

Comparative analysis of squirrel behavior and habitat use in light of climate change

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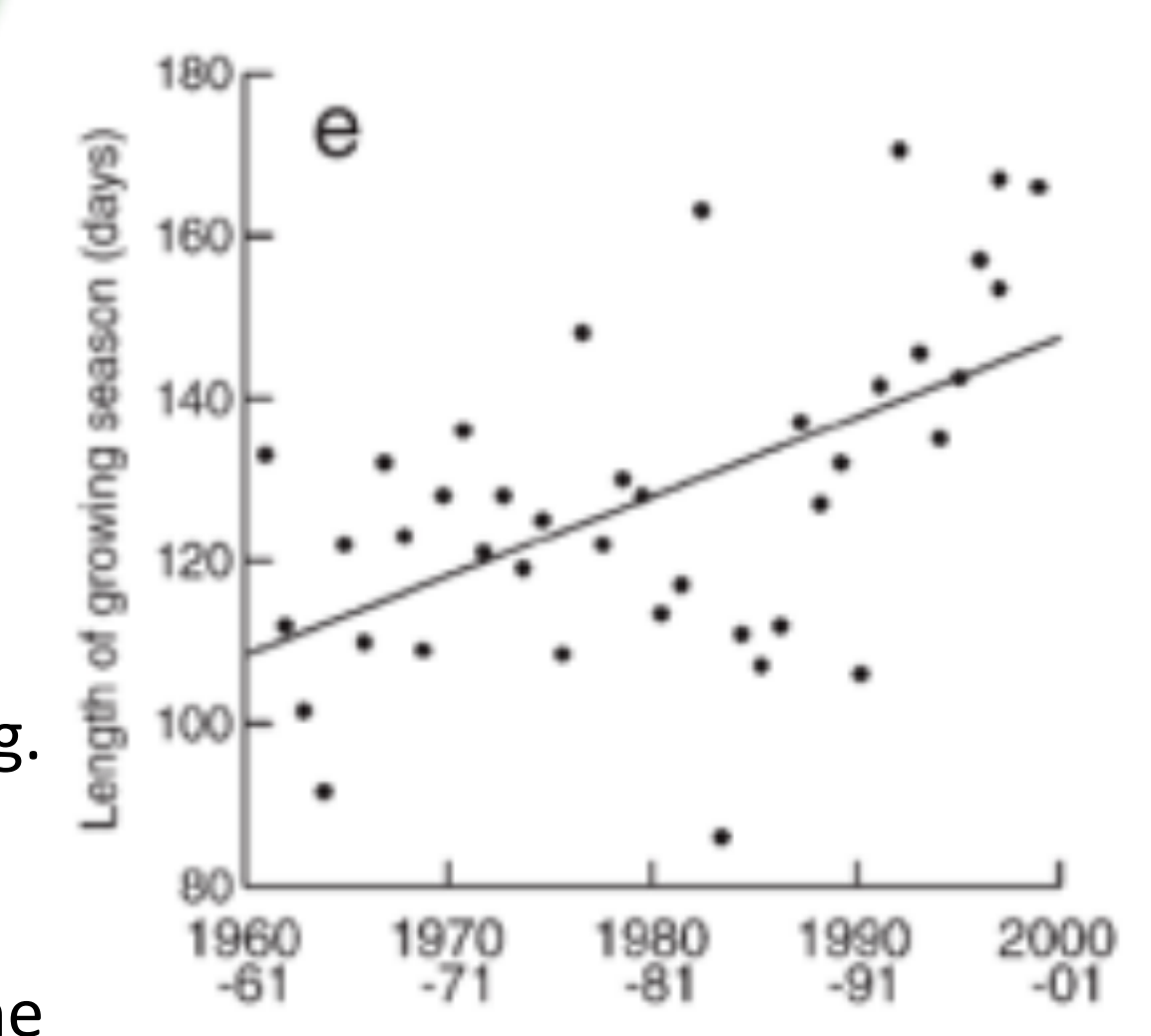
We're Nuts!

INTRODUCTION METHODS DISCUSSION

Eastern gray squirrels (*Sciurus carolinensis*) and American red squirrels (*Tamiasciurus hudsonicus*) are both evident members of the mammalian community, and have been successful in adapting to urban landscape. Though there have been numerous studies to examine climate change in the midwest¹, few have looked at the relationship between climate change and the effect it has on squirrels, specifically, squirrels in an urban setting. Both Eastern gray and American red squirrels often forage for food in the later summer and fall to be stored during the winter months. Gray squirrels are more likely to select for acorns, conifer seeds, developing flowers, and leaves while red squirrels primarily select for different species of coniferous cones⁴. Additionally, Gray squirrels exhibit a dominance hierarchy, most obvious near concentrated food sources¹. Red squirrels are known to be territorial¹. Red squirrels prefer coniferous trees and gray squirrels prefer deciduous trees⁶, both of which are pre-



ferred on Concordia's Campus. Minnesota is one of the fastest warming states with an increasing growing season^{7,8} (see Fig. 1). Temperature is expected to rise by 2.5 – 10°F (1.4 – 5.6°C) over the next century² which will likely impact squirrel behavior and habitat use. This project seeks to analyze different behaviors and differential habitat use of eastern gray squirrels and American red squirrels and how those behaviors change based on weather conditions.



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Part Two: Telemetry

Tracking was conducted to locate and identify behaviors of tagged squirrels. Location and behaviors (foraging, caching, and mating)

Figure 1. Change over time of growing season in northwestern Minnesota (Murray et al. 2006).



Hypothesis: Campus squirrels will climate continues to change (as measured through behavioral, habitat use, and temperature comparisons).

METHODS

Part One: Trapping.

Tomahawk live traps were set around various locations on Concordia's campus, and checked every 20 minutes. Peanut butter was used to lure the squirrels into the trap, and once in the trap, and cloth was placed over the top of the live trap to reduce stress. Once squirrels were cap-

tured and sex was identified, they were placed in a squirrel handling cone in order to be weighed, PIT tagged, and for a radio collar to be placed with a set of colored beads for identification purposes.

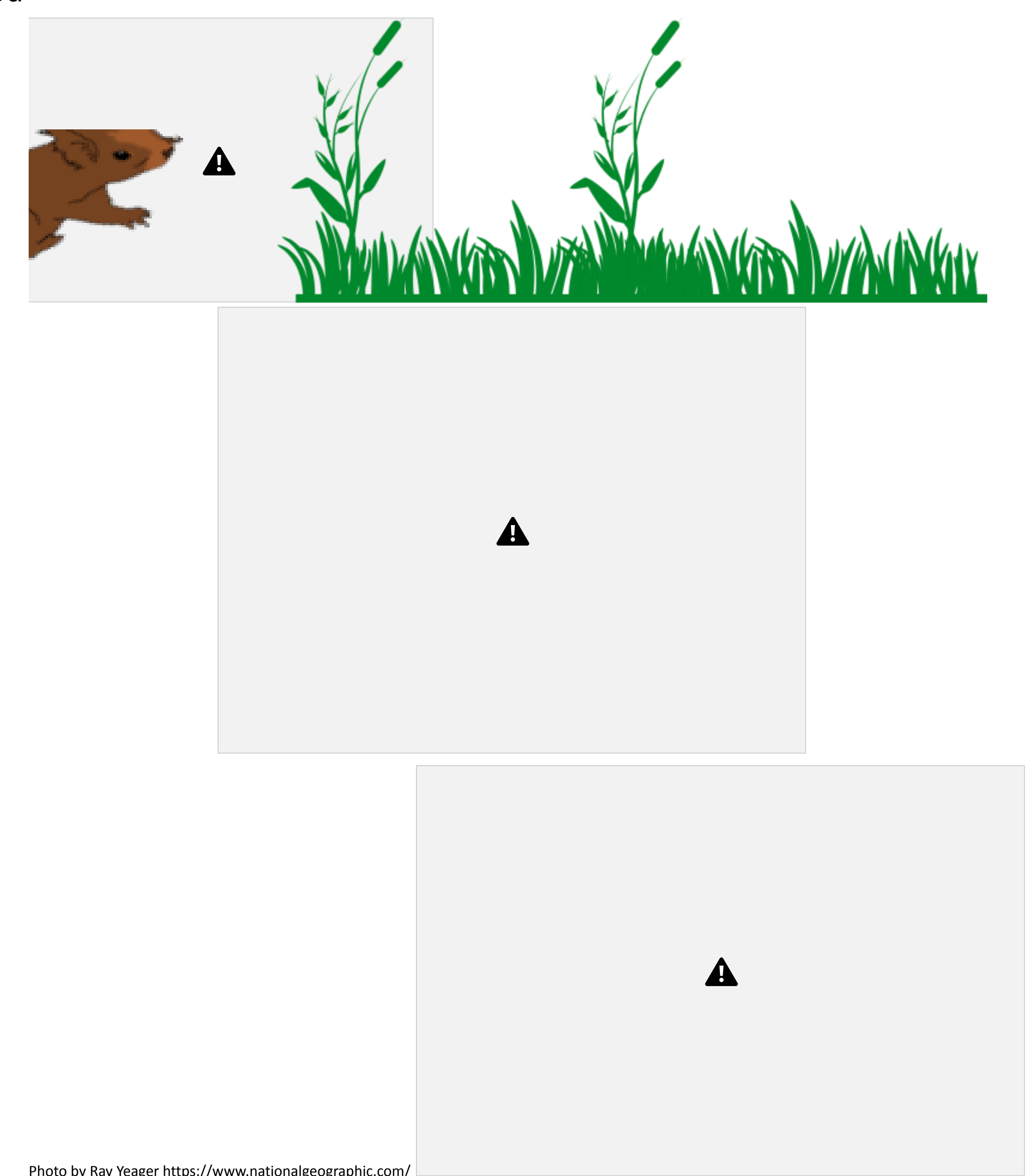
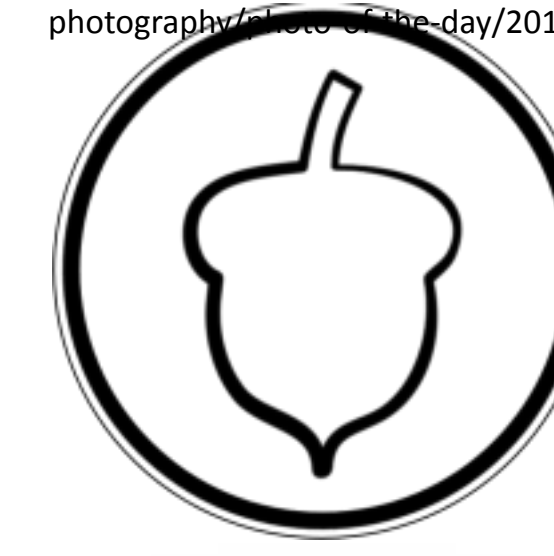


Photo by Ray Yeager <https://www.nationalgeographic.com/>

alter their behavior and space use as our

RESULTS CONCLUSION

photograph by <https://www.flickr.com/photos/2012/2/squirrel-snowstorm/>



82 total captured squirrels
748 observed locations

There is a consistent preference of squirrels to forage, cache, or mate at temperatures that are cooler (average around 50°F), as fewer active squirrels were observed at warmer temperatures (>90°F). Given that this experiment in a longitudinal study, examination of climate patterns in the Fargo/Moorhead area was also a key component. Though climate change can have numerous effects on weather, such as, precipitation, extreme lows and highs, and sea-level rise, this experiment focused on the aspect of an overall warming climate. With climate expected to rise by 2.5 – 10°F (1.4 – 5.6°C) over the next century, alterations in squirrels behavior will likely be observed².

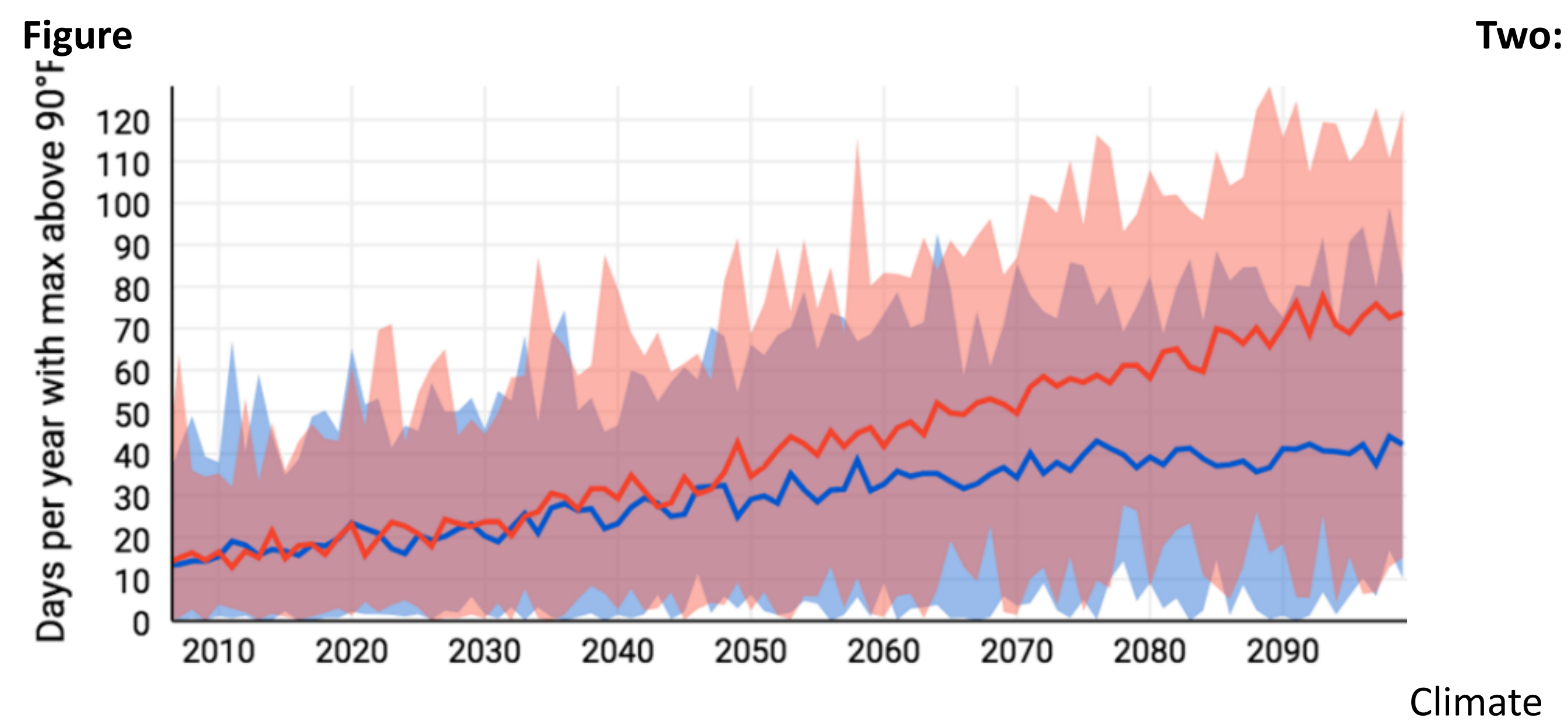
Future Studies: This experiment focused primarily on whether or not a squirrel was seen compared to temperature. Future studies will aim to focus more on individual behaviors, such as mating patterns or alterations in space use. We will continue to collect data for the ongoing study of squirrel behavior and habitat use.

Figure One: : Logistic fit analysis



of whether or not the squirrel was seen and compared to temperature.

Result: Squirrels were less likely to be seen at warmer temperatures (ChiSq analysis showed statistical significance with a value of $<.0001$). The mean temperature at which squirrels were observed outside of the nest was 50°F



data in the Fargo/Moorhead area collected from NOAA. The blue band shows the range of projections for a possible future in which global emissions of heat-trapping gases peak around 2040 and then decline. The red band shows the range of projections for a possible future in which global emissions of heat-trapping gases continue to increase through the 21st century. The red and blue lines show actual and predicted averages ranging from the year 2010-2090.

- Squirrels are more likely to be observed on cooler days.
- Climate change is ongoing, and our data supports that temperature increase will have an impact on squirrel behavior and habitat use.

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