Birds and Climate Change

National Park Service
U.S. Department of the Interior

Morristown 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 Morristown 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 39 (e.g., Figure 2), remain stable for 16, and worsen for 13 species. Suitable climate ceases to occur for 28 species in summer, potentially resulting in extirpation of those species from the Park. 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 41, remain stable for 19, and worsen for 9 species. Suitable climate ceases to occur for 13 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 30 species not found at the Park today, potentially resulting in local colonization.

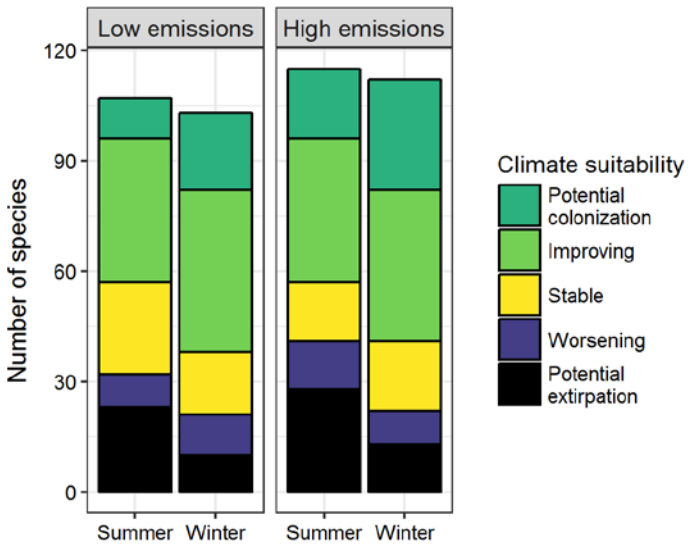

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.21 in summer (34th percentile across all national parks) and 0.23 in winter (32nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.16 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 9 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 5 of these climate-sensitive species, 4 might be extirpated from the Park in at least one season by 2050.

Figure 2. Climate at the Park in summer is projected to remain suitable for the Red-winged Blackbird (*Agelaius phoeniceus*) through 2050. Photo by Andy Reago & Chrissy McClarren/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, Morristown 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 5 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	Worsening
Mute Swan	x	Potential extirpation
Wood Duck	x	Improving
Gadwall	-	Improving
American Black Duck	-	Potential extirpation
Mallard	Potential extirpation^	Worsening
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Improving
Ring-necked Duck	-	Improving
Hooded Merganser	-	Improving^
Common Merganser	-	Potential extirpation
Red-breasted Merganser	-	Potential colonization^
Northern Bobwhite	Improving*	Improving*
Ring-necked Pheasant	Potential extirpation	Potential extirpation
Ruffed Grouse	x	Potential extirpation
Wild Turkey	x	Potential extirpation
Common Loon	-	Potential colonization^
Pied-billed Grebe	x	Improving
Double-crested Cormorant	x	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Improving	Improving
Great Egret	Improving	-
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Green Heron	Improving	-

Common Name	Summer Trend	Winter Trend
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Improving	Stable
Turkey Vulture	x	Improving
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Improving
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	x	Worsening
Bald Eagle	x	Potential colonization
Red-shouldered Hawk	Potential colonization	Improving
Red-tailed Hawk	Improving	Stable
Rough-legged Hawk	-	Stable
Killdeer	Improving	Improving
Least Sandpiper	-	Potential colonization
American Woodcock	x	Improving
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	Potential extirpation^	Improving
Herring Gull	-	Potential extirpation^
Forster's Tern	-	Potential colonization
Rock Pigeon	Worsening	Worsening
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Stable	-
Greater Roadrunner	-	Potential colonization
Barn Owl	-	Potential colonization
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Stable

Common Name	Summer Trend	Winter Trend
Common Nighthawk	Potential colonization	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Stable	Improving
Red-bellied Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Stable	Stable
Northern Flicker	Stable	Stable
Pileated Woodpecker	Improving	Improving
Merlin	-	Improving^
Olive-sided Flycatcher	Stable	-
Eastern Wood-Pewee	Improving	-
Yellow-bellied Flycatcher	Potential extirpation	-
Acadian Flycatcher	Stable	-
Willow Flycatcher	Potential extirpation	-
Eastern Phoebe	Improving	Potential colonization
Great Crested Flycatcher	Improving	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	Potential colonization
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Improving*	-
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Improving	-

Common Name	Summer Trend	Winter Trend
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Improving	Worsening
American Crow	Stable	Stable
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Stable	Stable
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Potential colonization	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving	Improving
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Stable	Stable
Brown-headed Nuthatch	-	Potential colonization
Brown Creeper	Potential extirpation^	Worsening
House Wren	Potential extirpation	Potential colonization
Pacific/Winter Wren	-	Improving
Sedge Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Improving
Veery	Potential extirpation	-
Hermit Thrush	-	Improving
Wood Thrush	Worsening*	-

Common Name	Summer Trend	Winter Trend
American Robin	Worsening	Improving
Gray Catbird	Potential extirpation	-
Brown Thrasher	Improving	Potential colonization
Northern Mockingbird	Improving	Improving
European Starling	Worsening	Stable
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Stable
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Stable	-
Northern Waterthrush	Potential extirpation	-
Blue-winged Warbler	Worsening	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Mourning Warbler	Potential extirpation	-
Kentucky Warbler	Improving*	-
Common Yellowthroat	Worsening	-
Hooded Warbler	Worsening	-
American Redstart	Potential extirpation	-
Northern Parula	Improving*	-
Yellow Warbler	Potential extirpation	-
Chestnut-sided Warbler	Potential extirpation	-
Blackpoll Warbler	Improving	-

Common Name	Summer Trend	Winter Trend
Pine Warbler	-	Potential colonization
Yellow-rumped Warbler	-	Improving
Prairie Warbler	Stable	-
Black-throated Green Warbler	Potential extirpation	-
Canada Warbler	Potential extirpation	-
Yellow-breasted Chat	Improving*	-
Eastern Towhee	Stable	x
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Worsening	Potential colonization
Field Sparrow	Improving	Improving
Savannah Sparrow	Potential extirpation	Potential colonization
Grasshopper Sparrow	Improving*	-
LeConte's Sparrow	-	Potential colonization
Seaside Sparrow	Potential colonization^	-
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	Potential extirpation	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Dark-eyed Junco	-	Stable
Summer Tanager	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Scarlet Tanager	Worsening*	-
Northern Cardinal	Improving	Stable
Rose-breasted Grosbeak	Potential extirpation	-
Blue Grosbeak	Potential colonization	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Bobolink	Potential extirpation	-
Red-winged Blackbird	Improving	Improving
Eastern Meadowlark	Improving	Improving*
Rusty Blackbird	-	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	Improving
Orchard Oriole	Improving*	-
Baltimore Oriole	Worsening*	-
House Finch	Potential extirpation	Worsening
Purple Finch	-	Stable
Common Redpoll	-	Potential extirpation
Pine Siskin	-	Stable
American Goldfinch	Worsening	Stable
Evening Grosbeak	-	Potential extirpation
House Sparrow	x	Worsening