



## Gauley River National Recreation Area

### 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 Gauley River National Recreation Area (hereafter, the Recreation Area) 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 Recreation Area, with greater impacts under the high-emissions pathway than under the low-emissions pathway (Figure 1).**

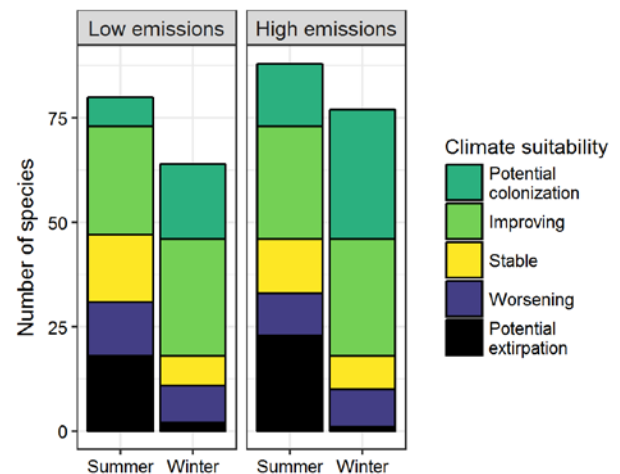
Among the species likely to be found at the Recreation Area today, climate suitability in summer under the high-emissions pathway is projected to improve for 27 (e.g., Figure 2), remain stable for 13, and worsen for 10 species. Suitable climate ceases to occur for 23 species in summer, potentially resulting in extirpation of those species from the Recreation Area. Climate is projected to become suitable in summer for 15 species not found at the Recreation Area today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 28, remain stable for 8, and worsen for 9 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 31 species not

**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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Recreation Area 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.

found at the Recreation Area today, potentially resulting in local colonization.



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

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Recreation Area between the present and 2050 is 0.22 in summer (36<sup>th</sup> percentile across all national parks) and 0.20 in winter (27<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.13 in summer and 0.16 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 Recreation Area is or may become home to 5 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.

## Management Implications

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Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Gauley River National Recreation Area falls within the intermediate change group.** Parks anticipating intermediate change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and

### 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

2015). Suitable climate is not projected to disappear for these 5 species at the Recreation Area; instead the Recreation Area may serve as an important refuge for these climate-sensitive species.



**Figure 2. Climate at the Recreation Area in summer is projected to remain suitable for the Northern Cardinal (*Cardinalis cardinalis*) through 2050.** Photo by Andy Morffew/Flickr (CC BY 2.0).

reducing other stressors. Furthermore, park managers have an opportunity to focus on supporting the 5 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Recreation Area 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	-	Stable
American Black Duck	-	Worsening*
Mallard	-	Stable
Blue-winged Teal	-	Potential colonization
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	x	Improving <sup>^</sup>
Red-breasted Merganser	-	Potential colonization <sup>^</sup>
Ruffed Grouse	x	Potential extirpation
Wild Turkey	x	Stable

Common Name	Summer Trend	Winter Trend
Double-crested Cormorant	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	Improving	Improving
Great Egret	Stable	-
Little Blue Heron	Potential colonization	-
Cattle Egret	Potential colonization	-
Black Vulture	Improving	-
Mississippi Kite	Potential colonization	-
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Worsening*
Bald Eagle	-	Improving
Red-shouldered Hawk	Potential colonization	-
Killdeer	Improving	Improving

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Least Sandpiper	-	Potential colonization
Bonaparte's Gull	-	Potential colonization
Forster's Tern	-	Potential colonization
Eurasian Collared-Dove	-	Potential colonization
Mourning Dove	Improving	Worsening
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Western Screech-Owl	-	Potential colonization
Eastern Screech-Owl	x	Stable
Burrowing Owl	Potential colonization <sup>^</sup>	-
Chuck-will's-widow	Potential colonization	-
Chimney Swift	Stable	-
Ruby-throated Hummingbird	Improving	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Improving	Improving*
Red-bellied Woodpecker	Improving	Improving
Yellow-bellied Sapsucker	Potential extirpation	-
Downy Woodpecker	Improving	Worsening
Northern Flicker	Potential extirpation	Improving
Pileated Woodpecker	Stable	Improving
American Kestrel	x	Improving
Eastern Wood-Pewee	Stable	-
Acadian Flycatcher	Stable	-
Eastern Phoebe	Stable	Improving
Great Crested Flycatcher	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Loggerhead Shrike	Potential colonization	Potential colonization
Bell's Vireo	Potential colonization	-
Red-eyed Vireo	Worsening	-
Blue Jay	Improving	Worsening
American Crow	Worsening	Worsening
Common Raven	Potential extirpation	-
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Improving	-
Carolina Chickadee	Improving	Improving
Tufted Titmouse	Improving	Stable
Red-breasted Nuthatch	Potential extirpation	Stable
White-breasted Nuthatch	Worsening	Worsening*
Brown-headed Nuthatch	Potential colonization <sup>^</sup>	Potential colonization
House Wren	Potential extirpation	Potential colonization
Sedge Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Bewick's Wren	-	Improving
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Improving	Improving
Hermit Thrush	-	Improving
Wood Thrush	Worsening	-
American Robin	Potential extirpation	Improving
Gray Catbird	Potential extirpation	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Brown Thrasher	Improving*	Potential colonization
Northern Mockingbird	Stable	-
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Northern Waterthrush	Potential extirpation	-
Golden-winged Warbler	Potential extirpation	-
Black-and-white Warbler	Stable	-
Prothonotary Warbler	Potential colonization	-
Swainson's Warbler	Improving	-
Common Yellowthroat	Worsening	-
Hooded Warbler	Stable	-
American Redstart	Potential extirpation	-
Northern Parula	Improving*	-
Blackburnian Warbler	Potential extirpation	-
Chestnut-sided Warbler	Potential extirpation	-
Palm Warbler	-	Potential colonization ^
Pine Warbler	-	Potential colonization
Yellow-throated Warbler	Improving*	-
Black-throated Green Warbler	Potential extirpation	-
Eastern Towhee	Stable	x
Chipping Sparrow	Worsening	Potential colonization
Field Sparrow	Improving	Improving
Vesper Sparrow	Potential extirpation	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Savannah Sparrow	-	Potential colonization
Grasshopper Sparrow	Improving	-
LeConte's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	Potential extirpation	Improving
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
Dark-eyed Junco	x	Stable
Summer Tanager	Potential colonization	-
Scarlet Tanager	Worsening*	-
Northern Cardinal	Improving	Improving
Rose-breasted Grosbeak	Potential extirpation	-
Blue Grosbeak	Potential colonization	-
Indigo Bunting	Improving	-
Dickcissel	Potential colonization	-
Red-winged Blackbird	Worsening	Improving
Eastern Meadowlark	Improving*	Improving*
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening	Improving
Brown-headed Cowbird	Stable	-
Orchard Oriole	Improving*	-
Baltimore Oriole	Potential extirpation	-
House Finch	Potential extirpation	Worsening*
American Goldfinch	Worsening	Worsening

