Birds and Climate Change

National Park Service
U.S. Department of the Interior

Great Sand Dunes 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 Great Sand Dunes 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 32, remain stable for 36, and worsen for 27 species. Suitable climate ceases to occur for 12 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 8 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 16, remain stable for 5, and worsen for 5 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 36 species not found at the Park today, potentially resulting in local colonization.

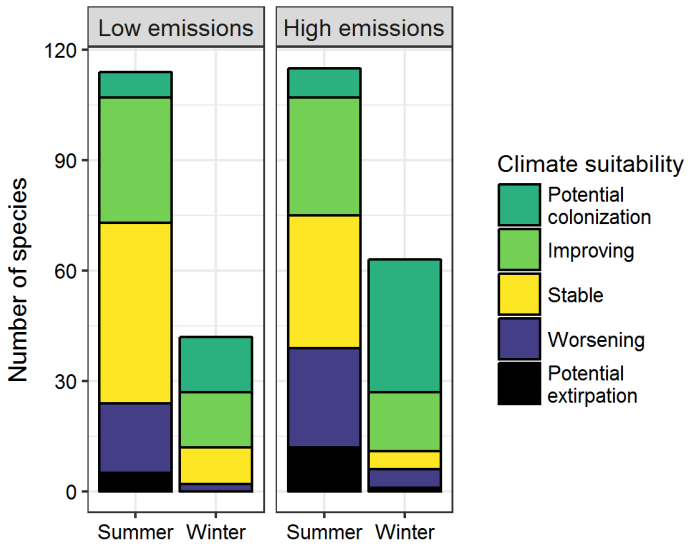

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.20 in summer (31st percentile across all national parks) and 0.28 in winter (43rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 in summer and 0.16 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 Ring-billed Gull (*Larus delawarensis*), might be extirpated from the Park in summer by 2050.

Figure 2. Although currently found at the Park, suitable climate for the American Robin (*Turdus migratorius*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. 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, Great Sand Dunes National Park and Preserve 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 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
Gadwall	Stable^	Potential colonization
American Wigeon	-	Potential colonization
Mallard	Worsening^	Stable
Northern Shoveler	Stable^	Potential colonization
Redhead	Worsening^	-
Common Merganser	x	Improving
Ruddy Duck	Stable	-
Eared Grebe	x	Potential colonization
Great Blue Heron	Improving	-
Golden Eagle	x	Stable
Northern Harrier	Worsening^	-
Sharp-shinned Hawk	-	Potential colonization
Harris's Hawk	Potential colonization	-
Swainson's Hawk	Stable^	-

Common Name	Summer Trend	Winter Trend
Red-tailed Hawk	Improving	Improving*
Rough-legged Hawk	-	Worsening*
Virginia Rail	-	Potential colonization
Killdeer	Stable	-
Wilson's Phalarope	Stable^	-
Franklin's Gull	Potential extirpation	-
Ring-billed Gull	Potential extirpation^	-
Black Tern	Stable	-
Rock Pigeon	Improving	Potential colonization
Band-tailed Pigeon	Potential colonization	-
Eurasian Collared-Dove	x	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Improving	Improving*

Common Name	Summer Trend	Winter Trend
Greater Roadrunner	-	Potential colonization
Western Screech-Owl	x	Potential colonization
Great Horned Owl	x	Stable
Burrowing Owl	Improving^	-
Common Nighthawk	Improving*	-
Black-chinned Hummingbird	Improving	-
Broad-tailed Hummingbird	Worsening*	-
Red-naped Sapsucker	Stable^	Potential colonization
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Stable	-
Hairy Woodpecker	Improving	Stable
Northern Flicker	Worsening	Improving
American Kestrel	x	Improving
Merlin	-	Potential colonization^
Olive-sided Flycatcher	Worsening	-
Western Wood-Pewee	Stable^	-
Willow Flycatcher	Potential extirpation	-
Hammond's Flycatcher	Worsening	-
Gray Flycatcher	Improving	-
Dusky Flycatcher	Worsening*	-
Cordilleran Flycatcher	Stable	-
Say's Phoebe	Improving*	Potential colonization
Ash-throated Flycatcher	Improving	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Improving*	-
Loggerhead Shrike	Improving*	Potential colonization
Warbling Vireo	Worsening	-
Gray Jay	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Pinyon Jay	Improving	-
Steller's Jay	Stable	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Improving*
Black-billed Magpie	Stable^	Worsening*
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Stable	-
Chihuahuan Raven	Potential colonization	-
Common Raven	Improving	Worsening*
Horned Lark	Stable	Improving
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Worsening	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Stable	Worsening
Mountain Chickadee	Worsening*	Stable
Oak/Juniper Titmouse (Plain Titmouse)	-	Potential colonization
Bushtit	Stable	Improving*
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Improving*	Improving
Pygmy Nuthatch	Improving	Improving^
Brown Creeper	Stable^	-
Rock Wren	Stable	Potential colonization
House Wren	Stable	-
Marsh Wren	-	Potential colonization
Bewick's Wren	Improving	Potential colonization
Blue-gray Gnatcatcher	Stable	-
Golden-crowned Kinglet	Stable	-

Common Name	Summer Trend	Winter Trend
Ruby-crowned Kinglet	Worsening*	-
Western Bluebird	Improving	Potential colonization
Mountain Bluebird	Worsening*	Improving*
Townsend's Solitaire	Worsening^	Improving
Hermit Thrush	Stable	-
American Robin	Potential extirpation	Improving
Gray Catbird	Stable	-
Curve-billed Thrasher	Potential colonization	Potential colonization
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	-	Potential colonization
Sage Thrasher	Stable	-
Northern Mockingbird	Improving*	-
European Starling	Stable	Improving
Cedar Waxwing	Potential extirpation	-
Chestnut-collared Longspur	-	Potential colonization
Orange-crowned Warbler	Stable	-
MacGillivray's Warbler	Worsening	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	-
Wilson's Warbler	Worsening	-
Green-tailed Towhee	Worsening*^	Potential colonization
Spotted Towhee	Improving	-
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	Stable	-
Brewer's Sparrow	Worsening*	-

Common Name	Summer Trend	Winter Trend
Vesper Sparrow	Worsening*	-
Lark Sparrow	Improving*	-
Black-throated Sparrow	-	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	Stable^	Potential colonization
Savannah Sparrow	Potential extirpation	-
Song Sparrow	Potential extirpation	Potential colonization
Lincoln's Sparrow	Worsening*	-
White-crowned Sparrow	Worsening*	Potential colonization
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Black-headed Grosbeak	Improving*	-
Blue Grosbeak	Potential colonization	-
Red-winged Blackbird	Worsening	Potential colonization
Western Meadowlark	Stable	Improving*
Yellow-headed Blackbird	Improving	-
Brewer's Blackbird	Worsening	-
Common Grackle	Improving	-
Great-tailed Grackle	Improving	Potential colonization
Brown-headed Cowbird	Stable	-
Bullock's Oriole	Improving	-
Scott's Oriole	Potential colonization	-
Pine Grosbeak	Worsening^	-
House Finch	Improving*	-
Cassin's Finch	Worsening	-
Red Crossbill	Stable^	-
Pine Siskin	Worsening	-
Lesser Goldfinch	Improving	-
American Goldfinch	Stable	Potential colonization

Common Name	Summer Trend	Winter Trend
Evening Grosbeak	Improving	-

Common Name	Summer Trend	Winter Trend
House Sparrow	x	Potential colonization