Birds and Climate Change

National Park Service
U.S. Department of the Interior

Scotts Bluff 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 Scotts Bluff 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 21, remain stable for 20 (e.g., Figure 2), and worsen for 8 species. Suitable climate ceases to occur for 19 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 12 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 18, remain stable for 12, 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 38 species not found at the Monument today, potentially resulting in local colonization.

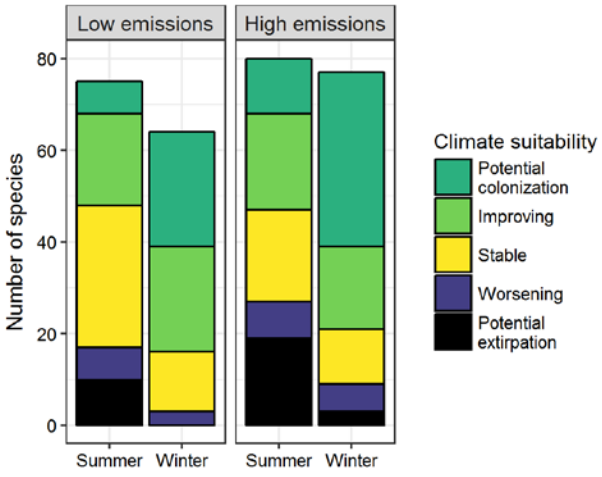

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.24 in summer (39th percentile across all national parks) and 0.24 in winter (35th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 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 Monument is or may become home to 6 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 5 of these climate-sensitive species, one, the Western Wood-Pewee (*Contopus sordidulus*), 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 Violet-green Swallow (*Tachycineta thalassina*) through 2050. 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, Scotts Bluff 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 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.

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	x	Stable
Mallard	Worsening^	Improving
Canvasback	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Scaled Quail	-	Potential colonization
Gambel's Quail	Potential colonization	Potential colonization
Northern Bobwhite	Improving*	Improving*
Ring-necked Pheasant	Improving	-
Pied-billed Grebe	-	Potential colonization
Eared Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Great Blue Heron	Stable	-
Black-crowned Night-Heron	x	Potential colonization
Sharp-shinned Hawk	-	Improving
Cooper's Hawk	-	Improving
Bald Eagle	-	Worsening*
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Worsening	Improving
American Coot	-	Potential colonization
Killdeer	Stable	-
Greater Yellowlegs	-	Potential colonization
Rock Pigeon	Potential extirpation	Potential extirpation
Eurasian Collared-Dove	x	Stable
White-winged Dove	-	Improving
Mourning Dove	Stable	Improving

Common Name	Summer Trend	Winter Trend
Inca Dove	-	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Great Horned Owl	x	Worsening*
Burrowing Owl	Improving*^	-
Common Nighthawk	Improving	-
Chimney Swift	Improving	-
Belted Kingfisher	Stable	-
Red-headed Woodpecker	Improving	-
Red-naped Sapsucker	-	Potential colonization
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	-	Stable
Northern Flicker	Potential extirpation	Improving
Gilded Flicker	Potential colonization	-
American Kestrel	x	Improving
Prairie Falcon	x	Stable
Western Wood-Pewee	Potential extirpation^	-
Say's Phoebe	Stable	Potential colonization
Western Kingbird	Stable	-
Eastern Kingbird	Potential extirpation	-
Scissor-tailed Flycatcher	Potential colonization	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Improving	-
Blue Jay	Improving*	Worsening*
Black-billed Magpie	Worsening^	Worsening*
American Crow	Stable	Improving

Common Name	Summer Trend	Winter Trend
Chihuahuan Raven	Potential colonization	-
Horned Lark	Improving	-
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Stable	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Improving	Worsening*
Oak/Juniper Titmouse (Plain Titmouse)	-	Potential colonization
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Improving	Improving
Rock Wren	Stable	Potential colonization
House Wren	Potential extirpation	-
Bewick's Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Stable	Potential colonization
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	-	Potential colonization
Western Bluebird	-	Potential colonization
Townsend's Solitaire	-	Worsening*
American Robin	Potential extirpation	Improving
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Stable	-
Northern Mockingbird	Improving*	Improving
European Starling	Potential extirpation	Stable
American Pipit	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Cedar Waxwing	Potential extirpation	Stable
Common Yellowthroat	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	-	Potential colonization
Yellow-breasted Chat	Potential extirpation	-
Spotted Towhee	Potential extirpation	-
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	Potential colonization	Potential colonization
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	Potential colonization	Potential colonization
American Tree Sparrow	-	Stable
Chipping Sparrow	Potential extirpation	-
Brewer's Sparrow	-	Potential colonization
Field Sparrow	Stable	-
Lark Sparrow	Improving	-
Black-throated Sparrow	-	Potential colonization
Lark Bunting	Worsening	Potential colonization
Grasshopper Sparrow	Worsening	-
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	-	Improving
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Potential extirpation	-
Indigo Bunting	Improving	-
Dickcissel	Improving*	-
Red-winged Blackbird	Worsening	Improving
Eastern Meadowlark	Potential colonization	-
Western Meadowlark	Stable	Improving
Yellow-headed Blackbird	Worsening	-
Brewer's Blackbird	Potential extirpation	-
Common Grackle	Improving	-
Brown-headed Cowbird	Potential extirpation	Potential colonization
Orchard Oriole	Stable	-
Bullock's Oriole	Stable	-
Baltimore Oriole	Improving	-
House Finch	Stable	Stable
Purple Finch	-	Potential extirpation
Cassin's Finch	-	Stable
Pine Siskin	Potential extirpation	Stable
Lesser Goldfinch	Potential colonization	-
American Goldfinch	Potential extirpation	Improving
House Sparrow	x	Stable