Birds and Climate Change

National Park Service
U.S. Department of the Interior

Congaree National 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 Congaree National 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 19, remain stable for 28 (e.g., Figure 2), and worsen for 23 species. Suitable climate ceases to occur for 17 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 23 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 10, remain stable for 51, and worsen for 21 species. Suitable climate ceases to occur for 12 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 62 species not found at the Park today, potentially resulting in local colonization.

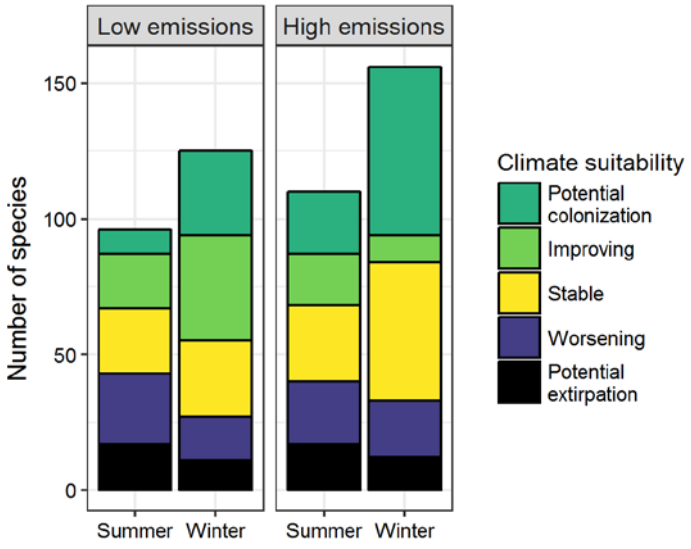

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.20 in summer (32nd percentile across all national parks) and 0.24 in winter (35th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 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 12 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 12 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Park 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, Congaree National 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 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 12 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 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	-	Potential extirpation
Muscovy Duck	-	Potential colonization
Wood Duck	x	Stable
Mallard	-	Potential extirpation
Mottled Duck	Potential colonization	-
Cinnamon Teal	-	Potential colonization
Ring-necked Duck	-	Stable
Hooded Merganser	-	Worsening*^
Scaled Quail	Potential colonization	Potential colonization
Northern Bobwhite	Worsening	-
Wild Turkey	x	Potential extirpation
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Stable
Wood Stork	Improving	-
Magnificent Frigatebird	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Stable
Anhinga	Improving^	Stable
Brown Pelican	Potential colonization	-^
American Bittern	-	Potential colonization^
Great Blue Heron	Improving	Stable
Great Egret	Improving*	Improving*
Snowy Egret	x	Potential colonization
Little Blue Heron	Improving*	-

Common Name	Summer Trend	Winter Trend
Tricolored Heron	Potential colonization^	-
Cattle Egret	Improving*	-
Green Heron	Improving*	-
Yellow-crowned Night-Heron	Improving	Potential colonization
White Ibis	Improving*	Stable
Glossy Ibis	-	Potential colonization
White-faced Ibis	-	Potential colonization^
Roseate Spoonbill	-	Potential colonization
Black Vulture	Stable	Stable
Turkey Vulture	x	Stable
Osprey	x	Stable
White-tailed Kite	Potential colonization	-
Swallow-tailed Kite	Improving	-
Mississippi Kite	Stable	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Potential extirpation
Cooper's Hawk	x	Stable
Bald Eagle	-	Stable
Harris's Hawk	-	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Worsening	Stable
Red-tailed Hawk	Potential extirpation	Stable
Ferruginous Hawk	-	Potential colonization
American Coot	-	Stable
Limpkin	-	Potential colonization
Wilson's Plover	-	Potential colonization
Killdeer	Stable	Stable

Common Name	Summer Trend	Winter Trend
Greater Yellowlegs	-	Stable
Stilt Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
American Woodcock	-	Stable
Ring-billed Gull	-	Potential extirpation
Gull-billed Tern	-	Potential colonization
Caspian Tern	-	Potential colonization
Sandwich Tern	-	Potential colonization^
Rock Pigeon	Stable	-
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Stable
White-tipped Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Eastern Screech-Owl	-	Stable
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Improving
Lesser Nighthawk	Potential colonization	Potential colonization
Chuck-will's-widow	Worsening	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Stable	-
Allen's Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Potential extirpation	Worsening

Common Name	Summer Trend	Winter Trend
Red-headed Woodpecker	Worsening	Worsening*
Red-bellied Woodpecker	Stable	Stable
Yellow-bellied Sapsucker	-	Worsening
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Worsening	Potential extirpation
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Stable	Worsening
Pileated Woodpecker	Stable	Stable
Crested Caracara	Potential colonization	Potential colonization
American Kestrel	-	Stable
Merlin	-	Stable^
Peregrine Falcon	-	Potential colonization
Eastern Wood-Pewee	Potential extirpation	-
Acadian Flycatcher	Stable	-
Dusky Flycatcher	-	Potential colonization
Eastern Phoebe	Potential extirpation	Stable
Say's Phoebe	-	Potential colonization
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Worsening	-
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	-	Potential colonization
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening*	-
Loggerhead Shrike	Stable	Improving
White-eyed Vireo	Improving	Improving*
Yellow-throated Vireo	Stable	-
Red-eyed Vireo	Stable	-

Common Name	Summer Trend	Winter Trend
Green Jay	Potential colonization	Potential colonization
Blue Jay	Stable	Worsening
American Crow	Worsening	Worsening
Fish Crow	Worsening*	Stable
Chihuahuan Raven	Potential colonization	Potential colonization
Horned Lark	-	Stable
Northern Rough-winged Swallow	Improving*	Potential colonization
Purple Martin	Stable	-
Violet-green Swallow	-	Potential colonization
Barn Swallow	Worsening	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Stable
Tufted Titmouse	Worsening	Worsening
Verdin	Potential colonization	Potential colonization
Red-breasted Nuthatch	-	Stable
White-breasted Nuthatch	Stable	Potential extirpation
Brown-headed Nuthatch	Worsening*^	Worsening*
Brown Creeper	-	Stable
House Wren	-	Stable
Pacific/Winter Wren	-	Worsening
Carolina Wren	Improving	Stable
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Stable	Improving*
Black-tailed Gnatcatcher	-	Potential colonization
Golden-crowned Kinglet	-	Worsening
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Worsening	Worsening
Hermit Thrush	-	Stable

Common Name	Summer Trend	Winter Trend
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Worsening
Gray Catbird	Potential extirpation	Stable
Brown Thrasher	Potential extirpation	Stable
Long-billed Thrasher	Potential colonization^	Potential colonization
Bendire's Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Worsening	Improving
European Starling	Potential extirpation	Stable
American Pipit	-	Stable
Cedar Waxwing	-	Worsening*
Ovenbird	Potential extirpation	Potential colonization
Worm-eating Warbler	Stable	-
Black-and-white Warbler	Potential extirpation	Stable
Prothonotary Warbler	Stable	-
Swainson's Warbler	Improving*	-
Orange-crowned Warbler	-	Improving
Kentucky Warbler	Improving*	-
Common Yellowthroat	Potential extirpation	Worsening*
Hooded Warbler	Improving*	-
American Redstart	Improving	-
Northern Parula	Stable	Potential colonization
Palm Warbler	-	Stable^
Pine Warbler	Worsening^	Improving
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	Stable
Prairie Warbler	Worsening	-
Black-throated Gray Warbler	-	Potential colonization
Hermit Warbler	-	Potential colonization^
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Worsening	-
Olive Sparrow	-	Potential colonization
Green-tailed Towhee	-	Potential colonization
Eastern Towhee	Worsening*	x
Canyon Towhee	Potential colonization	-
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Stable
Brewer's Sparrow	-	Potential colonization
Field Sparrow	-	Worsening
Vesper Sparrow	-	Stable
Black-throated Sparrow	-	Potential colonization
Savannah Sparrow	-	Stable
Fox Sparrow	-	Worsening*
Song Sparrow	-	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Stable
Dark-eyed Junco	-	Potential extirpation
Summer Tanager	Worsening	-
Scarlet Tanager	Potential extirpation	-
Western Tanager	-	Potential colonization
Northern Cardinal	Stable	Improving
Pyrrhuloxia	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Blue Grosbeak	Worsening	-
Indigo Bunting	Worsening	Potential colonization
Painted Bunting	Stable	Potential colonization
Red-winged Blackbird	Stable	Stable
Eastern Meadowlark	Stable	Worsening
Rusty Blackbird	-	Worsening
Common Grackle	Potential extirpation	Worsening
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	Stable
Orchard Oriole	Worsening*	-

Common Name	Summer Trend	Winter Trend
Hooded Oriole	Potential colonization	-
Altamira Oriole	-	Potential colonization
Audubon's Oriole	-	Potential colonization
House Finch	Potential extirpation	Stable
Purple Finch	-	Potential extirpation
Pine Siskin	-	Potential extirpation
American Goldfinch	Potential extirpation	Worsening