



## Casa Grande Ruins 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 Casa Grande Ruins 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 climate suitability projected to improve for some species and worsen for others (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 8 (e.g., Figure 2), remain stable for 10, and worsen for 4 species. Suitable climate does not cease to occur for any species in summer. Climate is projected to become suitable in summer for 16 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 9, remain stable for 9, and worsen for 15 species. Suitable climate ceases to occur for 2 species in winter, potentially resulting in extirpation from the Monument. Climate is projected to become suitable in winter for 55 species not found at the Monument 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 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.

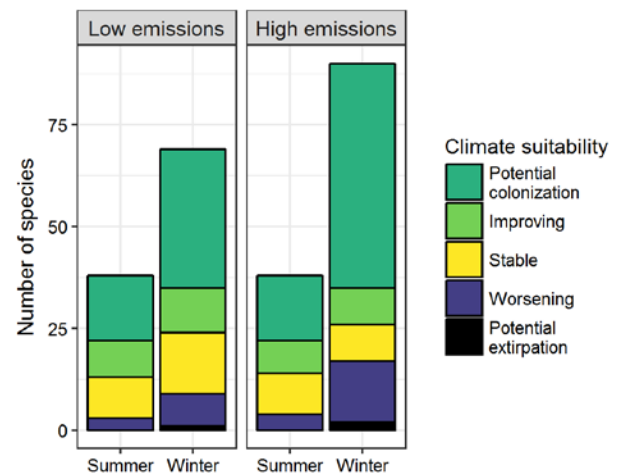


Figure 1. Projected changes in climate suitability for birds at the Monument, by emissions pathway and season.

## Results (continued)

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### Potential Turnover Index

**Potential bird species turnover for the Monument between the present and 2050 is 0.12 in summer (16<sup>th</sup> percentile across all national parks) and 0.17 in winter (21<sup>st</sup> percentile) under the high-emissions pathway. Potential species turnover remains 0.12 in summer and declines to 0.12 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 18 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, Casa Grande Ruins 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

Suitable climate is not projected to disappear for these 18 species at the Monument; instead the Monument may serve as an important refuge for these climate-sensitive species.



**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 18 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

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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
Muscovy Duck	-	Potential colonization
Wood Duck	-	Potential colonization
Mallard	Potential colonization <sup>^</sup>	-
Redhead	Potential colonization <sup>^</sup>	-
Long-tailed Duck	-	Potential colonization
Bufflehead	-	Potential colonization
Barrow's Goldeneye	-	Potential colonization <sup>^</sup>
Hooded Merganser	-	Potential colonization <sup>^</sup>
Red-breasted Merganser	-	Potential colonization <sup>^</sup>
Gambel's Quail	Stable	Worsening
Pacific Loon	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Horned Grebe	-	Potential colonization
Wood Stork	-	Potential colonization
Magnificent Frigatebird	-	Potential colonization
Double-crested Cormorant	-	Potential colonization
Great Blue Heron	Potential colonization	-
Tricolored Heron	-	Potential colonization
Green Heron	Potential colonization	-
Yellow-crowned Night-Heron	-	Potential colonization
White Ibis	-	Potential colonization
Turkey Vulture	x	Improving*
Northern Harrier	-	Stable
Swainson's Hawk	Potential colonization <sup>^</sup>	-

Common Name	Summer Trend	Winter Trend
Red-tailed Hawk	Improving	Worsening
Limpkin	-	Potential colonization
American Oystercatcher	-	Potential colonization ^
Black-bellied Plover	-	Potential colonization
Wilson's Plover	-	Potential colonization
Semipalmated Plover	-	Potential colonization ^
Killdeer	Potential colonization	-
Mountain Plover	Potential colonization	-
Wandering Tattler	-	Potential colonization
Willet	-	Potential colonization ^
Whimbrel	-	Potential colonization
Marbled Godwit	-	Potential colonization
Ruddy Turnstone	-	Potential colonization ^
Red Knot	-	Potential colonization ^
Sanderling	-	Potential colonization
Short-billed Dowitcher	-	Potential colonization ^
Bonaparte's Gull	-	Potential colonization
Laughing Gull	-	Potential colonization
Heermann's Gull	-	Potential colonization
Mew Gull	-	Potential colonization
Western Gull	-	Potential colonization ^
Iceland Gull (Thayer's)	-	Potential colonization

Common Name	Summer Trend	Winter Trend
Glaucous-winged Gull	-	Potential colonization
Forster's Tern	-	Potential colonization
Royal Tern	-	Potential colonization ^
Black Skimmer	-	Potential colonization ^
Rock Pigeon	Improving	Improving
White-crowned Pigeon	Potential colonization	-
Eurasian Collared-Dove	x	Improving
White-winged Dove	Stable	-
Mourning Dove	Worsening	Improving
Inca Dove	-	Worsening
Greater Roadrunner	-	Worsening*
Barn Owl	-	Potential colonization
Great Horned Owl	-	Potential extirpation
Burrowing Owl	Improving ^	Stable
Anna's Hummingbird	Improving	Improving
Costa's Hummingbird	Stable	-
Allen's Hummingbird	-	Potential colonization
Gila Woodpecker	Worsening*	Stable
Arizona Woodpecker	-	Potential colonization
Gilded Flicker	Worsening*	Stable
American Kestrel	-	Worsening
Prairie Falcon	-	Stable
Say's Phoebe	-	Worsening
Ash-throated Flycatcher	Stable	x
Great Crested Flycatcher	-	Potential colonization
Loggerhead Shrike	-	Worsening
Black-whiskered Vireo	Potential colonization	-

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Clark's Nutcracker	-	Potential colonization
Common Raven	Stable	Potential extirpation
Horned Lark	Potential colonization	-
Verdin	Stable	Stable
Bushtit	-	Potential colonization
Pygmy Nuthatch	-	Potential colonization^
Rock Wren	-	Worsening
Cactus Wren	Stable	Worsening*
California Gnatcatcher	-	Potential colonization
Townsend's Solitaire	-	Potential colonization
Gray Catbird	-	Potential colonization
Northern Mockingbird	Stable	Worsening*
European Starling	Stable	Improving
Ovenbird	-	Potential colonization
Orange-crowned Warbler	-	Stable
Common Yellowthroat	Potential colonization	-
Yellow-rumped Warbler	Stable	Worsening*
Townsend's Warbler	-	Potential colonization

<b>Common Name</b>	<b>Summer Trend</b>	<b>Winter Trend</b>
Hermit Warbler	-	Potential colonization^
California Towhee	-	Potential colonization
Rufous-winged Sparrow	Potential colonization	-
Brewer's Sparrow	-	Stable
Lark Sparrow	Potential colonization	-
Lark Bunting	-	Improving*
Song Sparrow	Potential colonization	-
Swamp Sparrow	-	Potential colonization
White-crowned Sparrow	-	Worsening
Painted Bunting	-	Potential colonization
Red-winged Blackbird	Improving	Worsening
Tricolored Blackbird	Potential colonization	-
Western Meadowlark	Potential colonization	-
Brewer's Blackbird	-	Improving
Great-tailed Grackle	Improving*	Improving
Brown-headed Cowbird	Improving	-
Altamira Oriole	-	Potential colonization
House Finch	Worsening*	Worsening
Lesser Goldfinch	Improving*	Worsening*
House Sparrow	x	Stable