Birds and Climate Change

National Park Service
U.S. Department of the Interior

Timpanogos Cave 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 Timpanogos Cave 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 1, remain stable for 11, and worsen for 8 species. Suitable climate ceases to occur for 8 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 35 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 4, remain stable for 1, and worsen for 5 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 55 species not found at the Monument today, potentially resulting in local colonization.

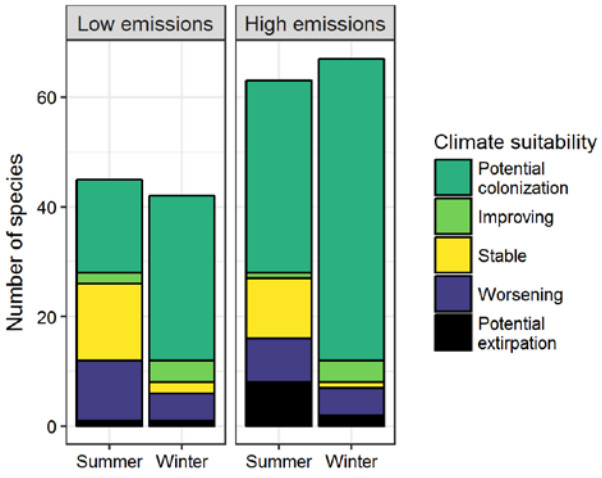

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.40 in summer (71st percentile across all national parks) and 0.34 in winter (55th percentile) under the high-emissions pathway. Potential species turnover declines to 0.20 in summer and 0.20 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 5 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, one, the Red-naped Sapsucker (*Sphyrapicus nuchalis*), might be extirpated from the Monument in summer 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, Timpanogos Cave 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.

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
Wood Duck	-	Potential colonization
Northern Shoveler	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Hooded Merganser	-	Potential colonization^
Ruddy Duck	-	Potential colonization
Gambel's Quail	Potential colonization	-
Northern Bobwhite	Potential colonization	Potential colonization
Pied-billed Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	-
Mississippi Kite	Potential colonization	-
Northern Harrier	-	Potential colonization
Sharp-shinned Hawk	-	Potential colonization
Cooper's Hawk	-	Potential colonization
Red-tailed Hawk	-	Potential colonization
American Coot	-	Potential colonization
Mourning Dove	Potential colonization	Potential colonization
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	Potential colonization
Chimney Swift	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Black-chinned Hummingbird	Improving	-
Broad-tailed Hummingbird	Stable	-
Belted Kingfisher	Stable	Improving
Golden-fronted Woodpecker	-	Potential colonization
Red-naped Sapsucker	Potential extirpation^	Potential colonization
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Hairy Woodpecker	Stable	-
Northern Flicker	Worsening*	-
Gilded Flicker	Potential colonization	-
American Kestrel	-	Potential colonization
Cordilleran Flycatcher	Stable	-
Say's Phoebe	-	Potential colonization
Ash-throated Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	-	Potential colonization
Warbling Vireo	Worsening	-
Steller's Jay	Stable	Worsening*
Black-billed Magpie	Worsening*^	-
Violet-green Swallow	Stable	-
Barn Swallow	Potential colonization	-
Carolina Chickadee	Potential colonization	Potential colonization
Black-capped Chickadee	Potential extirpation	Potential extirpation
Mountain Chickadee	Worsening	Worsening*
Tufted Titmouse	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Bushtit	-	Potential colonization
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Potential colonization	Potential colonization
Brown Creeper	-	Improving
Rock Wren	-	Potential colonization
Pacific/Winter Wren	-	Potential colonization
Bewick's Wren	Potential colonization	-
Blue-gray Gnatcatcher	Potential colonization	Potential colonization
American Dipper	x	Worsening*
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	Potential extirpation	Potential colonization
Western Bluebird	-	Potential colonization
Townsend's Solitaire	Worsening*^	Worsening*
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Stable	-
Wood Thrush	Potential colonization	-
American Robin	Potential extirpation	Improving
Gray Catbird	Potential colonization	-
Curve-billed Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	-
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
American Pipit	-	Potential colonization
Cedar Waxwing	-	Potential colonization
Chestnut-collared Longspur	-	Potential colonization
Worm-eating Warbler	Potential colonization	-
Yellow Warbler	Worsening	-
Yellow-rumped Warbler	Stable	Potential colonization
Prairie Warbler	Potential colonization	-
Green-tailed Towhee	Stable^	-
Eastern Towhee	Potential colonization	-
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Chipping Sparrow	Stable	-
Brewer's Sparrow	-	Potential colonization
Field Sparrow	Potential colonization	Potential colonization
Black-throated Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Song Sparrow	Stable	-
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Scarlet Tanager	Potential colonization	-
Western Tanager	Worsening*	-
Northern Cardinal	Potential colonization	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Potential colonization	-
Eastern Meadowlark	Potential colonization	-
Great-tailed Grackle	Potential colonization	Potential colonization
Brown-headed Cowbird	-	Potential colonization
Scott's Oriole	Potential colonization	-
House Finch	Potential colonization	Potential colonization
Pine Siskin	Potential extirpation	Worsening*
Lesser Goldfinch	Potential colonization	-
American Goldfinch	-	Potential colonization
House Sparrow	-	Potential colonization