

Spatial and abiotic effects of urbanization on small mammal communities

Bri Casement, Leslie Lopez, and Nicholas Green

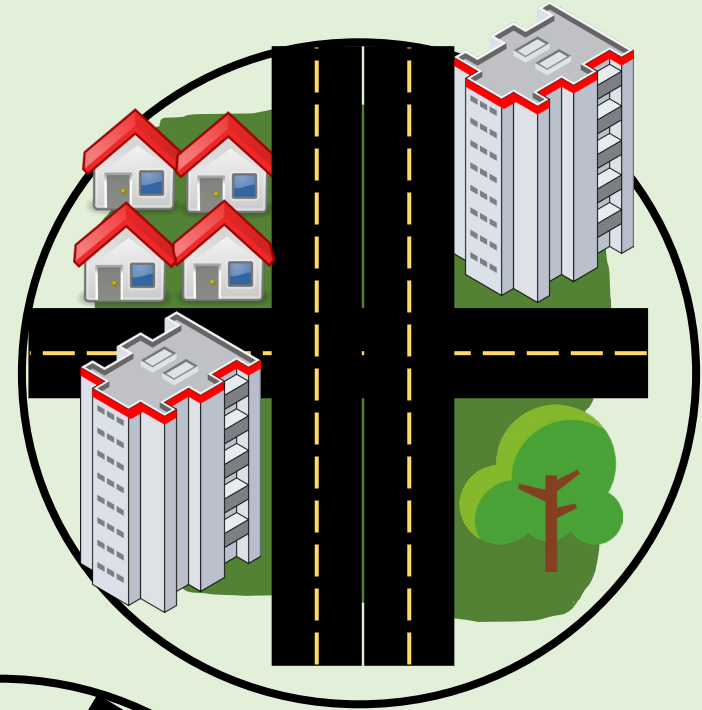
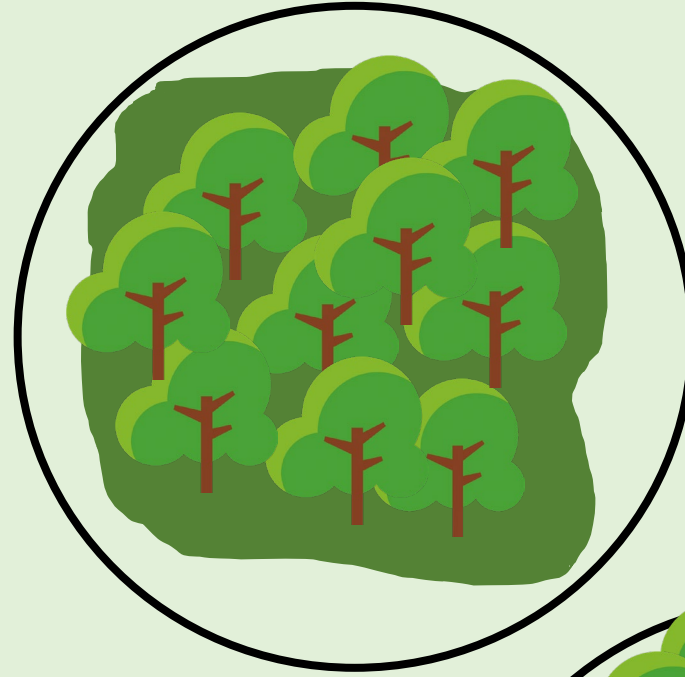
Department of Ecology, Evolution, and Organismal Biology

Kennesaw State University



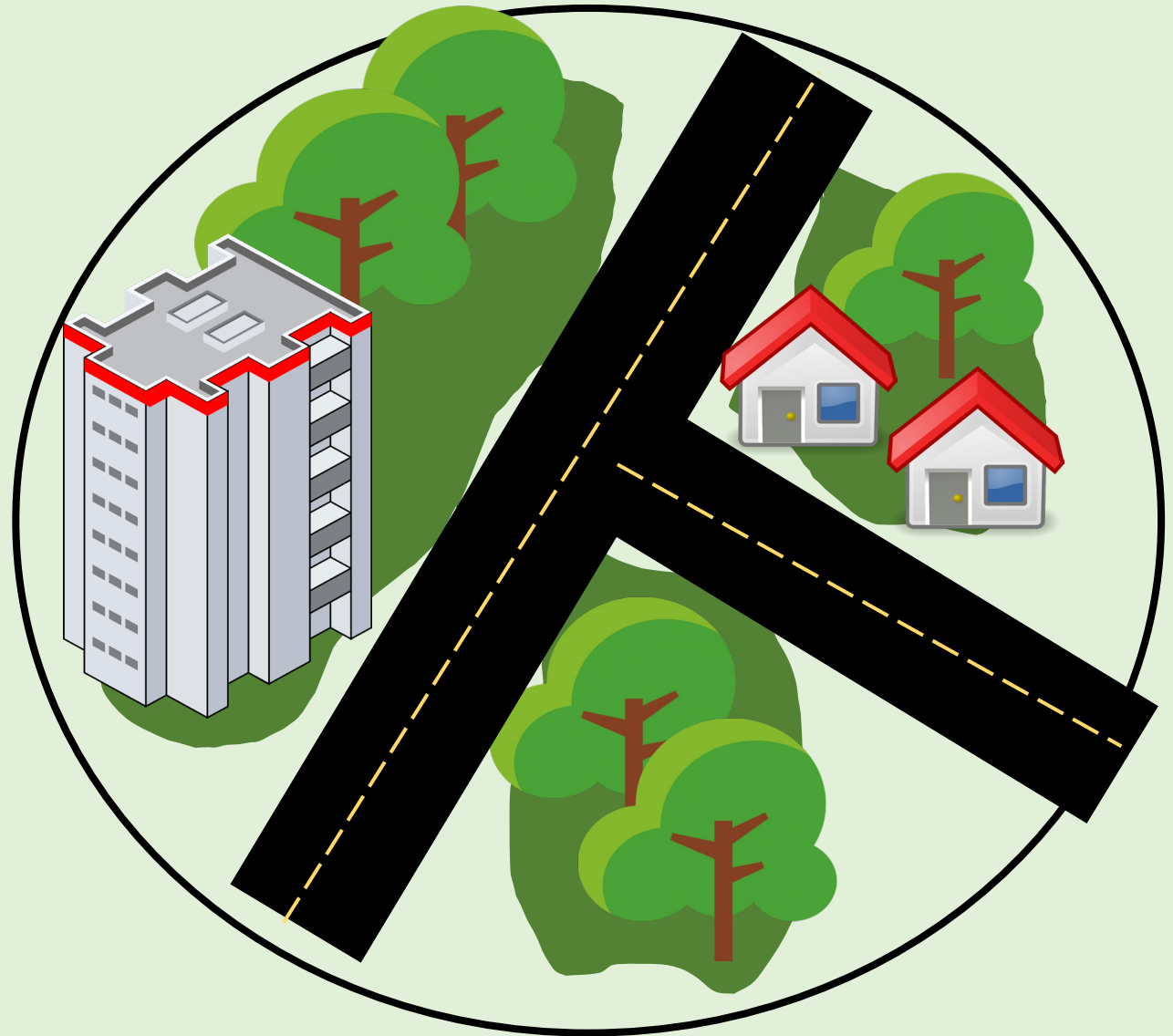
Background and introduction

- **Urbanization:** increasing human population density and artificial structures
- Urban areas are expanding, breaking up natural areas into fragments
- Matrix separates fragments with impervious surfaces
- City life is very different from native habitat life



Effects of urbanization – Overview

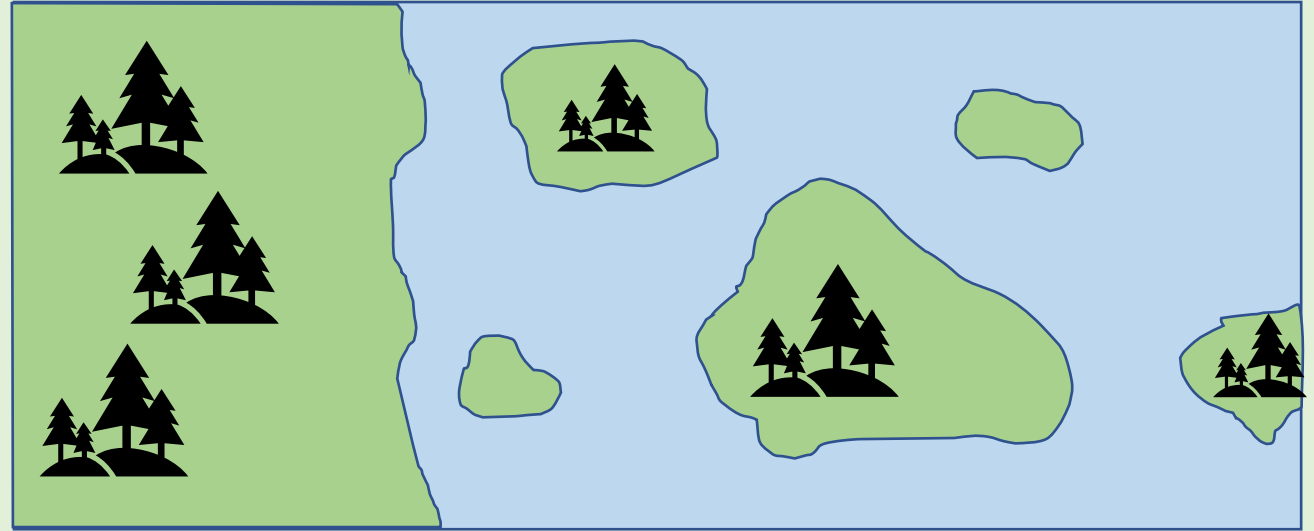
- Spatial changes
 - Fragmentation
 - Matrix (roads and impervious surfaces)
- Environmental changes
 - Urban heat islands
 - Increased noise
- Human factors interact with all of these
 - Human population
 - Income levels



Island biogeography in urban settings

- Islands = fragments
- Remaining large sections = mainland
- Impervious surfaces = matrix surrounding islands
- Animals can survive in urban islands, but more challenges than mainland

Traditional island biogeography



Urban island biogeography



Small mammals in the big city

- Small mammals are excellent study system for effects of urbanization
 - Numerous
 - Diverse
 - Responsive to local conditions
 - Ecosystem services
 - Baseline biology well understood



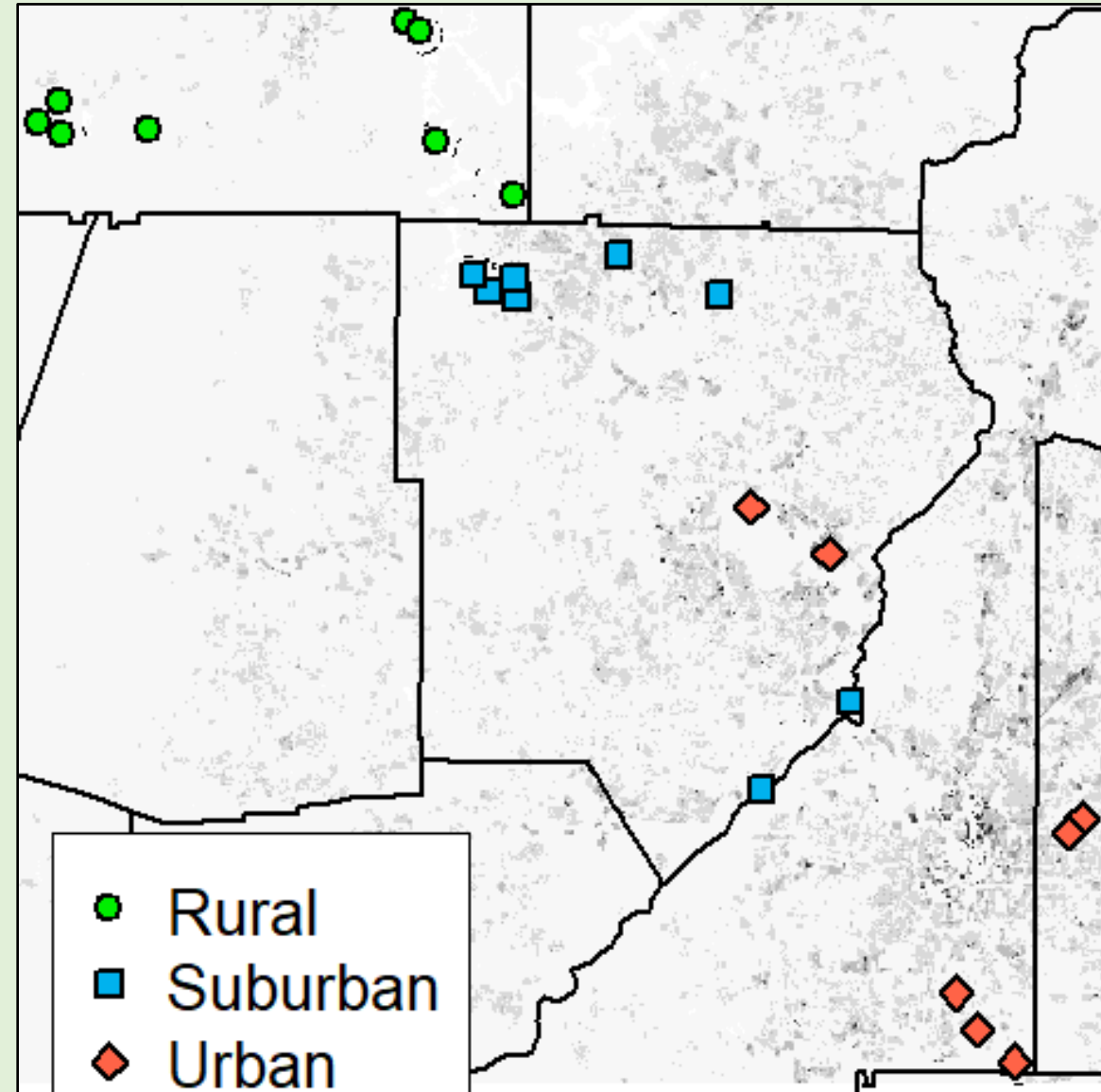
Objectives and Hypotheses

- **Main objective:** Determine what spatial aspects, environmental conditions, and socioeconomic factors affect small mammal community structure along an urban-rural gradient.
- Tested several hypotheses:
 1. **Hypothesis 1:** Small mammal community structure in urban habitat fragments driven by processes described in IBT
 2. **Hypothesis 2:** Small mammal responses to urbanization driven by human processes such as pollution and socioeconomic factors



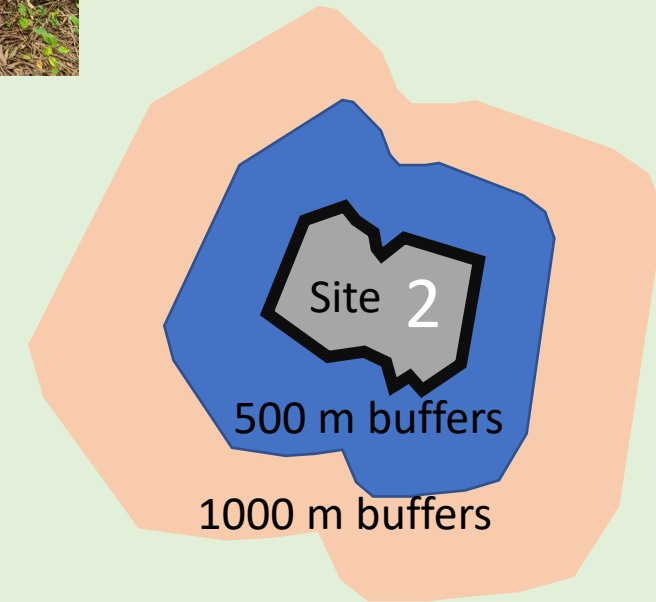
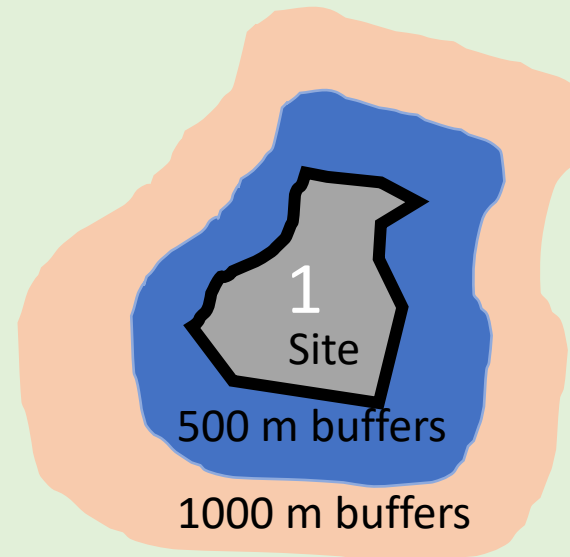
Field methods: small mammal sampling

- 23 sites along urban-to-rural gradient
- 640 trapnights per site, 14,720 total
- Individuals caught:
 - Identified to species
 - Weighed and measured
 - Assessed sex and reproductive status
 - Tagged and released



Methods: variable collection

- Environmental variables collected in field
- Spatial variables of each site measured with GIS
- Socioeconomic variables found through U.S. Census Bureau
- Socioeconomic and environmental variables related to site level buffers



Methods: data analysis

- Endpoints (response variables)
 - Small mammal richness
 - Small mammal community structure (Simpson's Index, D)
 - Small mammal population density
- Explanatory variables
 - Human population, land cover, elevation, ambient noise, temperature, socioeconomic variables

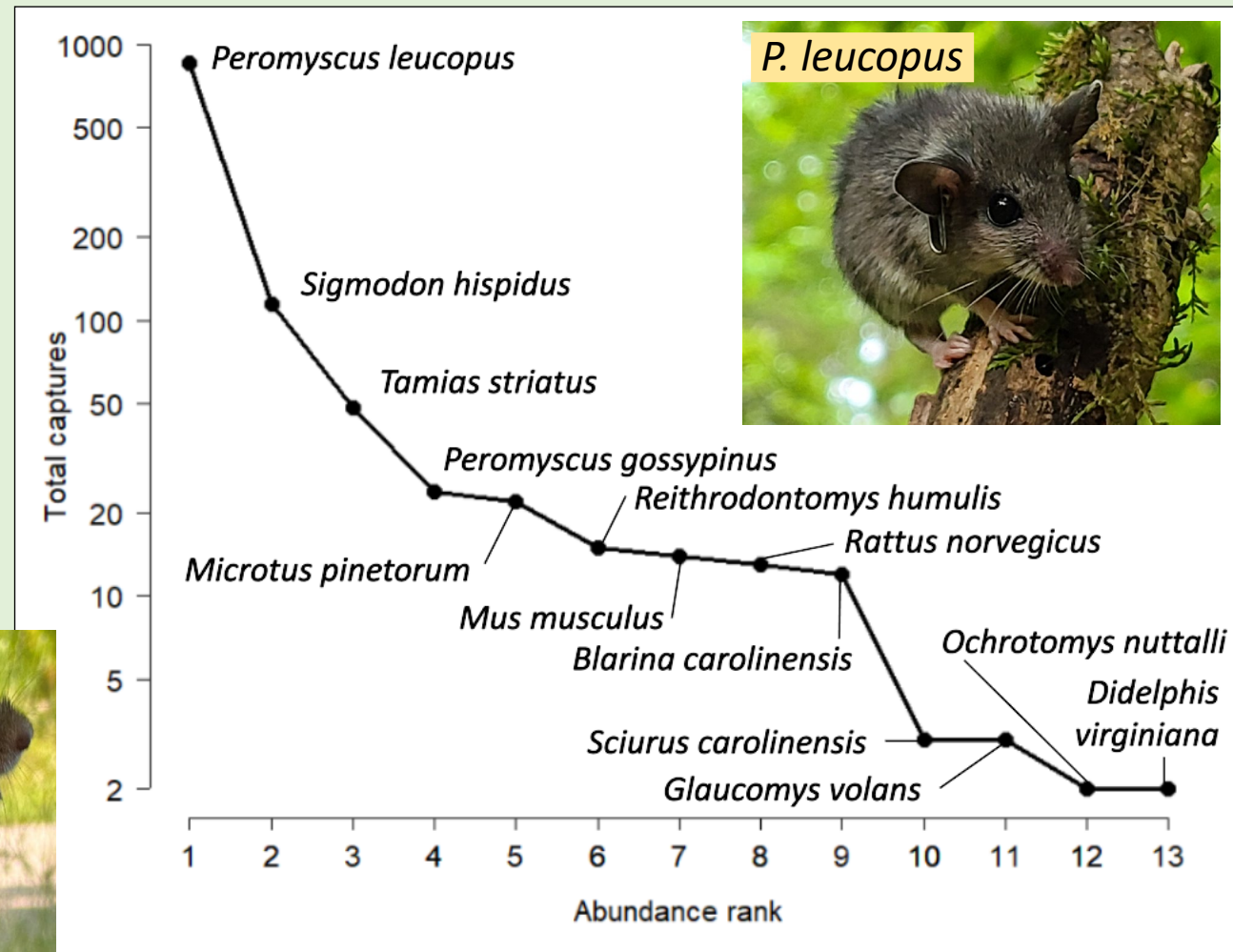
Approach

1. Screened for correlations between response and explanatory variables
2. Kruskal-Wallis tests for richness and Simpson's index
3. NMDS and MRPP to test for differences in community structure



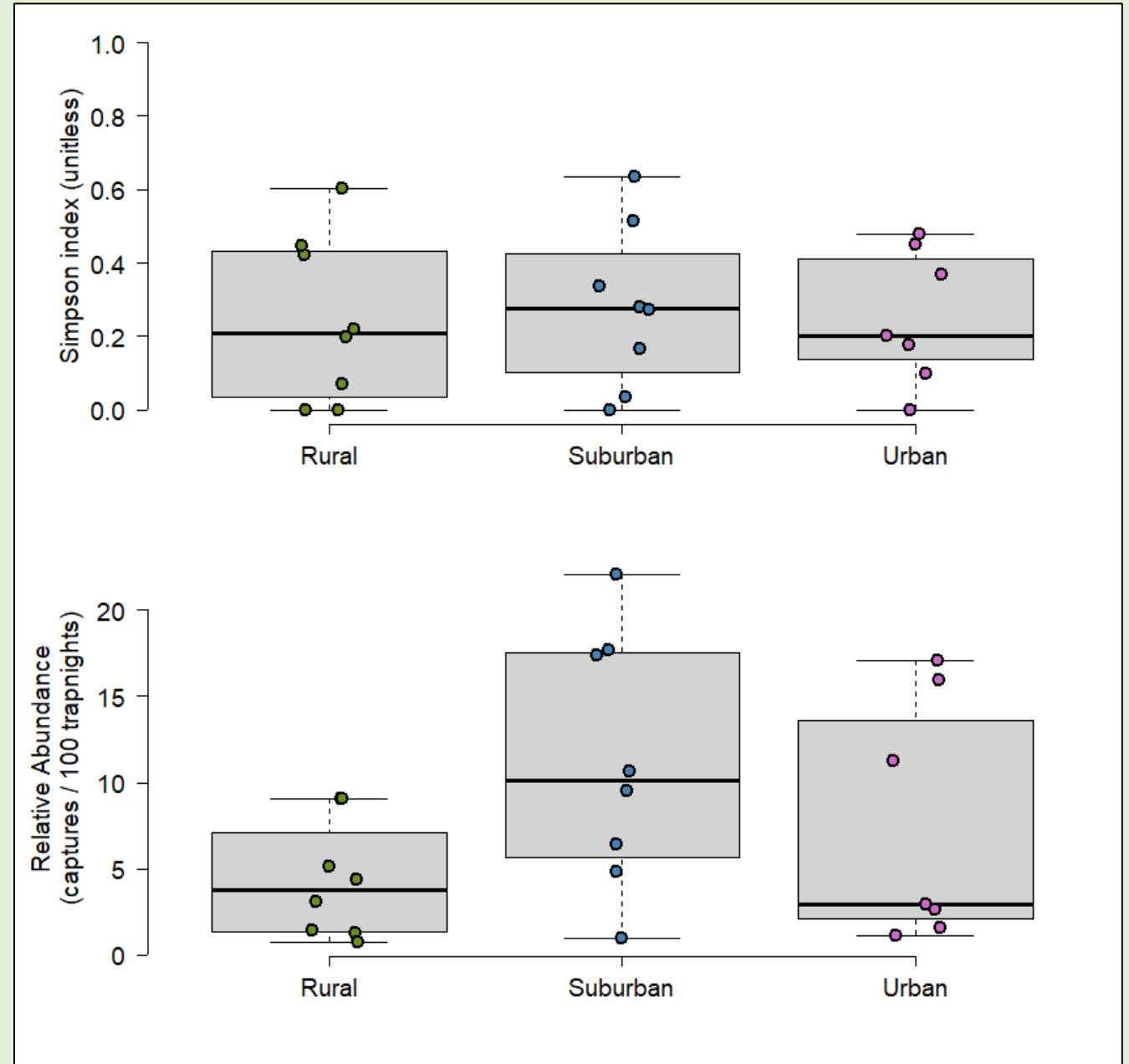
Results- rank abundance

- 1,135 total captures of 13 species
- Captures dominated by *P. leucopus*
- Species excluded: *G. volans*, *O. nuttali*, *S. carolinensis*, and *D. virginiana*
- Human commensals not seen as frequently as expected



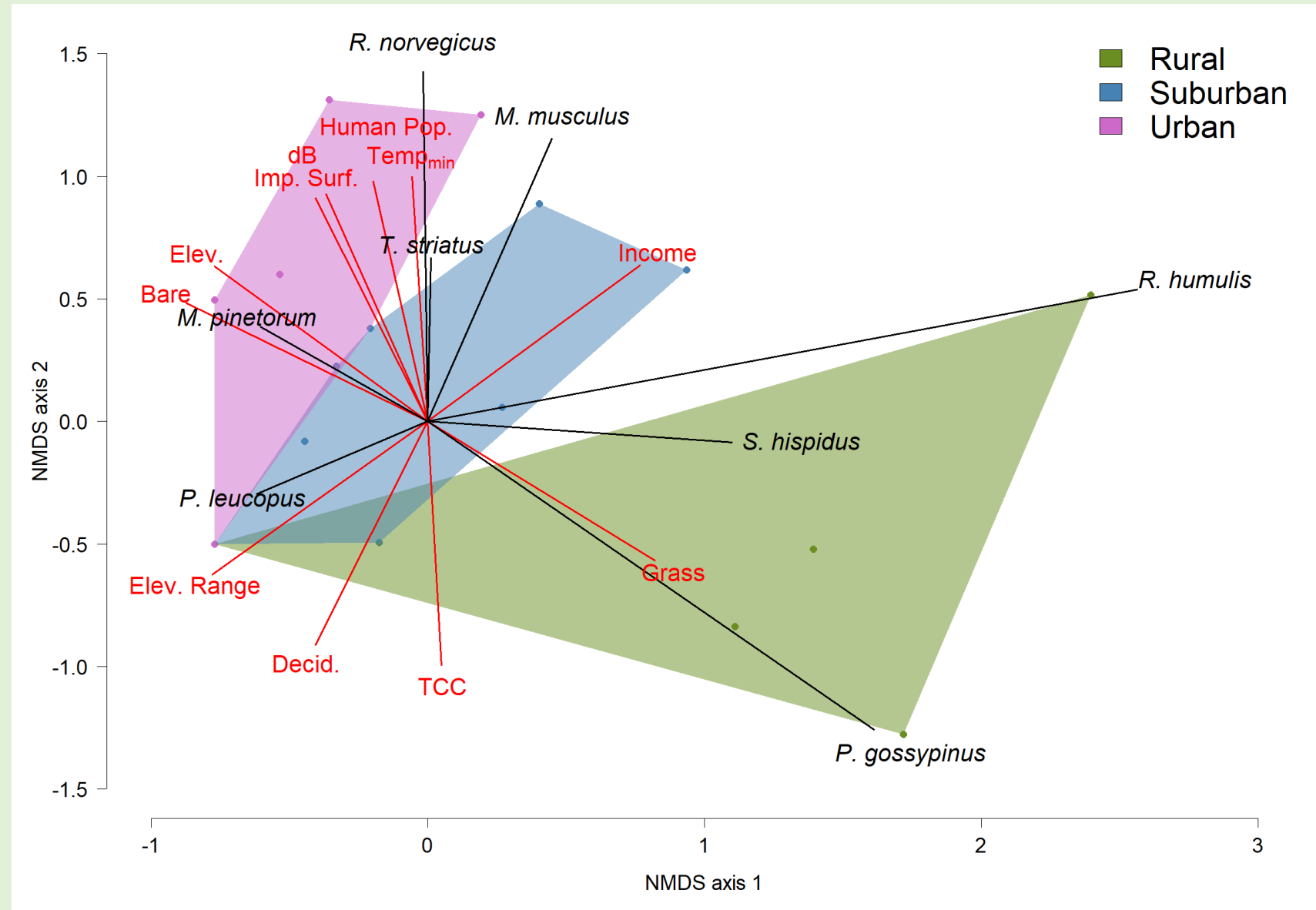
Results

- Simpson's index and overall abundance did not differ significantly between treatments
- Kruskal-Wallis tests, $P > 0.05$



Results

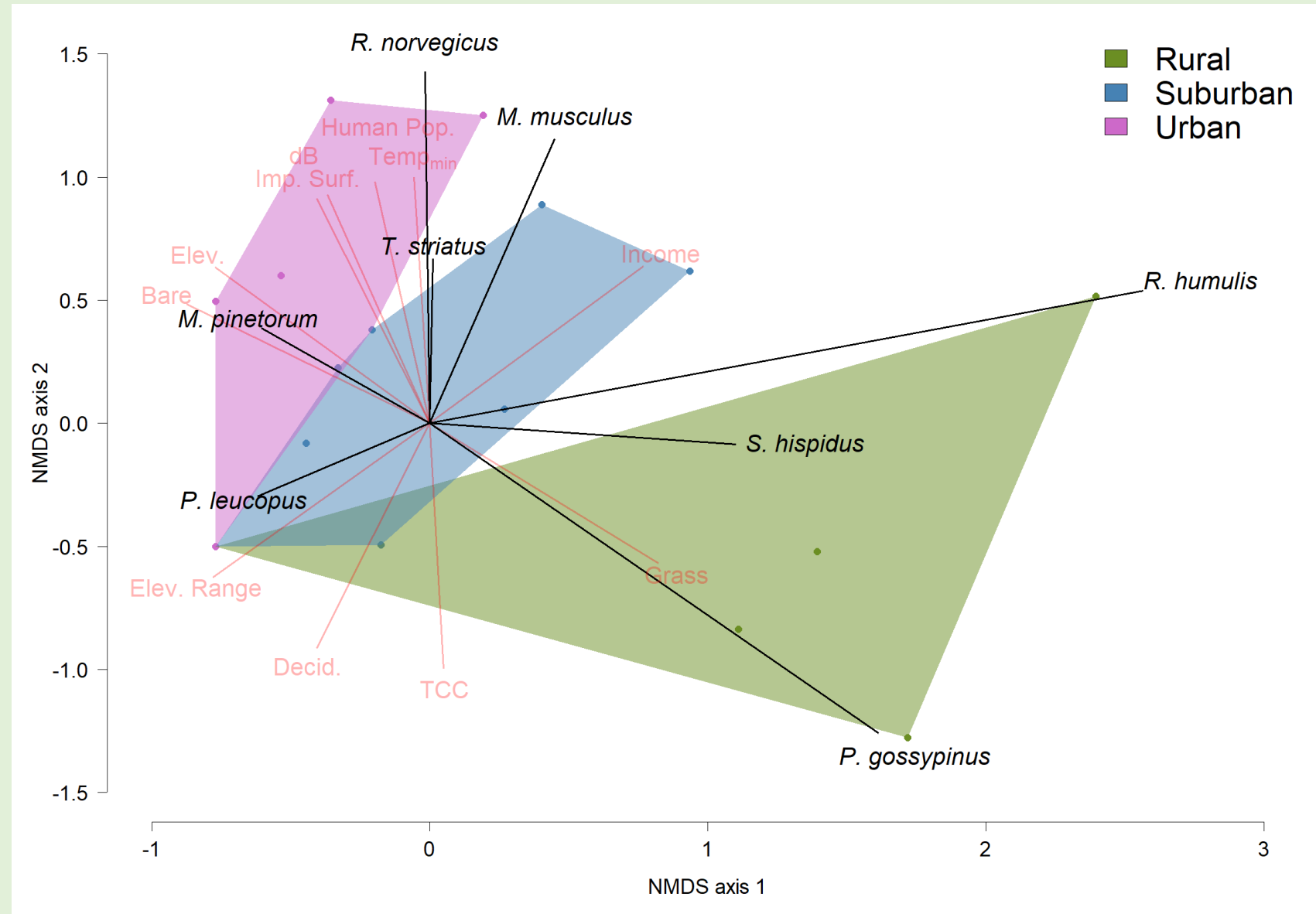
- Black lines show species densities
- Red lines show predictor variables
- Urban, suburban, and rural are significantly different from each other (MRPP A = 0.11, $P < 0.05$)



NMDS ordination using variables in 1000 m buffer

Results

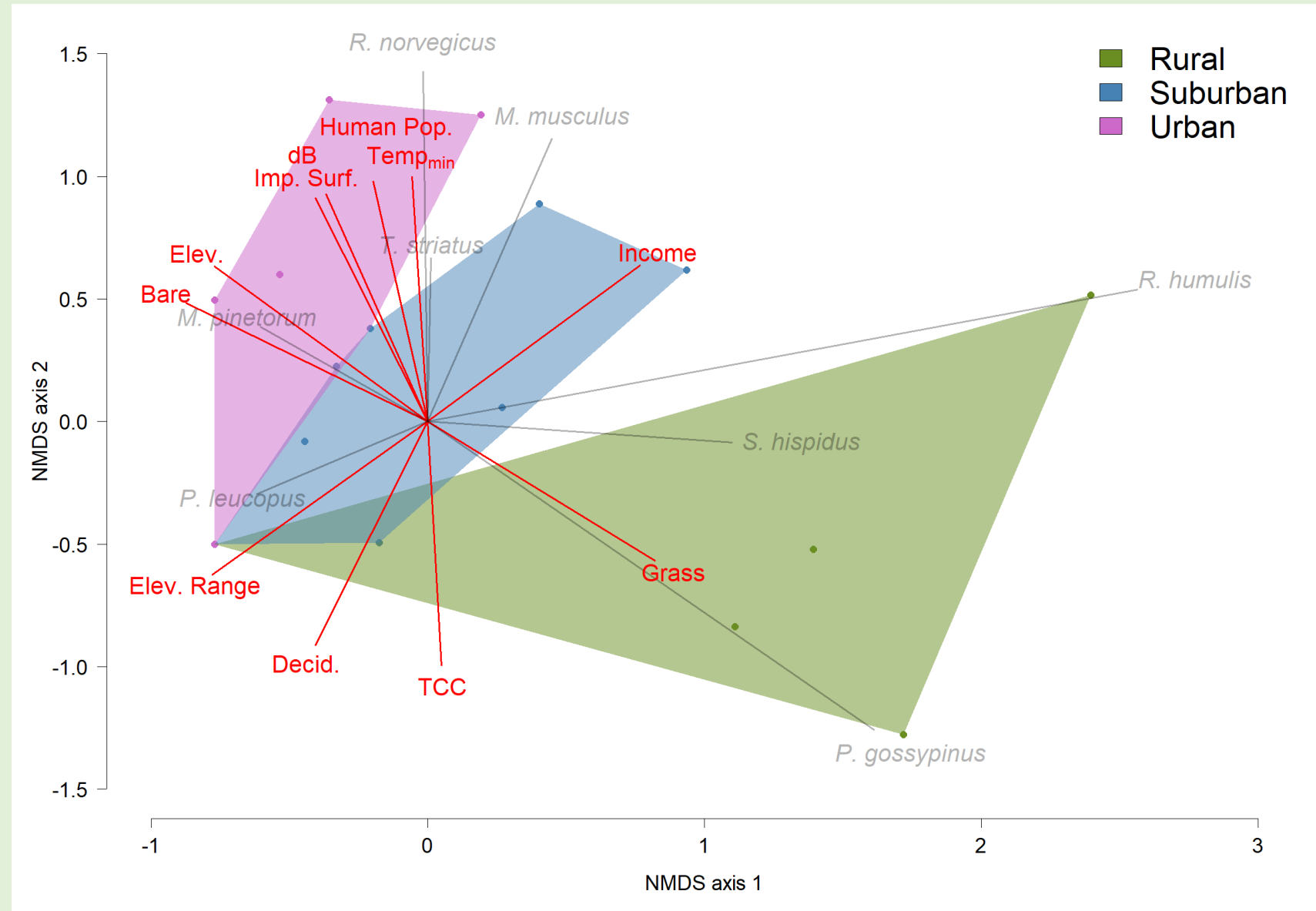
- *S. hispidus*, *R. humulis*, *P. gossypinus* associated with rural areas
- *M. pinetorum* and *R. norvegicus* associated with urban areas
- *P. leucopus* abundant at all levels of urbanization
- *M. musculus* and *T. striatus* not associated with urbanization



NMDS ordination using variables in 1000 m buffer

Results

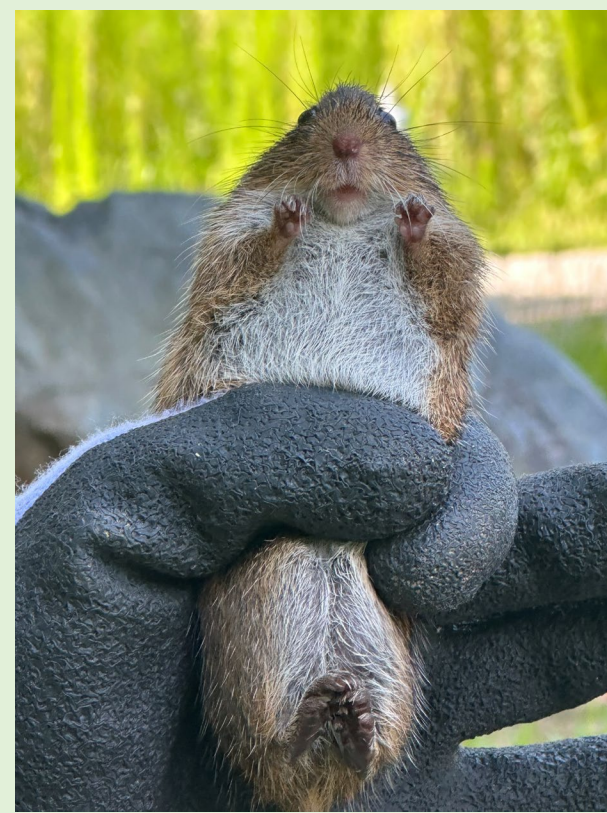
- Grass cover, tree canopy cover, deciduous tree cover greater in rural areas
- Human population, minimum nighttime temperature, impervious surfaces, and decibels greater in urban areas
- Median household income and elevation ranges not associated with urbanization



NMDS ordination using variables in 1000 m buffer

Conclusion

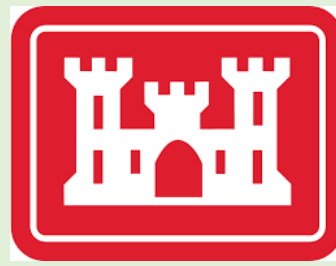
- *P. leucopus* dominated sites regardless of degree of urbanization
- Univariate measures of small mammal community structure and richness not significantly different across urban-to-rural gradient
- Multivariate analysis showed small mammal densities driven by several environmental, spatial, and socioeconomic variables



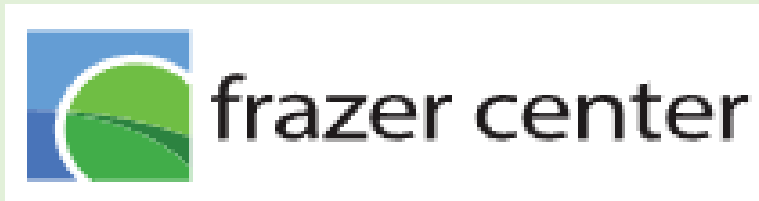
Acknowledgements

Thank you to Kennesaw State University, our undergraduate student researchers, and the organizations below for allowing us to sample their land!

- USACE
- Cobb County Parks Department
- Georgia Power at Plant Bowen
- Frazer Forest
- Fernbank Museum of Natural History
- Atlanta Expo Center
- The Conservation Fund



Georgia Power



World Class Show Facilities





Thank you!

