



Bryce Canyon 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 Bryce Canyon 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 18, remain stable for 48, and worsen for 16 species. Suitable climate ceases to occur for 19 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 10 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 15, remain stable for 10, and worsen for 6 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 43 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.

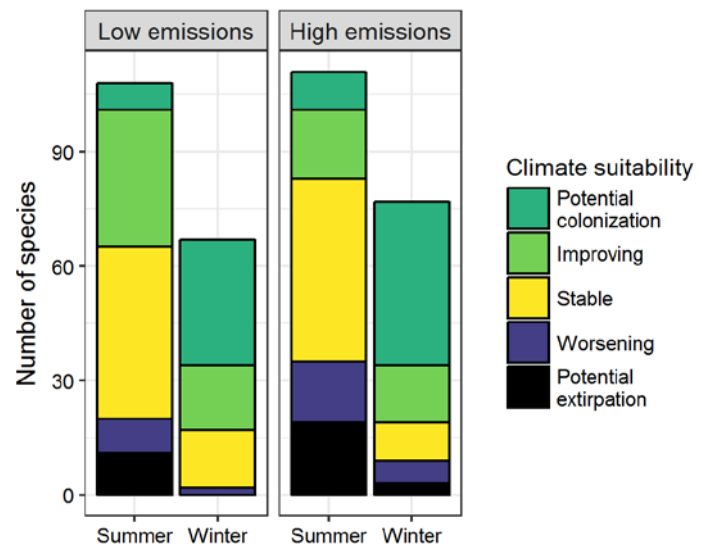


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.20 in summer (31st percentile across all national parks) and 0.29 in winter (45th percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.23 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 12 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, Bryce Canyon National Park falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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

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, 2 might be extirpated from the Park in at least one season by 2050.



Figure 2. Although currently found at the Park, suitable climate for the American Robin (*Turdus migratorius*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by Andy Reago & Chrissy McClarren/Flickr (CC BY 2.0).

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 12 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	Stable
Wood Duck	-	Potential colonization
Gadwall	-	Potential colonization
Mallard	Potential extirpation [^]	Stable
Northern Shoveler	-	Potential colonization
Canvasback	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization [^]
Ruddy Duck	Potential extirpation	Potential colonization
Gambel's Quail	Improving	Improving*
Pied-billed Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Clark's Grebe	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Stable	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Northern Harrier	Worsening [^]	Improving
Cooper's Hawk	x	Improving
Bald Eagle	-	Stable
Harris's Hawk	Potential colonization	-
Swainson's Hawk	Stable [^]	-
Red-tailed Hawk	Stable	Improving
Sora	-	Potential colonization
American Coot	x	Improving
Killdeer	Stable	Potential colonization
Rock Pigeon	Stable	-

Common Name	Summer Trend	Winter Trend
Band-tailed Pigeon	Stable	-
Eurasian Collared-Dove	x	Improving*
White-winged Dove	-	Potential colonization
Mourning Dove	Improving	Potential colonization
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Common Nighthawk	Improving	-
Black-chinned Hummingbird	Improving*	-
Broad-tailed Hummingbird	Stable	-
Belted Kingfisher	Stable	-
Gila Woodpecker	-	Potential colonization
Red-naped Sapsucker	Worsening^	-
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Stable	Stable
American Three-toed Woodpecker	x	Potential extirpation^
Northern Flicker	Worsening*	Improving
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Stable^	-
Hammond's Flycatcher	Potential extirpation	-
Gray Flycatcher	Stable	-
Dusky Flycatcher	Worsening*	-
Cordilleran Flycatcher	Stable	-
Black Phoebe	Improving	Potential colonization
Say's Phoebe	Stable	-
Ash-throated Flycatcher	Improving*	-

Common Name	Summer Trend	Winter Trend
Cassin's Kingbird	Improving*	-
Western Kingbird	Improving*	-
Loggerhead Shrike	Improving	-
Warbling Vireo	Potential extirpation	-
Pinyon Jay	Stable	-
Steller's Jay	Stable	Worsening*
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	-
Black-billed Magpie	Worsening*^	Worsening*
Clark's Nutcracker	Worsening^	Worsening*
American Crow	Stable	Stable
Chihuahuan Raven	Potential colonization	Potential colonization
Common Raven	Stable	Worsening
Horned Lark	Stable	Stable
Northern Rough-winged Swallow	Stable	-
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Worsening*	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Stable	-
Mountain Chickadee	Stable	Worsening*
Juniper Titmouse	Stable	-
Bushtit	Stable	-
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	Improving
Pygmy Nuthatch	Stable	Stable^
Brown Creeper	Stable^	-
Rock Wren	Stable	-
House Wren	Potential extirpation	-
Bewick's Wren	Improving*	-
Cactus Wren	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Blue-gray Gnatcatcher	Stable	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	-
Ruby-crowned Kinglet	Potential extirpation	-
Western Bluebird	Stable	Improving*
Mountain Bluebird	Stable	Improving*
Townsend's Solitaire	Worsening^	Stable
Hermit Thrush	Stable	Potential colonization
American Robin	Potential extirpation	Improving
Curve-billed Thrasher	Potential colonization	Potential colonization
Bendire's Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	Potential colonization
Sage Thrasher	Worsening	-
Northern Mockingbird	Improving*	-
European Starling	Stable	Improving
American Pipit	-	Potential colonization
Chestnut-collared Longspur	-	Potential colonization
Orange-crowned Warbler	Potential extirpation	-
MacGillivray's Warbler	Stable	-
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Stable	Potential colonization
Grace's Warbler	Stable	-
Black-throated Gray Warbler	Stable	-
Green-tailed Towhee	Worsening*^	Potential colonization
Spotted Towhee	Stable	-
Rufous-crowned Sparrow	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Stable	-
Brewer's Sparrow	Worsening*	Potential colonization
Vesper Sparrow	Potential extirpation	-
Lark Sparrow	Improving*	-
Black-throated Sparrow	Stable	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	Potential extirpation	-
Song Sparrow	Potential extirpation	-
Lincoln's Sparrow	Potential extirpation	Potential colonization
White-crowned Sparrow	Potential extirpation	-
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Potential colonization	-
Lazuli Bunting	Worsening	-
Red-winged Blackbird	Potential extirpation	Improving
Western Meadowlark	Stable	-
Yellow-headed Blackbird	Stable	-
Brewer's Blackbird	Worsening*	Stable
Great-tailed Grackle	Improving	Potential colonization
Brown-headed Cowbird	Stable	-
Bullock's Oriole	Improving	-
Scott's Oriole	Improving	-
House Finch	Improving*	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Cassin's Finch	Worsening*	Worsening*
Red Crossbill	Worsening^	x

Common Name	Summer Trend	Winter Trend
Pine Siskin	Worsening	Stable
Lesser Goldfinch	Improving*	-
American Goldfinch	Potential extirpation	Improving