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Climate Change Impacts on Bird Communities Vary Throughout Cities in Kansas

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Introduction

It is important to study climate change's impacts on biodiversity in order to find a solution before the effects on wildlife are irreversible.

According to the New York Times, the previous five years were the warmest years in recorded history. Eighteen of the nineteen warmest years have occurred since 2001.

Along with climate change, urbanization has altered wildlife distributions and community dynamics. The greatest diversity of wildlife usually occurs in moderate levels of urbanization, while urban communities are often less species rich.

One strong abiotic trend seen in cities is the urban heat island effect. On average, cities are 1-3°C warmer than nearby rural areas due to more reflective and dark surfaces (e.g. asphalt), less vegetation, and less airflow.

Research Objective

Our research objective for this project was to determine if climate change affected long-term bird trends in urban and rural areas throughout Kansas.

Hypothesis: Climate change will decrease bird population abundance and species richness because altered climate patterns like storms, droughts, and heat waves may cause a decrease in suitable habitat. We would expect these trends to be strongest in cities, due to the urban heat island effect.

Methods

Data was downloaded from the Breeding Bird Survey (BBS). Across North America, data on breeding birds are collected annually in June with BBS volunteers since 1966. We used data collected from 1970 to 2015, specifically total abundance and species richness of the bird community in five cities (Table 1; Fig. 1).

Urbanization designations were taken from the 2010 US Census. Historical weather data was taken from Weather Underground. We used Pearson's correlation analysis to determine associations between average June temperature and bird abundance and richness for each site.

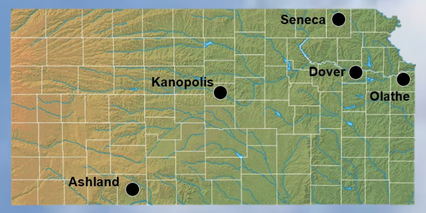

Figure 1. Study locations throughout Kansas. Cities were selected based on data availability and distribution across the state.

Table 1. Kansas cities and towns used for our study, in order of population size. Relationships between average June temperature and species richness and abundance are represented by Pearson's correlation statistic (r). R values < -0.5 and > 0.5 are considered strong associations between the two variables.

City	Urban or Rural	Population Size	Population Density	Temperature ~ Richness	Temperature ~ Abundance
Ashland	Rural	134	80 people/mi^2	-0.16	-0.29
Kanopolis	Rural	471	392 people/mi^2	0.36	0.70
Dover	Rural	1,556	27 people/mi^2	-0.17	-0.26
Seneca	Urban	2,048	1,256 people/mi^2	0.18	-0.26
Olathe	Urban	135,473	2,242 people/mi^2	-0.13	-0.23

Results

Across all study locations, average June temperatures varied from year to year. Overall, temperatures increased across our study period, but the increase was slight (r = 0.103). The largest temperature change was a 10 degree drop in 1981 to 1982. This is seen in the data in all cities.

Across study locations, bird communities had weak associations with average temperatures (Fig. 2). With increasing June temperatures, abundance increased (r = 0.16) and species richness decreased (r = -0.08), albeit weakly.

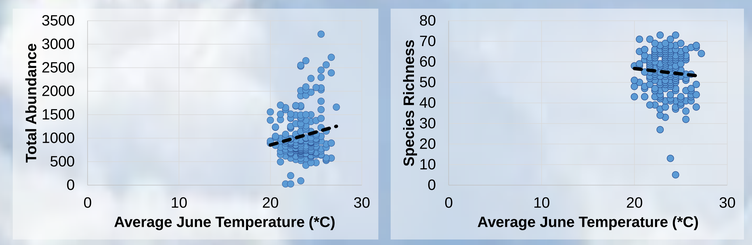

Figure 2. Total bird abundance and species richness was weakly correlated with average June temperatures across all five study sites.

Only one location had strong relationships between bird data and climate: Kanopolis, KS. Kanopolis' bird abundance (r = 0.70) and species richness (r = 0.36) was positively associated with annual temperatures (Fig. 3). Kanopolis was one of the rural locations (Table 1).

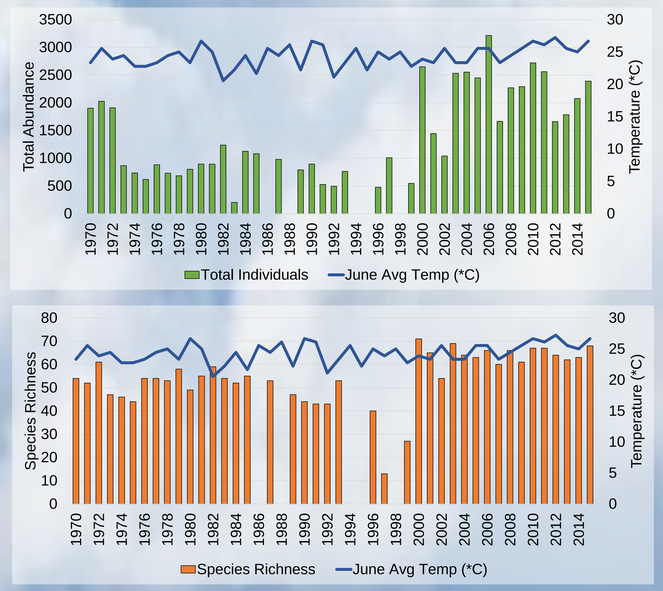

Figure 3. Total bird abundance (top) and species richness (bottom) was positively correlated with average June temperatures in Kanopolis from 1970 – 2015.

There was a greater species richness in cities such as Seneca and Dover compared to cities like Ashland. Bird communities in cities like Olathe and Kanopolis were more even in their species abundances (i.e. no one dominant species), compared to the other sites.

Results, Continued

Community composition was vastly different across the urban and rural sites. From 1970 to 2015, the house sparrow (*Passer domesticus*) was the dominant bird species for most years in Olathe and Seneca. In Ashland, the dominant species was the cliff swallow (*Petrochelidon pyrrhonota*). Kanopolis and Dover had very even communities, with the dickcissel (*Spiza americana*) slightly dominating both town's bird communities, Fig. 4 & 5).

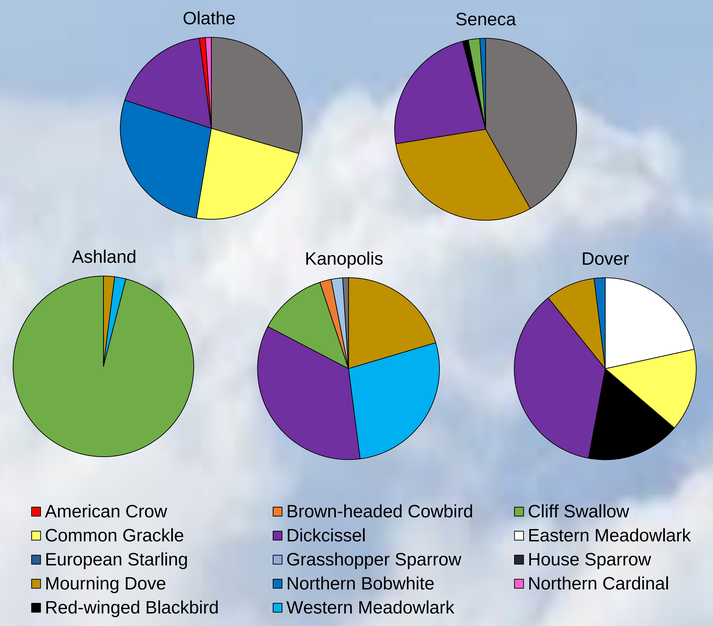

Figure 4. Dominant bird species for the 45 year study period across all study locations.

Figure 5. Dominant bird species from each city: house sparrow, cliff swallow, and dickcissel (L-R). Photos from Google Images.

Conclusions

Overall, temperature had a weak relationship with total individual birds observed and species richness. The only location in which these two variables were strongly associated was in a rural area, leading us to reject our hypothesis.

Climate change impacts may vary throughout different locations due to levels of urbanization, habitat availability, and other abiotic factors.

References

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