



Big Hole National Battlefield

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 Big Hole National Battlefield (hereafter, the Battlefield) 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 Battlefield, 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 Battlefield today, climate suitability in summer under the high-emissions pathway is projected to improve for 11 (e.g., Figure 2), remain stable for 24, and worsen for 13 species. Suitable climate ceases to occur for 5 species in summer, potentially resulting in extirpation of those species from the Battlefield. Climate is projected to become suitable in summer for 14 species not found at the Battlefield today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 8, remain stable for 7, and worsen for 2 species. Suitable climate ceases to occur for 1 species in winter, potentially resulting in extirpation from the Battlefield. Climate is projected to become suitable in winter for 22 species not found at the Battlefield 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 Battlefield based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Battlefield 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.

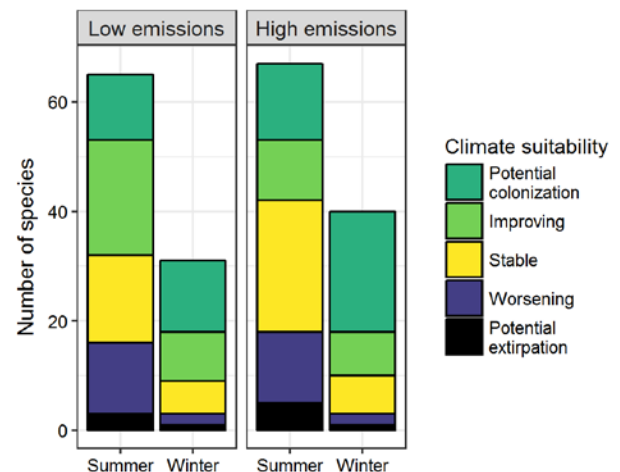


Figure 1. Projected changes in climate suitability for birds at the Battlefield, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Battlefield between the present and 2050 is 0.13 in summer (17th percentile across all national parks) and 0.19 in winter (26th percentile) under the high-emissions pathway. Potential species turnover declines to 0.10 in summer and 0.14 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 Battlefield is or may become home to 9 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

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

climate is not projected to disappear for these 9 species at the Battlefield; instead the Battlefield may serve as an important refuge for these climate-sensitive species.



Figure 2. Climate at the Battlefield in summer is projected to remain suitable for the Red-winged Blackbird (*Agelaius phoeniceus*) through 2050. Photo by Andy Reago & Chrissy McClarren/Flickr (CC BY 2.0).

Furthermore, park managers have an opportunity to focus on supporting the 9 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 Battlefield based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Battlefield 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
American Wigeon	Stable [^]	Potential colonization
Mallard	Stable [^]	Stable
Green-winged Teal	x	Stable
Scaled Quail	Potential colonization	Potential colonization
Ring-necked Pheasant	Potential colonization	-
Wild Turkey	-	Potential colonization
Sharp-shinned Hawk	-	Potential colonization
Red-tailed Hawk	Worsening	-
Killdeer	Stable	Improving
Long-billed Curlew	Worsening [^]	-
Wilson's Snipe	Worsening*	-
Wilson's Phalarope	Worsening [^]	-
Eurasian Collared-Dove	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Mourning Dove	Potential colonization	-
Great Horned Owl	x	Stable
Common Nighthawk	Improving*	-
Belted Kingfisher	Potential extirpation	Stable
Red-naped Sapsucker	Stable [^]	Potential colonization
Hairy Woodpecker	Improving	Improving
Northern Flicker	Stable	Improving
American Kestrel	x	Potential colonization
Merlin	-	Potential colonization [^]
Western Wood-Pewee	Stable [^]	-
Willow Flycatcher	Worsening*	-
Dusky Flycatcher	Stable	-
Cordilleran Flycatcher	Improving*	-
Ash-throated Flycatcher	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Eastern Kingbird	Stable	-
Loggerhead Shrike	Potential colonization	Potential colonization
Warbling Vireo	Worsening*	-
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Potential colonization	Potential colonization
Black-billed Magpie	-	Worsening*
Clark's Nutcracker	Stable^	Stable
American Crow	Improving	Potential colonization
Chihuahuan Raven	-	Potential colonization
Common Raven	Stable	Worsening*
Horned Lark	Potential extirpation	-
Northern Rough-winged Swallow	Improving	-
Tree Swallow	Stable	-
Violet-green Swallow	Stable	-
Barn Swallow	Improving*	-
Cliff Swallow	Improving	-
Mountain Chickadee	Stable	Stable
Bushtit	-	Potential colonization
Red-breasted Nuthatch	Worsening	Stable
White-breasted Nuthatch	-	Potential colonization
Pygmy Nuthatch	Potential colonization	-
Brown Creeper	-	Potential colonization
House Wren	Potential colonization	-
Bewick's Wren	-	Potential colonization
Golden-crowned Kinglet	Stable	Improving
Ruby-crowned Kinglet	Worsening*	-
Western Bluebird	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Mountain Bluebird	Worsening	-
Swainson's Thrush	Potential extirpation	-
American Robin	Worsening	Improving
Gray Catbird	Improving	-
Sage Thrasher	-	Potential colonization
European Starling	Improving*	-
Snow Bunting	-	Potential extirpation
Northern Waterthrush	Potential extirpation	-
Common Yellowthroat	Stable	-
Yellow Warbler	Worsening	-
Grace's Warbler	Potential colonization	-
Yellow-breasted Chat	Potential colonization	-
Canyon Towhee	Potential colonization	-
Chipping Sparrow	Stable	-
Brewer's Sparrow	Stable	-
Vesper Sparrow	Stable	-
Black-throated Sparrow	-	Potential colonization
Savannah Sparrow	Potential extirpation	-
Fox Sparrow	Stable	-
Song Sparrow	Stable	Potential colonization
White-crowned Sparrow	Worsening*	-
Dark-eyed Junco	x	Improving
Western Tanager	Stable	-
Red-winged Blackbird	Improving	Improving
Western Meadowlark	-	Potential colonization
Yellow-headed Blackbird	Worsening	-
Brewer's Blackbird	Improving	-
Brown-headed Cowbird	Stable	-

Common Name	Summer Trend	Winter Trend
Red Crossbill	Stable^	x
Pine Siskin	Stable	Improving
Lesser Goldfinch	Potential colonization	-

Common Name	Summer Trend	Winter Trend
American Goldfinch	-	Potential colonization
Evening Grosbeak	Potential colonization	-