



Colonial National Historical 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 Colonial National Historical 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 19, remain stable for 34, and worsen for 25 species. Suitable climate ceases to occur for 32 species in summer, potentially resulting in extirpation of those species from the Park (e.g., Figure 2). Climate is projected to become suitable in summer for 15 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 69, remain stable for 35, and worsen for 19 species. Suitable climate ceases to occur for 27 species in winter, potentially resulting in extirpation from the Park. Climate is projected to become suitable in winter for 42 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.

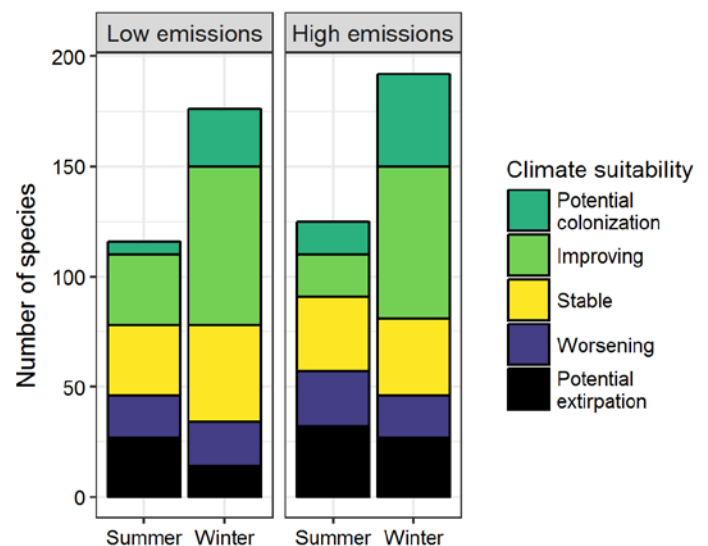


Figure 1. Projected changes in climate suitability for birds at the Park, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Park between the present and 2050 is 0.22 in summer (34th percentile across all national parks) and 0.23 in winter (33rd percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 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 Park is or may become home to 28 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

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Colonial National Historical Park 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

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

Park may serve as an important refuge for 21 of these climate-sensitive species, 7 might be extirpated from the Park in at least one season by 2050.



Figure 2. Although currently found at the Park, 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).

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 21 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.

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 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
Black-bellied Whistling-Duck	Potential colonization	-
Fulvous Whistling-Duck	Potential colonization	-
Brant	-	Potential extirpation
Cackling/Canada Goose	x	Potential extirpation
Mute Swan	x	Potential extirpation
Wood Duck	x	Improving
Gadwall	Stable^	Improving
American Wigeon	-	Improving
American Black Duck	x	Potential extirpation
Mallard	Potential extirpation^	Worsening
Mottled Duck	-	Potential colonization
Northern Shoveler	-	Improving
Green-winged Teal	-	Improving

Common Name	Summer Trend	Winter Trend
Canvasback	-	Improving
Ring-necked Duck	-	Improving
Greater Scaup	-	Stable^
Lesser Scaup	-	Improving
Surf Scoter	-	Potential extirpation
White-winged Scoter	-	Potential extirpation
Black Scoter	-	Potential extirpation
Long-tailed Duck	-	Potential extirpation
Bufflehead	-	Stable
Common Goldeneye	-	Stable
Hooded Merganser	x	Worsening^
Common Merganser	-	Potential extirpation
Red-breasted Merganser	-	Worsening*^
Ruddy Duck	-	Improving
Northern Bobwhite	Worsening*	Worsening*

Common Name	Summer Trend	Winter Trend
Ring-necked Pheasant	-	Potential extirpation
Wild Turkey	x	Potential extirpation
Red-throated Loon	-	Potential extirpation
Common Loon	-	Worsening**^
Pied-billed Grebe	x	Improving
Horned Grebe	-	Worsening*
Red-necked Grebe	-	Potential extirpation^
Eared Grebe	-	Potential colonization
Wood Stork	Potential colonization	-
Northern Gannet	Stable^	Potential extirpation^
Neotropic Cormorant	-	Potential colonization
Double-crested Cormorant	x	Improving
Great Cormorant	-	Potential extirpation
Anhinga	Improving^	Potential colonization
American White Pelican	-	Potential colonization
Brown Pelican	Stable	Stable^
American Bittern	Potential extirpation	Stable^
Great Blue Heron	Stable	Improving
Great Egret	Improving*	Improving*
Snowy Egret	x	Potential colonization
Little Blue Heron	Improving*	Potential colonization
Tricolored Heron	Improving^	Potential colonization
Cattle Egret	Improving*	Potential colonization
Green Heron	Stable	-

Common Name	Summer Trend	Winter Trend
Black-crowned Night-Heron	x	Improving
Yellow-crowned Night-Heron	Improving	-
White Ibis	Improving	Potential colonization
Glossy Ibis	x	Potential colonization
White-faced Ibis	-	Potential colonization^
Black Vulture	Improving*	Improving
Turkey Vulture	x	Improving
Osprey	x	Improving
Northern Harrier	-	Worsening
Sharp-shinned Hawk	x	Stable
Cooper's Hawk	x	Improving
Bald Eagle	x	Potential extirpation
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	Improving	Improving
Red-tailed Hawk	Stable	Improving
Rough-legged Hawk	-	Potential extirpation
Clapper Rail	x	Worsening
King Rail	x	Improving^
Virginia Rail	x	Stable
Sora	-	Improving
Common Gallinule	-	Potential colonization
American Coot	-	Improving
American Avocet	-	Potential colonization^
Black-bellied Plover	-	Worsening
Semipalmated Plover	-	Stable^
Piping Plover	-	Potential colonization^
Killdeer	Worsening	Improving
Spotted Sandpiper	x	Improving*

Common Name	Summer Trend	Winter Trend
Greater Yellowlegs	-	Improving*
Lesser Yellowlegs	-	Improving
Long-billed Curlew	-	Potential colonization
Ruddy Turnstone	-	Potential extirpation^
Sanderling	-	Potential extirpation
Dunlin	-	Stable^
Least Sandpiper	-	Improving*
Long-billed Dowitcher	-	Potential colonization
Wilson's Snipe	-	Stable
American Woodcock	x	Stable
Bonaparte's Gull	-	Stable
Laughing Gull	Worsening^	Worsening*
Ring-billed Gull	Potential extirpation^	Stable
Herring Gull	Potential extirpation	Worsening**^
Great Black-backed Gull	x	Potential extirpation
Gull-billed Tern	-	Potential colonization
Forster's Tern	x	Improving*
Rock Pigeon	Potential extirpation	Stable
Eurasian Collared-Dove	-	Potential colonization
White-winged Dove	-	Potential colonization
Mourning Dove	Stable	Improving
Inca Dove	Potential colonization	Potential colonization
Common Ground-Dove	Potential colonization	-
Yellow-billed Cuckoo	Improving*	-
Black-billed Cuckoo	Potential extirpation	-

Common Name	Summer Trend	Winter Trend
Greater Roadrunner	Potential colonization	Potential colonization
Groove-billed Ani	-	Potential colonization
Barn Owl	x	Improving
Eastern Screech-Owl	x	Stable
Great Horned Owl	x	Potential extirpation
Barred Owl	x	Improving
Common Nighthawk	Improving*	-
Common Pauraque	-	Potential colonization
Chuck-will's-widow	Worsening	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Worsening	-
Buff-bellied Hummingbird	-	Potential colonization
Belted Kingfisher	Stable	Improving
Red-headed Woodpecker	Stable	Stable
Red-bellied Woodpecker	Stable	Improving
Yellow-bellied Sapsucker	-	Improving
Downy Woodpecker	Worsening	Stable
Hairy Woodpecker	Potential extirpation	Worsening
Northern Flicker	Improving	Worsening
Pileated Woodpecker	Stable	Worsening
Crested Caracara	-	Potential colonization
American Kestrel	x	Stable
Merlin	-	Stable^
Peregrine Falcon	-	Stable
Eastern Wood-Pewee	Worsening*	-
Acadian Flycatcher	Worsening	-
Willow Flycatcher	Potential extirpation	-
Eastern Phoebe	Stable	Improving
Great Crested Flycatcher	Worsening	-

Common Name	Summer Trend	Winter Trend
Brown-crested Flycatcher	Potential colonization	-
Western Kingbird	Potential colonization	-
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Improving*	Improving*
White-eyed Vireo	Improving*	Potential colonization
Yellow-throated Vireo	Stable	-
Warbling Vireo	Potential extirpation	-
Red-eyed Vireo	Potential extirpation	-
Blue Jay	Worsening	Stable
American Crow	Worsening	Worsening
Fish Crow	Worsening*	Stable
Horned Lark	-	Stable
Northern Rough-winged Swallow	Stable	-
Purple Martin	Improving	-
Tree Swallow	Potential extirpation	-
Barn Swallow	Stable	-
Cliff Swallow	Improving*	-
Cave Swallow	Potential colonization	-
Carolina Chickadee	Stable	Improving
Tufted Titmouse	Worsening	Stable
Red-breasted Nuthatch	-	Improving
White-breasted Nuthatch	Potential extirpation	Potential extirpation
Brown-headed Nuthatch	Stable^	Worsening*
Brown Creeper	-	Stable
House Wren	Potential extirpation	Improving
Pacific/Winter Wren	-	Improving
Sedge Wren	-	Improving*

Common Name	Summer Trend	Winter Trend
Marsh Wren	x	Improving
Carolina Wren	Worsening	Improving
Bewick's Wren	-	Potential colonization
Blue-gray Gnatcatcher	Worsening	Potential colonization
Golden-crowned Kinglet	-	Improving
Ruby-crowned Kinglet	-	Improving
Eastern Bluebird	Stable	Improving
Hermit Thrush	-	Improving
Wood Thrush	Worsening	-
American Robin	Potential extirpation	Stable
Gray Catbird	Potential extirpation	Stable
Brown Thrasher	Potential extirpation	Improving
Northern Mockingbird	Stable	Improving
European Starling	Worsening	Worsening
American Pipit	-	Improving*
Sprague's Pipit	-	Potential colonization
Cedar Waxwing	Potential extirpation	Improving
Chestnut-collared Longspur	-	Potential colonization
Ovenbird	Potential extirpation	-
Worm-eating Warbler	Stable	-
Northern Waterthrush	Potential extirpation	-
Black-and-white Warbler	Potential extirpation	-
Prothonotary Warbler	Worsening	-
Orange-crowned Warbler	-	Improving*
Kentucky Warbler	Improving*	-
Common Yellowthroat	Potential extirpation	Improving
Hooded Warbler	Stable	-

Common Name	Summer Trend	Winter Trend
American Redstart	Stable	-
Northern Parula	Worsening	-
Yellow Warbler	Potential extirpation	-
Palm Warbler	-	Worsening*^
Pine Warbler	Potential extirpation^	Improving
Yellow-rumped Warbler	-	Improving
Yellow-throated Warbler	Stable	Potential colonization
Prairie Warbler	Worsening	-
Black-throated Green Warbler	Improving	-
Yellow-breasted Chat	Stable	-
Eastern Towhee	Potential extirpation	x
Rufous-winged Sparrow	Potential colonization	-
Cassin's Sparrow	-	Potential colonization
Bachman's Sparrow	Potential colonization	Potential colonization
American Tree Sparrow	-	Potential extirpation
Chipping Sparrow	Potential extirpation	Improving
Field Sparrow	Worsening*	Improving
Vesper Sparrow	Potential extirpation	Improving*
Lark Sparrow	Potential colonization	Potential colonization
Savannah Sparrow	-	Improving
Grasshopper Sparrow	Potential extirpation	Potential colonization
Henslow's Sparrow	-	Potential colonization
LeConte's Sparrow	-	Improving*
Seaside Sparrow	Stable^	Stable^
Fox Sparrow	-	Improving
Song Sparrow	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Improving
Harris's Sparrow	-	Potential colonization
White-crowned Sparrow	-	Improving
Dark-eyed Junco	-	Worsening
Summer Tanager	Stable	-
Scarlet Tanager	Potential extirpation	-
Western Tanager	-	Stable
Northern Cardinal	Improving	Improving
Blue Grosbeak	Worsening	-
Indigo Bunting	Stable	-
Dickcissel	Stable	-
Bobolink	Stable	-
Red-winged Blackbird	Stable	Improving
Eastern Meadowlark	Stable	Stable
Rusty Blackbird	-	Stable
Common Grackle	Worsening	Improving
Boat-tailed Grackle	Stable^	Potential extirpation^
Great-tailed Grackle	Potential colonization	Potential colonization
Bronzed Cowbird	Potential colonization	Potential colonization
Brown-headed Cowbird	Worsening	Improving
Orchard Oriole	Stable	-
Baltimore Oriole	Potential extirpation	x
House Finch	Potential extirpation	Potential extirpation
Purple Finch	-	Stable
Pine Siskin	-	Improving
American Goldfinch	Potential extirpation	Stable

Common Name	Summer Trend	Winter Trend
Evening Grosbeak	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
House Sparrow	x	Potential extirpation