Birds and Climate Change

National Park Service
U.S. Department of the Interior

Capulin Volcano 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 Capulin Volcano 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 18, remain stable for 18, and worsen for 6 species. Suitable climate ceases to occur for 12 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 19 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 8, and worsen for 3 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 44 species not found at the Monument today, potentially resulting in local colonization.

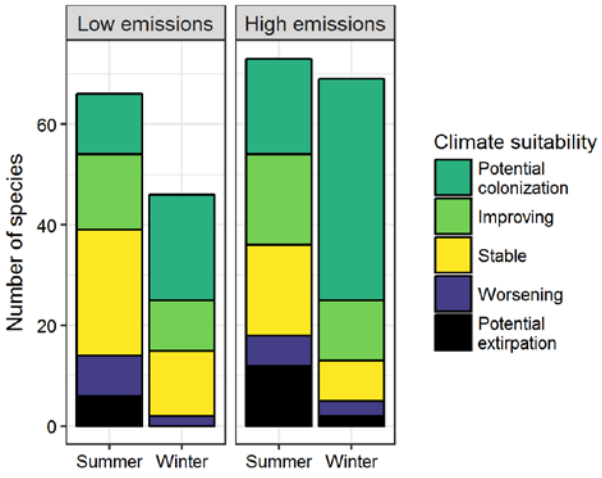

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.29 in summer (49th percentile across all national parks) and 0.26 in winter (38th percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.13 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 4 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 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, Capulin Volcano National Monument falls within the high turnover group.** Parks anticipating high turnover 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 4 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
Gadwall	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Ruddy Duck	-	Potential colonization
Gambel's Quail	Potential colonization	-
Northern Bobwhite	Potential colonization	Potential colonization
Wild Turkey	x	Potential extirpation
Pied-billed Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization
American White Pelican	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Great Blue Heron	-	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Cooper's Hawk	x	Potential colonization
Harris's Hawk	Potential colonization	-
Swainson's Hawk	Improving^	-
Red-tailed Hawk	Improving	Stable
Ferruginous Hawk	Stable^	-
Sora	-	Potential colonization
American Coot	-	Potential colonization
Killdeer	-	Potential colonization
Rock Pigeon	Potential extirpation	-
Band-tailed Pigeon	Potential colonization	-

Common Name	Summer Trend	Winter Trend
White-winged Dove	Improving	-
Mourning Dove	Improving	Improving*
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	-
Barn Owl	-	Potential colonization
Great Horned Owl	x	Stable
Burrowing Owl	-	Potential colonization
Common Nighthawk	Improving	-
Black-chinned Hummingbird	Improving	-
Broad-tailed Hummingbird	Worsening	-
Lewis's Woodpecker	x	Stable
Ladder-backed Woodpecker	Potential colonization	-
Northern Flicker	Worsening	Improving
American Kestrel	x	Improving
Western Wood-Pewee	Worsening*^	-
Black Phoebe	Potential colonization	Potential colonization
Eastern Phoebe	Improving	-
Say's Phoebe	Stable	-
Ash-throated Flycatcher	Improving*	-
Cassin's Kingbird	Improving*	-
Western Kingbird	Improving	-
Hutton's Vireo	Potential colonization^	-
Pinyon Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Improving
Black-billed Magpie	Potential extirpation^	-
Chihuahuan Raven	Improving*	-
Common Raven	Stable	Potential extirpation
Horned Lark	Stable	-

Common Name	Summer Trend	Winter Trend
Violet-green Swallow	Worsening	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Potential extirpation	Stable
Mountain Chickadee	Worsening	Worsening*
Bridled Titmouse	-	Potential colonization
Juniper Titmouse	Improving	Improving
Verdin	-	Potential colonization
Bushtit	Improving	-
White-breasted Nuthatch	Potential extirpation	Stable
Rock Wren	Stable	-
Canyon Wren	x	Improving
House Wren	Potential extirpation	-
Bewick's Wren	Improving	-
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Eastern Bluebird	-	Potential colonization
Western Bluebird	Stable	-
Mountain Bluebird	Potential extirpation	Improving
Townsend's Solitaire	-	Worsening*
Hermit Thrush	Potential extirpation	Potential colonization
American Robin	Potential extirpation	Improving
Brown Thrasher	-	Potential colonization
Bendire's Thrasher	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Crissal Thrasher	Potential colonization	-
Northern Mockingbird	Improving*	Improving
European Starling	Potential extirpation	-
American Pipit	-	Potential colonization
Phainopepla	Potential colonization	-
Chestnut-collared Longspur	-	Potential colonization
Yellow-rumped Warbler	-	Potential colonization
Black-throated Gray Warbler	Potential colonization	-
Red-faced Warbler	Potential colonization	-
Green-tailed Towhee	Potential extirpation^	-
Spotted Towhee	Stable	x
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	Improving*	Improving*
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	Potential colonization	-
Cassin's Sparrow	-	Potential colonization
Chipping Sparrow	Stable	Potential colonization
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving	-
Black-throated Sparrow	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Potential colonization
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Potential colonization
Dark-eyed Junco	-	Improving
Hepatic Tanager	Stable	-
Western Tanager	Stable	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Potential colonization	-
Eastern Meadowlark	Potential colonization	Potential colonization
Western Meadowlark	Stable	Improving
Common Grackle	Stable	-
Great-tailed Grackle	Potential colonization	-
Brown-headed Cowbird	Potential extirpation	Potential colonization
Bullock's Oriole	Improving	-
Scott's Oriole	Potential colonization	-
House Finch	Worsening	Stable
Pine Siskin	-	Worsening*
Lesser Goldfinch	Stable	-
House Sparrow	x	Stable