



## Cuyahoga Valley National 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 Cuyahoga Valley National 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 37, remain stable for 21 (e.g., Figure 2), and worsen for 19 species. Suitable climate ceases to occur for 37 species in summer, potentially resulting in extirpation of those species from the Park. Climate is projected to become suitable in summer for 16 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 53, remain stable for 20, and worsen for 14 species. Suitable climate ceases to occur for 10 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 23 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.

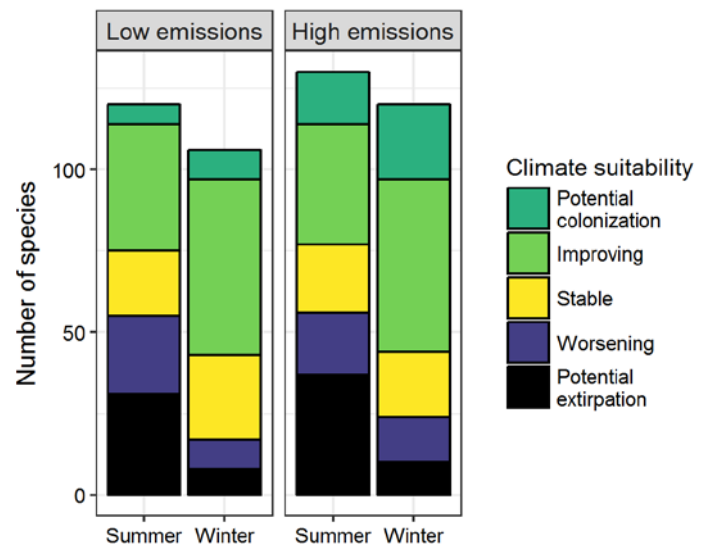


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Park between the present and 2050 is 0.28 in summer (48<sup>th</sup> percentile across all national parks) and 0.28 in winter (42<sup>nd</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.16 in summer and 0.23 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 16 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

### 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, Cuyahoga Valley National 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

### 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

Park may serve as an important refuge for 11 of these climate-sensitive species, 5 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 Red-winged Blackbird (*Agelaius phoeniceus*) through 2050.** Photo by Andy Reago & Chrissy McClarren/Flickr (CC BY 2.0).

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 11 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.

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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

Gregor Schuurman, Ph.D.  
Ecologist, NPS Climate Change Response Program  
970-267-7211, [gregor\\_schuurman@nps.gov](mailto:gregor_schuurman@nps.gov)

Joanna Wu  
Biologist, National Audubon Society  
415-644-4610, [science@audubon.org](mailto:science@audubon.org)

## 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                                  | Stable                |
| Wood Duck             | x                                  | Improving             |
| Gadwall               | -                                  | Improving             |
| American Wigeon       | -                                  | Improving             |
| American Black Duck   | x                                  | Worsening*            |
| Mallard               | Potential extirpation <sup>^</sup> | Stable                |
| Blue-winged Teal      | Potential extirpation              | -                     |
| Northern Shoveler     | Stable <sup>^</sup>                | Improving*            |
| Green-winged Teal     | -                                  | Improving             |
| Canvasback            | -                                  | Improving             |
| Ring-necked Duck      | -                                  | Improving             |
| Greater Scaup         | -                                  | Stable <sup>^</sup>   |
| Lesser Scaup          | -                                  | Improving             |
| White-winged Scoter   | -                                  | Potential extirpation |
| Bufflehead            | -                                  | Improving             |
| Common Goldeneye      | -                                  | Stable                |

| Common Name              | Summer Trend           | Winter Trend                       |
|--------------------------|------------------------|------------------------------------|
| Hooded Merganser         | x                      | Improving <sup>^</sup>             |
| Common Merganser         | x                      | Worsening*                         |
| Red-breasted Merganser   | -                      | Stable <sup>^</sup>                |
| Ruddy Duck               | -                      | Potential colonization             |
| Northern Bobwhite        | Improving*             | Potential colonization             |
| Wild Turkey              | x                      | Stable                             |
| Pied-billed Grebe        | x                      | Improving                          |
| Red-necked Grebe         | -                      | Potential extirpation <sup>^</sup> |
| Double-crested Cormorant | x                      | Improving                          |
| American White Pelican   | -                      | Potential colonization             |
| Great Blue Heron         | Improving              | Improving                          |
| Great Egret              | Improving              | Improving                          |
| Little Blue Heron        | Potential colonization | -                                  |
| Green Heron              | Improving              | -                                  |
| Black-crowned Night-     | x                      | Potential                          |

| Common Name                | Summer Trend            | Winter Trend            |
|----------------------------|-------------------------|-------------------------|
| Heron                      |                         | colonization            |
| Yellow-crowned Night-Heron | Potential colonization  | -                       |
| Black Vulture              | Potential colonization  | Potential colonization  |
| Turkey Vulture             | x                       | Improving*              |
| Northern Harrier           | Potential extirpation^  | Improving               |
| Sharp-shinned Hawk         | x                       | Improving               |
| Cooper's Hawk              | x                       | Worsening               |
| Bald Eagle                 | x                       | Improving               |
| Red-shouldered Hawk        | Improving               | Improving               |
| Red-tailed Hawk            | Improving               | Stable                  |
| Rough-legged Hawk          | -                       | Worsening*              |
| American Coot              | x                       | Stable                  |
| Killdeer                   | Stable                  | Improving*              |
| Solitary Sandpiper         | Stable                  | -                       |
| Lesser Yellowlegs          | Stable^                 | -                       |
| Dunlin                     | -                       | Potential colonization^ |
| Least Sandpiper            | -                       | Potential colonization  |
| Wilson's Snipe             | Potential extirpation   | -                       |
| American Woodcock          | x                       | Improving               |
| Laughing Gull              | Potential colonization^ | -                       |
| Ring-billed Gull           | Potential extirpation^  | Stable                  |
| Herring Gull               | Potential extirpation   | Worsening*^             |
| Great Black-backed Gull    | -                       | Stable                  |
| Rock Pigeon                | Worsening               | Worsening               |
| Mourning Dove              | Stable                  | Worsening               |
| Yellow-billed Cuckoo       | Improving*              | -                       |
| Black-billed Cuckoo        | Potential extirpation   | -                       |
| Eastern Screech-Owl        | x                       | Stable                  |

| Common Name               | Summer Trend           | Winter Trend           |
|---------------------------|------------------------|------------------------|
| Great Horned Owl          | x                      | Stable                 |
| Barred Owl                | x                      | Improving              |
| Common Nighthawk          | Improving              | -                      |
| Chuck-will's-widow        | Potential colonization | -                      |
| Chimney Swift             | Stable                 | -                      |
| Ruby-throated Hummingbird | Stable                 | -                      |
| Belted Kingfisher         | Potential extirpation  | Improving              |
| Red-headed Woodpecker     | Stable                 | Improving              |
| Red-bellied Woodpecker    | Improving              | Improving              |
| Yellow-bellied Sapsucker  | -                      | Improving*             |
| Downy Woodpecker          | Improving              | Worsening              |
| Hairy Woodpecker          | Stable                 | Stable                 |
| Northern Flicker          | Stable                 | Improving              |
| Pileated Woodpecker       | Improving              | Improving              |
| American Kestrel          | x                      | Improving              |
| Merlin                    | -                      | Improving^             |
| Peregrine Falcon          | x                      | Stable                 |
| Eastern Wood-Pewee        | Improving              | -                      |
| Acadian Flycatcher        | Improving              | -                      |
| Alder Flycatcher          | Potential extirpation  | -                      |
| Willow Flycatcher         | Potential extirpation  | -                      |
| Least Flycatcher          | Potential extirpation  | -                      |
| Eastern Phoebe            | Improving              | Potential colonization |
| Great Crested Flycatcher  | Improving              | -                      |
| Eastern Kingbird          | Stable                 | -                      |
| Scissor-tailed Flycatcher | Potential colonization | -                      |
| Loggerhead Shrike         | Potential colonization | Potential colonization |
| Northern Shrike           | -                      | Potential extirpation  |

| <b>Common Name</b>            | <b>Summer Trend</b>    | <b>Winter Trend</b>    |
|-------------------------------|------------------------|------------------------|
| White-eyed Vireo              | Improving*             | -                      |
| Bell's Vireo                  | Potential colonization | -                      |
| Yellow-throated Vireo         | Worsening              | -                      |
| Warbling Vireo                | Worsening              | -                      |
| Red-eyed Vireo                | Worsening              | -                      |
| Blue Jay                      | Stable                 | Stable                 |
| American Crow                 | Worsening              | Worsening              |
| Fish Crow                     | Potential colonization | -                      |
| Horned Lark                   | -                      | Stable                 |
| Northern Rough-winged Swallow | Improving              | -                      |
| Purple Martin                 | Improving*             | -                      |
| Tree Swallow                  | Potential extirpation  | -                      |
| Barn Swallow                  | Stable                 | -                      |
| Cliff Swallow                 | Stable                 | -                      |
| Carolina Chickadee            | Potential colonization | Potential colonization |
| Black-capped Chickadee        | Potential extirpation  | Potential extirpation  |
| Tufted Titmouse               | Improving              | Improving              |
| Red-breasted Nuthatch         | Potential extirpation  | Potential extirpation  |
| White-breasted Nuthatch       | Stable                 | Worsening              |
| Brown-headed Nuthatch         | -                      | Potential colonization |
| Brown Creeper                 | Potential extirpation^ | Improving              |
| House Wren                    | Worsening*             | -                      |
| Pacific/Winter Wren           | -                      | Improving              |
| Sedge Wren                    | Potential extirpation  | Potential colonization |
| Carolina Wren                 | Improving*             | Improving              |
| Bewick's Wren                 | Potential colonization | -                      |
| Blue-gray Gnatcatcher         | Improving              | -                      |
| Golden-crowned Kinglet        | Potential              | Improving              |

| <b>Common Name</b>      | <b>Summer Trend</b>   | <b>Winter Trend</b>    |
|-------------------------|-----------------------|------------------------|
|                         | extirpation           |                        |
| Ruby-crowned Kinglet    | -                     | Potential colonization |
| Eastern Bluebird        | Improving             | Improving              |
| Veery                   | Potential extirpation | -                      |
| Hermit Thrush           | Potential extirpation | Improving              |
| Wood Thrush             | Worsening             | -                      |
| American Robin          | Worsening             | Improving              |
| Gray Catbird            | Worsening*            | Stable                 |
| Brown Thrasher          | Improving             | Potential colonization |
| Northern Mockingbird    | Improving*            | Improving*             |
| European Starling       | Worsening             | Stable                 |
| American Pipit          | -                     | Potential colonization |
| Cedar Waxwing           | Potential extirpation | Improving              |
| Smith's Longspur        | -                     | Potential colonization |
| Snow Bunting            | -                     | Potential extirpation  |
| Ovenbird                | Stable                | -                      |
| Worm-eating Warbler     | Stable                | -                      |
| Northern Waterthrush    | Potential extirpation | -                      |
| Blue-winged Warbler     | Worsening             | -                      |
| Golden-winged Warbler   | Potential extirpation | -                      |
| Black-and-white Warbler | Stable                | -                      |
| Prothonotary Warbler    | Improving             | -                      |
| Mourning Warbler        | Potential extirpation | -                      |
| Kentucky Warbler        | Improving             | -                      |
| Common Yellowthroat     | Worsening             | -                      |
| Hooded Warbler          | Stable                | -                      |
| American Redstart       | Potential extirpation | -                      |

| <b>Common Name</b>           | <b>Summer Trend</b>     | <b>Winter Trend</b>    |
|------------------------------|-------------------------|------------------------|
| Northern Parula              | Improving*              | -                      |
| Blackburnian Warbler         | Potential extirpation   | -                      |
| Yellow Warbler               | Potential extirpation   | -                      |
| Chestnut-sided Warbler       | Potential extirpation   | -                      |
| Blackpoll Warbler            | Potential extirpation   | -                      |
| Black-throated Blue Warbler  | Potential extirpation   | -                      |
| Pine Warbler                 | Stable^                 | -                      |
| Yellow-rumped Warbler        | -                       | Improving              |
| Yellow-throated Warbler      | Improving               | -                      |
| Prairie Warbler              | Improving               | -                      |
| Black-throated Green Warbler | Potential extirpation   | -                      |
| Yellow-breasted Chat         | Improving*              | -                      |
| Eastern Towhee               | Improving               | x                      |
| American Tree Sparrow        | -                       | Worsening*             |
| Chipping Sparrow             | Worsening               | Potential colonization |
| Field Sparrow                | Improving               | Improving*             |
| Lark Sparrow                 | Potential colonization  | -                      |
| Savannah Sparrow             | Potential extirpation   | Potential colonization |
| Grasshopper Sparrow          | Improving*              | -                      |
| LeConte's Sparrow            | -                       | Potential colonization |
| Seaside Sparrow              | Potential colonization^ | -                      |
| Fox Sparrow                  | -                       | Improving*             |
| Song Sparrow                 | Potential extirpation   | Improving              |
| Lincoln's Sparrow            | -                       | Potential colonization |
| Swamp Sparrow                | Potential extirpation   | Improving              |
| White-throated Sparrow       | Potential               | Improving              |

| <b>Common Name</b>     | <b>Summer Trend</b>    | <b>Winter Trend</b>    |
|------------------------|------------------------|------------------------|
|                        | extirpation            |                        |
| Harris's Sparrow       | -                      | Potential colonization |
| White-crowned Sparrow  | -                      | Improving              |
| Dark-eyed Junco        | x                      | Stable                 |
| Summer Tanager         | Potential colonization | -                      |
| Scarlet Tanager        | Worsening              | -                      |
| Northern Cardinal      | Improving              | Improving              |
| Rose-breasted Grosbeak | Potential extirpation  | -                      |
| Blue Grosbeak          | Potential colonization | -                      |
| Indigo Bunting         | Improving              | -                      |
| Bobolink               | Potential extirpation  | -                      |
| Red-winged Blackbird   | Stable                 | Improving              |
| Eastern Meadowlark     | Improving              | Improving*             |
| Rusty Blackbird        | -                      | Improving              |
| Brewer's Blackbird     | -                      | Potential colonization |
| Common Grackle         | Worsening              | Improving              |
| Great-tailed Grackle   | Potential colonization | Potential colonization |
| Brown-headed Cowbird   | Worsening              | Improving              |
| Orchard Oriole         | Improving*             | -                      |
| Baltimore Oriole       | Worsening              | -                      |
| House Finch            | Worsening*             | Worsening              |
| Purple Finch           | Potential extirpation  | Stable                 |
| White-winged Crossbill | -                      | Potential extirpation  |
| Common Redpoll         | -                      | Potential extirpation  |
| Pine Siskin            | -                      | Potential extirpation  |
| American Goldfinch     | Worsening              | Worsening              |
| Evening Grosbeak       | -                      | Potential extirpation  |

|               |   |           |
|---------------|---|-----------|
| House Sparrow | x | Worsening |
|---------------|---|-----------|