Temperature Decreases Mammalian Species Richness Nationwide

Margaret Murray & Dr. Christine Rega-Brodsky
Department of Biology, Pittsburg State University, Pittsburg, KS 66762

Introduction

Understanding the impacts of temperature and precipitation on mammal communities is increasingly important with global climate change. Climate change includes changes in temperature and precipitation; even the slightest deviations can throw off the equilibrium of an ecosystem. Large scale analyses of climate and mammalian species richness have yielded positive relationships, specifically due to energy and water availability at warmer locations (Hortal et al., 2008). To assess links between climate and mammals within the United States, we used data from Snapshot USA.

Snapshot USA

Snapshot USA is the first nationwide synchronous camera trap survey of the United States (Cove et al., *Accepted*). The survey ran during the fall season of 2019 at over 100 locations, including Alaska and Hawaii. This study can allow us to look at "snapshots" in time and compare mammal population and communities with future data.

Objective

The objective of this research project was to investigate how species richness is affected by precipitation and temperature.

Methods

Study Area

Over 1,530 cameras were deployed across all 50 U.S. states from Aug 17 – Nov 24, 2019 (Fig. 1). Camera trap sampling covered 12 ecoregions with varying latitude, elevation, climate, and habitat types including grasslands, forests, anthropogenic areas, and wetlands. No bait was used to lure animals near the cameras. All images were processed though the Smithsonian's eMammal camera trap repository and included an expert review to ensure taxonomic accuracy; the images were reviewed at least twice (Cove et al., Accepted).

Analysis

We downloaded the publicly available Snapshot USA data from eMammal and corresponding climate data (NARR, 2021). We used a linear model to analyze the relationships between species richness and temperature and precipitation. Analyses were done in Program R (RStudio, 2020).

Results

Trap Nights

Snapshot USA collected data over 52,000 trap nights (Cove et al., *Accepted*) and detected 78 species (Fig 1 & 2). The average species richness for all the locations was 3.96 species per camera trap location.

Figure 2. Camera trap photographs of *Canis latrans* (left) and *Odocoileus virginianus* (right) taken within the Pittsburg State University Snapshot deployments.

Temperature

The average temperature was 18.45°C and values were normally distributed across the study sites. There was a significant negative relationship between temperature and mammal species richness ($R^2 = 0.03$, $p < 0.01$; Fig. 3a).

Precipitation

The average precipitation was about 3 cm across all the sites. These data were skewed left, meaning most sites had no precipitation and very few sites had over one centimeter of precipitation. Precipitation did not predict species richness across our sites ($R^2 = -0.0006$, $p = 0.78$; Fig. 3b).

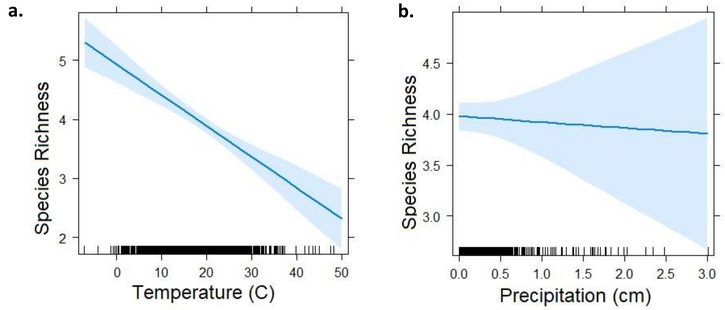

Figure 3. Linear models of species richness and (a) temperature (°C) and (b) precipitation (cm). Blue shading indicates 95% confidence intervals.

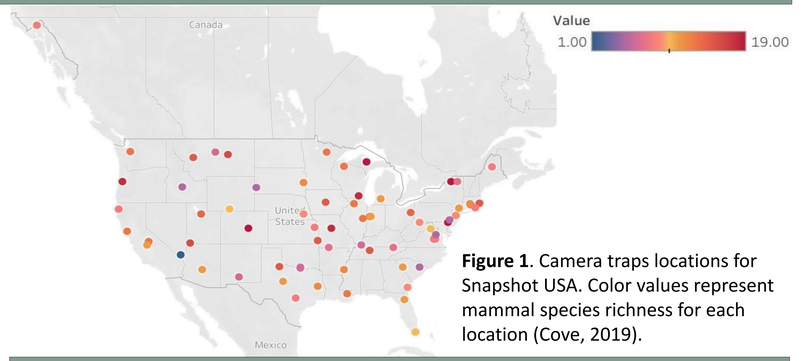

Figure 1. Camera traps locations for Snapshot USA. Color values represent mammal species richness for each location (Cove, 2019).

Discussion

We rejected the null hypothesis, as temperature had a significant relationship with species richness. The results of our models differ from the findings of Gaston (2000), who found significant positive relationships between species richness and both temperature and precipitation, while we found that precipitation lacked a relationship with species richness. This could be due to many factors that were not accounted for, such as imperfect detection with camera traps, downed logs, and microhabitats (Kolowski, 2017). Even so, our findings indicate that temperature is an important factor for mammal community assembly and may be impacted by increasing temperatures due to climate change.

References

Cove, M.V., Kays, R., Bontrager, H., Bresnan, C., Frerichs, T., Klann, R., Lee, T.E., Crockett, S.C., Crupi, A.P., Weiss, K.C.B., Rowe, H., Sprauge, T., Schipper, J., Lepczyk, C.A., Fantle-Lepczyk, J.E., … McShea, W.J. *Accepted*. SNAPSHOT USA: The first coordinated national camera trap survey of the United States – Data from 2019. *Ecology*.

Cove, M. (2019). Snapshot USA metrics. *Tableau.*

Gaston, K.J. (2000). Global patterns in biodiversity. *Nature, 405*, 220-227.

Hortal, J., Rodriguez, J., Nieto-Diaz, M., & Lobo, J. M. (2008). Regional and environmental effects on the species richness of mammal assemblages. *Journal of Biogeography, 35*, 1202-1214.

Kolowski, J. M. (2017). Camera trap placement and the potential for bias due to trails and other features. *PLOS ONE (12)10*, e0186679.

North American Regional Reanalysis (NARR). 2020. A long-term, consistent, high-resolution climate dataset for the North American domain. Provided by NOAA/OAR/ESRL PSL, Boulder, Colorado, USA from their website https://psl.noaa.gov

RStudio Team (2020). RStudio: Integrated Development for R. R Studio, PBC, Boston, MA.