



Colorado National Monument

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 Colorado National Monument (hereafter, the Monument) 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 11, remain stable for 41 (e.g., Figure 2), and worsen for 8 species. Suitable climate ceases to occur for 29 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 22 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 19, remain stable for 17, and worsen for 5 species. Suitable climate ceases to occur for 6 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 42 species not found at the Monument 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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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.

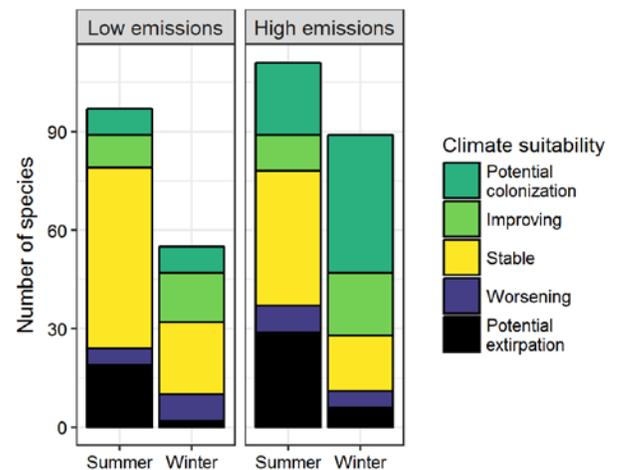


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.27 in summer (45th percentile across all national parks) and 0.22 in winter (31st percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.06 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 Monument is or may become home to 12 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).

Management Implications

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

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

While the Monument may serve as an important refuge for 7 of these climate-sensitive species, 5 might be extirpated from the Monument in at least one season by 2050.



Figure 2. Climate at the Monument in summer is projected to remain suitable for the Violet-green Swallow (*Tachycineta thalassina*) through 2050. Photo by Becky Matsubara/Flickr (CC BY 2.0).

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 7 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.

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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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
American Wigeon	-	Improving
Mallard	Potential extirpation [^]	Stable
Ring-necked Duck	-	Improving
Greater Scaup	-	Potential colonization [^]
Hooded Merganser	-	Potential colonization [^]
Scaled Quail	-	Potential colonization
Gambel's Quail	Improving	Improving*
Northern Bobwhite	Potential colonization	Potential colonization
Chukar	Stable	Stable
Horned Grebe	-	Potential colonization
American Bittern	-	Potential colonization [^]
Great Blue Heron	Stable	-

Common Name	Summer Trend	Winter Trend
Cattle Egret	Potential colonization	-
Yellow-crowned Night-Heron	Potential colonization	-
Golden Eagle	x	Stable
Mississippi Kite	Potential colonization	-
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Stable
Bald Eagle	x	Worsening
Swainson's Hawk	Stable [^]	-
Red-tailed Hawk	Stable	Improving
Killdeer	Stable	-
Greater Yellowlegs	-	Potential colonization
Least Sandpiper	-	Potential colonization
Gull-billed Tern	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Rock Pigeon	Potential extirpation	Potential extirpation
Eurasian Collared-Dove	x	Improving
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	Potential colonization
Western Screech-Owl	-	Stable
Burrowing Owl	-	Potential colonization
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Stable	-
Chuck-will's-widow	Potential colonization	-
Black-chinned Hummingbird	Improving	-
Broad-tailed Hummingbird	Stable	-
Gila Woodpecker	-	Potential colonization
Golden-fronted Woodpecker	-	Potential colonization
Red-naped Sapsucker	Potential extirpation [^]	-
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Stable	Potential extirpation
Hairy Woodpecker	Stable	-
Northern Flicker	Worsening	Improving
Gilded Flicker	Potential colonization	Potential colonization
American Kestrel	x	Improving
Olive-sided Flycatcher	Potential extirpation	-
Western Wood-Pewee	Potential extirpation [^]	-
Gray Flycatcher	Stable	-

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

Common Name	Summer Trend	Winter Trend
Juniper Titmouse	Stable	Stable
Verdin	-	Potential colonization
Bushtit	Stable	Improving*
Red-breasted Nuthatch	Potential extirpation	-
White-breasted Nuthatch	Stable	-
Rock Wren	Stable	-
Canyon Wren	x	Improving*
House Wren	Potential extirpation	-
Bewick's Wren	Improving	Improving*
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	Improving*	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	Potential extirpation	-
Ruby-crowned Kinglet	Potential extirpation	-
Western Bluebird	Stable	Stable
Mountain Bluebird	Stable	Improving*
Townsend's Solitaire	Potential extirpation^	Worsening*
Swainson's Thrush	Potential extirpation	-
American Robin	Potential extirpation	Improving
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	-	Potential colonization
Crissal Thrasher	Potential colonization	Potential colonization
Sage Thrasher	Worsening	Potential colonization
Northern Mockingbird	Improving*	Potential colonization

Common Name	Summer Trend	Winter Trend
European Starling	Potential extirpation	Stable
American Pipit	-	Potential colonization
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	-	Stable
Smith's Longspur	-	Potential colonization
Orange-crowned Warbler	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	Potential extirpation	Improving
Black-throated Gray Warbler	Stable	-
Green-tailed Towhee	Stable^	-
Spotted Towhee	Stable	x
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	-	Potential colonization
Abert's Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	Stable	-
Brewer's Sparrow	Worsening*	Potential colonization
Field Sparrow	-	Potential colonization
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Stable	-
Black-throated Sparrow	Stable	Potential colonization
Sagebrush/Bell's Sparrow (Sage Sparrow)	Stable^	-
Lark Bunting	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Savannah Sparrow	-	Potential colonization
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	Potential extirpation	Potential colonization
White-crowned Sparrow	Stable	Improving
Dark-eyed Junco	x	Stable
Western Tanager	Stable	-
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Stable	-
Painted Bunting	Potential colonization	-
Dickcissel	Potential colonization	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Western Meadowlark	Worsening*	-
Brewer's Blackbird	Potential extirpation	-
Common Grackle	Improving*	-
Great-tailed Grackle	Potential colonization	-
Brown-headed Cowbird	Stable	Potential colonization
Bullock's Oriole	Stable	-
Scott's Oriole	Potential colonization	-
House Finch	Stable	Stable
Cassin's Finch	Worsening	Stable
Pine Siskin	Potential extirpation	-
Lesser Goldfinch	Improving	-
American Goldfinch	Potential extirpation	Stable
Evening Grosbeak	-	Potential extirpation
House Sparrow	x	Worsening