Birds and Climate Change

National Park Service
U.S. Department of the Interior

Valley Forge National Historical Park

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 Valley Forge National Historical Park (hereafter, the Park) 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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Park 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 Park, 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 Park today, climate suitability in summer under the high-emissions pathway is projected to improve for 30, remain stable for 14 (e.g., Figure 2), and worsen for 12 species. Suitable climate ceases to occur for 19 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 19 species not found at the Park today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 48, remain stable for 24, and worsen for 10 species. Suitable climate ceases to occur for 6 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 29 species not found at the Park today, potentially resulting in local colonization.

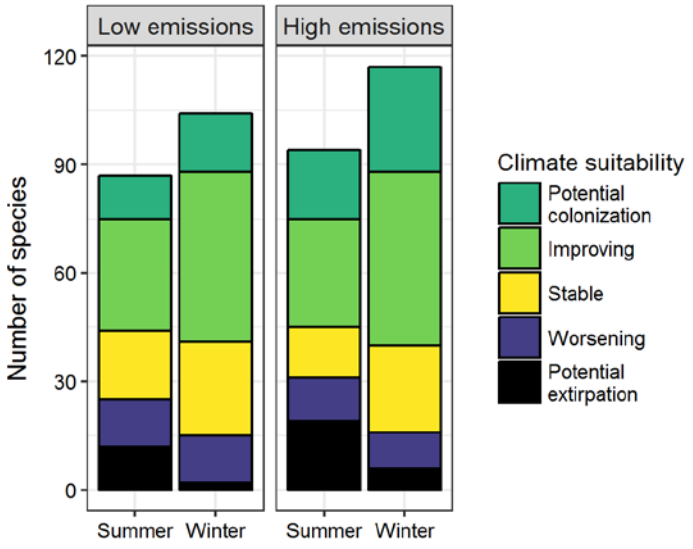

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.22 in summer (35th percentile across all national parks) and 0.19 in winter (25th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.11 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 Park 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 Park may serve as an important refuge for 9 of these climate-sensitive species, 2 might be extirpated from the Park in at least one season by 2050.

Figure 2. Climate at the Park 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, Valley Forge National Historical Park 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 9 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 Park based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Park 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
Mute Swan	x	Potential extirpation
Wood Duck	x	Improving
Gadwall	-	Improving
American Black Duck	-	Potential extirpation
Mallard	Potential extirpation^	Stable
Blue-winged Teal	-	Potential colonization
Green-winged Teal	-	Improving
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Greater Scaup	-	Improving*^
Lesser Scaup	-	Improving
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Hooded Merganser	-	Improving^
Common Merganser	x	Stable
Red-breasted Merganser	-	Improving^
Pied-billed Grebe	-	Improving
Eared Grebe	-	Potential colonization
Double-crested Cormorant	x	Improving
American White Pelican	-	Potential colonization
Great Blue Heron	Improving	Improving
Great Egret	Improving*	Potential colonization
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving

Common Name	Summer Trend	Winter Trend
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	x	Worsening*
Bald Eagle	x	Improving
Red-shouldered Hawk	Improving	Improving
Red-tailed Hawk	Improving	Stable
Rough-legged Hawk	-	Stable
American Coot	-	Improving
Killdeer	Improving	Improving
Greater Yellowlegs	-	Potential colonization
Dunlin	-	Potential colonization^
Least Sandpiper	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Ring-billed Gull	Potential extirpation^	Improving
Herring Gull	-	Stable^
Great Black-backed Gull	-	Potential extirpation
Forster's Tern	-	Potential colonization
Rock Pigeon	Worsening	Worsening
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Improving	Improving
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Potential extirpation	-
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Eastern Screech-Owl	x	Worsening*
Great Horned Owl	-	Worsening*

Common Name	Summer Trend	Winter Trend
Common Nighthawk	Potential colonization	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Stable	Improving
Red-bellied Woodpecker	Improving	Stable
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Worsening	Stable
Northern Flicker	Stable	Stable
Pileated Woodpecker	Improving	Improving
American Kestrel	x	Stable
Merlin	-	Improving^
Peregrine Falcon	-	Stable
Eastern Wood-Pewee	Improving	-
Acadian Flycatcher	Stable	-
Willow Flycatcher	Potential extirpation	-
Eastern Phoebe	Improving	Potential colonization
Great Crested Flycatcher	Improving	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	Potential colonization
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Stable	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Worsening

Common Name	Summer Trend	Winter Trend
American Crow	Worsening	Stable
Fish Crow	Stable	Stable
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Improving	Improving
Black-capped Chickadee	-	Potential extirpation
Tufted Titmouse	Improving	Improving
White-breasted Nuthatch	Worsening	Worsening
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	-	Worsening
House Wren	Potential extirpation	Potential colonization
Pacific/Winter Wren	-	Improving
Sedge Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Improving
Veery	Potential extirpation	-
Hermit Thrush	-	Improving
Wood Thrush	Potential extirpation	-
American Robin	Worsening	Stable
Gray Catbird	Potential extirpation	Potential extirpation
Brown Thrasher	Stable	-
Northern Mockingbird	Improving	Improving

Common Name	Summer Trend	Winter Trend
European Starling	Worsening	Stable
American Pipit	-	Improving*
Cedar Waxwing	Potential extirpation	Stable
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Blue-winged Warbler	Stable	-
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Improving*
Common Yellowthroat	Worsening	Potential colonization
American Redstart	Potential extirpation	-
Northern Parula	Improving*	-
Yellow Warbler	Potential extirpation	-
Palm Warbler	-	Potential colonization^
Pine Warbler	-	Potential colonization
Yellow-rumped Warbler	-	Improving
Prairie Warbler	Stable	-
Eastern Towhee	Potential extirpation	x
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Improving	Improving
Vesper Sparrow	-	Potential colonization
Lark Sparrow	Potential colonization	-
Savannah Sparrow	-	Improving*

Common Name	Summer Trend	Winter Trend
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Seaside Sparrow	Potential colonization^	-
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Stable
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Stable
Blue Grosbeak	Improving*	-

Common Name	Summer Trend	Winter Trend
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Improving	Improving
Rusty Blackbird	-	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Stable	-
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Potential extirpation
Pine Siskin	-	Improving
American Goldfinch	Worsening	Stable
House Sparrow	x	Worsening