



Big Bend 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 Big Bend 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.

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 52, remain stable for 34 (e.g., Figure 2), and worsen for 19 species. Suitable climate ceases to occur for 12 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 11 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 55, remain stable for 57, and worsen for 30 species. Suitable climate ceases to occur for 21 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 32 species not found at the Park today, potentially resulting in local colonization.

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.

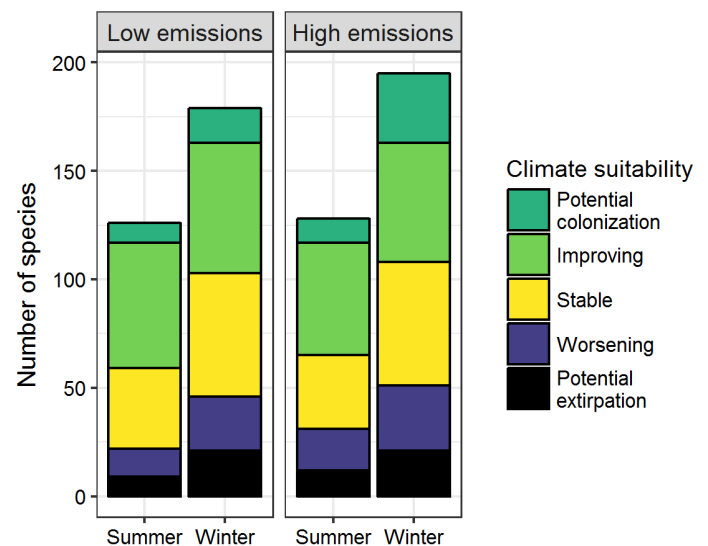


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.13 in summer (16th percentile across all national parks) and 0.10 in winter (8th percentile) under the high-emissions pathway. Potential species turnover declines to 0.09 in summer and 0.07 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 21 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

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Big Bend 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.

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

climate is not projected to disappear for these 21 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.



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).

Furthermore, park managers have an opportunity to focus on supporting the 21 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.

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
Muscovy Duck	-	Potential colonization
Wood Duck	x	Potential extirpation
Gadwall	-	Stable
American Wigeon	-	Stable
Mallard	Improving [^]	Stable
Blue-winged Teal	-	Improving
Cinnamon Teal	x	Improving*
Northern Shoveler	-	Improving
Green-winged Teal	-	Improving
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Lesser Scaup	-	Stable
Bufflehead	-	Improving*
Hooded Merganser	-	Stable [^]
Red-breasted Merganser	-	Potential colonization [^]
Ruddy Duck	Potential	Improving*

Common Name	Summer Trend	Winter Trend
	colonization	
Scaled Quail	Worsening*	Worsening*
Northern Bobwhite (does not occur naturally)	-	Stable
Montezuma Quail	x	Stable
Wild Turkey	x	Potential extirpation
Least Grebe	-	Stable
Pied-billed Grebe	x	Worsening
Eared Grebe	-	Improving
Clark's Grebe	-	Potential colonization
Double-crested Cormorant	-	Stable
Brown Pelican	-	Potential colonization [^]
American Bittern	-	Improving [^]
Least Bittern	-	Improving
Great Blue Heron	Improving	Worsening
Great Egret	Improving	Improving

Common Name	Summer Trend	Winter Trend
Cattle Egret	Improving	Improving*
Green Heron	Improving	Improving
Black-crowned Night-Heron	x	Improving*
White-faced Ibis	-	Improving^
Black Vulture	Worsening	Worsening*
Turkey Vulture	x	Stable
White-tailed Kite	-	Potential colonization
Swallow-tailed Kite	Potential colonization	-
Golden Eagle	x	Stable
Mississippi Kite	Potential extirpation	-
Northern Harrier	-	Improving
Sharp-shinned Hawk	x	Worsening
Cooper's Hawk	x	Stable
Harris's Hawk	Improving*	Improving*
Red-shouldered Hawk	-	Potential extirpation
Gray Hawk	Stable	x
Swainson's Hawk	Stable^	-
Red-tailed Hawk	Stable	Worsening
Ferruginous Hawk	-	Stable
Clapper Rail	-	Potential colonization
Virginia Rail	-	Improving
Sora	-	Improving*
American Coot	x	Stable
Limpkin	-	Potential colonization
Black-bellied Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization^
Killdeer	Improving*	Worsening
Spotted Sandpiper	-	Improving

Common Name	Summer Trend	Winter Trend
Wandering Tattler	-	Potential colonization
Willet	-	Potential colonization^
Whimbrel	-	Potential colonization
Marbled Godwit	-	Potential colonization
Dunlin	-	Potential colonization^
Least Sandpiper	-	Improving*
Short-billed Dowitcher	-	Potential colonization^
Wilson's Snipe	-	Stable
Bonaparte's Gull	-	Potential colonization
Laughing Gull	-	Potential colonization
Ring-billed Gull	-	Stable
Western Gull	-	Potential colonization^
Yellow-footed Gull	-	Potential colonization
Royal Tern	-	Potential colonization^
Black Skimmer	-	Potential colonization^
Rock Pigeon	-	Stable
Band-tailed Pigeon	Improving	Stable
Eurasian Collared-Dove	x	Stable
White-winged Dove	Improving*	Worsening
Mourning Dove	Worsening	Stable
Inca Dove	Improving	Improving
Common Ground-Dove	Improving	Improving
Yellow-billed Cuckoo	Potential extirpation	-
Greater Roadrunner	Stable	Improving
Barn Owl	x	Stable
Western Screech-Owl	x	Improving
Great Horned Owl	x	Potential

Common Name	Summer Trend	Winter Trend
		extirpation
Northern Pygmy-Owl	-	Potential colonization
Burrowing Owl	Stable^	-
Lesser Nighthawk	Improving*	-
Common Nighthawk	Worsening*	-
White-throated Swift	x	Improving*
Black-chinned Hummingbird	Improving	x
Anna's Hummingbird	Potential colonization	Improving*
Costa's Hummingbird	Potential colonization	Improving*
Broad-tailed Hummingbird	Stable	-
Allen's Hummingbird	-	Stable
Belted Kingfisher	-	Stable
Green Kingfisher	x	Worsening*
Acorn Woodpecker	Improving	Stable
Golden-fronted Woodpecker	Stable	Worsening*
Yellow-bellied Sapsucker	-	Potential extirpation
Red-naped Sapsucker	-	Stable
Ladder-backed Woodpecker	Stable	Stable
Arizona Woodpecker	-	Potential colonization
Northern Flicker	Improving	Worsening
American Kestrel	x	Improving
Merlin	-	Stable^
Peregrine Falcon	x	Improving*
Prairie Falcon	x	Improving*
Northern Beardless-Tyrannulet	Potential colonization	-
Olive-sided Flycatcher	Improving	-
Western Wood-Pewee	Improving^	-
Willow Flycatcher	Stable	-
Gray Flycatcher	Improving	Stable
Dusky Flycatcher	Stable	Improving*
Cordilleran Flycatcher	Improving	-

Common Name	Summer Trend	Winter Trend
Black Phoebe	Improving	Improving
Eastern Phoebe	-	Worsening*
Say's Phoebe	Worsening	Improving
Vermilion Flycatcher	Worsening	Improving
Ash-throated Flycatcher	Improving	x
Great Crested Flycatcher	-	Potential colonization
Brown-crested Flycatcher	Improving*	-
Great Kiskadee	Potential colonization	-
Couch's Kingbird	Stable	-
Cassin's Kingbird	Stable	-
Western Kingbird	Improving	-
Scissor-tailed Flycatcher	Worsening*	-
Loggerhead Shrike	Improving	Stable
White-eyed Vireo	-	Stable
Bell's Vireo	Improving*	x
Hutton's Vireo	Improving^	Improving
Warbling Vireo	Improving	-
Red-eyed Vireo	Potential extirpation	-
Black-whiskered Vireo	Potential colonization	-
Green Jay	Potential colonization	Potential colonization
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	-	Potential extirpation
Mexican Jay	x	Stable
Chihuahuan Raven	Improving	Stable
Common Raven	Stable	Potential extirpation
Horned Lark	Stable	Stable
Northern Rough-winged Swallow	Improving*	Improving*
Tree Swallow	-	Potential colonization
Violet-green Swallow	Improving	Potential colonization

Common Name	Summer Trend	Winter Trend
Barn Swallow	Potential extirpation	-
Cliff Swallow	Improving	-
Cave Swallow	Worsening	-
Bridled Titmouse	Potential colonization	-
Black-crested Titmouse	Worsening	x
Verdin	Improving	Improving
Bushtit	Stable	Worsening
Red-breasted Nuthatch	-	Potential extirpation
White-breasted Nuthatch	Stable	Stable
Brown Creeper	-	Potential extirpation
Rock Wren	Stable	Stable
Canyon Wren	x	Worsening*
House Wren	-	Improving
Marsh Wren	-	Stable
Carolina Wren	Potential extirpation	Potential extirpation
Bewick's Wren	Stable	Worsening*
Cactus Wren	Stable	Improving
Blue-gray Gnatcatcher	Stable	Improving
Black-tailed Gnatcatcher	Improving*	Improving*
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Stable
Eastern Bluebird	-	Potential extirpation
Western Bluebird	Improving	Stable
Mountain Bluebird	-	Stable
Townsend's Solitaire	-	Stable
Hermit Thrush	Stable	Stable
American Robin	Potential extirpation	Potential extirpation
Gray Catbird	-	Improving
Curve-billed Thrasher	Improving	Improving
Brown Thrasher	-	Potential

Common Name	Summer Trend	Winter Trend
		extirpation
LeConte's Thrasher	Potential colonization	Potential colonization
Crissal Thrasher	Improving*	Stable
Sage Thrasher	-	Improving
Northern Mockingbird	Worsening	Worsening
European Starling	Improving	Improving
American Pipit	-	Improving
Cedar Waxwing	-	Potential extirpation
Phainopepla	Stable	Improving*
Black-and-white Warbler	Potential extirpation	-
Orange-crowned Warbler	-	Stable
Lucy's Warbler	Improving*	-
MacGillivray's Warbler	Stable	-
Common Yellowthroat	Improving	Stable
American Redstart	Potential extirpation	-
Northern Parula	-	Improving
Yellow-rumped Warbler	Stable	Worsening
Black-throated Gray Warbler	-	Improving
Hermit Warbler	-	Potential colonization ^
Wilson's Warbler	Stable	Improving
Red-faced Warbler	Improving	-
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Improving ^	Stable
Spotted Towhee	Improving	x
Rufous-crowned Sparrow	x	Worsening*
Canyon Towhee	Stable	Worsening*
Cassin's Sparrow	Worsening*	Stable
Chipping Sparrow	Potential extirpation	Worsening
Brewer's Sparrow	-	Improving*
Field Sparrow	-	Potential extirpation

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

Common Name	Summer Trend	Winter Trend
Painted Bunting	Worsening*	-
Dickcissel	Potential extirpation	-
Red-winged Blackbird	Improving*	Worsening
Tricolored Blackbird	Potential colonization	-
Eastern Meadowlark	Improving	Stable
Western Meadowlark	Improving	Stable
Yellow-headed Blackbird	Improving	x
Brewer's Blackbird	-	Worsening*
Great-tailed Grackle	Improving*	Stable
Bronzed Cowbird	Stable	-
Brown-headed Cowbird	Improving	Worsening
Orchard Oriole	Potential extirpation	-
Hooded Oriole	Stable	-
Bullock's Oriole	Improving*	-
Altamira Oriole	-	Potential colonization
Scott's Oriole	Worsening*	-
Black Rosy-Finch	-	Potential colonization ^
House Finch	Worsening*	Worsening
Pine Siskin	Improving	Potential extirpation
Lesser Goldfinch	Stable	Worsening*
American Goldfinch	Potential extirpation	Potential extirpation
House Sparrow	x	Potential extirpation