



## Kings Mountain National Military 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 Kings Mountain National Military 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 6, remain stable for 10, and worsen for 15 species. Suitable climate ceases to occur for 11 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 21 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 3, remain stable for 5, and worsen for 2 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 53 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.

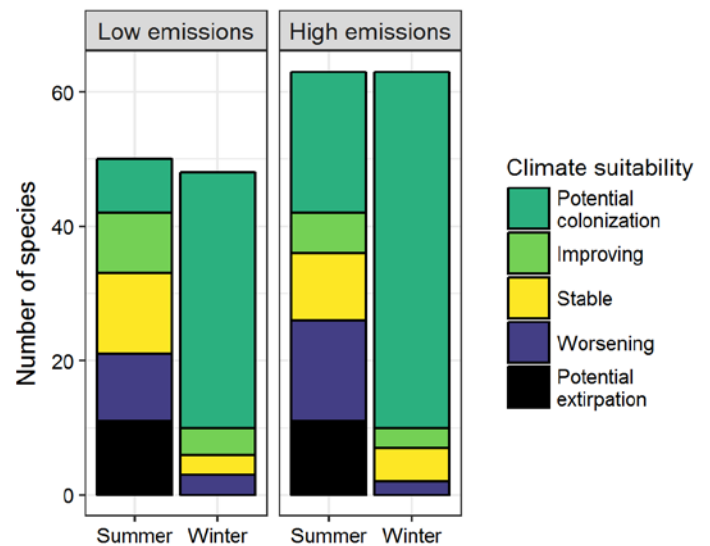


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Park between the present and 2050 is 0.23 in summer (37<sup>th</sup> percentile across all national parks) and 0.25 in winter (37<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.15 in summer and 0.19 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 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. 2015). Suitable

### 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, Kings Mountain National Military Park 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

climate is not projected to disappear for these 5 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 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).

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.

## Contacts

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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

Common Name	Summer Trend	Winter Trend
Blue-winged Teal	-	Potential colonization
Northern Bobwhite	Worsening	Worsening*
Eared Grebe	-	Potential colonization
Neotropical Cormorant	-	Potential colonization
Anhinga	Potential colonization <sup>^</sup>	Potential colonization
American White Pelican	-	Potential colonization
Brown Pelican	-	Potential colonization <sup>^</sup>
Great Egret	-	Potential colonization
Snowy Egret	-	Potential colonization
Little Blue Heron	Potential colonization	Potential colonization
Cattle Egret	Potential colonization	Potential colonization
Black-crowned Night-Heron	-	Potential colonization

Common Name	Summer Trend	Winter Trend
White Ibis	Potential colonization	Potential colonization
Glossy Ibis	-	Potential colonization
White-faced Ibis	-	Potential colonization <sup>^</sup>
Osprey	-	Potential colonization
Harris's Hawk	-	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Stable	-
Ferruginous Hawk	-	Potential colonization
King Rail	-	Potential colonization <sup>^</sup>
Sora	-	Potential colonization
Black-necked Stilt	-	Potential colonization
Spotted Sandpiper	-	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Greater Yellowlegs	-	Potential colonization
Lesser Yellowlegs	-	Potential colonization
Long-billed Curlew	-	Potential colonization
Stilt Sandpiper	-	Potential colonization
Long-billed Dowitcher	-	Potential colonization
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	-
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	Potential colonization
Yellow-billed Cuckoo	Improving*	-
Greater Roadrunner	Potential colonization	-
Lesser Nighthawk	Potential colonization	-
Common Nighthawk	Potential colonization	-
Common Pauraque	-	Potential colonization
Chimney Swift	Worsening	-
Black-chinned Hummingbird	Potential colonization	-
Red-headed Woodpecker	Stable	-
Red-bellied Woodpecker	Improving	Improving
Ladder-backed Woodpecker	Potential colonization	-
Downy Woodpecker	Worsening	-
Hairy Woodpecker	Potential extirpation	Worsening*
Northern Flicker	Improving	-
Pileated Woodpecker	Stable	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Crested Caracara	-	Potential colonization
Eastern Wood-Pewee	Worsening*	-
Acadian Flycatcher	Worsening	-
Eastern Phoebe	Worsening	-
Vermilion Flycatcher	-	Potential colonization
Great Crested Flycatcher	Worsening	-
Brown-crested Flycatcher	Potential colonization	-
Western Kingbird	Potential colonization	-
White-eyed Vireo	-	Potential colonization
Yellow-throated Vireo	Stable	-
Red-eyed Vireo	Worsening	-
Blue Jay	Stable	Stable
American Crow	Worsening	Stable
Northern Rough-winged Swallow	-	Potential colonization
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Stable	Stable
White-breasted Nuthatch	Potential extirpation	-
Marsh Wren	-	Potential colonization
Carolina Wren	Improving	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Eastern Bluebird	Worsening	Stable
Wood Thrush	Worsening	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	Potential colonization
Brown Thrasher	Worsening	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Long-billed Thrasher	-	Potential colonization
European Starling	Potential extirpation	-
Sprague's Pipit	-	Potential colonization
Smith's Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Black-and-white Warbler	Potential extirpation	-
Swainson's Warbler	Potential colonization	-
Orange-crowned Warbler	-	Potential colonization
Hooded Warbler	Improving*	-
Pine Warbler	Worsening^	-
Yellow-throated Warbler	-	Potential colonization
Yellow-breasted Chat	Stable	-
Eastern Towhee	Worsening*	-
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Chipping Sparrow	Potential extirpation	-
Lark Sparrow	Potential colonization	Potential colonization
Grasshopper Sparrow	-	Potential colonization
Henslow's Sparrow	-	Potential colonization
Lincoln's Sparrow	-	Potential colonization
Harris's Sparrow	-	Potential colonization
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-
Northern Cardinal	Improving	-
Painted Bunting	Potential colonization	-
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Potential extirpation	-
Hooded Oriole	Potential colonization	-
American Goldfinch	Potential extirpation	-