Birds and Climate Change

National Park Service
U.S. Department of the Interior

Herbert Hoover 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 Herbert Hoover 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 17, remain stable for 11 (e.g., Figure 2), and worsen for 9 species. Suitable climate ceases to occur for 10 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 28 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 13, remain stable for 11, and worsen for 6 species. Suitable climate ceases to occur for 4 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 45 species not found at the Site today, potentially resulting in local colonization.

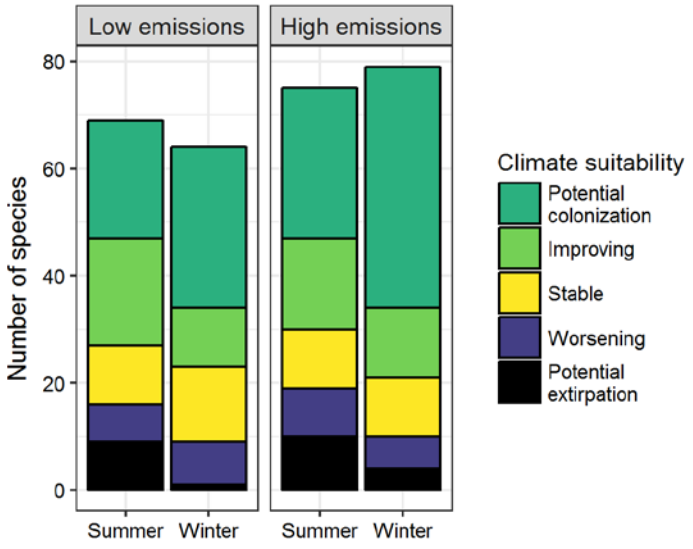

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.31 in summer (54th percentile across all national parks) and 0.31 in winter (49th percentile) under the high-emissions pathway. Potential species turnover declines to 0.25 in summer and 0.23 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 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 Site may serve as an important refuge for 4 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Site in summer by 2050.

Figure 2. Climate at the Site 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, Herbert Hoover National Historic Site 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	Improving
Wood Duck	-	Potential colonization
American Wigeon	-	Potential colonization
Mallard	Potential extirpation^	Stable
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Greater Scaup	-	Potential colonization^
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Hooded Merganser	-	Potential colonization^
Red-breasted Merganser	-	Potential colonization^
Ring-necked Pheasant	Worsening*	Potential extirpation
Common Loon	-	Potential colonization^
Horned Grebe	-	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	-
Little Blue Heron	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Potential colonization	-
Mississippi Kite	Potential colonization	-
Bald Eagle	-	Worsening*
Red-shouldered Hawk	Potential colonization	Improving
Red-tailed Hawk	Improving	Stable
Ferruginous Hawk	-	Potential colonization
Rough-legged Hawk	-	Worsening*
Killdeer	Stable	-
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Rock Pigeon	Worsening	Worsening*
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Stable
Common Nighthawk	Improving*	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Potential extirpation	Stable
Red-bellied Woodpecker	Improving	Improving
Downy Woodpecker	Improving	Worsening
Northern Flicker	Potential extirpation	Improving
American Kestrel	x	Stable

Common Name	Summer Trend	Winter Trend
Prairie Falcon	-	Potential colonization
Eastern Wood-Pewee	Improving	-
Acadian Flycatcher	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	Potential colonization	-
Warbling Vireo	Stable	-
Blue Jay	Improving	Improving
American Crow	Stable	Stable
Horned Lark	-	Improving
Northern Rough-winged Swallow	Improving	-
Purple Martin	Potential colonization	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Carolina Chickadee	Potential colonization	Potential colonization
Black-capped Chickadee	Stable	Potential extirpation
White-breasted Nuthatch	-	Worsening
House Wren	Worsening*	-
Pacific/Winter Wren	-	Potential colonization
Sedge Wren	-	Potential colonization
Carolina Wren	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	-	Potential colonization
Ruby-crowned Kinglet	-	Potential colonization
Hermit Thrush	-	Potential colonization
American Robin	Worsening	Improving
Gray Catbird	Potential extirpation	-
Brown Thrasher	Improving	Potential colonization
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Worsening	Stable
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Worsening*
Smith's Longspur	-	Potential colonization
Prothonotary Warbler	Potential colonization	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-
Northern Parula	Potential colonization	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	-	Potential colonization
Yellow-throated Warbler	Potential colonization	-
Yellow-breasted Chat	Potential colonization	-
Eastern Towhee	Stable	-
American Tree Sparrow	-	Stable

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Potential extirpation	-
Field Sparrow	Stable	Potential colonization
Savannah Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Fox Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Stable
Summer Tanager	Potential colonization	-
Northern Cardinal	Improving	Improving
Blue Grosbeak	Potential colonization	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Dickcissel	Improving	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Improving	Improving*
Western Meadowlark	-	Potential colonization
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	-
Baltimore Oriole	Improving	-
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	Worsening	Stable

Common Name	Summer Trend	Winter Trend
House Sparrow	x	Stable