Birds and Climate Change

National Park Service
U.S. Department of the Interior

Devils Tower 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 Devils Tower 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 20, remain stable for 21, and worsen for 24 species. Suitable climate ceases to occur for 34 species in summer, potentially resulting in extirpation of those species from the Monument (e.g., Figure 2). 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 9, remain stable for 3, and worsen for 6 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 45 species not found at the Monument today, potentially resulting in local colonization.

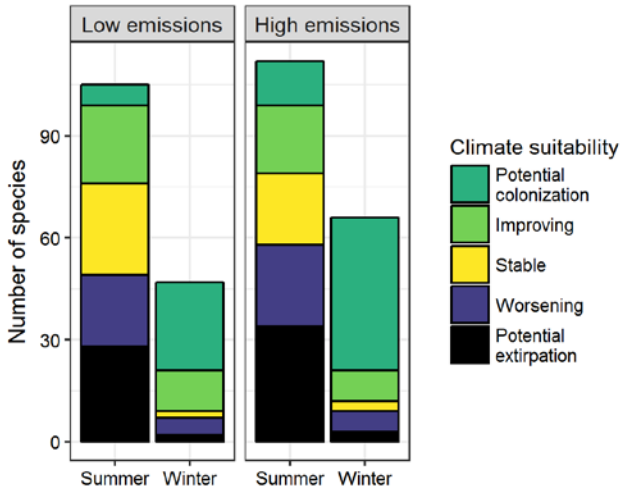

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.28 in summer (48th percentile across all national parks) and 0.34 in winter (54th percentile) under the high-emissions pathway. Potential species turnover declines to 0.19 in summer and 0.21 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 17 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, 6 might be extirpated from the Monument in at least one season by 2050.

Figure 2. Although currently found at the Monument, 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, Devils Tower 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.

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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 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	x	Potential colonization
Wood Duck	-	Potential colonization
Gadwall	Worsening*^	Potential colonization
American Wigeon	Potential extirpation^	-
Mallard	Worsening*^	-
Blue-winged Teal	Worsening*	-
Northern Shoveler	Worsening^	Potential colonization
Canvasback	-	Potential colonization
Redhead	Worsening^	-
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Scaled Quail	Potential colonization	-
Gambel's Quail	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Ring-necked Pheasant	Improving*	-
Wild Turkey	x	Stable
Pied-billed Grebe	-	Potential colonization
Western Grebe	x	Potential colonization
American White Pelican	x	Potential colonization
Great Blue Heron	Stable	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Golden Eagle	x	Worsening*

Common Name	Summer Trend	Winter Trend
Northern Harrier	Worsening*^	Potential colonization
Cooper's Hawk	-	Potential colonization
Bald Eagle	-	Stable
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Worsening	Potential colonization
Ferruginous Hawk	Worsening^	-
Rough-legged Hawk	-	Worsening
American Coot	x	Potential colonization
Killdeer	Improving	Potential colonization
Wilson's Snipe	-	Potential colonization
Ring-billed Gull	-	Potential colonization
Iceland Gull (Thayer's)	-	Potential colonization
Rock Pigeon	Potential extirpation	Worsening
Eurasian Collared-Dove	x	Potential colonization
Mourning Dove	Stable	-
Barn Owl	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Eastern Screech-Owl	-	Potential colonization
Great Horned Owl	x	Improving
Common Nighthawk	Stable	-
Chimney Swift	Improving	-
Belted Kingfisher	Potential extirpation	-
Red-headed Woodpecker	Improving*	-
Red-bellied Woodpecker	-	Potential colonization
Downy Woodpecker	Improving	Stable

Common Name	Summer Trend	Winter Trend
Hairy Woodpecker	Potential extirpation	-
Northern Flicker	Worsening*	Improving
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Worsening*^	-
Least Flycatcher	Potential extirpation	-
Gray Flycatcher	Potential colonization	-
Dusky Flycatcher	Worsening	-
Cordilleran Flycatcher	Worsening	-
Say's Phoebe	Worsening*	-
Cassin's Kingbird	Improving	-
Western Kingbird	Improving	-
Eastern Kingbird	Worsening	-
Loggerhead Shrike	-	Potential colonization
Bell's Vireo	Potential colonization	-
Warbling Vireo	Improving	-
Red-eyed Vireo	Stable	-
Gray Jay	Potential extirpation	-
Pinyon Jay	Stable	-
Steller's Jay	Stable	-
Blue Jay	Improving*	Improving
Black-billed Magpie	Worsening^	-
Clark's Nutcracker	Potential extirpation^	-
American Crow	Improving	Improving
Common Raven	Potential extirpation	-
Horned Lark	Stable	-
Northern Rough-winged Swallow	Improving*	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Stable	-

Common Name	Summer Trend	Winter Trend
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Stable	Worsening*
Mountain Chickadee	Stable	-
Juniper Titmouse	Potential colonization	-
Bushtit	-	Potential colonization
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	Improving
Pygmy Nuthatch	Improving	-
Brown Creeper	Potential extirpation^	Potential colonization
Rock Wren	Worsening	-
House Wren	Worsening	-
Marsh Wren	-	Potential colonization
Bewick's Wren	Potential colonization	-
Ruby-crowned Kinglet	Potential extirpation	Potential colonization
Eastern Bluebird	Improving	Potential colonization
Mountain Bluebird	Potential extirpation	-
Townsend's Solitaire	Potential extirpation^	Worsening*
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential extirpation	-
American Robin	Potential extirpation	Improving
Gray Catbird	Potential extirpation	-
Brown Thrasher	Improving*	-
Northern Mockingbird	Potential colonization	-
European Starling	Stable	-

Common Name	Summer Trend	Winter Trend
Cedar Waxwing	Potential extirpation	-
Chestnut-collared Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
MacGillivray's Warbler	Stable	-
Common Yellowthroat	Potential extirpation	-
American Redstart	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Potential colonization
Wilson's Warbler	Stable	-
Green-tailed Towhee	Stable^	-
Spotted Towhee	Worsening	-
Rufous-winged Sparrow	Potential colonization	-
Cassin's Sparrow	Potential colonization	-
American Tree Sparrow	-	Improving
Chipping Sparrow	Potential extirpation	-
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving	-
Lark Bunting	Worsening*	-
Savannah Sparrow	Potential extirpation	-
Grasshopper Sparrow	Improving	-
Song Sparrow	Potential extirpation	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Northern Cardinal	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Worsening	-
Dickcissel	Potential colonization	-
Red-winged Blackbird	Worsening	Potential colonization
Western Meadowlark	Stable	-
Yellow-headed Blackbird	Worsening	-
Rusty Blackbird	-	Potential colonization
Brewer's Blackbird	Potential extirpation	-
Common Grackle	Improving*	Potential colonization
Great-tailed Grackle	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Brown-headed Cowbird	Worsening	Potential colonization
Orchard Oriole	Improving*	-
Bullock's Oriole	Stable	-
Baltimore Oriole	Potential colonization	-
Pine Grosbeak	Potential extirpation^	Potential extirpation
House Finch	Improving	-
Cassin's Finch	Worsening	-
Red Crossbill	Potential extirpation^	x
Common Redpoll	-	Potential extirpation
Pine Siskin	Potential extirpation	Worsening*
American Goldfinch	Potential extirpation	Improving