



Zion 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 Zion 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 27 (e.g., Figure 2), remain stable for 42, and worsen for 19 species. Suitable climate ceases to occur for 32 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 15 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 51, remain stable for 33, and worsen for 14 species. Suitable climate ceases to occur for 8 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 39 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.

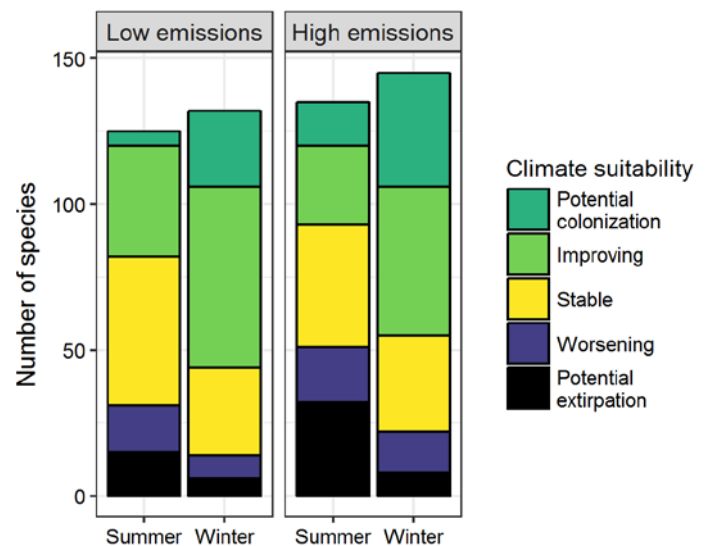


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.27 in summer (45th percentile across all national parks) and 0.22 in winter (32nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.15 in summer and 0.17 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 14 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 9 of these

Management Implications

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

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-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 (*Zenaidura macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

across boundaries, managing the disturbance regime, and possibly more intensive management actions. Furthermore, park managers have an opportunity to focus on supporting the 9 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
Cackling/Canada Goose	x	Potential extirpation
Gadwall	-	Improving
American Wigeon	-	Improving
Mallard	Potential extirpation [^]	Improving
Cinnamon Teal	x	Improving
Northern Shoveler	-	Improving
Green-winged Teal	x	Stable
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Hooded Merganser	-	Improving [^]
Common Merganser	x	Stable
Ruddy Duck	Potential extirpation	Improving
Gambel's Quail	Improving*	Improving*
Northern Bobwhite	Potential	Potential

Common Name	Summer Trend	Winter Trend
	colonization	colonization
Chukar	Worsening	Worsening
Wild Turkey	x	Stable
Pied-billed Grebe	x	Improving
American White Pelican	-	Potential colonization
American Bittern	-	Potential colonization [^]
Great Blue Heron	Stable	Improving
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Golden Eagle	x	Stable
Mississippi Kite	Potential colonization	-
Northern Harrier	Worsening [^]	Stable
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Improving
Bald Eagle	x	Stable

Common Name	Summer Trend	Winter Trend
Harris's Hawk	Potential colonization	Potential colonization
Swainson's Hawk	Improving*^	-
Red-tailed Hawk	Stable	Improving
Ferruginous Hawk	-	Improving
Rough-legged Hawk	-	Potential extirpation
Sora	x	Potential colonization
Common Gallinule	-	Potential colonization
American Coot	x	Improving
Killdeer	Stable	Improving
Mountain Plover	Potential colonization	-
Spotted Sandpiper	x	Potential colonization
Greater Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Least Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Wilson's Snipe	-	Worsening
Gull-billed Tern	-	Potential colonization
Rock Pigeon	Stable	Stable
Band-tailed Pigeon	Stable	-
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving	Potential colonization
Mourning Dove	Improving	Improving
Inca Dove	-	Potential colonization
Greater Roadrunner	Improving*	Improving*
Western Screech-Owl	-	Stable
Great Horned Owl	x	Potential extirpation

Common Name	Summer Trend	Winter Trend
Northern Pygmy-Owl	x	Worsening
Burrowing Owl	-	Potential colonization
Lesser Nighthawk	Improving	-
Common Nighthawk	Stable	-
Common Pauraque	-	Potential colonization
White-throated Swift	x	Potential colonization
Black-chinned Hummingbird	Stable	-
Anna's Hummingbird	Potential colonization	Potential colonization
Costa's Hummingbird	Improving	-
Broad-tailed Hummingbird	Worsening*	-
Belted Kingfisher	Stable	Stable
Lewis's Woodpecker	x	Stable
Acorn Woodpecker	Stable	Stable
Gila Woodpecker	Potential colonization	Potential colonization
Golden-fronted Woodpecker	Potential colonization	Potential colonization
Red-naped Sapsucker	Potential extirpation^	Improving*
Red-breasted Sapsucker	-	Stable
Ladder-backed Woodpecker	Improving*	Improving*
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Worsening*	Stable
Gilded Flicker	Potential colonization	Potential colonization
American Kestrel	x	Improving
Merlin	-	Stable^
Peregrine Falcon	x	Improving
Prairie Falcon	x	Worsening*
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Worsening*^	-

Common Name	Summer Trend	Winter Trend
Willow Flycatcher	Potential extirpation	-
Gray Flycatcher	Worsening	Potential colonization
Dusky Flycatcher	Worsening	-
Cordilleran Flycatcher	Stable	-
Black Phoebe	Improving	Improving*
Say's Phoebe	Stable	Improving*
Vermilion Flycatcher	Stable	Improving
Ash-throated Flycatcher	Improving*	-
Brown-crested Flycatcher	Improving	-
Cassin's Kingbird	Stable	-
Western Kingbird	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	-	Improving
Bell's Vireo	Improving	-
Hutton's Vireo	-	Potential colonization
Warbling Vireo	Potential extirpation	-
Pinyon Jay	Stable	Worsening*
Steller's Jay	Worsening	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Stable
Clark's Nutcracker	Potential extirpation [^]	Worsening*
American Crow	-	Potential extirpation
Common Raven	Potential extirpation	Worsening
Horned Lark	-	Worsening*
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Worsening*	Potential colonization
Barn Swallow	Improving*	-

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

Common Name	Summer Trend	Winter Trend
LeConte's Thrasher	Potential colonization	Potential colonization
Crissal Thrasher	Potential colonization	-
Northern Mockingbird	Improving*	Improving*
European Starling	Stable	Stable
American Pipit	-	Improving
Cedar Waxwing	Potential extirpation	Stable
Phainopepla	Improving	Potential colonization
Orange-crowned Warbler	Potential extirpation	Improving
Lucy's Warbler	Improving	-
MacGillivray's Warbler	Potential extirpation	-
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Improving
Grace's Warbler	Stable	-
Black-throated Gray Warbler	Stable	-
Wilson's Warbler	Potential extirpation	-
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Worsening*^	Improving
Spotted Towhee	Worsening*	x
Rufous-crowned Sparrow	x	Improving
Abert's Towhee	Improving	Improving*
Chipping Sparrow	Potential extirpation	Potential colonization
Brewer's Sparrow	Worsening*	-
Black-chinned Sparrow	x	Potential colonization
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Stable	Potential colonization
Black-throated Sparrow	Stable	-

Common Name	Summer Trend	Winter Trend
Savannah Sparrow	-	Improving*
Henslow's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Improving*
White-throated Sparrow	-	Improving
White-crowned Sparrow	Stable	Improving
Golden-crowned Sparrow	-	Stable
Dark-eyed Junco	x	Stable
Summer Tanager	Improving	-
Western Tanager	Worsening*	-
Rose-breasted Grosbeak	Stable	-
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Worsening	-
Indigo Bunting	Stable	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Potential colonization	Potential colonization
Western Meadowlark	Worsening*	Improving
Yellow-headed Blackbird	Stable	-
Brewer's Blackbird	Potential extirpation	-
Great-tailed Grackle	Improving*	-
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Improving	Potential colonization
Hooded Oriole	Improving	-
Bullock's Oriole	Stable	-
Scott's Oriole	Improving	-
House Finch	Stable	Improving
Cassin's Finch	Worsening	Worsening
Red Crossbill	Potential	-

Common Name	Summer Trend	Winter Trend
	extirpation ^	
Pine Siskin	Potential extirpation	Stable
Lesser Goldfinch	Stable	Improving

Common Name	Summer Trend	Winter Trend
American Goldfinch	Potential extirpation	Stable
Evening Grosbeak	Potential extirpation	-
House Sparrow	x	Stable