Birds and Climate Change

National Park Service
U.S. Department of the Interior

Sagamore Hill 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 Sagamore Hill 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 13, remain stable for 9, and worsen for 4 species. Suitable climate ceases to occur for 10 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 22 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 22, remain stable for 22, and worsen for 14 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 39 species not found at the Site today, potentially resulting in local colonization.

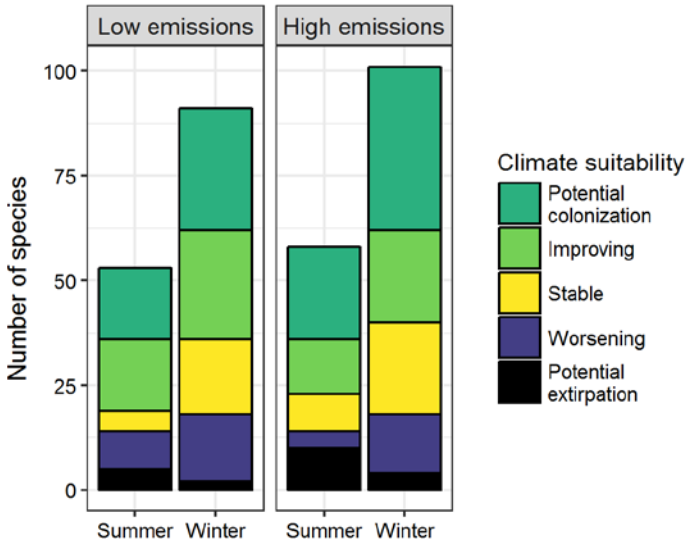

Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Site between the present and 2050 is 0.24 in summer (40th percentile across all national parks) and 0.17 in winter (22nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.13 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 11 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 10 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Site in summer 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, Sagamore Hill 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 10 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
Brant	-	Stable
Cackling/Canada Goose	x	Worsening
Mute Swan	-	Potential extirpation
Gadwall	Improving^	Improving
Eurasian Wigeon	-	Potential colonization
American Wigeon	-	Improving
American Black Duck	x	Worsening*
Mallard	Potential extirpation^	Worsening
Blue-winged Teal	Improving	Potential colonization
Northern Shoveler	-	Improving
Green-winged Teal	x	Improving
Canvasback	-	Stable
Ring-necked Duck	-	Improving
Greater Scaup	-	Improving^
Long-tailed Duck	Stable	Stable

Common Name	Summer Trend	Winter Trend
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Barrow's Goldeneye	-	Potential colonization^
Red-breasted Merganser	-	Improving^
Ruddy Duck	-	Improving
Red-throated Loon	-	Stable
Common Loon	-	Improving^
Eared Grebe	-	Potential colonization
Double-crested Cormorant	x	Improving
American White Pelican	-	Potential colonization
Brown Pelican	-	Potential colonization^
Great Blue Heron	Improving	Improving
Great Egret	Improving*	Potential colonization
Little Blue Heron	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Tricolored Heron	-	Potential colonization
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Potential colonization	Potential colonization
Turkey Vulture	-	Potential colonization
Mississippi Kite	Potential colonization	-
Sharp-shinned Hawk	-	Stable
Red-shouldered Hawk	Potential colonization	Potential colonization
Red-tailed Hawk	Improving	Worsening
Killdeer	-	Improving
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Marbled Godwit	-	Potential colonization
Least Sandpiper	-	Potential colonization
Western Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Laughing Gull	Potential colonization^	Potential colonization
Ring-billed Gull	-	Improving
Herring Gull	Stable	Stable^
Great Black-backed Gull	x	Stable
Forster's Tern	-	Potential colonization
Rock Pigeon	-	Potential extirpation
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Stable

Common Name	Summer Trend	Winter Trend
Barn Owl	-	Potential colonization
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Worsening*
Barred Owl	-	Potential colonization
Chuck-will's-widow	Potential colonization	-
Belted Kingfisher	-	Stable
Red-bellied Woodpecker	Improving	Stable
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Improving	Worsening
Hairy Woodpecker	Stable	Worsening*
Northern Flicker	Stable	Stable
Pileated Woodpecker	Potential colonization	-
Peregrine Falcon	-	Stable
Eastern Phoebe	-	Potential colonization
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	Potential colonization
White-eyed Vireo	-	Potential colonization
Bell's Vireo	Potential colonization	-
Blue Jay	Stable	Worsening
American Crow	Worsening	Worsening
Fish Crow	-	Stable
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Potential colonization	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving	Stable

Common Name	Summer Trend	Winter Trend
White-breasted Nuthatch	Potential extirpation	Worsening*
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	-	Stable
House Wren	Potential extirpation	Potential colonization
Sedge Wren	-	Potential colonization
Marsh Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Blue-gray Gnatcatcher	Potential colonization	-
American Robin	Worsening	Improving
Gray Catbird	Potential extirpation	Stable
Northern Mockingbird	Improving	Improving
European Starling	Worsening	Stable
American Pipit	-	Potential colonization
Smith's Longspur	-	Potential colonization
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	-	Potential colonization
Northern Parula	Potential colonization	-
Yellow Warbler	Potential extirpation	-
Pine Warbler	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Chipping Sparrow	Potential extirpation	Improving
Vesper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Stable
Dark-eyed Junco	-	Worsening
Northern Cardinal	Improving	Worsening
Blue Grosbeak	Potential colonization	-
Indigo Bunting	Improving*	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Boat-tailed Grackle	Potential colonization^	-
Great-tailed Grackle	Potential colonization	-
Brown-headed Cowbird	Stable	-
House Finch	-	Potential extirpation
Purple Finch	-	Stable
American Goldfinch	Potential extirpation	Worsening
House Sparrow	x	Worsening