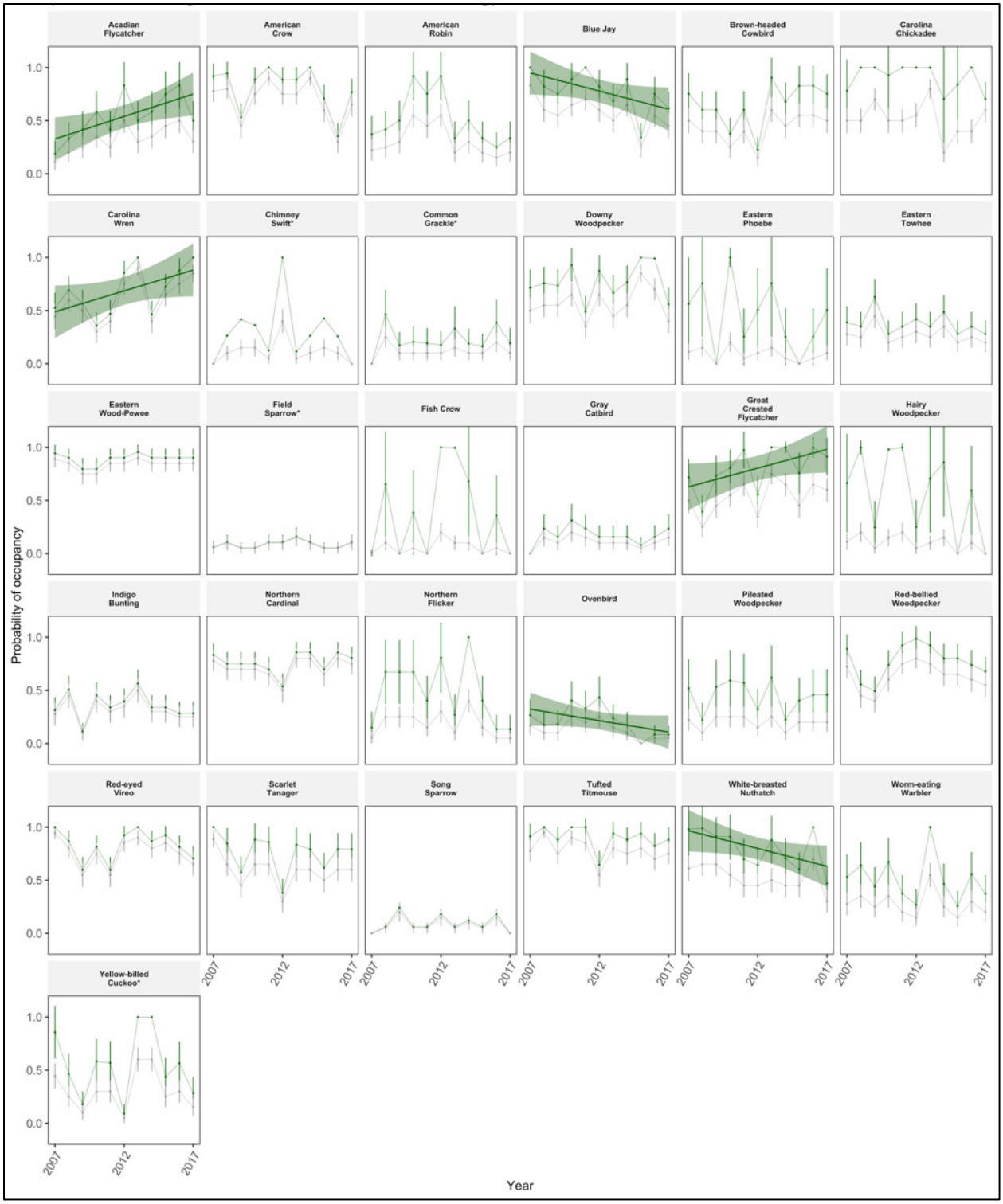


Figure A-7. Trends in Annual Occupancy – Harpers Ferry National Historical Park (10% increasing, 81% stable, and 10% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

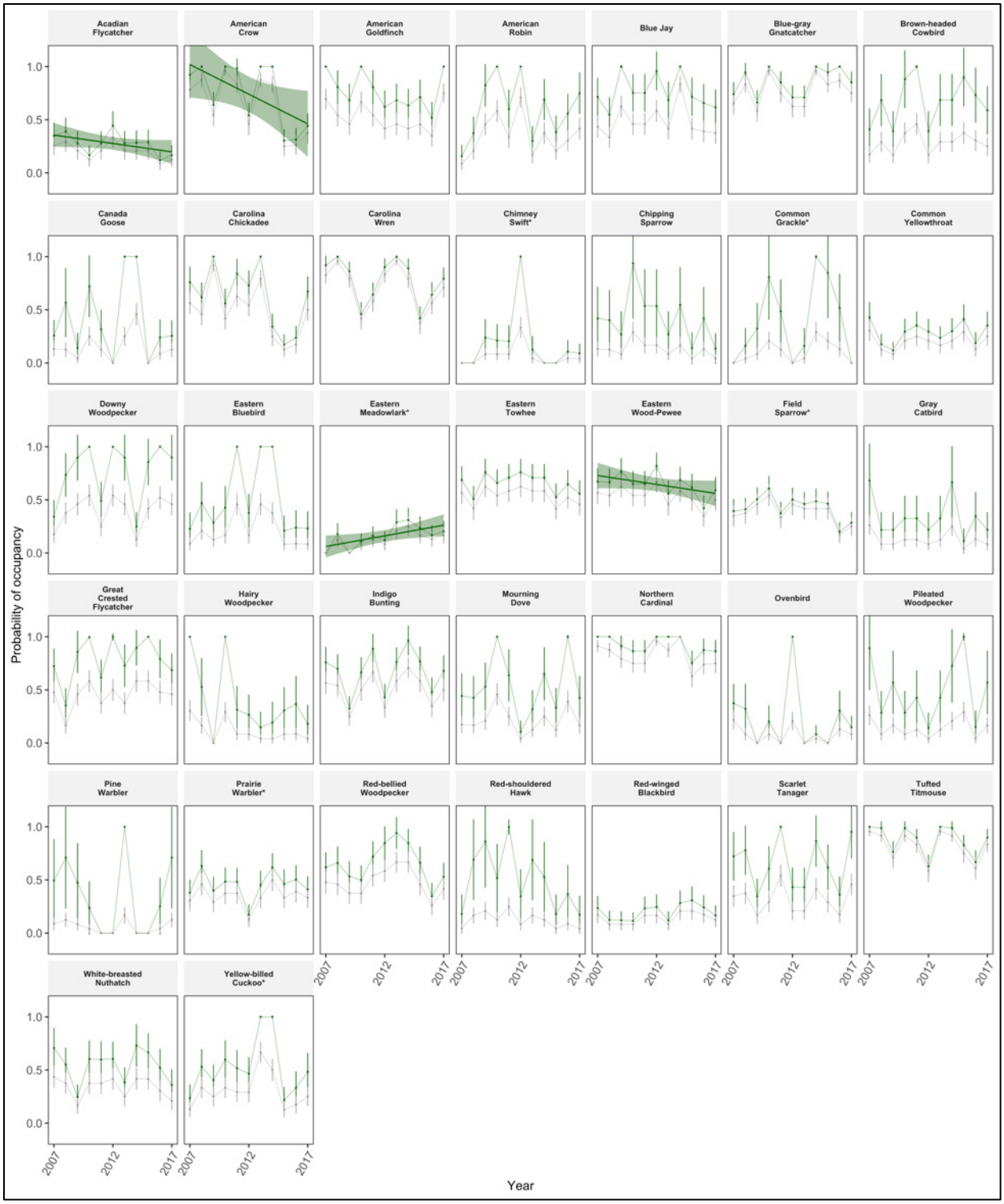


Figure A-8. Trends in Annual Occupancy – Manassas National Battlefield Park (3% increasing, 89% stable, and 8% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

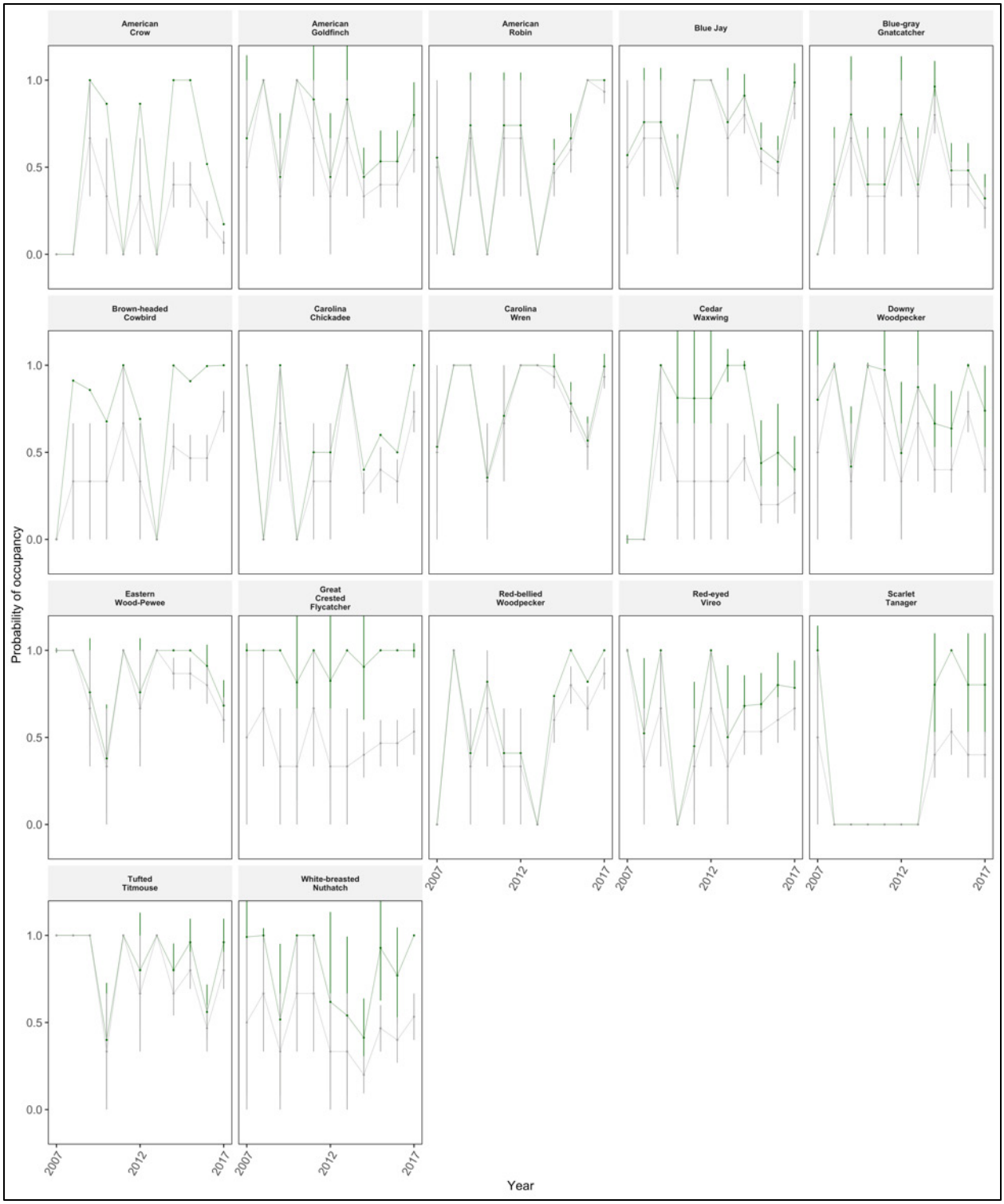


Figure A-9. Trends in Annual Occupancy – Monocacy National Battlefield Park (0% increasing, 100% stable, 0% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

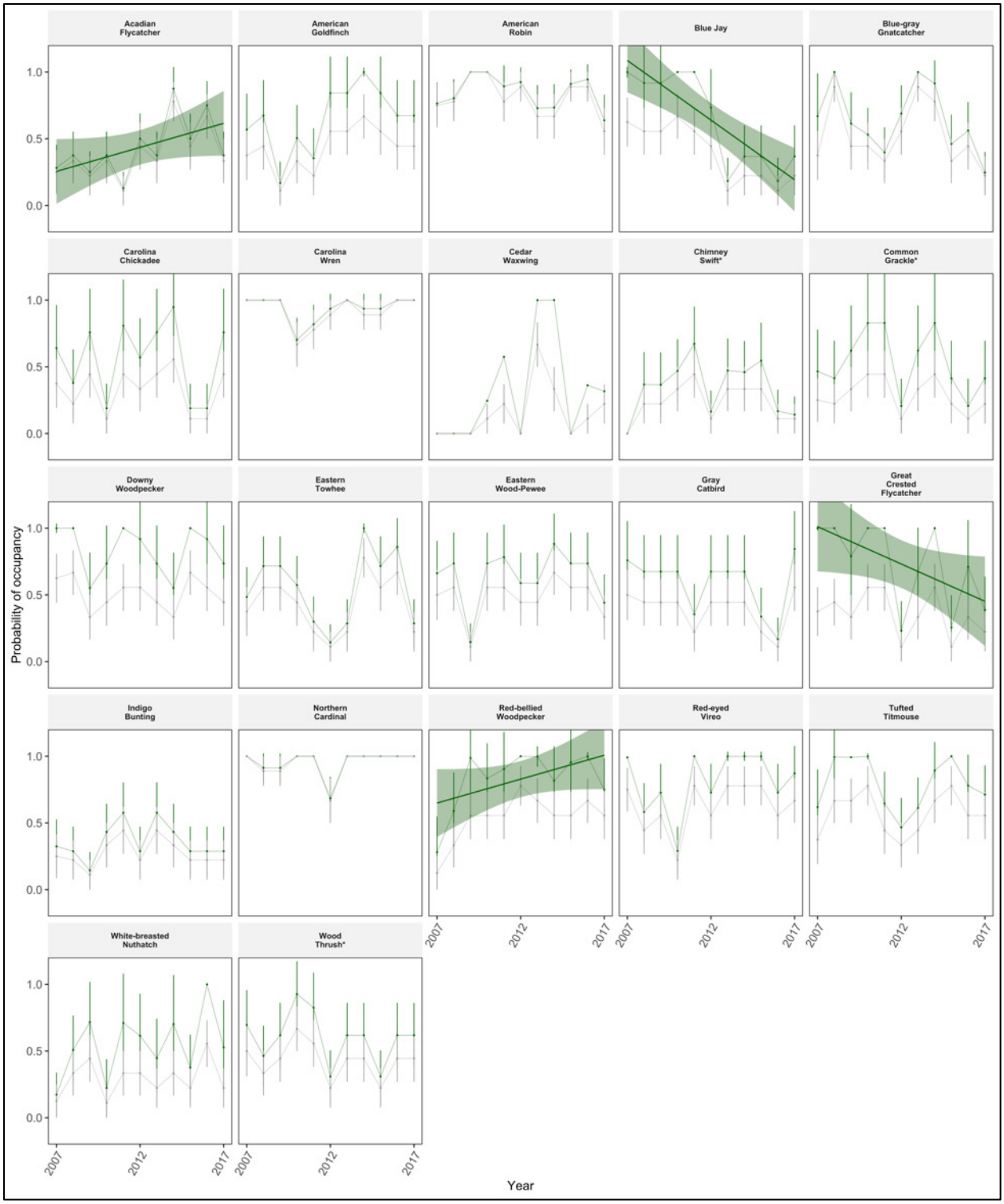


Figure A-10. Trends in Annual Occupancy – National Capital Parks East (9% increasing, 82% stable, and 9& declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

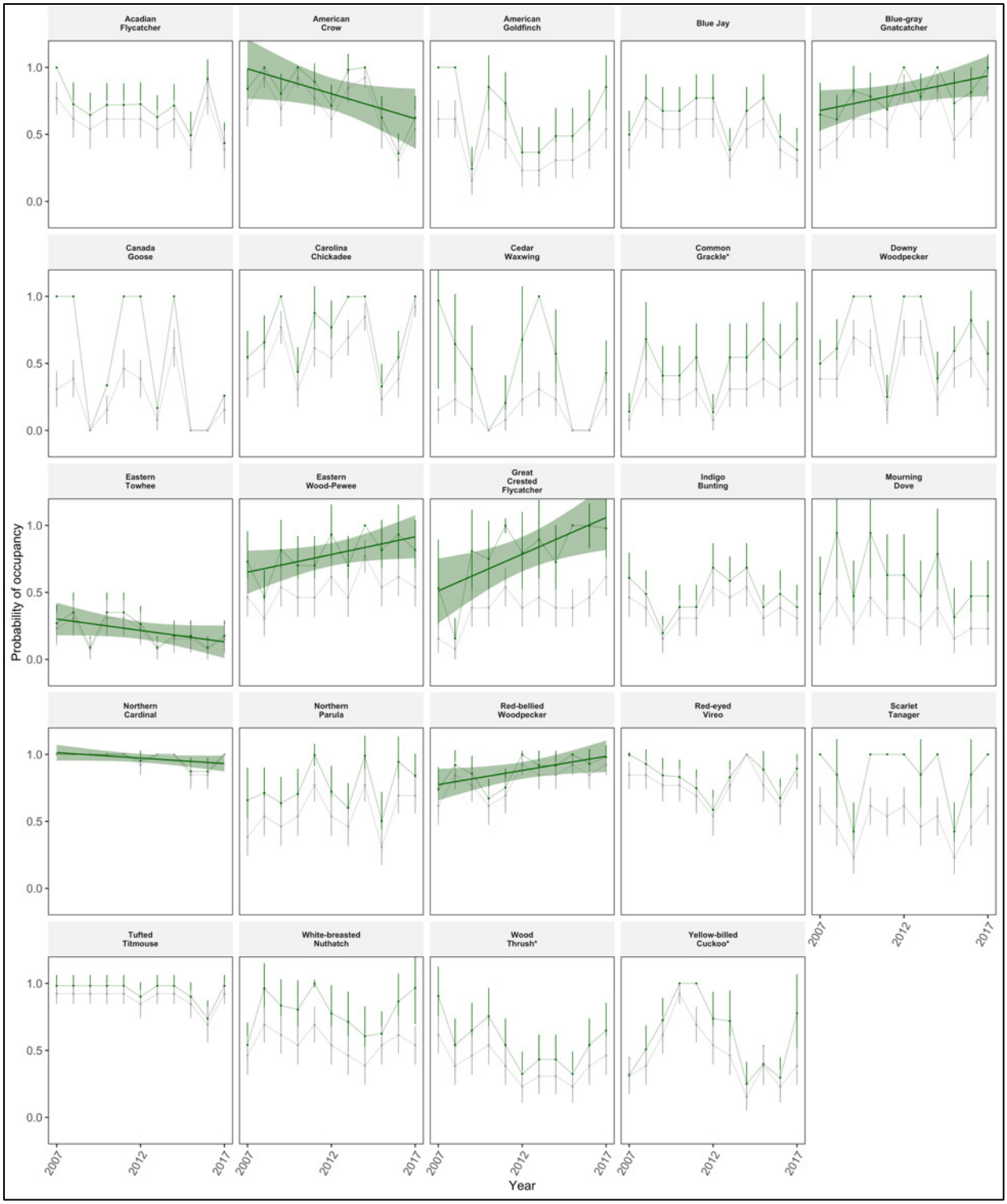


Figure A-11. Trends in Annual Occupancy – Piscataway/Fort Washington (17% increasing, 71% stable, and 12% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

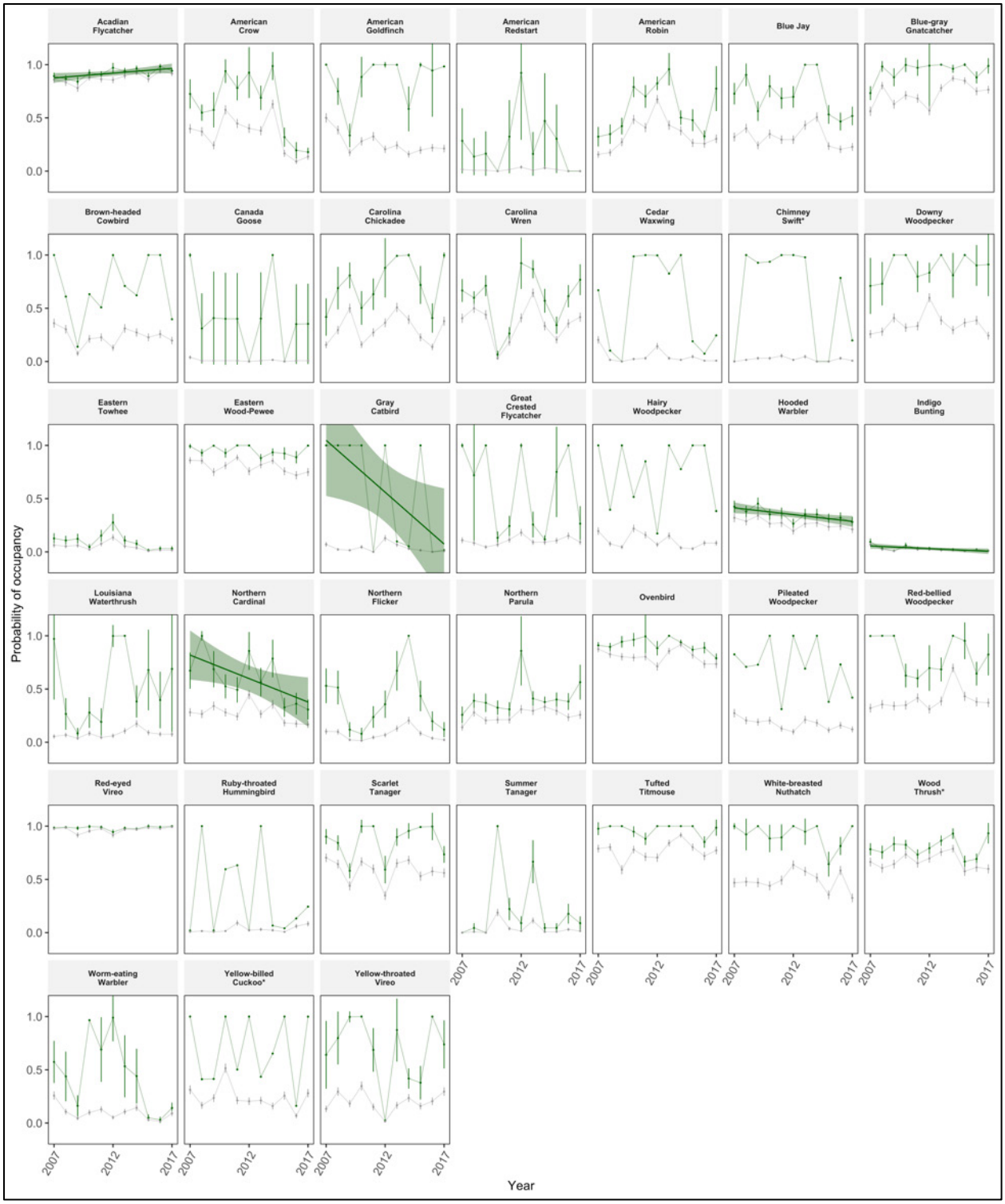


Figure A-12. Trends in Annual Occupancy – Prince William Forest Park (3% increasing, 87% stable, and 11% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

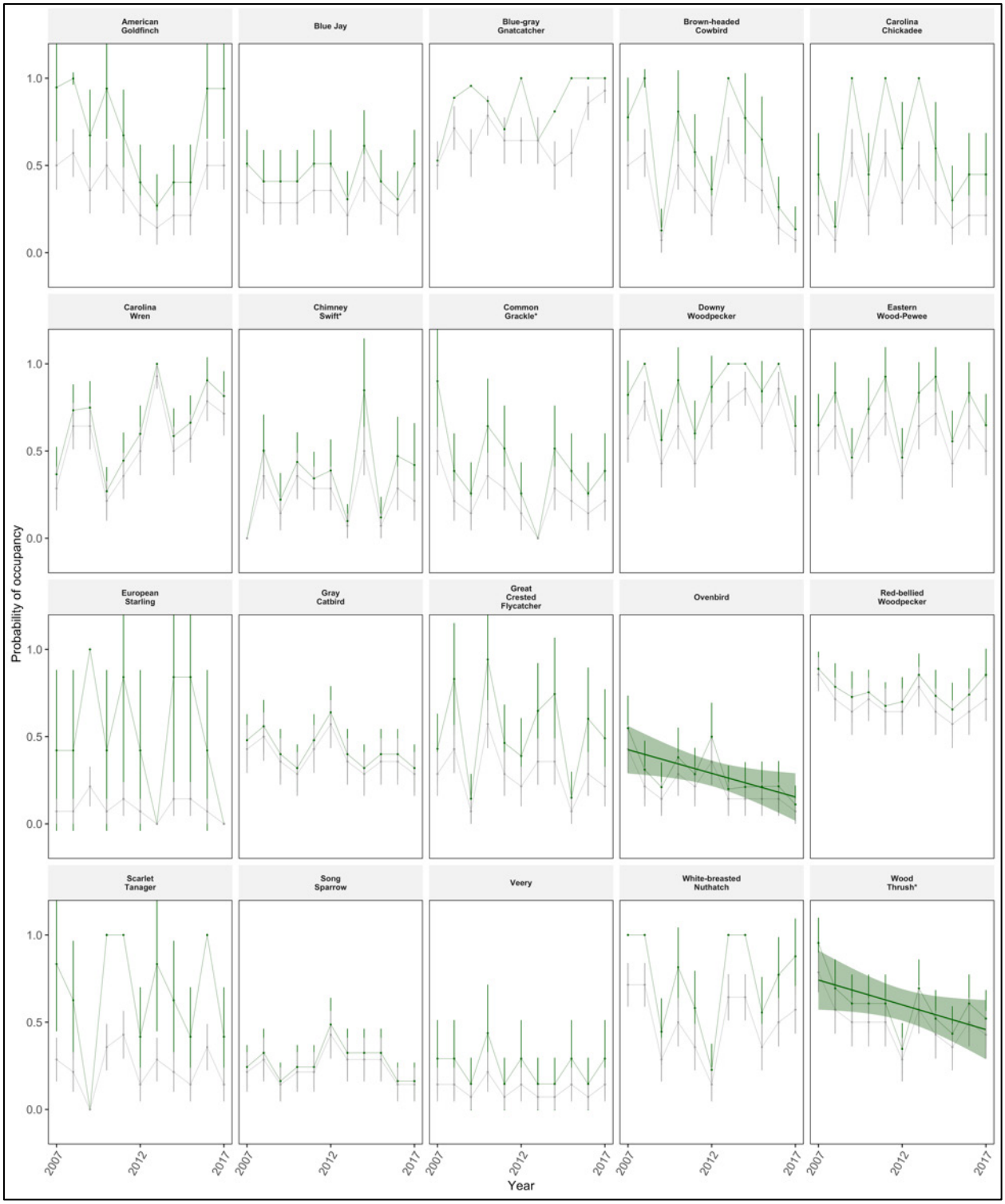


Figure A-13. Trends in Annual Occupancy – Rock Creek Park (0% increasing, 90% stable, and 10% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

Appendix B. Trends in Population Density

Trends in population density (birds per ha) for each species in each park per year in the National Capital Region Network between 2007 and 2017 are shown in Figures B1–B13.

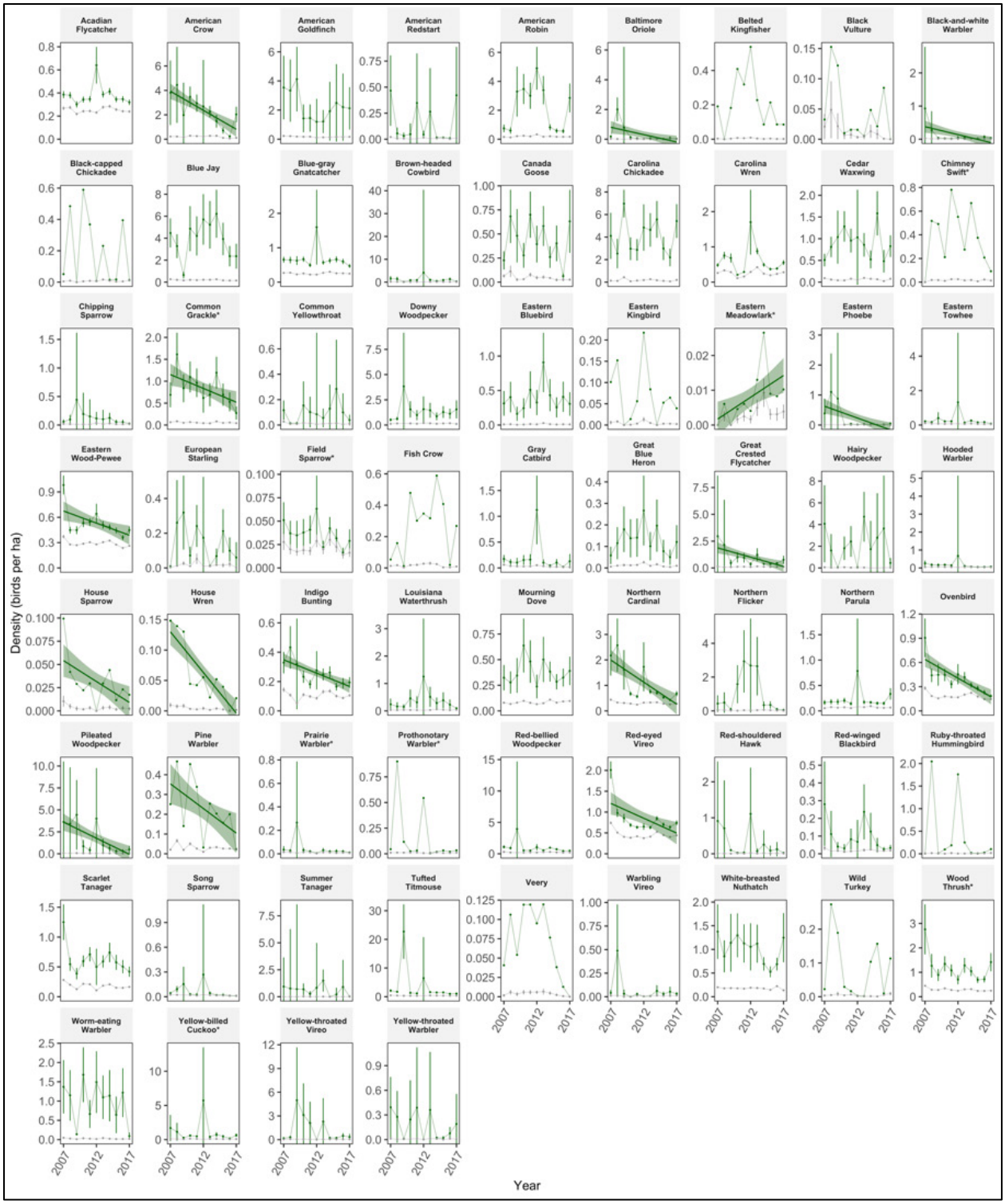


Figure B-1. Trends in Annual Density – National Capital Region Network (1% increasing, 76% stable, and 22% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

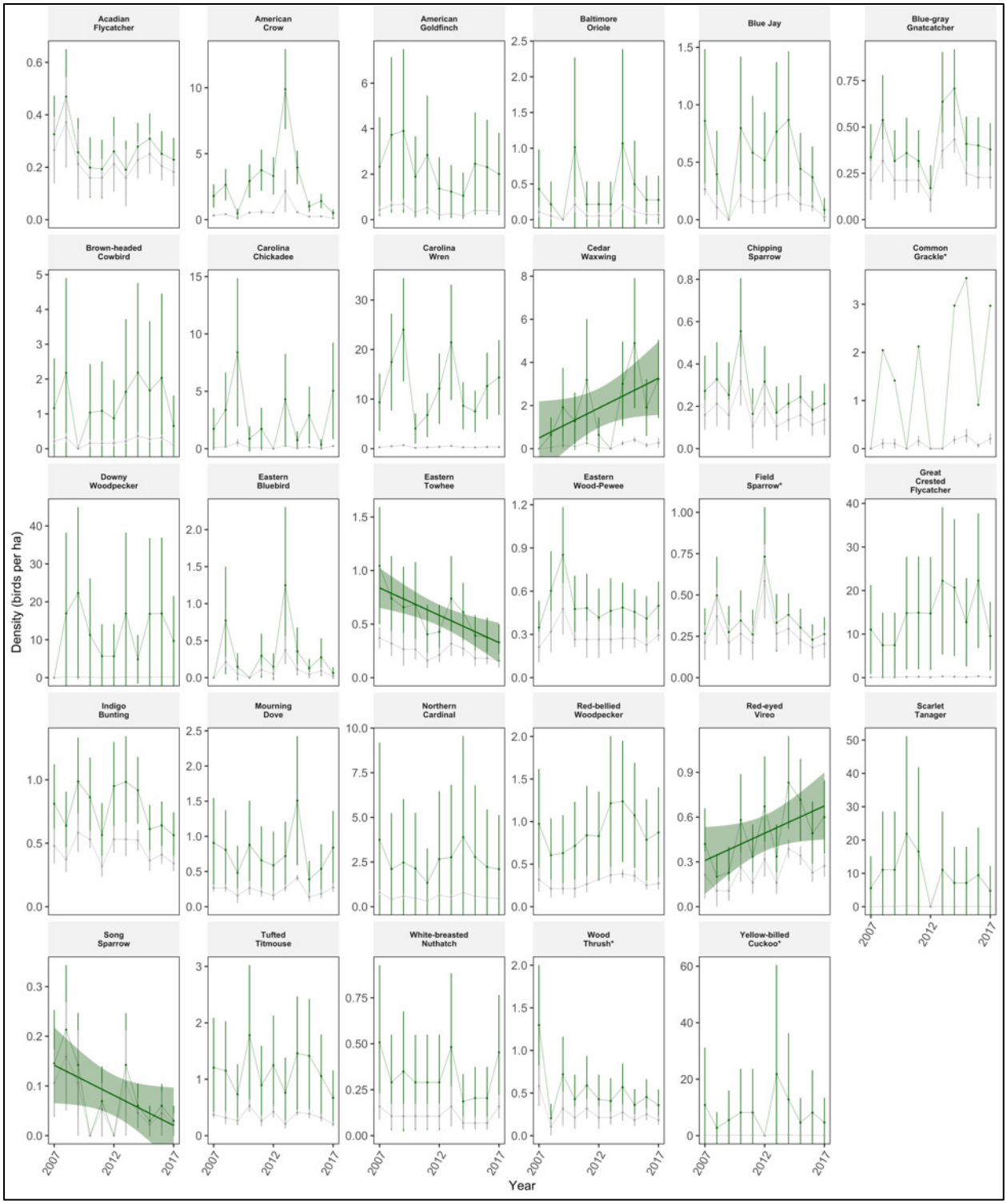


Figure B-2. Trends in Annual Density – Antietam National Battlefield (7% increasing, 86% stable, and 7% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

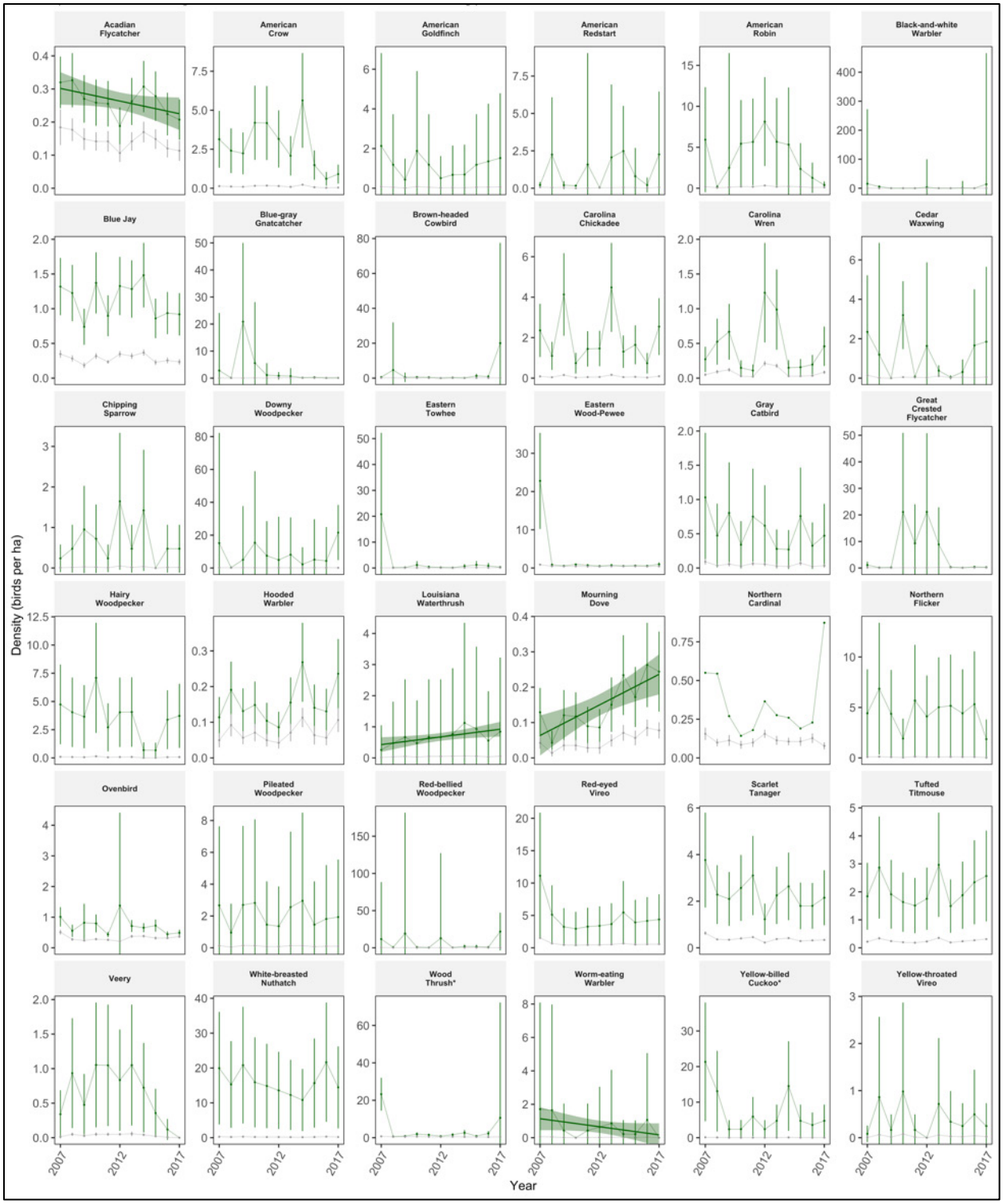


Figure B-3. Trends in Annual Density – Catoctin Mountain Park (6% increasing, 89% stable, 6% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

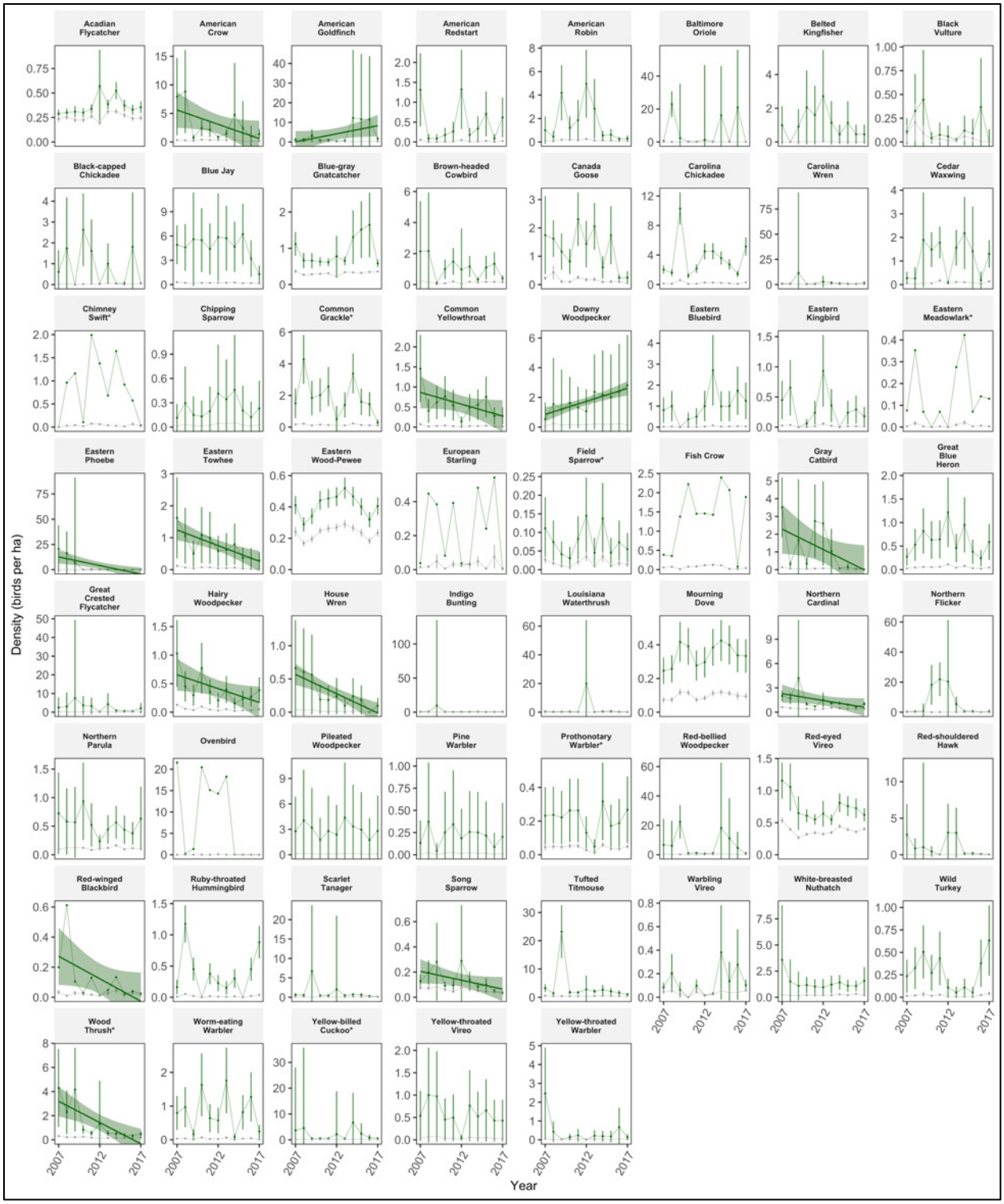


Figure B-4. Trends in Annual Density – C&O Canal National Historical Park (3% increasing, 79% stable, and 18% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

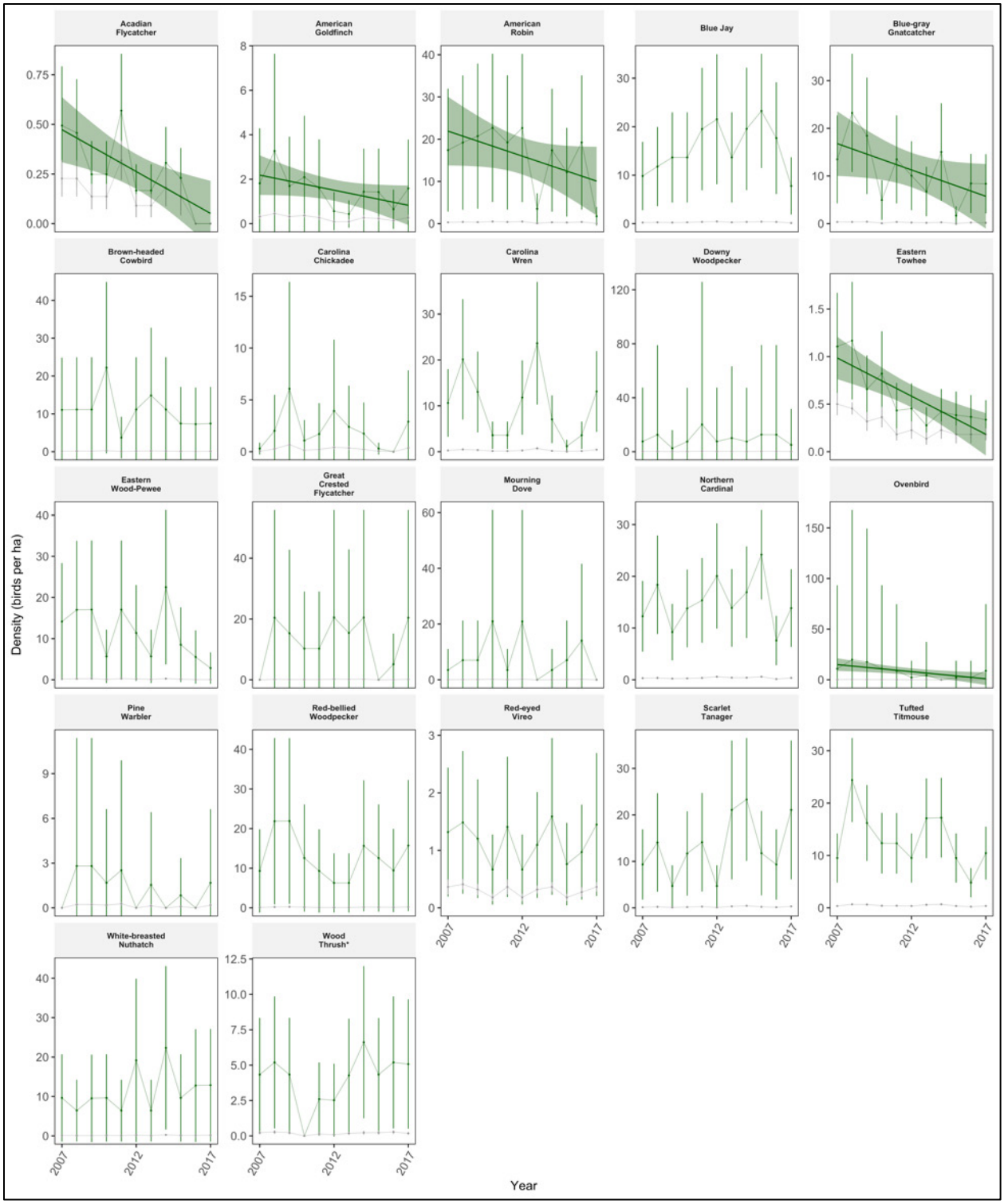


Figure B-5. Trends in Annual Density – Greenbelt National Park (0% increasing, 73% stable, and 27% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

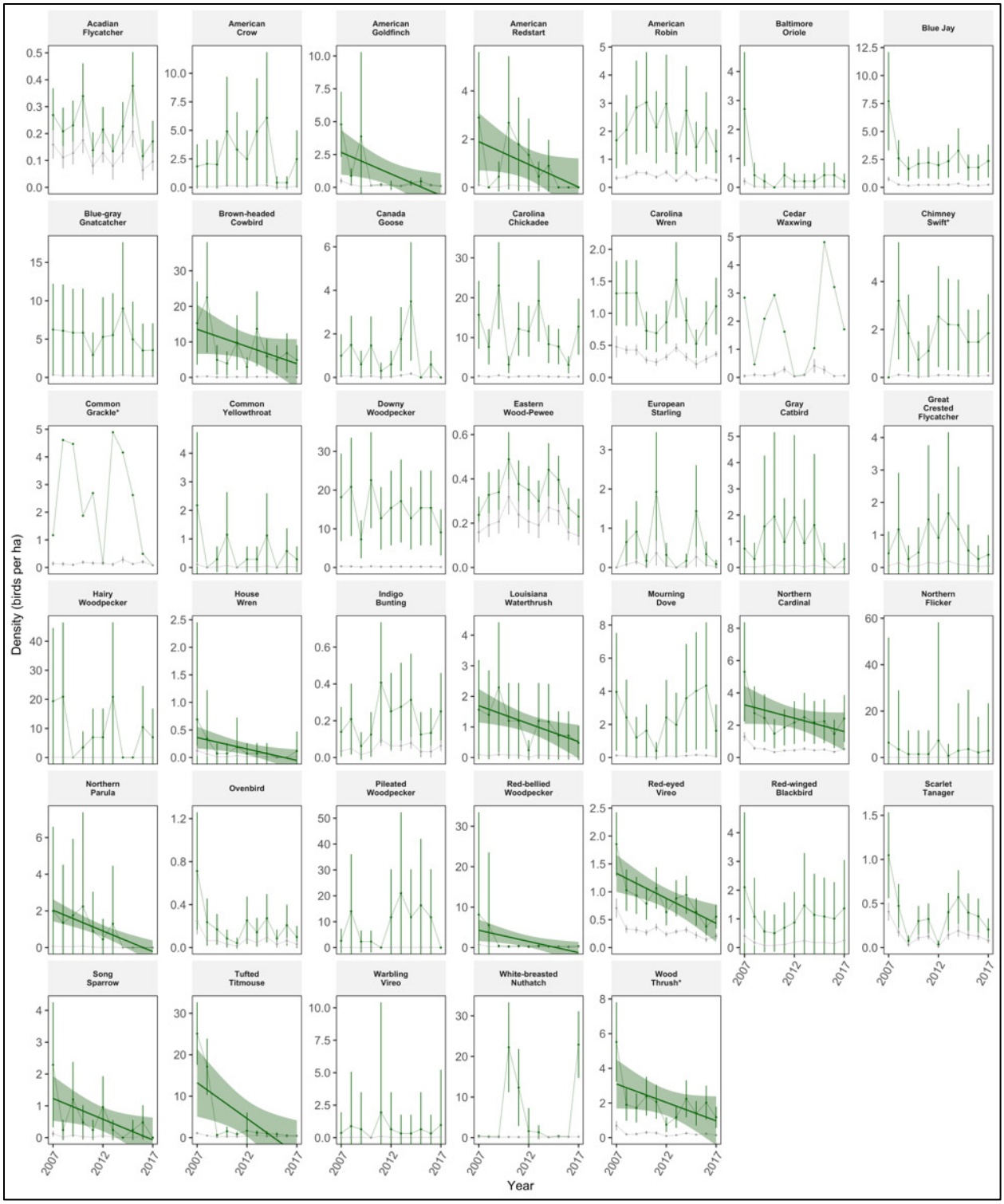


Figure B-6. Trends in Annual Density – George Washington Memorial Parkway (0% increasing, 70% stable, and 30% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

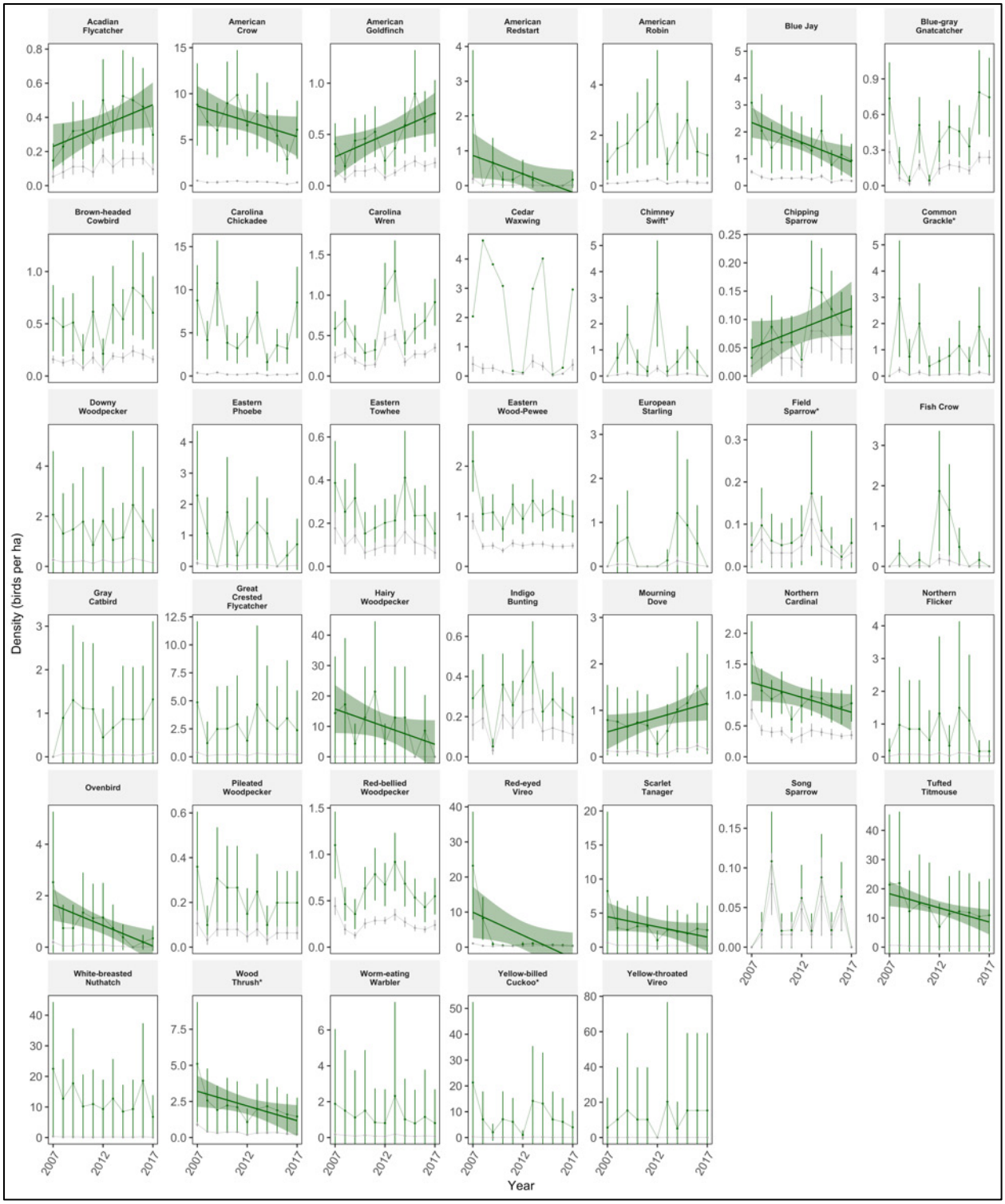


Figure B-7. Trends in Annual Density – Harpers Ferry National Historical Park (10% increasing, 65% stable, and 25% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

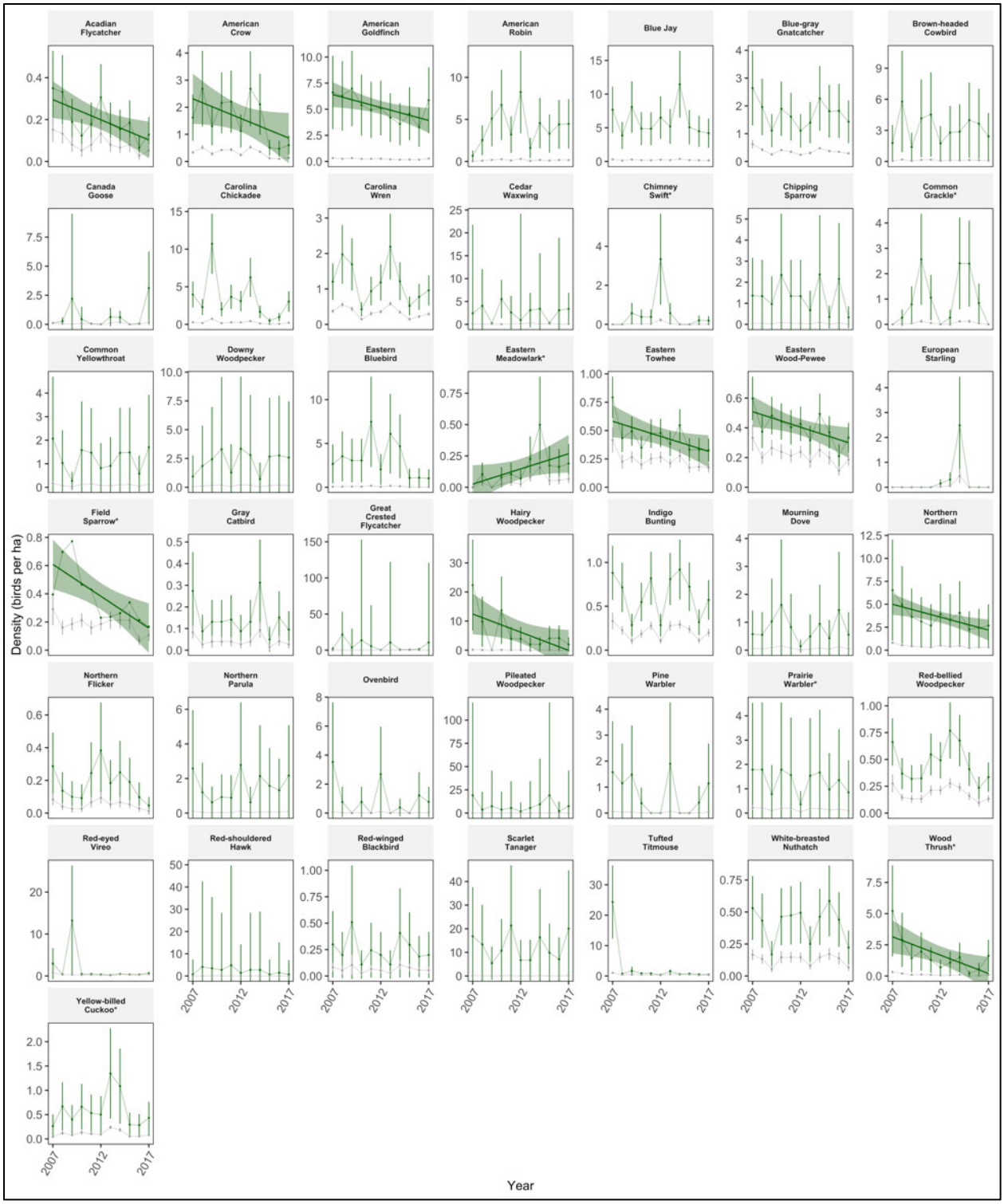


Figure B-8. Trends in Annual Density – Manassas National Battlefield Park (2% increasing, 77% stable, and 21% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

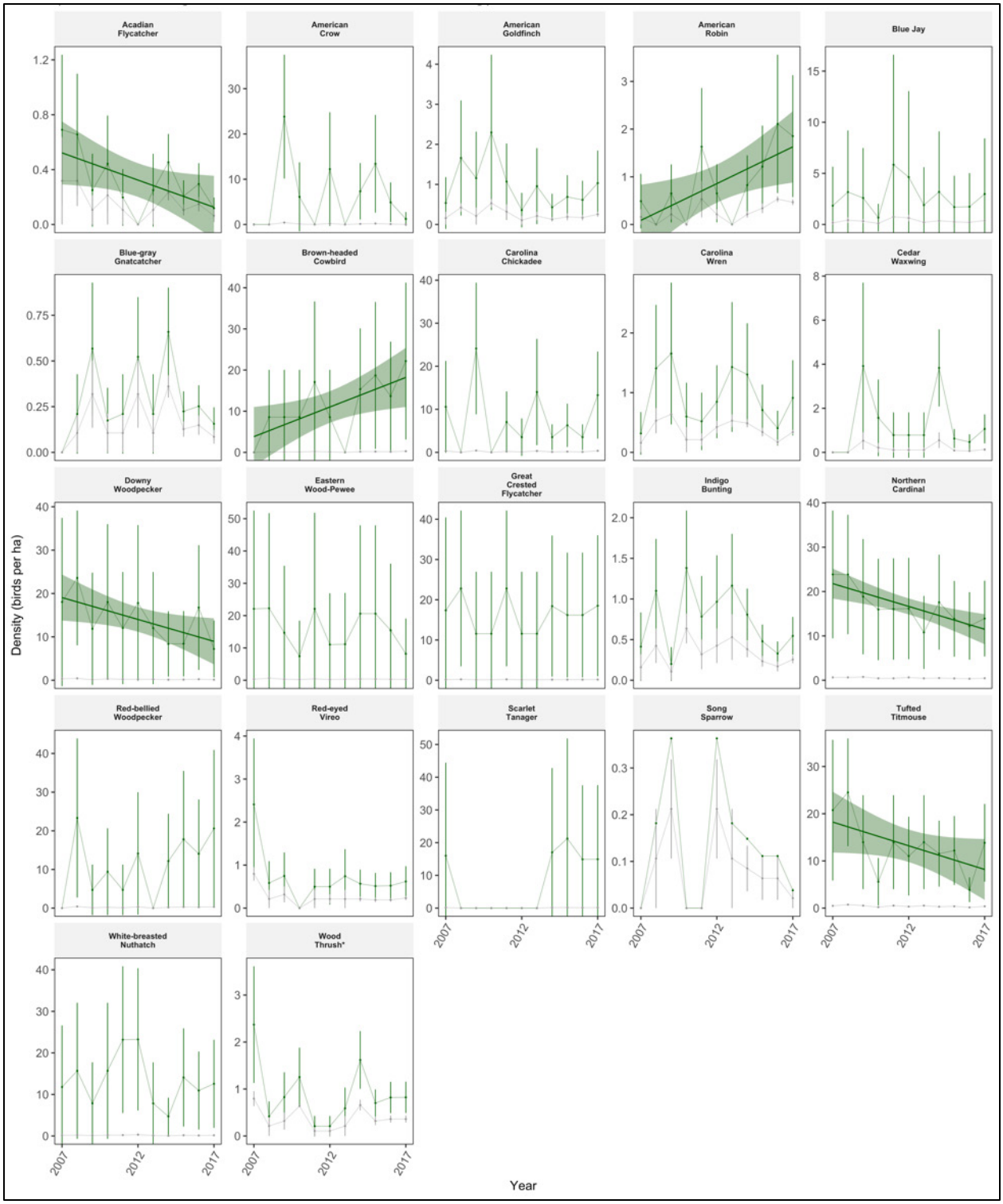


Figure B-9. Trends in Annual Density – Monocacy National Battlefield Park (9% increasing, 73% stable, and 18% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

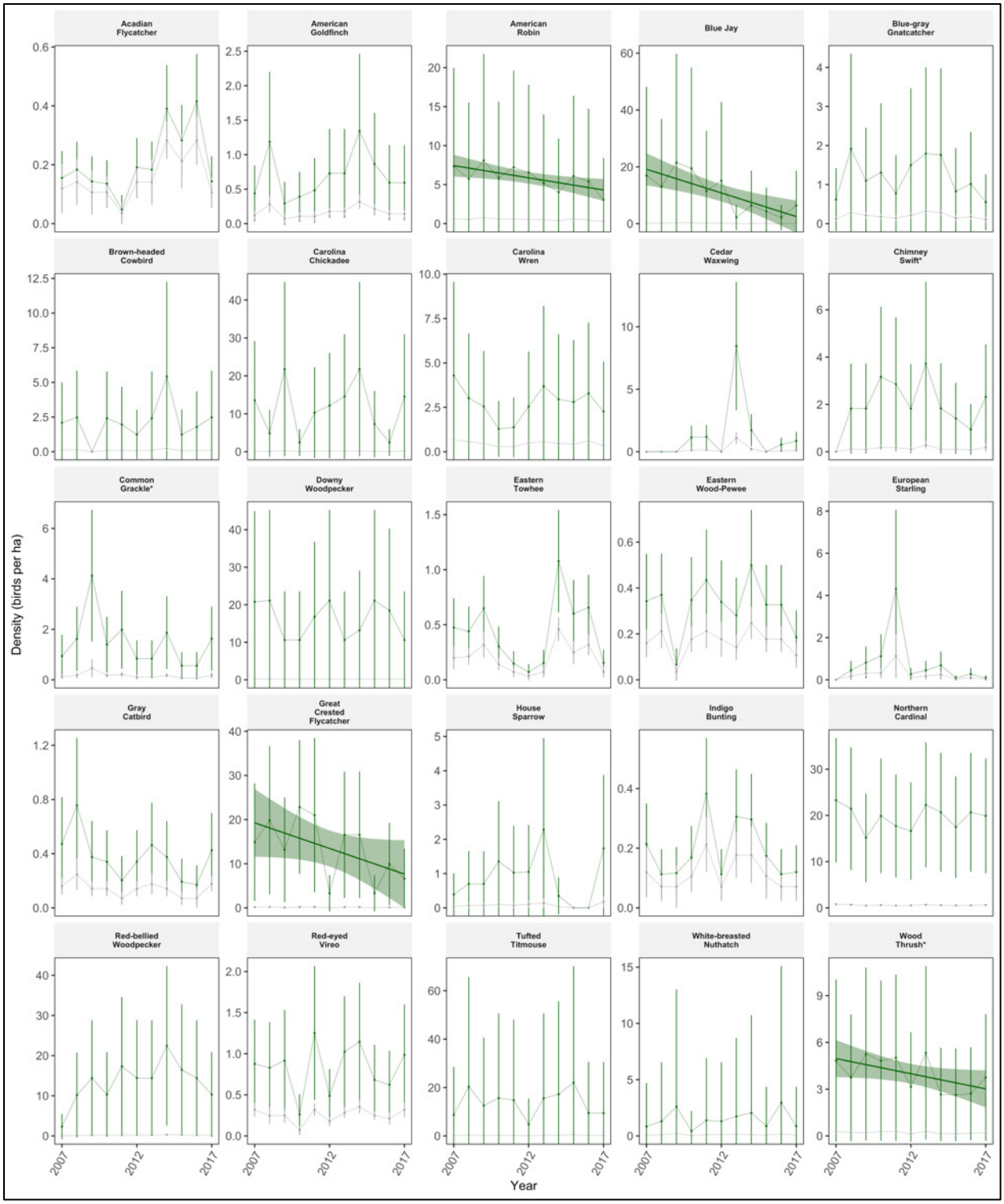


Figure B-10. Trends in Annual Density - National Capital Parks – East (0% increasing, 84% stable, and 16% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

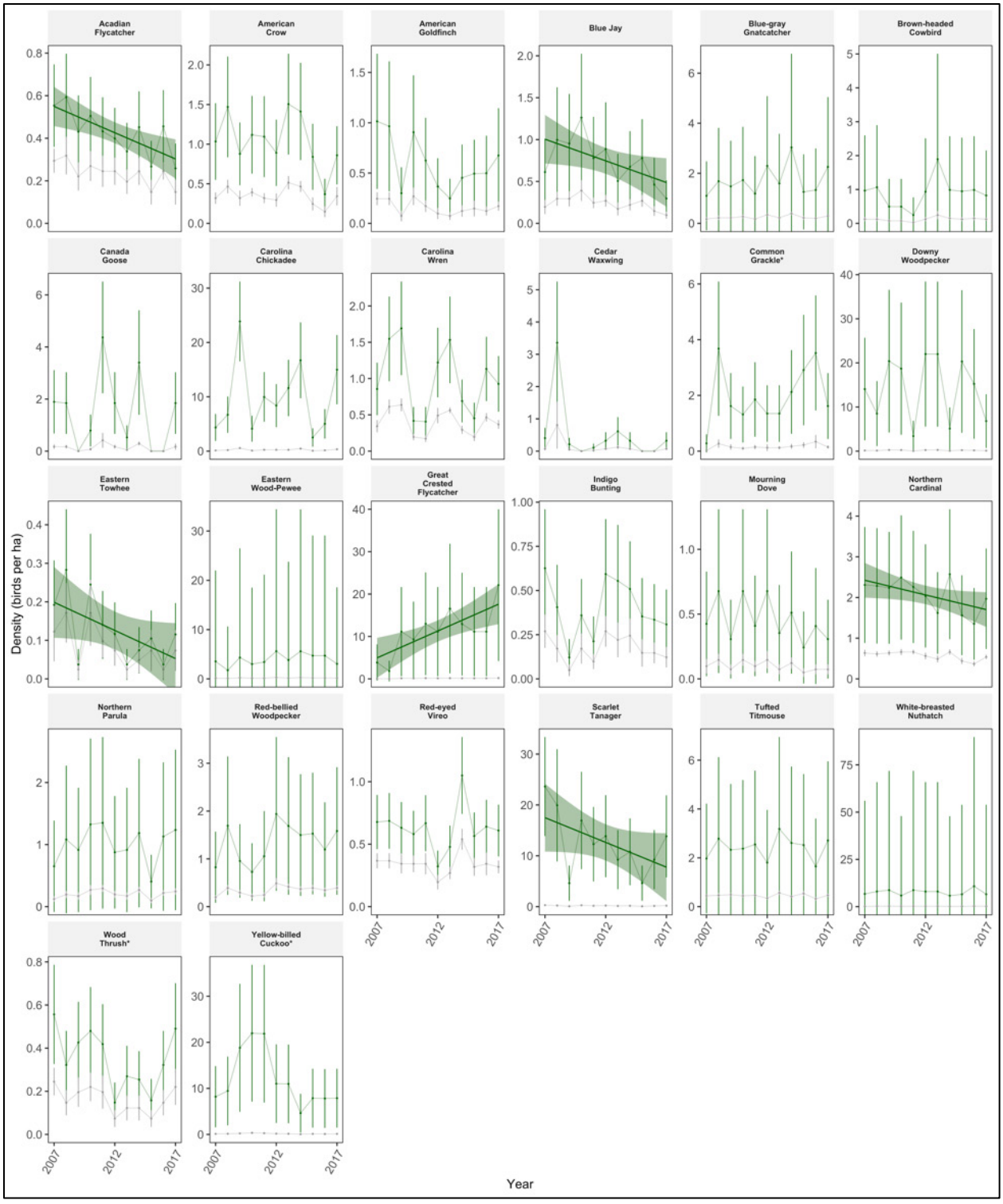


Figure B-11. Trends in Annual Density – Piscataway/Fort Washington (4% increasing, 77% stable, and 19% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

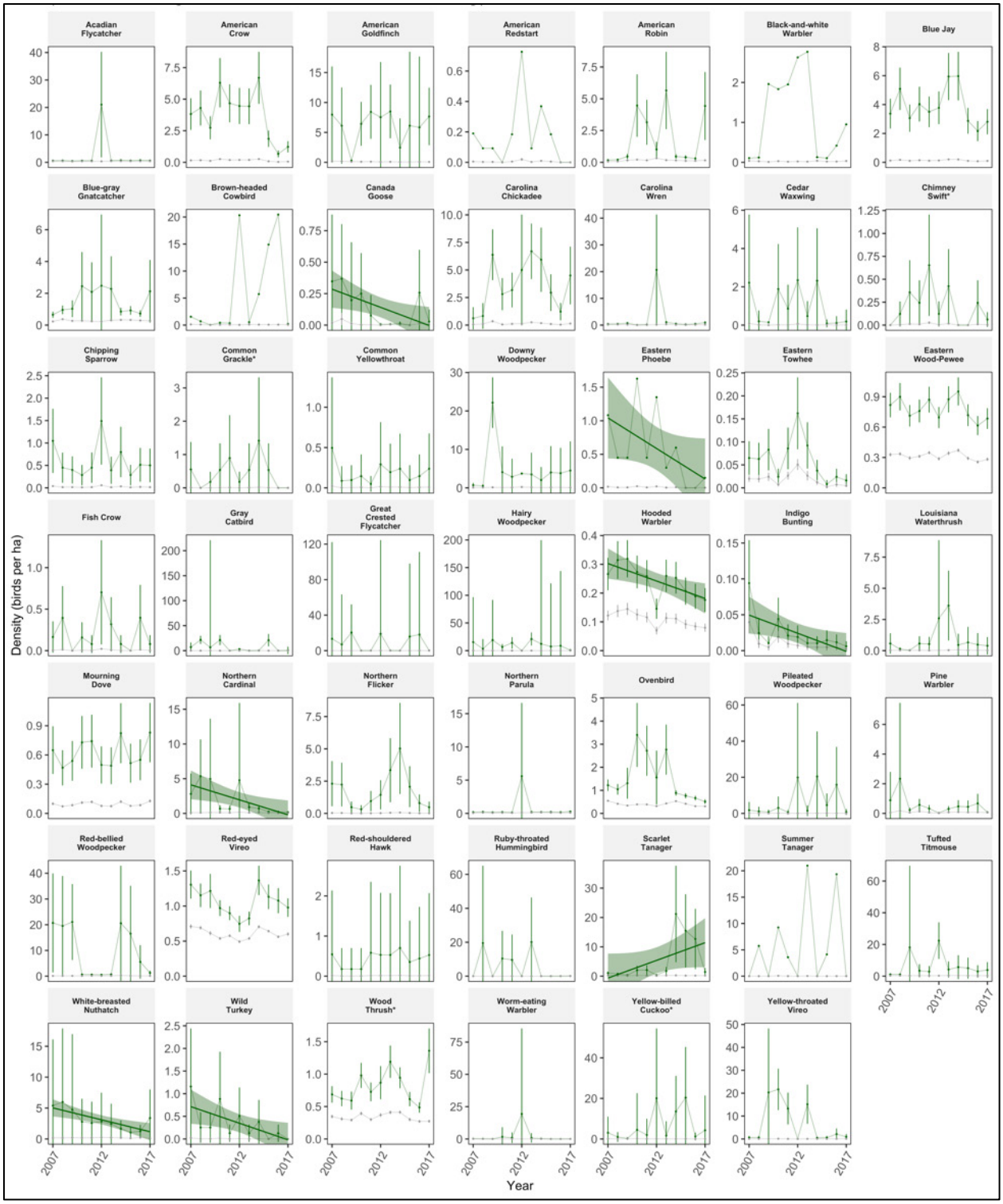


Figure B-12. Trends in Annual Density – Prince William Forest Park (2% increasing, 83% stable, and 15% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

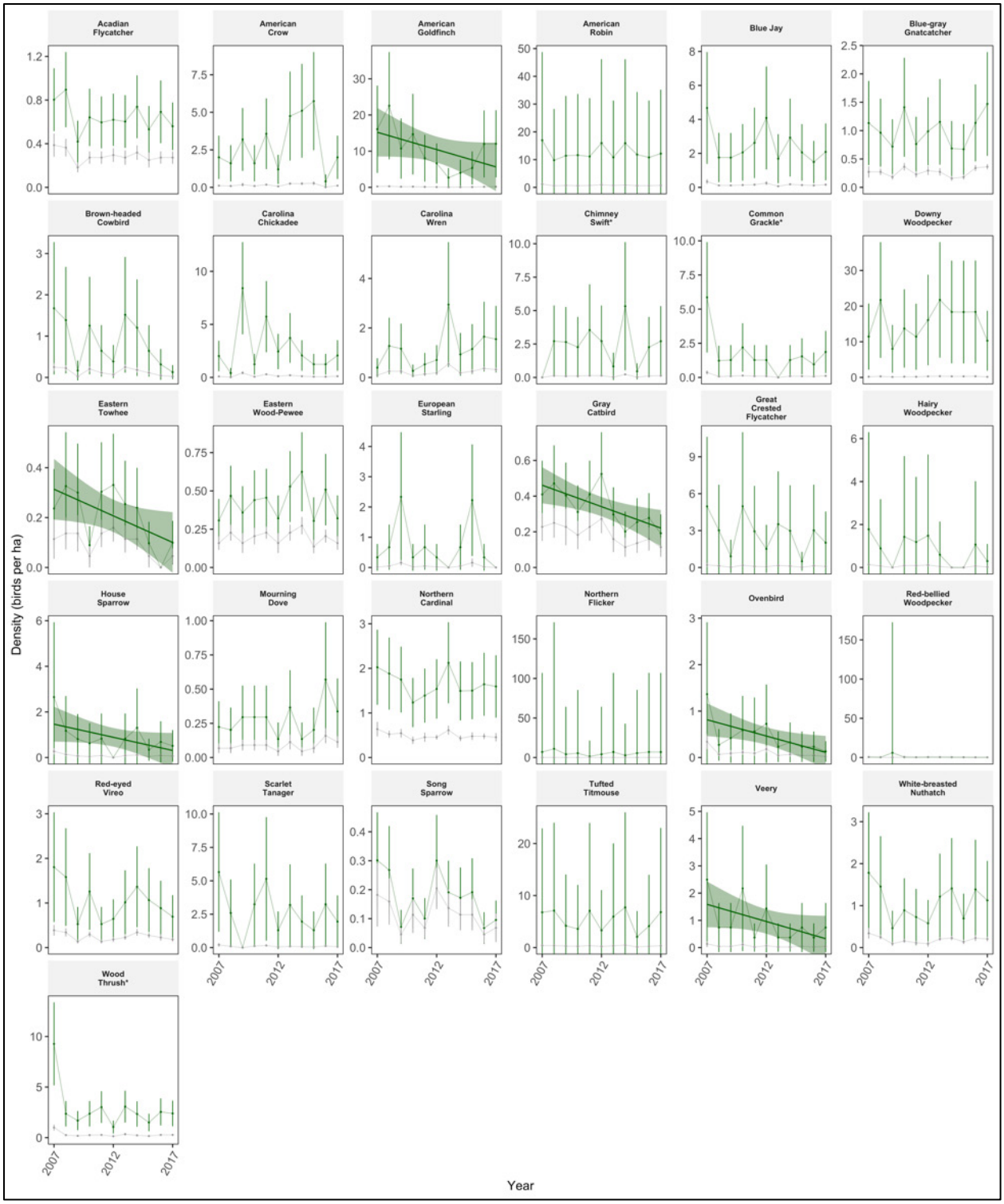


Figure B-13. Trends in Annual Density – Rock Creek Park (0% increasing, 81% stable, and 19% declining). Significant positive or negative trends are indicated by linear models. Gray and green points, lines, and error bars indicate naïve and model estimates, respectively. Species of continental concern are shown with asterisk.

Appendix C. Covariates in Top-Performing Models Used to Estimate Probability of Occupancy and Species Abundance.

Table C-1. Covariates in top-prforming models (evaluated by corrected Akaike's information criterion) used to estimate probability of occupancy and species abundance. 4-letter abbreviations are shown for park units (Unit_Code) and species (4-letter Alpha_Code). Poisson and negative binomial distributions are shown by "P" and "NB", respectively.

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
NCRN	ACFL	*Observer_Ord.Day_Wind*	1	18.9	*Observer.Day_P*	0.74	0.89
NCRN	AMCR	*Observer_Ord.Day_Time*	1	3.03	*Observer.Day_NB*	0.95	1.18
NCRN	AMGO	*Observer_Ord.Day_Time*	1	4.82	*Observer.Day_NB*	1	1.06
NCRN	AMRE	*Observer_Ord.Day_Wind*	0.54	1.82	*Observer.Day_NB*	1	1.18
NCRN	AMRO	*Observer_Ord.Day_Time*	0.99	2.72	*Observer.Day_NB*	1	1.04
NCRN	BAOR	*Observer_Ord.Day_Wind*	0.86	13.45	*Observer.Day_NB*	1	1
NCRN	BAWW	*Observer_Ord.Day_Time*	0.85	10.43	*Observer.Day_NB*	1	1.06
NCRN	BCCH	*Observer_Ord.Day_Wind*	0.98	0.05	*Observer.Day_NB*	0.56	1.2
NCRN	BEKI	*Null*	0.58	0.43	*Null_NB*	1	1.08
NCRN	BGGN	*Observer_Ord.Day_Wind*	0.94	1.65	*Observer.Day_P*	0.73	0.91
NCRN	BHCO	*Observer_Ord.Day_Time*	0.86	0.65	*Observer.Day_NB*	1	1.1
NCRN	BLJA	*Observer_Ord.Day_Time*	1	2.66	*Observer.Day_NB*	1	1.06
NCRN	BLVU	*Null*	0.99	0.48	*Observer.Day_NB*	1	3.65
NCRN	CACH	*Observer_Ord.Day_Wind*	0.62	11.39	*Observer.Day_NB*	0.59	1.1
NCRN	CANG	*Observer_Ord.Day_Time*	0.97	0.74	*Observer.Day_NB*	1	2.12
NCRN	CARW	*Observer_Ord.Day_Wind*	1	10.94	*Observer.Day_NB*	0.93	1.01
NCRN	CEDW	*Observer_Ord.Day_Time*	0.99	1.98	*Observer.Day_NB*	1	1.92
NCRN	CHSP	*Observer*	0.58	0.72	*Observer.Day_NB*	0.94	1.09
NCRN	CHSW	*Observer_Ord.Day_Time*	0.84	1.47	*Observer.Day_NB*	0.85	1.23
NCRN	COGR	*Observer_Ord.Day_Wind*	0.44	2.1	*Observer.Day_NB*	1	1.39
NCRN	COYE	*Observer_Ord.Day_Wind*	0.95	12.43	*Observer.Day_NB*	1	1.14
NCRN	DOWO	*Observer_Ord.Day_Wind*	0.99	4.71	*Observer.Day_P*	0.77	0.91

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
NCRN	EABL	*Null*	0.69	4.61	*Null_NB*	1	1.26
NCRN	EAKI	*Ord.Day*	0.99	0.03	*Null_NB*	0.94	1.28
NCRN	EAME	*Ord.Day*	1	5.74	*Null_NB*	1	0.96
NCRN	EAPH	*Observer_Ord.Day_Wind*	0.91	0.45	*Observer.Day_NB*	0.97	1.1
NCRN	EATO	*Observer_Ord.Day_Time*	0.61	5.75	*Observer.Day_NB*	0.75	0.96
NCRN	EAWP	*Observer_Ord.Day_Time*	1	6.32	*Observer.Day_P*	0.76	0.8
NCRN	EUST	*Observer_Ord.Day_Time*	0.7	15.53	*Observer.Day_NB*	0.98	1.69
NCRN	FICR	*Observer_Ord.Day_Wind*	0.49	0.42	*Observer.Day_NB*	1	1.42
NCRN	FISP	*Null*	0.98	8.7	*Observer_NB*	0.66	1.03
NCRN	GBHE	*Null*	0.49	0.98	*Null_NB*	1	1.2
NCRN	GCFL	*Observer_Ord.Day_Time*	1	3.46	*Observer.Day_NB*	1	1.02
NCRN	GRCA	*Observer_Ord.Day_Time*	0.74	0.83	*Observer.Day_NB*	0.66	1.09
NCRN	HAWO	*Observer_Ord.Day_Time*	0.44	3.28	*Observer.Day_NB*	0.99	1.08
NCRN	HOSP	*Null*	0.99	0.04	*Null_NB*	0.99	1.04
NCRN	HOWA	*Observer_Ord.Day*	0.43	6.21	*Observer.Day_NB*	0.98	0.99
NCRN	HOWR	*Null*	0.54	7.2	*Null_NB*	1	1.2
NCRN	INBU	*Observer_Ord.Day_Wind*	0.41	4.24	*Observer_NB*	0.75	0.94
NCRN	LOWA	*Observer_Ord.Day_Wind*	1	3.08	*Observer.Day_NB*	1	1.08
NCRN	MODO	*Observer_Ord.Day_Time*	1	1.21	*Observer.Day_NB*	0.5	1.01
NCRN	NOCA	*Observer_Ord.Day_Wind*	1	12.12	*Observer.Day_NB*	1	0.95
NCRN	NOFL	*Observer_Ord.Day_Time*	0.4	5.67	*Observer.Day_NB*	0.83	1.09
NCRN	NOPA	*Observer_Ord.Day_Wind*	1	4.17	*Observer.Day_NB*	1	0.99
NCRN	OVEN	*Observer_Ord.Day_Time*	1	31.69	*Observer.Day_NB*	1	0.9
NCRN	PIWA	*Observer_Ord.Day_Wind*	0.91	5.43	*Observer.Day_NB*	0.58	1.02
NCRN	PIWO	*Observer*	0.48	1.59	*Observer_NB*	0.67	1.02
NCRN	PRAW	*Observer_Ord.Day_Time*	0.4	7.89	*Observer.Day_NB*	1	1.19
NCRN	PROW	*Observer_Ord.Day_Time*	0.78	0.71	*Observer.Day_NB*	0.82	1.02

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
NCRN	RBWO	*Observer_Ord.Day_Wind*	1	0.31	*Observer.Day_P*	0.76	0.9
NCRN	REVI	*Observer_Ord.Day_Time*	1	15.89	*Observer_P*	0.61	0.86
NCRN	RSHA	*Ord.Day*	1	2.61	*Observer.Day_NB*	0.99	1.11
NCRN	RTHU	*Observer_Ord.Day_Wind*	0.59	9.62	*Observer_NB*	0.38	1.18
NCRN	RWBL	*Ord.Day*	0.84	1.64	*Observer.Day_NB*	1	1.2
NCRN	SCTA	*Observer_Ord.Day_Time*	1	7.57	*Observer.Day_NB*	0.62	0.99
NCRN	SOSP	*Observer_Ord.Day_Time*	0.71	0.82	*Observer_NB*	0.74	1.01
NCRN	SUTA	*Ord.Day*	0.74	1.97	*Observer.Day_NB*	0.78	1.12
NCRN	TUTI	*Observer_Ord.Day_Wind*	0.59	11.47	*Observer.Day_P*	0.74	0.95
NCRN	VEER	*Ord.Day*	0.59	0.57	*Null_NB*	0.94	1.21
NCRN	WAVI	*Observer_Ord.Day_Wind*	0.96	0.13	*Observer.Day_NB*	0.87	1.06
NCRN	WBNU	*Observer_Ord.Day_Wind*	1	0.75	*Observer.Day_P*	0.74	1
NCRN	WEWA	*Ord.Day*	0.62	2.02	*Observer.Day_NB*	1	1.07
NCRN	WITU	*Observer_Ord.Day_Time*	1	2.3	*Observer.Day_NB*	0.91	1.71
NCRN	WOTH	*Observer_Ord.Day_Time*	1	2.7	*Observer.Day_NB*	1	0.99
NCRN	YBCU	*Observer_Ord.Day_Wind*	1	1.12	*Observer.Day_NB*	0.99	1.02
NCRN	YTVI	*Observer_Ord.Day_Wind*	0.99	9.66	*Observer.Day_NB*	0.65	1.05
NCRN	YTWA	*Observer_Ord.Day_Time*	0.81	0.6	*Observer.Day_NB*	1	1.21
ANTI	ACFL	*Null*	0.77	0	*Null_P*	0.79	0.94
ANTI	AMCR	*Null*	0.79	0.5	*Null_NB*	0.99	1.7
ANTI	AMGO	*Null*	0.83	0.61	*Null_P*	0.79	1
ANTI	BAOR	*Ord.Day*	0.99	0.2	*Null_P*	0.79	1.08
ANTI	BGGN	*Ord.Day*	0.92	0.77	*Null_P*	0.79	0.82
ANTI	BHCO	*Null*	0.77	0.23	*Null_P*	0.76	1.14
ANTI	BLJA	*Null*	0.8	0.29	*Null_P*	0.79	1.3
ANTI	CACH	*Null*	0.79	0	*Null_NB*	0.68	1.25
ANTI	CARW	*Null*	1	0.56	*Null_P*	0.79	0.7

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
ANTI	CEDW	*Ord.Day*	1	1.71	*Null_NB*	0.99	2.22
ANTI	CHSP	*Null*	0.79	0	*Null_P*	0.79	1.15
ANTI	COGR	*Null*	0.7	0.45	*Null_NB*	1	1.55
ANTI	DOWO	*Ord.Day*	0.57	0.32	*Null_P*	0.79	1.01
ANTI	EABL	*Null*	0.72	0.2	*Null_P*	0.68	1.35
ANTI	EATO	*Null*	0.76	0.38	*Null_P*	0.79	1.03
ANTI	EAWP	*Null*	0.74	0.2	*Null_P*	0.79	0.86
ANTI	FISP	*Null*	0.57	1.2	*Null_NB*	0.58	1.1
ANTI	GCFL	*Ord.Day*	1	0.83	*Null_P*	0.79	0.9
ANTI	INBU	*Null*	1	0.09	*Null_P*	0.79	0.73
ANTI	MODO	*Null*	0.77	2.21	*Null_P*	0.79	0.85
ANTI	NOCA	*Null*	0.89	2.95	*Null_P*	0.79	0.55
ANTI	NOMO	*Ord.Day*	0.78	1.33	*Null_P*	0.78	1.32
ANTI	RBWO	*Null*	0.61	0.86	*Null_P*	0.79	0.8
ANTI	REVI	*Null*	0.61	1.59	*Null_P*	0.79	1.01
ANTI	SCTA	*Null*	0.53	1.56	*Null_P*	0.79	1.18
ANTI	SOSP	*Null*	0.77	0.57	*Null_P*	0.5	1.47
ANTI	TUTI	*Ord.Day*	0.53	1.59	*Null_P*	0.79	0.74
ANTI	WBNU	*Null*	0.71	0.9	*Null_P*	0.79	1.02
ANTI	WOTH	*Null*	0.66	2.12	*Null_NB*	0.84	1.09
ANTI	YBCU	*Null*	0.79	0.46	*Null_P*	0.79	0.92
CATO	ACFL	*Ord.Day*	0.95	0.52	*Null_NB*	0.7	1
CATO	AMCR	*Null*	0.57	0.7	*Null_NB*	1	1.19
CATO	AMGO	*Ord.Day*	0.68	0.18	*Null_P*	0.57	1.08
CATO	AMRE	*Observer_Ord.Day*	0.37	0.9	*Observer.Day_NB*	1	1.28
CATO	AMRO	*Observer*	0.58	3.57	*Observer_NB*	0.76	1.17
CATO	BAWW	*Ord.Day*	1	0.18	*Observer.Day_P*	0.36	1.21

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
CATO	BGGN	*Observer_Ord.Day_Wind*	0.99	0.61	*Observer.Day_P*	0.75	0.99
CATO	BHCO	*Observer_Ord.Day_Time*	0.46	0.47	*Observer.Day_P*	0.76	1.09
CATO	BLJA	*Null*	0.7	2.07	*Null_P*	0.34	1.09
CATO	CACH	*Null*	0.7	0.43	*Null_NB*	1	1.11
CATO	CARW	*Ord.Day*	0.98	0.07	*Null_P*	0.72	1.07
CATO	CEDW	*Ord.Day*	0.74	0.61	*Observer.Day_NB*	0.95	1.22
CATO	CHSP	*Ord.Day*	0.59	0.1	*Null_NB*	0.97	1.43
CATO	DOWO	*Observer_Ord.Day_Time*	0.54	0.67	*Observer.Day_P*	0.77	1.02
CATO	EATO	*Ord.Day*	0.93	0.66	*Observer.Day_P*	0.26	1.23
CATO	EAWP	*Null*	0.98	0.94	*Observer.Day_P*	0.44	0.59
CATO	GCFL	*Observer_Ord.Day*	0.55	0.2	*Observer.Day_P*	0.65	1.11
CATO	GRCA	*Null*	1	0.16	*Null_NB*	1	1.18
CATO	HAWO	*Ord.Day*	0.58	1.21	*Null_NB*	0.7	1.17
CATO	HOWA	*Ord.Day*	0.25	0.39	*Null_NB*	0.93	1
CATO	LOWA	*Ord.Day*	0.97	25.47	*Null_NB*	0.99	1.07
CATO	MODO	*Null*	0.52	0.27	*Null_P*	0.74	1.05
CATO	NOCA	*Observer_Ord.Day_Wind*	0.75	0.23	*Observer.Day_P*	0.3	1.11
CATO	NOFL	*Null*	0.74	0.32	*Null_NB*	0.54	1.11
CATO	OVEN	*Ord.Day*	1	2.39	*Observer.Day_P*	0.52	1.06
CATO	PIWO	*Ord.Day*	0.65	0.35	*Null_P*	0.74	1.02
CATO	RBWO	*Ord.Day*	0.99	0.79	*Observer.Day_P*	0.77	0.87
CATO	REVI	*Observer*	1	5.2	*Null_P*	0.74	0.66
CATO	SCTA	*Observer_Ord.Day_Time*	0.99	0.25	*Null_P*	0.71	0.82
CATO	TUTI	*Ord.Day*	0.76	1.48	*Null_P*	0.74	1.04
CATO	VEER	*Null*	0.94	0.59	*Null_NB*	1	1.27
CATO	WBNU	*Ord.Day*	1	2.04	*Null_P*	0.73	1
CATO	WEWA	*Ord.Day*	1	0.96	*Null_P*	0.65	1.19

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
CATO	WOTH	*Observer_Ord.Day_Time*	1	0.9	*Observer.Day_P*	0.56	0.98
CATO	YBCU	*Ord.Day*	0.42	0.38	*Null_P*	0.44	1.09
CATO	YTVI	*Null*	0.82	0.06	*Null_P*	0.73	1.09
CHOH	ACFL	*Observer_Ord.Day_Wind*	0.87	2.46	*Observer_P*	0.46	0.91
CHOH	AMCR	*Observer_Ord.Day_Time*	1	2.97	*Observer_NB*	0.71	1.09
CHOH	AMGO	*Observer_Ord.Day_Time*	1	0.42	*Observer.Day_P*	0.75	1
CHOH	AMRE	*Ord.Day*	1	0.14	*Null_NB*	0.99	1.25
CHOH	AMRO	*Observer*	0.52	0.21	*Observer_NB*	0.74	1.13
CHOH	BADO	*Ord.Day*	0.99	1.22	*Null_NB*	1	1.44
CHOH	BAOR	*Ord.Day*	0.69	6.49	*Observer.Day_P*	0.53	0.98
CHOH	BCCH	*Observer_Ord.Day_Wind*	0.43	0.57	*Observer.Day_NB*	0.74	1.19
CHOH	BEKI	*Null*	0.75	0.12	*Null_NB*	0.62	1.11
CHOH	BGGN	*Observer_Ord.Day_Time*	1	3.1	*Observer.Day_P*	0.75	0.85
CHOH	BHCO	*Observer_Ord.Day*	0.55	1.02	*Observer.Day_P*	0.71	1.13
CHOH	BHVI	*Null*	0.83	0.71	*Null_P*	0.72	1.09
CHOH	BLJA	*Observer_Ord.Day_Time*	0.99	0.68	*Observer.Day_NB*	1	1.09
CHOH	BLVU	*Ord.Day*	0.59	0.44	*Observer.Day_NB*	1	2.47
CHOH	CACH	*Null*	0.35	1.52	*Null_NB*	0.69	1.15
CHOH	CANG	*Observer_Ord.Day_Time*	0.83	0.15	*Observer.Day_NB*	1	2.35
CHOH	CARW	*Observer_Ord.Day_Time*	1	0.37	*Observer.Day_P*	0.75	0.79
CHOH	CEDW	*Observer_Ord.Day_Time*	1	0.79	*Observer.Day_NB*	1	1.68
CHOH	CERW	*Null*	0.64	4.13	*Null_NB*	0.5	1.21
CHOH	CHSP	*Ord.Day*	0.56	0.11	*Null_NB*	1	1.08
CHOH	CHSW	*Null*	0.6	0.09	*Observer_NB*	0.53	1.4
CHOH	COGR	*Observer_Ord.Day_Time*	0.91	1.39	*Observer.Day_NB*	1	1.4
CHOH	CORA	*Null*	0.78	0.31	*Null_NB*	0.97	1.22
CHOH	COYE	*Ord.Day*	0.78	0.24	*Null_NB*	0.99	1.14

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
CHOH	DCCO	*Ord.Day*	1	8.5	*Null_NB*	1	1.62
CHOH	DOWO	*Observer_Ord.Day_Time*	0.39	1.42	*Observer.Day_P*	0.73	0.86
CHOH	EABL	*Null*	0.72	3.68	*Null_NB*	1	1.15
CHOH	EAKI	*Null*	0.84	0.1	*Null_NB*	0.9	1.44
CHOH	EAME	*Ord.Day*	0.92	0.03	*Null_NB*	1	1.26
CHOH	EAPH	*Ord.Day*	0.89	0.12	*Observer.Day_P*	0.44	1.1
CHOH	EATO	*Ord.Day*	0.76	0.81	*Null_NB*	1	1.02
CHOH	EAWP	*Ord.Day*	0.74	1.2	*Null_P*	0.74	0.84
CHOH	EUST	*Ord.Day*	0.9	2.16	*Observer_NB*	0.76	1.88
CHOH	FICR	*Ord.Day*	0.91	0.57	*Observer.Day_NB*	1	1.3
CHOH	FISP	*Null*	0.69	0.04	*Null_NB*	0.95	1.01
CHOH	GBHE	*Null*	0.61	1.02	*Null_NB*	1	1.2
CHOH	GCFL	*Observer_Ord.Day_Time*	1	0.4	*Observer.Day_P*	0.76	0.94
CHOH	GRCA	*Observer_Ord.Day*	0.46	0.76	*Observer_NB*	0.5	1.11
CHOH	HAWO	*Ord.Day*	0.67	0.25	*Null_P*	0.3	1.12
CHOH	HOWR	*Null*	1	7.43	*Null_NB*	1	1.02
CHOH	INBU	*Observer_Ord.Day_Wind*	0.46	2.55	*Observer.Day_P*	0.49	1.08
CHOH	LOWA	*Observer_Ord.Day_Wind*	0.76	0.12	*Observer.Day_P*	0.42	1.05
CHOH	MALL	*Ord.Day*	0.98	0.86	*Null_NB*	1	1.46
CHOH	MODO	*Null*	0.63	2.37	*Null_P*	0.74	1.01
CHOH	NOCA	*Observer_Ord.Day_Time*	1	1.52	*Observer.Day_P*	0.54	0.9
CHOH	NOFL	*Observer_Ord.Day*	0.45	0.82	*Observer.Day_P*	0.69	1.2
CHOH	NOMO	*Null*	0.59	0.39	*Null_P*	0.71	1.22
CHOH	NOPA	*Ord.Day*	0.94	0.55	*Observer.Day_P*	0.75	0.98
CHOH	NRWS	*Ord.Day*	0.59	0.93	*Null_NB*	1	1.65
CHOH	OVEN	*Observer*	0.56	0.2	*Observer.Day_P*	0.28	1.3
CHOH	PIWA	*Null*	0.71	6.68	*Null_NB*	1	1.11

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
CHOH	PIWO	*Ord.Day*	0.7	1.41	*Null_P*	0.69	1.04
CHOH	PROW	*Ord.Day*	0.74	0.25	*Null_NB*	0.95	1.01
CHOH	RBWO	*Observer_Ord.Day_Time*	0.98	2.15	*Observer.Day_P*	0.77	0.72
CHOH	REVI	*Observer_Ord.Day_Time*	0.6	1.09	*Observer.Day_P*	0.44	0.82
CHOH	RSHA	*Ord.Day*	1	0.33	*Observer.Day_NB*	0.66	1.2
CHOH	RTHU	*Null*	0.78	7.26	*Null_P*	0.53	1.13
CHOH	RWBL	*Ord.Day*	1	0.08	*Observer.Day_NB*	0.63	1.05
CHOH	SCTA	*Observer_Ord.Day*	0.43	0.31	*Observer.Day_NB*	0.42	1.01
CHOH	SOSP	*Null*	0.7	0.4	*Observer_NB*	0.45	1.03
CHOH	TUTI	*Observer_Ord.Day_Time*	1	1.43	*Observer.Day_P*	0.75	0.87
CHOH	TUVU	*Null*	0.44	1.98	*Null_NB*	1	1.44
CHOH	WAVI	*Observer_Ord.Day_Wind*	0.42	0.18	*Observer.Day_NB*	0.97	1.12
CHOH	WBNU	*Observer_Ord.Day_Wind*	0.53	0.31	*Observer.Day_P*	0.59	0.95
CHOH	WEVI	*Ord.Day*	0.88	0.02	*Null_P*	0.74	1.11
CHOH	WEWA	*Ord.Day*	0.99	0.44	*Null_NB*	0.68	1.18
CHOH	WITU	*Observer_Ord.Day_Time*	1	0.86	*Null_NB*	0.77	1.67
CHOH	WODU	*Null*	0.79	9.88	*Null_NB*	0.92	2.29
CHOH	WOTH	*Observer_Ord.Day_Time*	0.88	0.41	*Observer.Day_NB*	0.52	1.02
CHOH	YBCU	*Observer_Ord.Day_Wind*	0.99	1.07	*Observer.Day_P*	0.34	0.96
CHOH	YEWA	*Ord.Day*	1	0.11	*Null_NB*	1	1.26
CHOH	YTVI	*Null*	0.61	0.42	*Null_P*	0.69	1.04
CHOH	YTWA	*Observer_Ord.Day_Time*	0.68	0.36	*Observer.Day_NB*	1	1.13
GREE	ACFL	*Null*	0.8	0.41	*Null_P*	0.81	1.01
GREE	AMGO	*Null*	0.79	0.41	*Null_P*	0.81	1
GREE	AMRO	*Ord.Day*	0.9	2.29	*Null_P*	0.81	1.01
GREE	BGGN	*Ord.Day*	0.52	1.87	*Null_P*	0.81	0.85
GREE	BHCO	*Null*	0.81	0.74	*Null_P*	0.81	1.11

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
GREE	BLJA	*Ord.Day*	0.6	4.45	*Null_P*	0.81	0.86
GREE	CACH	*Null*	0.76	0.48	*Null_P*	0.81	1.22
GREE	CARW	*Ord.Day*	0.61	2.99	*Null_P*	0.81	0.82
GREE	DOWO	*Null*	0.81	0.34	*Null_P*	0.81	0.94
GREE	EATO	*Null*	0.79	0.25	*Null_P*	0.81	0.84
GREE	EAWP	*Null*	0.77	1.05	*Null_P*	0.81	1.03
GREE	GCFL	*Null*	0.81	0.28	*Null_P*	0.81	0.92
GREE	MODO	*Null*	0.59	1.87	*Null_P*	0.81	1.21
GREE	NOCA	*Null*	0.61	3.57	*Null_P*	0.81	0.92
GREE	OVEN	*Ord.Day*	0.68	1.45	*Null_P*	0.81	0.97
GREE	PIWA	*Ord.Day*	0.58	0.01	*Null_P*	0.81	1.08
GREE	RBWO	*Null*	0.57	1.62	*Null_P*	0.81	0.83
GREE	REVI	*Null*	0.76	0.56	*Null_P*	0.81	0.82
GREE	SCTA	*Null*	0.67	3.43	*Null_P*	0.81	0.9
GREE	TUTI	*Null*	0.85	3.59	*Null_P*	0.81	0.71
GREE	WBNU	*Ord.Day*	0.86	1.29	*Null_P*	0.81	0.93
GREE	WOTH	*Null*	0.8	0.56	*Null_NB*	0.79	1.33
GWMP	ACFL	*Null*	0.69	0.02	*Null_P*	0.76	1.06
GWMP	AMCR	*Ord.Day*	0.62	0.06	*Null_NB*	0.67	1.13
GWMP	AMGO	*Null*	0.56	1.93	*Observer_NB*	0.6	1.14
GWMP	AMRE	*Ord.Day*	0.95	1.06	*Null_NB*	0.85	1.48
GWMP	AMRO	*Null*	1	4.41	*Null_P*	0.54	1.14
GWMP	BAOR	*Ord.Day*	0.95	0.57	*Null_NB*	1	1.79
GWMP	BGGN	*Ord.Day*	0.9	0.22	*Null_NB*	0.83	1.11
GWMP	BHCO	*Null*	0.72	1.09	*Null_P*	0.72	1.19
GWMP	BLJA	*Ord.Day*	0.89	0.21	*Null_NB*	1	1.04
GWMP	CACH	*Null*	0.66	1.74	*Null_P*	0.58	1.2

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
GWMP	CANG	*Ord.Day*	0.97	0.5	*Null_NB*	1	1.43
GWMP	CARW	*Ord.Day*	0.54	0.12	*Null_NB*	0.53	1.04
GWMP	CEDW	*Ord.Day*	1	0.59	*Observer.Day_NB*	1	1.73
GWMP	CHSW	*Null*	0.75	0.09	*Null_NB*	1	1.19
GWMP	COGR	*Observer_Ord.Day_Time*	0.72	2.31	*Observer_NB*	0.68	1.35
GWMP	COYE	*Null*	0.63	0.55	*Null_NB*	0.94	1.31
GWMP	DOWO	*Ord.Day*	0.86	2.25	*Null_P*	0.76	0.86
GWMP	EAWP	*Null*	0.71	1.92	*Null_P*	0.73	1.01
GWMP	EUST	*Ord.Day*	0.51	0.33	*Null_NB*	1	2.26
GWMP	GCFL	*Ord.Day*	0.93	0.59	*Null_P*	0.76	1.04
GWMP	GRCA	*Ord.Day*	0.55	2.55	*Null_NB*	0.9	1.29
GWMP	HAWO	*Null*	0.63	0.91	*Null_P*	0.76	1.16
GWMP	HOWR	*Null*	0.59	2.25	*Null_NB*	1	1.32
GWMP	INBU	*Ord.Day*	0.63	0.02	*Null_P*	0.75	1.11
GWMP	LOWA	*Ord.Day*	0.53	0.01	*Null_NB*	1	1.16
GWMP	MODO	*Null*	0.57	1.44	*Null_NB*	0.96	1.2
GWMP	NOCA	*Null*	1	2.3	*Null_NB*	1	0.97
GWMP	NOFL	*Null*	0.66	2	*Null_P*	0.75	1.22
GWMP	NOPA	*Null*	0.74	0.06	*Null_NB*	0.51	1.15
GWMP	OVEN	*Null*	0.7	0.3	*Null_NB*	1	1.23
GWMP	PIWO	*Null*	0.76	0.05	*Null_P*	0.76	1.15
GWMP	RBWO	*Ord.Day*	1	0.45	*Observer.Day_P*	0.82	0.97
GWMP	REVI	*Ord.Day*	0.72	0.03	*Null_P*	0.54	1.07
GWMP	RWBL	*Null*	0.76	0.14	*Null_NB*	0.99	0.93
GWMP	SCTA	*Ord.Day*	0.62	0.14	*Null_NB*	0.61	1.01
GWMP	SOSP	*Null*	0.6	0.75	*Null_NB*	1	1.47
GWMP	TUTI	*Null*	0.8	2.68	*Observer.Day_P*	0.81	1.06

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
GWMP	WAVI	*Null*	0.74	0.12	*Null_P*	0.59	1.36
GWMP	WBNU	*Ord.Day*	0.44	2.16	*Observer.Day_P*	0.69	0.98
GWMP	WOTH	*Ord.Day*	0.44	0.1	*Null_NB*	0.98	1.14
HAFE	ACFL	*Null*	0.55	2.22	*Null_P*	0.76	1.03
HAFE	AMCR	*Null*	0.67	1.94	*Null_NB*	1	1.27
HAFE	AMGO	*Ord.Day*	1	0.16	*Null_P*	0.63	1.13
HAFE	AMRE	*Ord.Day*	0.78	4.2	*Null_NB*	1	1.84
HAFE	AMRO	*Null*	0.67	0.6	*Null_NB*	1	1.26
HAFE	BGGN	*Null*	0.76	0.1	*Null_P*	0.7	1.22
HAFE	BHCO	*Null*	0.71	0.88	*Null_P*	0.75	0.94
HAFE	BLJA	*Null*	0.65	1.03	*Null_P*	0.76	1.19
HAFE	CACH	*Observer_Ord.Day*	0.36	0.3	*Null_NB*	0.89	1.11
HAFE	CARW	*Ord.Day*	0.99	0.81	*Null_P*	0.73	1.06
HAFE	CEDW	*Ord.Day*	1	0.08	*Observer.Day_NB*	1	1.81
HAFE	CHSP	*Null*	0.75	0	*Null_P*	0.53	1.24
HAFE	CHSW	*Ord.Day*	0.54	0.4	*Null_NB*	1	1.6
HAFE	COGR	*Ord.Day*	0.7	0.29	*Null_NB*	1	1.47
HAFE	DOWO	*Ord.Day*	0.95	0.36	*Null_P*	0.76	0.81
HAFE	EAPH	*Null*	0.58	0.53	*Null_NB*	1	1.48
HAFE	EATO	*Null*	0.57	2.64	*Null_NB*	0.63	1.03
HAFE	EAWP	*Null*	1	1.61	*Null_P*	0.76	0.85
HAFE	EUST	*Null*	1	0	*Null_NB*	1	1.44
HAFE	FICR	*Ord.Day*	0.53	0.6	*Null_NB*	1	2.06
HAFE	FISP	*Null*	0.56	1.13	*Null_NB*	1	1.24
HAFE	GCFL	*Ord.Day*	1	0.32	*Null_P*	0.73	1.04
HAFE	GRCA	*Null*	0.74	0.22	*Null_NB*	1	1.15
HAFE	HAWO	*Ord.Day*	0.72	1.32	*Null_P*	0.73	1.28

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
HAFE	HOFI	*Null*	1	0.73	*Null_NB*	1	1.49
HAFE	INBU	*Null*	0.58	1.49	*Null_NB*	1	1.02
HAFE	MODO	*Ord.Day*	0.84	0.2	*Null_P*	0.76	0.96
HAFE	NOCA	*Null*	0.69	1.06	*Null_NB*	0.99	1.06
HAFE	NOFL	*Null*	0.61	0.3	*Null_P*	0.69	1.19
HAFE	OVEN	*Ord.Day*	0.55	0.69	*Null_NB*	1	1.13
HAFE	PIWO	*Ord.Day*	0.61	1.34	*Null_P*	0.75	1.01
HAFE	RBWO	*Null*	0.68	0.22	*Null_P*	0.76	0.85
HAFE	REVI	*Null*	0.8	1.89	*Observer.Day_P*	0.81	0.9
HAFE	SCTA	*Ord.Day*	0.99	1.62	*Null_P*	0.59	1.06
HAFE	SOSP	*Null*	0.72	0.51	*Null_NB*	0.57	1.44
HAFE	TUTI	*Null*	1	0.55	*Null_P*	0.76	0.85
HAFE	WBNU	*Ord.Day*	1	0.26	*Null_P*	0.73	1.01
HAFE	WEWA	*Ord.Day*	0.57	0.3	*Null_NB*	0.54	1.11
HAFE	WOTH	*Ord.Day*	0.99	0.14	*Null_NB*	0.98	1.04
HAFE	YBCU	*Ord.Day*	0.57	2.3	*Null_P*	0.76	1.05
HAFE	YTVI	*Null*	0.75	0.02	*Null_P*	0.76	1.17
MANA	ACFL	*Null*	0.75	0.24	*Null_NB*	0.96	1.05
MANA	AMCR	*Null*	0.72	0.93	*Null_P*	0.75	1.09
MANA	AMGO	*Null*	0.71	0.47	*Null_NB*	1	1.19
MANA	AMRO	*Null*	0.7	1.64	*Null_NB*	0.89	1.19
MANA	BGGN	*Null*	1	2.03	*Null_P*	0.75	0.96
MANA	BHCO	*Null*	0.69	0.98	*Null_NB*	0.74	1.04
MANA	BLJA	*Null*	0.74	1.6	*Null_NB*	0.89	1.31
MANA	BRTH	*Null*	0.55	0.86	*Null_NB*	0.51	1.3
MANA	CACH	*Null*	0.71	1.11	*Null_NB*	0.98	1.19
MANA	CANG	*Ord.Day*	1	1.52	*Observer.Day_NB*	1	1.74

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
MANA	CARW	*Ord.Day*	0.73	0.79	*Null_P*	0.75	0.83
MANA	CEDW	*Ord.Day*	0.93	5.02	*Observer.Day_NB*	1	1.48
MANA	CHSP	*Null*	0.64	1.92	*Null_NB*	0.93	1.25
MANA	CHSW	*Ord.Day*	0.74	0.35	*Null_NB*	1	1.65
MANA	COGR	*Null*	0.57	0.72	*Null_NB*	1	1.66
MANA	COYE	*Null*	0.57	3.99	*Null_NB*	1	1.01
MANA	DOWO	*Null*	0.64	1.06	*Null_P*	0.75	0.93
MANA	EABL	*Ord.Day*	0.8	1.14	*Null_NB*	0.57	1.36
MANA	EAME	*Ord.Day*	0.8	0.24	*Null_NB*	0.94	1.02
MANA	EATO	*Null*	0.58	0.35	*Null_P*	0.39	1.06
MANA	EAWP	*Ord.Day*	0.61	0.2	*Null_P*	0.75	0.95
MANA	EUST	*Null*	0.75	0.18	*Null_NB*	1	2.39
MANA	FISP	*Ord.Day*	0.66	2.06	*Observer_NB*	0.54	1.07
MANA	GCFL	*Ord.Day*	1	0.82	*Observer.Day_P*	0.68	1.13
MANA	GRCA	*Null*	0.69	0.45	*Null_P*	0.75	1.18
MANA	HAWO	*Ord.Day*	0.76	1.22	*Null_P*	0.65	1.32
MANA	INBU	*Ord.Day*	0.51	1.33	*Null_P*	0.68	1.05
MANA	MODO	*Null*	0.61	0.4	*Null_P*	0.75	1.02
MANA	NOCA	*Null*	1	1.96	*Null_P*	0.75	0.93
MANA	NOFL	*Null*	0.72	0.16	*Null_P*	0.65	1.11
MANA	NOMO	*Null*	0.7	1.26	*Null_P*	0.75	1.14
MANA	NOPA	*Ord.Day*	0.99	0.15	*Null_NB*	0.92	1.12
MANA	OVEN	*Ord.Day*	1	0.94	*Null_NB*	0.61	1.18
MANA	PIWA	*Null*	0.51	0.86	*Null_NB*	0.91	1.33
MANA	PIWO	*Null*	0.73	0.26	*Null_P*	0.67	1.12
MANA	PRAW	*Ord.Day*	0.98	0.29	*Null_NB*	0.97	1.04
MANA	RBWO	*Ord.Day*	1	0.42	*Null_P*	0.75	0.93

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
MANA	REVI	*Ord.Day*	0.87	0.08	*Observer.Day_NB*	0.54	0.97
MANA	RSHA	*Null*	0.61	0.49	*Null_P*	0.7	1.21
MANA	RWBL	*Ord.Day*	0.53	0.31	*Null_NB*	1	1.21
MANA	SCTA	*Null*	0.65	3.6	*Null_P*	0.75	0.93
MANA	TUTI	*Null*	0.97	1	*Observer.Day_P*	0.81	0.93
MANA	WBNU	*Ord.Day*	0.97	1.04	*Null_P*	0.75	1.01
MANA	WOTH	*Null*	0.74	0.12	*Null_NB*	1	1.12
MANA	YBCH	*Ord.Day*	0.92	1.08	*Null_NB*	0.67	1.15
MANA	YBCU	*Ord.Day*	0.94	0.69	*Null_P*	0.75	1.01
MONO	ACFL	*Null*	0.69	0.05	*Null_P*	0.81	1.09
MONO	AMCR	*Null*	0.67	1.39	*Null_P*	0.81	1.34
MONO	AMGO	*Null*	0.77	0.45	*Null_P*	0.75	1.33
MONO	AMRO	*Null*	0.75	1	*Null_P*	0.81	1.08
MONO	BGGN	*Null*	0.7	0.34	*Null_P*	0.81	0.96
MONO	BHCO	*Ord.Day*	0.83	1.29	*Null_P*	0.81	0.97
MONO	BLJA	*Null*	0.72	1.28	*Null_P*	0.81	0.98
MONO	CACH	*Null*	0.79	1.45	*Null_P*	0.81	1.17
MONO	CARW	*Null*	1	1.23	*Null_P*	0.81	0.69
MONO	CEDW	*Ord.Day*	0.97	1.07	*Null_NB*	1	2.46
MONO	DOWO	*Ord.Day*	0.81	2.78	*Null_P*	0.81	0.87
MONO	EAWP	*Null*	0.61	2.51	*Null_P*	0.81	0.77
MONO	GCFL	*Ord.Day*	0.75	3.6	*Null_P*	0.81	0.93
MONO	INBU	*Null*	0.78	0.06	*Null_P*	0.81	1.08
MONO	NOCA	*Null*	0.89	5.19	*Null_P*	0.81	0.76
MONO	RBWO	*Null*	0.53	0.99	*Null_P*	0.81	0.79
MONO	REVI	*Ord.Day*	0.88	0.77	*Null_P*	0.81	0.95
MONO	SCTA	*Null*	0.8	0.33	*Null_P*	0.81	0.91

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
MONO	SOSP	*Null*	0.78	0	*Null_P*	0.79	1.59
MONO	TUTI	*Null*	0.57	1.35	*Null_P*	0.81	0.93
MONO	WBNU	*Ord.Day*	0.58	1.89	*Null_P*	0.81	0.97
MONO	WOTH	*Null*	0.78	0.06	*Null_P*	0.8	1.19
NACE	ACFL	*Null*	0.69	0.7	*Null_P*	0.79	1.1
NACE	AMGO	*Null*	0.52	1.14	*Null_P*	0.79	1.07
NACE	AMRO	*Ord.Day*	0.97	1.95	*Null_P*	0.57	1.29
NACE	BGGN	*Ord.Day*	1	3.31	*Null_P*	0.79	1
NACE	BHCO	*Ord.Day*	0.86	0.15	*Null_NB*	0.54	1.16
NACE	BLJA	*Null*	0.79	0.28	*Null_P*	0.79	1.08
NACE	CACH	*Null*	0.65	0.84	*Null_P*	0.58	1.42
NACE	CARW	*Null*	0.99	1.08	*Null_P*	0.79	0.69
NACE	CEDW	*Ord.Day*	0.98	0.93	*Null_NB*	1	2.3
NACE	CHSW	*Ord.Day*	0.59	0.49	*Null_NB*	1	1.5
NACE	COGR	*Null*	0.71	1.35	*Null_NB*	1	1.55
NACE	DOWO	*Null*	0.73	0.46	*Null_P*	0.79	0.87
NACE	EATO	*Null*	0.76	0.98	*Null_P*	0.79	1.17
NACE	EAWP	*Null*	0.77	0.3	*Null_P*	0.79	0.9
NACE	EUST	*Ord.Day*	0.99	8.02	*Null_NB*	1	1.45
NACE	GCFL	*Ord.Day*	0.61	0.94	*Null_P*	0.79	1.23
NACE	GRCA	*Null*	0.77	1.77	*Null_P*	0.79	1.05
NACE	HOSP	*Null*	0.89	0.05	*Null_NB*	1	1.7
NACE	INBU	*Null*	0.63	1.91	*Null_P*	0.64	1.24
NACE	NOCA	*Null*	0.97	1.92	*Null_P*	0.79	0.71
NACE	RBWO	*Ord.Day*	0.88	0.5	*Null_P*	0.79	0.9
NACE	REVI	*Null*	0.68	0.54	*Null_P*	0.79	0.91
NACE	TUTI	*Ord.Day*	0.56	0.45	*Null_P*	0.59	1.2

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
NACE	WBNU	*Ord.Day*	0.71	0.28	*Null_P*	0.79	1.1
NACE	WOTH	*Null*	0.61	1.87	*Null_NB*	0.94	1.13
PISC_FOWA	ACFL	*Ord.Day*	0.61	0.9	*Null_P*	0.77	0.9
PISC_FOWA	AMCR	*Null*	0.6	1.45	*Null_P*	0.77	1.08
PISC_FOWA	AMGO	*Null*	0.77	0.26	*Null_P*	0.77	1.12
PISC_FOWA	BGGN	*Ord.Day*	0.97	0.39	*Null_P*	0.77	0.88
PISC_FOWA	BHCO	*Ord.Day*	0.87	0.09	*Null_NB*	0.56	1.16
PISC_FOWA	BLJA	*Null*	0.64	0.36	*Null_NB*	0.58	1.04
PISC_FOWA	CACH	*Null*	0.77	3.97	*Null_P*	0.77	1
PISC_FOWA	CANG	*Ord.Day*	0.96	0.79	*Null_NB*	1	1.86
PISC_FOWA	CARW	*Null*	1	5.23	*Null_P*	0.77	0.78
PISC_FOWA	CEDW	*Ord.Day*	0.93	1.39	*Null_NB*	1	3.16
PISC_FOWA	COGR	*Null*	0.77	0.22	*Null_NB*	1	1.78
PISC_FOWA	DOWO	*Ord.Day*	0.94	0.84	*Null_P*	0.77	0.88
PISC_FOWA	EATO	*Null*	0.74	0.72	*Null_NB*	0.84	1.26
PISC_FOWA	EAWP	*Null*	0.72	0.82	*Null_P*	0.77	0.81
PISC_FOWA	GCFL	*Ord.Day*	0.99	0.47	*Null_P*	0.77	1
PISC_FOWA	INBU	*Null*	0.74	0.49	*Null_NB*	0.97	1.11
PISC_FOWA	MODO	*Null*	0.6	0.31	*Null_P*	0.77	0.96
PISC_FOWA	NOCA	*Null*	0.99	1.03	*Null_P*	0.77	0.66
PISC_FOWA	NOPA	*Ord.Day*	0.92	0.31	*Null_P*	0.77	0.8

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
PISC_FOWA	RBWO	*Ord.Day*	0.98	1.54	*Null_P*	0.77	0.68
PISC_FOWA	REVI	*Ord.Day*	0.83	0.9	*Null_P*	0.77	0.75
PISC_FOWA	SCTA	*Null*	0.77	1.05	*Null_P*	0.77	0.93
PISC_FOWA	TUTI	*Null*	0.96	0.36	*Null_P*	0.77	0.68
PISC_FOWA	WBNU	*Ord.Day*	1	0.4	*Null_P*	0.77	0.93
PISC_FOWA	WOTH	*Null*	0.77	0.44	*Null_P*	0.74	1.08
PISC_FOWA	YBCU	*Ord.Day*	1	1.22	*Null_P*	0.77	0.96
PRWI	ACFL	*Observer*	0.47	0.6	*Observer_P*	0.45	0.55
PRWI	AMCR	*Observer_Ord.Day_Time*	1	1.09	*Null_NB*	0.96	1.11
PRWI	AMGO	*Observer_Ord.Day_Time*	1	0.61	*Observer.Day_NB*	0.81	1.05
PRWI	AMRE	*Ord.Day*	0.81	0.32	*Null_NB*	0.94	1.27
PRWI	AMRO	*Observer_Ord.Day_Time*	1	3.16	*Observer.Day_NB*	1	1.11
PRWI	BAWW	*Observer_Ord.Day_Time*	0.83	0.17	*Observer.Day_NB*	0.66	1.16
PRWI	BGGN	*Observer_Ord.Day_Time*	1	0.54	*Observer.Day_P*	0.74	0.73
PRWI	BHCO	*Observer_Ord.Day*	0.57	0.26	*Observer.Day_P*	0.74	1.04
PRWI	BHVI	*Ord.Day*	0.99	1.92	*Null_P*	0.73	1.17
PRWI	BLJA	*Ord.Day*	0.85	0.84	*Null_NB*	1	1.11
PRWI	CACH	*Observer_Ord.Day_Time*	0.54	3.17	*Observer.Day_NB*	1	1.12
PRWI	CANG	*Ord.Day*	0.99	0.32	*Observer.Day_NB*	1	3.36
PRWI	CARW	*Observer_Ord.Day_Time*	0.49	0.3	*Observer.Day_P*	0.74	1.04
PRWI	CEDW	*Observer_Ord.Day*	0.57	1.38	*Observer.Day_NB*	1	1.9
PRWI	CHSP	*Null*	0.71	6.8	*Null_NB*	0.52	1.21
PRWI	CHSW	*Ord.Day*	0.92	2.02	*Null_NB*	0.98	1.24
PRWI	COGR	*Null*	0.99	0.18	*Null_NB*	0.57	1.23
PRWI	COYE	*Ord.Day*	0.98	0.16	*Null_NB*	0.97	1.26

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
PRWI	DOWO	*Observer_Ord.Day_Wind*	0.98	1.54	*Observer.Day_P*	0.76	0.93
PRWI	EAPH	*Ord.Day*	0.96	0.14	*Null_NB*	0.76	1.14
PRWI	EATO	*Null*	0.66	0.92	*Null_NB*	0.93	1.19
PRWI	EAWP	*Observer_Ord.Day_Time*	1	2.2	*Null_P*	0.68	0.61
PRWI	FICR	*Ord.Day*	0.86	0.05	*Null_NB*	1	1.42
PRWI	GCFL	*Observer_Ord.Day*	0.4	0.62	*Observer.Day_P*	0.58	1.1
PRWI	GRCA	*Observer*	0.49	2.25	*Observer.Day_P*	0.76	1.19
PRWI	HAWO	*Observer*	0.5	0.31	*Observer_P*	0.54	1.12
PRWI	HOWA	*Ord.Day*	0.74	0.2	*Null_NB*	0.94	0.97
PRWI	INBU	*Null*	0.66	1.68	*Null_NB*	0.99	1.25
PRWI	LOWA	*Observer_Ord.Day_Time*	0.46	0.21	*Observer.Day_NB*	0.9	1.23
PRWI	MODO	*Null*	0.74	0.06	*Null_P*	0.55	1.05
PRWI	NOCA	*Observer_Ord.Day_Time*	0.97	0.81	*Observer_NB*	0.75	1.05
PRWI	NOFL	*Null*	0.5	0.91	*Null_NB*	0.55	1.07
PRWI	NOPA	*Observer_Ord.Day_Wind*	0.82	0.65	*Observer.Day_NB*	0.79	1.03
PRWI	OVEN	*Observer_Ord.Day_Time*	1	1.48	*Observer.Day_P*	0.74	0.83
PRWI	PIWA	*Observer_Ord.Day*	0.56	0.14	*Observer.Day_NB*	1	1.04
PRWI	PIWO	*Observer*	0.31	1.09	*Observer_P*	0.48	1.05
PRWI	RBWO	*Observer_Ord.Day_Wind*	0.54	0.78	*Observer.Day_P*	0.76	0.92
PRWI	REVI	*Observer*	1	2.07	*Observer.Day_P*	0.74	0.55
PRWI	RHWO	*Ord.Day*	0.93	0.06	*Null_NB*	0.71	1.36
PRWI	RSHA	*Ord.Day*	0.54	54	*Null_P*	0.7	1.08
PRWI	RTHA	*Null*	0.96	0.37	*Null_NB*	0.94	1.13
PRWI	RTHU	*Observer*	0.63	2.13	*Observer_P*	0.49	1.02
PRWI	SCTA	*Observer_Ord.Day_Time*	1	3.4	*Observer_P*	0.49	0.84
PRWI	SUTA	*Null*	0.62	2.27	*Observer_P*	0.29	1.28
PRWI	TUTI	*Observer_Ord.Day_Time*	1	1.57	*Observer.Day_P*	0.75	0.9

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
PRWI	WBNU	*Observer_Ord.Day_Wind*	0.91	0.92	*Observer.Day_P*	0.75	0.94
PRWI	WEVI	*Null*	0.99	0.18	*Null_P*	0.73	1.08
PRWI	WEWA	*Observer_Ord.Day_Time*	0.46	0.83	*Observer.Day_P*	0.59	1.36
PRWI	WITU	*Ord.Day*	0.94	0.2	*Null_NB*	0.86	1.29
PRWI	WOTH	*Observer_Ord.Day_Time*	1	1.52	*Observer.Day_P*	0.67	1.04
PRWI	YBCU	*Observer_Ord.Day_Wind*	0.87	2.22	*Observer.Day_P*	0.84	1.09
PRWI	YTVI	*Observer_Ord.Day_Wind*	0.77	3.17	*Observer.Day_P*	0.52	1.07
ROCR	ACFL	*Null*	0.72	0.02	*Null_P*	0.77	0.82
ROCR	AMCR	*Ord.Day*	0.81	0	*Null_NB*	1	1.33
ROCR	AMGO	*Null*	0.69	1.08	*Null_P*	0.73	1.17
ROCR	AMRO	*Null*	0.66	5.38	*Null_P*	0.62	1.14
ROCR	BGGN	*Observer_Ord.Day*	0.46	0.48	*Null_P*	0.69	0.82
ROCR	BHCO	*Ord.Day*	0.63	0.25	*Null_P*	0.76	1.17
ROCR	BLJA	*Null*	0.68	0.99	*Null_NB*	1	1.16
ROCR	CACH	*Null*	0.67	2.19	*Null_NB*	0.89	1.3
ROCR	CARW	*Ord.Day*	0.94	1.57	*Null_P*	0.77	0.88
ROCR	CHSW	*Ord.Day*	1	0.74	*Null_NB*	0.97	1.27
ROCR	COGR	*Null*	0.68	0.4	*Null_NB*	1	1.26
ROCR	DOWO	*Ord.Day*	0.77	1.97	*Null_P*	0.77	0.81
ROCR	EATO	*Null*	0.74	0.04	*Null_NB*	0.88	1.19
ROCR	EAWP	*Null*	0.67	1.46	*Null_P*	0.77	0.78
ROCR	EUST	*Null*	0.74	0.66	*Null_NB*	1	1.79
ROCR	GCFL	*Ord.Day*	0.98	0.46	*Null_NB*	0.71	1.27
ROCR	GRCA	*Null*	0.72	0.74	*Null_NB*	0.96	0.98
ROCR	HAWO	*Null*	0.76	0.08	*Null_P*	0.76	1.17
ROCR	HOSP	*Null*	0.74	0.09	*Null_NB*	1	1.11
ROCR	MODO	*Null*	0.76	0.13	*Null_P*	0.77	0.95

Unit Code	Alpha Code	*Occupancy Model*	Occupancy cumulative Akaike weight	Occupancy Goodness of Fit c-hat	*Abundance Model*	Abundance cumulative Akaike weight	Abundance Goodness of Fit c-hat
ROCR	NOCA	*Null*	0.99	0.17	*Null_P*	0.77	1
ROCR	NOFL	*Null*	0.75	0	*Null_P*	0.67	1.16
ROCR	OVEN	*Ord.Day*	0.62	0.21	*Null_NB*	0.99	1.21
ROCR	RBWO	*Ord.Day*	1	2.29	*Observer.Day_P*	0.77	0.89
ROCR	REVI	*Null*	0.69	0	*Null_P*	0.77	0.93
ROCR	SCTA	*Null*	0.74	0.88	*Null_NB*	0.65	1.32
ROCR	SOSP	*Null*	0.69	1.47	*Null_NB*	1	1.09
ROCR	TUTI	*Null*	0.59	4	*Null_P*	0.77	0.89
ROCR	VEER	*Null*	0.64	0.6	*Null_NB*	1	1.38
ROCR	WBNU	*Ord.Day*	1	1.28	*Null_P*	0.74	1.1
ROCR	WOTH	*Null*	0.74	1.45	*Null_NB*	1	1.09
WOTR	ACFL	*Observer_Ord.Day_Wind*	0.93	1.99	*Observer.Day_NB*	1	0.95
WOTR	AMCR	*Observer_Ord.Day_Time*	0.95	0.19	*Observer.Day_NB*	1	1.14
WOTR	AMRO	*Observer_Ord.Day_Time*	0.53	0.15	*Observer.Day_NB*	1	1.19
WOTR	BGGN	*Observer_Ord.Day_Wind*	0.79	0.22	*Observer.Day_NB*	1	1.02
WOTR	BLJA	*Observer_Ord.Day_Time*	0.67	1.21	*Observer.Day_NB*	1	1.01
WOTR	CACH	*Observer_Ord.Day_Time*	1	0.65	*Observer.Day_NB*	1	1.06
WOTR	CARW	*Observer_Ord.Day_Wind*	0.61	0.25	*Observer.Day_NB*	1	0.57
WOTR	DOWO	*Observer_Ord.Day_Time*	0.81	0.34	*Observer.Day_NB*	1	1
WOTR	NOCA	*Observer_Ord.Day_Wind*	0.87	0	*Observer.Day_NB*	1	0.63
WOTR	RBWO	*Observer_Ord.Day_Time*	0.51	0.85	*Observer.Day_NB*	1	0.96
WOTR	REVI	*Observer_Ord.Day_Wind*	0.96	0.16	*Observer.Day_NB*	1	0.58
WOTR	TUTI	*Observer_Ord.Day_Time*	0.97	1.57	*Observer.Day_NB*	1	0.74
WOTR	WBNU	*Observer_Ord.Day_Wind*	0.99	1.73	*Observer.Day_NB*	1	0.84

Appendix D. Annual Species Richness

Figures D1–D14 and corresponding Tables D1–D14 show annual species richness (number of unique species) at each monitoring location within each park.

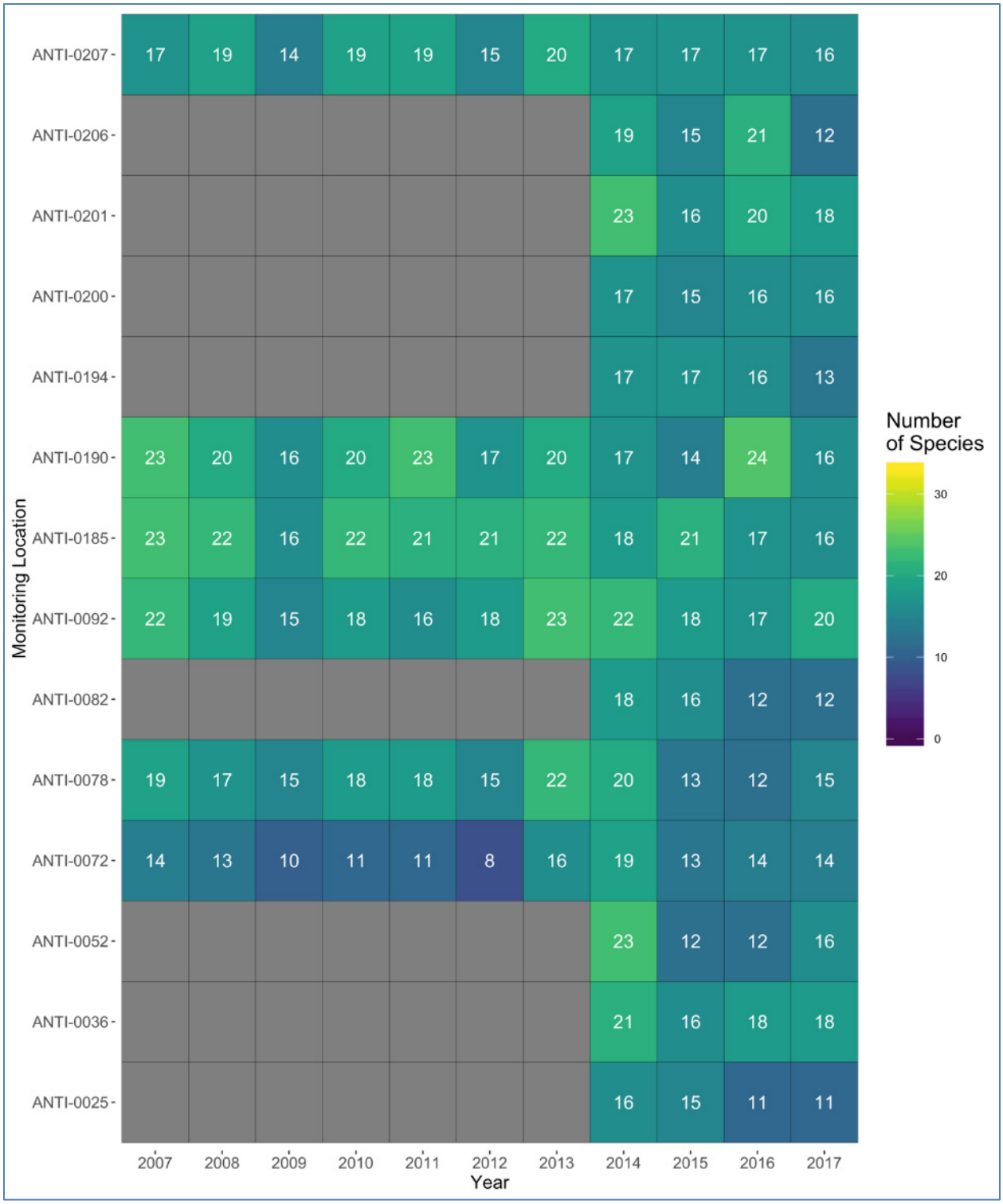


Figure D-1. Number of species detected annually at each monitoring location – Antietam National Battlefield. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-1.

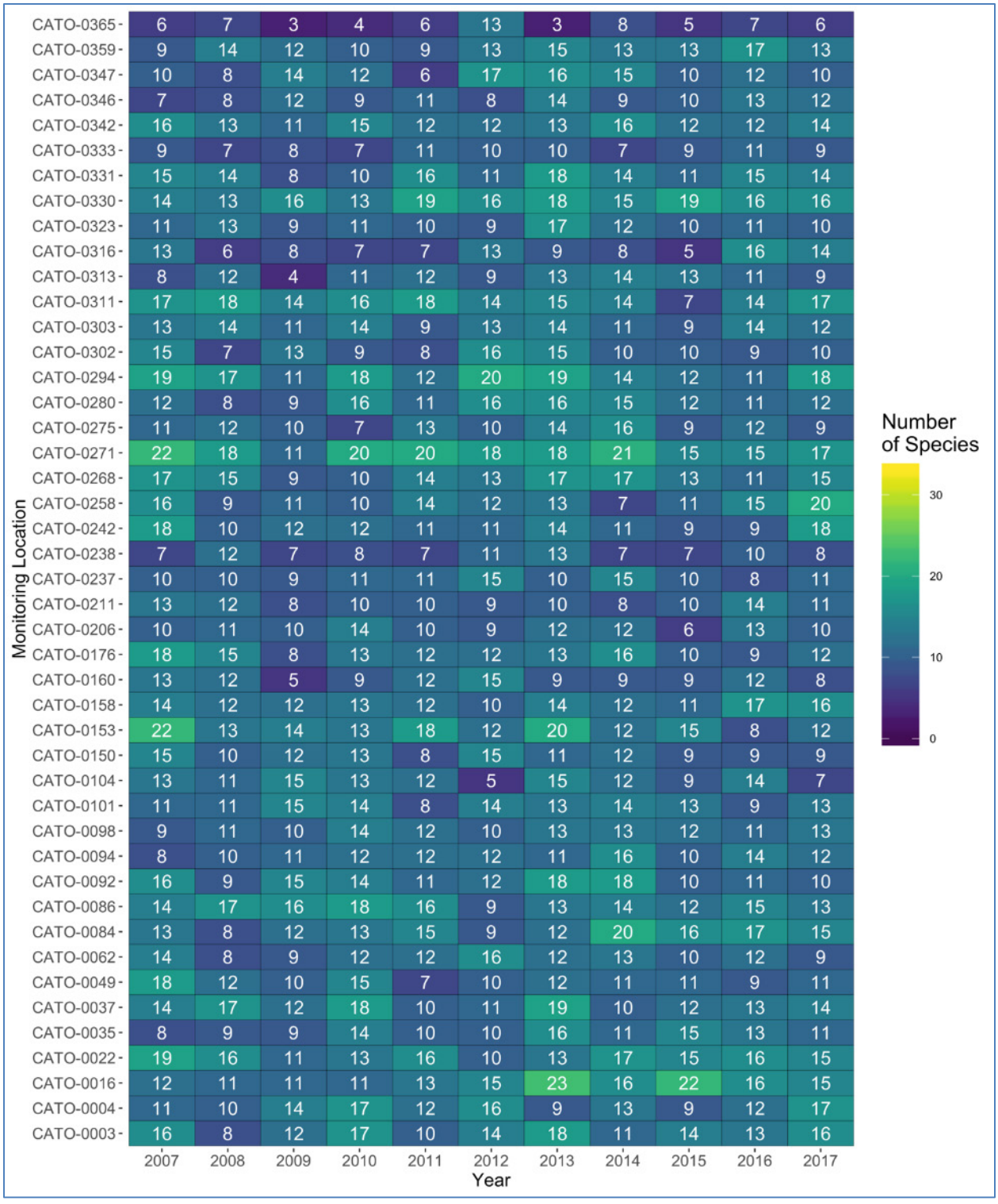


Figure D-2. Number of species detected annually at each monitoring location – Catoctin Mountain Park. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-2.

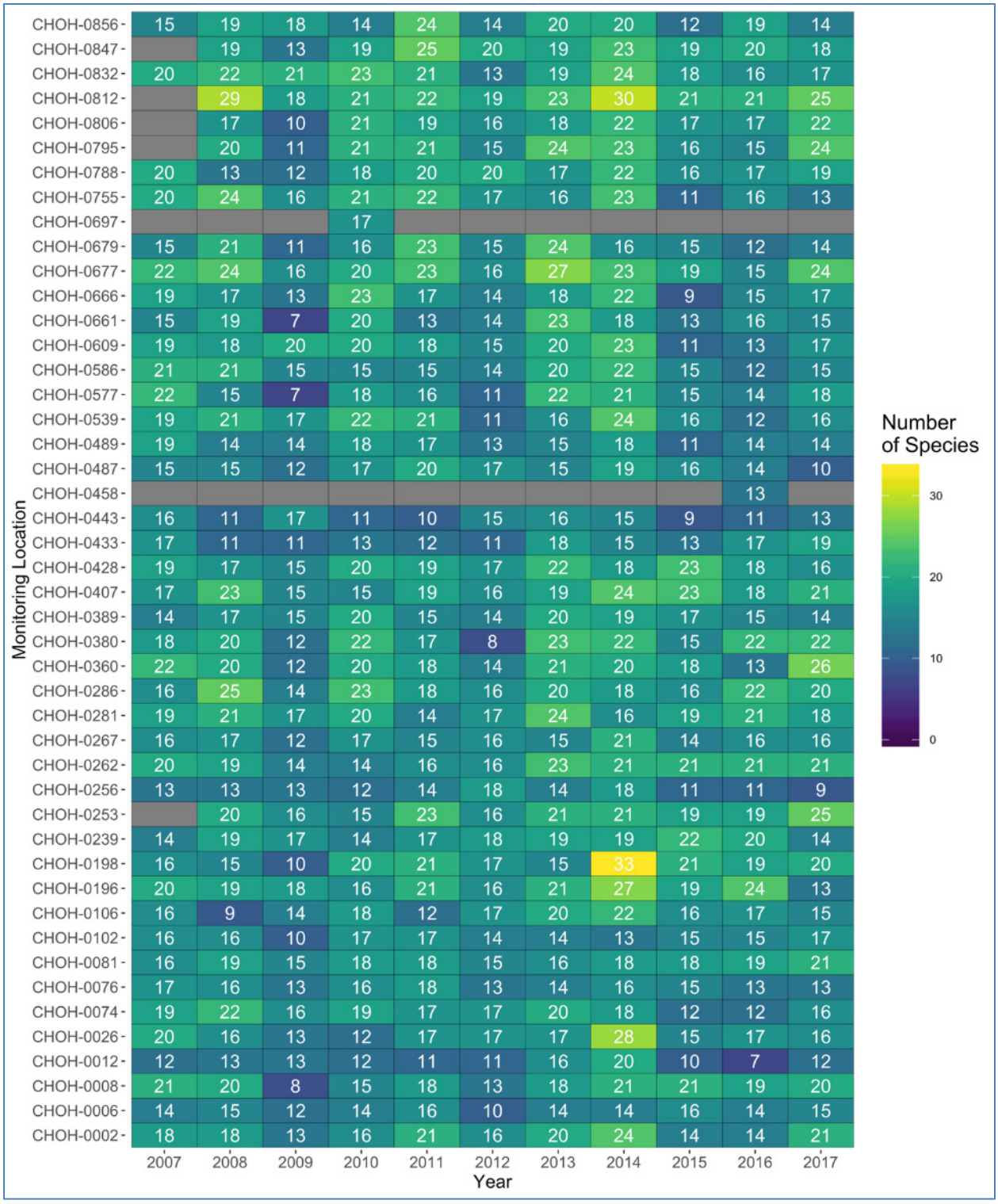


Figure D-3. Number of species detected annually at each monitoring location – C&O Canal National Historical Park (Part 1). Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-3.

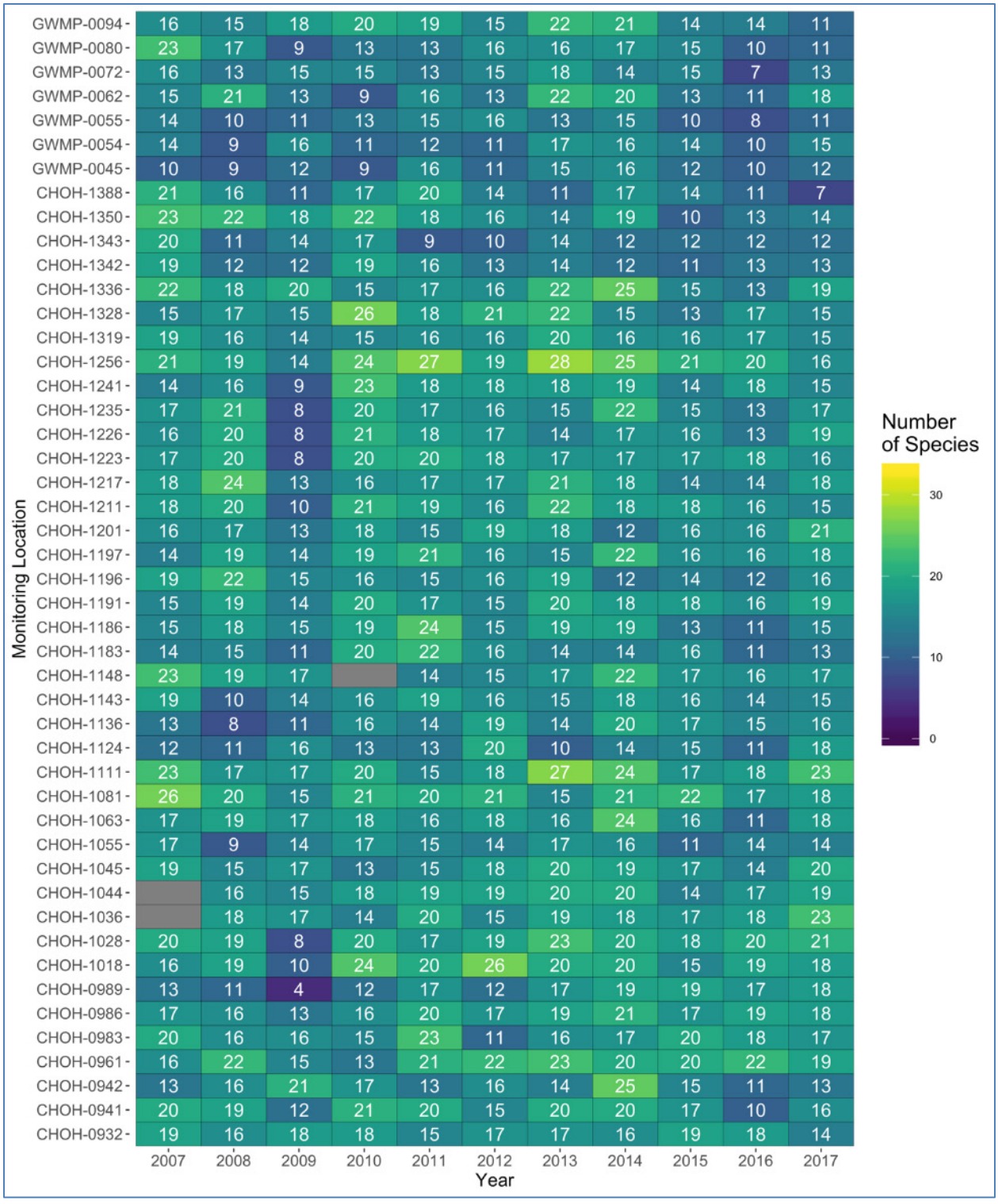


Figure D-4. Number of species detected annually at each monitoring location – C&O Canal National Historical Park (Part 2). Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-4.

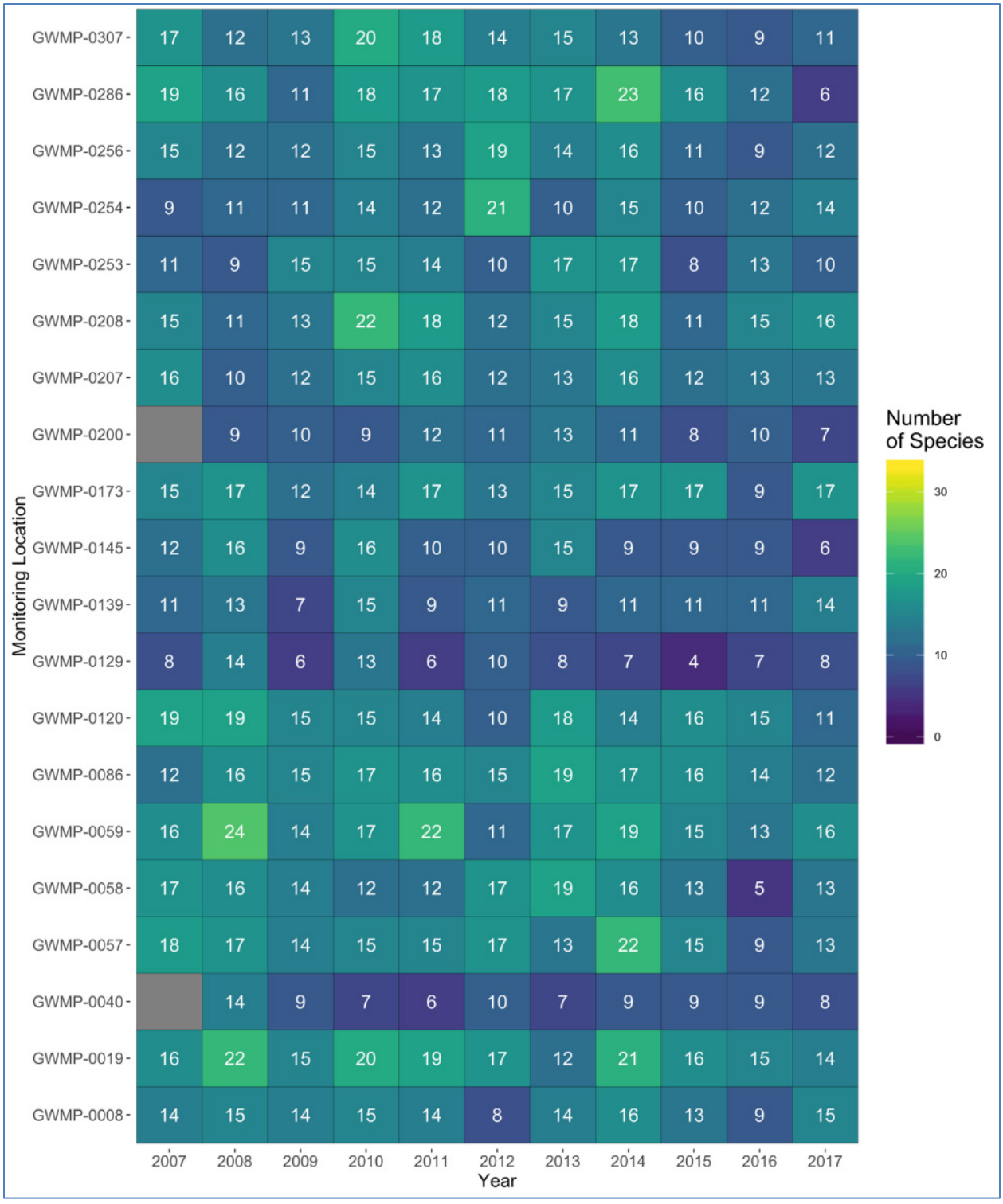


Figure D-5. Number of species detected annually at each monitoring location – George Washington Memorial Parkway. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-5.

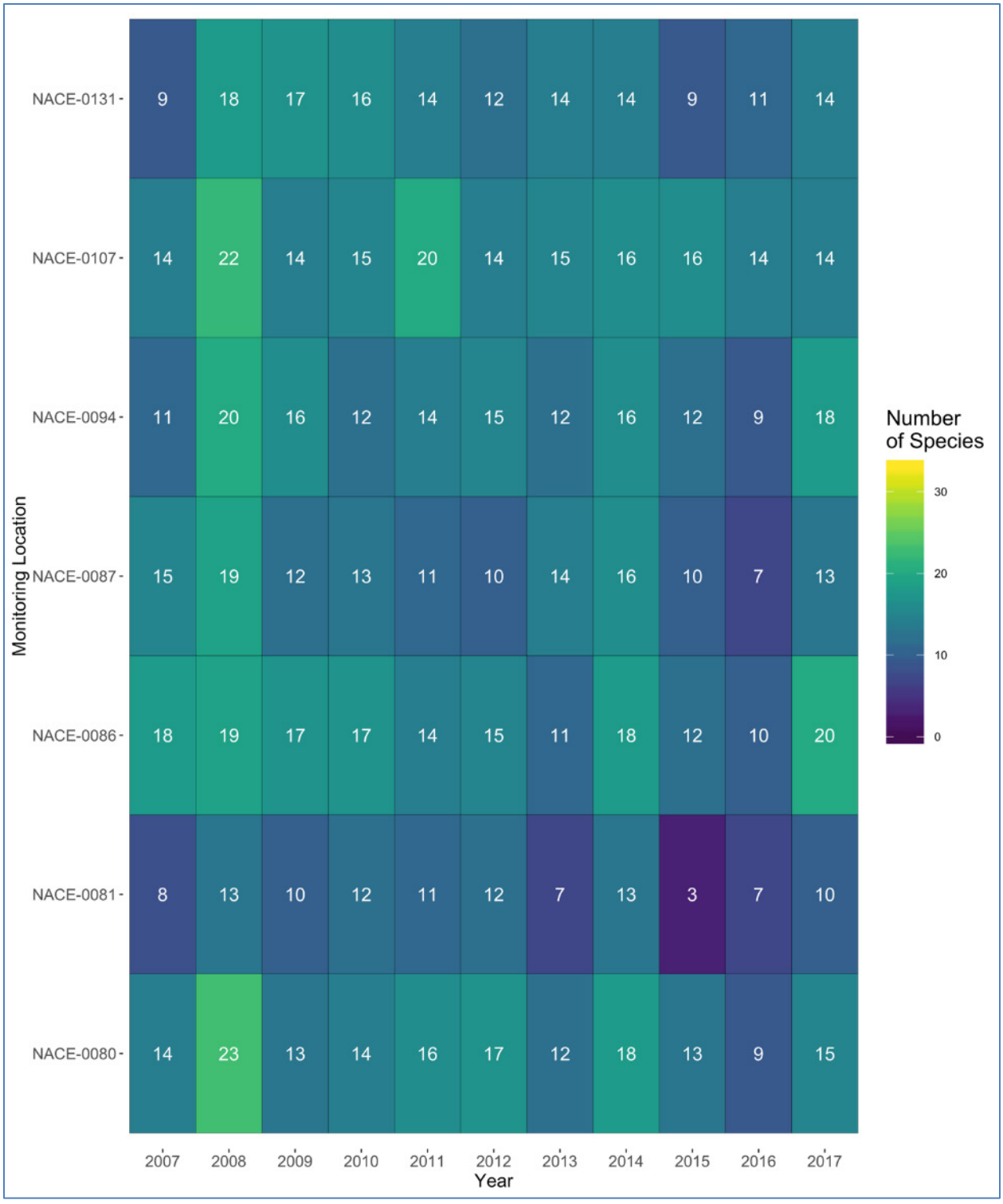


Figure D-6. Number of species detected annually at each monitoring location – Greenbelt National Park. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-6.

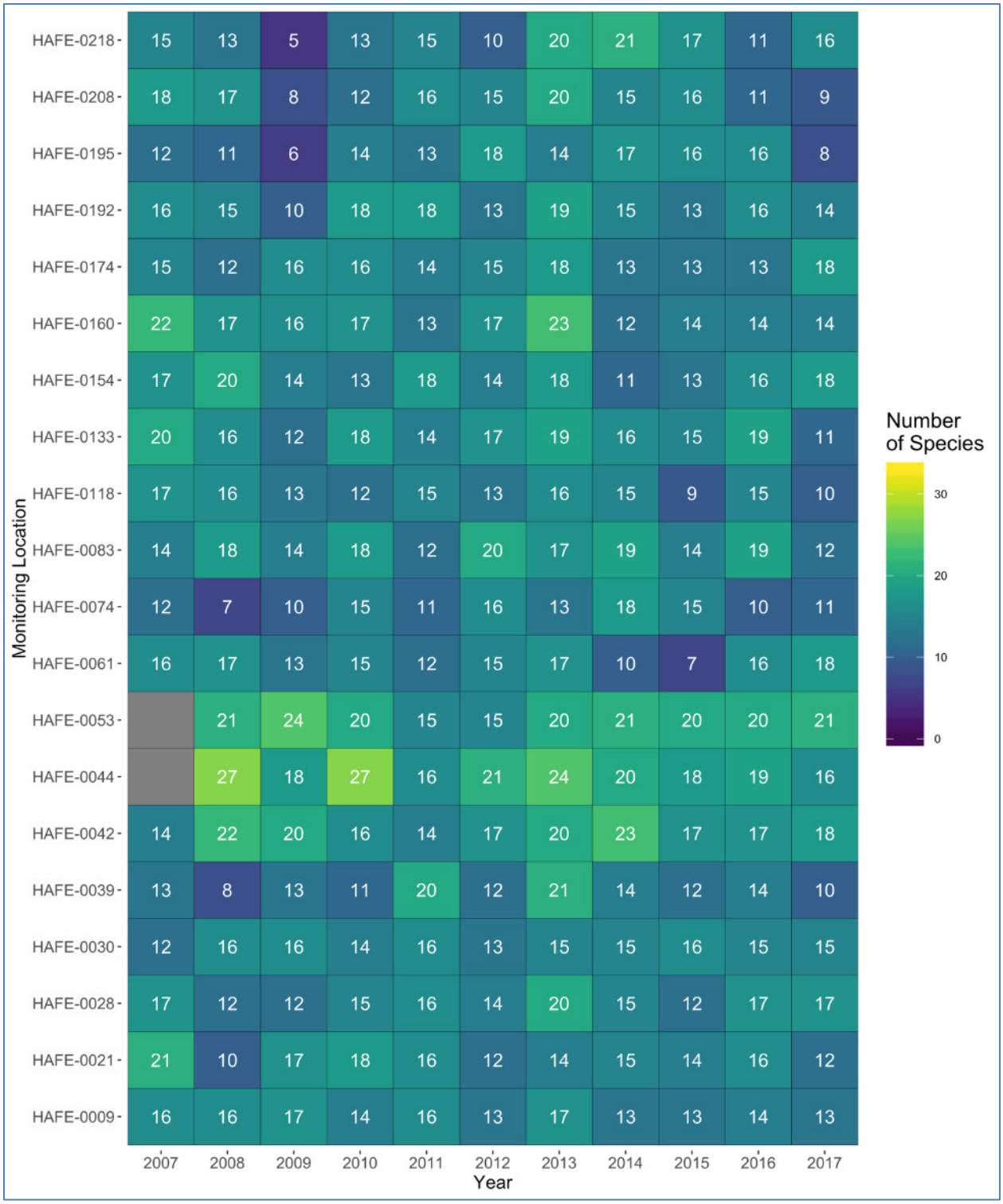


Figure D-7. Number of species detected annually at each monitoring location – Harpers Ferry National Historical Park. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-7.

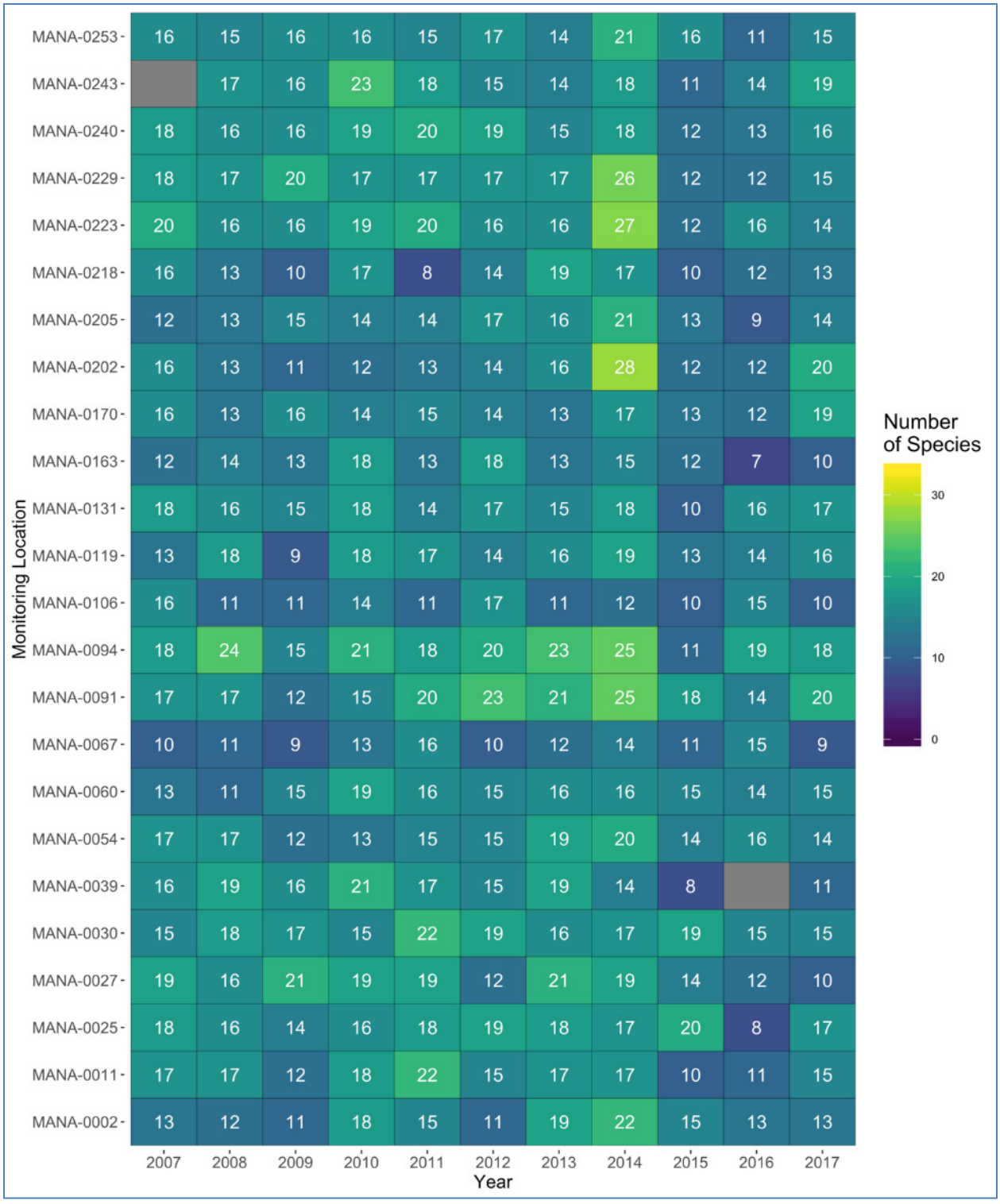


Figure D-8. Number of species detected annually at each monitoring location – Manassas National Battlefield Park. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-8.

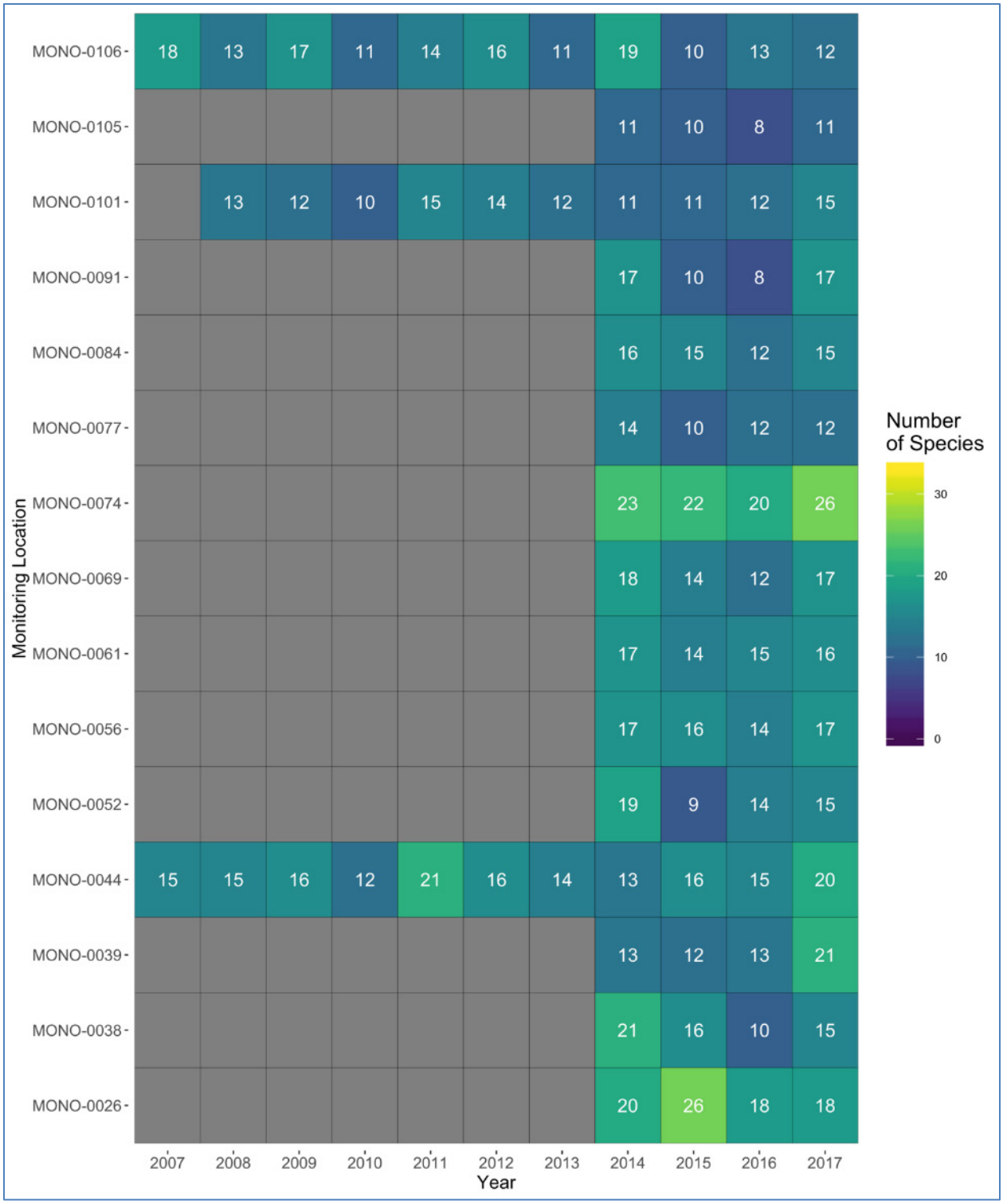


Figure D-9. Number of species detected annually at each monitoring location – Monocacy National Battlefield Park. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-9.

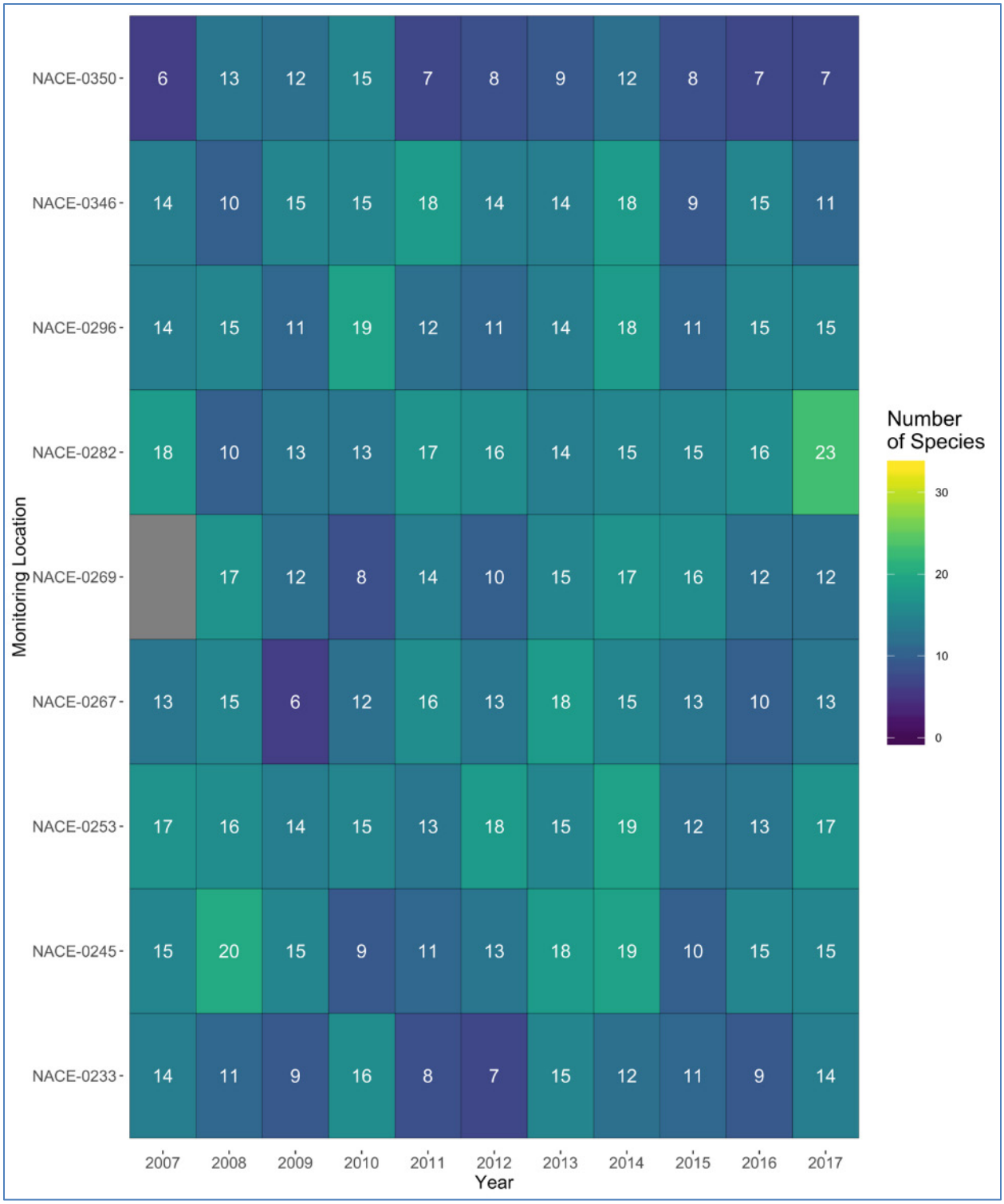


Figure D-10. Number of species detected annually at each monitoring location – National Capital Parks – East. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-10.

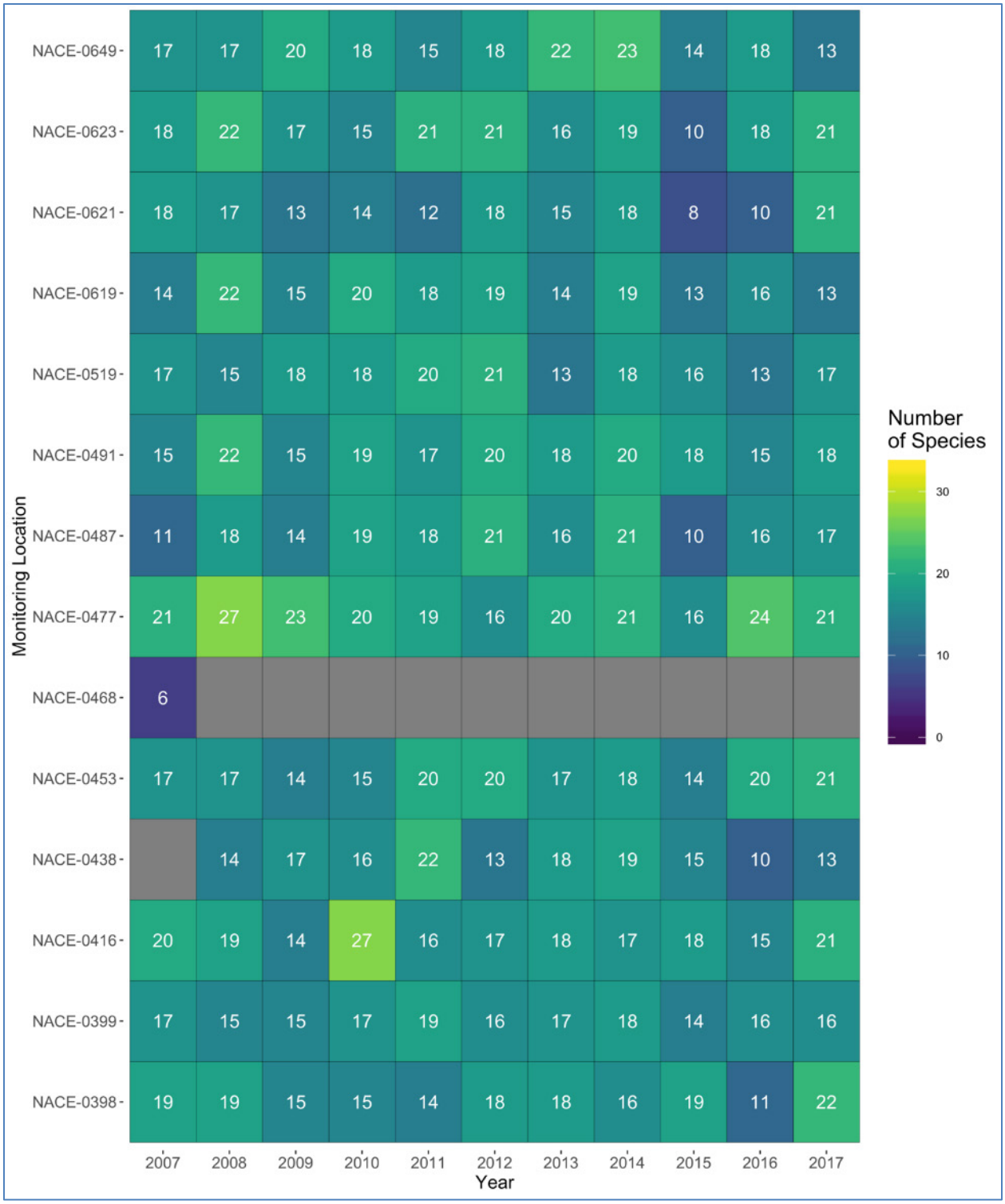


Figure D-11. Number of species detected annually at each monitoring location – Piscataway/Fort Washington. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-11.

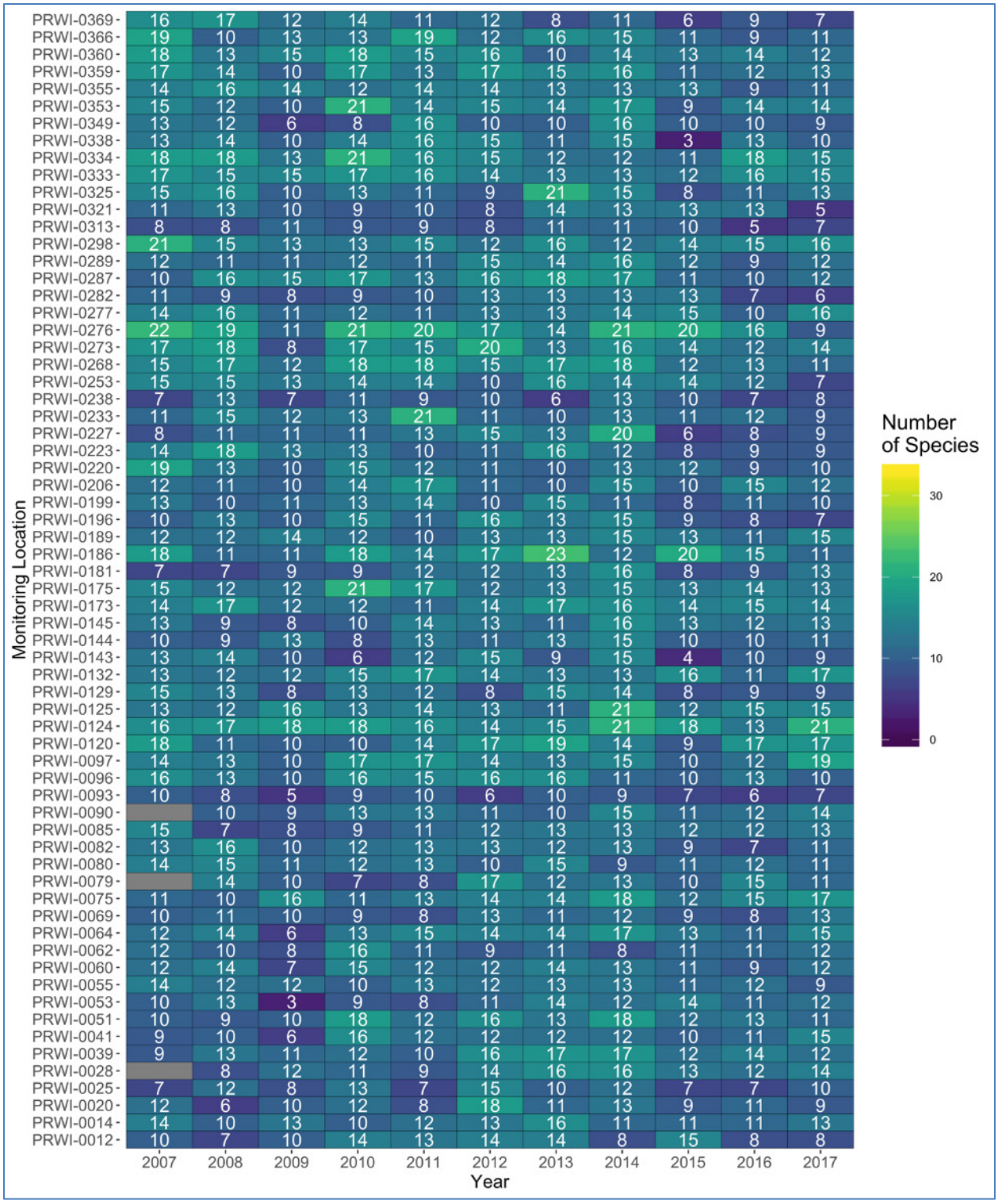


Figure D-12. Number of species detected annually at each monitoring location – Prince William Forest Park (Part 1). Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-12.

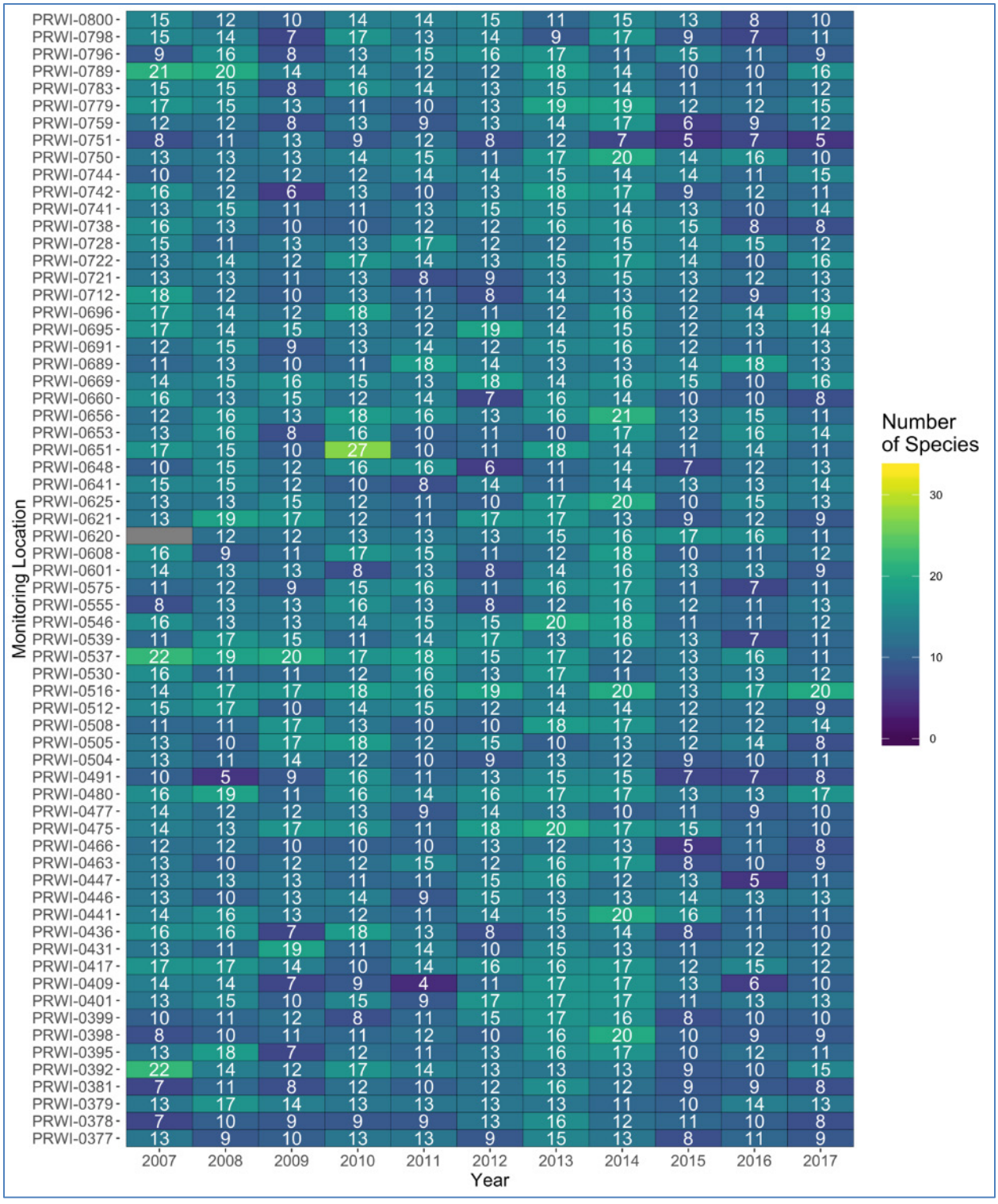


Figure D-13. Number of species detected annually at each monitoring location – Prince William Forest Park (Part 2). Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-13.

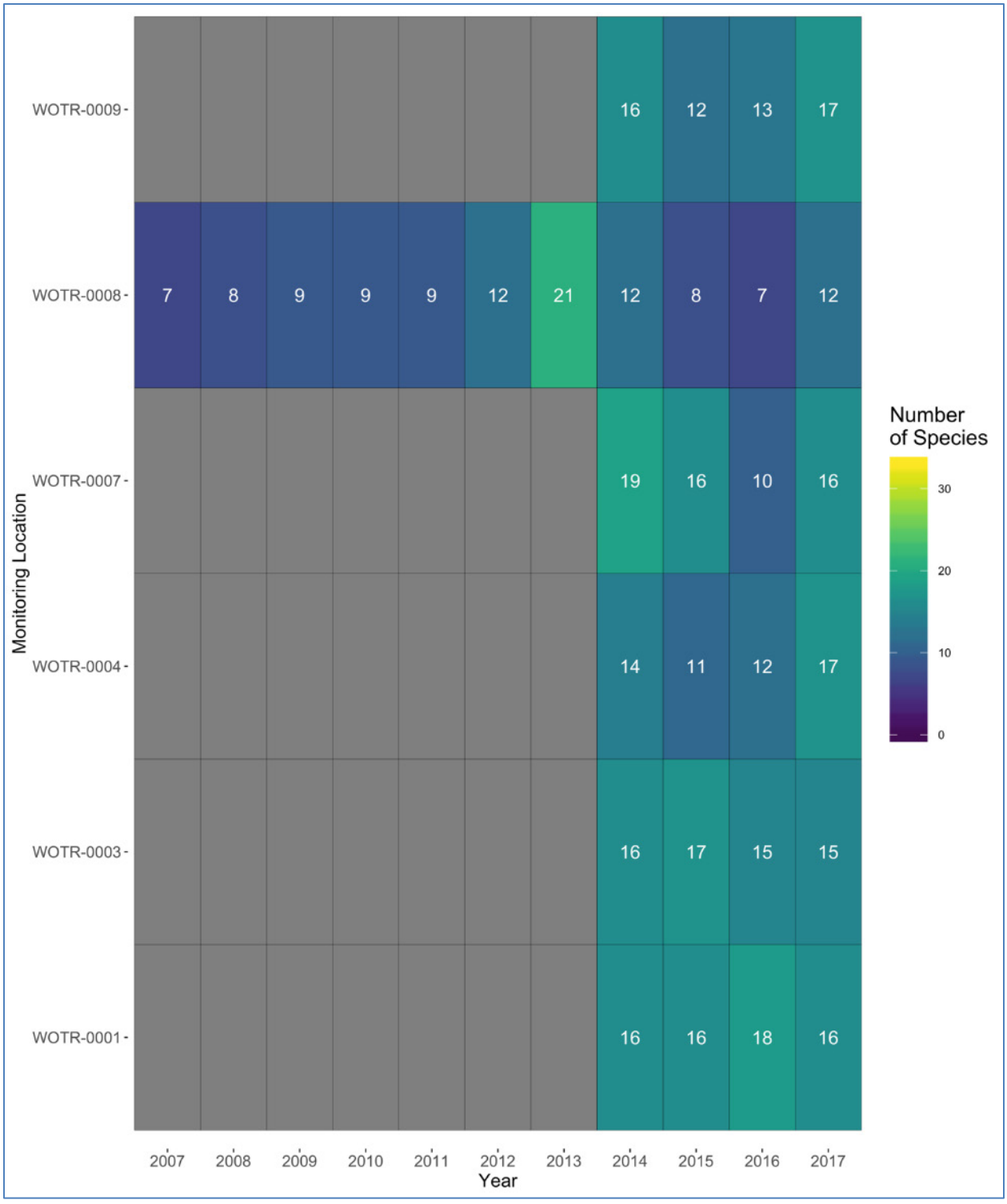


Figure D-14. Number of species detected annually at each monitoring location – Wolf Trap National Park for the Performing Arts. Blue and Yellow indicate lower and higher numbers of species, respectively. Gray cells, with no numbers, show where monitoring locations were not visited. This information is duplicated in Table D-14.

Table D-1. Number of species detected annually at each monitoring location – Antietam National Battlefield. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-1.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
ANTI-0207	17	19	14	19	19	15	20	17	17	17	16
ANTI-0206	NA	NA	NA	NA	NA	NA	NA	19	15	21	12
ANTI-0201	NA	NA	NA	NA	NA	NA	NA	23	16	20	18
ANTI-0200	NA	NA	NA	NA	NA	NA	NA	17	15	16	16
ANTI-0194	NA	NA	NA	NA	NA	NA	NA	17	17	16	13
ANTI-0190	23	20	16	20	23	17	20	17	14	24	16
ANTI-0185	23	22	16	22	21	21	22	18	21	17	16
ANTI-0092	22	19	15	18	16	18	23	22	18	17	20
ANTI-0082	NA	NA	NA	NA	NA	NA	NA	18	16	12	12
ANTI-0078	19	17	15	18	18	15	22	20	13	12	15
ANTI-0072	14	13	10	11	11	8	16	19	13	14	14
ANTI-0052	NA	NA	NA	NA	NA	NA	NA	23	12	12	16
ANTI-0036	NA	NA	NA	NA	NA	NA	NA	21	16	18	18
ANTI-0025	NA	NA	NA	NA	NA	NA	NA	16	15	11	11

Table D-2. Number of species detected annually at each monitoring location – Catoctin Mountain Park. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-2.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CATO-0365	6	7	3	4	6	13	3	8	5	7	6
CATO-0359	9	14	12	10	9	13	15	13	13	17	13
CATO-0347	10	8	14	12	6	17	16	15	10	12	10
CATO-0346	7	8	12	9	11	8	14	9	10	13	12
CATO-0342	16	13	11	15	12	12	13	16	12	12	14
CATO-0333	9	7	8	7	11	10	10	7	9	11	9
CATO-0331	15	14	8	10	16	11	18	14	11	15	14
CATO-0330	14	13	16	13	19	16	18	15	19	16	16
CATO-0323	11	13	9	11	10	9	17	12	10	11	10
CATO-0316	13	6	8	7	7	13	9	8	5	16	14
CATO-0313	8	12	4	11	12	9	13	14	13	11	9
CATO-0311	17	18	14	16	18	14	15	14	7	14	17
CATO-0303	13	14	11	14	9	13	14	11	9	14	12
CATO-0302	15	7	13	9	8	16	15	10	10	9	10
CATO-0294	19	17	11	18	12	20	19	14	12	11	18
CATO-0280	12	8	9	16	11	16	16	15	12	11	12
CATO-0275	11	12	10	7	13	10	14	16	9	12	9
CATO-0271	22	18	11	20	20	18	18	21	15	15	17
CATO-0268	17	15	9	10	14	13	17	17	13	11	15
CATO-0258	16	9	11	10	14	12	13	7	11	15	20
CATO-0242	18	10	12	12	11	11	14	11	9	9	18
CATO-0238	7	12	7	8	7	11	13	7	7	10	8
CATO-0237	10	10	9	11	11	15	10	15	10	8	11
CATO-0211	13	12	8	10	10	9	10	8	10	14	11
CATO-0206	10	11	10	14	10	9	12	12	6	13	10
CATO-0176	18	15	8	13	12	12	13	16	10	9	12
CATO-0160	13	12	5	9	12	15	9	9	9	12	8
CATO-0158	14	12	12	13	12	10	14	12	11	17	16
CATO-0153	22	13	14	13	18	12	20	12	15	8	12

Table D-2 (continued). Number of species detected annually at each monitoring location – Catoctin Mountain Park. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-2.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CATO-0150	15	10	12	13	8	15	11	12	9	9	9
CATO-0104	13	11	15	13	12	5	15	12	9	14	7
CATO-0101	11	11	15	14	8	14	13	14	13	9	13
CATO-0098	9	11	10	14	12	10	13	13	12	11	13
CATO-0094	8	10	11	12	12	12	11	16	10	14	12
CATO-0092	16	9	15	14	11	12	18	18	10	11	10
CATO-0086	14	17	16	18	16	9	13	14	12	15	13
CATO-0084	13	8	12	13	15	9	12	20	16	17	15
CATO-0062	14	8	9	12	12	16	12	13	10	12	9
CATO-0049	18	12	10	15	7	10	12	11	11	9	11
CATO-0037	14	17	12	18	10	11	19	10	12	13	14
CATO-0035	8	9	9	14	10	10	16	11	15	13	11
CATO-0022	19	16	11	13	16	10	13	17	15	16	15
CATO-0016	12	11	11	11	13	15	23	16	22	16	15
CATO-0004	11	10	14	17	12	16	9	13	9	12	17
CATO-0003	16	8	12	17	10	14	18	11	14	13	16

Table D-3. Number of species detected annually at each monitoring location – C&O Canal National Historical Park (Part 1). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-3.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CHOH-0856	15	19	18	14	24	14	20	20	12	19	14
CHOH-0847	NA	19	13	19	25	20	19	23	19	20	18
CHOH-0832	20	22	21	23	21	13	19	24	18	16	17
CHOH-0812	NA	29	18	21	22	19	23	30	21	21	25
CHOH-0806	NA	17	10	21	19	16	18	22	17	17	22
CHOH-0795	NA	20	11	21	21	15	24	23	16	15	24
CHOH-0788	20	13	12	18	20	20	17	22	16	17	19
CHOH-0755	20	24	16	21	22	17	16	23	11	16	13
CHOH-0697	NA	NA	NA	17	NA	NA	NA	NA	NA	NA	NA
CHOH-0679	15	21	11	16	23	15	24	16	15	12	14
CHOH-0677	22	24	16	20	23	16	27	23	19	15	24
CHOH-0666	19	17	13	23	17	14	18	22	9	15	17
CHOH-0661	15	19	7	20	13	14	23	18	13	16	15
CHOH-0609	19	18	20	20	18	15	20	23	11	13	17
CHOH-0586	21	21	15	15	15	14	20	22	15	12	15
CHOH-0577	22	15	7	18	16	11	22	21	15	14	18
CHOH-0539	19	21	17	22	21	11	16	24	16	12	16
CHOH-0489	19	14	14	18	17	13	15	18	11	14	14
CHOH-0487	15	15	12	17	20	17	15	19	16	14	10
CHOH-0458	NA	NA	NA	NA	NA	NA	NA	NA	NA	13	NA
CHOH-0443	16	11	17	11	10	15	16	15	9	11	13
CHOH-0433	17	11	11	13	12	11	18	15	13	17	19
CHOH-0428	19	17	15	20	19	17	22	18	23	18	16
CHOH-0407	17	23	15	15	19	16	19	24	23	18	21
CHOH-0389	14	17	15	20	15	14	20	19	17	15	14
CHOH-0380	18	20	12	22	17	8	23	22	15	22	22
CHOH-0360	22	20	12	20	18	14	21	20	18	13	26
CHOH-0286	16	25	14	23	18	16	20	18	16	22	20
CHOH-0281	19	21	17	20	14	17	24	16	19	21	18

Table D-3 (continued). Number of species detected annually at each monitoring location – C&O Canal National Historical Park (Part 1). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-3.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CHOH-0267	16	17	12	17	15	16	15	21	14	16	16
CHOH-0262	20	19	14	14	16	16	23	21	21	21	21
CHOH-0256	13	13	13	12	14	18	14	18	11	11	9
CHOH-0253	NA	20	16	15	23	16	21	21	19	19	25
CHOH-0239	14	19	17	14	17	18	19	19	22	20	14
CHOH-0198	16	15	10	20	21	17	15	33	21	19	20
CHOH-0196	20	19	18	16	21	16	21	27	19	24	13
CHOH-0106	16	9	14	18	12	17	20	22	16	17	15
CHOH-0102	16	16	10	17	17	14	14	13	15	15	17
CHOH-0081	16	19	15	18	18	15	16	18	18	19	21
CHOH-0076	17	16	13	16	18	13	14	16	15	13	13
CHOH-0074	19	22	16	19	17	17	20	18	12	12	16
CHOH-0026	20	16	13	12	17	17	17	28	15	17	16
CHOH-0012	12	13	13	12	11	11	16	20	10	7	12
CHOH-0008	21	20	8	15	18	13	18	21	21	19	20
CHOH-0006	14	15	12	14	16	10	14	14	16	14	15
CHOH-0002	18	18	13	16	21	16	20	24	14	14	21

Table D-4. Number of species detected annually at each monitoring location – C&O Canal National Historical Park (Part 2). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-4.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GWMP-0094	16	15	18	20	19	15	22	21	14	14	11
GWMP-0080	23	17	9	13	13	16	16	17	15	10	11
GWMP-0072	16	13	15	15	13	15	18	14	15	7	13
GWMP-0062	15	21	13	9	16	13	22	20	13	11	18
GWMP-0055	14	10	11	13	15	16	13	15	10	8	11
GWMP-0054	14	9	16	11	12	11	17	16	14	10	15
GWMP-0045	10	9	12	9	16	11	15	16	12	10	12
CHOH-1388	21	16	11	17	20	14	11	17	14	11	7
CHOH-1350	23	22	18	22	18	16	14	19	10	13	14
CHOH-1343	20	11	14	17	9	10	14	12	12	12	12
CHOH-1342	19	12	12	19	16	13	14	12	11	13	13
CHOH-1336	22	18	20	15	17	16	22	25	15	13	19
CHOH-1328	15	17	15	26	18	21	22	15	13	17	15
CHOH-1319	19	16	14	15	16	16	20	16	16	17	15
CHOH-1256	21	19	14	24	27	19	28	25	21	20	16
CHOH-1241	14	16	9	23	18	18	18	19	14	18	15
CHOH-1235	17	21	8	20	17	16	15	22	15	13	17
CHOH-1226	16	20	8	21	18	17	14	17	16	13	19
CHOH-1223	17	20	8	20	20	18	17	17	17	18	16
CHOH-1217	18	24	13	16	17	17	21	18	14	14	18
CHOH-1211	18	20	10	21	19	16	22	18	18	16	15
CHOH-1201	16	17	13	18	15	19	18	12	16	16	21
CHOH-1197	14	19	14	19	21	16	15	22	16	16	18
CHOH-1196	19	22	15	16	15	16	19	12	14	12	16
CHOH-1191	15	19	14	20	17	15	20	18	18	16	19
CHOH-1186	15	18	15	19	24	15	19	19	13	11	15
CHOH-1183	14	15	11	20	22	16	14	14	16	11	13
CHOH-1148	23	19	17	NA	14	15	17	22	17	16	17
CHOH-1143	19	10	14	16	19	16	15	18	16	14	15

Table D-4 (continued). Number of species detected annually at each monitoring location – C&O Canal National Historical Park (Part 2). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-4.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
CHOH-1136	13	8	11	16	14	19	14	20	17	15	16
CHOH-1124	12	11	16	13	13	20	10	14	15	11	18
CHOH-1111	23	17	17	20	15	18	27	24	17	18	23
CHOH-1081	26	20	15	21	20	21	15	21	22	17	18
CHOH-1063	17	19	17	18	16	18	16	24	16	11	18
CHOH-1055	17	9	14	17	15	14	17	16	11	14	14
CHOH-1045	19	15	17	13	15	18	20	19	17	14	20
CHOH-1044	NA	16	15	18	19	19	20	20	14	17	19
CHOH-1036	NA	18	17	14	20	15	19	18	17	18	23
CHOH-1028	20	19	8	20	17	19	23	20	18	20	21
CHOH-1018	16	19	10	24	20	26	20	20	15	19	18
CHOH-0989	13	11	4	12	17	12	17	19	19	17	18
CHOH-0986	17	16	13	16	20	17	19	21	17	19	18
CHOH-0983	20	16	16	15	23	11	16	17	20	18	17
CHOH-0961	16	22	15	13	21	22	23	20	20	22	19
CHOH-0942	13	16	21	17	13	16	14	25	15	11	13
CHOH-0941	20	19	12	21	20	15	20	20	17	10	16
CHOH-0932	19	16	18	18	15	17	17	16	19	18	14

Table D-5. Number of species detected annually at each monitoring location – George Washington Memorial Parkway. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-5.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GWMP-0307	17	12	13	20	18	14	15	13	10	9	11
GWMP-0286	19	16	11	18	17	18	17	23	16	12	6
GWMP-0256	15	12	12	15	13	19	14	16	11	9	12
GWMP-0254	9	11	11	14	12	21	10	15	10	12	14
GWMP-0253	11	9	15	15	14	10	17	17	8	13	10
GWMP-0208	15	11	13	22	18	12	15	18	11	15	16
GWMP-0207	16	10	12	15	16	12	13	16	12	13	13
GWMP-0200	NA	9	10	9	12	11	13	11	8	10	7
GWMP-0173	15	17	12	14	17	13	15	17	17	9	17
GWMP-0145	12	16	9	16	10	10	15	9	9	9	6
GWMP-0139	11	13	7	15	9	11	9	11	11	11	14
GWMP-0129	8	14	6	13	6	10	8	7	4	7	8
GWMP-0120	19	19	15	15	14	10	18	14	16	15	11
GWMP-0086	12	16	15	17	16	15	19	17	16	14	12
GWMP-0059	16	24	14	17	22	11	17	19	15	13	16
GWMP-0058	17	16	14	12	12	17	19	16	13	5	13
GWMP-0057	18	17	14	15	15	17	13	22	15	9	13
GWMP-0040	NA	14	9	7	6	10	7	9	9	9	8
GWMP-0019	16	22	15	20	19	17	12	21	16	15	14
GWMP-0008	14	15	14	15	14	8	14	16	13	9	15

Table D-6. Number of species detected annually at each monitoring location – Greenbelt National Park. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-6.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NACE-0131	9	18	17	16	14	12	14	14	9	11	14
NACE-0107	14	22	14	15	20	14	15	16	16	14	14
NACE-0094	11	20	16	12	14	15	12	16	12	9	18
NACE-0087	15	19	12	13	11	10	14	16	10	7	13
NACE-0086	18	19	17	17	14	15	11	18	12	10	20
NACE-0081	8	13	10	12	11	12	7	13	3	7	10
NACE-0080	14	23	13	14	16	17	12	18	13	9	15

Table D-7. Number of species detected annually at each monitoring location – Harpers Ferry National Historical Park. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-7.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
HAFE-0218	15	13	5	13	15	10	20	21	17	11	16
HAFE-0208	18	17	8	12	16	15	20	15	16	11	9
HAFE-0195	12	11	6	14	13	18	14	17	16	16	8
HAFE-0192	16	15	10	18	18	13	19	15	13	16	14
HAFE-0174	15	12	16	16	14	15	18	13	13	13	18
HAFE-0160	22	17	16	17	13	17	23	12	14	14	14
HAFE-0154	17	20	14	13	18	14	18	11	13	16	18
HAFE-0133	20	16	12	18	14	17	19	16	15	19	11
HAFE-0118	17	16	13	12	15	13	16	15	9	15	10
HAFE-0083	14	18	14	18	12	20	17	19	14	19	12
HAFE-0074	12	7	10	15	11	16	13	18	15	10	11
HAFE-0061	16	17	13	15	12	15	17	10	7	16	18
HAFE-0053	NA	21	24	20	15	15	20	21	20	20	21
HAFE-0044	NA	27	18	27	16	21	24	20	18	19	16
HAFE-0042	14	22	20	16	14	17	20	23	17	17	18
HAFE-0039	13	8	13	11	20	12	21	14	12	14	10
HAFE-0030	12	16	16	14	16	13	15	15	16	15	15
HAFE-0028	17	12	12	15	16	14	20	15	12	17	17
HAFE-0021	21	10	17	18	16	12	14	15	14	16	12
HAFE-0009	16	16	17	14	16	13	17	13	13	14	13

Table D-8. Number of species detected annually at each monitoring location – Manassas National Battlefield Park. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-8.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MANA-0253	16	15	16	16	15	17	14	21	16	11	15
MANA-0243	NA	17	16	23	18	15	14	18	11	14	19
MANA-0240	18	16	16	19	20	19	15	18	12	13	16
MANA-0229	18	17	20	17	17	17	17	26	12	12	15
MANA-0223	20	16	16	19	20	16	16	27	12	16	14
MANA-0218	16	13	10	17	8	14	19	17	10	12	13
MANA-0205	12	13	15	14	14	17	16	21	13	9	14
MANA-0202	16	13	11	12	13	14	16	28	12	12	20
MANA-0170	16	13	16	14	15	14	13	17	13	12	19
MANA-0163	12	14	13	18	13	18	13	15	12	7	10
MANA-0131	18	16	15	18	14	17	15	18	10	16	17
MANA-0119	13	18	9	18	17	14	16	19	13	14	16
MANA-0106	16	11	11	14	11	17	11	12	10	15	10
MANA-0094	18	24	15	21	18	20	23	25	11	19	18
MANA-0091	17	17	12	15	20	23	21	25	18	14	20
MANA-0067	10	11	9	13	16	10	12	14	11	15	9
MANA-0060	13	11	15	19	16	15	16	16	15	14	15
MANA-0054	17	17	12	13	15	15	19	20	14	16	14
MANA-0039	16	19	16	21	17	15	19	14	8	NA	11
MANA-0030	15	18	17	15	22	19	16	17	19	15	15
MANA-0027	19	16	21	19	19	12	21	19	14	12	10
MANA-0025	18	16	14	16	18	19	18	17	20	8	17
MANA-0011	17	17	12	18	22	15	17	17	10	11	15
MANA-0002	13	12	11	18	15	11	19	22	15	13	13

Table D-9. Number of species detected annually at each monitoring location – Monocacy National Battlefield Park. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-9.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
MONO-0106	18	13	17	11	14	16	11	19	10	13	12
MONO-0105	NA	NA	NA	NA	NA	NA	NA	11	10	8	11
MONO-0101	NA	13	12	10	15	14	12	11	11	12	15
MONO-0091	NA	NA	NA	NA	NA	NA	NA	17	10	8	17
MONO-0084	NA	NA	NA	NA	NA	NA	NA	16	15	12	15
MONO-0077	NA	NA	NA	NA	NA	NA	NA	14	10	12	12
MONO-0074	NA	NA	NA	NA	NA	NA	NA	23	22	20	26
MONO-0069	NA	NA	NA	NA	NA	NA	NA	18	14	12	17
MONO-0061	NA	NA	NA	NA	NA	NA	NA	17	14	15	16
MONO-0056	NA	NA	NA	NA	NA	NA	NA	17	16	14	17
MONO-0052	NA	NA	NA	NA	NA	NA	NA	19	9	14	15
MONO-0044	15	15	16	12	21	16	14	13	16	15	20
MONO-0039	NA	NA	NA	NA	NA	NA	NA	13	12	13	21
MONO-0038	NA	NA	NA	NA	NA	NA	NA	21	16	10	15
MONO-0026	NA	NA	NA	NA	NA	NA	NA	20	26	18	18

Table D-10. Number of species detected annually at each monitoring location – National Capital Parks – East. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-10.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NACE-0350	6	13	12	15	7	8	9	12	8	7	7
NACE-0346	14	10	15	15	18	14	14	18	9	15	11
NACE-0296	14	15	11	19	12	11	14	18	11	15	15
NACE-0282	18	10	13	13	17	16	14	15	15	16	23
NACE-0269	NA	17	12	8	14	10	15	17	16	12	12
NACE-0267	13	15	6	12	16	13	18	15	13	10	13
NACE-0253	17	16	14	15	13	18	15	19	12	13	17
NACE-0245	15	20	15	9	11	13	18	19	10	15	15
NACE-0233	14	11	9	16	8	7	15	12	11	9	14

Table D-11. Number of species detected annually at each monitoring location – Piscataway/Fort Washington. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-11.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
NACE-0649	17	17	20	18	15	18	22	23	14	18	13
NACE-0623	18	22	17	15	21	21	16	19	10	18	21
NACE-0621	18	17	13	14	12	18	15	18	8	10	21
NACE-0619	14	22	15	20	18	19	14	19	13	16	13
NACE-0519	17	15	18	18	20	21	13	18	16	13	17
NACE-0491	15	22	15	19	17	20	18	20	18	15	18
NACE-0487	11	18	14	19	18	21	16	21	10	16	17
NACE-0477	21	27	23	20	19	16	20	21	16	24	21
NACE-0468	6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
NACE-0453	17	17	14	15	20	20	17	18	14	20	21
NACE-0438	NA	14	17	16	22	13	18	19	15	10	13
NACE-0416	20	19	14	27	16	17	18	17	18	15	21
NACE-0399	17	15	15	17	19	16	17	18	14	16	16
NACE-0398	19	19	15	15	14	18	18	16	19	11	22

Table D-12. Number of species detected annually at each monitoring location – Prince William Forest Park (Part 1). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-12.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PRWI-0369	16	17	12	14	11	12	8	11	6	9	7
PRWI-0366	19	10	13	13	19	12	16	15	11	9	11
PRWI-0360	18	13	15	18	15	16	10	14	13	14	12
PRWI-0359	17	14	10	17	13	17	15	16	11	12	13
PRWI-0355	14	16	14	12	14	14	13	13	13	9	11
PRWI-0353	15	12	10	21	14	15	14	17	9	14	14
PRWI-0349	13	12	6	8	16	10	10	16	10	10	9
PRWI-0338	13	14	10	14	16	15	11	15	3	13	10
PRWI-0334	18	18	13	21	16	15	12	12	11	18	15
PRWI-0333	17	15	15	17	16	14	13	13	12	16	15
PRWI-0325	15	16	10	13	11	9	21	15	8	11	13
PRWI-0321	11	13	10	9	10	8	14	13	13	13	5
PRWI-0313	8	8	11	9	9	8	11	11	10	5	7
PRWI-0298	21	15	13	13	15	12	16	12	14	15	16
PRWI-0289	12	11	11	12	11	15	14	16	12	9	12
PRWI-0287	10	16	15	17	13	16	18	17	11	10	12
PRWI-0282	11	9	8	9	10	13	13	13	13	7	6
PRWI-0277	14	16	11	12	11	13	13	14	15	10	16
PRWI-0276	22	19	11	21	20	17	14	21	20	16	9
PRWI-0273	17	18	8	17	15	20	13	16	14	12	14
PRWI-0268	15	17	12	18	18	15	17	18	12	13	11
PRWI-0253	15	15	13	14	14	10	16	14	14	12	7
PRWI-0238	7	13	7	11	9	10	6	13	10	7	8
PRWI-0233	11	15	12	13	21	11	10	13	11	12	9
PRWI-0227	8	11	11	11	13	15	13	20	6	8	9
PRWI-0223	14	18	13	13	10	11	16	12	8	9	9
PRWI-0220	19	13	10	15	12	11	10	13	12	9	10
PRWI-0206	12	11	10	14	17	11	10	15	10	15	12
PRWI-0199	13	10	11	13	14	10	15	11	8	11	10

Table D-12 (continued). Number of species detected annually at each monitoring location – Prince William Forest Park (Part 1). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-12.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PRWI-0196	10	13	10	15	11	16	13	15	9	8	7
PRWI-0189	12	12	14	12	10	13	13	15	13	11	15
PRWI-0186	18	11	11	18	14	17	23	12	20	15	11
PRWI-0181	7	7	9	9	12	12	13	16	8	9	13
PRWI-0175	15	12	12	21	17	12	13	15	13	14	13
PRWI-0173	14	17	12	12	11	14	17	16	14	15	14
PRWI-0145	13	9	8	10	14	13	11	16	13	12	13
PRWI-0144	10	9	13	8	13	11	13	15	10	10	11
PRWI-0143	13	14	10	6	12	15	9	15	4	10	9
PRWI-0132	13	12	12	15	17	14	13	13	16	11	17
PRWI-0129	15	13	8	13	12	8	15	14	8	9	9
PRWI-0125	13	12	16	13	14	13	11	21	12	15	15
PRWI-0124	16	17	18	18	16	14	15	21	18	13	21
PRWI-0120	18	11	10	10	14	17	19	14	9	17	17
PRWI-0097	14	13	10	17	17	14	13	15	10	12	19
PRWI-0096	16	13	10	16	15	16	16	11	10	13	10
PRWI-0093	10	8	5	9	10	6	10	9	7	6	7
PRWI-0090	NA	10	9	13	13	11	10	15	11	12	14
PRWI-0085	15	7	8	9	11	12	13	13	12	12	13
PRWI-0082	13	16	10	12	13	13	12	13	9	7	11
PRWI-0080	14	15	11	12	13	10	15	9	11	12	11
PRWI-0079	NA	14	10	7	8	17	12	13	10	15	11
PRWI-0075	11	10	16	11	13	14	14	18	12	15	17
PRWI-0069	10	11	10	9	8	13	11	12	9	8	13
PRWI-0064	12	14	6	13	15	14	14	17	13	11	15
PRWI-0062	12	10	8	16	11	9	11	8	11	11	12
PRWI-0060	12	14	7	15	12	12	14	13	11	9	12
PRWI-0055	14	12	12	10	13	12	13	13	11	12	9
PRWI-0053	10	13	3	9	8	11	14	12	14	11	12

Table D-12 (continued). Number of species detected annually at each monitoring location – Prince William Forest Park (Part 1). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-12.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PRWI-0051	10	9	10	18	12	16	13	18	12	13	11
PRWI-0041	9	10	6	16	12	12	12	12	10	11	15
PRWI-0039	9	13	11	12	10	16	17	17	12	14	12
PRWI-0028	NA	8	12	11	9	14	16	16	13	12	14
PRWI-0025	7	12	8	13	7	15	10	12	7	7	10
PRWI-0020	12	6	10	12	8	18	11	13	9	11	9
PRWI-0014	14	10	13	10	12	13	16	11	11	11	13
PRWI-0012	10	7	10	14	13	14	14	8	15	8	8

Table D-13. Number of species detected annually at each monitoring location – Prince William Forest Park (Part 2). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-13.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PRWI-0800	15	12	10	14	14	15	11	15	13	8	10
PRWI-0798	15	14	7	17	13	14	9	17	9	7	11
PRWI-0796	9	16	8	13	15	16	17	11	15	11	9
PRWI-0789	21	20	14	14	12	12	18	14	10	10	16
PRWI-0783	15	15	8	16	14	13	15	14	11	11	12
PRWI-0779	17	15	13	11	10	13	19	19	12	12	15
PRWI-0759	12	12	8	13	9	13	14	17	6	9	12
PRWI-0751	8	11	13	9	12	8	12	7	5	7	5
PRWI-0750	13	13	13	14	15	11	17	20	14	16	10
PRWI-0744	10	12	12	12	14	14	15	14	14	11	15
PRWI-0742	16	12	6	13	10	13	18	17	9	12	11
PRWI-0741	13	15	11	11	13	15	15	14	13	10	14
PRWI-0738	16	13	10	10	12	12	16	16	15	8	8
PRWI-0728	15	11	13	13	17	12	12	15	14	15	12
PRWI-0722	13	14	12	17	14	13	15	17	14	10	16
PRWI-0721	13	13	11	13	8	9	13	15	13	12	13
PRWI-0712	18	12	10	13	11	8	14	13	12	9	13
PRWI-0696	17	14	12	18	12	11	12	16	12	14	19
PRWI-0695	17	14	15	13	12	19	14	15	12	13	14
PRWI-0691	12	15	9	13	14	12	15	16	12	11	13
PRWI-0689	11	13	10	11	18	14	13	13	14	18	13
PRWI-0669	14	15	16	15	13	18	14	16	15	10	16
PRWI-0660	16	13	15	12	14	7	16	14	10	10	8
PRWI-0656	12	16	13	18	16	13	16	21	13	15	11
PRWI-0653	13	16	8	16	10	11	10	17	12	16	14
PRWI-0651	17	15	10	27	10	11	18	14	11	14	11
PRWI-0648	10	15	12	16	16	6	11	14	7	12	13
PRWI-0641	15	15	12	10	8	14	11	14	13	13	14
PRWI-0625	13	13	15	12	11	10	17	20	10	15	13

Table D-13 (continued). Number of species detected annually at each monitoring location – Prince William Forest Park (Part 2). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-13.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PRWI-0621	13	19	17	12	11	17	17	13	9	12	9
PRWI-0620	NA	12	12	13	13	13	15	16	17	16	11
PRWI-0608	16	9	11	17	15	11	12	18	10	11	12
PRWI-0601	14	13	13	8	13	8	14	16	13	13	9
PRWI-0575	11	12	9	15	16	11	16	17	11	7	11
PRWI-0555	8	13	13	16	13	8	12	16	12	11	13
PRWI-0546	16	13	13	14	15	15	20	18	11	11	12
PRWI-0539	11	17	15	11	14	17	13	16	13	7	11
PRWI-0537	22	19	20	17	18	15	17	12	13	16	11
PRWI-0530	16	11	11	12	16	13	17	11	13	13	12
PRWI-0516	14	17	17	18	16	19	14	20	13	17	20
PRWI-0512	15	17	10	14	15	12	14	14	12	12	9
PRWI-0508	11	11	17	13	10	10	18	17	12	12	14
PRWI-0505	13	10	17	18	12	15	10	13	12	14	8
PRWI-0504	13	11	14	12	10	9	13	12	9	10	11
PRWI-0491	10	5	9	16	11	13	15	15	7	7	8
PRWI-0480	16	19	11	16	14	16	17	17	13	13	17
PRWI-0477	14	12	12	13	9	14	13	10	11	9	10
PRWI-0475	14	13	17	16	11	18	20	17	15	11	10
PRWI-0466	12	12	10	10	10	13	12	13	5	11	8
PRWI-0463	13	10	12	12	15	12	16	17	8	10	9
PRWI-0447	13	13	13	11	11	15	16	12	13	5	11
PRWI-0446	13	10	13	14	9	15	13	13	14	13	13
PRWI-0441	14	16	13	12	11	14	15	20	16	11	11
PRWI-0436	16	16	7	18	13	8	13	14	8	11	10
PRWI-0431	13	11	19	11	14	10	15	13	11	12	12
PRWI-0417	17	17	14	10	14	16	16	17	12	15	12
PRWI-0409	14	14	7	9	4	11	17	17	13	6	10
PRWI-0401	13	15	10	15	9	17	17	17	11	13	13

Table D-13 (continued). Number of species detected annually at each monitoring location – Prince William Forest Park (Part 2). NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-13.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PRWI-0399	10	11	12	8	11	15	17	16	8	10	10
PRWI-0398	8	10	11	11	12	10	16	20	10	9	9
PRWI-0395	13	18	7	12	11	13	16	17	10	12	11
PRWI-0392	22	14	12	17	14	13	13	13	9	10	15
PRWI-0381	7	11	8	12	10	12	16	12	9	9	8
PRWI-0379	13	17	14	13	13	13	13	11	10	14	13
PRWI-0378	7	10	9	9	9	13	16	12	11	10	8
PRWI-0377	13	9	10	13	13	9	15	13	8	11	9

Table D-14. Number of species detected annually at each monitoring location – Wolf Trap National Park for the Performing Arts. NAs represent monitoring locations that were not visited in a given year. This information is duplicated in Figure D-14.

Monitoring Location	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
WOTR-0009	NA	NA	NA	NA	NA	NA	NA	16	12	13	17
WOTR-0008	7	8	9	9	9	12	21	12	8	7	12
WOTR-0007	NA	NA	NA	NA	NA	NA	NA	19	16	10	16
WOTR-0004	NA	NA	NA	NA	NA	NA	NA	14	11	12	17
WOTR-0003	NA	NA	NA	NA	NA	NA	NA	16	17	15	15
WOTR-0001	NA	NA	NA	NA	NA	NA	NA	16	16	18	16

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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