Birds and Climate Change

National Park Service
U.S. Department of the Interior

Denali National Park and Preserve

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 Denali National Park and Preserve (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 26 (e.g., Figure 2), remain stable for 17, and worsen for 40 species. Suitable climate ceases to occur for 3 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 40 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 3, remain stable for 2, and worsen for 7 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 11 species not found at the Park today, potentially resulting in local colonization.

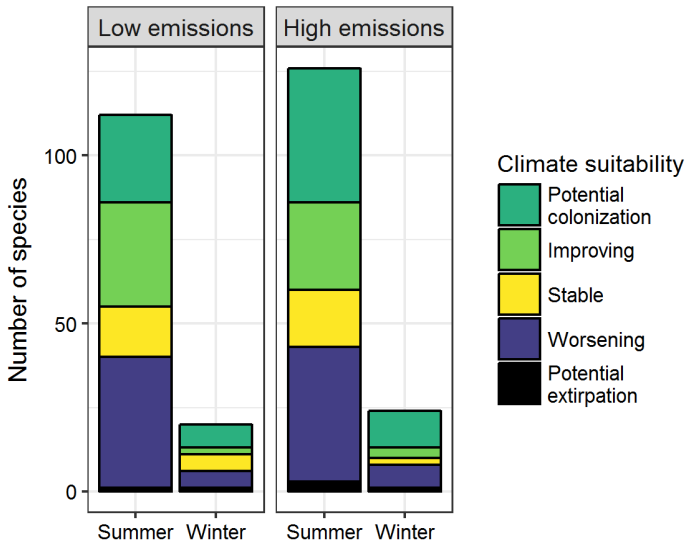

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.28 in summer (47th percentile across all national parks) and 0.19 in winter (25th percentile) under the high-emissions pathway. Potential species turnover declines to 0.20 in summer and 0.14 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 21 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 20 of these climate-sensitive species, one, the Smith's Longspur (*Calcarius pictus*), though only marginally present in the Park today, might be extirpated in summer by 2050.

Figure 2. Climate at the Park in summer is projected to remain suitable for the American Robin (*Turdus migratorius*) 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, Denali National Park and Preserve falls within the high potential colonization group.** Parks anticipating high potential colonization 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 20 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
Tundra Swan	Worsening	-
Gadwall	Improving^	-
American Wigeon	Worsening^	-
Mallard	Improving^	-
Blue-winged Teal	Improving	-
Northern Shoveler	Stable^	-
Northern Pintail	Worsening	-
Redhead	Improving^	-
Greater Scaup	Worsening	-
Common Eider	-	Potential colonization
Long-tailed Duck	Worsening	Potential colonization
Common Goldeneye	x	Potential colonization
Barrow's Goldeneye	x	Improving^
Common Merganser	x	Potential colonization
Red-breasted Merganser	Stable	-
Ruddy Duck	Potential	-

Common Name	Summer Trend	Winter Trend
	colonization	
Gray Partridge	Potential colonization	Potential colonization
Willow Ptarmigan	Worsening*	Worsening*
Rock Ptarmigan	Worsening	Worsening
Red-throated Loon	Worsening	-
Pacific Loon	Worsening	-
Common Loon	Improving	-
Red-necked Grebe	Worsening	-
American Bittern	Potential colonization	-
Northern Harrier	Improving^	-
Red-tailed Hawk	Improving	-
Rough-legged Hawk	Worsening	-
American Golden-Plover	Worsening	-
Semipalmated Plover	Worsening	-
Solitary Sandpiper	Stable	-
Greater Yellowlegs	Stable	-
Lesser Yellowlegs	Worsening*^	-

Common Name	Summer Trend	Winter Trend
Upland Sandpiper	Improving	-
Wilson's Snipe	Worsening	-
Red-necked Phalarope	Worsening	-
Long-tailed Jaeger	Worsening	-
Black Guillemot	-	Potential colonization
Bonaparte's Gull	Worsening	-
Franklin's Gull	Potential colonization	-
Mew Gull	Worsening*	-
Ring-billed Gull	Potential colonization^	-
Herring Gull	Improving	-
Glaucous-winged Gull	Stable	-
Black Tern	Potential colonization	-
Arctic Tern	Worsening	-
Rock Pigeon	Improving	-
Black-billed Cuckoo	Potential colonization	-
Great Horned Owl	x	Potential extirpation
Snowy Owl	-	Potential colonization
Northern Hawk Owl	x	Worsening*^
Rufous Hummingbird	Potential colonization	-
Belted Kingfisher	Improving	-
Yellow-bellied Sapsucker	Potential colonization	-
Red-breasted Sapsucker	Potential colonization	-
Downy Woodpecker	Improving	-
Hairy Woodpecker	Improving	-
Northern Flicker	Stable	-
Merlin	x	Improving^
Olive-sided Flycatcher	Worsening	-
Western Wood-Pewee	Stable^	-
Alder Flycatcher	Improving	-

Common Name	Summer Trend	Winter Trend
Least Flycatcher	Potential colonization	-
Hammond's Flycatcher	Worsening	-
Say's Phoebe	Potential extirpation	-
Northern Shrike	x	Potential colonization
Warbling Vireo	Potential colonization	-
Philadelphia Vireo	Potential colonization	-
Red-eyed Vireo	Potential colonization	-
Gray Jay	Worsening*	Worsening
Black-billed Magpie	Improving^	Worsening*
Common Raven	Improving	Worsening
Horned Lark	Potential extirpation	-
Tree Swallow	Improving	-
Violet-green Swallow	Worsening	-
Cliff Swallow	Improving	-
Black-capped Chickadee	Improving*	-
Boreal Chickadee	Worsening^	Worsening
Red-breasted Nuthatch	Improving*	Potential colonization
Brown Creeper	Improving^	-
Pacific/Winter Wren	Potential colonization	-
Sedge Wren	Potential colonization	-
Golden-crowned Kinglet	Improving	-
Ruby-crowned Kinglet	Stable	-
Arctic Warbler	Worsening*	-
Townsend's Solitaire	Stable^	-
Veery	Potential colonization	-
Gray-cheeked Thrush	Worsening*	-
Swainson's Thrush	Stable	-
Hermit Thrush	Improving	-

Common Name	Summer Trend	Winter Trend
American Robin	Improving	-
Varied Thrush	Worsening*^	-
American Pipit	Stable	-
Bohemian Waxwing	Worsening^	-
Cedar Waxwing	Potential colonization	-
Lapland Longspur	Worsening	-
Smith's Longspur	Potential extirpation^	-
Ovenbird	Potential colonization	-
Northern Waterthrush	Stable	-
Black-and-white Warbler	Potential colonization	-
Orange-crowned Warbler	Worsening*	-
Nashville Warbler	Potential colonization	-
MacGillivray's Warbler	Potential colonization	-
Mourning Warbler	Potential colonization	-
American Redstart	Potential colonization	-
Magnolia Warbler	Potential colonization	-
Bay-breasted Warbler	Potential colonization	-
Blackburnian Warbler	Potential colonization	-
Yellow Warbler	Improving	-
Chestnut-sided Warbler	Potential colonization	-
Blackpoll Warbler	Worsening	-
Yellow-rumped Warbler	Worsening	-
Townsend's Warbler	Stable	-
Black-throated Green Warbler	Potential colonization	-
Canada Warbler	Potential colonization	-
Wilson's Warbler	Worsening*	-
American Tree Sparrow	Worsening*	-
Chipping Sparrow	Potential colonization	-
Clay-colored Sparrow	Potential colonization	-
Savannah Sparrow	Stable	-
LeConte's Sparrow	Potential colonization^	-
Fox Sparrow	Worsening*	-
Lincoln's Sparrow	Stable	-
Swamp Sparrow	Potential colonization	-
White-throated Sparrow	Potential colonization	-
White-crowned Sparrow	Worsening*	-
Golden-crowned Sparrow	Worsening	-
Western Tanager	Potential colonization	-
Rose-breasted Grosbeak	Potential colonization	-
Rusty Blackbird	Stable	-
Brewer's Blackbird	Potential colonization	-
Pine Grosbeak	Worsening^	Stable
Purple Finch	Potential colonization	-
White-winged Crossbill	Stable	Improving
Common Redpoll	Worsening*	Stable
Pine Siskin	Improving	Potential colonization
Evening Grosbeak	Potential colonization	Potential colonization