Birds and Climate Change

National Park Service
U.S. Department of the Interior

Tuzigoot 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 Tuzigoot 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 31 (e.g., Figure 2), remain stable for 29, and worsen for 3 species. Suitable climate ceases to occur for 6 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 21 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 26, remain stable for 36, and worsen for 24 species. Suitable climate ceases to occur for 10 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 34 species not found at the Monument today, potentially resulting in local colonization.

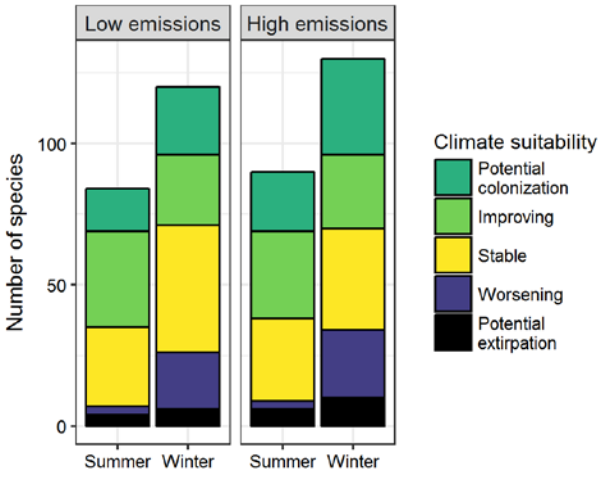

Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.16 in summer (24th percentile across all national parks) and 0.13 in winter (13th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.09 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 7 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). Suitable climate is not projected to disappear for these 7 species at the Monument; instead the Monument may serve as an important refuge for these climate-sensitive species.

Figure 2. Climate at the Monument in summer is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050. Photo by Andy Morffew/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, Tuzigoot National Monument falls within the high potential colonization group.** Parks anticipating high potential colonization 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 7 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Wood Duck	x	Stable
Gadwall	-	Stable
American Wigeon	-	Worsening
Mallard	Stable^	Worsening
Mottled Duck	Potential colonization	-
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Worsening
Green-winged Teal	-	Stable
Canvasback	-	Stable
Ring-necked Duck	-	Stable
Lesser Scaup	-	Worsening
Bufflehead	-	Stable
Common Merganser	-	Worsening*
Ruddy Duck	Potential colonization	Stable
Gambel's Quail	Improving*	Improving
Northern Bobwhite	-	Potential colonization
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Stable
Wood Stork	Potential colonization	-
Neotropic Cormorant	x	Improving
Double-crested Cormorant	-	Stable
Anhinga	Potential colonization^	-
Great Blue Heron	Improving	Stable
Great Egret	-	Potential colonization
Tricolored Heron	Potential colonization^	-

Common Name	Summer Trend	Winter Trend
Cattle Egret	-	Potential colonization
Green Heron	Stable	-
Roseate Spoonbill	-	Potential colonization
Black Vulture	Potential colonization	-
White-tailed Kite	Potential colonization	-
Golden Eagle	-	Worsening
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Stable
Bald Eagle	-	Stable
Harris's Hawk	Potential colonization	-
White-tailed Hawk	-	Potential colonization
Red-tailed Hawk	Stable	Worsening
Ferruginous Hawk	-	Worsening
Virginia Rail	-	Stable
Sora	-	Improving
American Coot	x	Stable
Limpkin	-	Potential colonization
Black-necked Stilt	-	Potential colonization
American Avocet	-	Potential colonization^
Killdeer	Stable	-
Stilt Sandpiper	-	Potential colonization
Dunlin	-	Potential colonization^
Western Sandpiper	-	Potential colonization
Yellow-footed Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Rock Pigeon	Stable	Potential extirpation
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving*	Worsening
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Improving	Stable
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	-	Stable
Great Horned Owl	x	Stable
Common Pauraque	-	Potential colonization
Black-chinned Hummingbird	Improving	-
Anna's Hummingbird	Stable	Improving*
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Stable	Worsening
Gila Woodpecker	Improving*	Improving*
Golden-fronted Woodpecker	Potential colonization	-
Red-naped Sapsucker	-	Stable
Ladder-backed Woodpecker	Improving	Stable
Hairy Woodpecker	-	Potential extirpation
Northern Flicker	Stable	Worsening
Crested Caracara	Potential colonization	Potential colonization
American Kestrel	x	Improving
Peregrine Falcon	x	Improving*
Western Wood-Pewee	Worsening^	-
Hammond's Flycatcher	-	Improving*
Black Phoebe	Improving	Improving

Common Name	Summer Trend	Winter Trend
Eastern Phoebe	-	Potential colonization
Say's Phoebe	Worsening*	Stable
Vermilion Flycatcher	Improving	Improving*
Ash-throated Flycatcher	Stable	-
Brown-crested Flycatcher	Improving*	-
Cassin's Kingbird	Stable	-
Western Kingbird	Stable	-
Loggerhead Shrike	-	Stable
Bell's Vireo	Improving*	-
Hutton's Vireo	-^	Improving
Warbling Vireo	Potential extirpation	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	Worsening*
Common Raven	Stable	Stable
Northern Rough-winged Swallow	Improving	Potential colonization
Purple Martin	Potential colonization	-
Tree Swallow	-	Potential colonization
Violet-green Swallow	Potential extirpation	-
Cliff Swallow	Improving	-
Cave Swallow	Potential colonization	-
Mountain Chickadee	-	Worsening*
Bridled Titmouse	Stable	Stable
Juniper Titmouse	Stable	Worsening*
Black-crested Titmouse	Potential colonization	-
Verdin	Improving	Stable
Bushtit	Stable	-
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Stable	Potential extirpation

Common Name	Summer Trend	Winter Trend
Brown Creeper	-	Stable
Rock Wren	Stable	Stable
Canyon Wren	-	Stable
House Wren	Potential extirpation	Improving*
Marsh Wren	-	Worsening
Bewick's Wren	Improving*	Worsening*
Blue-gray Gnatcatcher	Stable	-
Ruby-crowned Kinglet	-	Improving
Western Bluebird	-	Worsening*
Townsend's Solitaire	-	Worsening*
Hermit Thrush	-	Improving*
American Robin	Stable	Potential extirpation
Long-billed Thrasher	-	Potential colonization
LeConte's Thrasher	Potential colonization	-
Crissal Thrasher	Stable	Stable
Northern Mockingbird	Stable	Improving
European Starling	Stable	Stable
American Pipit	-	Improving
Cedar Waxwing	-	Potential extirpation
Phainopepla	Improving	-
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	-	Improving
Lucy's Warbler	Improving*	-
Common Yellowthroat	Improving	Stable
Northern Parula	-	Potential colonization
Yellow Warbler	Improving	-
Yellow-rumped Warbler	-	Improving
Townsend's Warbler	-	Potential colonization
Hermit Warbler	-	Potential colonization^

Common Name	Summer Trend	Winter Trend
Wilson's Warbler	-	Potential colonization
Yellow-breasted Chat	Improving	-
Olive Sparrow	Potential colonization	-
Rufous-crowned Sparrow	-	Worsening
Canyon Towhee	Stable	-
Abert's Towhee	Improving*	Improving*
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	-	Improving
Brewer's Sparrow	-	Improving
Field Sparrow	-	Potential colonization
Lark Sparrow	Worsening*	-
Black-throated Sparrow	Stable	Improving*
Grasshopper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Song Sparrow	Improving	Worsening
Lincoln's Sparrow	-	Stable
White-throated Sparrow	-	Stable
White-crowned Sparrow	-	Stable
Dark-eyed Junco	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Summer Tanager	Improving	-
Western Tanager	Potential extirpation	-
Northern Cardinal	Improving*	Improving*
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving	-
Indigo Bunting	Stable	Potential colonization
Red-winged Blackbird	Improving	Improving
Western Meadowlark	-	Worsening
Brewer's Blackbird	Potential extirpation	Worsening
Great-tailed Grackle	Stable	Stable
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Improving	-
Hooded Oriole	Improving	-
Bullock's Oriole	Improving	-
House Finch	Stable	Worsening
Pine Siskin	-	Potential extirpation
Lesser Goldfinch	Improving	Stable
American Goldfinch	-	Potential extirpation
House Sparrow	x	Potential extirpation