McMicken College of Arts and Sciences

Department of Biological Sciences

University of Cincinnati

Urban Heat Island Effect on Monarch Butterfly Migratory Routes

Rachel Rieger[2], Adam Parlin[1], Patrick Guerra[1]

Department of Biology, University of Cincinnati, Cincinnati, OH 45221-0172 USA

INTRODUCTION

Migratory species have been experiencing substantial declines due to contemporary stressors like climate change, habitat alterations, and urbanization. Urbanization presents novel environmental stressors. For instance, the urban heat island effect (UHI) is a term that describes urbanized areas often having higher thermal profiles than neighboring rural areas[1]. Urban heat islands are associated with increased temperatures both during the day and the night[2]. Extreme thermal conditions can adversely affect the migration of monarch butterflies (Danaus plexippus).

In our study we present temperature data from the 2017 period of monarch migration. Maximum, minimum, and mean temperature data from high risk and low risk migratory routes are shown. This data shows the relative trend of temperature profiles in areas of urban versus rural development. By comparing the temperature profiles of urbanized areas versus rural areas, we can predict how increased thermal conditions affect monarch migratory behavior.

RESULTS

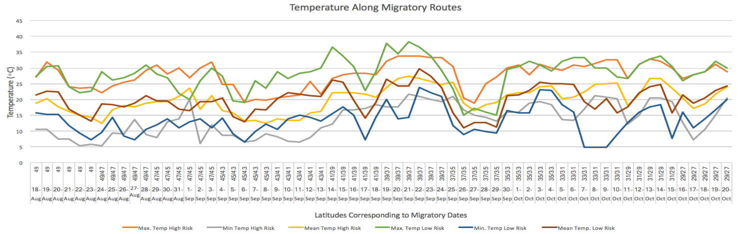

Fig. 1: Maximum, minimum, and mean temperature data along Low Risk and High Risk migratory routes by latitude.

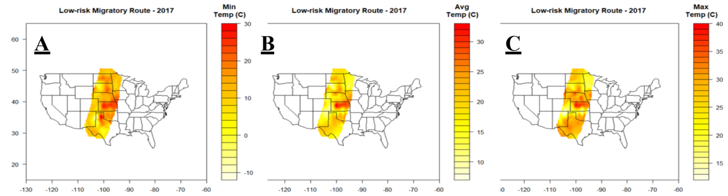

Fig. 2: Temperature profile for Low Risk migratory route through the Midwest United States. This route is classified low risk due to less densely populated cities and more abundant rural areas.
[A]: Minimum daily temperatures experienced by cities and towns during 2017 low risk migration.
[B]: Average daily temperatures experienced by cities and towns during 2017 low risk migration.
[C]: Maximum daily temperatures experienced by cities and towns during 2017 low risk migration.
*Red color signifies hotter temperatures, yellow signifies cooler temperatures, and orange signifies intermediate temperatures.

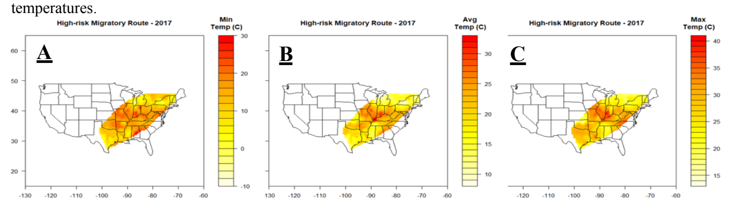

Fig. 3: Temperature profile for High Risk migratory route through the Eastern United States. This route is classified high risk due to more densely populated cities and more abundant urban areas.
[A]: Minimum daily temperatures experienced by cities and towns during 2017 high risk migration.
[B]: Average daily temperatures experienced by cities and towns during 2017 high risk migration.
[C]: Maximum daily temperatures experienced by cities and towns during 2017 high risk migration.
*Red color signifies hotter temperatures, yellow signifies cooler temperatures, and orange signifies intermediate temperatures.

METHODS

Temperature data, from a high risk and a low risk route, was obtained for 2017 during the months of August through October. This data was sorted into latitudes that correspond to the position of the monarch butterflies during the dates of peak migration. This data was compared in excel and QGIS applications.

CONSERVATION IMPLICATIONS

Urban areas often show increased temperatures both during the day and at night, due to entrapment of solar radiation, increased emission of greenhouse gases, and a decrease in evaporation.

In order to aid monarch butterflies in their migration, we as a society can incorporate pollinator gardens and areas of thermal refuge, such as forests, into urbanized areas. Both of these things will reduce the elevated temperatures in cities, and alleviate the stress on migratory monarchs.

MAIN CONCLUSION

- Urban areas have, on average, higher temperature profiles, as compared to rural areas

FUTURE WORK

- In the lab, we can expose monarch butterflies to high temperatures, simulating heat islands.
- We can observe how monarchs' migratory biology changes with increased temperatures.

ACKNOWLEDGEMENTS AND REFERENCES

[1] "Heat Island Effect." *EPA*, Environmental Protection Agency, 23 Jan. 2020, www.epa.gov/heat-islands.

[2] Berdahl, P, et al. "Heat Island Impacts." *EPA*, Environmental Protection Agency, 25 Nov. 2019, www.epa.gov/heat-islands/heat-island-impacts.