Birds and Climate Change

National Park Service
U.S. Department of the Interior

Chickamauga and Chattanooga 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 Chickamauga and Chattanooga 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 14, remain stable for 27, and worsen for 17 species. Suitable climate ceases to occur for 20 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 15 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 24, remain stable for 48, and worsen for 5 species. Suitable climate ceases to occur for 7 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 41 species not found at the Park today, potentially resulting in local colonization.

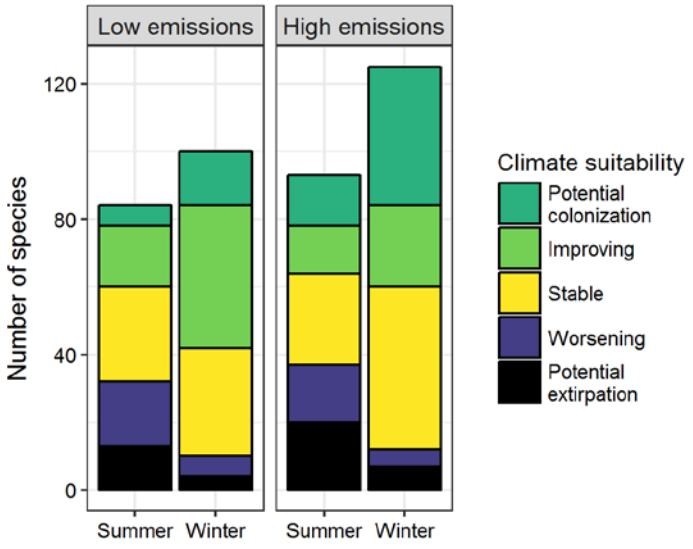

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.18 in summer (27th percentile across all national parks) and 0.20 in winter (28th percentile) under the high-emissions pathway. Potential species turnover declines to 0.09 in summer and 0.09 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 5 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 3 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, Chickamauga and Chattanooga National Military Park falls within the low change group.** Parks anticipating low 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 3 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
Cackling/Canada Goose	x	Potential extirpation
Gadwall	-	Improving
American Wigeon	-	Improving
Mallard	Potential extirpation^	Stable
Mottled Duck	-	Potential colonization
Blue-winged Teal	-	Potential colonization
Ring-necked Duck	-	Improving
Lesser Scaup	-	Improving
Bufflehead	-	Stable
Wild Turkey	x	Potential extirpation
Common Loon	-	Stable^
Pied-billed Grebe	-	Improving
Horned Grebe	-	Stable
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Stable	Improving
Great Egret	Improving	Potential colonization
Little Blue Heron	Potential colonization	Potential colonization
Cattle Egret	Potential colonization	Potential colonization
Green Heron	Stable	-
White Ibis	Potential colonization	Potential colonization
Black Vulture	Stable	Stable
Turkey Vulture	x	Stable

Common Name	Summer Trend	Winter Trend
Osprey	x	Potential colonization
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Worsening*
Cooper's Hawk	x	Stable
Bald Eagle	-	Stable
Red-shouldered Hawk	Improving	Stable
Red-tailed Hawk	Stable	Stable
Virginia Rail	-	Potential colonization
Sora	-	Potential colonization
American Coot	-	Improving
Killdeer	Potential extirpation	Improving
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
American Woodcock	-	Improving
Ring-billed Gull	-	Stable
Herring Gull	-	Potential extirpation^
Gull-billed Tern	-	Potential colonization
Rock Pigeon	Potential extirpation	Stable
Eurasian Collared-Dove	x	Improving
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Great Horned Owl	-	Potential extirpation
Barred Owl	x	Improving
Common Nighthawk	Improving	-
Chuck-will's-widow	Stable	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Stable	-
Belted Kingfisher	Stable	Stable
Red-headed Woodpecker	Stable	Stable
Red-bellied Woodpecker	Improving	Stable
Yellow-bellied Sapsucker	-	Improving
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Stable
Hairy Woodpecker	Potential extirpation	Worsening
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Improving	Stable
Pileated Woodpecker	Stable	Stable
Crested Caracara	-	Potential colonization
American Kestrel	x	Stable
Eastern Wood-Pewee	Worsening	-
Acadian Flycatcher	Stable	-
Eastern Phoebe	Worsening	Stable
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Worsening	-
Eastern Kingbird	Worsening	-
Scissor-tailed Flycatcher	Potential colonization	-
White-eyed Vireo	Improving	Potential colonization
Yellow-throated Vireo	Stable	-
Red-eyed Vireo	Stable	-
Blue Jay	Improving	Stable

Common Name	Summer Trend	Winter Trend
American Crow	Stable	Stable
Fish Crow	-	Improving*
Northern Rough-winged Swallow	Stable	-
Purple Martin	Improving	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Improving	Improving
Tufted Titmouse	Worsening	Stable
Black-crested Titmouse	Potential colonization	-
Red-breasted Nuthatch	-	Stable
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Stable^	Improving*
Brown Creeper	-	Worsening
House Wren	Potential extirpation	-
Pacific/Winter Wren	-	Stable
Marsh Wren	-	Potential colonization
Carolina Wren	Worsening	Stable
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Worsening	Stable
Hermit Thrush	-	Stable
Wood Thrush	Worsening	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	Potential colonization

Common Name	Summer Trend	Winter Trend
Brown Thrasher	Worsening	Improving
Northern Mockingbird	Stable	Stable
European Starling	Potential extirpation	Worsening
American Pipit	-	Improving
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	-	Stable
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Worsening	-
Black-and-white Warbler	Stable	-
Orange-crowned Warbler	-	Improving*
Kentucky Warbler	Stable	-
Common Yellowthroat	Worsening	-
Hooded Warbler	Improving*	-
American Redstart	Stable	-
Northern Parula	Worsening	-
Pine Warbler	Improving*^	Improving
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	-
Black-throated Green Warbler	Potential extirpation	-
Yellow-breasted Chat	Stable	-
Eastern Towhee	Worsening*	x
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Worsening*	Stable
Lark Sparrow	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Grasshopper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Fox Sparrow	-	Stable
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Stable
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Worsening
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Stable
Pyrrhuloxia	-	Potential colonization
Blue Grosbeak	Worsening	-
Indigo Bunting	Stable	-

Common Name	Summer Trend	Winter Trend
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Potential extirpation	Stable
Eastern Meadowlark	Stable	Stable
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Stable
Common Grackle	Potential extirpation	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential extirpation
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Stable
Evening Grosbeak	-	Stable
House Sparrow	x	Stable