Upper Delaware Scenic and Recreational River

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 Upper Delaware Scenic and Recreational River (hereafter, the River) 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 River based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the River 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 River, 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 River today, climate suitability in summer under the high-emissions pathway is projected to improve for 37, remain stable for 15 (e.g., Figure 2), and worsen for 14 species. Suitable climate ceases to occur for 37 species in summer, potentially resulting in extirpation of those species from the River. Climate is projected to become suitable in summer for 14 species not found at the River today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 41, remain stable for 7, and worsen for 6 species. Suitable climate ceases to occur for 5 species in winter, potentially resulting in extirpation from the River. Climate is projected to become suitable in winter for 38 species not found at the River today, potentially resulting in local colonization.

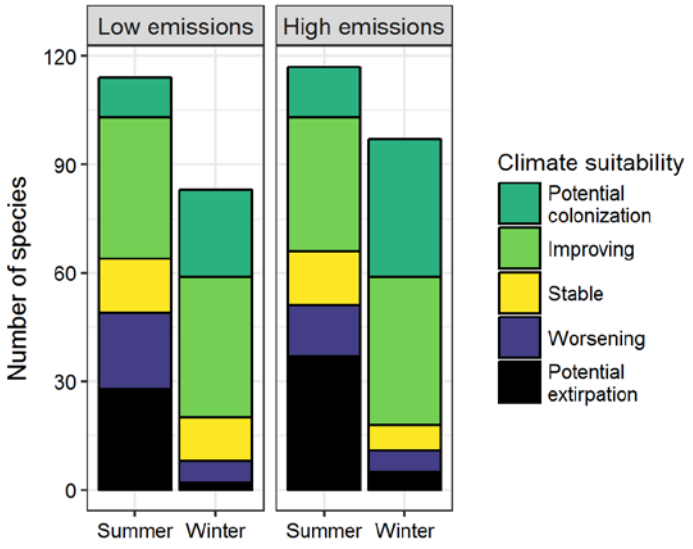

Figure 1. Projected changes in climate suitability for birds at the River, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the River between the present and 2050 is 0.35 in summer (62nd percentile across all national parks) and 0.45 in winter (75th percentile) under the high-emissions pathway. Potential species turnover declines to 0.27 in summer and 0.34 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 River 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 River may serve as an important refuge for 2 of these climate-sensitive species, 4 might be extirpated from the River in at least one season by 2050.

Figure 2. Climate at the River 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, Upper Delaware Scenic and Recreational River 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 2 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 River based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the River 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	-	Potential colonization
American Wigeon	-	Potential colonization
American Black Duck	x	Worsening*
Mallard	Potential extirpation^	Improving
Northern Shoveler	-	Potential colonization
Green-winged Teal	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	-	Potential colonization
Greater Scaup	-	Improving^
Lesser Scaup	-	Potential colonization
Bufflehead	-	Improving
Common Goldeneye	-	Stable
Hooded Merganser	-	Improving^
Common Merganser	x	Worsening*
Ruddy Duck	-	Potential colonization
Northern Bobwhite	Potential colonization	Potential colonization
Ruffed Grouse	x	Potential extirpation
Wild Turkey	x	Worsening*
Common Loon	Potential extirpation	-
Pied-billed Grebe	x	Potential colonization
Horned Grebe	-	Potential colonization
Double-crested Cormorant	x	Potential colonization
Great Blue Heron	Improving	Improving
Green Heron	Improving	-

Common Name	Summer Trend	Winter Trend
Black Vulture	Improving	Improving
Turkey Vulture	x	Improving*
Northern Harrier	-	Potential colonization
Sharp-shinned Hawk	x	Improving
Cooper's Hawk	x	Improving
Bald Eagle	x	Improving
Red-shouldered Hawk	Improving	Improving*
Red-tailed Hawk	Improving	Improving
Rough-legged Hawk	-	Stable
American Coot	-	Potential colonization
Killdeer	Improving	Potential colonization
American Woodcock	x	Potential colonization
Ring-billed Gull	Potential extirpation^	Improving
Rock Pigeon	Worsening	Stable
Mourning Dove	Improving	Improving
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Worsening	-
Eastern Screech-Owl	x	Potential colonization
Great Horned Owl	x	Improving
Chimney Swift	Improving	-
Ruby-throated Hummingbird	Stable	-
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Potential colonization	Potential colonization
Red-bellied Woodpecker	Improving*	Improving
Yellow-bellied Sapsucker	Potential extirpation	Potential colonization
Downy Woodpecker	Improving	Improving
Hairy Woodpecker	Potential extirpation	Stable
Northern Flicker	Stable	Improving

Common Name	Summer Trend	Winter Trend
Pileated Woodpecker	Worsening	Stable
American Kestrel	x	Potential colonization
Eastern Wood-Pewee	Improving	-
Acadian Flycatcher	Improving	-
Alder Flycatcher	Potential extirpation	-
Willow Flycatcher	Stable	-
Least Flycatcher	Potential extirpation	-
Eastern Phoebe	Stable	Potential colonization
Great Crested Flycatcher	Stable	-
Eastern Kingbird	Improving	-
Loggerhead Shrike	-	Potential colonization
White-eyed Vireo	Potential colonization	-
Bell's Vireo	Potential colonization	-
Yellow-throated Vireo	Improving	-
Warbling Vireo	Stable	-
Red-eyed Vireo	Worsening	-
Blue Jay	Stable	Worsening
American Crow	Worsening	Stable
Fish Crow	Improving	Potential colonization
Common Raven	Potential extirpation	Potential extirpation
Northern Rough-winged Swallow	Improving	-
Purple Martin	Potential colonization	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Improving	-
Cliff Swallow	Improving	-
Carolina Chickadee	Potential colonization	Potential colonization

Common Name	Summer Trend	Winter Trend
Black-capped Chickadee	Potential extirpation	Potential extirpation
Tufted Titmouse	Improving	Improving
Red-breasted Nuthatch	Potential extirpation	Potential extirpation
White-breasted Nuthatch	Stable	Improving
Brown Creeper	Potential extirpation^	Improving
House Wren	Stable	-
Pacific/Winter Wren	Potential extirpation	Potential colonization
Carolina Wren	Improving*	Improving
Blue-gray Gnatcatcher	Improving	-
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Potential colonization
Eastern Bluebird	Improving	Improving
Veery	Potential extirpation	-
Hermit Thrush	Potential extirpation	Improving
Wood Thrush	Worsening	-
American Robin	Stable	Improving
Gray Catbird	Worsening	Improving
Brown Thrasher	Improving	Potential colonization
Northern Mockingbird	Improving*	Improving
European Starling	Stable	Stable
Cedar Waxwing	Worsening	Improving
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Improving	-
Northern Waterthrush	Potential extirpation	-
Blue-winged Warbler	Stable	-
Black-and-white Warbler	Potential extirpation	-
Prothonotary Warbler	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Nashville Warbler	Potential extirpation	-
Mourning Warbler	Potential extirpation	-
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	Worsening	-
Hooded Warbler	Stable	-
American Redstart	Potential extirpation	-
Northern Parula	Improving	-
Magnolia 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	-
Pine Warbler	Potential extirpation^	-
Yellow-rumped Warbler	Potential extirpation	Potential colonization
Yellow-throated Warbler	Potential colonization	-
Prairie Warbler	Improving	-
Black-throated Green Warbler	Potential extirpation	-
Canada Warbler	Potential extirpation	-
Yellow-breasted Chat	Potential colonization	-
Eastern Towhee	Improving	-
American Tree Sparrow	-	Worsening*
Chipping Sparrow	Worsening	-
Field Sparrow	Improving	Improving*

Common Name	Summer Trend	Winter Trend
Savannah Sparrow	Potential extirpation	Potential colonization
Grasshopper Sparrow	Potential colonization	-
LeConte's Sparrow	-	Potential colonization
Fox Sparrow	-	Potential colonization
Song Sparrow	Worsening	Improving
Swamp Sparrow	Potential extirpation	Potential colonization
White-throated Sparrow	Potential extirpation	Improving
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Potential colonization
Dark-eyed Junco	x	Improving
Summer Tanager	Potential colonization	-
Scarlet Tanager	Worsening	-
Northern Cardinal	Improving	Improving
Rose-breasted Grosbeak	Worsening*	-
Blue Grosbeak	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Indigo Bunting	Improving	-
Dickcissel	Potential colonization	-
Bobolink	Potential extirpation	-
Red-winged Blackbird	Improving	Improving
Eastern Meadowlark	Improving	Potential colonization
Rusty Blackbird	-	Potential colonization
Common Grackle	Improving	Improving
Brown-headed Cowbird	Improving	-
Orchard Oriole	Improving*	-
Baltimore Oriole	Worsening	-
House Finch	Potential extirpation	Improving
Purple Finch	Potential extirpation	Worsening*
Common Redpoll	-	Potential extirpation
American Goldfinch	Stable	Improving
House Sparrow	x	Improving
Eurasian Tree Sparrow	-	Potential colonization