



Castillo de San Marcos National Monument

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 Castillo de San Marcos National Monument (hereafter, the Monument) 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 Monument, 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 Monument today, climate suitability in summer under the high-emissions pathway is projected to improve for 10 (e.g., Figure 2), remain stable for 17, and worsen for 23 species. Suitable climate ceases to occur for 8 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 17 species not found at the Monument today, potentially resulting in local colonization. Climate suitability in winter under the high-emissions pathway is projected to improve for 31, remain stable for 42, and worsen for 50 species. Suitable climate ceases to occur for 16 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 38 species not found at the

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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data (2016), plus those species for which climate at the Monument 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.

Monument today, potentially resulting in local colonization.

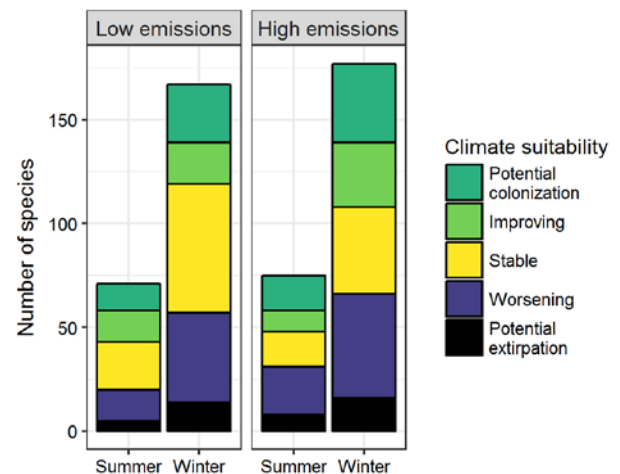


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

Results (continued)

Potential Turnover Index

Potential bird species turnover for the Monument between the present and 2050 is 0.15 in summer (22nd percentile across all national parks) and 0.13 in winter (14th percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.10 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 Monument is or may become home to 30 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).

Management Implications

Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Castillo de San Marcos National Monument falls within the low change group.** Parks anticipating low change can best support landscape-scale bird conservation by emphasizing habitat restoration, maintaining natural disturbance regimes, and reducing

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

While the Monument may serve as an important refuge for 25 of these climate-sensitive species, 5 might be extirpated from the Monument in at least one season by 2050.



Figure 2. Climate at the Monument 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).

other stressors. Furthermore, park managers have an opportunity to focus on supporting the 25 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.

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 Monument based on both NPS Inventory & Monitoring Program data and eBird observation data, plus those species for which climate at the Monument 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
Muscovy Duck	-	Improving*
Gadwall	-	Potential colonization
American Wigeon	-	Improving*
Mallard	Stable^	Stable
Blue-winged Teal	-	Improving
Cinnamon Teal	-	Potential colonization
Northern Shoveler	-	Potential colonization
Canvasback	-	Potential colonization
Ring-necked Duck	-	Improving
Greater Scaup	-	Potential extirpation^
Lesser Scaup	-	Stable
Black Scoter	-	Worsening
Long-tailed Duck	-	Improving
Bufflehead	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Hooded Merganser	-	Potential extirpation^
Red-breasted Merganser	-	Potential extirpation^
Ruddy Duck	-	Improving
Plain Chachalaca	-	Potential colonization
Red-throated Loon	-	Potential extirpation
Common Loon	-	Worsening*^
Pied-billed Grebe	-	Stable
Horned Grebe	-	Worsening
Wood Stork	Stable	Stable
Northern Gannet	-	Worsening*^
Double-crested Cormorant	x	Worsening
Anhinga	Improving*^	Improving
American White Pelican	x	Improving*
Brown Pelican	Worsening	Worsening^
Great Blue Heron	Worsening	Stable

Common Name	Summer Trend	Winter Trend
Great Egret	Worsening	Improving
Snowy Egret	x	Stable
Little Blue Heron	Stable	Worsening
Tricolored Heron	Worsening*^	Worsening
Reddish Egret	x	Stable
Cattle Egret	Stable	Improving*
Green Heron	Worsening	Worsening
Black-crowned Night-Heron	x	Stable
Yellow-crowned Night-Heron	Worsening	Worsening
White Ibis	Stable	Stable
Glossy Ibis	-	Improving
Roseate Spoonbill	x	Stable
Black Vulture	Worsening	Stable
Turkey Vulture	x	Improving
Osprey	x	Improving
Swallow-tailed Kite	Worsening	-
Northern Harrier	-	Improving
Sharp-shinned Hawk	-	Stable
Cooper's Hawk	x	Stable
Bald Eagle	x	Potential extirpation
Harris's Hawk	-	Potential colonization
Red-shouldered Hawk	Worsening	Improving
Short-tailed Hawk	-	Potential colonization
Red-tailed Hawk	Potential extirpation	Stable
Ferruginous Hawk	-	Potential colonization
Clapper Rail	x	Worsening*
Common Gallinule	-	Improving
American Coot	-	Stable
American Oystercatcher	x	Worsening*^
Black-bellied Plover	x	Worsening*
Wilson's Plover	x	Improving

Common Name	Summer Trend	Winter Trend
Semipalmated Plover	Stable	Worsening*^
Piping Plover	-	Worsening^
Killdeer	Improving	Stable
Spotted Sandpiper	-	Stable
Greater Yellowlegs	-	Stable
Willet	Stable^	Worsening*^
Whimbrel	-	Worsening
Marbled Godwit	Improving^	-
Ruddy Turnstone	x	Worsening*^
Sanderling	x	Worsening*
Dunlin	-	Worsening^
Least Sandpiper	-	Stable
Western Sandpiper	-	Stable
Short-billed Dowitcher	-	Worsening^
Long-billed Dowitcher	-	Improving*
Wilson's Snipe	-	Stable
Bonaparte's Gull	-	Potential extirpation
Laughing Gull	Worsening^	Stable
Ring-billed Gull	Potential extirpation^	Worsening
Yellow-footed Gull	-	Potential colonization
Herring Gull	-	Potential extirpation^
Great Black-backed Gull	-	Worsening*
Caspian Tern	x	Worsening
Forster's Tern	-	Worsening
Royal Tern	x	Worsening^
Sandwich Tern	x	Worsening^
Black Skimmer	x	Worsening*^
Rock Pigeon	Improving*	Improving
Eurasian Collared-Dove	x	Stable
White-winged Dove	Stable	Improving*
Mourning Dove	Stable	Improving

Common Name	Summer Trend	Winter Trend
Inca Dove	-	Potential colonization
Common Ground-Dove	Improving*	Improving
Greater Roadrunner	Potential colonization	Potential colonization
Great Horned Owl	x	Potential extirpation
Burrowing Owl	Potential colonization ^	Potential colonization
Lesser Nighthawk	Potential colonization	-
Chimney Swift	Worsening	-
Ruby-throated Hummingbird	Potential colonization	x
Belted Kingfisher	Improving	Worsening
Red-headed Woodpecker	-	Worsening
Golden-fronted Woodpecker	Potential colonization	-
Red-bellied Woodpecker	Stable	Worsening
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	-	Potential colonization
Downy Woodpecker	Potential extirpation	Potential extirpation
American Three-toed Woodpecker	-	Potential colonization ^
Northern Flicker	-	Potential extirpation
Pileated Woodpecker	Worsening	Stable
American Kestrel	-	Stable
Merlin	-	Stable ^
Peregrine Falcon	-	Improving
Northern Beardless-Tyrannulet	Potential colonization	-
Dusky Flycatcher	-	Potential colonization
Eastern Phoebe	-	Improving
Great Crested Flycatcher	Worsening	Potential colonization

Common Name	Summer Trend	Winter Trend
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	-	Potential colonization
Eastern Kingbird	Stable	-
Scissor-tailed Flycatcher	Potential colonization	-
Loggerhead Shrike	Worsening	Improving
White-eyed Vireo	-	Stable
Green Jay	-	Potential colonization
Blue Jay	Worsening	Potential extirpation
American Crow	Potential extirpation	Potential extirpation
Fish Crow	Worsening	Worsening
Chihuahuan Raven	Potential colonization	-
Northern Rough-winged Swallow	Improving	-
Purple Martin	Worsening	-
Tree Swallow	-	Stable
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Carolina Chickadee	Worsening*	Worsening*
Tufted Titmouse	Worsening*	Improving
Brown-headed Nuthatch	-	Worsening
Rock Wren	-	Potential colonization
House Wren	-	Worsening
Sedge Wren	-	Worsening
Carolina Wren	Stable	Worsening
Cactus Wren	-	Potential colonization
Blue-gray Gnatcatcher	Improving	Worsening
Black-tailed Gnatcatcher	Potential colonization	Potential colonization
Ruby-crowned Kinglet	-	Worsening

Common Name	Summer Trend	Winter Trend
Eastern Bluebird	Stable	Worsening
American Robin	Improving	Potential extirpation
Gray Catbird	-	Worsening
Curve-billed Thrasher	-	Potential colonization
Brown Thrasher	Potential extirpation	Worsening
Bendire's Thrasher	-	Potential colonization
Sage Thrasher	-	Potential colonization
Northern Mockingbird	Stable	Stable
European Starling	Stable	Improving
American Pipit	-	Improving*
Cedar Waxwing	-	Stable
Worm-eating Warbler	Potential colonization	-
Black-and-white Warbler	-	Worsening
Orange-crowned Warbler	-	Stable
Kentucky Warbler	Potential colonization	-
Common Yellowthroat	-	Stable
Hooded Warbler	Potential colonization	-
Northern Parula	Worsening	Improving
Palm Warbler	-	Stable^
Pine Warbler	-	Worsening
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	-	Stable
Prairie Warbler	Potential colonization	-
Black-throated Gray Warbler	-	Potential colonization
Hermit Warbler	-	Potential colonization^
Olive Sparrow	-	Potential colonization
Eastern Towhee	Worsening*	x

Common Name	Summer Trend	Winter Trend
Rufous-winged Sparrow	-	Potential colonization
Cassin's Sparrow	Potential colonization	-
Chipping Sparrow	-	Worsening
Field Sparrow	-	Stable
Lark Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Stable
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Worsening^
Song Sparrow	-	Potential extirpation
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Worsening
Dark-eyed Junco	-	Stable
Northern Cardinal	Stable	Stable
Painted Bunting	-	Improving
Dickcissel	Potential colonization	-
Red-winged Blackbird	Improving*	Stable
Western Meadowlark	-	Potential colonization
Rusty Blackbird	-	Potential colonization
Brewer's Blackbird	-	Potential colonization
Common Grackle	Worsening*	Worsening
Boat-tailed Grackle	Worsening*^	Worsening*^
Great-tailed Grackle	-	Potential colonization
Brown-headed Cowbird	Potential extirpation	Improving
Orchard Oriole	Potential extirpation	-
Hooded Oriole	Potential colonization	-

Common Name	Summer Trend	Winter Trend
Altamira Oriole	-	Potential colonization
House Finch	Potential extirpation	Potential extirpation

Common Name	Summer Trend	Winter Trend
American Goldfinch	-	Worsening
House Sparrow	x	Stable