

Assessing the Arthropod Diversity Along an Urban Gradient Using Spiders as a Model

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Background

- ▶ Urbanization generally cause loss of native species diversity (Blair 1996).
- ▶ Urbanization may also promote a few urban-adapted taxa and lead to biotic homogenization (Blair 1996).
- ▶ Little attention has been given to explore how urban development affects the diversity and abundance of arthropods including spiders (Shochat et al. 2004).



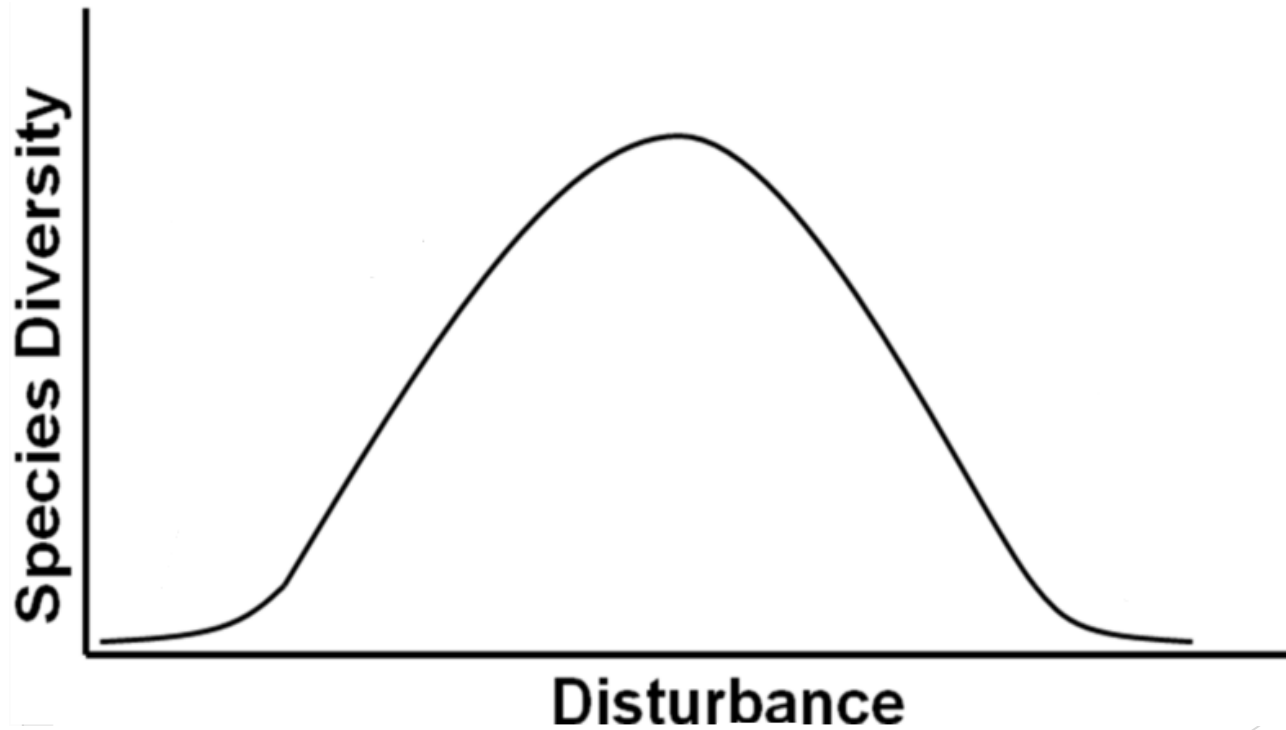
Southern House Spider
(*Kukulcania hibernalis*)



Common House Spider
(*Parasteatoda tepidariorum*)

Intermediate Disturbance Hypothesis

- ▶ The highest diversity is reported in moderately disturbed locations (Connell 1978).



Background

- ▶ 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 and Jenkins 2004).



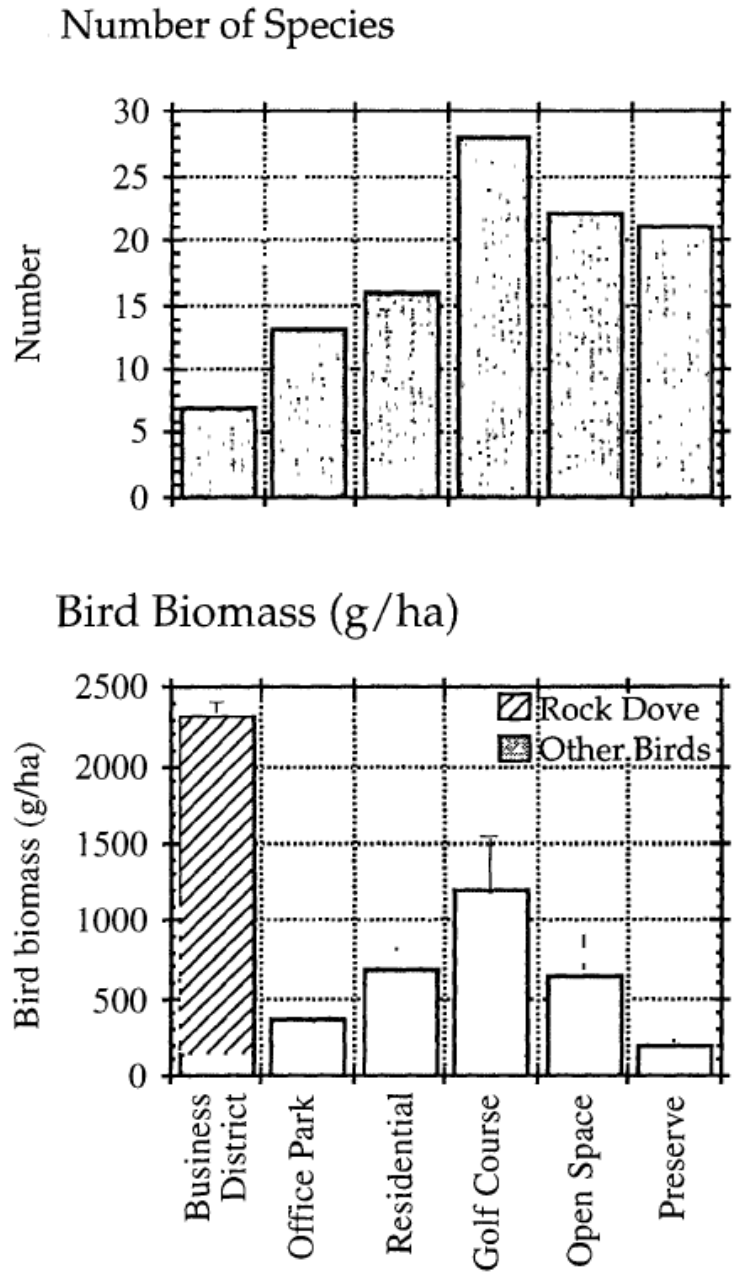
Tuft-legged Orbweaver
(*Mangora placida*)



Canopy Jumping Spider
(*Phidippus otiosus*)

Effects of Urbanization

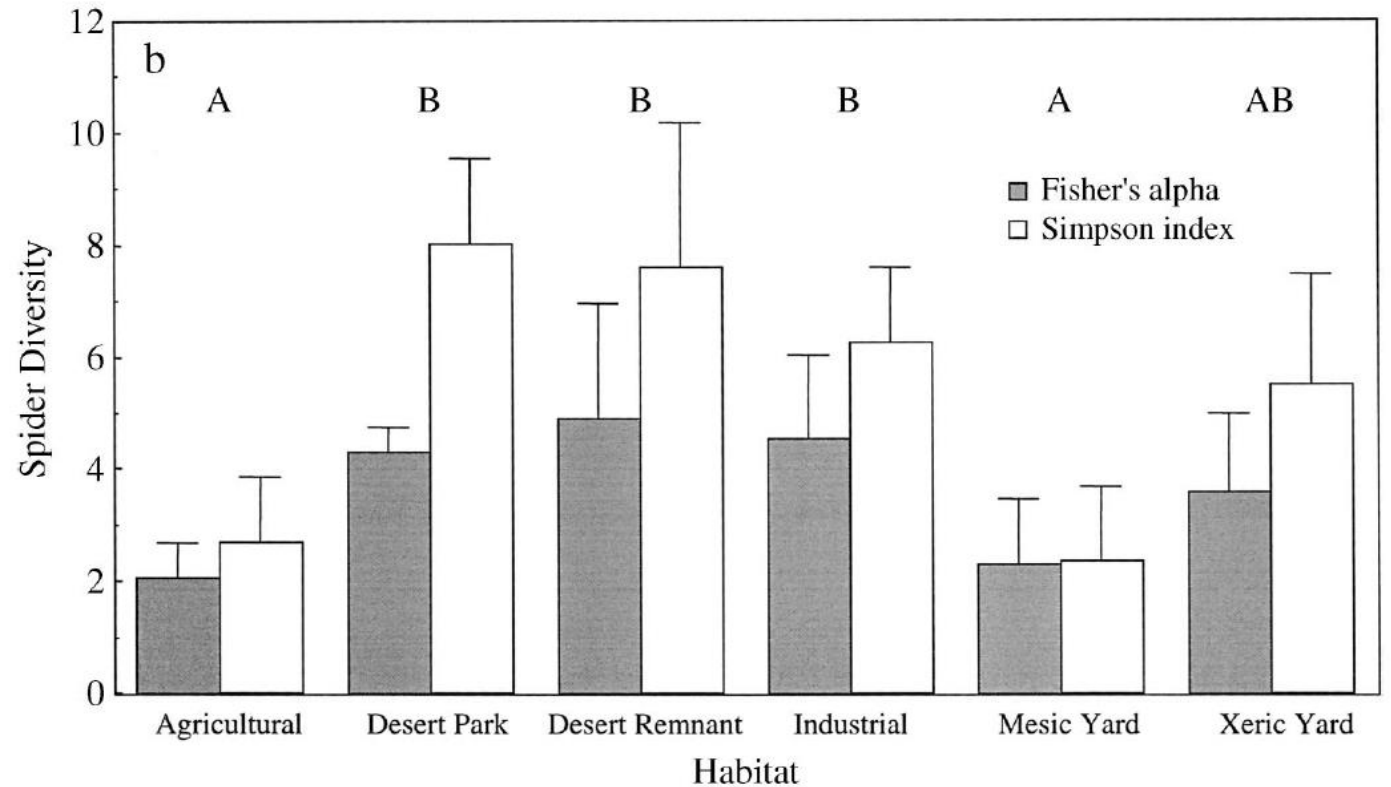
- ▶ Compared bird species distribution and abundance across **urban gradient**
- ▶ Species richness, Shannon diversity and biomass was highest at **moderately disturbed habitats**
- ▶ Support for intermediate disturbance hypothesis



(Blair 1996)

Effects of Urbanization

- ▶ Diversity was highest in **desert remnants habitat** (dominated by native vegetation, no built structures)
- ▶ Diversity was lowest in **mesic yards** (>50% lawns, exotic plants, and irrigation)



(Shochat et al. 2004)

Research Objectives

- 1) Study spider **diversity** and **abundance** along an **urban gradient**
 - Test the Intermediate Disturbance Hypothesis
- 2) Explore the relationships between **environmental conditions** and the diversity of spiders.
- 3) Compile a checklist of spiders in the Longwood Lancer Park flood plain.

Study Area

- ▶ Longwood University in Farmville, Virginia at the Lancer Park Flood Plain.
- ▶ This ~30-acre area with both aquatic and terrestrial habitats containing:
 - ▶ Third order stream
 - ▶ Seasonal pools and several man-made ponds
 - ▶ Eastern deciduous forests
 - ▶ Grasslands and hedge habitats
 - ▶ Buffer habitat with parking lots and roads



Research Design

- ▶ Three 5m x 5m study plots representing **forested habitat** (non-urban), **grassy habitat** (transitional), and **urban habitat**.

Field Data Collection

- Fall 2018 (N=5) and Spring 2019 (N=7)
- Collected using visual observations and sweep nets.
- Photographed and released back to the original capture location.
- Environmental data were also collected (temperature, humidity, light intensity and height)



Distribution of the experimental plots

Field Data Collection

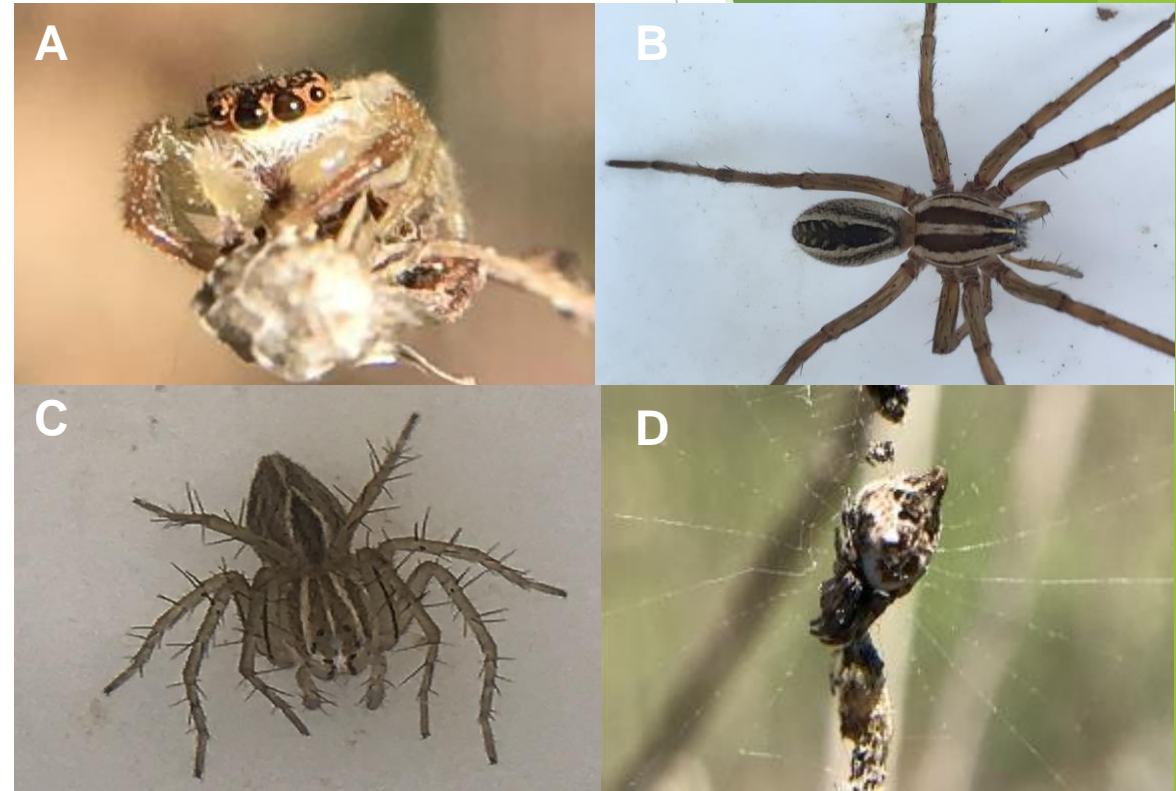
- ▶ Spiders were identified using field guides and identification keys provided by Bradley (2013), Gaddy (2009), and Howell and Jenkins (2004)
- ▶ Reported to iNaturalist online species repository (<https://www.inaturalist.org>)

Data Analysis

- ▶ Diversity was determined using the Shannon-Wiener Diversity Index.
- ▶ Data was analyzed statistically using R statistical software program.
- ▶ Two way ANOVAs and Simple Linear Regressions were used.

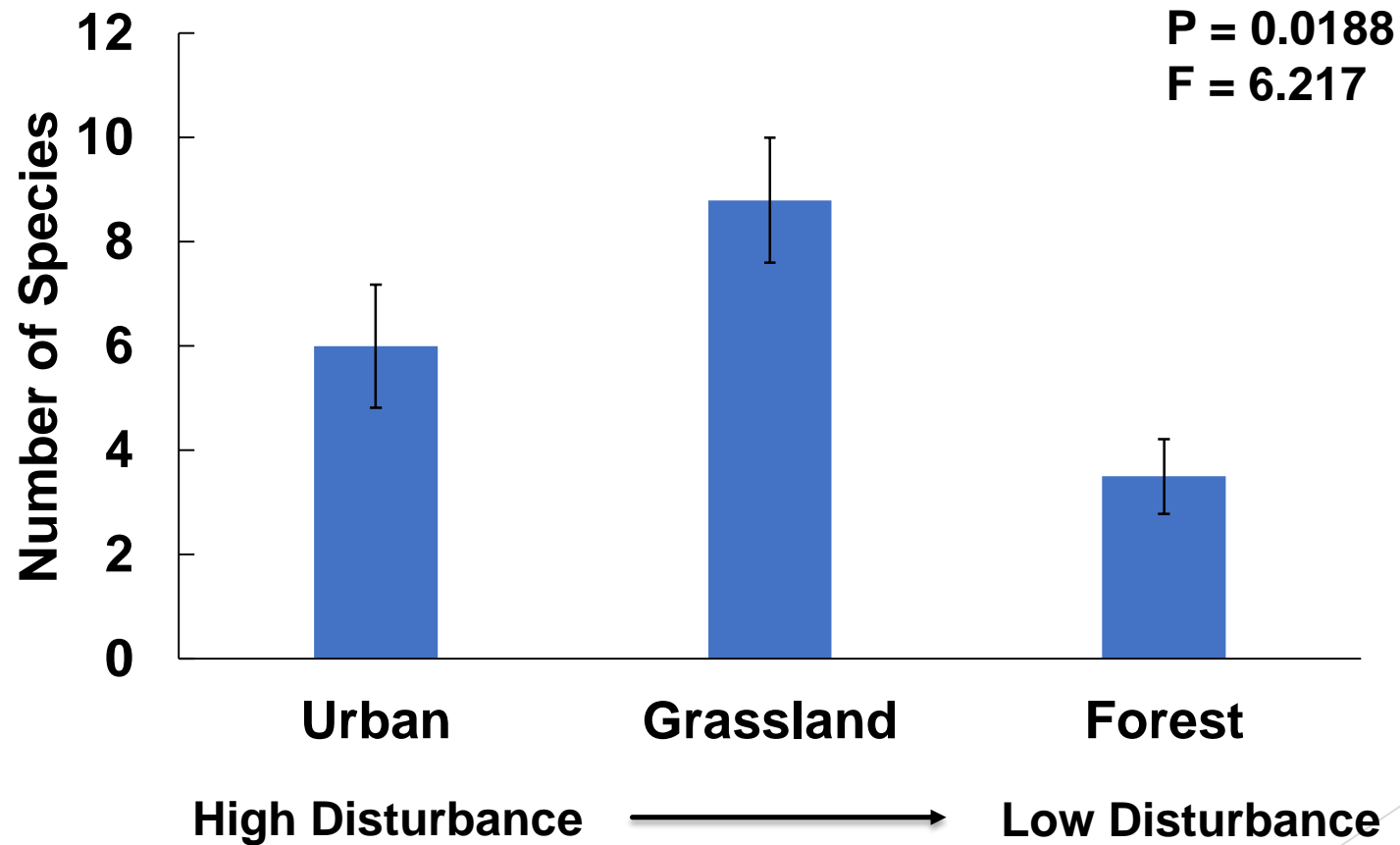
Results

- 11 Families, 51 Genera, 76 Taxa, and 345 Individuals
- Most abundant families and Taxa:
 - **Salticidae (17.4%);** White-jawed Jumping Spider (*Hentzia mitrata*) (20) (A)
 - **Lycosidae (16.2%);** Rabid Wolf Spider (*Rabidosa rabida*)(8) (B)
 - **Oxyopidae (15.7%);** Lynx Spider (*Oxyope sp.*) (48) (C)
 - **Araneidae (13.0%);** Humped Trashline Orbweaver (*Cyclosa turbinata*) (20) (D)



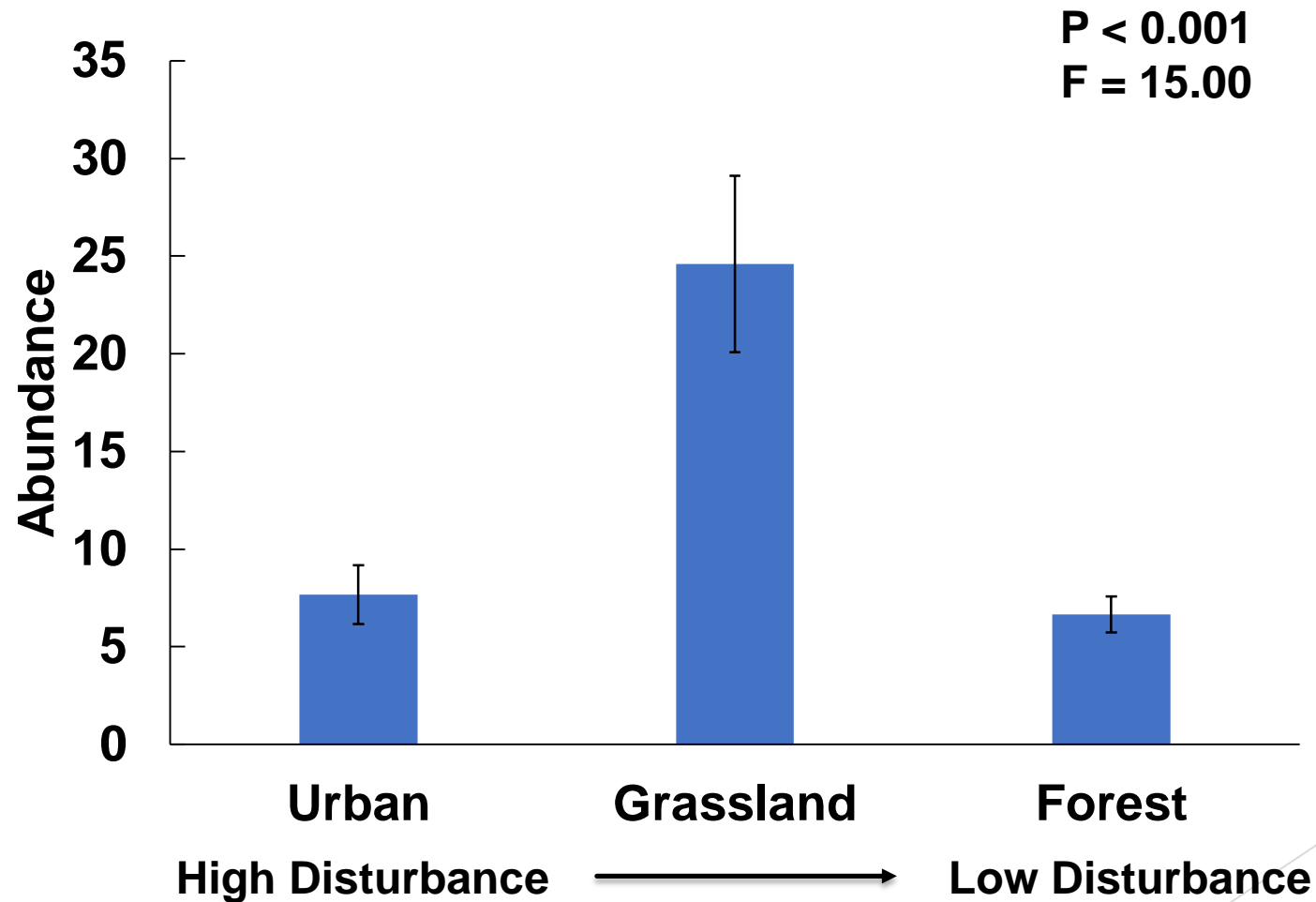
Results: Species richness

- **Fall 2018:** Highest number of species in grassland habitat.



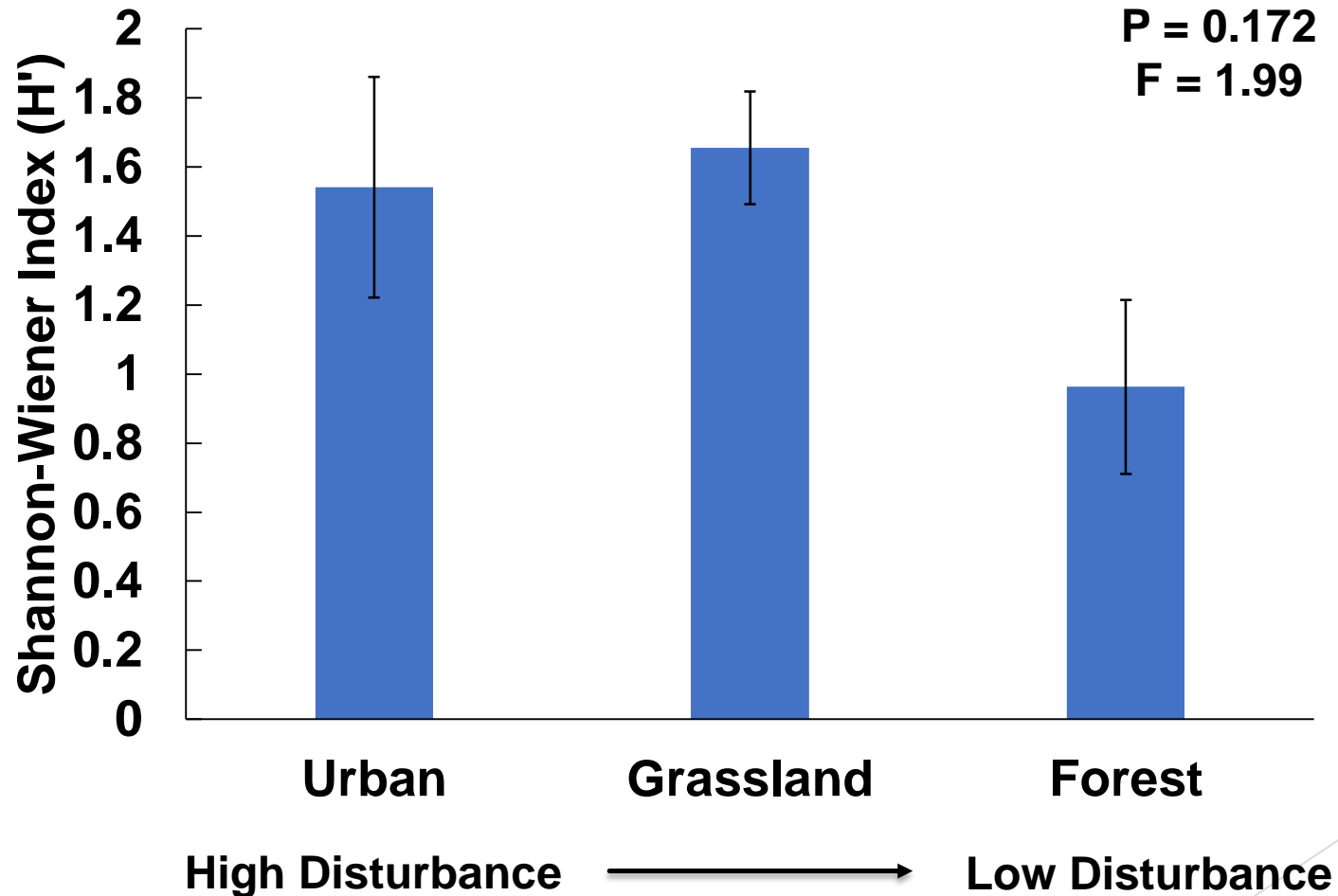
Results: Abundance

- **Fall 2018:** Highest abundance was in the grassland habitat



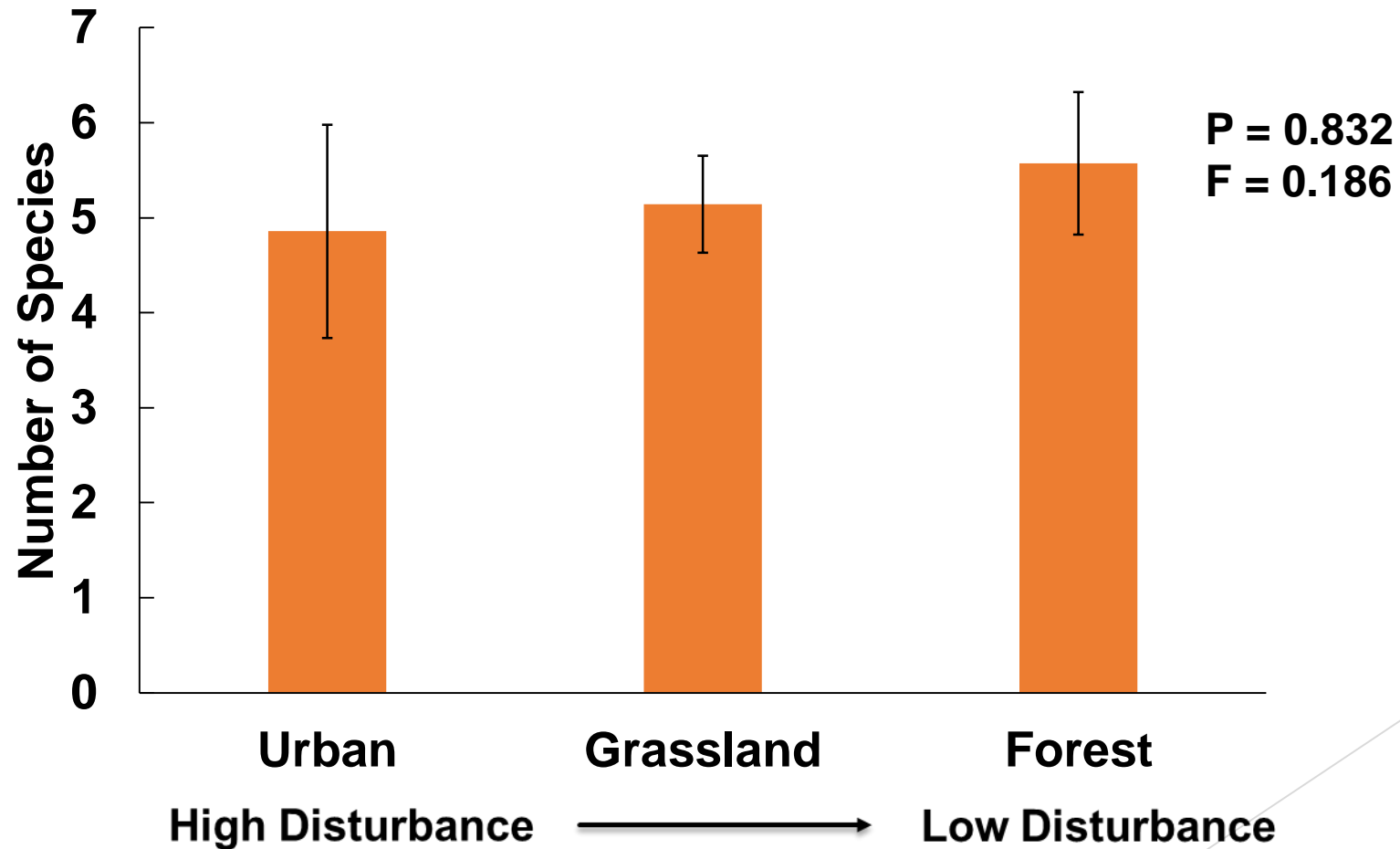
Results: Shannon-Wiener Diversity

- **Fall 2018:** No significant differences among habitats.



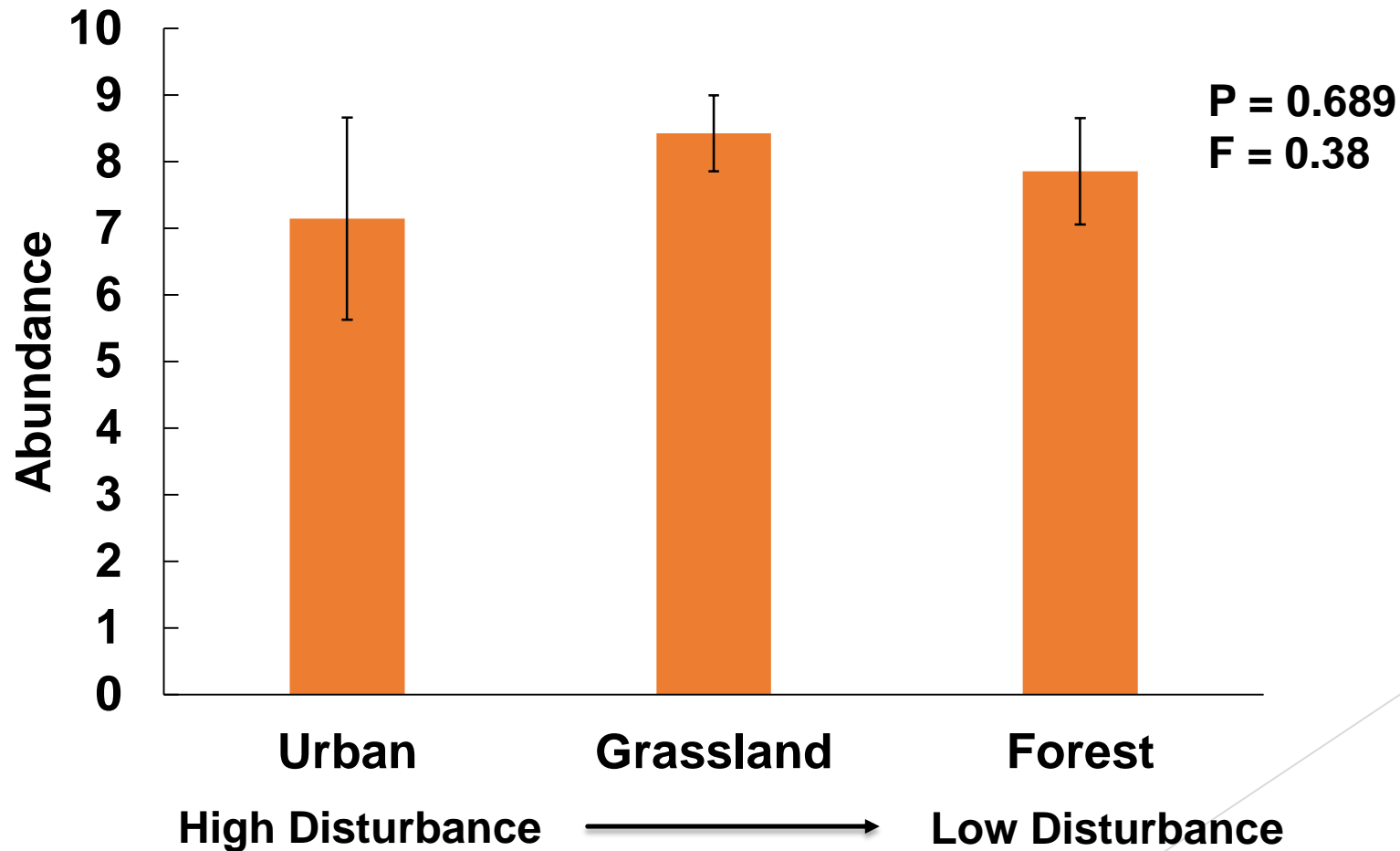
Results: Species Richness

- ▶ **Spring 2019:** Highest number of species in forested habitat



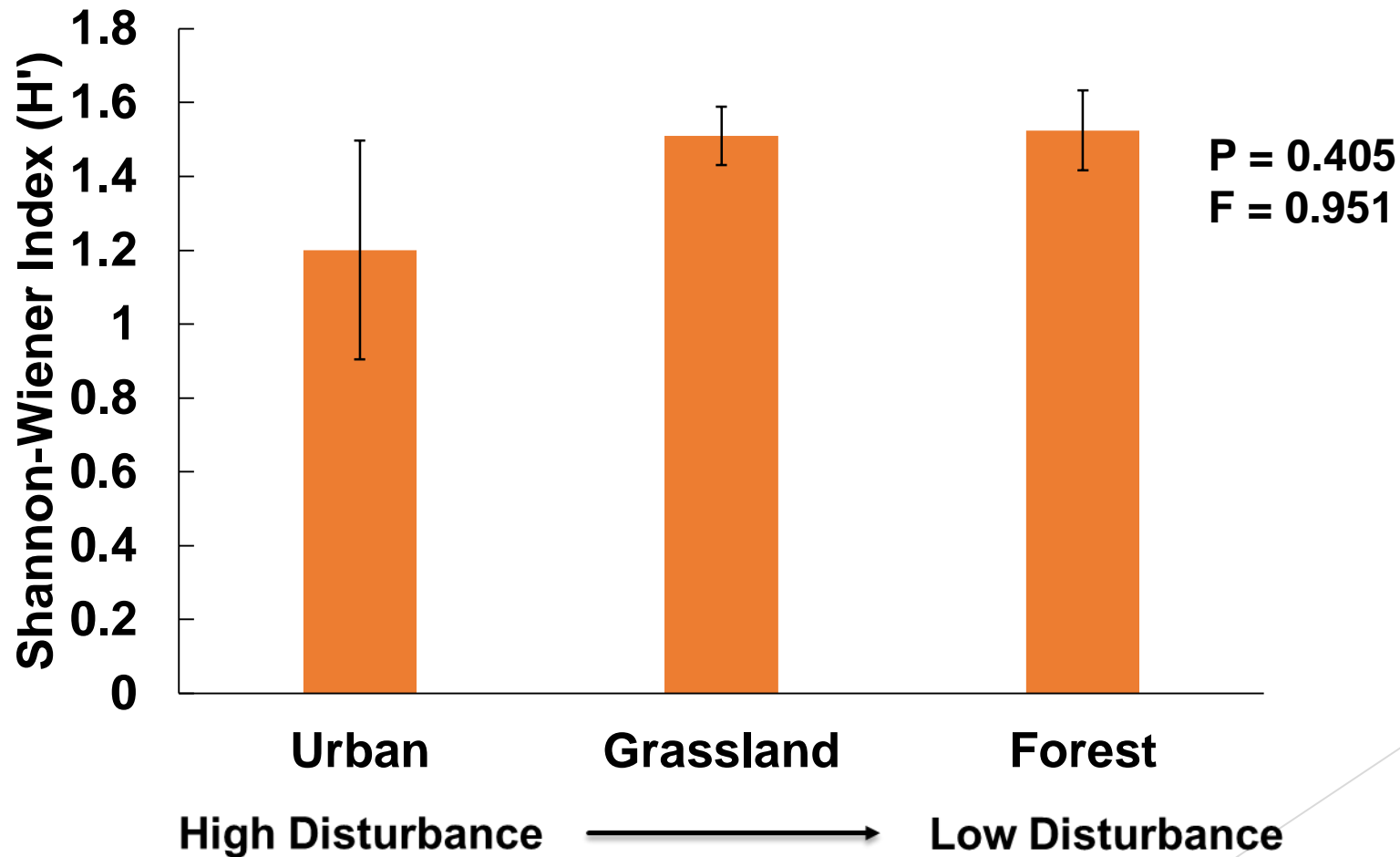
Results: Abundance

- **Spring 2019:** Highest abundance was in the grassland



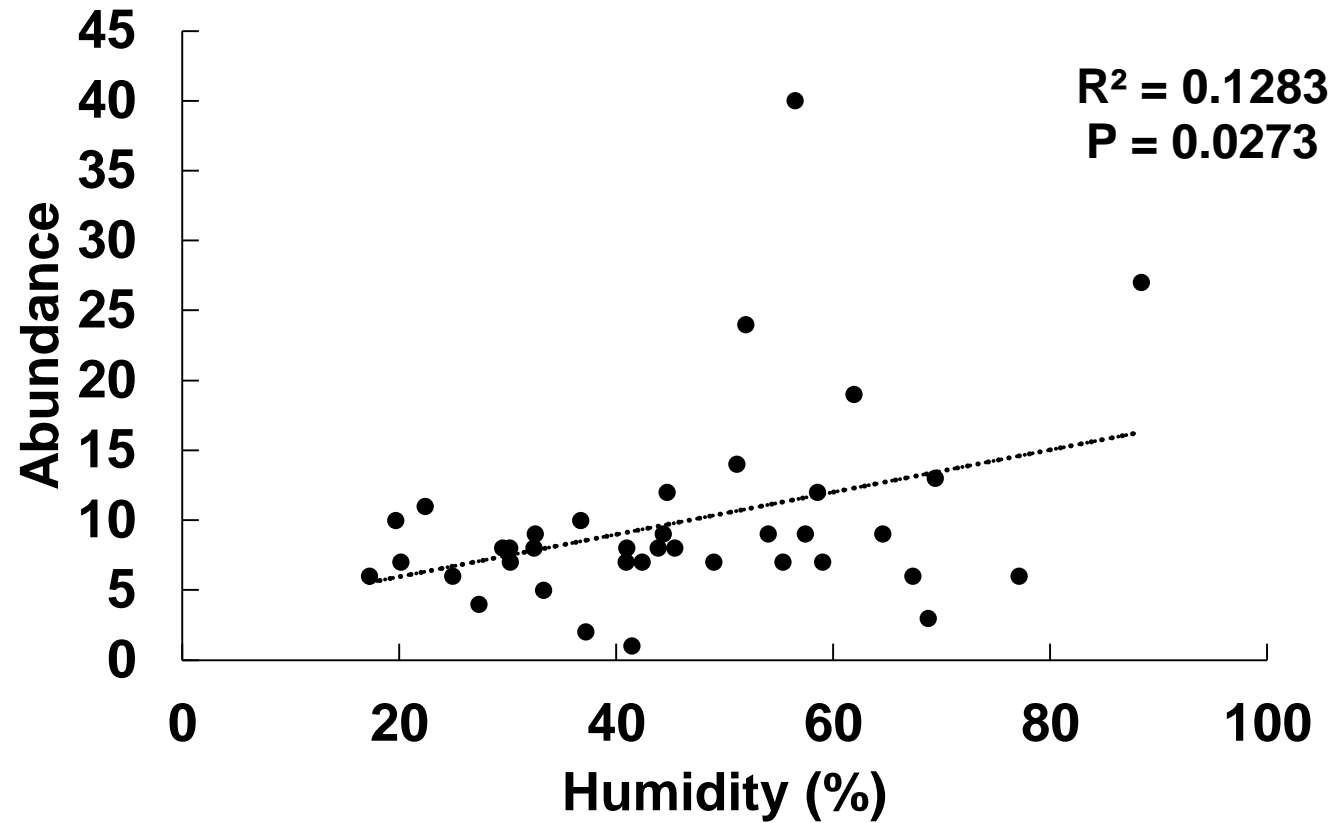
Results: Shannon-Wiener Diversity

- **Spring 2019:** No significant differences among habitats.



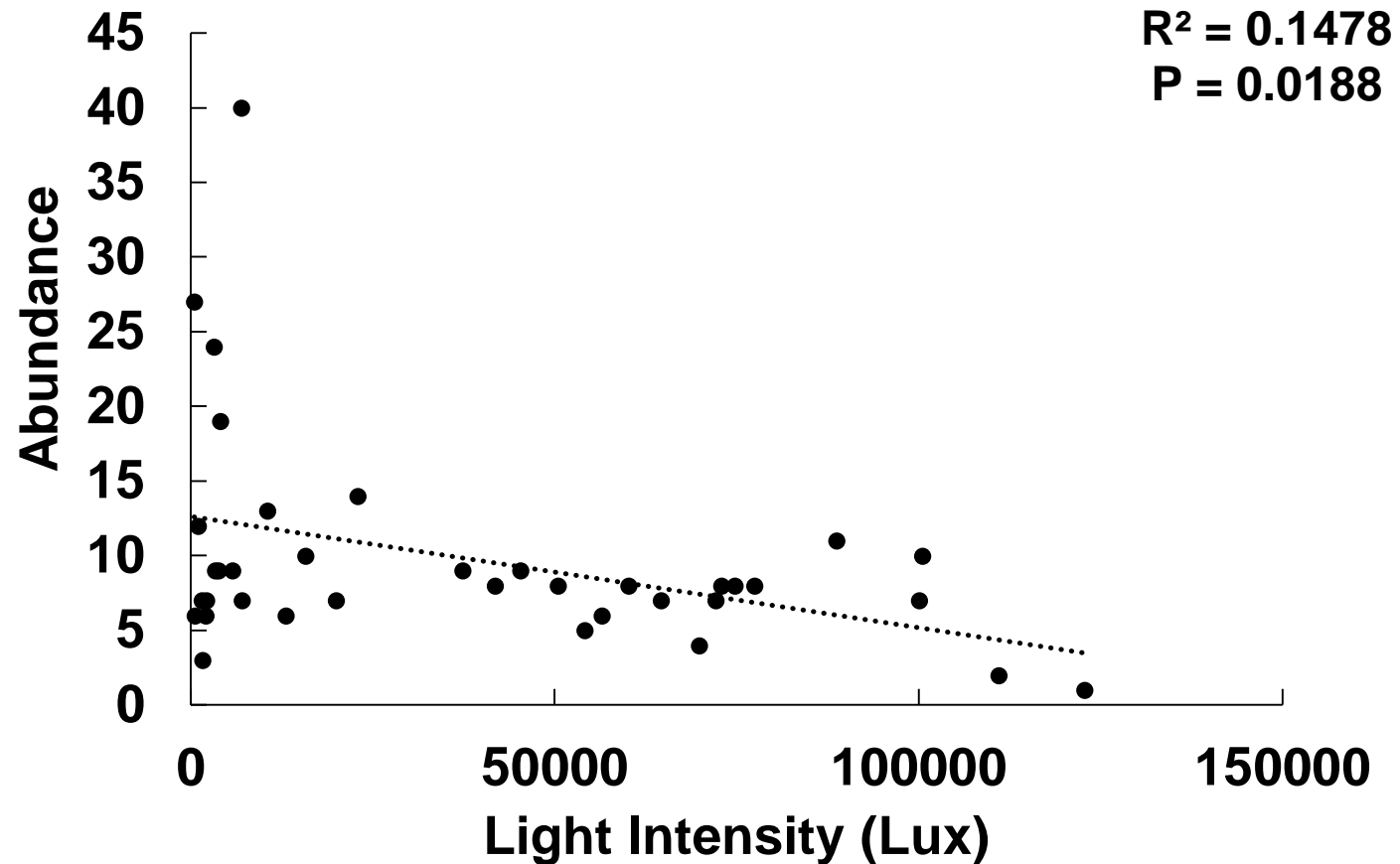
Results: Effects of humidity

- ▶ Abundance had a significant positive correlation with relative humidity.



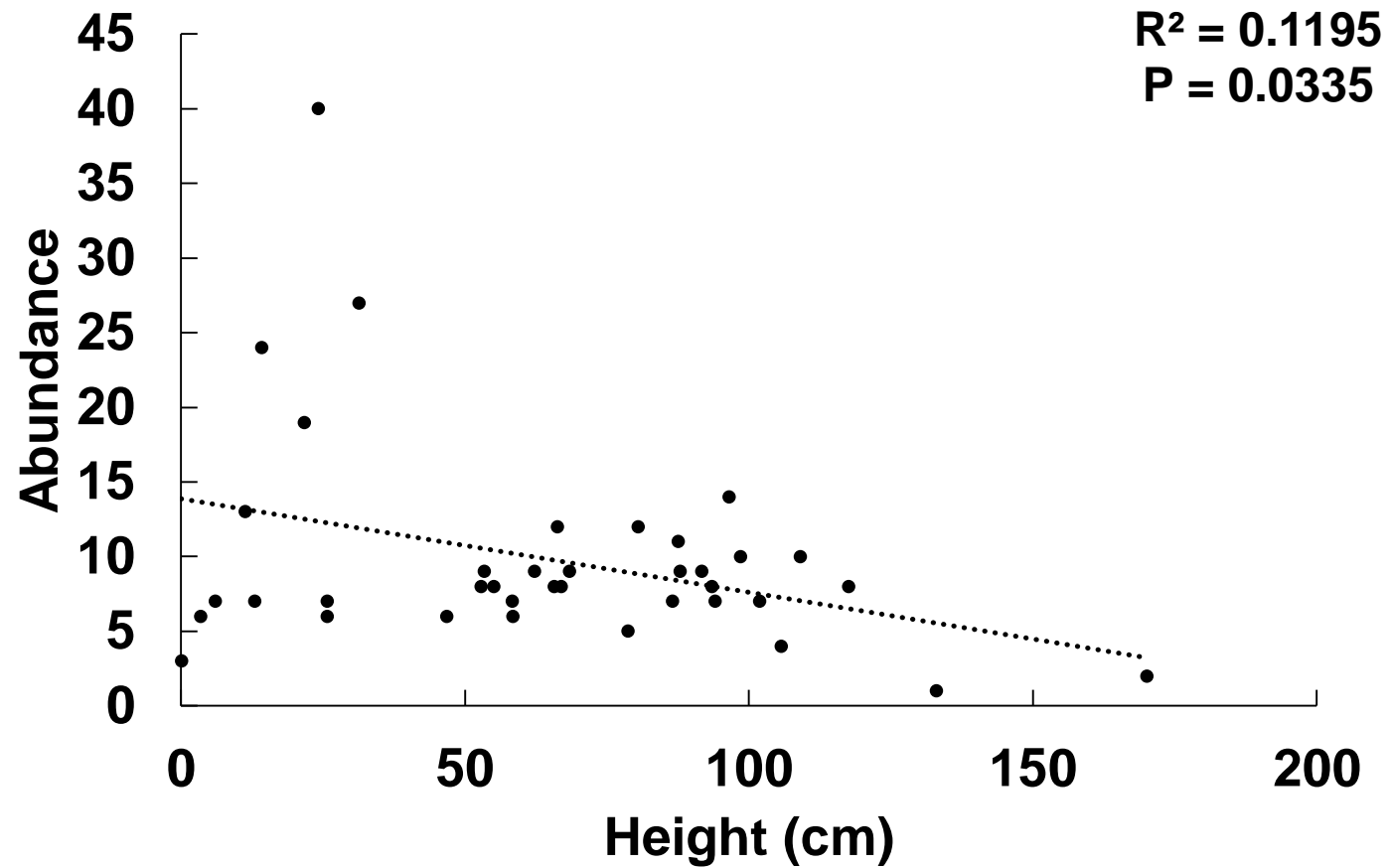
Results: Effects of light intensity

- ▶ Abundance had a significant negative correlation with light intensity



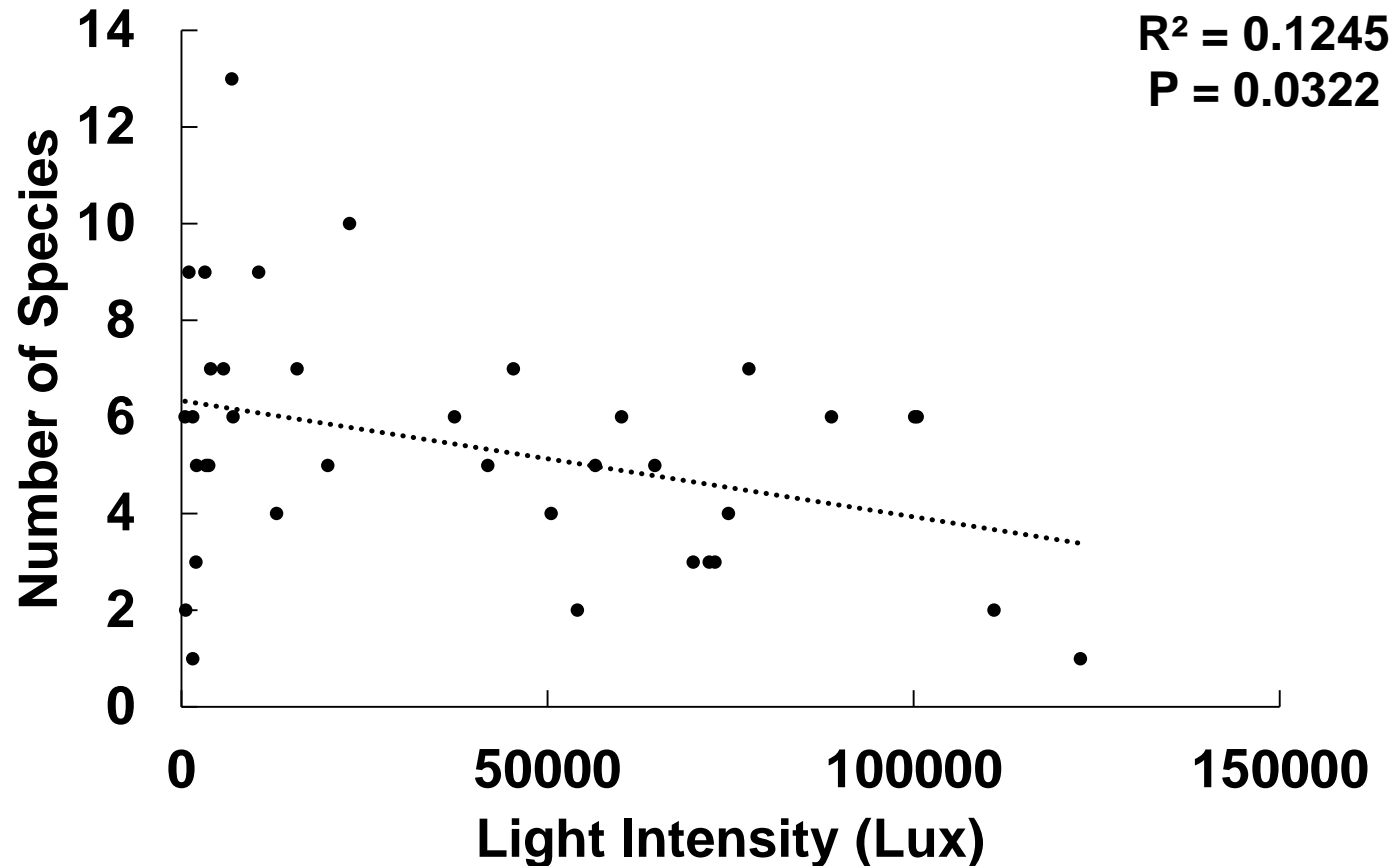
Results: Effects of height

- ▶ Abundance had a significant negative correlation with height



Results: Effects of light intensity

- ▶ Number of species had a significant negative correlation with light intensity



Conclusions and Discussion

- ▶ 11 Families, 51 Genera, 76 Taxa, and 345 Individuals
 - ▶ Rural habitats support diverse spider communities
- ▶ Less diversity and abundance in urban habitats in fall 2018
 - ▶ Provides evidence for negative impacts of urbanization
- ▶ Support for IDH with fall 2018 data but not with spring 2019
 - ▶ Possibly due to lack of “mature spider community” after winter
- ▶ More spiders in humid, low elevation and dark habitats

Discussion

Limitations

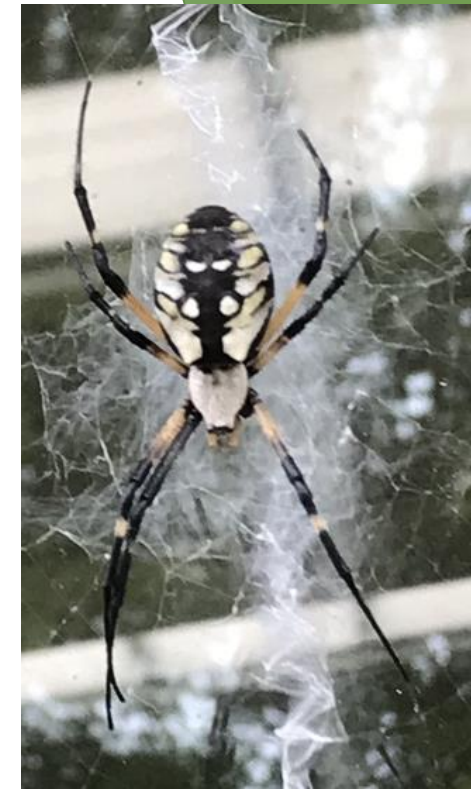
- ▶ Seasonality of spiders
- ▶ Extreme weather

Future Directions

- ▶ Continue sampling to increase sample size
- ▶ Analyze the seasonal variation
 - ▶ Sample throughout the year



Spotted Orbweaver
(*Neoscona crucifera*)



Yellow Garden Spider
(*Argiope aurantia*)

<https://www.inaturalist.org/projects/lancer-park-spiders-fall-2018>

<https://www.inaturalist.org/projects/lancer-park-spiders-spring-2019>

Acknowledgments

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- ▶ This study was conducted as an extension of Longwood BioBlitz (<https://blogs.longwood.edu/longwoodbioblitz/>) under VDGIF Scientific Collecting Permit # 059601.

References

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Questions?

