



## Fort Laramie National Historic Site

### 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 Fort Laramie National Historic Site (hereafter, the Site) 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 Site, 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 Site today, climate suitability in summer under the high-emissions pathway is projected to improve for 7, remain stable for 11 (e.g., Figure 2), and worsen for 8 species. Suitable climate ceases to occur for 21 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 18 species not found at the Site today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 13, remain stable for 3, and worsen for 2 species. Suitable climate ceases to occur for 3 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 55 species not found at the Site 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Site 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.

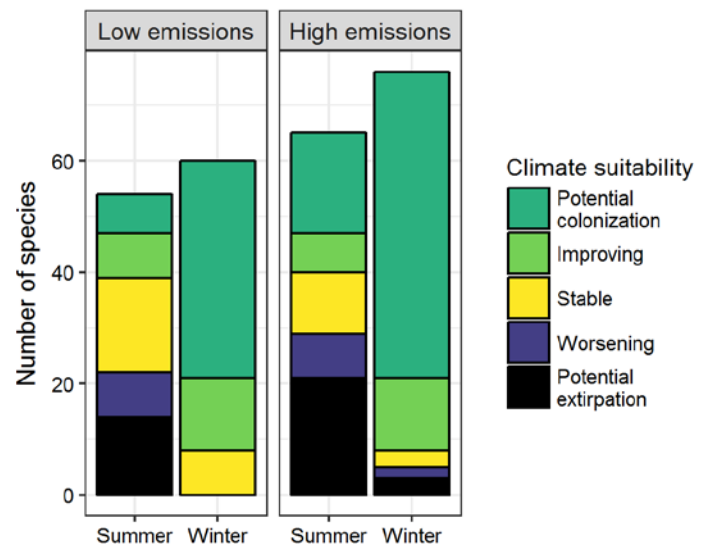


Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Site between the present and 2050 is 0.31 in summer (54<sup>th</sup> percentile across all national parks) and 0.32 in winter (50<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.17 in summer and 0.21 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 Site is or may become home to 4 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

## 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, Fort Laramie National Historic Site falls within the high potential extirpation group.** Parks anticipating high potential extirpation 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

### 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

by 2050; Table 1; Langham et al. 2015). Suitable climate is not projected to disappear for these 4 species at the Site; instead the Site may serve as an important refuge for these climate-sensitive species.



**Figure 2. Climate at the Site in summer is projected to remain suitable for the Mourning Dove (*Zenaida macroura*) through 2050.** Photo by KS Black/Flickr (Public Domain).

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 4 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 Site based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Site 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	Stable
Mallard	Worsening <sup>^</sup>	Improving
Cinnamon Teal	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Lesser Scaup	-	Potential colonization
Bufflehead	-	Potential colonization
Hooded Merganser	-	Potential colonization <sup>^</sup>
Ruddy Duck	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Pied-billed Grebe	-	Potential colonization
Eared Grebe	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Western Grebe	-	Potential colonization
Clark's Grebe	-	Potential colonization
American White Pelican	-	Potential colonization
Great Blue Heron	-	Potential colonization
Black-crowned Night-Heron	-	Potential colonization
Mississippi Kite	Potential colonization	-
Cooper's Hawk	-	Potential colonization
Red-tailed Hawk	Worsening	Potential colonization
Sora	-	Potential colonization
American Coot	-	Potential colonization
Killdeer	Stable	-

Common Name	Summer Trend	Winter Trend
Greater Yellowlegs	-	Potential colonization
Mew Gull	-	Potential colonization
Ring-billed Gull	-	Potential colonization
Rock Pigeon	Potential extirpation	Potential extirpation
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	-	Potential colonization
Greater Roadrunner	Potential colonization	Potential colonization
Barn Owl	-	Potential colonization
Great Horned Owl	x	Worsening*
Common Nighthawk	Improving	-
Belted Kingfisher	Potential extirpation	Improving
Red-headed Woodpecker	Improving	-
Red-naped Sapsucker	-	Potential colonization
Ladder-backed Woodpecker	Potential colonization	Potential colonization
Downy Woodpecker	Improving	Stable
Hairy Woodpecker	Stable	Potential extirpation
Northern Flicker	Worsening*	Improving
Gilded Flicker	Potential colonization	-
Western Wood-Pewee	Worsening*^	-
Willow Flycatcher	Potential extirpation	-
Black Phoebe	-	Potential colonization
Say's Phoebe	Stable	Potential colonization
Western Kingbird	Stable	-

Common Name	Summer Trend	Winter Trend
Eastern Kingbird	Potential extirpation	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Stable	-
Warbling Vireo	Potential extirpation	-
Blue Jay	Improving	Worsening*
Black-billed Magpie	Worsening*^	-
American Crow	Stable	Improving
Chihuahuan Raven	Potential colonization	-
Barn Swallow	Improving	-
Cliff Swallow	Stable	-
Black-capped Chickadee	Potential extirpation	Potential extirpation
Oak/Juniper Titmouse (Plain Titmouse)	-	Potential colonization
Verdin	-	Potential colonization
Bushtit	Potential colonization	-
Rock Wren	-	Potential colonization
House Wren	Potential extirpation	-
Bewick's Wren	-	Potential colonization
Cactus Wren	Potential colonization	-
Blue-gray Gnatcatcher	-	Potential colonization
Black-tailed Gnatcatcher	Potential colonization	-
Ruby-crowned Kinglet	Potential extirpation	Potential colonization
Eastern Bluebird	-	Potential colonization
Western Bluebird	-	Potential colonization
American Robin	Potential extirpation	Improving

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Potential extirpation	-
Crissal Thrasher	Potential colonization	Potential colonization
Northern Mockingbird	Potential colonization	-
European Starling	Potential extirpation	-
American Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Stable
Lucy's Warbler	Potential colonization	-
Common Yellowthroat	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Yellow-rumped Warbler	-	Potential colonization
Yellow-breasted Chat	Potential extirpation	-
Spotted Towhee	Potential extirpation	-
Rufous-crowned Sparrow	-	Potential colonization
Canyon Towhee	-	Potential colonization
Abert's Towhee	Potential colonization	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Brewer's Sparrow	-	Potential colonization
Lark Sparrow	Improving	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Black-throated Sparrow	-	Potential colonization
Lark Bunting	Worsening	Potential colonization
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Potential colonization
White-crowned Sparrow	Potential extirpation	Improving
Dark-eyed Junco	x	Improving
Pyrrhuloxia	-	Potential colonization
Black-headed Grosbeak	Worsening	-
Blue Grosbeak	Potential colonization	-
Dickcissel	Potential colonization	-
Red-winged Blackbird	Worsening	Improving
Eastern Meadowlark	Potential colonization	-
Western Meadowlark	Improving	Improving
Common Grackle	Stable	Potential colonization
Brown-headed Cowbird	Potential extirpation	Potential colonization
Orchard Oriole	Potential extirpation	-
Bullock's Oriole	Stable	-
House Finch	Stable	Improving
Lesser Goldfinch	-	Potential colonization
American Goldfinch	Potential extirpation	Improving