Birds and Climate Change

National Park Service
U.S. Department of the Interior

Cumberland Gap 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 Cumberland Gap 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.

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 11, remain stable for 17, and worsen for 11 species. Suitable climate ceases to occur for 8 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 19 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 12, remain stable for 7, and worsen for 8 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 31 species not found at the Park today, potentially resulting in local colonization.

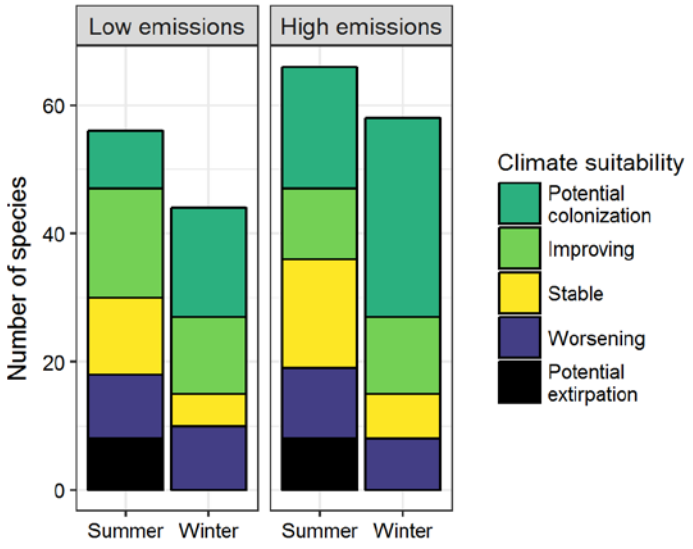

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

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 0.17 in winter (21st percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 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 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). While the Park may serve as an important refuge for 3 of these climate-sensitive species, one, the Brown Creeper (*Certhia americana*), might be extirpated from the Park in summer 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, Cumberland Gap National Historical 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 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
Mallard	-	Stable
Blue-winged Teal	-	Potential colonization
Green-winged Teal	-	Potential colonization
Bufflehead	-	Potential colonization
Common Goldeneye	-	Potential colonization
Red-breasted Merganser	-	Potential colonization^
Ruddy Duck	-	Potential colonization
Eared Grebe	-	Potential colonization
Double-crested Cormorant	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Improving*	Improving
Great Egret	Potential colonization	Potential colonization
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Potential colonization	-
Mississippi Kite	Potential colonization	-
Bald Eagle	-	Potential colonization
Red-shouldered Hawk	Improving*	-
Red-tailed Hawk	Improving	Improving
Killdeer	Potential colonization	-
Least Sandpiper	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Forster's Tern	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Worsening
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Great Horned Owl	x	Stable
Burrowing Owl	Potential colonization^	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Improving	-
Red-bellied Woodpecker	Improving	Stable
Downy Woodpecker	Stable	Stable
Hairy Woodpecker	Worsening	Worsening*
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Stable	Worsening
Pileated Woodpecker	Worsening	Improving
American Kestrel	-	Improving
Eastern Wood-Pewee	Stable	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Stable	Improving
Loggerhead Shrike	Potential colonization	-
Bell's Vireo	Potential colonization	-
Red-eyed Vireo	Worsening	-
Blue Jay	Improving	Worsening
American Crow	Stable	Worsening
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Stable	Improving
White-breasted Nuthatch	Worsening*	Worsening*

Common Name	Summer Trend	Winter Trend
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	Potential extirpation^	Worsening*
House Wren	-	Potential colonization
Sedge Wren	-	Potential colonization
Carolina Wren	Stable	Improving
Blue-gray Gnatcatcher	Stable	-
Golden-crowned Kinglet	-	Stable
Eastern Bluebird	Improving	-
Wood Thrush	Worsening	-
American Robin	Potential extirpation	-
Gray Catbird	-	Potential colonization
Brown Thrasher	Stable	-
European Starling	-	Stable
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Worsening*	-
Black-and-white Warbler	Stable	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Kentucky Warbler	Stable	-
Common Yellowthroat	Worsening	Potential colonization
Hooded Warbler	Stable	-
Northern Parula	Stable	-
Black-throated Blue Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Worsening	-
Black-throated Green Warbler	Potential extirpation	-
Eastern Towhee	Stable	-
Bachman's Sparrow	Potential colonization	Potential colonization
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	-
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	-
Lincoln's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
White-throated Sparrow	-	Improving
Scarlet Tanager	Worsening*	-
Northern Cardinal	Improving	Stable
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Dickcissel	Potential colonization	-
Eastern Meadowlark	Improving	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	-
Great-tailed Grackle	Potential colonization	-
American Goldfinch	Potential extirpation	Worsening