Birds and Climate Change

National Park Service
U.S. Department of the Interior

Ninety Six 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 Ninety Six 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 7, remain stable for 26, and worsen for 19 species. Suitable climate ceases to occur for 13 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 23 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 36, and worsen for 15 species. Suitable climate ceases to occur for 8 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 53 species not found at the Site today, potentially resulting in local colonization.

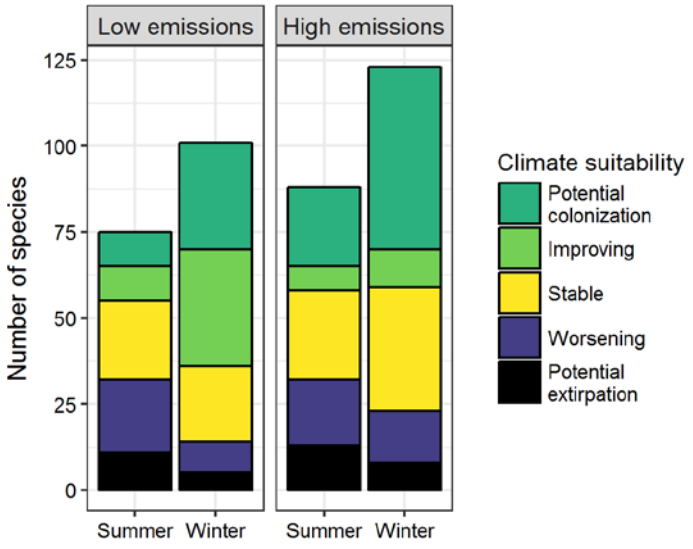

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.21 in summer (32nd percentile across all national parks) and 0.23 in winter (32nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.15 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 7 of these climate-sensitive species, one, the Hooded Merganser (*Lophodytes cucullatus*), might be extirpated from the Site in winter by 2050.

Figure 2. Although currently found at the Site, 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, Ninety Six National Historic Site 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 7 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	Potential extirpation
Wood Duck	x	Stable
Mallard	-	Worsening
Mottled Duck	Potential colonization	Potential colonization
Cinnamon Teal	-	Potential colonization
Ring-necked Duck	-	Stable
Bufflehead	-	Potential extirpation
Hooded Merganser	-	Potential extirpation^
Ruddy Duck	-	Stable
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Improving
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	-	Stable

Common Name	Summer Trend	Winter Trend
Anhinga	Potential colonization^	Potential colonization
Brown Pelican	-	Potential colonization^
Great Blue Heron	Stable	Stable
Great Egret	Improving*	Potential colonization
Snowy Egret	-	Potential colonization
Little Blue Heron	Improving*	Potential colonization
Tricolored Heron	Potential colonization^	-
Cattle Egret	-	Potential colonization
Green Heron	Improving*	-
Yellow-crowned Night-Heron	-	Potential colonization
White Ibis	Potential colonization	Potential colonization
Glossy Ibis	-	Potential colonization

Common Name	Summer Trend	Winter Trend
White-faced Ibis	-	Potential colonization^
Black Vulture	Improving*	Stable
Turkey Vulture	x	Stable
Osprey	x	Potential colonization
White-tailed Kite	Potential colonization	-
Northern Harrier	-	Worsening*
Sharp-shinned Hawk	-	Stable
Harris's Hawk	Potential colonization	Potential colonization
Red-shouldered Hawk	Stable	Stable
Red-tailed Hawk	Worsening	Stable
Ferruginous Hawk	-	Potential colonization
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Killdeer	Potential extirpation	Stable
Spotted Sandpiper	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
American Woodcock	-	Improving*
Ring-billed Gull	-	Worsening*
Eurasian Collared-Dove	-	Improving*
White-winged Dove	Potential colonization	Potential colonization
Mourning Dove	Stable	Stable
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Potential colonization	-
Great Horned Owl	-	Potential extirpation
Barred Owl	x	Improving
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Potential colonization	-
Common Pauraque	-	Potential colonization
Chimney Swift	Stable	-
Black-chinned Hummingbird	Potential colonization	-
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Stable	Stable
Red-headed Woodpecker	Stable	Worsening*
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Worsening	Worsening
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Stable	Worsening
Pileated Woodpecker	Stable	Worsening
Crested Caracara	-	Potential colonization
Eastern Wood-Pewee	Potential extirpation	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Worsening	Stable
Vermilion Flycatcher	Potential colonization	Potential colonization
Great Crested Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Couch's Kingbird	-	Potential colonization
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
White-eyed Vireo	Stable	-
Yellow-throated Vireo	Stable	-
Red-eyed Vireo	Stable	-
Blue Jay	Worsening	Worsening
American Crow	Worsening	Worsening
Fish Crow	Stable	Stable
Northern Rough-winged Swallow	-	Potential colonization
Barn Swallow	Stable	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Stable	Stable
Verdin	Potential colonization	-
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Worsening^	Stable
Canyon Wren	-	Potential colonization
Pacific/Winter Wren	-	Worsening
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Worsening	-
Golden-crowned Kinglet	-	Worsening
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Worsening	Worsening
Hermit Thrush	-	Stable

Common Name	Summer Trend	Winter Trend
Wood Thrush	Worsening*	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	-
Curve-billed Thrasher	Potential colonization	-
Brown Thrasher	Worsening*	Stable
Bendire's Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Worsening	Improving
European Starling	-	Stable
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	-	Stable
Worm-eating Warbler	Stable	-
Black-and-white Warbler	Potential extirpation	-
Prothonotary Warbler	Stable	-
Common Yellowthroat	Potential extirpation	-
Hooded Warbler	Improving*	-
Northern Parula	Stable	-
Pine Warbler	Worsening^	Stable
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	Potential colonization
Black-throated Gray Warbler	-	Potential colonization
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Stable	-
Eastern Towhee	Worsening*	x
Canyon Towhee	Potential colonization	-
Cassin's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Potential extirpation	Stable
Brewer's Sparrow	-	Potential colonization
Field Sparrow	Worsening*	Stable
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Stable
Henslow's Sparrow	-	Potential colonization
Song Sparrow	-	Stable
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Worsening
Summer Tanager	Stable	-
Western Tanager	-	Potential colonization
Northern Cardinal	Improving	Improving
Blue Grosbeak	Worsening	-
Indigo Bunting	Stable	Potential colonization

Common Name	Summer Trend	Winter Trend
Red-winged Blackbird	Potential extirpation	Stable
Eastern Meadowlark	Stable	Worsening*
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Stable
Common Grackle	Worsening	Stable
Great-tailed Grackle	-	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
Orchard Oriole	Stable	-
Altamira Oriole	-	Potential colonization
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Potential extirpation
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Stable
House Sparrow	-	Worsening