# Birds and Climate Change

National Park Service
U.S. Department of the Interior

## Thomas Stone 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 Thomas Stone 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 10, remain stable for 15, and worsen for 9 species. Suitable climate ceases to occur for 13 species in summer, potentially resulting in extirpation of those species from the Site (e.g., Figure 2). Climate is projected to become suitable in summer for 24 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 9, and worsen for 5 species. Suitable climate does not cease to occur for any species in winter. Climate is projected to become suitable in winter for 51 species not found at the Site today, potentially resulting in local colonization.

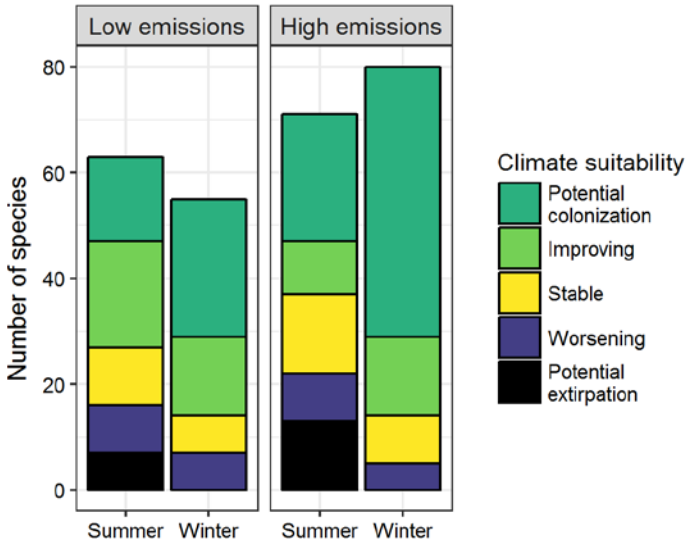


**Figure 1. Projected changes in climate suitability for birds at the Site, by emissions pathway and season.**

## Results (continued)

### Potential Turnover Index

**Potential bird species turnover for the Site between the present and 2050 is 0.27 in summer (45th percentile across all national parks) and 0.27 in winter (40th percentile) under the high-emissions pathway. Potential species turnover declines to 0.18 in summer and 0.18 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 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 Site may serve as an important refuge for 5 of these climate-sensitive species, one, the Mallard (*Anas platyrhynchos*), might be extirpated from the Site in summer by 2050.

**Figure 2. Although currently found at the Site, suitable climate for the American Goldfinch (*Spinus tristis*) may cease to occur here in summer by 2050, potentially resulting in local seasonal extirpation.** 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, Thomas Stone National Historic Site 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 5 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 |
|---|---|---|
| Fulvous Whistling-Duck | Potential colonization | - |
| Mallard | Potential extirpation^ | Stable |
| Blue-winged Teal | - | Potential colonization |
| Bufflehead | - | Potential colonization |
| Eared Grebe | - | Potential colonization |
| Wood Stork | Potential colonization | - |
| Neotropic Cormorant | - | Potential colonization |
| Anhinga | Potential colonization^ | Potential colonization |
| American White Pelican | - | Potential colonization |
| Brown Pelican | - | Potential colonization^ |
| Great Blue Heron | Stable | - |
| Great Egret | - | Potential colonization |
| Little Blue Heron | Potential colonization | - |
| Cattle Egret | Potential colonization | - |
| Green Heron | Improving | - |
| Black-crowned Night-Heron | - | Potential colonization |
| Yellow-crowned Night-Heron | Potential colonization | - |
| White Ibis | - | Potential colonization |
| Black Vulture | Improving | Improving |
| Turkey Vulture | x | Improving |
| Osprey | x | Potential colonization |
| Mississippi Kite | Potential colonization | - |
| White-tailed Hawk | - | Potential colonization |
| Red-shouldered Hawk | Improving | - |
| Red-tailed Hawk | - | Improving |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Virginia Rail | - | Potential colonization |
| Spotted Sandpiper | - | Potential colonization |
| Greater Yellowlegs | - | Potential colonization |
| Lesser Yellowlegs | - | Potential colonization |
| Least Sandpiper | - | Potential colonization |
| Western Sandpiper | - | Potential colonization |
| Long-billed Dowitcher | - | Potential colonization |
| Ring-billed Gull | - | Stable |
| Gull-billed Tern | - | Potential colonization |
| Forster's Tern | - | Potential colonization |
| Eurasian Collared-Dove | - | Potential colonization |
| White-winged Dove | - | Potential colonization |
| Mourning Dove | Stable | Worsening |
| Inca Dove | Potential colonization | Potential colonization |
| Yellow-billed Cuckoo | Improving | - |
| Greater Roadrunner | Potential colonization | Potential colonization |
| Groove-billed Ani | - | Potential colonization |
| Barn Owl | - | Potential colonization |
| Western Screech-Owl | - | Potential colonization |
| Burrowing Owl | Potential colonization^ | - |
| Common Nighthawk | Potential colonization | - |
| Chimney Swift | Worsening | - |
| Black-chinned Hummingbird | Potential colonization | - |
| Belted Kingfisher | Stable | - |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Red-bellied Woodpecker | Stable | Improving |
| Downy Woodpecker | Stable | Worsening* |
| Red-cockaded Woodpecker | - | Potential colonization |
| American Three-toed Woodpecker | - | Potential colonization^ |
| Northern Flicker | - | Stable |
| American Kestrel | - | Stable |
| Acadian Flycatcher | Worsening | - |
| Eastern Phoebe | Improving* | - |
| Western Kingbird | Potential colonization | - |
| Eastern Kingbird | Worsening | - |
| Scissor-tailed Flycatcher | Potential colonization | - |
| Loggerhead Shrike | Potential colonization | - |
| White-eyed Vireo | Improving | Potential colonization |
| Yellow-throated Vireo | Stable | - |
| Red-eyed Vireo | Potential extirpation | - |
| Blue Jay | Stable | Stable |
| American Crow | Worsening | Stable |
| Cliff Swallow | Potential colonization | - |
| Cave Swallow | Potential colonization | - |
| Carolina Chickadee | Stable | Improving |
| Tufted Titmouse | Stable | Improving |
| White-breasted Nuthatch | Potential extirpation | Worsening* |
| Brown-headed Nuthatch | Potential colonization^ | - |
| House Wren | - | Potential colonization |
| Marsh Wren | - | Potential colonization |
| Carolina Wren | Worsening | Improving |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Bewick's Wren | - | Potential colonization |
| Blue-gray Gnatcatcher | Stable | Potential colonization |
| Eastern Bluebird | Improving | Improving |
| Wood Thrush | Potential extirpation | - |
| American Robin | Potential extirpation | Stable |
| Gray Catbird | Potential extirpation | - |
| Northern Mockingbird | Improving | - |
| European Starling | Worsening | Worsening* |
| American Pipit | - | Potential colonization |
| Sprague's Pipit | - | Potential colonization |
| Cedar Waxwing | Potential extirpation | - |
| Chestnut-collared Longspur | - | Potential colonization |
| Smith's Longspur | - | Potential colonization |
| Ovenbird | Potential extirpation | - |
| Swainson's Warbler | Potential colonization | - |
| Orange-crowned Warbler | - | Potential colonization |
| Common Yellowthroat | Potential extirpation | Potential colonization |
| Hooded Warbler | Stable | - |
| American Redstart | Stable | - |
| Northern Parula | Stable | - |
| Yellow-rumped Warbler | - | Improving |
| Rufous-winged Sparrow | Potential colonization | - |
| Bachman's Sparrow | Potential colonization | Potential colonization |

| Common Name | Summer Trend | Winter Trend |
|---|---|---|
| Chipping Sparrow | Potential extirpation | Improving |
| Vesper Sparrow | - | Potential colonization |
| Lark Sparrow | Potential colonization | - |
| Grasshopper Sparrow | - | Potential colonization |
| Henslow's Sparrow | - | Potential colonization |
| Song Sparrow | Potential extirpation | Stable |
| Lincoln's Sparrow | - | Potential colonization |
| White-throated Sparrow | - | Improving |
| Harris's Sparrow | - | Potential colonization |
| Dark-eyed Junco | - | Worsening* |
| Northern Cardinal | Improving | Improving |
| Blue Grosbeak | Stable | - |
| Indigo Bunting | Stable | - |
| Painted Bunting | Potential colonization | - |
| Red-winged Blackbird | Worsening | Improving |
| Eastern Meadowlark | Improving | Improving |
| Western Meadowlark | - | Potential colonization |
| Brewer's Blackbird | - | Potential colonization |
| Common Grackle | Worsening | - |
| Great-tailed Grackle | Potential colonization | Potential colonization |
| Brown-headed Cowbird | Worsening | Improving |
| House Finch | Potential extirpation | - |
| Purple Finch | - | Potential colonization |
| American Goldfinch | Potential extirpation | Stable |