



## Marsh-Billings-Rockefeller National Historical 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 Marsh-Billings-Rockefeller National Historical 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 30, remain stable for 14 (e.g., Figure 2), and worsen for 11 species. Suitable climate ceases to occur for 30 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 23 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 33, remain stable for 6, and worsen for 6 species. Suitable climate ceases to occur for 7 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 38 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.

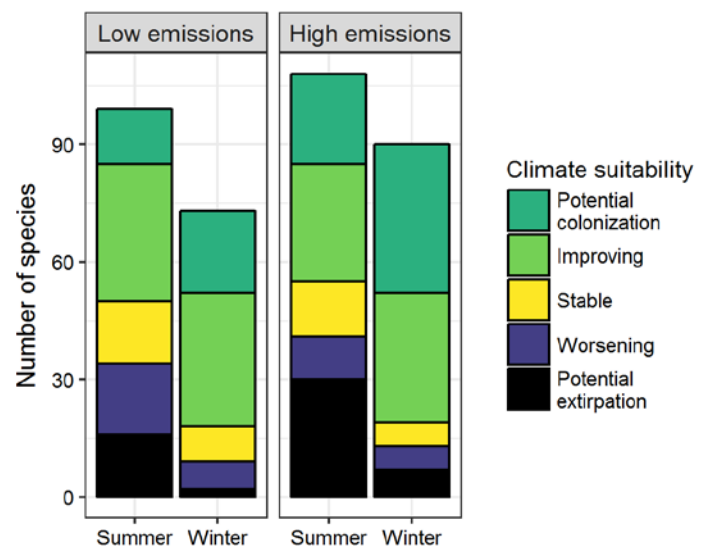


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Park between the present and 2050 is 0.48 in summer (88<sup>th</sup> percentile across all national parks) and 0.58 in winter (100<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.32 in summer and 0.42 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 6 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). While the Park may serve as an important refuge for 3 of these climate-sensitive species, 3 might be extirpated from the Park in at least one season by 2050.



**Figure 2. Climate at the Park in summer is projected to remain suitable for the American Goldfinch (*Spinus tristis*) through 2050.** Photo by John Benson/Flickr (CC BY 2.0).

## 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, Marsh-Billings-Rockefeller National Historical Park 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 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 3 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.

## Caveats

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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

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 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

x Species not modeled in this season

Common Name	Summer Trend	Winter Trend
Cackling/Canada Goose	x	Improving
Mute Swan	-	Potential colonization
Wood Duck	x	Improving
Gadwall	-	Potential colonization
American Wigeon	-	Potential colonization
American Black Duck	-	Improving
Mallard	Potential extirpation <sup>^</sup>	Improving
Ring-necked Duck	-	Potential colonization
Greater Scaup	-	Potential colonization <sup>^</sup>
Lesser Scaup	-	Potential colonization
Hooded Merganser	x	Improving <sup>^</sup>
Common Merganser	x	Stable
Northern Bobwhite	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Ring-necked Pheasant	Potential colonization	Potential colonization
Ruffed Grouse	x	Potential extirpation
Wild Turkey	x	Stable
Great Blue Heron	Improving	Potential colonization
Green Heron	Improving	-
Black Vulture	-	Potential colonization
Turkey Vulture	x	Potential colonization
Northern Harrier	-	Potential colonization
Sharp-shinned Hawk	-	Potential colonization
Cooper's Hawk	x	Improving
Bald Eagle	-	Improving
Red-shouldered Hawk	-	Potential colonization
Red-tailed Hawk	Improving	Improving

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Rough-legged Hawk	-	Potential colonization
Killdeer	Improving	-
Wilson's Snipe	Potential extirpation	-
Ring-billed Gull	-	Potential colonization
Herring Gull	Potential extirpation	Potential colonization^
Rock Pigeon	Improving	Improving
Mourning Dove	Improving	Worsening
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Stable	-
Eastern Screech-Owl	-	Potential colonization
Great Horned Owl	-	Potential colonization
Barred Owl	x	Improving
Chimney Swift	Improving	-
Ruby-throated Hummingbird	Stable	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Potential colonization	Potential colonization
Yellow-bellied Sapsucker	Potential extirpation	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Worsening	Worsening
Northern Flicker	Stable	Improving*
Pileated Woodpecker	Worsening	Worsening
American Kestrel	x	Potential colonization
Eastern Wood-Pewee	Improving	-
Acadian Flycatcher	Potential colonization	-
Alder Flycatcher	Potential extirpation	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Stable	-
Great Crested Flycatcher	Worsening	-
Eastern Kingbird	Improving	-
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Potential colonization	-
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Improving	-
Warbling Vireo	Improving	-
Red-eyed Vireo	Worsening	-
Blue Jay	Improving	Stable
American Crow	Worsening	Improving
Fish Crow	-	Potential colonization
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	-	Potential colonization
Northern Rough-winged Swallow	Potential colonization	-
Purple Martin	Potential colonization	-
Tree Swallow	Worsening	-
Barn Swallow	Improving	-
Carolina Chickadee	Potential colonization	Potential colonization
Black-capped Chickadee	Potential extirpation	Worsening
Tufted Titmouse	Improving*	Improving
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Improving	Improving
Brown Creeper	Potential extirpation^	Improving
House Wren	Improving	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Pacific/Winter Wren	Potential extirpation	Potential colonization
Carolina Wren	Improving*	Improving*
Blue-gray Gnatcatcher	Potential colonization	-
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving	Improving*
Veery	Potential extirpation	-
Hermit Thrush	Potential extirpation	Potential colonization
Wood Thrush	Stable	-
American Robin	Stable	Improving
Gray Catbird	Stable	Potential colonization
Brown Thrasher	Improving*	-
Northern Mockingbird	Potential colonization	Potential colonization
European Starling	Improving	Improving
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Worsening	Improving
Snow Bunting	-	Worsening*
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Potential colonization	-
Blue-winged Warbler	Potential colonization	-
Black-and-white Warbler	Potential extirpation	-
Nashville Warbler	Potential extirpation	-
Mourning Warbler	Potential extirpation	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Hooded Warbler	Potential colonization	-
American Redstart	Potential extirpation	-
Northern Parula	Stable	-
Magnolia Warbler	Potential extirpation	-
Blackburnian Warbler	Potential extirpation	-
Yellow Warbler	Worsening	-
Chestnut-sided Warbler	Potential extirpation	-
Black-throated Blue Warbler	Potential extirpation	-
Pine Warbler	Potential extirpation^	-
Yellow-rumped Warbler	Potential extirpation	Improving
Yellow-throated Warbler	Potential colonization	-
Prairie Warbler	Potential colonization	-
Black-throated Green Warbler	Potential extirpation	-
Yellow-breasted Chat	Potential colonization	-
Eastern Towhee	Improving*	-
American Tree Sparrow	-	Improving
Chipping Sparrow	Stable	-
Field Sparrow	Improving*	Potential colonization
Savannah Sparrow	Potential extirpation	-
Grasshopper Sparrow	Potential colonization	-
Fox Sparrow	-	Potential colonization
Song Sparrow	Stable	Improving
Swamp Sparrow	-	Potential colonization
White-throated Sparrow	Potential extirpation	Improving

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Scarlet Tanager	Stable	-
Northern Cardinal	Improving*	Improving
Rose-breasted Grosbeak	Worsening	-
Indigo Bunting	Improving	-
Dickcissel	Potential colonization	-
Bobolink	Worsening	-
Red-winged Blackbird	Improving	Improving
Eastern Meadowlark	Potential colonization	Potential colonization
Rusty Blackbird	-	Potential colonization
Common Grackle	Stable	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Brown-headed Cowbird	Improving	Improving
Orchard Oriole	Potential colonization	-
Baltimore Oriole	Improving	-
Pine Grosbeak	-	Potential extirpation
House Finch	Improving	Improving
Purple Finch	Potential extirpation	Improving
Common Redpoll	-	Worsening*
Pine Siskin	-	Stable
American Goldfinch	Stable	Improving
Evening Grosbeak	Potential extirpation	Potential extirpation
House Sparrow	x	Improving