Birds and Climate Change

National Park Service
U.S. Department of the Interior

Rocky Mountain 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 Rocky Mountain 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 68, remain stable for 34, and worsen for 20 species. Suitable climate ceases to occur for 9 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 9 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 53, remain stable for 15, and worsen for 9 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 21 species not found at the Park today, potentially resulting in local colonization.

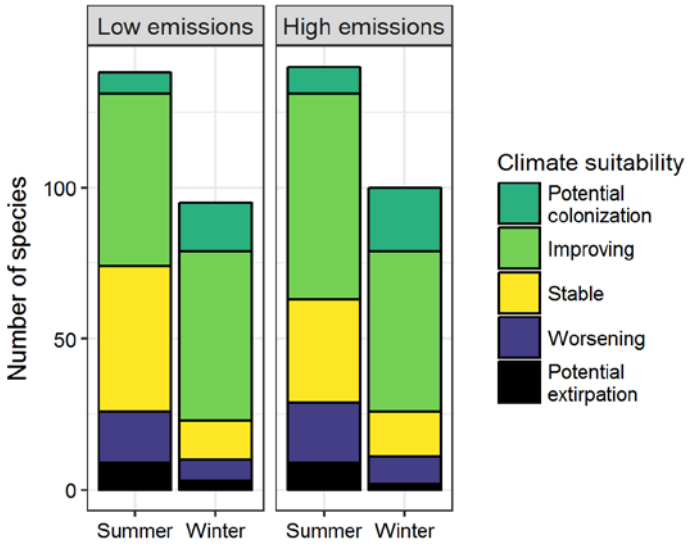

Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.21 in summer (32nd percentile across all national parks) and 0.31 in winter (48th percentile) under the high-emissions pathway. Potential species turnover declines to 0.14 in summer and 0.24 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 27 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 climate is not projected to disappear for these 27 species at the Park; instead the Park may serve as an important refuge for these climate-sensitive species.

Figure 2. Although currently found at the Park, suitable climate for the Red-winged Blackbird (*Agelaius phoeniceus*) 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Rocky Mountain 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 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 27 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.

Contacts

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

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
Gadwall	Stable^	-
American Wigeon	Worsening^	Improving
Mallard	Stable^	Improving
Blue-winged Teal	Stable	-
Northern Shoveler	Worsening^	-
Northern Pintail	Potential extirpation	-
Green-winged Teal	x	Potential colonization
Redhead	Stable^	x
Ring-necked Duck	x	Improving
Lesser Scaup	x	Improving
Bufflehead	x	Improving
Common Goldeneye	-	Stable
Barrow's Goldeneye	-	Stable^
Hooded Merganser	-	Improving^
Common Merganser	x	Stable
Ruddy Duck	Improving	-

Common Name	Summer Trend	Winter Trend
Scaled Quail	-	Potential colonization
Gambel's Quail	Potential colonization	Potential colonization
Chukar	-	Potential colonization
Wild Turkey	x	Improving
Pied-billed Grebe	x	Improving
Eared Grebe	x	Potential colonization
Great Blue Heron	Improving	Improving
Golden Eagle	x	Stable
Northern Harrier	Stable^	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Improving
Northern Goshawk	x	Worsening
Bald Eagle	x	Stable
Swainson's Hawk	Worsening^	-
Red-tailed Hawk	Stable	Improving

Common Name	Summer Trend	Winter Trend
Ferruginous Hawk	Stable^	-
Virginia Rail	x	Potential colonization
American Coot	x	Improving
Killdeer	Stable	-
Wilson's Snipe	Worsening*	-
Wilson's Phalarope	Worsening^	-
Franklin's Gull	Potential extirpation	-
Ring-billed Gull	Stable^	-
Herring Gull	-	Improving^
Rock Pigeon	Improving	Improving
Band-tailed Pigeon	Stable	Improving
Eurasian Collared-Dove	x	Improving
White-winged Dove	Improving	-
Mourning Dove	Improving*	Improving
Western Screech-Owl	-	Potential colonization
Great Horned Owl	x	Stable
Northern Pygmy-Owl	x	Improving
Common Nighthawk	Improving*	-
Chimney Swift	Improving	-
Black-chinned Hummingbird	Improving	-
Broad-tailed Hummingbird	Improving*	-
Rufous Hummingbird	Improving	-
Calliope Hummingbird	Stable	-
Belted Kingfisher	Improving	Worsening
Gila Woodpecker	-	Potential colonization
Red-naped Sapsucker	Improving^	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Improving*	Stable
American Three-toed Woodpecker	x	Worsening*^
Northern Flicker	Improving	Improving
American Kestrel	x	Improving*

Common Name	Summer Trend	Winter Trend
Merlin	-	Improving^
Olive-sided Flycatcher	Stable	-
Western Wood-Pewee	Improving*^	-
Willow Flycatcher	Stable	-
Least Flycatcher	Potential extirpation	-
Hammond's Flycatcher	Improving	-
Gray Flycatcher	Potential colonization	-
Dusky Flycatcher	Stable	-
Cordilleran Flycatcher	Improving*	-
Say's Phoebe	Improving	-
Ash-throated Flycatcher	Potential colonization	-
Cassin's Kingbird	Potential colonization	-
Western Kingbird	Improving	-
Eastern Kingbird	Stable	-
Loggerhead Shrike	Improving	-
Northern Shrike	-	Improving
Warbling Vireo	Worsening	-
Red-eyed Vireo	Stable	-
Gray Jay	Worsening*	Worsening*
Pinyon Jay	Improving	-
Steller's Jay	Improving*	Improving
Blue Jay	Stable	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Improving	Improving
Black-billed Magpie	Improving^	Worsening
Clark's Nutcracker	Stable^	Stable
American Crow	Improving	Improving
Common Raven	Stable	Stable
Horned Lark	Potential extirpation	Improving
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Stable	-

Common Name	Summer Trend	Winter Trend
Violet-green Swallow	Improving*	-
Barn Swallow	Improving	-
Cliff Swallow	Worsening	-
Black-capped Chickadee	Improving	Worsening
Mountain Chickadee	Stable	Improving
Chestnut-backed Chickadee	-	Potential colonization
Juniper Titmouse	Potential colonization	Potential colonization
Bushtit	Improving	Potential colonization
Red-breasted Nuthatch	Stable	Stable
White-breasted Nuthatch	Improving*	Improving
Pygmy Nuthatch	Improving	Improving*^
Brown Creeper	Improving^	Improving
Rock Wren	Worsening	-
Canyon Wren	x	Improving
House Wren	Improving*	-
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving	-
American Dipper	x	Worsening
Golden-crowned Kinglet	Improving	Improving
Ruby-crowned Kinglet	Worsening*	Improving
Western Bluebird	Improving	Potential colonization
Mountain Bluebird	Stable	Improving
Townsend's Solitaire	Worsening*^	Improving
Veery	Improving	-
Swainson's Thrush	Worsening*	-
Hermit Thrush	Improving	-
American Robin	Worsening	Improving*
Gray Catbird	Improving	-
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Stable	-
Crissal Thrasher	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Sage Thrasher	Worsening	Potential colonization
Northern Mockingbird	Improving	-
European Starling	Improving	Improving*
American Pipit	Potential extirpation	-
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Stable	Improving
Orange-crowned Warbler	Improving	-
MacGillivray's Warbler	Improving	-
Common Yellowthroat	Potential extirpation	-
American Redstart	Stable	-
Yellow Warbler	Worsening	-
Pine Warbler	-	Improving
Yellow-rumped Warbler	Stable	-
Grace's Warbler	Potential colonization	-
Black-throated Gray Warbler	Potential colonization	-
Wilson's Warbler	Worsening*	-
Yellow-breasted Chat	Improving	-
Green-tailed Towhee	Improving*^	Potential colonization
Spotted Towhee	Improving*	-
Canyon Towhee	Potential colonization	-
Abert's Towhee	-	Potential colonization
Cassin's Sparrow	Improving	-
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Improving	-
Brewer's Sparrow	Worsening*	-
Vesper Sparrow	Improving	-
Lark Sparrow	Improving	-
Black-throated Sparrow	-	Potential

Common Name	Summer Trend	Winter Trend
		colonization
Lark Bunting	Potential extirpation	-
Savannah Sparrow	Potential extirpation	-
Grasshopper Sparrow	Improving	-
Fox Sparrow	Stable	-
Song Sparrow	Improving	Improving*
Lincoln's Sparrow	Worsening*	-
White-crowned Sparrow	Worsening*	Improving
Dark-eyed Junco	x	Improving
Western Tanager	Improving*	-
Black-headed Grosbeak	Improving*	-
Blue Grosbeak	Improving	-
Lazuli Bunting	Stable	-
Indigo Bunting	Improving	-
Bobolink	Improving	-
Red-winged Blackbird	Potential extirpation	Improving*
Western Meadowlark	Improving	Improving*
Yellow-headed Blackbird	Stable	-

Common Name	Summer Trend	Winter Trend
Brewer's Blackbird	Improving	Improving
Common Grackle	Improving	-
Great-tailed Grackle	Improving	Potential colonization
Brown-headed Cowbird	Improving	-
Bullock's Oriole	Improving	-
Gray-crowned Rosy-Finch	-	Stable^
Black Rosy-Finch	-	Stable^
Brown-capped Rosy-Finch	x	Stable
Pine Grosbeak	Worsening*^	Worsening*
House Finch	Improving	Improving
Cassin's Finch	Stable	Improving*
Red Crossbill	Stable^	x
Common Redpoll	-	Potential extirpation
Pine Siskin	Stable	Improving
Lesser Goldfinch	Improving	-
American Goldfinch	Stable	Improving*
Evening Grosbeak	Improving	Improving
House Sparrow	x	Improving