



Russell Cave 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 Russell Cave 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 7, remain stable for 8, and worsen for 9 species. Suitable climate ceases to occur for 6 species in summer, potentially resulting in extirpation of those species from the Monument (e.g., Figure 2). Climate is projected to become suitable in summer for 16 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 10, remain stable for 9, and worsen for 1 species. Suitable climate does not cease to occur for any species in winter. 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.

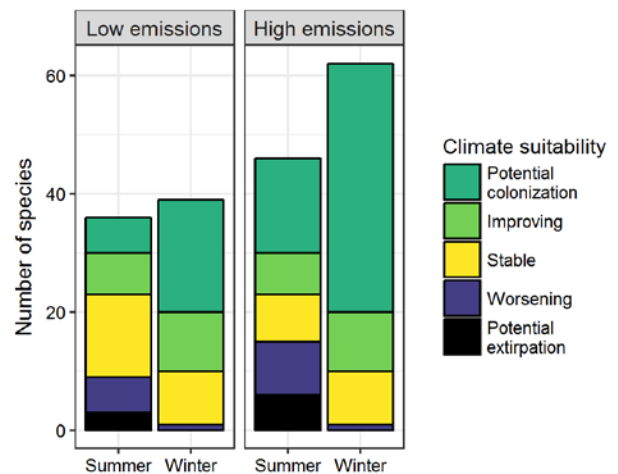


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.19 in summer (30th percentile across all national parks) and 0.21 in winter (29th percentile) under the high-emissions pathway. Potential species turnover declines to 0.08 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 Monument is home to one species, the Pine Warbler (*Setophaga pinus*), that is highly sensitive to climate change across its range (i.e., it is projected to lose climate suitability in over 50% of its current summer range in North America by 2050; Table 1; Langham et al. 2015). Suitable climate is not projected to disappear for this

Management Implications

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

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

species at the Monument; instead the Monument may serve as an important refuge for this climate-sensitive species.



Figure 2. Although currently found at the Monument, suitable climate for the American Goldfinch (*Spinus tristis*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation. Photo by John Benson/Flickr (CC BY 2.0).

Furthermore, park managers have an opportunity to focus on supporting the 1 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
Blue-winged Teal	-	Potential colonization
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Anhinga	-	Potential colonization
American White Pelican	-	Potential colonization
Great Egret	-	Potential colonization
Little Blue Heron	Potential colonization	Potential colonization
Cattle Egret	Potential colonization	Potential colonization
Yellow-crowned Night-Heron	Potential colonization	-
White Ibis	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Turkey Vulture	x	Improving
Osprey	-	Potential colonization
Virginia Rail	-	Potential colonization
Sora	-	Potential colonization
Spotted Sandpiper	-	Potential colonization
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Gull-billed Tern	-	Potential colonization
Forster's Tern	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving	-
Greater Roadrunner	Potential colonization	Potential colonization
Chimney Swift	Stable	-
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	Stable
Red-cockaded Woodpecker	-	Potential colonization
Crested Caracara	-	Potential colonization
Eastern Wood-Pewee	Worsening	-
Eastern Phoebe	Worsening	Improving
Scissor-tailed Flycatcher	Potential colonization	-
White-eyed Vireo	-	Potential colonization
Red-eyed Vireo	Stable	-
Blue Jay	Improving	Stable
American Crow	Stable	Stable
Barn Swallow	Worsening	-
Cliff Swallow	Potential colonization	-
Carolina Chickadee	Improving	Improving
Tufted Titmouse	Worsening	Improving
Black-crested Titmouse	Potential colonization	-
Marsh Wren	-	Potential colonization
Carolina Wren	Stable	Stable
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Worsening	Improving

Common Name	Summer Trend	Winter Trend
Wood Thrush	Worsening	-
Gray Catbird	-	Potential colonization
Northern Mockingbird	Stable	-
European Starling	Potential extirpation	-
Sprague's Pipit	-	Potential colonization
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Black-and-white Warbler	Improving	-
Orange-crowned Warbler	-	Potential colonization
Common Yellowthroat	-	Potential colonization
Pine Warbler	Improving**^	Improving
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Stable	-
Eastern Towhee	Worsening*	x
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	-
Lark Sparrow	Potential colonization	Potential colonization
Grasshopper Sparrow	-	Potential colonization
Lincoln's Sparrow	-	Potential colonization
White-throated Sparrow	-	Stable
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	-	Worsening*
Summer Tanager	Improving	-

Common Name	Summer Trend	Winter Trend
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	Stable
Pyrrhuloxia	-	Potential colonization
Indigo Bunting	Stable	-
Painted Bunting	Potential colonization	-
Western Meadowlark	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Common Grackle	Potential extirpation	Improving
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	-	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
American Goldfinch	Potential extirpation	Stable