Birds and Climate Change

National Park Service
U.S. Department of the Interior

Appalachian National Scenic Trail

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 Appalachian National Scenic Trail (hereafter, the Trail) 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 Trail based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Trail 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 Trail, 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 Trail today, climate suitability in summer under the high-emissions pathway is projected to improve for 61, remain stable for 21 (e.g., Figure 2), and worsen for 16 species. Suitable climate ceases to occur for 71 species in summer, potentially resulting in extirpation of those species from the Trail. Climate is projected to become suitable in summer for 6 species not found at the Trail today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 103, remain stable for 15, and worsen for 3 species. Suitable climate ceases to occur for 20 species in winter, potentially resulting in extirpation from the Trail. Climate is projected to become suitable in winter for 13 species not found at the Trail today, potentially resulting in local colonization.

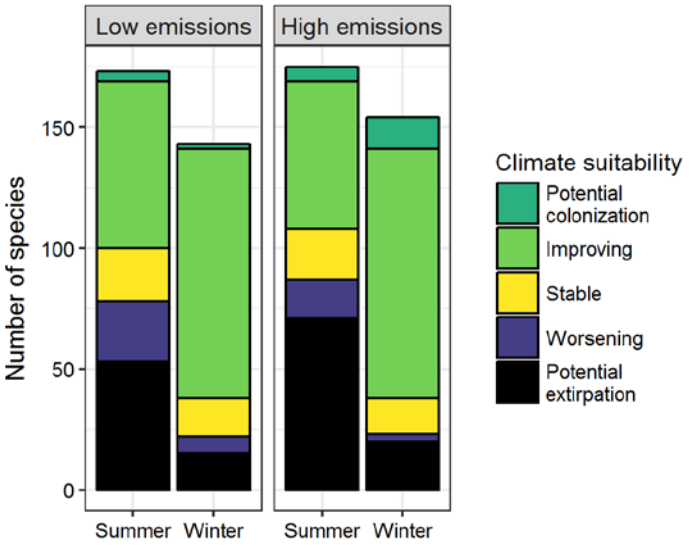

Figure 1. Projected changes in climate suitability for birds at the Trail, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Trail between the present and 2050 is 0.32 in summer (55th percentile across all national parks) and 0.39 in winter (65th percentile) under the high-emissions pathway. Potential species turnover declines to 0.19 in summer and 0.27 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 Trail is or may become home to 21 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 Trail may serve as an important refuge for 11 of these climate-sensitive species, 10 might be extirpated from the Trail in at least one season by 2050.

Figure 2. Climate at the Trail 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, Appalachian National Scenic Trail 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 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.

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

Gregor Schuurman, Ph.D.
Ecologist, NPS Climate Change Response Program
970-267-7211, gregor_schuurman@nps.gov

Joanna Wu
Biologist, National Audubon Society
415-644-4610, science@audubon.org

Species Projections

Table 1. Climate suitability projections by 2050 under the high-emissions pathway for all birds currently present at the Trail based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Trail 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
Mute Swan	x	Stable
Wood Duck	x	Improving*
Gadwall	-	Improving*
Eurasian Wigeon	-	Stable
American Wigeon	-	Improving*
American Black Duck	x	Worsening*
Mallard	Potential extirpation^	Improving
Blue-winged Teal	Potential extirpation	Improving
Northern Shoveler	-	Improving*
Green-winged Teal	x	Improving
Canvasback	-	Improving
Ring-necked Duck	x	Improving*
Greater Scaup	-	Improving^
Lesser Scaup	x	Improving
Surf Scoter	-	Stable

Common Name	Summer Trend	Winter Trend
White-winged Scoter	x	Improving
Long-tailed Duck	-	Stable
Bufflehead	x	Improving
Common Goldeneye	x	Improving
Hooded Merganser	x	Improving^
Common Merganser	x	Stable
Red-breasted Merganser	Stable	Improving^
Ruddy Duck	-	Improving
Northern Bobwhite	Improving*	Improving*
Ring-necked Pheasant	Worsening	Potential extirpation
Ruffed Grouse	x	Potential extirpation
Spruce Grouse	x	Potential extirpation
Wild Turkey	x	Stable
Common Loon	Potential extirpation	Improving^
Pied-billed Grebe	x	Improving

Common Name	Summer Trend	Winter Trend
Horned Grebe	-	Improving
Red-necked Grebe	-	Stable^
Double-crested Cormorant	x	Improving*
Great Cormorant	-	Improving
American White Pelican	-	Potential colonization
American Bittern	Potential extirpation	-
Great Blue Heron	Improving	Improving
Great Egret	Improving	-
Little Blue Heron	Improving	-
Cattle Egret	Improving	-
Green Heron	Improving	-
Yellow-crowned Night-Heron	Improving	-
White Ibis	Stable	-
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving
Golden Eagle	x	Stable
Mississippi Kite	Improving	-
Northern Harrier	Potential extirpation^	Improving
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Improving
Northern Goshawk	x	Potential extirpation
Bald Eagle	x	Improving
Red-shouldered Hawk	Improving	Improving
Red-tailed Hawk	Improving	Improving
Rough-legged Hawk	-	Improving
Virginia Rail	x	Improving
American Coot	x	Improving
Semipalmated Plover	Potential extirpation	-
Killdeer	Improving*	Improving
Greater Yellowlegs	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Willet	Potential extirpation^	-
Lesser Yellowlegs	Potential extirpation^	-
Least Sandpiper	x	Potential colonization
Wilson's Snipe	Potential extirpation	Stable
American Woodcock	x	Improving
Pigeon Guillemot	Potential colonization	-
Bonaparte's Gull	Potential extirpation	Improving*
Ring-billed Gull	Potential extirpation^	Improving
Herring Gull	Potential extirpation	Improving^
Great Black-backed Gull	x	Improving
Rock Pigeon	Stable	Stable
Eurasian Collared-Dove	x	Improving*
Mourning Dove	Improving	Improving
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Stable	-
Greater Roadrunner	-	Potential colonization
Barn Owl	x	Improving
Eastern Screech-Owl	x	Improving
Great Horned Owl	x	Improving
Snowy Owl	-	Potential extirpation
Northern Hawk Owl	-	Potential extirpation^
Barred Owl	x	Improving
Common Nighthawk	Improving	-
Chuck-will's-widow	Improving	-
Chimney Swift	Improving	-
Ruby-throated Hummingbird	Improving	-
Anna's Hummingbird	-	Improving

Common Name	Summer Trend	Winter Trend
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Improving*	Improving*
Red-bellied Woodpecker	Improving*	Improving
Yellow-bellied Sapsucker	Potential extirpation	Improving*
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Worsening	Worsening
Red-cockaded Woodpecker	-	Potential colonization
Black-backed Woodpecker	x	Potential extirpation
Northern Flicker	Stable	Improving
Pileated Woodpecker	Stable	Improving
American Kestrel	x	Improving
Merlin	x	Improving^
Peregrine Falcon	x	Improving
Olive-sided Flycatcher	Potential extirpation	-
Eastern Wood-Pewee	Improving	-
Yellow-bellied Flycatcher	Potential extirpation	-
Acadian Flycatcher	Stable	-
Alder Flycatcher	Potential extirpation	-
Willow Flycatcher	Worsening	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Improving	Improving
Say's Phoebe	-	Improving
Great Crested Flycatcher	Improving	-
Eastern Kingbird	Improving	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Improving	Improving*
Northern Shrike	-	Potential extirpation
White-eyed Vireo	Improving*	-

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

Common Name	Summer Trend	Winter Trend
Carolina Wren	Improving	Improving
Bewick's Wren	Improving	-
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	Potential extirpation	Stable
Ruby-crowned Kinglet	Potential extirpation	Improving
Eastern Bluebird	Improving*	Improving
Veery	Potential extirpation	-
Gray-cheeked Thrush	Potential extirpation	-
Swainson's Thrush	Potential extirpation	-
Hermit Thrush	Potential extirpation	Improving
Wood Thrush	Worsening	-
American Robin	Worsening	Improving
Varied Thrush	-	Potential extirpation
Gray Catbird	Worsening*	Improving
Brown Thrasher	Improving*	Improving*
Northern Mockingbird	Improving	Improving
European Starling	Stable	Improving
American Pipit	Potential extirpation	Improving
Bohemian Waxwing	-	Potential extirpation
Cedar Waxwing	Potential extirpation	Improving
Chestnut-collared Longspur	-	Potential colonization
Smith's Longspur	-	Potential colonization
Snow Bunting	-	Potential extirpation
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Stable	-

Common Name	Summer Trend	Winter Trend
Northern Waterthrush	Potential extirpation	-
Blue-winged Warbler	Stable	-
Golden-winged Warbler	Stable	-
Black-and-white Warbler	Worsening	-
Prothonotary Warbler	Improving	-
Swainson's Warbler	Improving	-
Tennessee Warbler	Potential extirpation	-
Nashville Warbler	Potential extirpation	-
Mourning Warbler	Potential extirpation	-
Kentucky Warbler	Improving	-
Common Yellowthroat	Worsening	Improving
Hooded Warbler	Stable	-
American Redstart	Potential extirpation	-
Cape May Warbler	Potential extirpation	-
Northern Parula	Improving	-
Magnolia Warbler	Potential extirpation	-
Bay-breasted Warbler	Potential extirpation	-
Blackburnian Warbler	Potential extirpation	-
Yellow Warbler	Potential extirpation	-
Chestnut-sided Warbler	Potential extirpation	-
Blackpoll Warbler	Potential extirpation	-
Black-throated Blue Warbler	Potential extirpation	-
Palm Warbler	Potential extirpation	Potential colonization^
Pine Warbler	Stable^	Improving
Yellow-rumped Warbler	Potential extirpation	Improving

Common Name	Summer Trend	Winter Trend
Yellow-throated Warbler	Improving	-
Prairie Warbler	Improving	-
Black-throated Green Warbler	Potential extirpation	-
Canada Warbler	Potential extirpation	-
Wilson's Warbler	Potential extirpation	-
Yellow-breasted Chat	Improving*	-
Eastern Towhee	Stable	x
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Worsening	Improving
Clay-colored Sparrow	Potential extirpation	-
Field Sparrow	Improving*	Improving
Vesper Sparrow	Potential extirpation	Improving
Savannah Sparrow	Potential extirpation	Improving*
Grasshopper Sparrow	Improving	-
LeConte's Sparrow	-	Potential colonization
Seaside Sparrow	Potential colonization^	-
Fox Sparrow	Potential extirpation	Improving
Song Sparrow	Potential extirpation	Improving
Lincoln's Sparrow	Potential extirpation	Potential colonization
Swamp Sparrow	Potential extirpation	Improving
White-throated Sparrow	Potential extirpation	Improving
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	Potential extirpation	Improving
Dark-eyed Junco	x	Improving
Summer Tanager	Improving*	-

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