Birds and Climate Change

National Park Service
U.S. Department of the Interior

Voyageurs National 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 Voyageurs National 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 25 (e.g., Figure 2), remain stable for 20, and worsen for 10 species. Suitable climate ceases to occur for 37 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 21 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 8, remain stable for 1, and worsen for 5 species. Suitable climate ceases to occur for 4 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 26 species not found at the Park today, potentially resulting in local colonization.

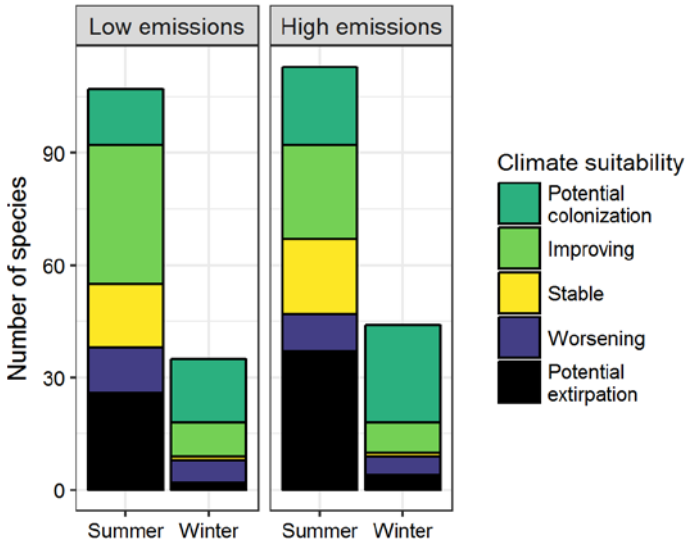

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.41 in summer (73rd percentile across all national parks) and 0.45 in winter (75th percentile) under the high-emissions pathway. Potential species turnover declines to 0.31 in summer and 0.33 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 7 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 4 of these climate-sensitive species, 3 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 American Goldfinch (*Spinus tristis*) through 2050. 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, Voyageurs National Park falls within the high turnover group.** Parks anticipating high turnover can focus on actions that increase species' ability to respond to environmental change, such as increasing the amount of potential habitat, working with cooperating agencies and landowners to improve habitat connectivity for birds across boundaries, managing the disturbance regime, and possibly more intensive management actions. Furthermore, park managers have an opportunity to focus on supporting the 4 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	Potential colonization
American Wigeon	Stable^	-
American Black Duck	-	Potential colonization
Mallard	Worsening^	-
Common Goldeneye	x	Improving
Common Merganser	x	Potential colonization
Red-breasted Merganser	Potential extirpation	-
Ring-necked Pheasant	Potential colonization	Potential colonization
Ruffed Grouse	x	Worsening*
Wild Turkey	-	Potential colonization
Common Loon	Worsening	-
Red-necked Grebe	Potential extirpation	-
American Bittern	Worsening	-
Great Blue Heron	Improving	-

Common Name	Summer Trend	Winter Trend
Great Egret	Potential colonization	-
Green Heron	Potential colonization	-
Sharp-shinned Hawk	-	Potential colonization
Red-tailed Hawk	Stable	Potential colonization
Rough-legged Hawk	-	Potential colonization
Killdeer	Improving	-
Wilson's Snipe	-	Potential colonization
Ring-billed Gull	Stable^	-
Herring Gull	Potential extirpation	-
Iceland Gull (Thayer's)	-	Potential colonization
Mourning Dove	Improving	Potential colonization
Yellow-billed Cuckoo	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Eastern Screech-Owl	-	Potential colonization
Great Horned Owl	-	Potential colonization
Barred Owl	x	Improving
Common Nighthawk	Improving	-
Chimney Swift	Improving*	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Stable	-
Red-headed Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Improving*	Potential colonization
Yellow-bellied Sapsucker	Stable	-
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Potential extirpation	Improving
Northern Flicker	Improving	Improving
Pileated Woodpecker	Stable	Worsening
American Kestrel	x	Potential colonization
Eastern Wood-Pewee	Improving	-
Alder Flycatcher	Potential extirpation	-
Willow Flycatcher	Potential colonization	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Stable	-
Great Crested Flycatcher	Stable	-
Eastern Kingbird	Improving	-
Loggerhead Shrike	Potential colonization	-
Bell's Vireo	Potential colonization	-
Red-eyed Vireo	Potential extirpation	-
Gray Jay	Potential extirpation	Potential extirpation

Common Name	Summer Trend	Winter Trend
Blue Jay	Improving	Stable
Black-billed Magpie	Potential extirpation^	-
American Crow	Stable	-
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	-	Potential colonization
Northern Rough-winged Swallow	Potential colonization	-
Purple Martin	Stable	-
Tree Swallow	Worsening	-
Barn Swallow	Improving	-
Cliff Swallow	Improving	-
Black-capped Chickadee	Worsening	Worsening
Red-breasted Nuthatch	Potential extirpation	Worsening
White-breasted Nuthatch	Improving*	-
Brown Creeper	Potential extirpation^	Improving
House Wren	Improving	-
Pacific/Winter Wren	Potential extirpation	-
Sedge Wren	Stable	-
Golden-crowned Kinglet	Potential extirpation	-
Ruby-crowned Kinglet	Potential extirpation	-
Eastern Bluebird	Improving*	-
Veery	Potential extirpation	-
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential extirpation	-
Wood Thrush	Stable	-
American Robin	Worsening	-
Gray Catbird	Stable	-
Brown Thrasher	Improving	-

Common Name	Summer Trend	Winter Trend
European Starling	Improving*	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Ovenbird	Potential extirpation	-
Blue-winged Warbler	Potential colonization	-
Golden-winged Warbler	Stable	-
Black-and-white Warbler	Potential extirpation	-
Tennessee Warbler	Potential extirpation	-
Nashville Warbler	Potential extirpation	-
Mourning Warbler	Worsening*	-
Common Yellowthroat	Improving	-
American Redstart	Potential extirpation	-
Northern Parula	Potential extirpation	-
Magnolia Warbler	Potential extirpation	-
Blackburnian Warbler	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Chestnut-sided Warbler	Potential extirpation	-
Palm Warbler	Stable	-
Pine Warbler	Stable^	-
Yellow-rumped Warbler	Potential extirpation	-
Black-throated Green Warbler	Potential extirpation	-
Canada Warbler	Potential extirpation	-
Eastern Towhee	Potential colonization	-
American Tree Sparrow	-	Potential colonization
Chipping Sparrow	Stable	-

Common Name	Summer Trend	Winter Trend
Clay-colored Sparrow	Worsening	-
Field Sparrow	Potential colonization	-
Vesper Sparrow	Potential colonization	-
Lark Sparrow	Potential colonization	-
Savannah Sparrow	Worsening	-
Grasshopper Sparrow	Potential colonization	-
Song Sparrow	Stable	-
Swamp Sparrow	Worsening*	-
White-throated Sparrow	Potential extirpation	-
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Scarlet Tanager	Stable	-
Northern Cardinal	Potential colonization	Potential colonization
Rose-breasted Grosbeak	Stable	-
Indigo Bunting	Potential colonization	-
Dickcissel	Potential colonization	-
Red-winged Blackbird	Improving	-
Eastern Meadowlark	Potential colonization	-
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Potential colonization
Common Grackle	Improving	-
Brown-headed Cowbird	Improving	-
Orchard Oriole	Potential colonization	-
Baltimore Oriole	Improving	-
Pine Grosbeak	Potential extirpation^	Potential extirpation
House Finch	Potential	Potential

Common Name	Summer Trend	Winter Trend
	colonization	colonization
Purple Finch	Potential extirpation	-
Common Redpoll	-	Worsening
Pine Siskin	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
American Goldfinch	Improving	Potential colonization
Evening Grosbeak	Potential extirpation	Potential extirpation
Eurasian Tree Sparrow	-	Potential colonization