Birds and Climate Change

National Park Service
U.S. Department of the Interior

Gateway National Recreation Area

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 Gateway National Recreation Area (hereafter, the Recreation Area) 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Recreation Area 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 Recreation Area, 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 Recreation Area today, climate suitability in summer under the high-emissions pathway is projected to improve for 52, remain stable for 50, and worsen for 15 species. Suitable climate ceases to occur for 27 species in summer, potentially resulting in extirpation of those species from the Recreation Area (e.g., Figure 2). Climate is projected to become suitable in summer for 14 species not found at the Recreation Area today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 68, remain stable for 54, and worsen for 17 species. Suitable climate ceases to occur for 13 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 28 species not found at the Recreation Area today, potentially resulting in local colonization.

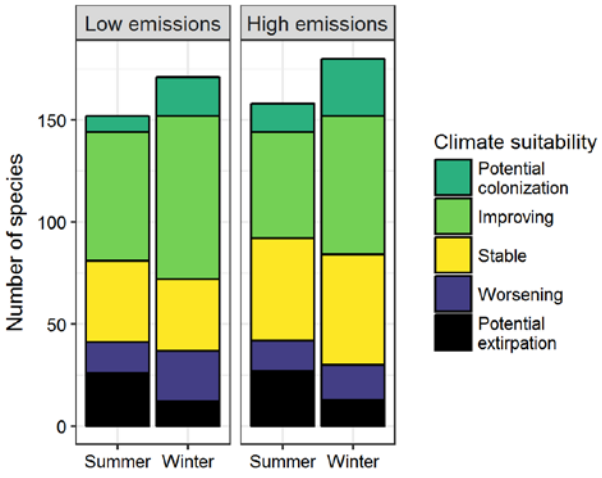

Figure 1. Projected changes in climate suitability for birds at the Recreation Area, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Recreation Area between the present and 2050 is 0.24 in summer (39th percentile across all national parks) and 0.19 in winter (25th percentile) under the high-emissions pathway. Potential species turnover declines to 0.18 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 Recreation Area is or may become home to 33 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 Recreation Area may serve as an important refuge for 32 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Recreation Area in summer by 2050.

Figure 2. Although currently found at the Recreation Area, 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, Gateway National Recreation Area 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 32 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Recreation Area 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	Improving	-
Brant	x	Stable
Cackling/Canada Goose	x	Worsening
Mute Swan	x	Potential extirpation
Wood Duck	x	Improving
Gadwall	Improving^	Improving
Eurasian Wigeon	-	Improving
American Wigeon	Improving^	Improving
American Black Duck	x	Worsening*
Mallard	Potential extirpation^	Worsening
Blue-winged Teal	Improving	Improving
Northern Shoveler	Improving^	Improving
Northern Pintail	Potential extirpation	x
Green-winged Teal	x	Improving
Canvasback	x	Improving

Common Name	Summer Trend	Winter Trend
Redhead	Improving^	x
Ring-necked Duck	-	Improving
Greater Scaup	Improving	Improving^
Lesser Scaup	x	Improving
Common Eider	x	Stable
Harlequin Duck	-	Stable
Surf Scoter	x	Improving
White-winged Scoter	-	Stable
Black Scoter	x	Improving
Long-tailed Duck	Stable	Stable
Bufflehead	x	Improving
Common Goldeneye	-	Stable
Barrow's Goldeneye	-	Improving^
Hooded Merganser	x	Improving^
Common Merganser	-	Stable
Red-breasted Merganser	Improving	Improving^
Ruddy Duck	Stable	Improving

Common Name	Summer Trend	Winter Trend
Northern Bobwhite	Improving	Stable
Ring-necked Pheasant	Potential extirpation	Potential extirpation
Wild Turkey	x	Potential extirpation
Red-throated Loon	Stable	Stable
Common Loon	Improving	Improving^
Pied-billed Grebe	x	Stable
Horned Grebe	x	Improving
Red-necked Grebe	-	Stable^
Eared Grebe	-	Improving
Western Grebe	-	Stable
Northern Gannet	Improving^	Stable^
Double-crested Cormorant	x	Improving
Great Cormorant	x	Stable
American White Pelican	x	Improving*
Brown Pelican	Stable	Stable^
American Bittern	Stable	Improving^
Great Blue Heron	Improving	Improving
Great Egret	Improving*	Improving*
Snowy Egret	x	Stable
Little Blue Heron	Improving*	-
Tricolored Heron	Stable^	-
Cattle Egret	Improving*	-
Green Heron	Improving*	-
Black-crowned Night-Heron	x	Stable
Yellow-crowned Night-Heron	Improving	-
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving
Golden Eagle	-	Stable
Mississippi Kite	Improving	-
Northern Harrier	Improving^	Improving
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	x	Worsening

Common Name	Summer Trend	Winter Trend
Northern Goshawk	-	Potential extirpation
Bald Eagle	x	Improving
Red-shouldered Hawk	Potential colonization	Improving
Red-tailed Hawk	Improving*	Worsening
Rough-legged Hawk	-	Potential extirpation
Clapper Rail	x	Stable
King Rail	-	Potential colonization^
Virginia Rail	x	Improving
American Coot	x	Stable
American Oystercatcher	x	Stable^
Black-bellied Plover	x	Stable
Semipalmated Plover	Stable	-
Killdeer	Improving	Improving
Solitary Sandpiper	Stable	-
Greater Yellowlegs	Improving	Improving*
Willet	Improving^	Stable^
Lesser Yellowlegs	Stable^	Potential colonization
Marbled Godwit	Stable^	Potential colonization
Ruddy Turnstone	x	Stable^
Red Knot	x	Stable^
Sanderling	x	Stable
Dunlin	x	Improving^
Purple Sandpiper	-	Stable
Least Sandpiper	x	Potential colonization
Western Sandpiper	Stable	Potential colonization
Long-billed Dowitcher	x	Potential colonization
Wilson's Snipe	Improving	Stable
American Woodcock	x	Improving
Wilson's Phalarope	Stable^	-

Common Name	Summer Trend	Winter Trend
Red-necked Phalarope	Stable	-
Pigeon Guillemot	Potential colonization	-
Bonaparte's Gull	Stable	Improving
Laughing Gull	Stable^	Improving
Ring-billed Gull	Improving^	Improving
Herring Gull	Improving	Improving^
Iceland Gull (Thayer's)	-	Potential colonization
Glaucous-winged Gull	Potential colonization	-
Glaucous Gull	Stable	x
Great Black-backed Gull	x	Stable
Black Tern	Improving	-
Forster's Tern	x	Potential colonization
Rock Pigeon	Worsening	Potential extirpation
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Stable	Stable
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Stable	-
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	x	Improving
Great Horned Owl	x	Worsening*
Snowy Owl	-	Stable
Barred Owl	-	Improving
Common Nighthawk	Potential colonization	-
Chuck-will's-widow	Improving	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Improving*	-
Belted Kingfisher	Stable	Stable
Red-bellied Woodpecker	Improving	Stable
Yellow-bellied Sapsucker	-	Improving

Common Name	Summer Trend	Winter Trend
Downy Woodpecker	Improving	Worsening
Hairy Woodpecker	Stable	Worsening
Red-cockaded Woodpecker	-	Potential colonization
Northern Flicker	Improving	Stable
Pileated Woodpecker	Potential colonization	Potential colonization
American Kestrel	x	Improving
Merlin	x	Improving^
Peregrine Falcon	x	Stable
Olive-sided Flycatcher	Improving	-
Eastern Wood-Pewee	Stable	-
Yellow-bellied Flycatcher	Stable	-
Acadian Flycatcher	Stable	-
Alder Flycatcher	Stable	-
Willow Flycatcher	Potential extirpation	-
Least Flycatcher	Stable	-
Eastern Phoebe	Stable	Potential colonization
Great Crested Flycatcher	Stable	-
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Potential colonization	Potential colonization
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Improving	Potential colonization
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Worsening	-
Warbling Vireo	Worsening*	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Stable	Worsening
American Crow	Worsening	Worsening

Common Name	Summer Trend	Winter Trend
Fish Crow	Improving	Improving
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Potential extirpation	Stable
Northern Rough-winged Swallow	Improving	-
Purple Martin	Improving*	-
Tree Swallow	Potential extirpation	Improving
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Carolina Chickadee	Improving	Improving*
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Worsening	Worsening
Red-breasted Nuthatch	-	Stable
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Potential colonization^	Potential colonization
Brown Creeper	-	Worsening*
House Wren	Potential extirpation	Potential colonization
Pacific/Winter Wren	-	Improving
Sedge Wren	-	Potential colonization
Marsh Wren	x	Improving
Carolina Wren	Improving	Stable
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	Stable	Improving
Eastern Bluebird	Stable	Stable
Veery	Potential extirpation	-
Swainson's Thrush	Stable	-
Hermit Thrush	-	Improving
Wood Thrush	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
American Robin	Worsening	Stable
Gray Catbird	Potential extirpation	Stable
Brown Thrasher	Worsening	Improving*
Northern Mockingbird	Improving	Improving
European Starling	Worsening	Stable
American Pipit	-	Improving*
Bohemian Waxwing	-	Stable
Cedar Waxwing	Potential extirpation	Stable
Smith's Longspur	-	Potential colonization
Snow Bunting	-	Potential extirpation
Ovenbird	Stable	-
Worm-eating Warbler	Worsening	-
Northern Waterthrush	Stable	-
Blue-winged Warbler	Potential extirpation	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Improving*
Mourning Warbler	Stable	-
Common Yellowthroat	Worsening	Improving
American Redstart	Potential extirpation	-
Northern Parula	Stable	-
Magnolia Warbler	Stable	-
Bay-breasted Warbler	Stable	-
Blackburnian Warbler	Stable	-
Yellow Warbler	Potential extirpation	-
Blackpoll Warbler	Improving	-
Palm Warbler	-	Improving^

Common Name	Summer Trend	Winter Trend
Pine Warbler	-	Potential colonization
Yellow-rumped Warbler	Stable	Improving
Prairie Warbler	Stable	-
Black-throated Green Warbler	Stable	-
Canada Warbler	Stable	-
Wilson's Warbler	Stable	-
Yellow-breasted Chat	Improving*	x
Eastern Towhee	Worsening*	x
Bachman's Sparrow	-	Potential colonization
American Tree Sparrow	-	Potential extirpation
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Stable	Stable
Vesper Sparrow	-	Potential colonization
Savannah Sparrow	Potential extirpation	Improving*
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Seaside Sparrow	Improving^	-^
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Worsening
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	Potential extirpation	Improving
White-throated Sparrow	Stable	Stable
Harris's Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Worsening
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Worsening
Rose-breasted Grosbeak	Potential extirpation	-
Blue Grosbeak	Improving*	-
Indigo Bunting	Improving	-
Painted Bunting	Potential colonization	-
Bobolink	Potential extirpation	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Improving*	Improving
Rusty Blackbird	-	Improving
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Boat-tailed Grackle	Improving^	Stable^
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Stable	-
Baltimore Oriole	Worsening*	-
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Stable
White-winged Crossbill	-	Stable
Common Redpoll	-	Stable
Pine Siskin	-	Stable
American Goldfinch	Potential extirpation	Worsening
House Sparrow	x	Worsening