



The Diversity and Distribution of Spiders (Arachnida: Araneae) along an Urban Gradient



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Purpose

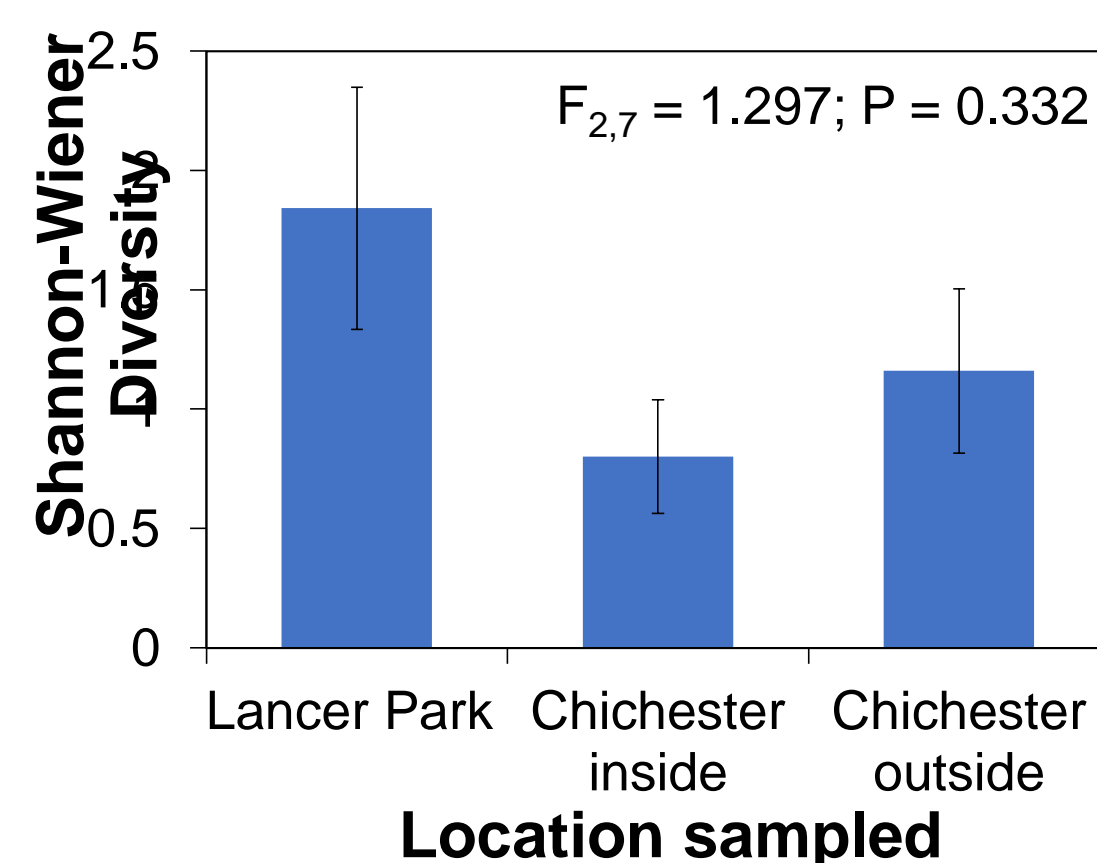
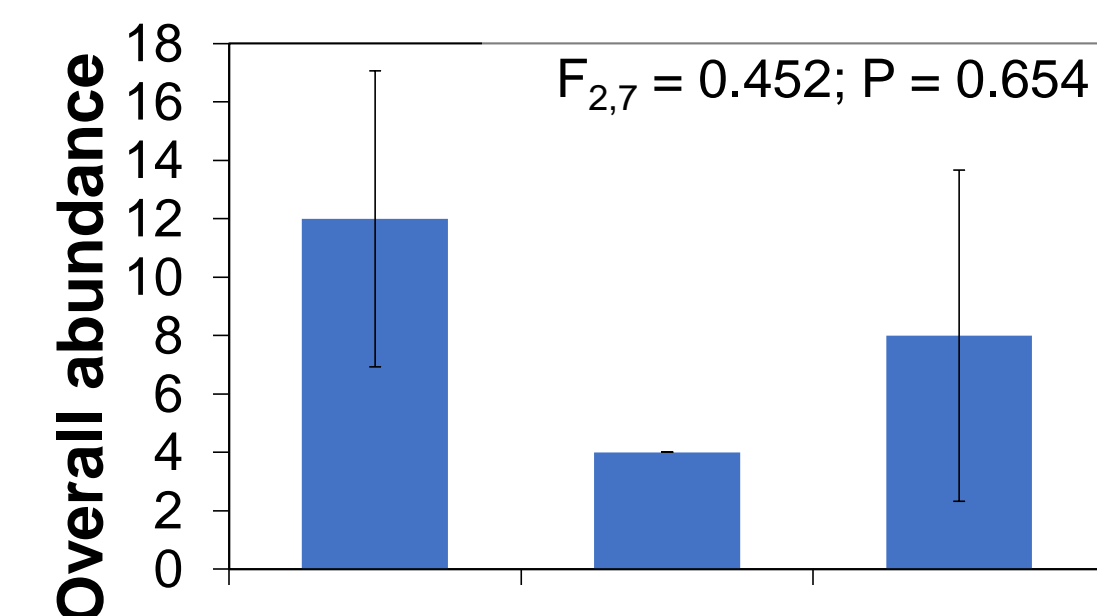
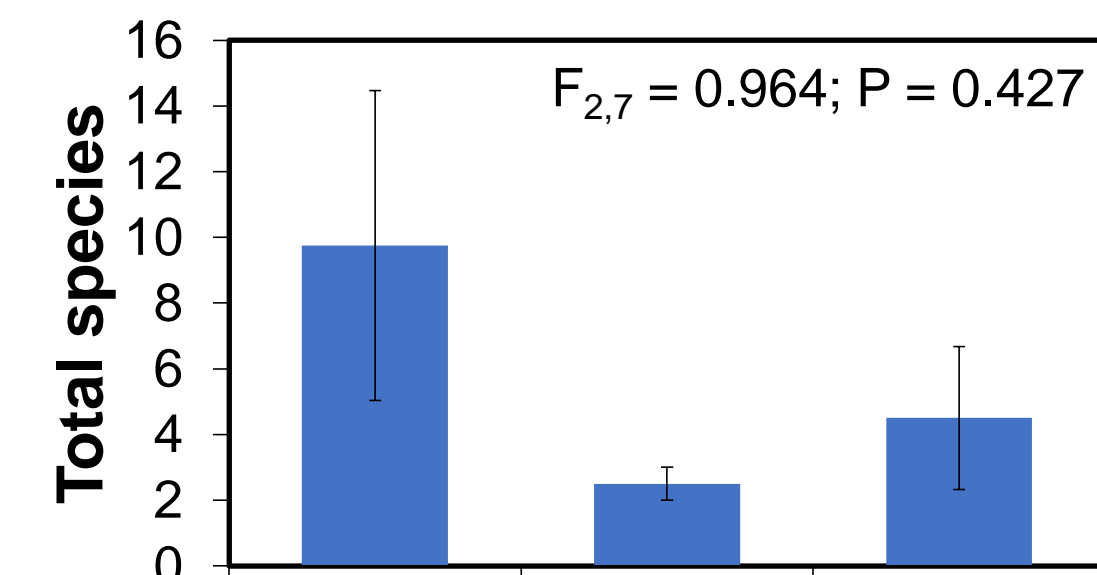
The overall objective of this research project is to evaluate the **potential impacts of urbanization on invertebrates** using spiders as a model organism. The specific objectives include,

- 1) Compare and contrast spider diversity from three distinct habitats covering an urban gradient
- 2) Explore the relationships between environmental conditions and the diversity of spiders
- 3) Generate a species checklist for Longwood University premises.

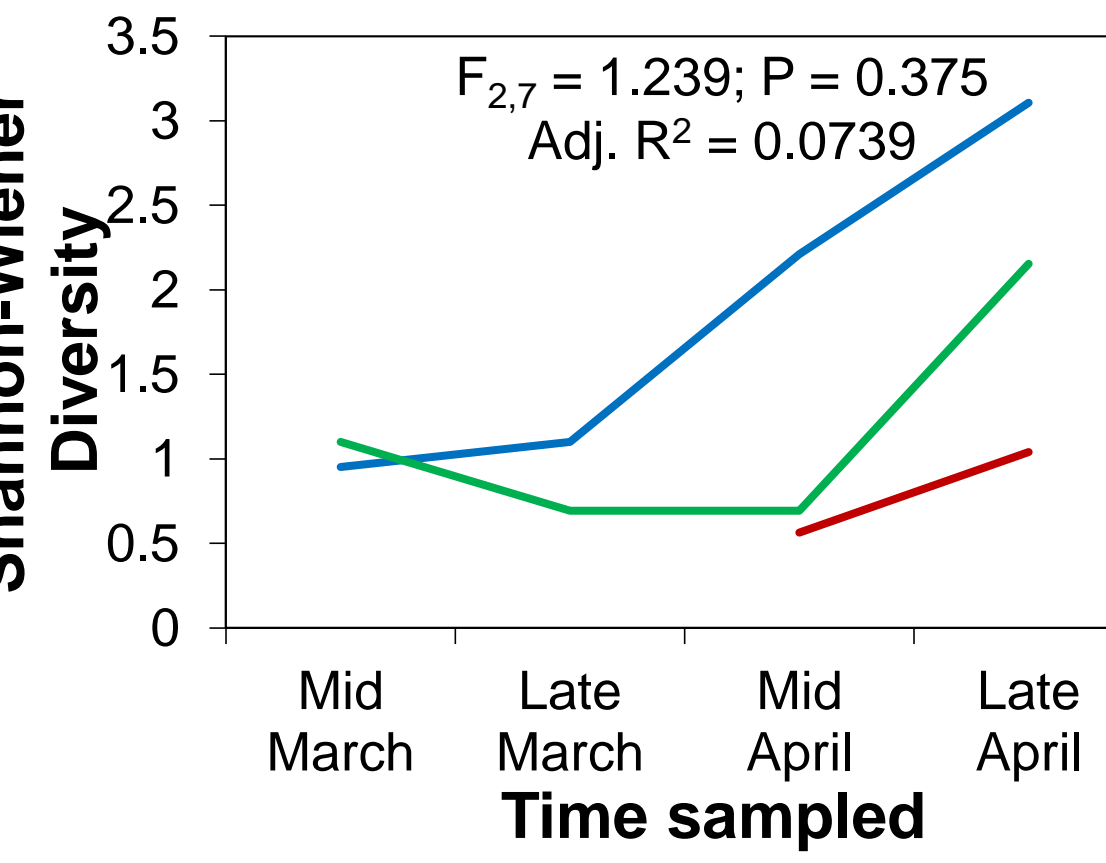
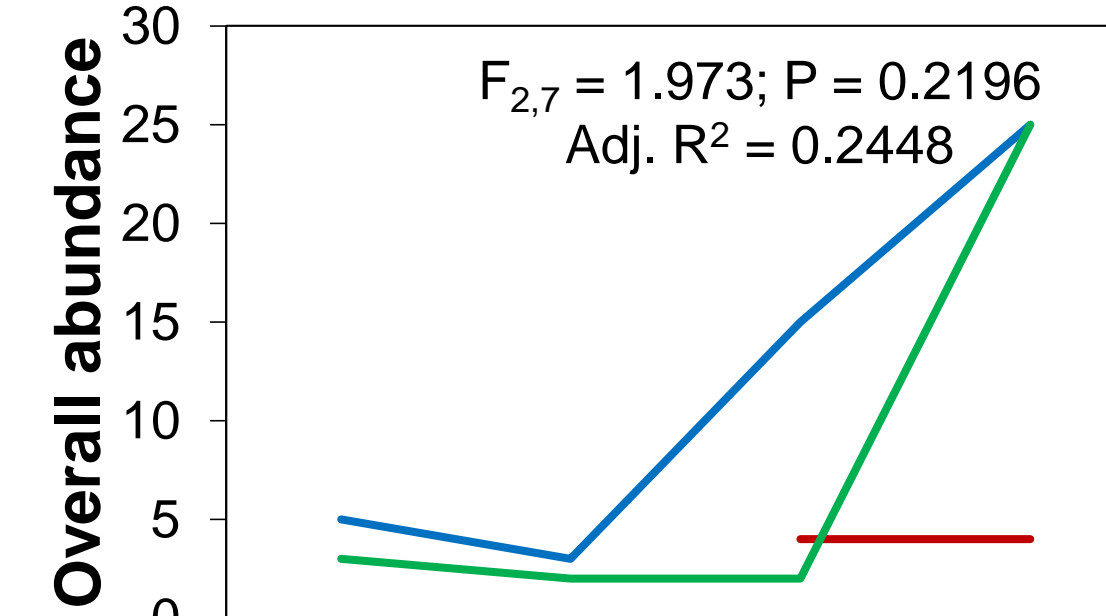
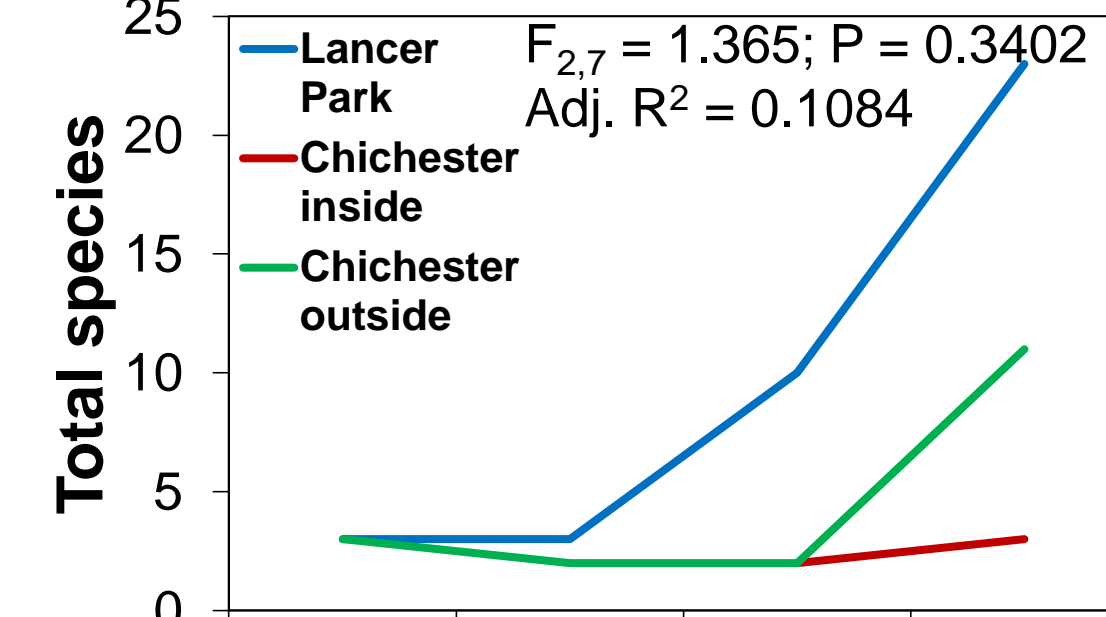
Background Information

- With the rapid expansion of human population, the impacts of urbanization generally cause **loss of native species diversity** (Blair 1996). However, urbanization may also promote a few urban-adapted taxa and lead to **biotic homogenization** (Blair 1996).
- Overall, little attention has been given to explore how urban development affects the diversity and abundance of arthropods including spiders (Shochat et al. 2004) despite the ubiquitous nature of arthropods in human dwellings.
- Although the United States supports a considerable diversity of spiders (~4,000 species, Bradley, 2013), many aspects of spider habitat use and niche specialization are poorly documented (Howell and Jenkins 2004).
- Additionally, the species diversity of spiders in the eastern United States is poorly documented (Howell & Jenkins, 2004).
- We performed a preliminary survey of spiders at Longwood University in the spring of 2018. We surveyed spiders in **indoor and outdoor habitats** and found that the diversity is higher in outdoor and marginal habitats compared to indoor habitats (Kish & Henkanaththegedara unpublished data).
- Our preliminary survey yielded 50 species of spiders under 43 genera and 16 families.
- There were positive correlations between diversity and environmental parameters such as temperature and relative humidity (Kish & Henkanaththegedara unpublished data).

Sampling Location Effects On Spider Diversity



Sampling Time Effects on Spider Diversity



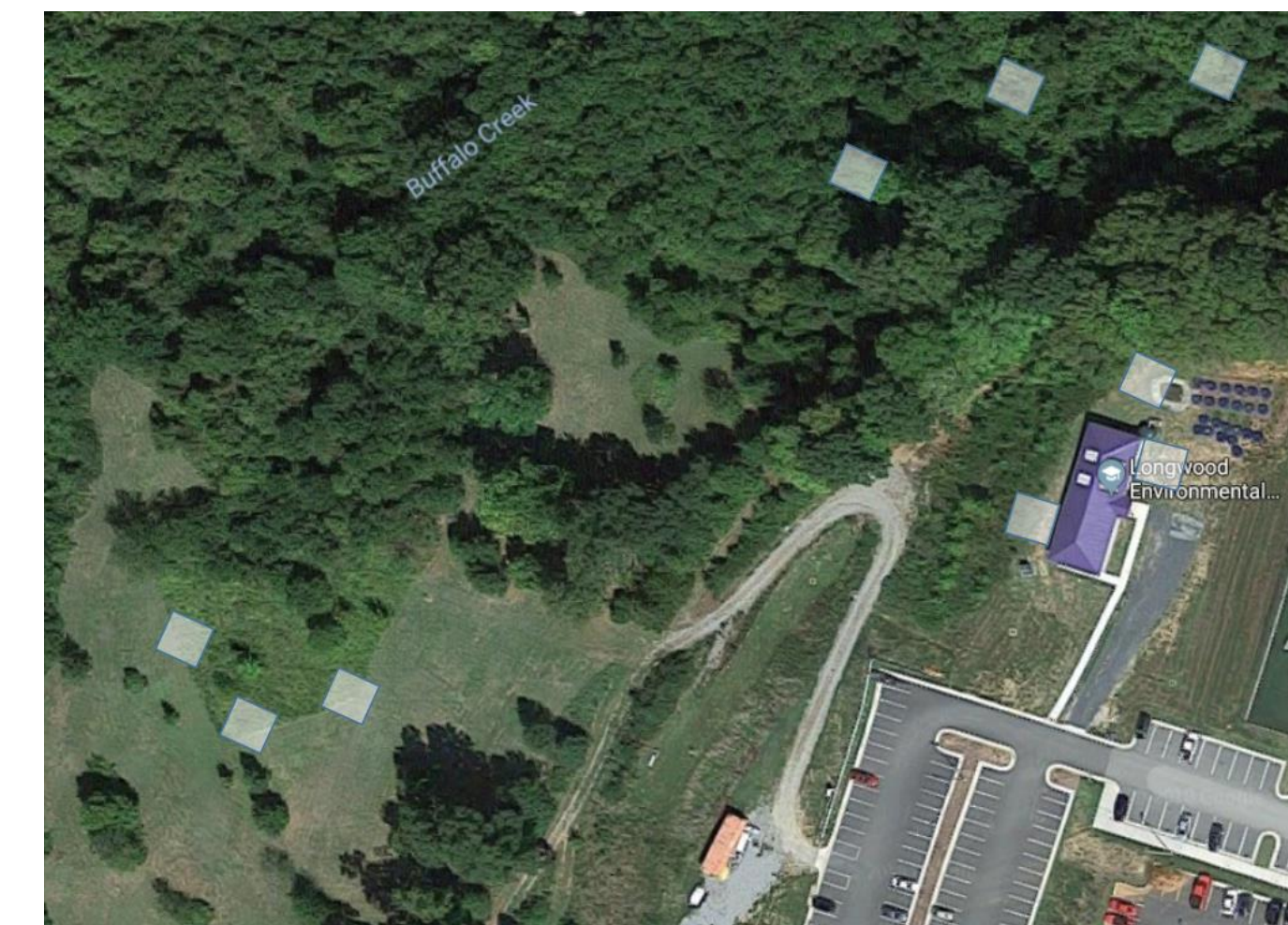
Research Plan

Study Area:

- This study will be conducted at Longwood University in Farmville, Virginia at the Lancer Park Flood Plain.
- This ~30-acre area represents a diverse array of both aquatic and terrestrial habitats including a third order stream, series of seasonal pools, several man-made ponds, eastern deciduous forests, grasslands and hedge habitats, and some buffer habitat with parking lots and roads.



Lancer Park flood plain



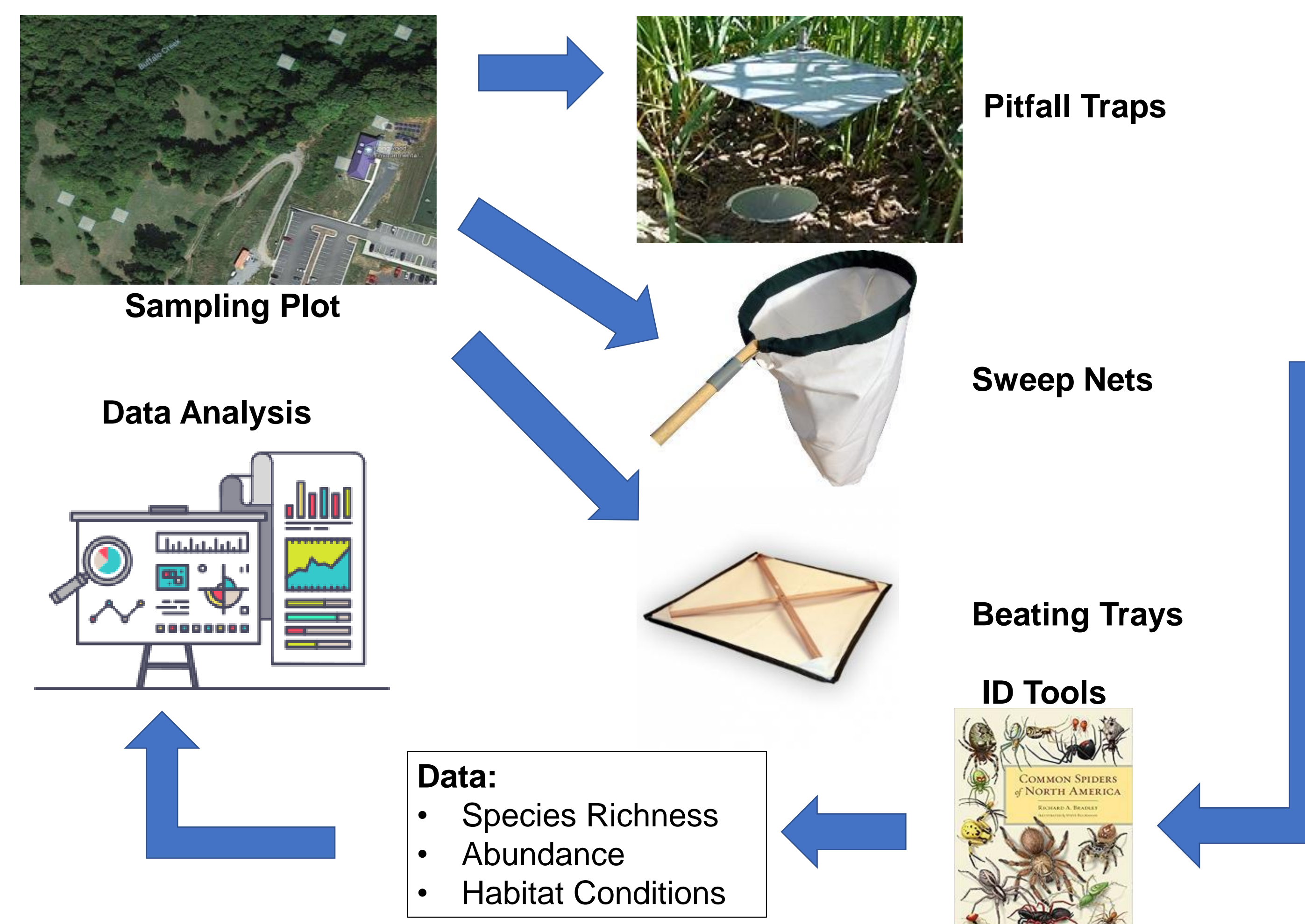
Distribution of the experimental plots

Research Design:

- We will collect data from three 10m x 10m study plots representing forested habitat (non-urban), grassy habitat (transitional), and urban buffer habitat (urban) for this research.

Field Data Collection:

- Spiders will be located visually by opportunistic sampling in each habitats by using sweep nets, beat sheets, visual observations, and pitfall traps.
- All spiders will be photographed and released back to the original capture location. Environmental data such as temperature and humidity, light levels, and the height at capture will be collected at capture locations using the RockyMars® RT36 temperature and humidity meter and Dr.Meter LX1330B Digital Illuminance/Light Meter, 0 - 200,000 Lux Luxmeter.
- Spiders will be identified using field guides and identification keys provided by Bradley (2013), Gaddy (2009), Howell and Jenkins (2004), bugguide.net (<https://bugguide.net/>), and reported to iNaturalist online species repository (<https://www.inaturalist.org/>).



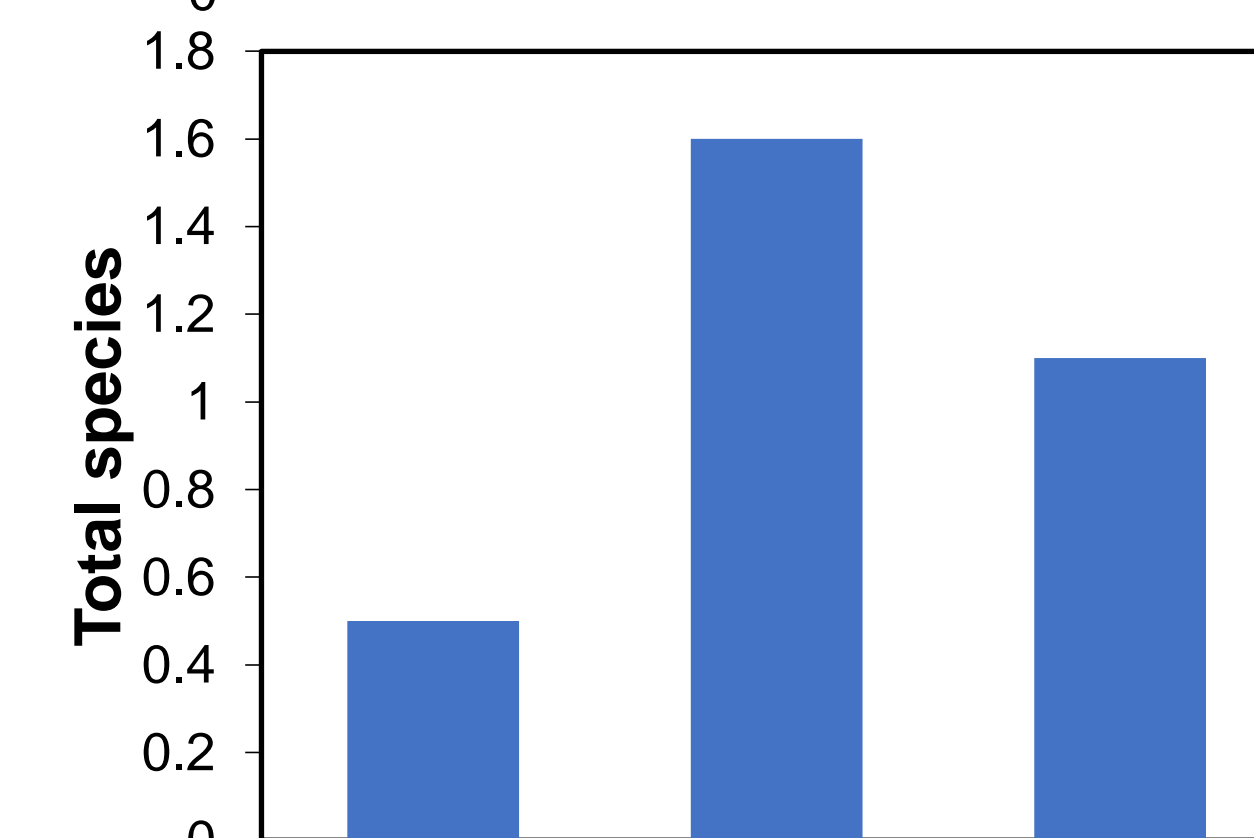
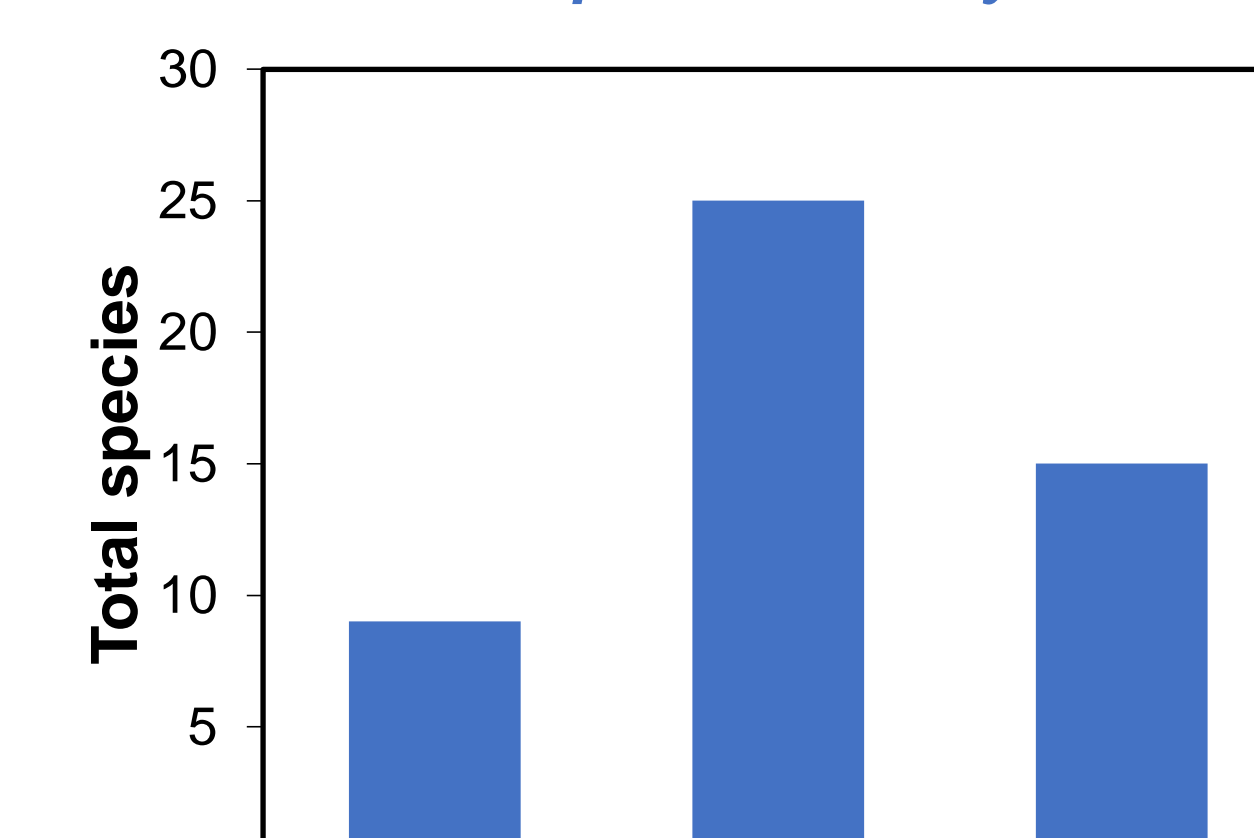
Expected Results

- We plan on collecting data on **spider species richness, abundance** and **habitat conditions**.
- The habitat condition data include temperature (°C), relative humidity (%), light intensity (lux), and height at capture (cm).

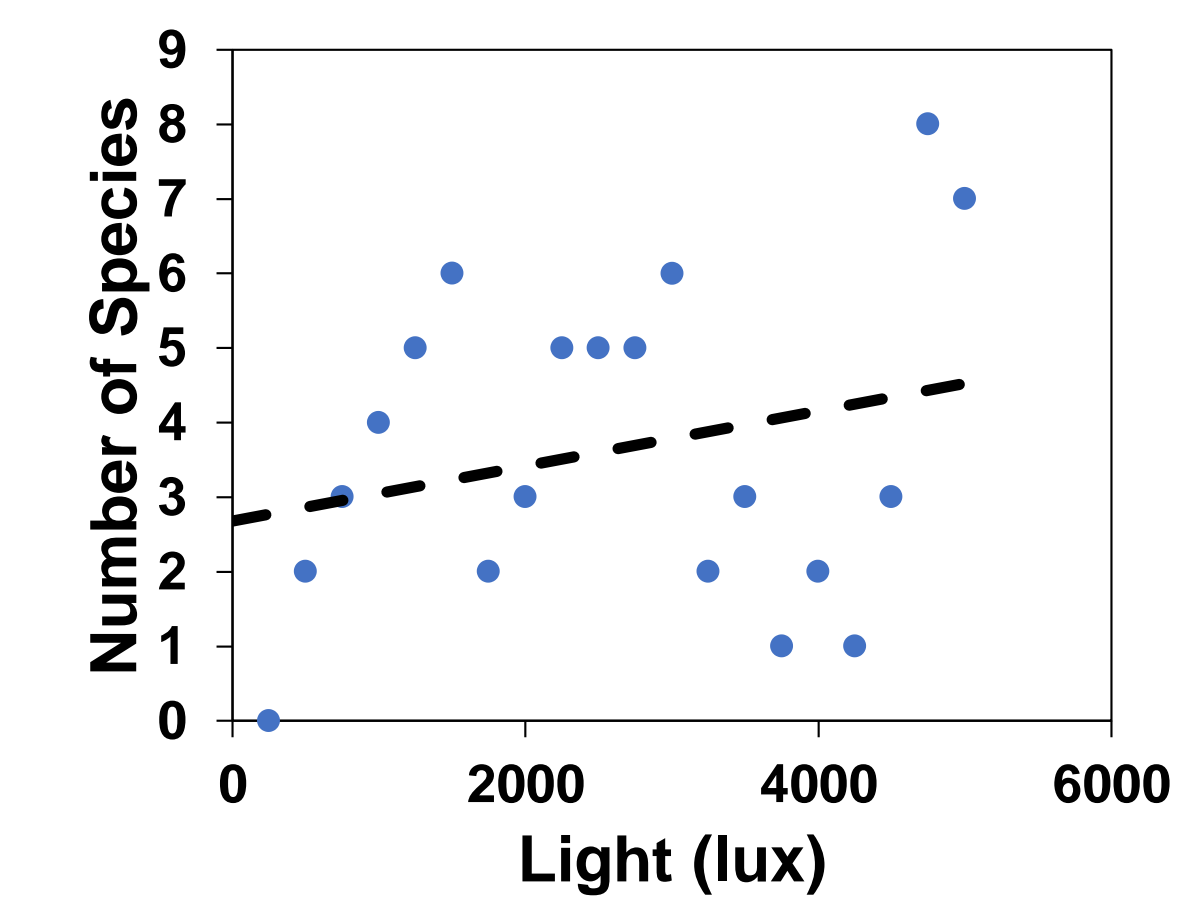
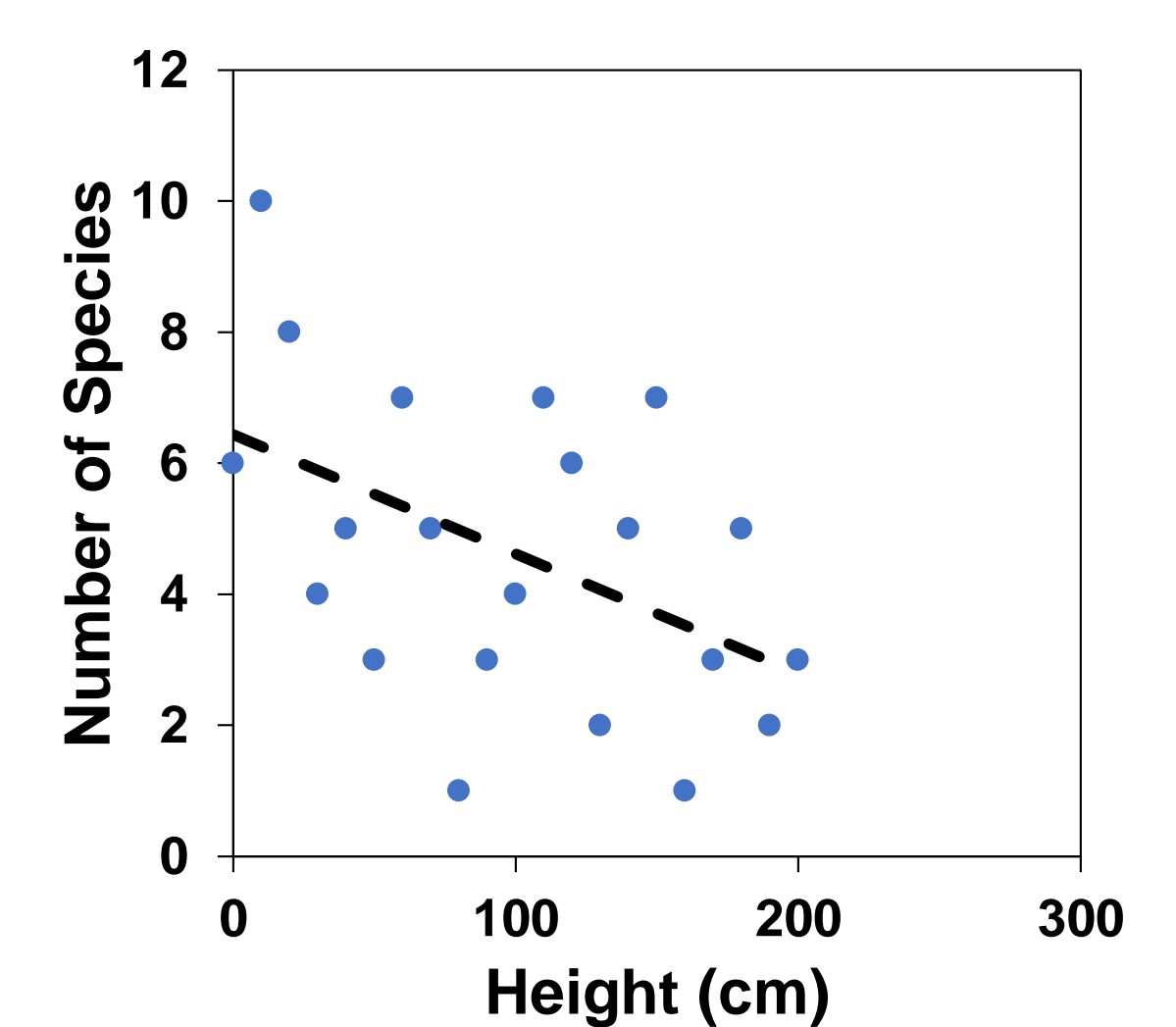
Data Analysis:

- Overall relative abundance of spiders for each family will be estimated by dividing the pooled number of individual spiders belonging to a given family by the total number of spiders.
- **Shannon-Wiener diversity index (H')** will be computed for each sample using the following formulae (Krebs 1999) to estimate overall diversity.
- $H' = -\sum (P_i * \ln P_i)$ and $D = \sum (P_i)^2$
Where, P_i = fraction of the entire population made up of species i .
- The mean differences between **habitats and sampling dates** for 1) number of species, 2) overall abundance, and 3) Shannon-Wiener diversity index will be analyzed using Analysis of Variance (ANOVA).
- The effects of **habitat conditions** on overall spider diversity will be analyzed using simple linear models considering temperature, relative humidity, light intensity and height at capture as predictor variables. All statistical analyses will be conducted using R statistical software program.

Expected Location Effects On Spider Diversity



Expected Environmental Effects On Spider Diversity



- With this data, we will be able to assess the **impacts of urbanization on spider diversity and abundance**.
- Additionally, the habitat condition data will help us to understand **habitat use** and **niche specialization** of spiders.

References

- 1) Blair, R.B. 1996. Land use and avian species diversity along an urban gradient. *Ecological Applications* 6:506-519.
- 2) Bradley, R. A. 2013. *Common Spiders of North America*. University of California Press, Berkeley and Los Angeles, CA. 4 pp.
- 3) Gaddy, L.L. 2009. *Spiders of the Carolinas*. Stensaas + Kollath Publishing, Duluth, Minnesota, USA.
- 4) Howell, W. M., and Jenkins, R. L. 2004. *Spiders of the Eastern United States*. Pearson Education, Boston, Massachusetts, USA.
- 5) Shochat, E., W.L. Stefanov, M.E.A. Whitehouse, S.H. Faeth. 2004. Urbanization and spider diversity: influences of human modification of habitat structure and productivity. *Ecological Applications* 14: 268-280



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