Birds and Climate Change

National Park Service
U.S. Department of the Interior

Cedar Breaks National Monument

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 Cedar Breaks National Monument (hereafter, the Monument) 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 12, remain stable for 27 (e.g., Figure 2), and worsen for 14 species. Suitable climate ceases to occur for 8 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 13 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 12, 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 Monument. Climate is projected to become suitable in winter for 49 species not found at the Monument today, potentially resulting in local colonization.

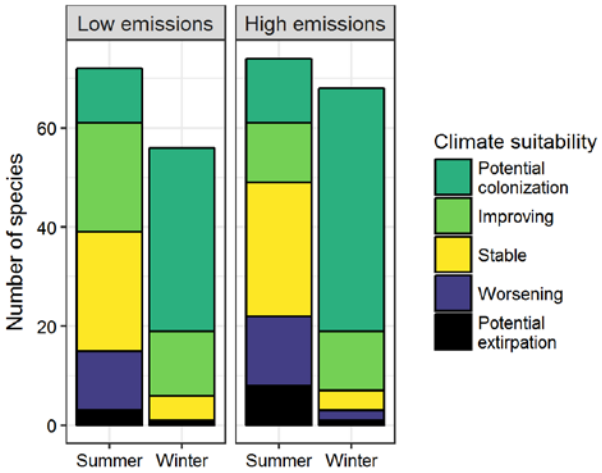

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.22 in summer (36th percentile across all national parks) and 0.39 in winter (64th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.34 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 Monument is or may become home to 12 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 Monument may serve as an important refuge for 11 of these climate-sensitive species, one, the Pine Grosbeak (*Pinicola enucleator*), might be extirpated from the Monument in summer by 2050.

Figure 2. Climate at the Monument in summer is projected to remain suitable for the Chipping Sparrow (*Spizella passerina*) through 2050. Photo by Fyn Kynd/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, Cedar Breaks National Monument 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 11 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.

Contacts

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

Species Projections

Table 1. Climate suitability projections by 2050 under the high-emissions pathway for all birds currently present at the Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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	-	Potential colonization
Gadwall	Worsening^	Potential colonization
American Wigeon	-	Potential colonization
Mallard	Stable^	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Scaled Quail	-	Potential colonization
Gambel's Quail	Potential colonization	Potential colonization
Wild Turkey	-	Potential colonization
Eared Grebe	-	Potential colonization
Western Grebe	-	Potential colonization
Great Blue Heron	-	Potential colonization
Northern Harrier	-	Potential colonization
Sharp-shinned Hawk	-	Potential colonization
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Stable	-
Virginia Rail	-	Potential colonization
American Coot	x	Potential colonization
Mountain Plover	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Mourning Dove	Potential colonization	Potential colonization
Greater Roadrunner	-	Potential colonization
Black-chinned Hummingbird	Stable	-
Broad-tailed Hummingbird	Improving*	-
Lewis's Woodpecker	x	Improving
Red-naped Sapsucker	Worsening^	Improving
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Stable	Stable
Northern Flicker	Stable	Stable
American Kestrel	x	Potential colonization
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Stable^	-
Gray Flycatcher	Potential colonization	-
Dusky Flycatcher	Worsening*	-
Cordilleran Flycatcher	Improving*	-
Say's Phoebe	-	Potential colonization
Ash-throated Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Improving*	-
Loggerhead Shrike	-	Potential colonization
Warbling Vireo	Worsening*	-
Gray Jay	Potential extirpation	-
Pinyon Jay	Potential colonization	-
Steller's Jay	Stable	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Potential colonization

Common Name	Summer Trend	Winter Trend
Clark's Nutcracker	Stable^	Worsening*
American Crow	-	Potential colonization
Chihuahuan Raven	Potential colonization	-
Common Raven	Stable	Worsening*
Horned Lark	-	Potential colonization
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Potential extirpation	-
Mountain Chickadee	Stable	Stable
Juniper Titmouse	Improving	Improving
Bushtit	Improving	Potential colonization
Red-breasted Nuthatch	Worsening*	-
White-breasted Nuthatch	Improving*	Potential colonization
Brown Creeper	Stable^	Improving
Rock Wren	Stable	Potential colonization
House Wren	Improving	-
Marsh Wren	-	Potential colonization
Bewick's Wren	Potential colonization	Potential colonization
Ruby-crowned Kinglet	Worsening*	Improving
Western Bluebird	Improving	Potential colonization
Mountain Bluebird	Stable	Improving*
Townsend's Solitaire	Worsening^	-
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Stable	-
American Robin	Worsening	Improving
Curve-billed Thrasher	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Crissal Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
European Starling	-	Potential colonization
American Pipit	Potential extirpation	-
Chestnut-collared Longspur	-	Potential colonization
Orange-crowned Warbler	Worsening*	-
MacGillivray's Warbler	Worsening*	-
Yellow-rumped Warbler	Stable	-
Grace's Warbler	Potential colonization	-
Wilson's Warbler	Worsening	-
Yellow-breasted Chat	Potential colonization	-
Green-tailed Towhee	Stable^	Potential colonization
Spotted Towhee	Improving	-
Canyon Towhee	-	Potential colonization
Abert's Towhee	-	Potential colonization
Chipping Sparrow	Stable	-
Brewer's Sparrow	-	Potential colonization
Vesper Sparrow	Worsening	-
Black-throated Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Lincoln's Sparrow	Potential extirpation	-
White-crowned Sparrow	Potential extirpation	Improving
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Black-headed Grosbeak	Stable	-
Red-winged Blackbird	-	Potential colonization
Western Meadowlark	Stable	Potential colonization
Brewer's Blackbird	Stable	-
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Potential colonization	-
Scott's Oriole	Potential colonization	-
Pine Grosbeak	Potential extirpation^	-
House Finch	Improving*	Improving
Cassin's Finch	Stable	Stable
Red Crossbill	Worsening^	-
Pine Siskin	Worsening	Improving
Lesser Goldfinch	Improving*	Potential colonization
American Goldfinch	-	Improving*
House Sparrow	-	Potential colonization