Birds and Climate Change

National Park Service
U.S. Department of the Interior

Mount Rushmore National Memorial

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 Mount Rushmore National Memorial (hereafter, the Memorial) 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 Memorial based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Memorial 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 Memorial, 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 Memorial today, climate suitability in summer under the high-emissions pathway is projected to improve for 15, remain stable for 7, and worsen for 14 species. Suitable climate ceases to occur for 36 species in summer, potentially resulting in extirpation of those species from the Memorial (e.g., Figure 2). Climate is projected to become suitable in summer for 14 species not found at the Memorial today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 3, remain stable for 4, and worsen for 2 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Memorial. Climate is projected to become suitable in winter for 50 species not found at the Memorial today, potentially resulting in local colonization.

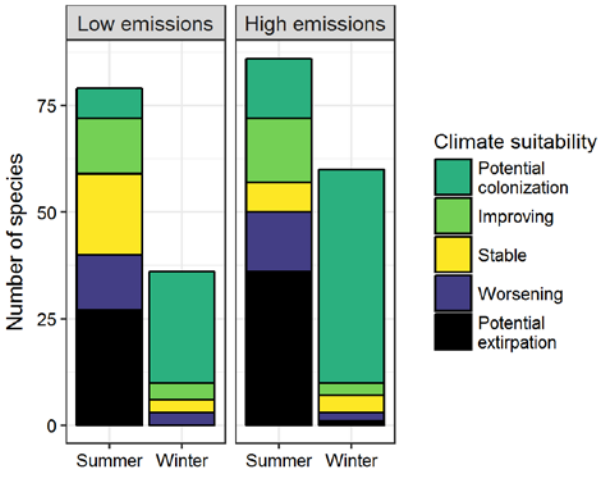

Figure 1. Projected changes in climate suitability for birds at the Memorial, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Memorial between the present and 2050 is 0.41 in summer (74th percentile across all national parks) and 0.45 in winter (76th percentile) under the high-emissions pathway. Potential species turnover declines to 0.26 in summer and 0.28 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 Memorial is or may become home to 10 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 Memorial may serve as an important refuge for 5 of these climate-sensitive species, 5 might be extirpated from the Memorial in at least one season by 2050.

Figure 2. Although currently found at the Memorial, suitable climate for the Violet-green Swallow (*Tachycineta thalassina*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by Becky Matsubara/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, Mount Rushmore National Memorial falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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 5 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 Memorial based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Memorial 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
Wood Duck	-	Potential colonization
Gadwall	-	Potential colonization
American Wigeon	-	Potential colonization
Mallard	Worsening*^	-
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Eared Grebe	-	Potential colonization
Western Grebe	-	Potential colonization
American White Pelican	x	Potential colonization
Great Blue Heron	Improving	Potential colonization
Northern Harrier	Worsening^	Potential colonization
Sharp-shinned Hawk	x	Potential colonization
Cooper's Hawk	x	Potential colonization
Red-tailed Hawk	Worsening	Potential colonization
Ferruginous Hawk	-	Potential colonization
Virginia Rail	-	Potential colonization

Common Name	Summer Trend	Winter Trend
American Coot	x	Potential colonization
Killdeer	-	Potential colonization
Wilson's Snipe	-	Potential colonization
Ring-billed Gull	-	Potential colonization
Iceland Gull (Thayer's)	-	Potential colonization
Rock Pigeon	Potential extirpation	Stable
Mourning Dove	Improving	Potential colonization
Barn Owl	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Eastern Screech-Owl	-	Potential colonization
Burrowing Owl	Improving^	-
Common Nighthawk	Improving*	-
Chimney Swift	Improving	-
Black-chinned Hummingbird	Potential colonization	-
Belted Kingfisher	Stable	-
Red-headed Woodpecker	Potential colonization	-
Red-bellied Woodpecker	-	Potential colonization
Red-naped Sapsucker	Potential extirpation^	-
Downy Woodpecker	Stable	-
Hairy Woodpecker	Potential extirpation	-
Northern Flicker	Potential extirpation	Improving
American Kestrel	x	Potential colonization
Western Wood-Pewee	Potential extirpation^	-

Common Name	Summer Trend	Winter Trend
Willow Flycatcher	Potential extirpation	-
Least Flycatcher	Potential extirpation	-
Dusky Flycatcher	Worsening	-
Cordilleran Flycatcher	Worsening	-
Eastern Phoebe	Improving	-
Great Crested Flycatcher	Improving	-
Eastern Kingbird	Worsening	-
Loggerhead Shrike	-	Potential colonization
Bell's Vireo	Potential colonization	-
Warbling Vireo	Worsening	-
Red-eyed Vireo	Potential extirpation	-
Gray Jay	Potential extirpation	-
Blue Jay	Improving*	-
Black-billed Magpie	Worsening^	Worsening*
American Crow	Potential extirpation	-
Horned Lark	Stable	-
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Worsening	-
Black-capped Chickadee	Potential extirpation	Worsening*
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	Stable
Pygmy Nuthatch	Improving	-
Brown Creeper	Potential extirpation^	-
Rock Wren	Improving	-

Common Name	Summer Trend	Winter Trend
Canyon Wren	x	Potential colonization
House Wren	Worsening	-
Marsh Wren	-	Potential colonization
Golden-crowned Kinglet	Potential extirpation	Potential colonization
Ruby-crowned Kinglet	Potential extirpation	-
Eastern Bluebird	-	Potential colonization
Mountain Bluebird	Potential extirpation	Potential colonization
Townsend's Solitaire	Potential extirpation^	Stable
Swainson's Thrush	Potential extirpation	-
American Robin	Worsening	Improving
Brown Thrasher	Potential colonization	-
Northern Mockingbird	Potential colonization	-
European Starling	Stable	-
Cedar Waxwing	Potential extirpation	Potential colonization
Chestnut-collared Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
MacGillivray's Warbler	Potential extirpation	-
Common Yellowthroat	Potential extirpation	-
American Redstart	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Potential colonization
Green-tailed Towhee	Potential colonization^	-
Spotted Towhee	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	Potential extirpation	-
Field Sparrow	Potential colonization	-
Lark Bunting	Worsening	-
Song Sparrow	Potential extirpation	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Western Tanager	Potential extirpation	-
Northern Cardinal	-	Potential colonization
Black-headed Grosbeak	Potential extirpation	-
Blue Grosbeak	Improving	-
Dickcissel	Potential colonization	-
Red-winged Blackbird	Worsening	Potential colonization
Eastern Meadowlark	Potential colonization	-
Western Meadowlark	Improving	Potential colonization
Brewer's Blackbird	Potential extirpation	Potential colonization
Common Grackle	Improving*	Potential colonization
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Potential colonization
Orchard Oriole	Potential colonization	-
Bullock's Oriole	Potential colonization	-
House Finch	Stable	-
Cassin's Finch	Stable	-

Common Name	Summer Trend	Winter Trend
Red Crossbill	Potential extirpation^	x
Pine Siskin	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
American Goldfinch	Potential extirpation	-