

# Extreme environmental conditions lead to a collapsed avian soundscapes; an agent-based model

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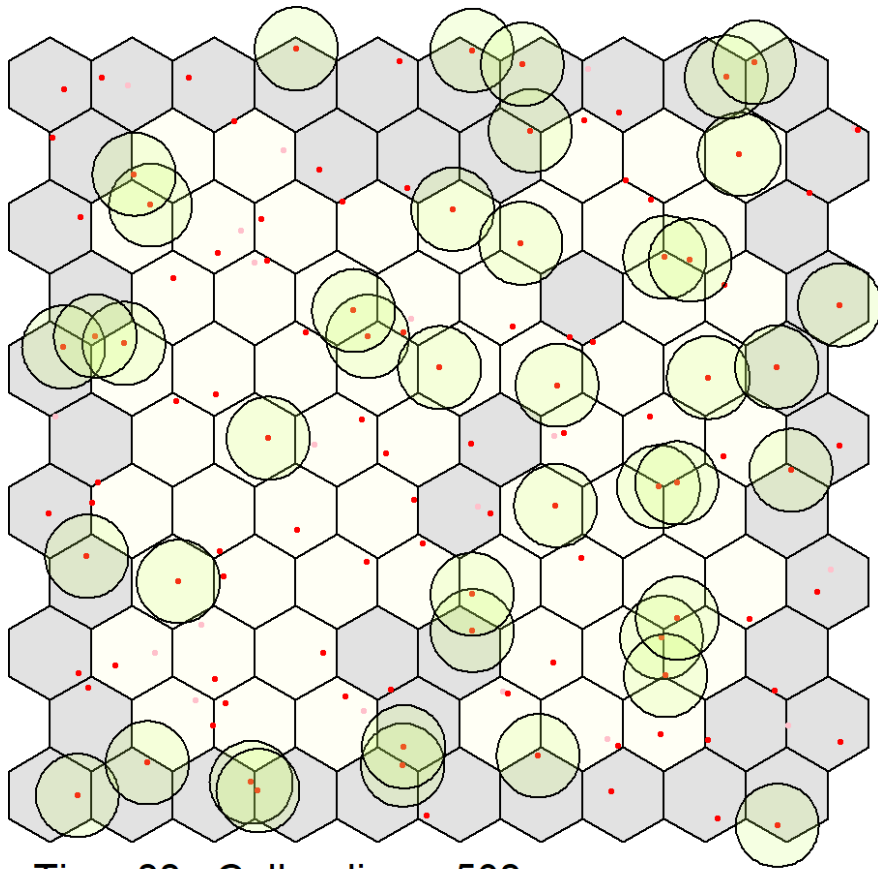
## Abstract

Climate change is increasing aridity in grassland and desert habitats across the southwestern United States, reducing available resources and drastically changing the breeding habitat of many bird species. Increases in aridity reduce sound propagation distances, potentially impacting habitat soundscapes, and leading to a breakdown of the avian soundscapes in the form of loss of vocal culture, reduced mating opportunities, and local population extinctions. We developed an agent-based model to examine how changes in aridity will affect both sound propagation and the ability of territorial birds to audibly contact their neighbors. We simulated vocal signal attenuation under a variety of environmental scenarios for the south central semi-arid prairies of the United States, ranging from contemporary weather conditions to predicted extremes under climate change. We also simulated how changes in physiological conditions, mainly evaporative water loss (EWL), would affect singing behavior. Under extreme climate change conditions, we found significantly fewer individuals successfully contacted all adjacent neighbors than did individuals in either the contemporary or mean climate change conditions. We also found that at higher sound frequencies and higher EWL, fewer individuals were able to successfully contact all of their neighbors, particularly in the extreme and extreme climate change conditions. These results indicate that climate change-mediated aridification may disrupt the avian soundscape, such that vocal communication no longer effectively functions for mate attraction or territorial defense. As climate change progresses increased aridity in current grasslands may favor shifts toward low frequency songs, colonial resource use, and altered songbird community compositions.

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Question	Variable	Value	Predictions
How do different climate scenarios...	Climate conditions (TAIR and RELH)		Drought conditions will lead to reduced contact rates
...physiology	Evaporative water loss (EWL)		EWL inclusion will lead to reduced contact rates
...species mean song frequency	Frequencies (kHz)	4, 8, 12	Higher freq. will have lower contact rates
...territory size	Hexagon size (km)		Lower contact rate as territory size increases



Time 88 Call radius = 508

