Birds and Climate Change

National Park Service
U.S. Department of the Interior

Fredericksburg and Spotsylvania National Military Park

Background

Birds are useful indicators of ecological change because they are highly mobile and generally conspicuous. As climate in a particular place changes, suitability may worsen for some species and improve for others. These changes in climate may create the potential for local extirpation or new colonization. **This brief summarizes projected changes in climate suitability by mid-century for birds at Fredericksburg and Spotsylvania National Military Park (hereafter, the Park) under two climate change scenarios (see Wu et al. 2018 for full results, and Langham et al. 2015 for more information regarding how climate suitability is characterized).** The high-emissions pathway (RCP8.5) represents a future in which little action is taken to reduce global emissions of greenhouse gases. The low-emissions pathway (RCP2.6) is a best-case scenario of aggressive efforts to reduce emissions. These emissions pathways are globally standardized and established by the Intergovernmental Panel on Climate Change for projecting future climate change. The findings below are model-based projections of how species distributions may change in response to climate change. A 10-km buffer was applied to each park to match the spatial resolution of the species distribution models (10 x 10 km), and climate suitability was taken as the average of all cells encompassed by the park and buffer.

IMPORTANT

This study focuses exclusively on changing climatic conditions for birds over time. But projected changes in climate suitability are not definitive predictions of future species ranges or abundances. Numerous other factors affect where species occur, including habitat quality, food abundance, species adaptability, and the availability of microclimates (see Caveats). Therefore, managers should consider changes in climate suitability alongside these other important influences.

We report trends in climate suitability for all species identified as currently present at the Park based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Park is projected to become suitable in the future (Figure 1 & Table 1). This brief provides park-specific projections whereas Wu et al. (2018), which did not incorporate park-specific species data and thus may differ from this brief, provides system-wide comparison and conclusions.

Results

Climate change is expected to alter the bird community at the Park, with greater impacts under the high-emissions pathway than under the low-emissions pathway (Figure 1). Among the species likely to be found at the Park today, climate suitability in summer under the high-emissions pathway is projected to improve for 16, remain stable for 24, and worsen for 17 species. Suitable climate ceases to occur for 19 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 21 species not found at the Park today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 45, remain stable for 18, and worsen for 11 species. Suitable climate ceases to occur for 5 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 47 species not found at the Park today, potentially resulting in local colonization.

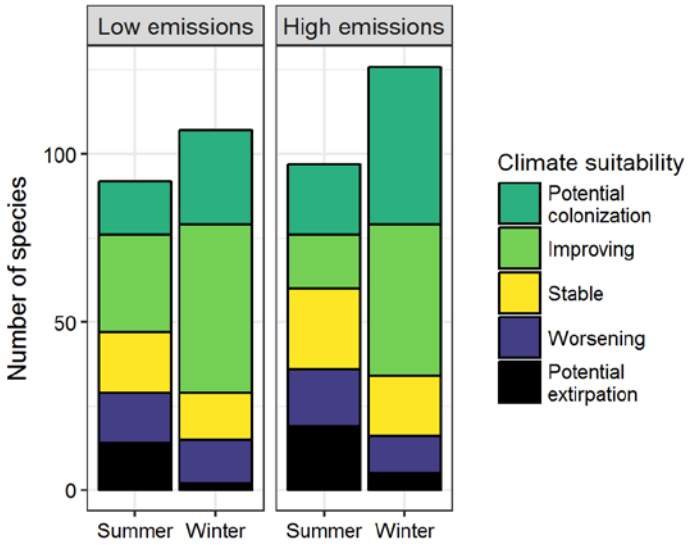

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.21 in summer (33rd percentile across all national parks) and 0.24 in winter (36th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.15 in winter under the low-emissions pathway. Turnover index was calculated based on the theoretical proportions of potential extirpations and potential colonizations by 2050 relative to today (as reported in Wu et al. 2018), and therefore assumes that all potential extirpations and colonizations are realized. According to this index, no change would be represented as 0, whereas a complete change in the bird community would be represented as 1.

Climate Sensitive Species

The Park is or may become home to 9 species that are highly sensitive to climate change across their range (i.e., they are projected to lose climate suitability in over 50% of their current range in North America in summer and/or winter by 2050; Table 1; Langham et al. 2015). While the Park may serve as an important refuge for 7 of these climate-sensitive species, 2 might be extirpated from the Park in at least one season by 2050.

Figure 2. Although currently found at the Park, suitable climate for the American Goldfinch (*Spinus tristis*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by John Benson/Flickr (CC BY 2.0).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Fredericksburg and Spotsylvania National Military Park falls within the intermediate change group.** Parks anticipating intermediate change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 7 species that are highly sensitive to climate change across their range (Table 1; Langham et al. 2015) but for which the park is a potential refuge. Monitoring to identify changes in bird communities will inform the selection of appropriate management responses.

Caveats

The species distribution models included in this study are based solely on climate variables (i.e., a combination of annual and seasonal measures of temperature and precipitation), which means there are limits on their interpretation. Significant changes in climate suitability, as measured here, will not always result in a species response, and all projections should be interpreted as potential trends. Multiple other factors mediate responses to climate change, including habitat availability, ecological processes that affect demography, biotic interactions that inhibit and facilitate species' colonization or extirpation, dispersal capacity, species' evolutionary adaptive capacity, and phenotypic plasticity (e.g., behavioral adjustments). Ultimately, models can tell us where to focus our concern and which species are most likely to be affected, but monitoring is the only way to validate these projections and should inform any on-the-ground conservation action.

More Information

For more information, including details on the methods, please see the scientific publication (Wu et al. 2018) and the project overview brief, and visit the NPS Climate Change Response Program website.

References

eBird Basic Dataset (2016) Version: ebd_relAug-2016. Cornell Lab of Ornithology, Ithaca, New York.

Langham et al. (2015) Conservation Status of North American Birds in the Face of Future Climate Change. PLOS ONE.

Wu et al. (2018) Projected avifaunal responses to climate change across the U.S. National Park System. PLOS ONE.

Contacts

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

Species Projections

Table 1. Climate suitability projections by 2050 under the high-emissions pathway for all birds currently present at the Park based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Park is projected to become suitable in the future. "Potential colonization" indicates that climate is projected to become suitable for the species, whereas "potential extirpation" indicates that climate is suitable today but projected to become unsuitable. Omitted species were either not modeled due to data deficiency or were absent from the I&M and eBird datasets. Observations of late-season migrants may result in these species appearing as present in the park when they may only migrate through. Species are ordered according to taxonomic groups, denoted by alternating background shading.

*** Species in top and bottom 10th percentile of absolute change**

^ Species that are highly climate sensitive

- Species not found or found only occasionally, and not projected to colonize by 2050

x Species not modeled in this season

Common Name	Summer Trend	Winter Trend
Cackling/Canada Goose	x	Worsening*
Mute Swan	-	Potential extirpation
Wood Duck	x	Improving
Mallard	Potential extirpation^	Stable
Blue-winged Teal	-	Potential colonization
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Lesser Scaup	-	Improving
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Hooded Merganser	-	Improving^
Common Merganser	-	Potential extirpation
Red-breasted Merganser	-	Potential colonization^
Ruddy Duck	Improving	Improving
Northern Bobwhite	Stable	Stable

Common Name	Summer Trend	Winter Trend
Wild Turkey	-	Potential extirpation
Common Loon	-	Stable^
Pied-billed Grebe	-	Improving
Horned Grebe	-	Improving
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	-	Potential colonization
American White Pelican	-	Potential colonization
Brown Pelican	-	Potential colonization^
Great Blue Heron	Improving	Improving
Great Egret	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Green Heron	Improving	-
Black-crowned Night-Heron	-	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	-	Potential colonization
Black Vulture	Improving	Stable
Turkey Vulture	x	Improving
Osprey	-	Potential colonization
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	-	Stable
Bald Eagle	x	Stable
Red-shouldered Hawk	Improving	Improving
Red-tailed Hawk	Stable	Stable
Sora	-	Potential colonization
American Coot	-	Improving
Killdeer	Improving	Improving
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
American Woodcock	-	Improving
Ring-billed Gull	-	Improving

Common Name	Summer Trend	Winter Trend
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
Rock Pigeon	Worsening	Stable
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Improving	Worsening
Inca Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Barn Owl	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Great Horned Owl	-	Potential extirpation
Burrowing Owl	Potential colonization^	-
Common Nighthawk	Potential colonization	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Stable	-
Red-bellied Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Worsening	Worsening
Hairy Woodpecker	Potential extirpation	Worsening*
Red-cockaded Woodpecker	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Northern Flicker	Stable	Stable
Pileated Woodpecker	Improving	Improving
American Kestrel	x	Worsening*
Merlin	-	Potential colonization^
Eastern Wood-Pewee	Worsening	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	Improving
Great Crested Flycatcher	Stable	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
Loggerhead Shrike	Potential colonization	-
White-eyed Vireo	Stable	Potential colonization
Yellow-throated Vireo	Stable	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Stable
American Crow	Worsening	Stable
Fish Crow	Stable	Stable
Common Raven	Potential extirpation	-
Purple Martin	Improving	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Stable	Improving
White-breasted Nuthatch	Worsening*	Worsening*
Brown-headed Nuthatch	Potential colonization^	-
Brown Creeper	-	Worsening*

Common Name	Summer Trend	Winter Trend
House Wren	Potential extirpation	Potential colonization
Pacific/Winter Wren	-	Improving
Sedge Wren	-	Potential colonization
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Stable	Potential colonization
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Improving
Hermit Thrush	-	Improving
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	-
Brown Thrasher	Worsening	Improving*
Northern Mockingbird	Improving	Improving
European Starling	Worsening	Worsening
American Pipit	-	Potential colonization
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Worsening	-
Black-and-white Warbler	Stable	-
Swainson's Warbler	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	Potential extirpation	Potential colonization
Hooded Warbler	Improving*	-
Northern Parula	Stable	-
Pine Warbler	Potential extirpation^	-
Yellow-rumped Warbler	-	Improving
Prairie Warbler	Worsening	-
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	Potential colonization	-
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Worsening	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	-
Savannah Sparrow	-	Improving
Henslow's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	-	Worsening
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Improving
Blue Grosbeak	Worsening	-
Indigo Bunting	Stable	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Improving	Improving
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Stable	-
Baltimore Oriole	Potential extirpation	-
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Improving
Pine Siskin	-	Improving
American Goldfinch	Potential extirpation	Worsening
Evening Grosbeak	-	Stable
House Sparrow	x	Worsening*