



## Fort Pulaski 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 Fort Pulaski 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 11, remain stable for 25 (e.g., Figure 2), and worsen for 23 species. Suitable climate ceases to occur for 10 species in summer, potentially resulting in extirpation of those species from the Monument. Climate is projected to become suitable in summer for 20 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 23, remain stable for 55, and worsen for 46 species. Suitable climate ceases to occur for 21 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 45 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.

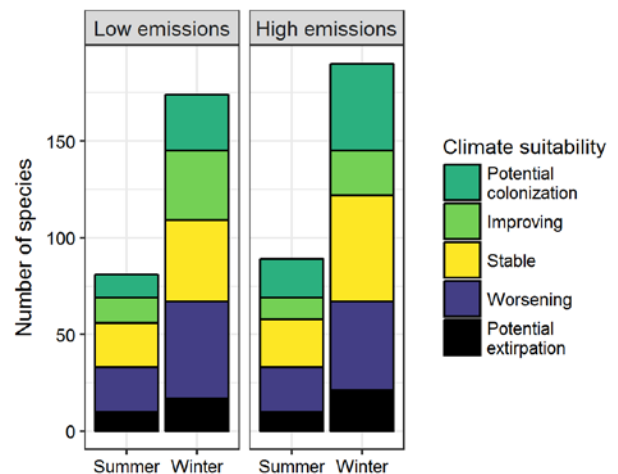


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Monument between the present and 2050 is 0.18 in summer (26<sup>th</sup> percentile across all national parks) and 0.15 in winter (17<sup>th</sup> percentile) under the high-emissions pathway. Potential species turnover declines to 0.12 in summer and 0.11 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 32 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

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Parks differ in potential colonization and extirpation rates, and therefore different climate change adaptation strategies may apply. **Under the high-emissions pathway, Fort Pulaski 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 other stressors.

### Caveats

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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 28 of these climate-sensitive species, 4 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 Northern Cardinal (*Cardinalis cardinalis*) through 2050.** Photo by Andy Morffew/Flickr (CC BY 2.0).

Furthermore, park managers have an opportunity to focus on supporting the 28 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 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
Black-bellied Whistling-Duck	Improving*	-
Wood Duck	x	Worsening
Gadwall	-	Improving*
American Wigeon	-	Worsening
Mallard	-	Potential extirpation
Mottled Duck	Potential colonization	-
Cinnamon Teal	-	Potential colonization
Canvasback	-	Improving*
Ring-necked Duck	-	Stable
Greater Scaup	-	Worsening <sup>^</sup>
Lesser Scaup	-	Improving
Surf Scoter	-	Potential extirpation
White-winged Scoter	-	Potential extirpation

Common Name	Summer Trend	Winter Trend
Black Scoter	-	Potential extirpation
Bufflehead	-	Potential extirpation
Common Goldeneye	-	Stable
Hooded Merganser	x	Potential extirpation <sup>^</sup>
Red-breasted Merganser	-	Worsening* <sup>^</sup>
Ruddy Duck	-	Stable
Plain Chachalaca	-	Potential colonization
Scaled Quail	Potential colonization	Potential colonization
Northern Bobwhite	Improving*	Improving*
Red-throated Loon	-	Potential extirpation
Common Loon	-	Worsening <sup>^</sup>
Least Grebe	-	Potential colonization
Pied-billed Grebe	-	Stable

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Horned Grebe	-	Worsening
Wood Stork	Worsening	Potential extirpation
Northern Gannet	Stable^	Worsening^
Double-crested Cormorant	x	Stable
Anhinga	Improving^	Stable
American White Pelican	x	Improving*
Brown Pelican	Stable	Stable^
Least Bittern	-	Potential colonization
Great Blue Heron	Stable	Stable
Great Egret	Improving	Improving
Snowy Egret	x	Improving
Little Blue Heron	Improving*	Worsening
Tricolored Heron	Improving^	Worsening*
Reddish Egret	x	Potential colonization
Cattle Egret	Stable	Improving*
Green Heron	Improving*	Worsening
Black-crowned Night-Heron	-	Stable
Yellow-crowned Night-Heron	Stable	Worsening
White Ibis	Stable	Stable
Glossy Ibis	-	Worsening
White-faced Ibis	-	Potential colonization^
Black Vulture	Worsening	Stable
Turkey Vulture	x	Improving
Osprey	x	Worsening
White-tailed Kite	-	Potential colonization
Swallow-tailed Kite	Worsening	-
Mississippi Kite	Worsening	-
Northern Harrier	-	Stable
Sharp-shinned Hawk	-	Potential extirpation
Cooper's Hawk	-	Stable

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Bald Eagle	-	Potential extirpation
Harris's Hawk	Potential colonization	Potential colonization
White-tailed Hawk	-	Potential colonization
Red-shouldered Hawk	-	Improving
Red-tailed Hawk	Potential extirpation	Stable
Ferruginous Hawk	-	Potential colonization
Clapper Rail	x	Worsening*
Virginia Rail	-	Stable
Sora	-	Stable
American Coot	-	Stable
Limpkin	-	Potential colonization
American Oystercatcher	x	Worsening**^
Black-bellied Plover	-	Worsening*
Snowy Plover	-	Stable
Wilson's Plover	x	Stable
Semipalmated Plover	-	Worsening**^
Piping Plover	-	Worsening^
Killdeer	Improving	Improving
Spotted Sandpiper	-	Improving*
Greater Yellowlegs	Stable	Worsening
Willet	Stable^	Worsening**^
Lesser Yellowlegs	-	Stable
Marbled Godwit	Stable^	Worsening
Ruddy Turnstone	x	Worsening^
Red Knot	-	Stable^
Sanderling	x	Stable
Dunlin	-	Worsening^
Purple Sandpiper	-	Worsening
Least Sandpiper	-	Stable
Western Sandpiper	-	Worsening
Short-billed Dowitcher	x	Worsening^

Common Name	Summer Trend	Winter Trend
Wilson's Snipe	-	Improving*
Bonaparte's Gull	-	Worsening*
Laughing Gull	Worsening*^	Stable
Ring-billed Gull	Potential extirpation^	Worsening
Yellow-footed Gull	-	Potential colonization
Herring Gull	Stable	Worsening^
Great Black-backed Gull	-	Potential extirpation
Caspian Tern	x	Stable
Black Tern	Stable	-
Forster's Tern	x	Worsening
Royal Tern	x	Stable^
Black Skimmer	x	Stable^
Rock Pigeon	Improving*	Improving
Eurasian Collared-Dove	-	Improving
White-winged Dove	Potential colonization	-
Mourning Dove	Stable	Stable
White-tipped Dove	-	Potential colonization
Yellow-billed Cuckoo	Stable	-
Great Horned Owl	-	Potential extirpation
Snowy Owl	-	Stable
Lesser Nighthawk	Potential colonization	Potential colonization
Common Pauraque	-	Potential colonization
Chimney Swift	Stable	-
Ringed Kingfisher	-	Potential colonization
Belted Kingfisher	Potential extirpation	Worsening
Red-bellied Woodpecker	Worsening	Worsening
Yellow-bellied Sapsucker	-	Stable
Ladder-backed Woodpecker	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Downy Woodpecker	Worsening	Potential extirpation
Northern Flicker	Stable	Potential extirpation
Gilded Flicker	Potential colonization	Potential colonization
Pileated Woodpecker	-	Worsening
American Kestrel	x	Stable
Merlin	-	Potential extirpation^
Peregrine Falcon	-	Improving*
Northern Beardless-Tyrannulet	Potential colonization	-
Eastern Phoebe	-	Improving
Say's Phoebe	-	Potential colonization
Great Crested Flycatcher	Potential extirpation	Potential colonization
Brown-crested Flycatcher	Potential colonization	-
Great Kiskadee	Potential colonization	Potential colonization
Couch's Kingbird	Potential colonization	Potential colonization
Western Kingbird	Potential colonization	x
Eastern Kingbird	Worsening	-
Loggerhead Shrike	Improving*	Improving
White-eyed Vireo	Worsening	Stable
Red-eyed Vireo	Potential extirpation	-
Green Jay	Potential colonization	Potential colonization
Blue Jay	Worsening	Worsening
American Crow	Worsening	Potential extirpation
Fish Crow	Worsening*	Worsening*
Chihuahuan Raven	Potential colonization	Potential colonization
Northern Rough-winged Swallow	Stable	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Purple Martin	Worsening	x
Tree Swallow	-	Worsening*
Violet-green Swallow	-	Potential colonization
Barn Swallow	Stable	-
Carolina Chickadee	Worsening*	Stable
Tufted Titmouse	Worsening	Stable
Verdin	Potential colonization	Potential colonization
White-breasted Nuthatch	-	Potential extirpation
Brown-headed Nuthatch	Worsening^	Worsening*
Brown Creeper	-	Stable
House Wren	-	Stable
Sedge Wren	-	Stable
Marsh Wren	x	Worsening
Carolina Wren	Worsening	Stable
Bewick's Wren	-	Potential colonization
Cactus Wren	Potential colonization	Potential colonization
Blue-gray Gnatcatcher	Stable	Stable
Black-tailed Gnatcatcher	-	Potential colonization
Golden-crowned Kinglet	-	Stable
Ruby-crowned Kinglet	-	Stable
Eastern Bluebird	Worsening	Worsening
Hermit Thrush	-	Stable
American Robin	Stable	Potential extirpation
Gray Catbird	Potential extirpation	Worsening
Curve-billed Thrasher	Potential colonization	Potential colonization
Brown Thrasher	Potential extirpation	Stable
Long-billed Thrasher	Potential colonization^	Potential colonization
Northern Mockingbird	Stable	Improving

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
European Starling	Improving	Improving
American Pipit	-	Improving*
Cedar Waxwing	-	Potential extirpation
Smith's Longspur	-	Potential colonization
Ovenbird	-	Potential colonization
Black-and-white Warbler	-	Worsening*
Orange-crowned Warbler	-	Improving
Common Yellowthroat	-	Stable
Northern Parula	Worsening	-
Palm Warbler	-	Stable^
Pine Warbler	Potential extirpation^	Stable
Yellow-rumped Warbler	-	Stable
Yellow-throated Warbler	Worsening*	-
Prairie Warbler	Stable	-
Black-throated Gray Warbler	-	Potential colonization
Hermit Warbler	-	Potential colonization^
Olive Sparrow	-	Potential colonization
Green-tailed Towhee	-	Potential colonization
Cassin's Sparrow	Potential colonization	Potential colonization
Chipping Sparrow	-	Stable
Lark Sparrow	-	Potential colonization
Black-throated Sparrow	-	Potential colonization
Lark Bunting	-	Potential colonization
Savannah Sparrow	-	Stable
Nelson's/Saltmarsh Sparrow (Sharp-tailed Sparrow)	-	Worsening^
Seaside Sparrow	-	Worsening^

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Song Sparrow	-	Potential extirpation
Lincoln's Sparrow	-	Potential colonization
Swamp Sparrow	-	Stable
White-throated Sparrow	-	Worsening
Northern Cardinal	Stable	Stable
Indigo Bunting	Potential extirpation	-
Painted Bunting	Stable	-
Red-winged Blackbird	Stable	Stable
Eastern Meadowlark	-	Stable
Western Meadowlark	-	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Common Grackle	Worsening	Worsening
Boat-tailed Grackle	Worsening^	Worsening*^
Bronzed Cowbird	Potential colonization	-
Brown-headed Cowbird	Stable	Improving
Orchard Oriole	Worsening*	-
Hooded Oriole	Potential colonization	-
Altamira Oriole	-	Potential colonization
House Finch	Potential extirpation	Potential extirpation
American Goldfinch	-	Stable
House Sparrow	x	Stable