Birds and Climate Change

National Park Service
U.S. Department of the Interior

Carlsbad Caverns 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 Carlsbad Caverns 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 36 (e.g., Figure 2), remain stable for 45, and worsen for 9 species. Suitable climate ceases to occur for 30 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 13 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 50, remain stable for 53, and worsen for 33 species. Suitable climate ceases to occur for 19 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 31 species not found at the Park today, potentially resulting in local colonization.

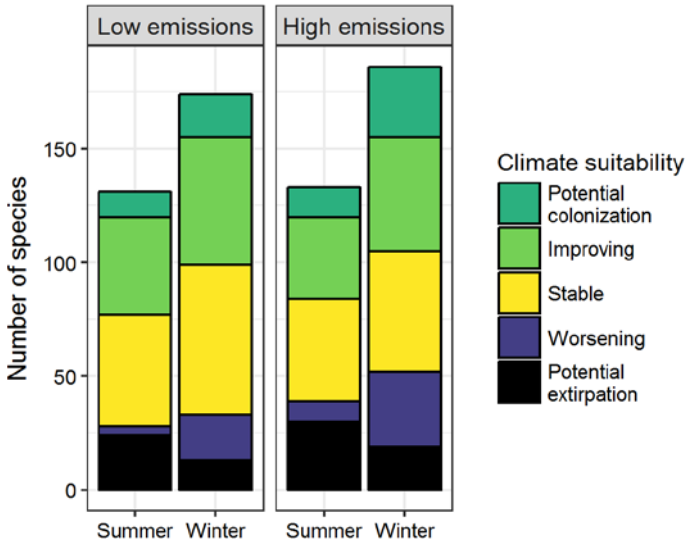

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.14 in summer (19th percentile across all national parks) and 0.12 in winter (12th percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 in summer and 0.08 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 15 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 13 of these climate-sensitive species, 2 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 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, Carlsbad Caverns National Park falls within the low change group.** Parks anticipating low 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 13 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Wood Duck	-	Potential extirpation
Gadwall	-	Improving
American Wigeon	-	Stable
Mallard	Potential extirpation^	Worsening
Mottled Duck	Potential colonization	-
Blue-winged Teal	Stable	Improving
Cinnamon Teal	x	Improving
Northern Shoveler	-	Worsening
Green-winged Teal	-	Improving
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Lesser Scaup	-	Stable
Bufflehead	-	Improving
Common Goldeneye	-	Potential extirpation
Hooded Merganser	-	Stable^
Common Merganser	-	Potential extirpation
Ruddy Duck	-	Stable
Scaled Quail	Worsening*	Worsening*
Northern Bobwhite	Stable	Potential colonization
Wild Turkey	x	Stable
Least Grebe	-	Potential colonization
Pied-billed Grebe	x	Improving*
Eared Grebe	-	Stable
Wood Stork	Potential colonization	-
Magnificent Frigatebird	-	Potential colonization
Double-crested Cormorant	-	Stable
Anhinga	Potential colonization^	-

Common Name	Summer Trend	Winter Trend
American Bittern	-	Stable^
Great Blue Heron	Stable	Improving
Great Egret	Stable	-
Tricolored Heron	Potential colonization^	-
Cattle Egret	Improving	Improving
Green Heron	Improving	-
Black-crowned Night-Heron	x	Worsening*
Roseate Spoonbill	-	Potential colonization
Black Vulture	Potential colonization	Potential colonization
Osprey	-	Potential colonization
Golden Eagle	x	Worsening*
Northern Harrier	Stable^	Worsening
Sharp-shinned Hawk	-	Worsening
Cooper's Hawk	x	Improving
Northern Goshawk	-	Potential extirpation
Bald Eagle	-	Potential extirpation
Harris's Hawk	-	Improving*
White-tailed Hawk	-	Potential colonization
Gray Hawk	Improving	-
Swainson's Hawk	Worsening*^	-
Red-tailed Hawk	Stable	Stable
Ferruginous Hawk	-	Worsening*
Rough-legged Hawk	-	Potential extirpation
Virginia Rail	-	Worsening
Sora	-	Stable
Common Gallinule	-	Worsening
American Coot	x	Improving
Limpkin	-	Potential colonization
American Avocet	-	Potential colonization^
Killdeer	Stable	Improving
Spotted Sandpiper	-	Improving*
Stilt Sandpiper	-	Potential colonization
Least Sandpiper	-	Improving*
Western Sandpiper	-	Stable
Long-billed Dowitcher	-	Stable
Wilson's Snipe	-	Stable
Ring-billed Gull	-	Potential extirpation
Yellow-footed Gull	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Rock Pigeon	Potential extirpation	Stable
Band-tailed Pigeon	Stable	Stable
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving*	Stable
Mourning Dove	Stable	Stable
Inca Dove	Improving	Improving*
Common Ground-Dove	-	Potential colonization
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Improving	Improving
Groove-billed Ani	-	Potential colonization
Barn Owl	x	Stable
Western Screech-Owl	x	Stable
Great Horned Owl	x	Worsening
Burrowing Owl	Worsening*^	Worsening*
Lesser Nighthawk	Improving*	-
Common Nighthawk	Worsening*	-
Common Pauraque	-	Potential colonization
White-throated Swift	x	Improving*

Common Name	Summer Trend	Winter Trend
Black-chinned Hummingbird	Improving*	-
Costa's Hummingbird	Potential colonization	-
Broad-tailed Hummingbird	Potential extirpation	-
Buff-bellied Hummingbird	-	Potential colonization
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Potential extirpation	Stable
Green Kingfisher	-	Potential colonization
Lewis's Woodpecker	-	Improving
Red-bellied Woodpecker	-	Improving
Yellow-bellied Sapsucker	-	Stable
Red-naped Sapsucker	-	Stable
Ladder-backed Woodpecker	Improving*	Improving
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	Potential extirpation	Worsening
Crested Caracara	Potential colonization	Potential colonization
American Kestrel	x	Improving
Merlin	-	Worsening^
Peregrine Falcon	x	Improving*
Prairie Falcon	x	Worsening
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Potential extirpation^	-
Willow Flycatcher	Potential extirpation	-
Gray Flycatcher	Potential extirpation	-
Cordilleran Flycatcher	Stable	-
Black Phoebe	Stable	Improving*
Eastern Phoebe	-	Improving*

Common Name	Summer Trend	Winter Trend
Say's Phoebe	Stable	Stable
Vermilion Flycatcher	Improving	-
Ash-throated Flycatcher	Stable	-
Cassin's Kingbird	Worsening*	-
Western Kingbird	Worsening	-
Scissor-tailed Flycatcher	Stable	-
Loggerhead Shrike	Worsening*	Improving
White-eyed Vireo	Improving	Potential colonization
Bell's Vireo	Improving*	-
Warbling Vireo	Potential extirpation	-
Steller's Jay	Potential extirpation	Worsening
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	Worsening*
American Crow	-	Potential extirpation
Chihuahuan Raven	Stable	Worsening*
Common Raven	Stable	Improving*
Horned Lark	Potential extirpation	Potential extirpation
Northern Rough-winged Swallow	Improving	Potential colonization
Purple Martin	Potential colonization	-
Violet-green Swallow	Potential extirpation	Potential colonization
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Cave Swallow	Stable	-
Carolina Chickadee	-	Potential colonization
Mountain Chickadee	Potential extirpation	Worsening*
Verdin	Improving*	Stable
Bushtit	Potential extirpation	Worsening
Red-breasted Nuthatch	-	Potential extirpation

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

Common Name	Summer Trend	Winter Trend
Black-and-white Warbler	-	Potential colonization
Orange-crowned Warbler	-	Improving*
Lucy's Warbler	Improving*	-
Common Yellowthroat	Improving	Improving
American Redstart	Stable	-
Northern Parula	-	Potential colonization
Yellow Warbler	Stable	-
Yellow-rumped Warbler	Stable	Improving
Grace's Warbler	Stable	-
Black-throated Gray Warbler	-	Potential colonization
Wilson's Warbler	Potential extirpation	Potential colonization
Yellow-breasted Chat	Improving*	-
Olive Sparrow	Potential colonization	-
Green-tailed Towhee	Stable^	Improving
Spotted Towhee	Potential extirpation	x
Eastern Towhee	Stable	x
Rufous-crowned Sparrow	x	Worsening*
Canyon Towhee	Improving*	Stable
Abert's Towhee	Potential colonization	-
Cassin's Sparrow	Worsening*	Stable
Bachman's Sparrow	Potential colonization	-
Chipping Sparrow	Potential extirpation	Improving
Brewer's Sparrow	-	Improving
Field Sparrow	-	Improving*
Black-chinned Sparrow	x	Stable
Vesper Sparrow	-	Improving*
Lark Sparrow	Worsening*	Improving*
Black-throated Sparrow	Stable	Stable
Sagebrush/Bell's Sparrow	-	Worsening*

Common Name	Summer Trend	Winter Trend
(Sage Sparrow)		
Lark Bunting	Stable	Stable
Savannah Sparrow	-	Stable
Henslow's Sparrow	-	Potential colonization
Fox Sparrow	-	Stable
Song Sparrow	-	Worsening
Lincoln's Sparrow	-	Improving
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Stable
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Stable
Dark-eyed Junco	x	Potential extirpation
Hepatic Tanager	Stable	-
Summer Tanager	Improving*	-
Western Tanager	Potential extirpation	-
Northern Cardinal	Improving*	Improving*
Pyrrhuloxia	Improving*	Improving
Black-headed Grosbeak	Potential extirpation	-
Blue Grosbeak	Stable	-
Lazuli Bunting	Potential extirpation	-
Indigo Bunting	Improving	Potential colonization
Painted Bunting	Improving	-

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