# Birds and Climate Change

National Park Service
U.S. Department of the Interior

## Knife River Indian Villages 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 Knife River Indian Villages 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.

**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.

### 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 28, remain stable for 21 (e.g., Figure 2), and worsen for 13 species. Suitable climate ceases to occur for 17 species in summer, potentially resulting in extirpation of those species from the Site. Climate is projected to become suitable in summer for 9 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 15, remain stable for 5, and worsen for 6 species. Suitable climate ceases to occur for 6 species in winter, potentially resulting in extirpation from the Site. Climate is projected to become suitable in winter for 38 species not found at the Site today, potentially resulting in local colonization.

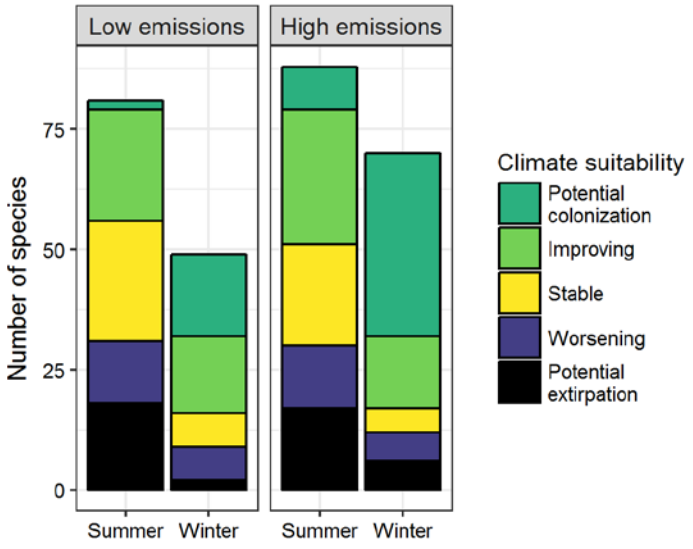


**Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.**

## Results (continued)

### Potential Turnover Index

**Potential bird species turnover for the Site between the present and 2050 is 0.17 in summer (25th percentile across all national parks) and 0.40 in winter (66th percentile) under the high-emissions pathway. Potential species turnover declines to 0.09 in summer and 0.22 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 10 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 climate is not projected to disappear for these 10 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 American Goldfinch (*Spinus tristis*) through 2050.** Photo by John Benson/Flickr (CC BY 2.0).

## Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Knife River Indian Villages National Historic Site 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. Furthermore, park managers have an opportunity to focus on supporting the 10 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

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.

### 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 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 | Improving |
| Wood Duck | x | Potential colonization |
| Gadwall | Worsening^ | Potential colonization |
| American Wigeon | Worsening^ | Potential colonization |
| Mallard | Worsening^ | Improving |
| Blue-winged Teal | Stable | - |
| Northern Shoveler | - | Potential colonization |
| Canvasback | - | Potential colonization |
| Lesser Scaup | - | Potential colonization |
| Common Goldeneye | - | Improving |
| Common Merganser | - | Potential colonization |
| Northern Bobwhite | Potential colonization | Potential colonization |
| Gray Partridge | Worsening | Potential extirpation |
| Ring-necked Pheasant | Improving | Improving |
| Sharp-tailed Grouse | Worsening^ | Worsening* |
| Wild Turkey | x | Improving |
| American White Pelican | x | Potential colonization |
| Great Blue Heron | Improving | Potential colonization |
| Golden Eagle | - | Worsening |
| Northern Harrier | Worsening^ | Potential colonization |
| Sharp-shinned Hawk | x | Potential colonization |
| Cooper's Hawk | x | Potential colonization |
| Northern Goshawk | - | Worsening* |
| Bald Eagle | x | Improving |
| Swainson's Hawk | Worsening*^ | - |
| Red-tailed Hawk | Improving | - |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Killdeer | Improving | - |
| Mountain Plover | Potential colonization | - |
| Upland Sandpiper | Stable | - |
| Wilson's Snipe | Potential extirpation | Potential colonization |
| Franklin's Gull | Worsening | - |
| Ring-billed Gull | - | Potential colonization |
| California Gull | x | Potential colonization^ |
| Mourning Dove | Improving | - |
| Eastern Screech-Owl | - | Potential colonization |
| Great Horned Owl | x | Improving |
| Common Nighthawk | Improving* | - |
| Chimney Swift | Potential colonization | - |
| Belted Kingfisher | Potential extirpation | Potential colonization |
| Lewis's Woodpecker | - | Potential colonization |
| Red-headed Woodpecker | Improving* | Potential colonization |
| Red-bellied Woodpecker | - | Potential colonization |
| Downy Woodpecker | Improving | Stable |
| Hairy Woodpecker | Potential extirpation | - |
| Northern Flicker | Improving | Improving |
| American Kestrel | x | Potential colonization |
| Merlin | x | Improving^ |
| Prairie Falcon | - | Improving |
| Eastern Wood-Pewee | Stable | - |
| Willow Flycatcher | Worsening | - |
| Least Flycatcher | Potential extirpation | - |
| Eastern Phoebe | Potential colonization | - |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Say's Phoebe | Worsening | - |
| Great Crested Flycatcher | Improving | - |
| Western Kingbird | Improving | - |
| Eastern Kingbird | Stable | - |
| Loggerhead Shrike | - | Potential colonization |
| Northern Shrike | - | Worsening |
| Bell's Vireo | Potential colonization | - |
| Warbling Vireo | Stable | - |
| Red-eyed Vireo | Potential extirpation | - |
| Blue Jay | Improving* | Stable |
| Black-billed Magpie | Stable^ | - |
| American Crow | Stable | - |
| Horned Lark | Worsening* | - |
| Northern Rough-winged Swallow | Improving | - |
| Purple Martin | Stable | - |
| Tree Swallow | Potential extirpation | - |
| Barn Swallow | Improving | - |
| Cliff Swallow | Stable | - |
| Black-capped Chickadee | Stable | Worsening |
| Red-breasted Nuthatch | - | Potential extirpation |
| White-breasted Nuthatch | Stable | Stable |
| Pygmy Nuthatch | - | Potential colonization^ |
| Brown Creeper | - | Improving |
| House Wren | Stable | - |
| Sedge Wren | Worsening | - |
| Eastern Bluebird | Improving | Potential colonization |
| American Robin | Potential extirpation | Potential colonization |
| Gray Catbird | Improving | - |
| Brown Thrasher | Improving | - |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| European Starling | Improving | Potential colonization |
| Bohemian Waxwing | - | Worsening* |
| Cedar Waxwing | Stable | Improving |
| Smith's Longspur | - | Potential colonization |
| Snow Bunting | - | Potential extirpation |
| Ovenbird | Potential extirpation | - |
| Black-and-white Warbler | Potential extirpation | - |
| Common Yellowthroat | Stable | - |
| American Redstart | Potential extirpation | - |
| Yellow Warbler | Potential extirpation | - |
| Yellow-breasted Chat | Stable | - |
| Spotted Towhee | Potential extirpation | - |
| Cassin's Sparrow | Potential colonization | - |
| American Tree Sparrow | - | Improving |
| Chipping Sparrow | Stable | - |
| Clay-colored Sparrow | Potential extirpation | - |
| Field Sparrow | Improving | - |
| Vesper Sparrow | Potential extirpation | - |
| Lark Sparrow | Improving* | - |
| Savannah Sparrow | Potential extirpation | - |
| Grasshopper Sparrow | Stable | - |
| Song Sparrow | Potential extirpation | Potential colonization |
| Swamp Sparrow | - | Potential colonization |
| White-crowned Sparrow | - | Potential colonization |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Dark-eyed Junco | - | Improving |
| Northern Cardinal | Potential colonization | Potential colonization |
| Black-headed Grosbeak | Improving | - |
| Blue Grosbeak | Potential colonization | - |
| Lazuli Bunting | Stable | - |
| Indigo Bunting | Improving | - |
| Dickcissel | Improving* | - |
| Bobolink | Worsening* | - |
| Red-winged Blackbird | Improving | Improving |
| Western Meadowlark | Improving | Potential colonization |
| Yellow-headed Blackbird | Stable | - |
| Brewer's Blackbird | Potential extirpation | Potential colonization |
| Common Grackle | Improving | - |
| Great-tailed Grackle | Potential colonization | Potential colonization |
| Brown-headed Cowbird | Stable | Potential colonization |
| Orchard Oriole | Improving | - |
| Baltimore Oriole | Improving* | - |
| Pine Grosbeak | - | Potential extirpation |
| House Finch | - | Potential colonization |
| Common Redpoll | - | Potential extirpation |
| Pine Siskin | - | Stable |
| American Goldfinch | Stable | - |
| Evening Grosbeak | - | Potential extirpation |
| House Sparrow | x | Stable |
| Eurasian Tree Sparrow | - | Potential colonization |