Birds and Climate Change

National Park Service
U.S. Department of the Interior

Moores Creek National Battlefield

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 Moores Creek National Battlefield (hereafter, the Battlefield) 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 Battlefield based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Battlefield 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 Battlefield, 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 Battlefield today, climate suitability in summer under the high-emissions pathway is projected to improve for 7 (e.g., Figure 2), remain stable for 14, and worsen for 23 species. Suitable climate ceases to occur for 14 species in summer, potentially resulting in extirpation of those species from the Battlefield. Climate is projected to become suitable in summer for 34 species not found at the Battlefield today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 13, remain stable for 28, and worsen for 17 species. Suitable climate ceases to occur for 7 species in winter, potentially resulting in extirpation from the Battlefield. Climate is projected to become suitable in winter for 44 species not found at the Battlefield today, potentially resulting in local colonization.

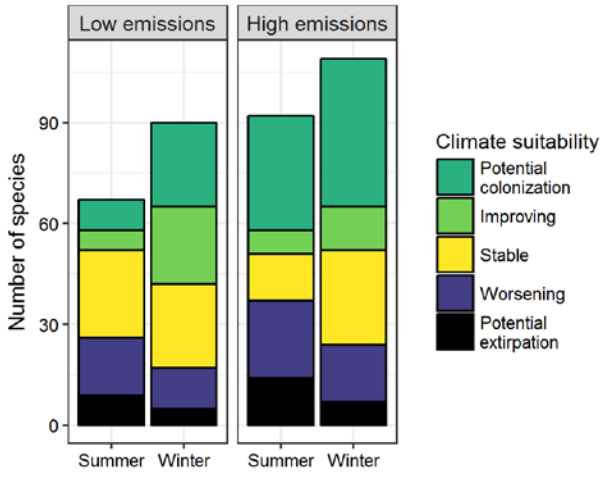

Figure 1. Projected changes in climate suitability for birds at the Battlefield, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Battlefield between the present and 2050 is 0.25 in summer (42nd percentile across all national parks) and 0.21 in winter (28th percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 in summer and 0.11 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 Battlefield is or may become home to 10 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 climate is not projected to disappear for these 10 species at the Battlefield; instead the Battlefield may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Battlefield in summer is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/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, Moores Creek National Battlefield 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 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 10 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.

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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 Battlefield based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Battlefield 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	-	Potential extirpation
Muscovy Duck	-	Potential colonization
Wood Duck	x	Stable
American Black Duck	-	Potential extirpation
Mottled Duck	Potential colonization	-
Cinnamon Teal	-	Potential colonization
Northern Bobwhite	Worsening	Worsening*
Least Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	Potential colonization^	-
Great Blue Heron	Stable	Stable
Great Egret	Improving*	Improving*
Tricolored Heron	Potential colonization^	-
Green Heron	Stable	-
Yellow-crowned Night-Heron	-	Potential colonization
White-faced Ibis	-	Potential colonization^
Roseate Spoonbill	-	Potential colonization
Black Vulture	Stable	Improving*
Turkey Vulture	x	Improving
White-tailed Kite	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Swallow-tailed Kite	Potential colonization	-
Northern Harrier	-	Worsening
Sharp-shinned Hawk	-	Potential extirpation
Cooper's Hawk	x	Stable
Harris's Hawk	Potential colonization	-
Red-shouldered Hawk	Worsening	Improving
Red-tailed Hawk	Potential extirpation	Stable
Ferruginous Hawk	-	Potential colonization
Limpkin	-	Potential colonization
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Snowy Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
American Woodcock	x	Stable
Gull-billed Tern	-	Potential colonization
Caspian Tern	-	Potential colonization
Sandwich Tern	-	Potential colonization^
White-winged Dove	Potential colonization	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Stable	-
Greater Roadrunner	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Groove-billed Ani	-	Potential colonization
Barred Owl	x	Stable
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Worsening	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Worsening	-
Black-chinned Hummingbird	Potential colonization	-
Allen's Hummingbird	-	Potential colonization
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Potential extirpation	Stable
Red-headed Woodpecker	Stable	Worsening
Golden-fronted Woodpecker	Potential colonization	-
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Worsening	Worsening
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Improving	Worsening
Pileated Woodpecker	Improving*	Worsening
Crested Caracara	Potential colonization	Potential colonization
Eastern Wood-Pewee	Potential extirpation	-
Acadian Flycatcher	Stable	-
Eastern Phoebe	-	Improving
Say's Phoebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-
Great Kiskadee	Potential colonization	-
Couch's Kingbird	-	Potential colonization
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
White-eyed Vireo	Stable	Stable
Red-eyed Vireo	Potential extirpation	-
Green Jay	Potential colonization	-
Blue Jay	Stable	Stable
American Crow	Worsening	Worsening
Fish Crow	Worsening	Stable
Northern Rough-winged Swallow	-	Potential colonization
Cliff Swallow	Potential colonization	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Worsening	Improving
Tufted Titmouse	Worsening	Worsening
Red-breasted Nuthatch	-	Improving
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Worsening^	Worsening
Brown Creeper	-	Stable
House Wren	-	Improving
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Worsening	Worsening
Hermit Thrush	-	Stable
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Worsening
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Potential extirpation	Stable
Long-billed Thrasher	Potential colonization^	-
Northern Mockingbird	Worsening	Stable
European Starling	Potential extirpation	-
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	-	Worsening
Black-and-white Warbler	-	Stable
Prothonotary Warbler	Worsening	-
Kentucky Warbler	Improving*	-
Common Yellowthroat	Potential extirpation	Worsening*
Hooded Warbler	Improving*	-
Northern Parula	Stable	Potential colonization
Palm Warbler	-	Worsening*^
Pine Warbler	Worsening*^	Stable
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	-
Prairie Warbler	Worsening*	-
Wilson's Warbler	-	Potential colonization
Eastern Towhee	Worsening*	x
Canyon Towhee	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Stable
Field Sparrow	Potential extirpation	Stable
Lark Sparrow	Potential colonization	-
Lark Bunting	-	Potential colonization
Fox Sparrow	-	Worsening*
Song Sparrow	-	Worsening
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Worsening	-
Western Tanager	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Northern Cardinal	Improving	Improving
Indigo Bunting	-	Potential colonization
Painted Bunting	-	Potential colonization
Dickcissel	Potential colonization	-
Red-winged Blackbird	Stable	Stable
Rusty Blackbird	-	Worsening*
Common Grackle	Worsening	Stable
Boat-tailed Grackle	Potential colonization^	-
Great-tailed Grackle	-	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Stable
Hooded Oriole	Potential colonization	-
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	-	Stable