Birds and Climate Change

National Park Service
U.S. Department of the Interior

Roosevelt-Vanderbilt National Historic Sites

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 Roosevelt-Vanderbilt National Historic Sites (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 21 (e.g., Figure 2), remain stable for 13, and worsen for 12 species. Suitable climate ceases to occur for 17 species in summer, potentially resulting in extirpation of those species from the Site. 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 19, remain stable for 9, and worsen for 9 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 32 species not found at the Site today, potentially resulting in local colonization.

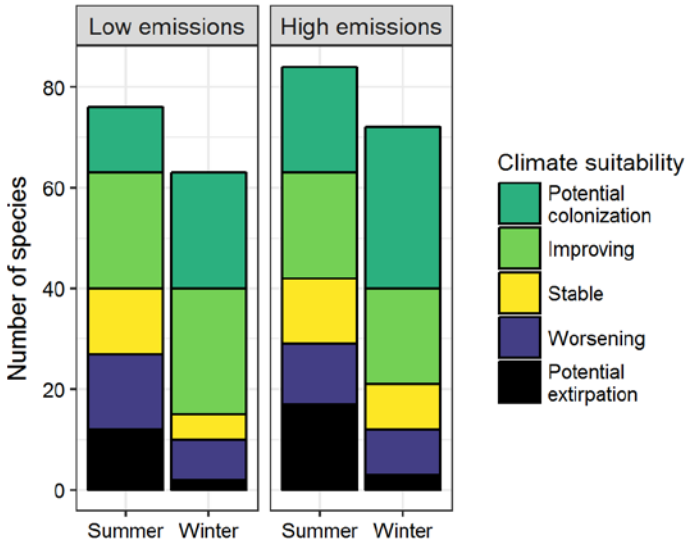

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.28 in summer (47th percentile across all national parks) and 0.25 in winter (36th percentile) under the high-emissions pathway. Potential species turnover declines to 0.18 in summer and 0.19 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 or may become home to 8 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 Site may serve as an important refuge for 4 of these climate-sensitive species, 4 might be extirpated from the Site in at least one season by 2050.

Figure 2. Climate at the Site 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, Roosevelt-Vanderbilt National Historic Sites falls within the high turnover group.** Parks anticipating high turnover 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 4 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 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 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
American Wigeon	-	Potential colonization
Mallard	Potential extirpation^	Worsening
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Greater Scaup	-	Potential colonization^
Hooded Merganser	-	Potential colonization^
Common Merganser	-	Potential extirpation
Red-breasted Merganser	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
Common Loon	-	Potential colonization^
Pied-billed Grebe	-	Potential colonization
Double-crested Cormorant	x	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Improving	-
Great Egret	Potential colonization	-
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Black Vulture	Potential colonization	Improving
Turkey Vulture	x	Improving*
Mississippi Kite	Potential colonization	-
Sharp-shinned Hawk	-	Improving

Common Name	Summer Trend	Winter Trend
Bald Eagle	-	Improving
Red-shouldered Hawk	Improving	Improving*
Red-tailed Hawk	Improving	Stable
American Coot	-	Potential colonization
Killdeer	-	Potential colonization
American Woodcock	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	Potential extirpation^	Stable
Herring Gull	-	Potential extirpation^
Rock Pigeon	Worsening	Worsening*
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Improving	Improving
Barn Owl	-	Potential colonization
Common Nighthawk	Potential colonization	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Worsening	-
Belted Kingfisher	Stable	-
Red-bellied Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Stable	Stable
Northern Flicker	Stable	Improving
Pileated Woodpecker	Improving	Improving
Eastern Wood-Pewee	Improving	-
Eastern Phoebe	Improving	Potential colonization
Great Crested Flycatcher	Improving	-
Eastern Kingbird	Stable	-

Common Name	Summer Trend	Winter Trend
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	Potential colonization
White-eyed Vireo	Potential colonization	-
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Worsening
American Crow	Worsening	Stable
Fish Crow	Improving	Stable
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Potential colonization	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving	Stable
White-breasted Nuthatch	Stable	Stable
Brown Creeper	-	Worsening*
House Wren	Potential extirpation	-
Sedge Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Blue-gray Gnatcatcher	Improving	-
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving	Improving
Veery	Potential extirpation	-
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	Worsening
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	-
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Stable	-
Prothonotary Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-
American Redstart	Potential extirpation	-
Northern Parula	Potential colonization	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	Potential extirpation^	Potential colonization
Yellow-throated Warbler	Potential colonization	-
Prairie Warbler	Stable	-
Black-throated Green Warbler	Potential extirpation	-
Yellow-breasted Chat	Potential colonization	-
Eastern Towhee	Stable	-
American Tree Sparrow	-	Worsening*

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Worsening	-
Savannah Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Stable
Summer Tanager	Potential colonization	-
Scarlet Tanager	Worsening*	-
Northern Cardinal	Improving	Stable
Rose-breasted Grosbeak	Potential extirpation	-
Blue Grosbeak	Potential colonization	-
Indigo Bunting	Improving	-
Red-winged Blackbird	Stable	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	-
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	-
Orchard Oriole	Potential colonization	-
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Worsening*
American Goldfinch	Worsening	Improving
House Sparrow	x	Worsening*