Birds and Climate Change

National Park Service
U.S. Department of the Interior

Mesa Verde National Park

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 Mesa Verde National Park (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 17, remain stable for 37 (e.g., Figure 2), and worsen for 17 species. Suitable climate ceases to occur for 35 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 14 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 17, remain stable for 13, and worsen for 7 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 43 species not found at the Park today, potentially resulting in local colonization.

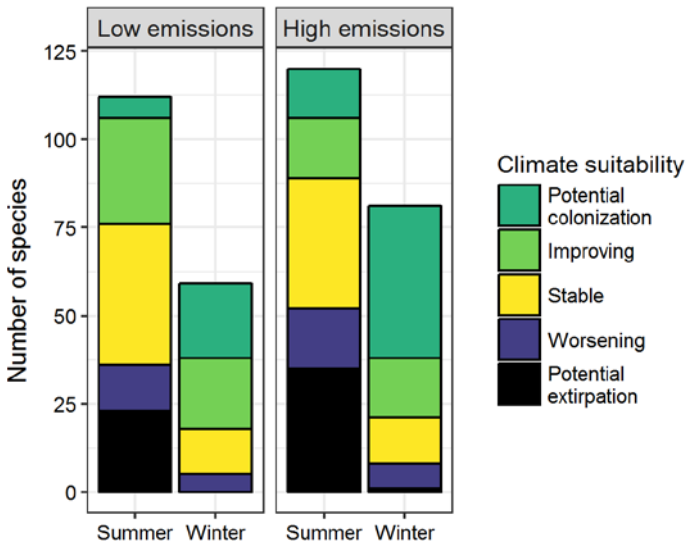

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.21 in summer (34th percentile across all national parks) and 0.23 in winter (33rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.12 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 14 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 9 of these climate-sensitive species, 5 might be extirpated from the Park in at least one season by 2050.

Figure 2. Climate at the Park in summer is projected to remain suitable for the Mourning Dove (*Zenaida macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Mesa Verde National Park falls within the intermediate change group.** Parks anticipating intermediate change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 9 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
Cackling/Canada Goose	-	Worsening*
Mallard	Potential extirpation^	Stable
Blue-winged Teal	Potential extirpation	-
Cinnamon Teal	x	Potential colonization
Common Merganser	-	Stable
Ruddy Duck	-	Potential colonization
Gambel's Quail	Improving*	-
Northern Bobwhite	Potential colonization	Potential colonization
Wild Turkey	x	Improving
Clark's Grebe	-	Potential colonization
American White Pelican	-	Potential colonization
American Bittern	-	Potential colonization^
Great Blue Heron	Stable	-

Common Name	Summer Trend	Winter Trend
White-faced Ibis	-	Potential colonization^
Golden Eagle	x	Worsening*
Northern Harrier	Worsening*^	Stable
Swainson's Hawk	Improving*^	-
Red-tailed Hawk	Stable	Improving
Sora	-	Potential colonization
Killdeer	Stable	-
Mountain Plover	Potential colonization	-
Greater Yellowlegs	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Wilson's Phalarope	Potential extirpation^	-
Ring-billed Gull	Stable^	-
Rock Pigeon	Stable	-
Band-tailed Pigeon	Stable	-

Common Name	Summer Trend	Winter Trend
Eurasian Collared-Dove	x	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	Potential colonization
Great Horned Owl	x	Worsening*
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Improving	-
Black-chinned Hummingbird	Improving*	-
Broad-tailed Hummingbird	Stable	-
Belted Kingfisher	Stable	-
Red-naped Sapsucker	Potential extirpation^	-
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Improving	-
Hairy Woodpecker	Potential extirpation	Stable
Northern Flicker	Worsening*	Improving
Gilded Flicker	-	Potential colonization
American Kestrel	x	Improving
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Worsening*^	-
Willow Flycatcher	Stable	-
Hammond's Flycatcher	Potential extirpation	-
Gray Flycatcher	Stable	-
Dusky Flycatcher	Worsening	-
Cordilleran Flycatcher	Stable	-
Black Phoebe	Improving	Potential colonization
Say's Phoebe	Stable	-

Common Name	Summer Trend	Winter Trend
Ash-throated Flycatcher	Improving*	-
Cassin's Kingbird	Improving*	-
Western Kingbird	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Stable	-
Warbling Vireo	Potential extirpation	-
Pinyon Jay	Stable	Stable
Steller's Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Improving
Black-billed Magpie	Worsening*^	Worsening*
Clark's Nutcracker	Potential extirpation^	Worsening*
American Crow	Potential extirpation	Potential extirpation
Chihuahuan Raven	Potential colonization	-
Common Raven	Potential extirpation	Worsening*
Horned Lark	Stable	-
Northern Rough-winged Swallow	Stable	-
Purple Martin	Improving	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Worsening	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Potential extirpation	-
Mountain Chickadee	Worsening	Worsening*
Juniper Titmouse	Stable	Stable
Verdin	-	Potential colonization
Bushtit	Stable	Improving*
Red-breasted Nuthatch	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
White-breasted Nuthatch	Stable	Stable
Pygmy Nuthatch	Stable	-
Rock Wren	Stable	Improving*
Canyon Wren	x	Improving
House Wren	Potential extirpation	-
Bewick's Wren	Improving*	Improving*
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Stable	Potential colonization
Ruby-crowned Kinglet	Potential extirpation	Improving
Western Bluebird	Worsening	Improving
Mountain Bluebird	Potential extirpation	Improving
Townsend's Solitaire	Potential extirpation^	Stable
Hermit Thrush	Potential extirpation	Potential colonization
American Robin	Potential extirpation	Improving
Gray Catbird	Potential extirpation	-
Curve-billed Thrasher	Potential colonization	Potential colonization
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	Potential colonization
Sage Thrasher	Worsening	-
Northern Mockingbird	Improving*	Potential colonization
European Starling	Potential extirpation	-
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	-
Chestnut-collared Longspur	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Orange-crowned Warbler	Potential extirpation	-
MacGillivray's Warbler	Stable	-
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Potential colonization
Black-throated Gray Warbler	Stable	-
Green-tailed Towhee	Worsening*^	Potential colonization
Spotted Towhee	Worsening	x
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	Potential colonization	Potential colonization
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	Potential colonization	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Stable	Potential colonization
Brewer's Sparrow	Worsening*	Potential colonization
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Stable	-
Black-throated Sparrow	Worsening	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	Worsening^	-
Lark Bunting	-	Potential colonization
Savannah Sparrow	Potential extirpation	Potential colonization
Song Sparrow	Potential extirpation	-
Lincoln's Sparrow	Potential extirpation	Potential colonization
White-crowned Sparrow	Stable	Improving

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Worsening	-
Red-winged Blackbird	Potential extirpation	-
Eastern Meadowlark	Potential colonization	Potential colonization
Western Meadowlark	Worsening	Improving
Brewer's Blackbird	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Common Grackle	Stable	-
Great-tailed Grackle	Improving	-
Brown-headed Cowbird	Potential extirpation	Potential colonization
Bullock's Oriole	Stable	-
Scott's Oriole	Improving	-
Brown-capped Rosy-Finch	-	Stable
House Finch	Stable	Stable
Cassin's Finch	Worsening	-
Pine Siskin	Potential extirpation	Stable
Lesser Goldfinch	Improving*	-
American Goldfinch	Potential extirpation	-