Birds and Climate Change

National Park Service
U.S. Department of the Interior

Bandelier 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 Bandelier 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 33, remain stable for 28, and worsen for 15 species. Suitable climate ceases to occur for 28 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 18 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 35, remain stable for 12, and worsen for 10 species. Suitable climate ceases to occur for 6 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.

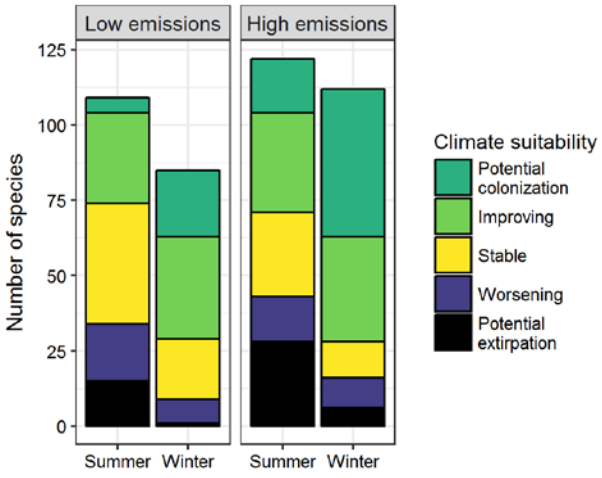

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.25 in summer (40th percentile across all national parks) and 0.26 in winter (39th percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.15 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 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 Monument may serve as an important refuge for 12 of these climate-sensitive species, 2 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 Red-winged Blackbird (*Agelaius phoeniceus*) 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, Bandelier 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 12 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	-	Stable
American Wigeon	-	Improving
Mallard	Potential extirpation^	Improving
Cinnamon Teal	-	Potential colonization
Green-winged Teal	-	Improving
Ring-necked Duck	-	Improving
Lesser Scaup	-	Potential colonization
Common Goldeneye	-	Stable
Hooded Merganser	-	Potential colonization^
Common Merganser	-	Stable
Ruddy Duck	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Wild Turkey	x	Stable

Common Name	Summer Trend	Winter Trend
Pied-billed Grebe	-	Potential colonization
Neotropic Cormorant	-	Potential colonization
American Bittern	-	Potential colonization^
Great Blue Heron	Improving	-
Yellow-crowned Night-Heron	Potential colonization	-
Golden Eagle	-	Worsening*
Northern Harrier	-	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Improving
Bald Eagle	-	Stable
Harris's Hawk	Potential colonization	Potential colonization
Swainson's Hawk	Improving*^	-
Red-tailed Hawk	Stable	Improving
Common Gallinule	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Killdeer	Stable	-
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Rock Pigeon	Potential extirpation	-
Band-tailed Pigeon	Stable	-
Eurasian Collared-Dove	x	Potential colonization
White-winged Dove	Improving	Improving*
Mourning Dove	Improving	Improving
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	-
Barn Owl	-	Potential colonization
Burrowing Owl	-	Potential colonization
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Improving	-
White-throated Swift	x	Improving
Black-chinned Hummingbird	Improving*	-
Anna's Hummingbird	Potential colonization	-
Costa's Hummingbird	Potential colonization	-
Broad-tailed Hummingbird	Worsening	-
Acorn Woodpecker	Improving	Improving
Gila Woodpecker	Potential colonization	-
Red-naped Sapsucker	Worsening^	Improving*
Ladder-backed Woodpecker	Improving*	-

Common Name	Summer Trend	Winter Trend
Downy Woodpecker	Improving	Potential extirpation
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Worsening*	Improving
Gilded Flicker	-	Potential colonization
American Kestrel	x	Improving
Merlin	-	Stable^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Worsening*^	-
Willow Flycatcher	Potential extirpation	-
Hammond's Flycatcher	Potential extirpation	Potential colonization
Gray Flycatcher	Improving	Potential colonization
Dusky Flycatcher	Worsening*	Potential colonization
Cordilleran Flycatcher	Stable	-
Black Phoebe	Improving	Potential colonization
Say's Phoebe	Improving	Improving*
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Improving*	-
Brown-crested Flycatcher	Potential colonization	-
Cassin's Kingbird	Improving*	-
Western Kingbird	Improving	-
Bell's Vireo	Potential colonization	-
Warbling Vireo	Potential extirpation	-
Pinyon Jay	Stable	Stable
Steller's Jay	Worsening	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Stable

Common Name	Summer Trend	Winter Trend
Black-billed Magpie	Potential extirpation^	Worsening*
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Potential extirpation	Potential extirpation
Common Raven	Potential extirpation	Worsening*
Horned Lark	Stable	-
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Worsening*	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Mountain Chickadee	Worsening	Worsening*
Bridled Titmouse	Potential colonization	Potential colonization
Juniper Titmouse	Stable	Stable
Verdin	Potential colonization	Potential colonization
Bushtit	Stable	Improving
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	Stable
Pygmy Nuthatch	Stable	Worsening*^
Brown Creeper	Stable^	Potential extirpation
Rock Wren	Stable	Improving*
Canyon Wren	x	Improving
House Wren	Potential extirpation	-
Bewick's Wren	Improving	Improving*
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	Potential extirpation	Improving
Eastern Bluebird	-	Potential colonization
Western Bluebird	Stable	Improving*
Mountain Bluebird	Worsening	Improving
Townsend's Solitaire	Worsening^	Stable
Hermit Thrush	Potential extirpation	Improving*
American Robin	Potential extirpation	Improving
Curve-billed Thrasher	Improving*	-
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	-
Northern Mockingbird	Improving*	Potential colonization
European Starling	Potential extirpation	Improving
American Pipit	-	Potential colonization
Cedar Waxwing	-	Improving
Phainopepla	Potential colonization	Potential colonization
Orange-crowned Warbler	Potential extirpation	-
Lucy's Warbler	Potential colonization	-
MacGillivray's Warbler	Potential extirpation	-
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Stable	Potential colonization
Grace's Warbler	Improving	-

Common Name	Summer Trend	Winter Trend
Black-throated Gray Warbler	Stable	-
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Worsening*^	-
Spotted Towhee	Stable	x
Canyon Towhee	Improving*	Improving
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	Potential extirpation	Potential colonization
Black-chinned Sparrow	-	Potential colonization
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Improving	-
Lark Bunting	-	Potential colonization
Savannah Sparrow	Potential extirpation	Potential colonization
Song Sparrow	-	Improving
Lincoln's Sparrow	Potential extirpation	Improving
Swamp Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Dark-eyed Junco	x	Improving
Hepatic Tanager	Improving*	-
Summer Tanager	Improving	-
Western Tanager	Stable	-

Common Name	Summer Trend	Winter Trend
Pyrrhuloxia	Potential colonization	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Stable	-
Indigo Bunting	Improving	-
Red-winged Blackbird	Potential extirpation	Improving
Eastern Meadowlark	Improving*	Potential colonization
Western Meadowlark	Worsening*	-
Yellow-headed Blackbird	Stable	-
Brewer's Blackbird	Potential extirpation	-
Great-tailed Grackle	Improving*	-
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Improving	Potential colonization
Hooded Oriole	Potential colonization	-
Bullock's Oriole	Improving	-
House Finch	Improving	Improving
Cassin's Finch	Worsening	Worsening*
Red Crossbill	Worsening^	x
Pine Siskin	Potential extirpation	Worsening
Lesser Goldfinch	Improving	-
American Goldfinch	Potential extirpation	-
Evening Grosbeak	Stable	Worsening