Birds and Climate Change

National Park Service
U.S. Department of the Interior

Glen Canyon 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 Glen Canyon 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 11, remain stable for 41 (e.g., Figure 2), and worsen for 5 species. Suitable climate ceases to occur for 24 species in summer, potentially resulting in extirpation of those species from the Recreation Area. Climate is projected to become suitable in summer for 22 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 37, remain stable for 36, and worsen for 14 species. Suitable climate ceases to occur for 13 species in winter, potentially resulting in extirpation from the Recreation Area. Climate is projected to become suitable in winter for 36 species not found at the Recreation Area today, potentially resulting in local colonization.

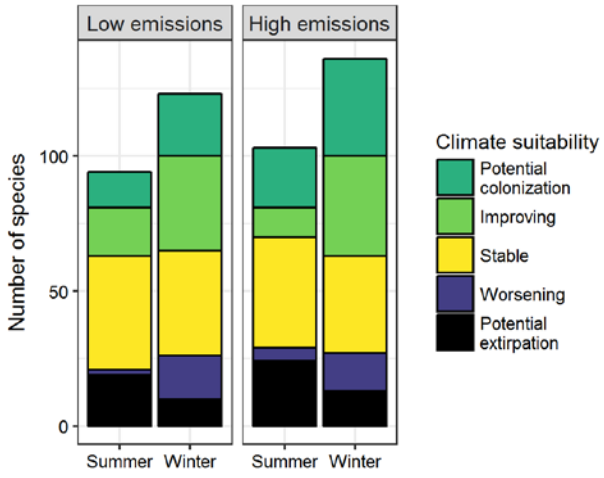

Figure 1. Projected changes in climate suitability for birds at the Recreation Area, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Recreation Area between the present and 2050 is 0.24 in summer (39th percentile across all national parks) and 0.21 in winter (29th percentile) under the high-emissions pathway. Potential species turnover declines to 0.19 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 19 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 12 of these climate-sensitive species, 7 might be extirpated from the Recreation Area in at least one season by 2050.

Figure 2. Climate at the Recreation Area in summer is projected to remain suitable for the Mourning Dove (*Zenaida macroura*) through 2050. Photo by KS Black/Flickr (Public Domain).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Glen Canyon National Recreation Area falls within the high potential colonization group.** Parks anticipating high potential colonization 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 12 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.

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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	Worsening*
Wood Duck	-	Worsening
Gadwall	Potential extirpation^	Stable
American Wigeon	Potential extirpation^	Stable
Mallard	Potential extirpation^	Stable
Blue-winged Teal	-	Potential colonization
Cinnamon Teal	x	Improving
Northern Shoveler	Potential extirpation^	Improving
Green-winged Teal	x	Stable
Canvasback	-	Improving
Redhead	Stable^	x
Ring-necked Duck	-	Improving
Greater Scaup	-	Stable^
Lesser Scaup	-	Improving

Common Name	Summer Trend	Winter Trend
White-winged Scoter	-	Stable
Long-tailed Duck	-	Potential extirpation
Bufflehead	-	Improving
Common Goldeneye	x	Worsening
Barrow's Goldeneye	-	Stable^
Hooded Merganser	-	Improving^
Common Merganser	x	Worsening
Red-breasted Merganser	-	Stable^
Ruddy Duck	Stable	Improving
Scaled Quail	-	Potential colonization
Northern Bobwhite	-	Potential colonization
Chukar	-	Potential extirpation
Common Loon	-	Stable^
Pied-billed Grebe	-	Stable
Horned Grebe	-	Stable

Common Name	Summer Trend	Winter Trend
Eared Grebe	x	Improving*
Western Grebe	x	Stable
Wood Stork	Potential colonization	-
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Potential extirpation
Anhinga	Potential colonization^	-
Least Bittern	-	Potential colonization
Great Blue Heron	Potential extirpation	Stable
Golden Eagle	x	Worsening*
Northern Harrier	Potential extirpation^	Stable
Sharp-shinned Hawk	x	Worsening
Cooper's Hawk	-	Stable
Bald Eagle	-	Potential extirpation
Harris's Hawk	Potential colonization	-
Red-tailed Hawk	Stable	Stable
Virginia Rail	-	Stable
Sora	-	Improving
American Coot	x	Stable
Killdeer	Stable	Improving
Spotted Sandpiper	-	Improving
Wilson's Snipe	-	Improving
Ring-billed Gull	-	Potential extirpation
Yellow-footed Gull	-	Potential colonization
California Gull	-	Worsening*^
Herring Gull	-	Potential extirpation^
Rock Pigeon	Potential extirpation	Potential extirpation
Eurasian Collared-Dove	x	Improving*

Common Name	Summer Trend	Winter Trend
White-winged Dove	Potential colonization	Improving*
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	-
Common Ground-Dove	Potential colonization	-
Greater Roadrunner	Improving	Improving*
Great Horned Owl	x	Worsening*
Burrowing Owl	-	Potential colonization
Common Nighthawk	Stable	-
Common Pauraque	-	Potential colonization
White-throated Swift	x	Potential colonization
Black-chinned Hummingbird	Improving	-
Costa's Hummingbird	Potential colonization	Potential colonization
Belted Kingfisher	-	Worsening
Lewis's Woodpecker	x	Stable
Gila Woodpecker	Potential colonization	Potential colonization
Golden-fronted Woodpecker	Potential colonization	Potential colonization
Red-naped Sapsucker	Stable^	Improving*
Downy Woodpecker	-	Potential extirpation
Hairy Woodpecker	Potential extirpation	Potential extirpation
Northern Flicker	-	Worsening
Gilded Flicker	-	Potential colonization
American Kestrel	-	Stable
Merlin	-	Worsening^
Peregrine Falcon	x	Improving
Prairie Falcon	x	Stable
Western Wood-Pewee	Potential extirpation^	-

Common Name	Summer Trend	Winter Trend
Willow Flycatcher	Potential extirpation	-
Gray Flycatcher	Stable	Potential colonization
Dusky Flycatcher	-	Potential colonization
Black Phoebe	Improving	Improving
Say's Phoebe	Improving	Improving*
Vermilion Flycatcher	-	Potential colonization
Ash-throated Flycatcher	Improving*	-
Brown-crested Flycatcher	Potential colonization	-
Cassin's Kingbird	Stable	-
Western Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Improving*	Improving
Pinyon Jay	-	Stable
Steller's Jay	Improving	Stable
California/Woodhouse's Scrub-Jay (Western Scrub-Jay)	Stable	Stable
American Crow	Potential extirpation	Potential extirpation
Chihuahuan Raven	Potential colonization	Potential colonization
Common Raven	Potential extirpation	Potential extirpation
Horned Lark	Worsening*	Worsening
Northern Rough-winged Swallow	Stable	Potential colonization
Tree Swallow	Potential extirpation	-
Violet-green Swallow	Worsening*	-
Barn Swallow	Stable	-
Cliff Swallow	Stable	-
Cave Swallow	Potential colonization	-
Mountain Chickadee	-	Worsening*

Common Name	Summer Trend	Winter Trend
Juniper Titmouse	Stable	Stable
Verdin	Potential colonization	-
Bushtit	Stable	Stable
Pygmy Nuthatch	Stable	Stable^
Rock Wren	Stable	Improving*
Canyon Wren	x	Stable
House Wren	Potential extirpation	-
Marsh Wren	-	Stable
Bewick's Wren	Stable	Improving
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Stable	Improving*
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Ruby-crowned Kinglet	Stable	Improving
Mountain Bluebird	Stable	Stable
American Robin	Potential extirpation	Worsening
Curve-billed Thrasher	Potential colonization	-
Bendire's Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Potential colonization
European Starling	Potential extirpation	Stable
American Pipit	-	Improving*
Sprague's Pipit	-	Potential colonization
Phainopepla	-	Potential colonization
Orange-crowned Warbler	Stable	Improving
Lucy's Warbler	Improving	-
Common Yellowthroat	Stable	-
Yellow Warbler	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Yellow-rumped Warbler	Potential extirpation	Improving
Black-throated Gray Warbler	Stable	-
Yellow-breasted Chat	Stable	-
Green-tailed Towhee	Stable^	Potential colonization
Spotted Towhee	Stable	x
Canyon Towhee	-	Potential colonization
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	Potential extirpation	Potential colonization
Brewer's Sparrow	Worsening	-
Vesper Sparrow	Potential extirpation	Potential colonization
Lark Sparrow	Worsening*	-
Black-throated Sparrow	Stable	Improving*
Sagebrush/Bell's Sparrow (Sage Sparrow)	-	Improving
Lark Bunting	-	Potential colonization
Savannah Sparrow	Potential extirpation	-
Henslow's Sparrow	-	Potential colonization
Song Sparrow	Potential extirpation	Stable
Lincoln's Sparrow	Stable	Improving
Swamp Sparrow	-	Improving
White-crowned Sparrow	Stable	Improving

Common Name	Summer Trend	Winter Trend
Dark-eyed Junco	x	Stable
Western Tanager	Stable	-
Pyrrhuloxia	Potential colonization	Potential colonization
Black-headed Grosbeak	Stable	-
Blue Grosbeak	Improving*	-
Lazuli Bunting	Stable	-
Painted Bunting	Potential colonization	-
Red-winged Blackbird	Stable	Stable
Eastern Meadowlark	Potential colonization	Potential colonization
Western Meadowlark	Worsening*	-
Yellow-headed Blackbird	Stable	-
Brewer's Blackbird	Potential extirpation	Improving
Great-tailed Grackle	Improving*	Improving*
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Stable	-
Hooded Oriole	Stable	-
Bullock's Oriole	Stable	-
Baltimore Oriole	Potential extirpation	-
House Finch	Improving*	Stable
Cassin's Finch	-	Stable
Lesser Goldfinch	Stable	Improving*
American Goldfinch	-	Potential extirpation
House Sparrow	x	Potential extirpation