# Birds and Climate Change

National Park Service
U.S. Department of the Interior

## Lake Roosevelt National Recreation Area

### 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 Lake Roosevelt National Recreation Area (hereafter, the Recreation Area) 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Recreation Area 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 Recreation Area, 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 Recreation Area today, climate suitability in summer under the high-emissions pathway is projected to improve for 18, remain stable for 36 (e.g., Figure 2), and worsen for 35 species. Suitable climate ceases to occur for 25 species in summer, potentially resulting in extirpation of those species from the Recreation Area. Climate is projected to become suitable in summer for 3 species not found at the Recreation Area today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 62, remain stable for 13, and worsen for 29 species. Suitable climate ceases to occur for 6 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 26 species not found at the Recreation Area today, potentially resulting in local colonization.

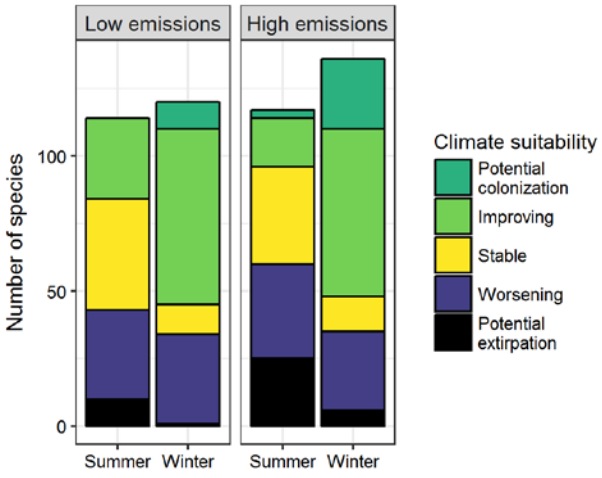


**Figure 1. Projected changes in climate suitability for birds at the Recreation Area, by emissions pathway and season.**

## Results (continued)

### Potential Turnover Index

**Potential bird species turnover for the Recreation Area between the present and 2050 is 0.16 in summer (22nd percentile across all national parks) and 0.22 in winter (32nd percentile) under the high-emissions pathway. Potential species turnover declines to 0.11 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 Recreation Area is or may become home to 27 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 Recreation Area may serve as an important refuge for 26 of these climate-sensitive species, one, the American Wigeon (*Anas americana*), might be extirpated from the Recreation Area in summer by 2050.

**Figure 2. Climate at the Recreation Area 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).

## Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Lake Roosevelt National Recreation Area 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 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 26 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 Recreation Area based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Recreation Area 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 | Improving* |
| Gadwall | Worsening^ | Improving |
| Eurasian Wigeon | - | Potential colonization |
| American Wigeon | Potential extirpation^ | Improving |
| Mallard | Worsening^ | Improving |
| Blue-winged Teal | Potential extirpation | - |
| Cinnamon Teal | x | Potential colonization |
| Northern Shoveler | Worsening^ | Potential colonization |
| Northern Pintail | Potential extirpation | x |
| Green-winged Teal | - | Improving |
| Canvasback | x | Improving* |
| Ring-necked Duck | x | Improving |
| Greater Scaup | - | Improving^ |
| Lesser Scaup | x | Improving |
| Long-tailed Duck | - | Improving |
| Bufflehead | x | Improving |
| Common Goldeneye | x | Worsening |
| Barrow's Goldeneye | x | Worsening^ |
| Hooded Merganser | x | Improving^ |
| Common Merganser | x | Worsening |
| Ruddy Duck | Worsening | Improving |
| California Quail | Stable | Stable |
| Chukar | Stable | Worsening |
| Gray Partridge | - | Worsening* |
| Ring-necked Pheasant | Stable | Stable |
| Ruffed Grouse | x | Potential extirpation |
| Wild Turkey | x | Worsening |
| Pacific Loon | - | Potential colonization |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Common Loon | Potential extirpation | Improving^ |
| Pied-billed Grebe | x | Improving |
| Horned Grebe | - | Improving |
| Red-necked Grebe | - | Stable^ |
| Eared Grebe | - | Improving |
| Western Grebe | x | Improving |
| Double-crested Cormorant | x | Improving* |
| American White Pelican | - | Potential colonization |
| Great Blue Heron | Improving* | Improving |
| Great Egret | Improving | - |
| Black-crowned Night-Heron | - | Potential colonization |
| White-faced Ibis | - | Potential colonization^ |
| Golden Eagle | x | Worsening |
| Northern Harrier | Worsening^ | Improving |
| Sharp-shinned Hawk | x | Improving |
| Cooper's Hawk | x | Improving |
| Northern Goshawk | - | Worsening* |
| Bald Eagle | x | Worsening |
| Swainson's Hawk | Worsening^ | - |
| Red-tailed Hawk | Improving | Improving |
| Rough-legged Hawk | - | Worsening |
| Virginia Rail | x | Improving |
| American Coot | x | Improving |
| Killdeer | Improving | Improving* |
| Greater Yellowlegs | - | Potential colonization |
| Dunlin | - | Potential colonization^ |
| Long-billed Dowitcher | - | Potential colonization |
| Wilson's Snipe | Potential extirpation | - |
| Mew Gull | - | Improving |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Ring-billed Gull | Worsening^ | Improving |
| California Gull | x | Improving^ |
| Herring Gull | - | Improving^ |
| Iceland Gull (Thayer's) | - | Improving |
| Glaucous-winged Gull | - | Improving |
| Rock Pigeon | Improving* | Stable |
| Eurasian Collared-Dove | x | Improving |
| Mourning Dove | Improving* | Improving |
| Barn Owl | - | Potential colonization |
| Western Screech-Owl | x | Improving |
| Great Horned Owl | x | Stable |
| Northern Pygmy-Owl | - | Worsening |
| Common Nighthawk | Stable | - |
| Black-chinned Hummingbird | Improving | - |
| Rufous Hummingbird | Stable | - |
| Calliope Hummingbird | Worsening | - |
| Belted Kingfisher | Stable | Improving |
| Red-naped Sapsucker | Worsening*^ | Potential colonization |
| Downy Woodpecker | Improving* | Improving |
| Hairy Woodpecker | Potential extirpation | Potential extirpation |
| White-headed Woodpecker | Stable^ | Worsening |
| Northern Flicker | Worsening* | Improving |
| Pileated Woodpecker | Stable | Potential extirpation |
| American Kestrel | x | Improving |
| Merlin | x | Stable^ |
| Peregrine Falcon | x | Improving |
| Prairie Falcon | x | Stable |
| Olive-sided Flycatcher | Potential extirpation | - |
| Western Wood-Pewee | Worsening*^ | - |
| Willow Flycatcher | Worsening | - |
| Least Flycatcher | Potential extirpation | - |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Hammond's Flycatcher | Worsening* | - |
| Gray Flycatcher | Stable | - |
| Dusky Flycatcher | Worsening | - |
| Pacific-slope Flycatcher | Stable | - |
| Say's Phoebe | Worsening | Improving |
| Western Kingbird | Stable | - |
| Eastern Kingbird | Stable | - |
| Loggerhead Shrike | Stable | Potential colonization |
| Northern Shrike | - | Worsening* |
| Bell's Vireo | Potential colonization | - |
| Warbling Vireo | Stable | - |
| Red-eyed Vireo | Stable | - |
| Steller's Jay | Stable | Worsening* |
| California/Woodhouse's Scrub-Jay (Western Scrub-Jay) | - | Potential colonization |
| Black-billed Magpie | Worsening^ | Worsening |
| Clark's Nutcracker | Worsening^ | Worsening* |
| American Crow | Stable | Stable |
| Northwestern Crow | - | Potential colonization |
| Common Raven | Potential extirpation | Worsening |
| Horned Lark | Stable | Improving* |
| Northern Rough-winged Swallow | Improving* | - |
| Tree Swallow | Potential extirpation | - |
| Violet-green Swallow | Worsening | - |
| Barn Swallow | Improving* | - |
| Cliff Swallow | Stable | - |
| Black-capped Chickadee | Potential extirpation | Worsening |
| Mountain Chickadee | Worsening | Worsening |
| Chestnut-backed Chickadee | Stable | Worsening |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Red-breasted Nuthatch | Potential extirpation | Potential extirpation |
| White-breasted Nuthatch | Improving* | Stable |
| Pygmy Nuthatch | Worsening | Worsening*^ |
| Brown Creeper | - | Improving |
| Rock Wren | Stable | Potential colonization |
| Canyon Wren | x | Stable |
| House Wren | Stable | - |
| Pacific/Winter Wren | - | Improving |
| Marsh Wren | - | Improving |
| Bewick's Wren | Improving* | Improving* |
| American Dipper | x | Worsening* |
| Golden-crowned Kinglet | - | Stable |
| Ruby-crowned Kinglet | Potential extirpation | Improving* |
| Western Bluebird | Worsening | Improving |
| Mountain Bluebird | Potential extirpation | - |
| Townsend's Solitaire | Worsening^ | Worsening* |
| Veery | Potential extirpation | - |
| Swainson's Thrush | Potential extirpation | - |
| Hermit Thrush | Potential extirpation | Potential colonization |
| American Robin | Worsening | Improving |
| Varied Thrush | - | Worsening* |
| Gray Catbird | Stable | - |
| Sage Thrasher | Worsening | - |
| European Starling | Improving | Improving |
| American Pipit | - | Potential colonization |
| Bohemian Waxwing | - | Worsening* |
| Cedar Waxwing | Stable | Stable |
| Chestnut-collared Longspur | - | Potential colonization |
| Orange-crowned Warbler | Worsening | - |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Nashville Warbler | Potential extirpation | - |
| MacGillivray's Warbler | Worsening | - |
| Common Yellowthroat | Stable | - |
| Yellow Warbler | Potential extirpation | - |
| Yellow-rumped Warbler | Potential extirpation | Improving* |
| Townsend's Warbler | Stable | - |
| Wilson's Warbler | Potential extirpation | - |
| Yellow-breasted Chat | Improving* | - |
| Spotted Towhee | Stable | x |
| Rufous-winged Sparrow | Potential colonization | - |
| American Tree Sparrow | - | Stable |
| Chipping Sparrow | Stable | - |
| Clay-colored Sparrow | Potential extirpation | - |
| Brewer's Sparrow | Worsening | - |
| Vesper Sparrow | Worsening* | - |
| Lark Sparrow | Improving* | - |
| Black-throated Sparrow | - | Potential colonization |
| Sagebrush/Bell's Sparrow (Sage Sparrow) | Worsening^ | - |
| Savannah Sparrow | Potential extirpation | Potential colonization |
| Grasshopper Sparrow | Improving* | - |
| Song Sparrow | Stable | Improving |
| Lincoln's Sparrow | - | Potential colonization |
| White-crowned Sparrow | - | Improving* |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Golden-crowned Sparrow | - | Potential colonization |
| Dark-eyed Junco | x | Improving |
| Western Tanager | Worsening | - |
| Black-headed Grosbeak | Stable | - |
| Lazuli Bunting | Stable | - |
| Bobolink | Stable | - |
| Red-winged Blackbird | Stable | Improving |
| Western Meadowlark | Worsening | Improving |
| Yellow-headed Blackbird | Worsening | - |
| Brewer's Blackbird | Worsening* | Improving |
| Great-tailed Grackle | Potential colonization | Potential colonization |
| Brown-headed Cowbird | Stable | Potential colonization |
| Bullock's Oriole | Stable | - |
| Baltimore Oriole | Improving | - |
| Gray-crowned Rosy-Finch | - | Worsening^ |
| Pine Grosbeak | - | Potential extirpation |
| House Finch | Improving* | Improving |
| Cassin's Finch | Worsening | Worsening* |
| Red Crossbill | Worsening*^ | x |
| Common Redpoll | - | Potential extirpation |
| Pine Siskin | Potential extirpation | Worsening |
| Lesser Goldfinch | - | Potential colonization |
| American Goldfinch | Stable | Improving |
| Evening Grosbeak | Potential extirpation | Worsening* |
| House Sparrow | x | Improving |