Birds and Climate Change

National Park Service
U.S. Department of the Interior

Petersburg National Battlefield

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 Petersburg National Battlefield (hereafter, the Battlefield) 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 Battlefield based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Battlefield 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 Battlefield, 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 Battlefield today, climate suitability in summer under the high-emissions pathway is projected to improve for 10, remain stable for 22, and worsen for 17 species. Suitable climate ceases to occur for 23 species in summer, potentially resulting in extirpation of those species from the Battlefield (e.g., Figure 2). Climate is projected to become suitable in summer for 21 species not found at the Battlefield today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 48, remain stable for 31, and worsen for 5 species. Suitable climate ceases to occur for 8 species in winter, potentially resulting in extirpation from the Battlefield. Climate is projected to become suitable in winter for 47 species not found at the Battlefield today, potentially resulting in local colonization.

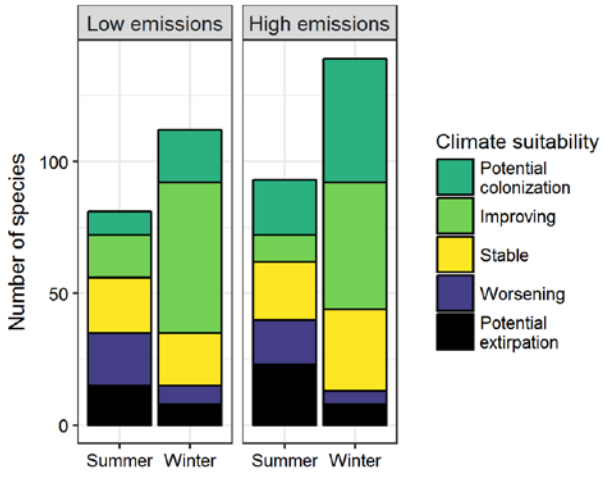

Figure 1. Projected changes in climate suitability for birds at the Battlefield, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Battlefield between the present and 2050 is 0.22 in summer (35th percentile across all national parks) and 0.22 in winter (30th percentile) under the high-emissions pathway. Potential species turnover declines to 0.10 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 Battlefield is or may become home to 9 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 Battlefield may serve as an important refuge for 6 of these climate-sensitive species, 3 might be extirpated from the Battlefield in at least one season by 2050.

Figure 2. Although currently found at the Battlefield, 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, Petersburg National Battlefield 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 6 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 Battlefield based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Battlefield 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
Fulvous Whistling-Duck	Potential colonization	-
Cackling/Canada Goose	x	Potential extirpation
Mute Swan	-	Potential extirpation
Wood Duck	x	Improving
Gadwall	-	Improving
American Wigeon	-	Improving
American Black Duck	-	Potential extirpation
Mallard	Potential extirpation^	Stable
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Improving*
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Lesser Scaup	-	Improving
Bufflehead	-	Improving
Hooded Merganser	-	Stable^
Red-breasted Merganser	-	Stable^
Ruddy Duck	-	Improving*
Northern Bobwhite	Stable	-
Wild Turkey	x	Stable
Pied-billed Grebe	-	Improving
Horned Grebe	-	Stable
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Improving
Anhinga	-	Potential colonization
American White Pelican	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Brown Pelican	-	Potential colonization^
Great Blue Heron	Stable	Improving
Great Egret	Improving*	Potential colonization
Little Blue Heron	Potential colonization	-
Cattle Egret	-	Potential colonization
Green Heron	Improving	-
Black-crowned Night-Heron	-	Potential colonization
White Ibis	Potential colonization	Potential colonization
Black Vulture	Stable	Improving
Turkey Vulture	x	Improving
Osprey	x	Improving
Mississippi Kite	Improving*	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	-	Improving
Bald Eagle	-	Stable
Harris's Hawk	Potential colonization	-
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Improving	Improving
Red-tailed Hawk	-	Improving
Ferruginous Hawk	-	Potential colonization
King Rail	-	Potential colonization^
Virginia Rail	-	Potential colonization
Sora	-	Potential colonization
American Coot	-	Improving
Killdeer	Stable	Improving
Spotted Sandpiper	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Western Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Wilson's Snipe	-	Stable
Bonaparte's Gull	-	Improving
Laughing Gull	Potential extirpation^	Potential extirpation
Ring-billed Gull	-	Stable
Herring Gull	-	Potential extirpation^
Great Black-backed Gull	-	Potential extirpation
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Improving*
Rock Pigeon	Potential extirpation	Stable
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Potential colonization	-
Groove-billed Ani	-	Potential colonization
Barn Owl	-	Potential colonization
Great Horned Owl	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Common Nighthawk	Potential colonization	-
Common Pauraque	-	Potential colonization
Chimney Swift	Worsening	-
Black-chinned Hummingbird	Potential colonization	-
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Stable	Improving
Red-bellied Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Worsening	Stable
Hairy Woodpecker	Potential extirpation	Worsening*
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Improving	Stable
Gilded Flicker	Potential colonization	-
Pileated Woodpecker	Stable	Stable
Eastern Wood-Pewee	Worsening	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Worsening	Improving
Great Crested Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Worsening	-
White-eyed Vireo	Stable	Potential colonization
Yellow-throated Vireo	Worsening	-
Warbling Vireo	Potential extirpation	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Stable
American Crow	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Fish Crow	Stable	Improving
Purple Martin	Stable	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Potential colonization	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Worsening	Stable
White-breasted Nuthatch	Potential extirpation	Worsening*
Brown-headed Nuthatch	-	Improving*
Brown Creeper	-	Worsening
House Wren	Potential extirpation	Improving
Pacific/Winter Wren	-	Stable
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Improving
Hermit Thrush	-	Stable
Wood Thrush	Worsening	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	-
Brown Thrasher	Worsening	Improving
Northern Mockingbird	Stable	Stable
European Starling	Potential extirpation	Stable
American Pipit	-	Improving*

Common Name	Summer Trend	Winter Trend
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Chestnut-collared Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Black-and-white Warbler	Potential extirpation	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Improving*
Common Yellowthroat	Potential extirpation	Potential colonization
Hooded Warbler	Improving*	-
Northern Parula	Worsening	-
Palm Warbler	-	Stable^
Pine Warbler	Stable^	Improving
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Worsening	Potential colonization
Prairie Warbler	Stable	-
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	Potential colonization	Potential colonization
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	-	Stable
Lark Sparrow	Potential colonization	-
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Improving

Common Name	Summer Trend	Winter Trend
Grasshopper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Fox Sparrow	-	Stable
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Improving
White-throated Sparrow	-	Improving
Dark-eyed Junco	-	Worsening
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Improving
Blue Grosbeak	Worsening	-
Indigo Bunting	Stable	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Stable	Stable
Common Grackle	Worsening*	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
Orchard Oriole	Improving*	-
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Stable
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Stable
House Sparrow	x	Worsening