



Appomattox Court House National Historical 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 Appomattox Court House National Historical 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.

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 8, remain stable for 17, and worsen for 13 species. Suitable climate ceases to occur for 11 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 22 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 21, remain stable for 3, and worsen for 5 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 44 species not found at the Park today, potentially resulting in local colonization.

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.

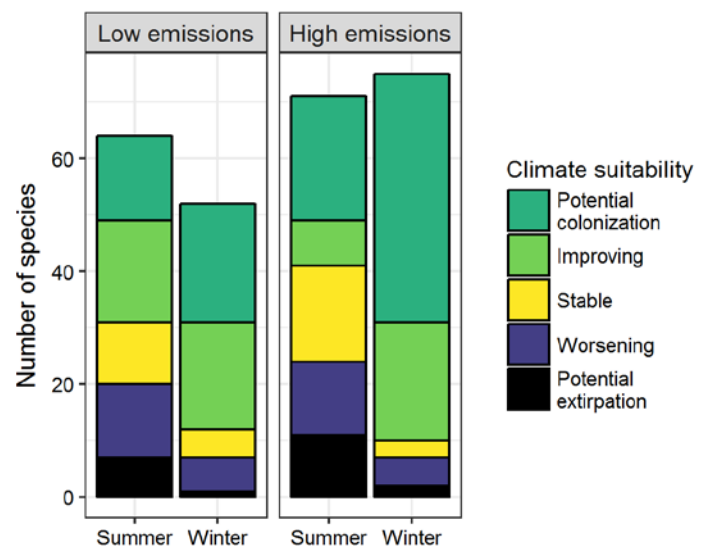


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.20 in summer (31st percentile across all national parks) and 0.21 in winter (29th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.10 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 4 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). Suitable

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Appomattox Court House National Historical Park falls within the high potential colonization group.** Parks anticipating high potential colonization can focus on actions that increase species' ability to respond to environmental change, such as increasing the amount of potential habitat, working with cooperating agencies and landowners to improve habitat

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

climate is not projected to disappear for these 4 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.



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).

connectivity for birds across boundaries, managing the disturbance regime, and possibly more intensive management actions. Furthermore, park managers have an opportunity to focus on supporting the 4 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.

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.

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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
Blue-winged Teal	-	Potential colonization
Bufflehead	-	Potential colonization
Red-breasted Merganser	-	Potential colonization [^]
Eared Grebe	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization [^]	Potential colonization
American White Pelican	-	Potential colonization
Great Egret	Potential colonization	Potential colonization
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Black-crowned Night-Heron	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	-	Potential colonization
Turkey Vulture	x	Improving
Osprey	-	Potential colonization
Mississippi Kite	Potential colonization	-
Red-shouldered Hawk	-	Improving
Red-tailed Hawk	Improving	-
Ferruginous Hawk	-	Potential colonization
Killdeer	Potential colonization	-
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Long-billed Dowitcher	-	Potential colonization
Forster's Tern	-	Potential colonization
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Worsening*
Inca Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Burrowing Owl	Potential colonization^	-
Common Nighthawk	Potential colonization	-
Chimney Swift	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Red-bellied Woodpecker	Improving	Improving
Downy Woodpecker	Stable	Worsening*
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Stable	Stable
Pileated Woodpecker	Stable	Improving
Eastern Wood-Pewee	Worsening	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	-
Western Kingbird	Potential colonization	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	-
White-eyed Vireo	Stable	Potential colonization
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Improving	Improving

Common Name	Summer Trend	Winter Trend
American Crow	Worsening	Stable
Common Raven	-	Potential extirpation
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Stable	Improving
White-breasted Nuthatch	Worsening*	Worsening*
Brown-headed Nuthatch	Potential colonization^	-
House Wren	Potential extirpation	Potential colonization
Sedge Wren	-	Potential colonization
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Improving
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Improving
Gray Catbird	-	Potential colonization
Brown Thrasher	Stable	-
Northern Mockingbird	Improving	Improving
European Starling	Worsening	-
American Pipit	-	Potential colonization
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Chestnut-collared Longspur	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	Potential extirpation	Potential colonization
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Worsening	-
Yellow-breasted Chat	Stable	-
Eastern Towhee	Worsening*	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	-
Grasshopper Sparrow	Worsening	-
Henslow's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Worsening*
Summer Tanager	Improving*	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Improving
Blue Grosbeak	Stable	-
Indigo Bunting	Stable	-
Painted Bunting	Potential colonization	-
Eastern Meadowlark	Improving	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Stable	-
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	Potential extirpation	Worsening*