Birds and Climate Change

National Park Service
U.S. Department of the Interior

Allegheny Portage Railroad National Historic Site

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 Allegheny Portage Railroad National Historic Site (hereafter, the Site) 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Site 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 Site, 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 Site today, climate suitability in summer under the high-emissions pathway is projected to improve for 15, remain stable for 7, and worsen for 17 species. Suitable climate ceases to occur for 12 species in summer, potentially resulting in extirpation of those species from the Site (e.g., Figure 2). Climate is projected to become suitable in summer for 21 species not found at the Site today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 11, remain stable for 2, and worsen for 4 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 43 species not found at the Site today, potentially resulting in local colonization.

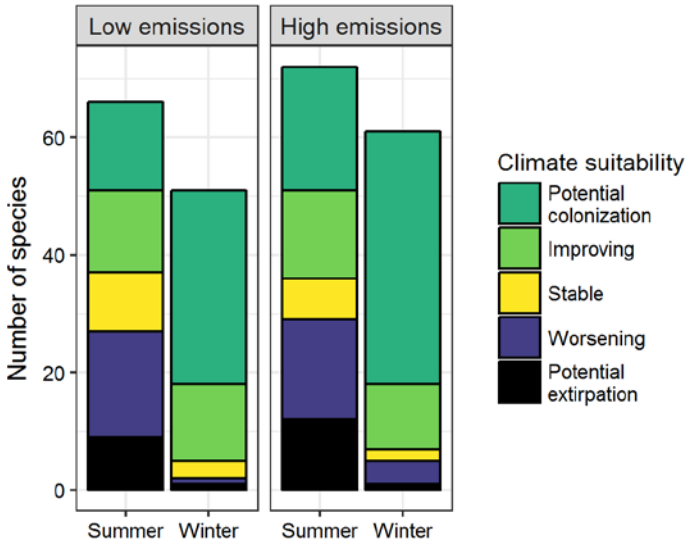

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.29 in summer (49th percentile across all national parks) and 0.34 in winter (54th percentile) under the high-emissions pathway. Potential species turnover declines to 0.22 in summer and 0.32 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 Site is not, nor may become, home to species that are highly sensitive to climate change across their range (i.e., species that 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).

Figure 2. Although currently found at the Site, suitable climate for the American Redstart (*Setophaga ruticilla*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by Becky Matsubara/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, Allegheny Portage Railroad National Historic Site falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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. 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Site 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 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	Improving
Wood Duck	-	Potential colonization
Gadwall	-	Potential colonization
American Wigeon	-	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Ruddy Duck	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Pied-billed Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Double-crested Cormorant	-	Potential colonization
Great Egret	Potential colonization	-
Black Vulture	-	Potential colonization
Turkey Vulture	x	Potential colonization
Bald Eagle	-	Potential colonization
Red-shouldered Hawk	Potential colonization	Potential colonization
Red-tailed Hawk	-	Improving
American Coot	-	Potential colonization
Killdeer	-	Potential colonization
American Woodcock	-	Potential colonization
Mourning Dove	Improving	-
Eastern Screech-Owl	x	Improving
Great Horned Owl	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Improving	-
Red-headed Woodpecker	Potential colonization	-
Red-bellied Woodpecker	Improving	Improving
Downy Woodpecker	Improving	-
Hairy Woodpecker	Worsening	-
Northern Flicker	Potential extirpation	-
Pileated Woodpecker	Improving	-
American Kestrel	-	Potential colonization
Willow Flycatcher	Worsening*	-
Eastern Phoebe	Stable	Potential colonization
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	-	Potential colonization
White-eyed Vireo	Potential colonization	-
Bell's Vireo	Potential colonization	-
Red-eyed Vireo	Worsening	-
Blue Jay	Improving	Worsening*
American Crow	Worsening	Worsening*
Fish Crow	Potential colonization	Potential colonization
Purple Martin	Potential colonization	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving	Improving
White-breasted Nuthatch	Stable	Worsening*
House Wren	Worsening	-
Pacific/Winter Wren	-	Potential colonization
Blue-gray Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	Potential extirpation	Improving
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving	-
Veery	Potential extirpation	-
Hermit Thrush	-	Potential colonization
Wood Thrush	Worsening	-
American Robin	Worsening	Improving
Gray Catbird	Worsening	Potential colonization
Brown Thrasher	Improving	Potential colonization
European Starling	Worsening	-
Cedar Waxwing	Worsening	Improving
Ovenbird	Potential extirpation	-
Prothonotary Warbler	Potential colonization	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-
Hooded Warbler	Stable	-
American Redstart	Potential extirpation	-
Northern Parula	Potential colonization	-
Yellow Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Chestnut-sided Warbler	Potential extirpation	-
Yellow-rumped Warbler	-	Potential colonization
Yellow-throated Warbler	Potential colonization	-
Black-throated Green Warbler	Potential extirpation	-
Yellow-breasted Chat	Potential colonization	-
Eastern Towhee	Improving	-
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Worsening	Potential colonization
Field Sparrow	Improving	Improving*
Savannah Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Fox Sparrow	-	Potential colonization
Song Sparrow	Worsening	Improving
Swamp Sparrow	-	Potential colonization
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	-	Stable

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