

# Testing the Theory of Island Biogeography on Micro-habitats

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## Introduction

- The theory of island biogeography posits that the diversity of species on an island varies with its distance from a mainland and island volume (MacArthur and Wilson 1967).
  - Studies equilibrium of new species immigration & local species extinction
  - Factors in environmental disturbance as affecting biodiversity and populations
  - Urbanization embodies this aspect
- This study argued that the theory can be applied to any fragmented habitat, specifically microhabitats (used log microhabitats).
- The objectives were to observe how proximity to disturbance and log size influence species richness and abundance in an urban environment.

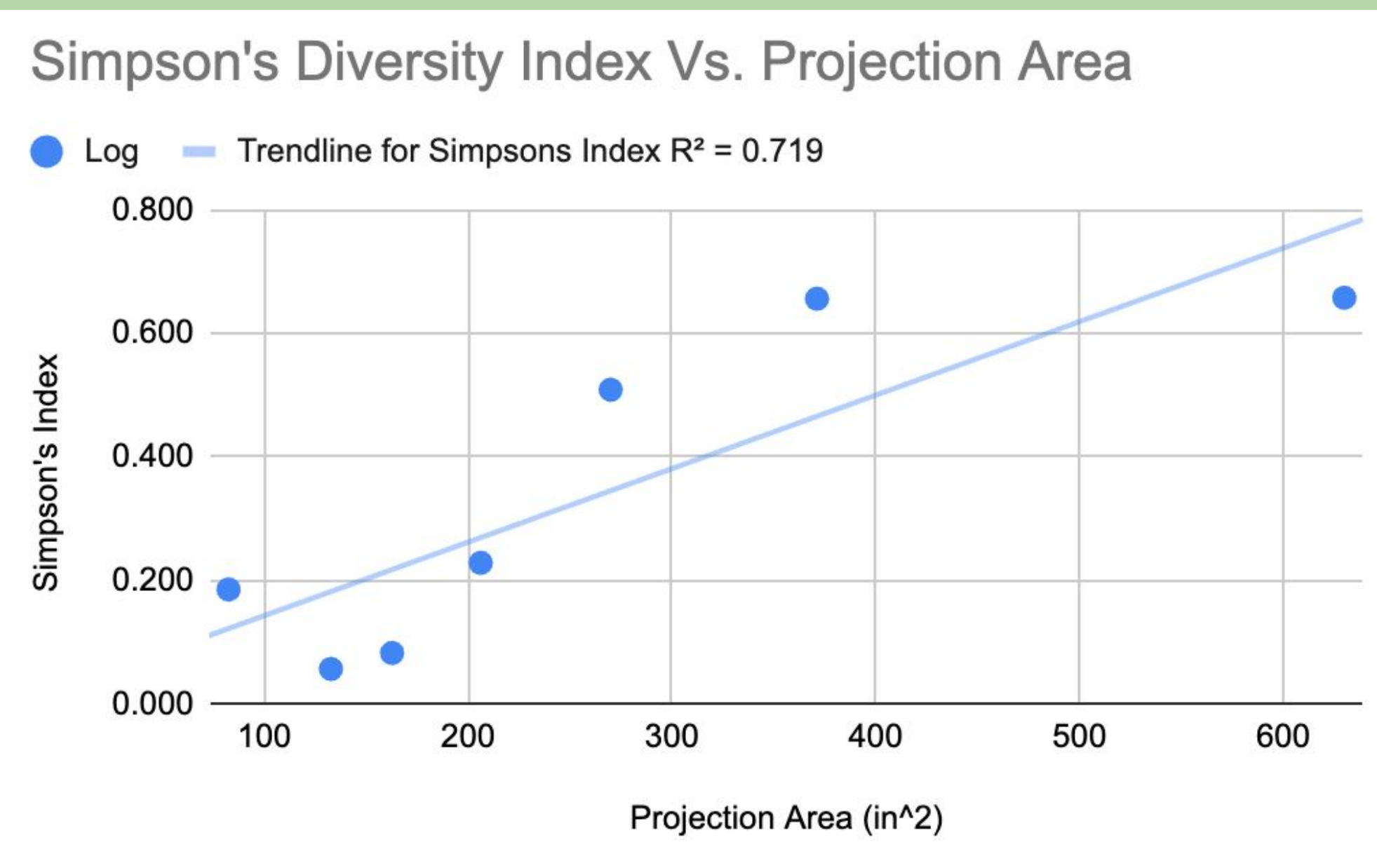


Figure 1: Simpson's Diversity Index vs. projection area, n = 7. Linear trendline,  $R^2 = 0.719$ .

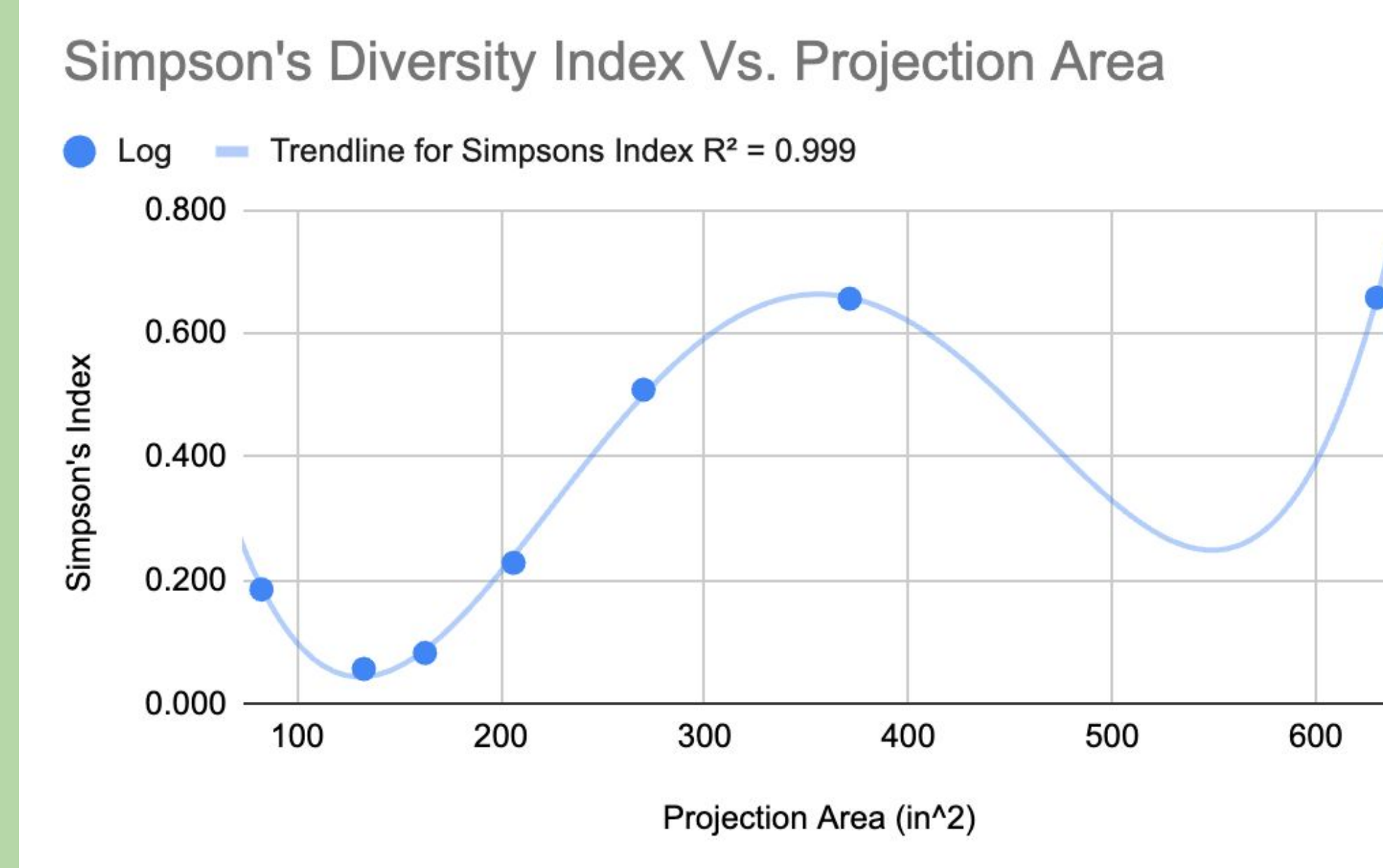


Figure 2: See Figure 1. 4<sup>th</sup> degree polynomial trendline,  $R^2 = 0.999$ .

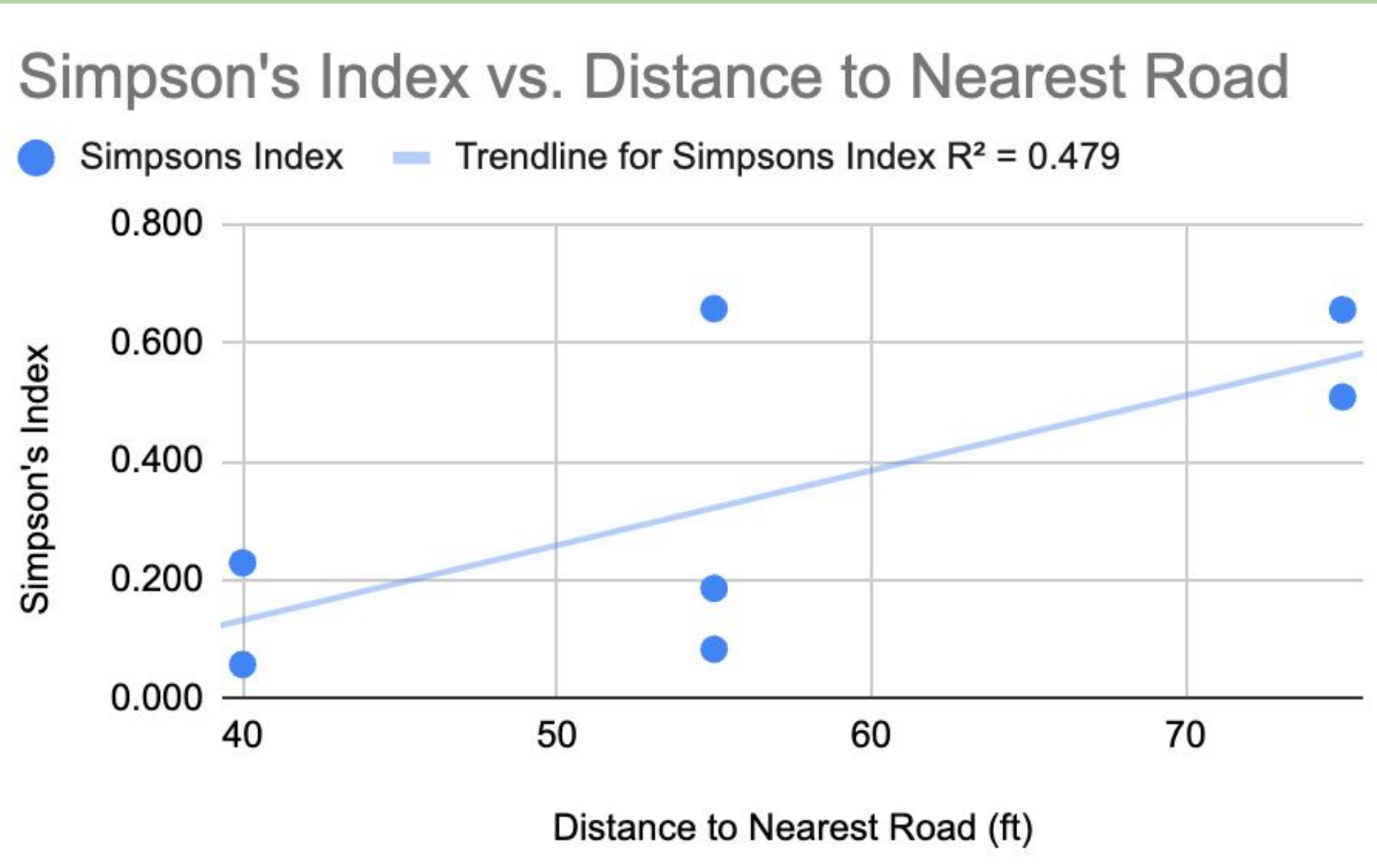


Figure 3: Simpson's Index vs. distance to nearest road, n = 7. Linear trendline,  $R^2 = 0.479$ .

Table 2: Identifying Generalist Versus Specialist Species

Sample	Site/Log	Species Alignment	Common Name	Generalist or Specialist
ASC-000	1,1	Cylindroiulus caerulescinctus	Blue-black millipede	Generalist
ASC-001	1,1	Lygaeus turgicus	Fable milkweed bug	Specialist
ASC-003	1,1	Cylindroiulus caerulescinctus	Blue-black millipede	Generalist
ASC-013	1,3	Armadillidium vulgare	Common Pill bug	Generalist
ASC-017	2,2	Scarites subterraneus	Big-headed ground beetle	Generalist
ASC-018	2,2	Lumbricus terrestris	Common Earthworm	Generalist
ASC-024	3,2	Armadillidium nasatum	Rough Pill Bug	Generalist

Figure 4: Table identifying DNA-sequenced and species-aligned samples as generalist or specialist, n=8

## Methods

### Sample Collection

- Collected from wetland, garden and woodland sites
- Invertebrates were collected by turning over logs at each site, sampling 2-3 logs per site
- Log volume, projection area, distance to road, and moisture were measured.

### DNA Isolation, Extraction, PCR, Gel Electrophoresis

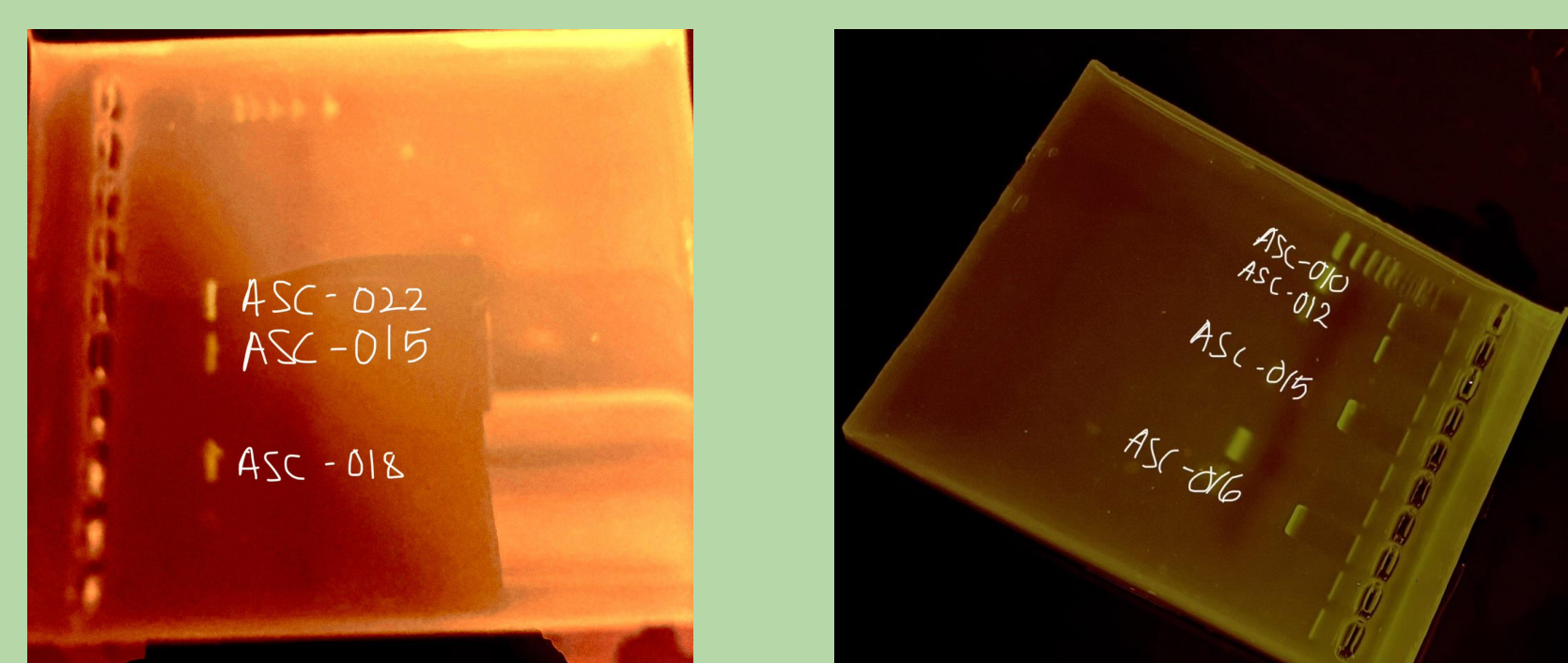
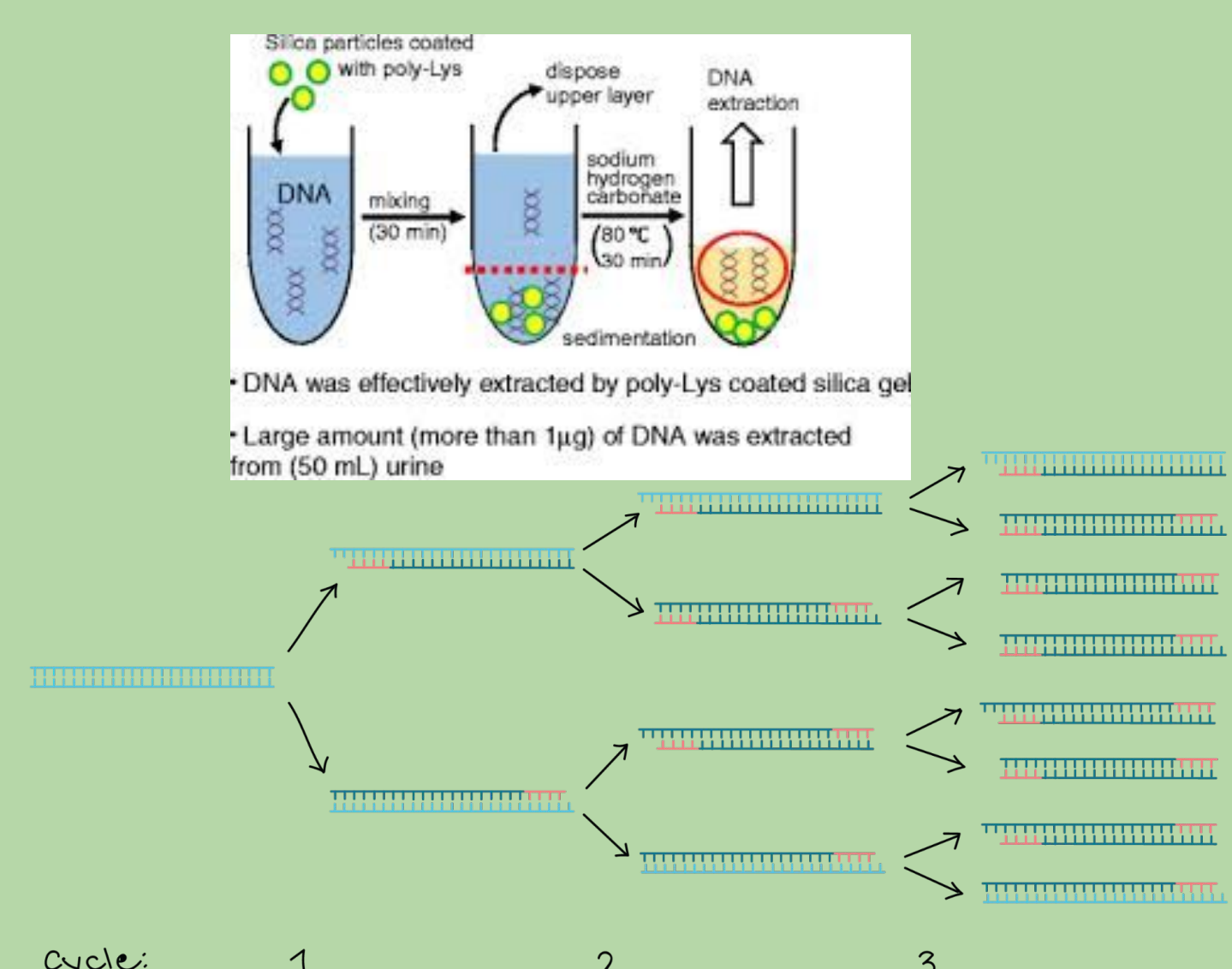


Photo 1: Log 1 from the native plant garden; the outlier.



Photo 2: Log 3 from the native plant garden; standard shape.

## Acknowledgements

Thank you to Howard Waldman, the team's lab mentor, for assistance in creating the procedure, and providing the resources, space, and time necessary to complete it.

## Discussion

- The results support the correlation between habitat size and species richness.
- Figure 1 reveals an outlier. Log 1 from the Native Plant Garden lies far to the right of the graph, weakening the positive linear trend.
  - This log's shape was different from all the others; it had an irregular similar to the letter 'y' (see photo 1).
  - Because the log's shape directly affects its volume and projection area, the irregular shape likely caused the outlier.
- Our results do not support distance to the nearest road as a proxy for distance from the mainland.
- The difference in human traffic at each site was likely the true source of anthropogenic disturbance, not the nearest road.

## Errors

- The team's largest challenge was estimating the number of individuals in each species while simultaneously collecting samples.
  - Likely exacerbated by the tendency of certain species to live underground.
  - Estimation errors would significantly impact Simpson's Index calculations.
- Did not procure a large number of bands during electrophoresis, likely a result of improper technique during the DNA extraction or PCR process.

## Conclusion

Isolating the effect of proximity to a mainland has become increasingly challenging as urbanization and, thereby, environmental disturbance have increased since the theory's creation. Overall, this experiment lays the foundation for future research on how urbanization affects the relevance of the theory in microhabitats.

## References

- <sup>1</sup> MacArthur, R. H., & Wilson, E. O. (1967). *The Theory of Island Biogeography*. Princeton University Press.
- cheffers, B. R., Edwards, D. P., Diesmos, A., Williams, <sup>2</sup> S. E., & Evans, T. A. "Microhabitats Reduce Animals' Exposure to Climate Extremes." *Global Change Biology* 20, no. 2 (February 2014): 495–503. <https://doi.org/10.1111/gcb.12439>

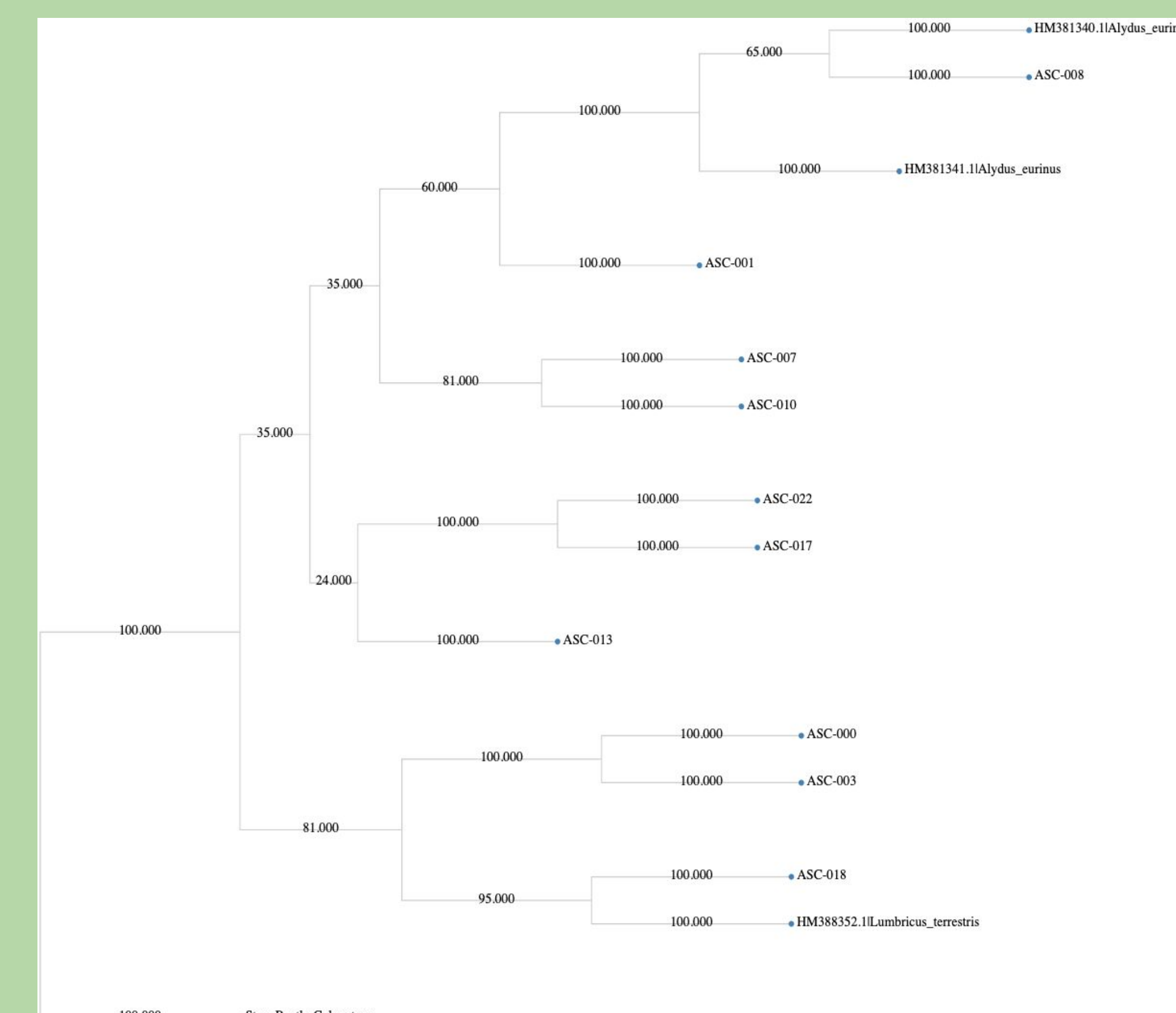


Figure 5: Neighbor-joining phylogenetic tree of all successfully processed samples