Birds and Climate Change

National Park Service
U.S. Department of the Interior

Guadalupe Mountains 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 Guadalupe Mountains 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 32, remain stable for 32 (e.g., Figure 2), and worsen for 11 species. Suitable climate ceases to occur for 35 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 18 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 47, remain stable for 35, and worsen for 29 species. Suitable climate ceases to occur for 18 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.

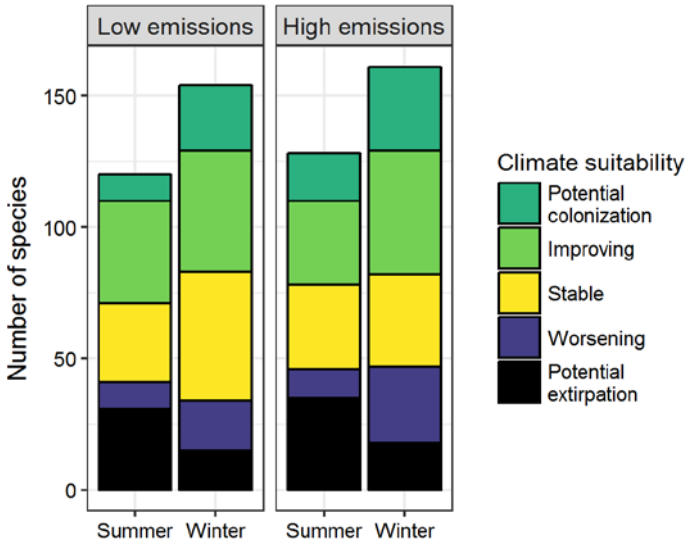

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.16 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 0.10 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 13 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 8 of these climate-sensitive species, 5 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 Mourning Dove (*Zenaida macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Guadalupe Mountains 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 8 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	-
American Wigeon	-	Stable
Mallard	Potential extirpation^	Worsening
Mottled Duck	Potential colonization	-
Green-winged Teal	-	Improving
Ring-necked Duck	-	Improving
Lesser Scaup	-	Stable
Ruddy Duck	Potential colonization	-
Scaled Quail	Worsening*	Worsening*
Northern Bobwhite	Potential colonization	Potential colonization
Montezuma Quail	x	Stable
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Improving

Common Name	Summer Trend	Winter Trend
Wood Stork	Potential colonization	-
Anhinga	Potential colonization^	-
Great Blue Heron	Stable	Improving
Great Egret	Stable	-
Tricolored Heron	Potential colonization^	-
Cattle Egret	Stable	Improving
Roseate Spoonbill	-	Potential colonization
Black Vulture	Potential colonization	Potential colonization
Turkey Vulture	x	Improving
Osprey	-	Potential colonization
White-tailed Kite	Potential colonization	-
Golden Eagle	x	Worsening*
Northern Harrier	-	Worsening
Sharp-shinned Hawk	x	Worsening

Common Name	Summer Trend	Winter Trend
Cooper's Hawk	x	Improving
Northern Goshawk	-	Potential extirpation
Bald Eagle	-	Potential extirpation
Harris's Hawk	-	Improving*
White-tailed Hawk	-	Potential colonization
Gray Hawk	Potential colonization	-
Swainson's Hawk	Worsening*^	-
Red-tailed Hawk	Stable	Improving
Ferruginous Hawk	-	Worsening*
Rough-legged Hawk	-	Potential extirpation
American Coot	x	Improving
Limpkin	-	Potential colonization
Killdeer	Stable	Improving*
Spotted Sandpiper	-	Improving*
Stilt Sandpiper	-	Potential colonization
Western Sandpiper	-	Potential colonization
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	-	Potential colonization
White-winged Dove	Improving*	Stable
Mourning Dove	Stable	Improving
Inca Dove	-	Improving*
Common Ground-Dove	-	Potential colonization
Greater Roadrunner	Improving*	Improving
Groove-billed Ani	-	Potential colonization
Western Screech-Owl	x	Stable
Great Horned Owl	x	Worsening
Burrowing Owl	Worsening*^	Worsening*
Lesser Nighthawk	Stable	-
Common Nighthawk	Worsening*	-
Common Pauraque	-	Potential colonization
White-throated Swift	x	Improving*
Black-chinned Hummingbird	Improving*	-
Broad-tailed Hummingbird	Potential extirpation	-
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	-	Stable
Green Kingfisher	-	Potential colonization
Lewis's Woodpecker	-	Stable
Acorn Woodpecker	Stable	Worsening
Golden-fronted Woodpecker	-	Potential colonization
Yellow-bellied Sapsucker	-	Stable
Red-naped Sapsucker	-	Worsening
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*

Common Name	Summer Trend	Winter Trend
Prairie Falcon	x	Stable
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Potential extirpation^	-
Gray Flycatcher	Potential extirpation	-
Dusky Flycatcher	Potential extirpation	-
Cordilleran Flycatcher	Worsening	-
Black Phoebe	Improving	Improving*
Eastern Phoebe	-	Stable
Say's Phoebe	Stable	Stable
Vermilion Flycatcher	Improving	-
Ash-throated Flycatcher	Improving	-
Cassin's Kingbird	Stable	Potential colonization
Western Kingbird	Stable	-
Loggerhead Shrike	Worsening*	Improving
Bell's Vireo	Improving*	-
Hutton's Vireo	Stable^	-
Warbling Vireo	Potential extirpation	-
Steller's Jay	Potential extirpation	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential extirpation	Worsening*
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	Potential extirpation	-
Cliff Swallow	Stable	-

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

Common Name	Summer Trend	Winter Trend
Gray Catbird	-	Stable
Curve-billed Thrasher	Improving	Improving
Long-billed Thrasher	Potential colonization^	Potential colonization
LeConte's Thrasher	-	Potential colonization
Crissal Thrasher	Improving	Worsening*
Sage Thrasher	-	Worsening
Northern Mockingbird	Stable	Improving
European Starling	Potential extirpation	Stable
American Pipit	-	Improving*
Cedar Waxwing	-	Potential extirpation
Phainopepla	Improving	Stable
Chestnut-collared Longspur	-	Worsening
Black-and-white Warbler	Stable	Potential colonization
Orange-crowned Warbler	Stable	-
Common Yellowthroat	Improving	-
Northern Parula	-	Potential colonization
Yellow-rumped Warbler	Stable	Improving
Grace's Warbler	Potential extirpation	-
Black-throated Gray Warbler	Potential extirpation	Potential colonization
Townsend's Warbler	-	Potential colonization
Wilson's Warbler	Stable	Potential colonization
Yellow-breasted Chat	Improving*	-
Green-tailed Towhee	Potential extirpation^	Improving
Spotted Towhee	Potential extirpation	x
Eastern Towhee	Stable	x
Rufous-crowned Sparrow	x	Stable
Canyon Towhee	Improving	Stable

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

Common Name	Summer Trend	Winter Trend
Painted Bunting	Improving	-
Red-winged Blackbird	Improving	Improving
Tricolored Blackbird	Potential colonization	-
Eastern Meadowlark	Worsening*	Stable
Western Meadowlark	Worsening*	Worsening
Brewer's Blackbird	-	Stable
Common Grackle	-	Stable
Great-tailed Grackle	Stable	Improving
Bronzed Cowbird	Improving	-
Brown-headed Cowbird	Improving	Improving
Bullock's Oriole	Stable	-

Common Name	Summer Trend	Winter Trend
Baltimore Oriole	Stable	-
Scott's Oriole	Stable	-
House Finch	Stable	Worsening
Cassin's Finch	-	Worsening
Red Crossbill	Potential extirpation^	x
Pine Siskin	Potential extirpation	Potential extirpation
Lesser Goldfinch	Improving	Stable
American Goldfinch	-	Potential extirpation
Evening Grosbeak	Improving	Potential extirpation
House Sparrow	x	Worsening