EVALUATION OF THE RELATIONSHIP BETWEEN STREAM MICROHABITATS AND TAXA AND TRAIT DIVERSITY IN PIEDMONT STREAMS IN NORTH CAROLINA

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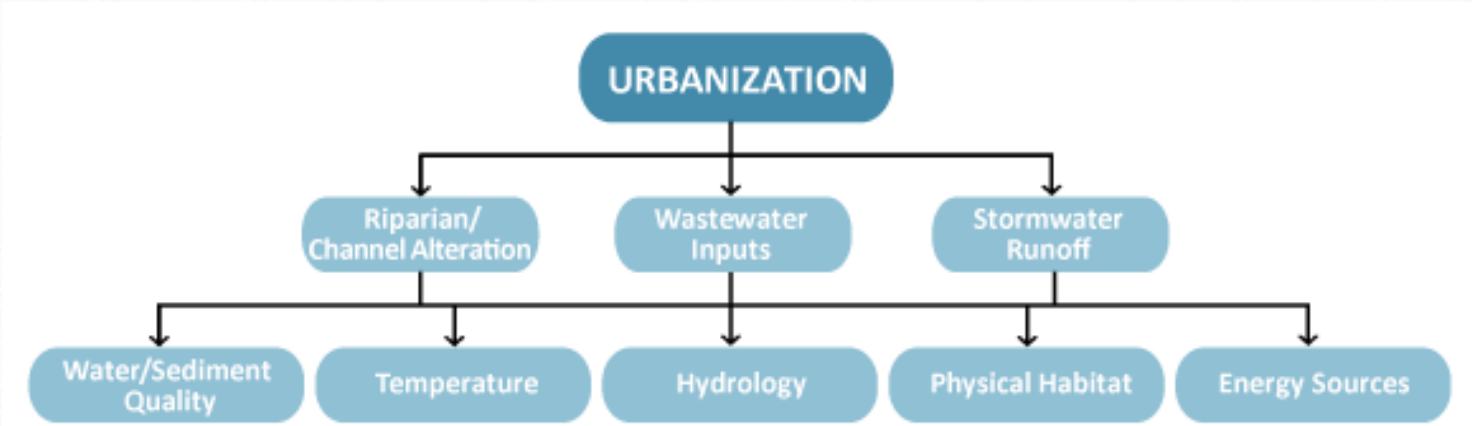
Urban Stream Syndrome

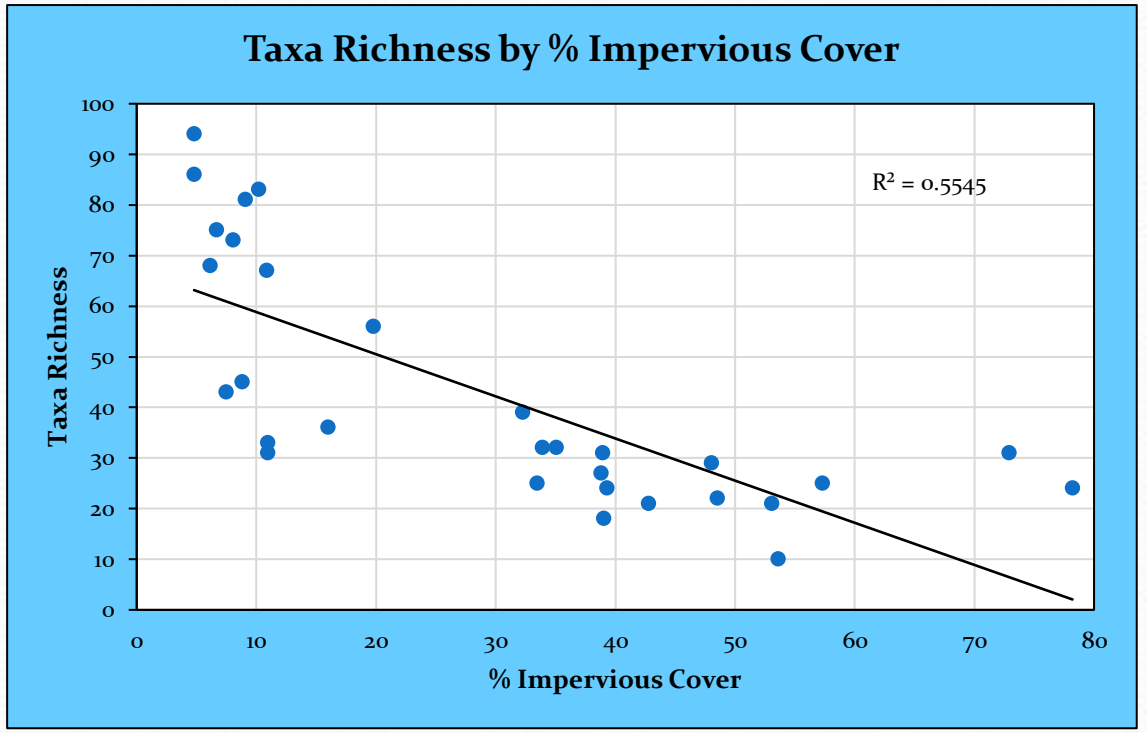
- Stream habitat quality and benthic macroinvertebrate community diversity are negatively impacted by urbanization



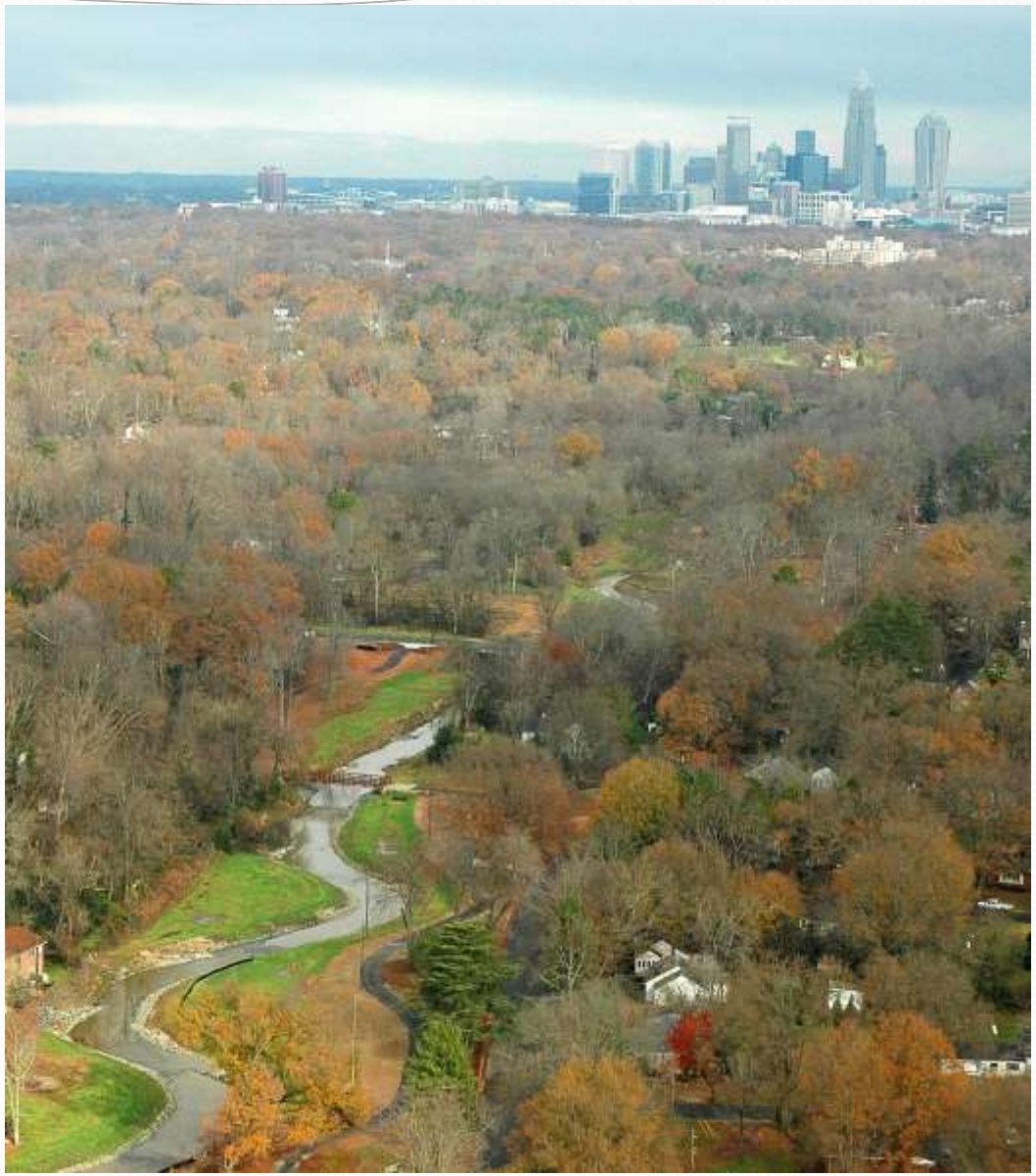
Urban Stream Syndrome

- Negative impacts on Total Taxa and EPT Taxa Richness can be seen at Impervious Cover as low as 5% (Schueler 1994, Paul and Meyer 2001, Cuffney et al. 2010).

- Watershed managers respond to urban stream degradation by repairing degraded streams using stream restoration techniques.



- Stream restorations that just address geomorphological channel characteristics without addressing the ecological requirements of benthic macroinvertebrates fail to stimulate recovery of the benthic macroinvertebrate community (Palmer et al. 2005; Sudduth et al. 2011).



Research Questions

- To better inform restoration design and implementation, **this study** investigated the relationship between stream habitat quality and benthic macroinvertebrate community diversity and function.

- **How are taxa and taxa traits distributed within and between the microhabitats found in streams?**

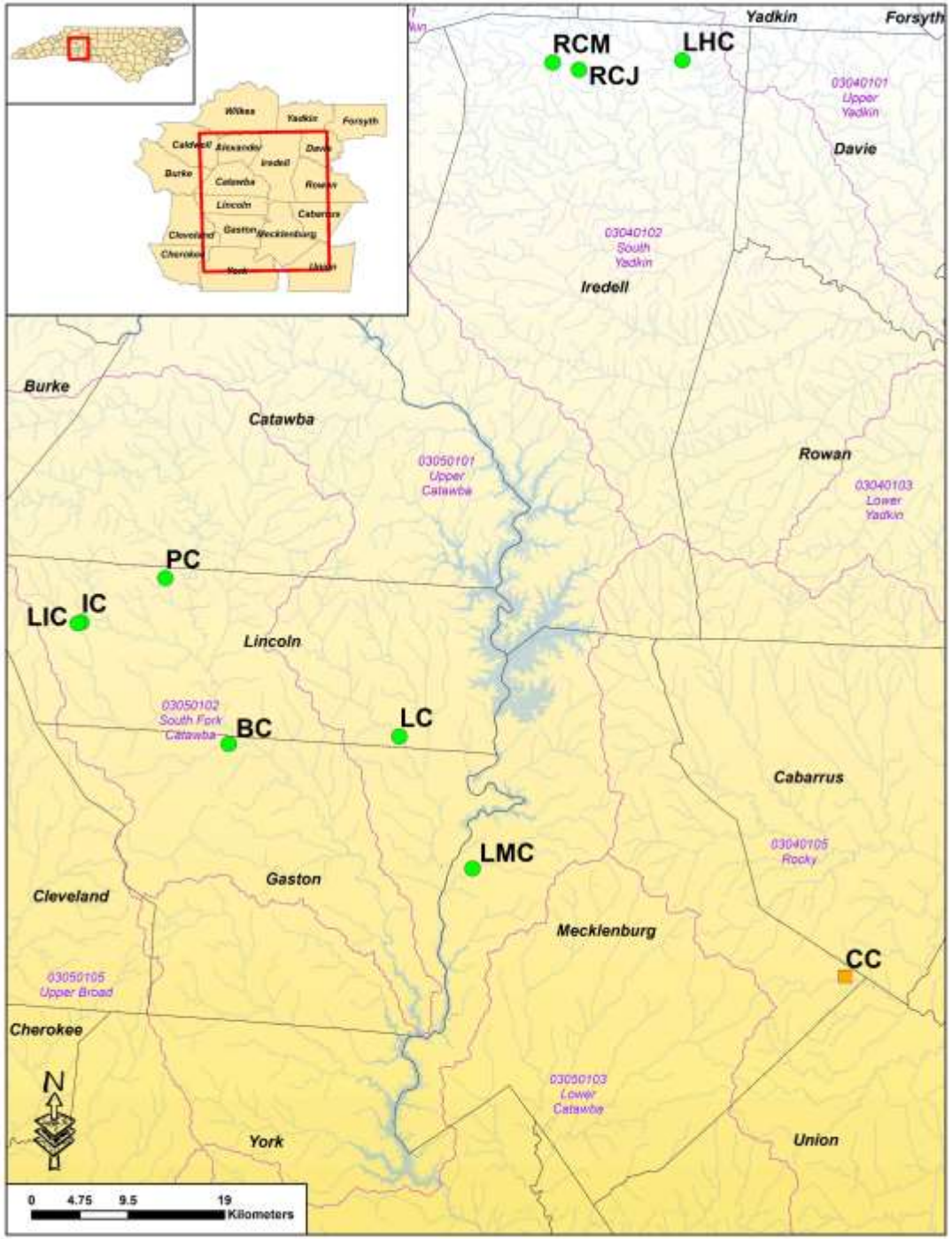
  a. I hypothesized that similar traits are found among the benthic macroinvertebrate taxa residing in similar microhabitats within the same stream.

  b. I hypothesized that the diversity of traits is positively correlated with the diversity of microhabitats.

Methods: Study Sites

- Rural stream study sites in Mecklenburg, Lincoln and Iredell Counties in Piedmont North Carolina.

- *Stream Habitat Conditions*:
  - Supporting (green)
  - Partially Supporting (yellow)



Methods: Benthic Macroinvertebrates

1. Quantitative samples using:
   i. *Surber Sampler* (0.25 m^2): 3 samples from 5 microhabitats (Root Wad, Undercut Bank, Leaf Pack, Backwater Area, and Sandy Area).

   ii. *Kick Net*: Within a representative Riffle in the study reach, a 1 by 3-meter area was sampled using a kick net.

   iii. Woody Debris was visually examined.

   iv. All micro habitat samples were kept separate.

   v. All stream study sites were 100 m long.

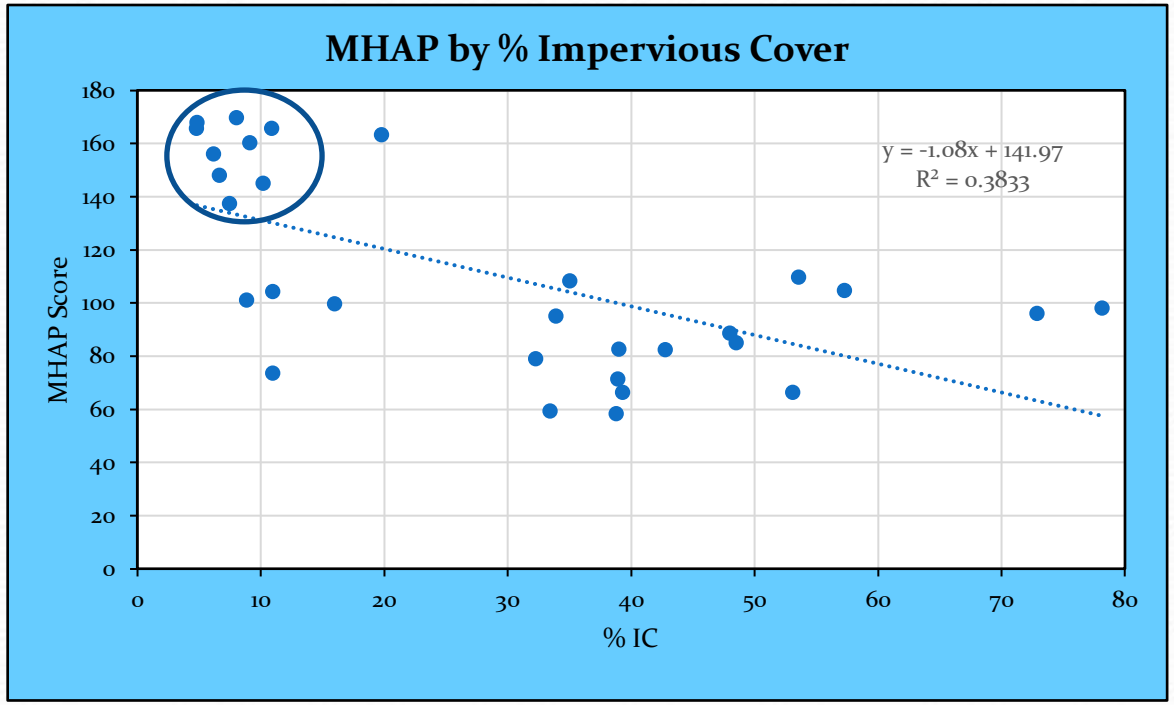
Methods

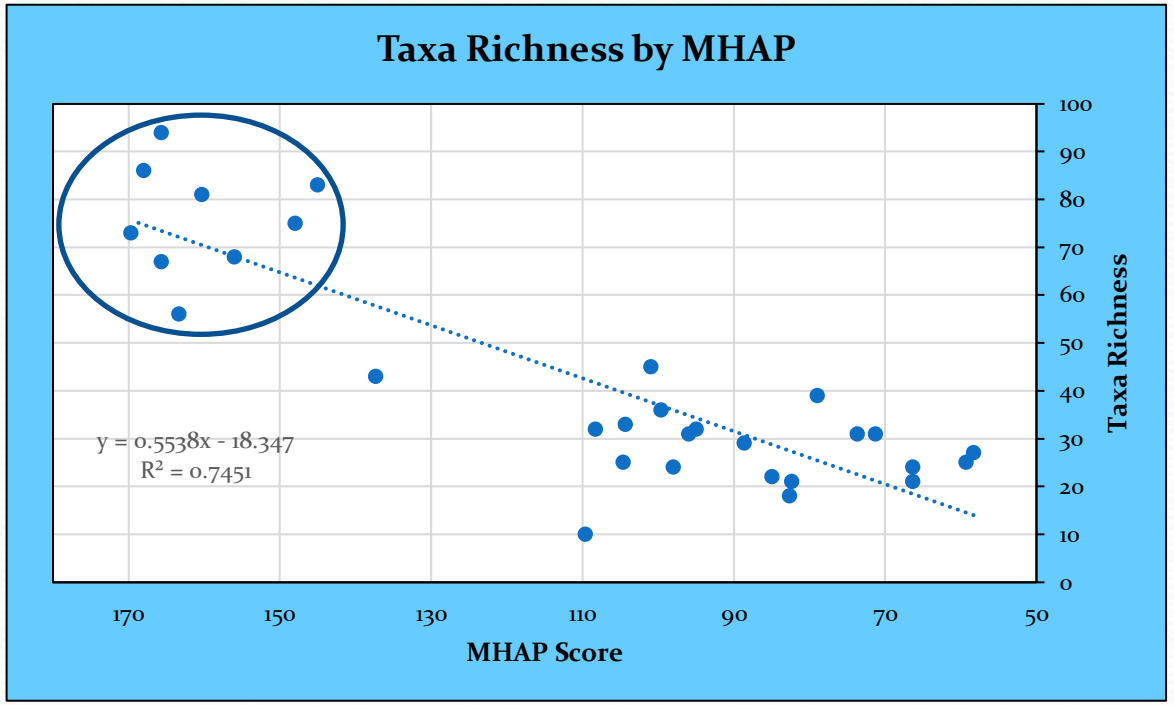
2. **Stream Habitat Quality** was measured using the Mecklenburg Habitat Assessment Protocol (*MHAP*) at all sites.
   a) MHAP procedure based on EPA Rapid Bioassessment Procedures (Barbour et al. 1999).

3. **Habitat Diversity**
   a. The number of microhabitats found in each 100-meter study reach were counted.

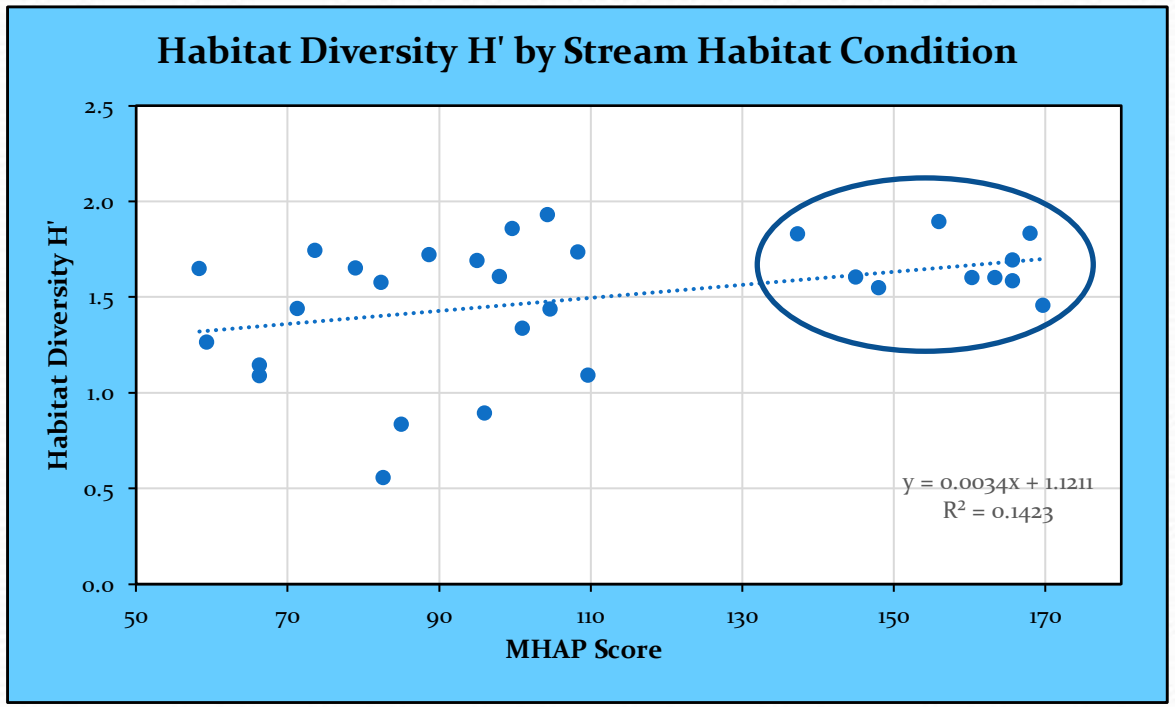
   b. The number of transitions between major habitat types (riffles, runs, pools and backwater areas) were calculated.

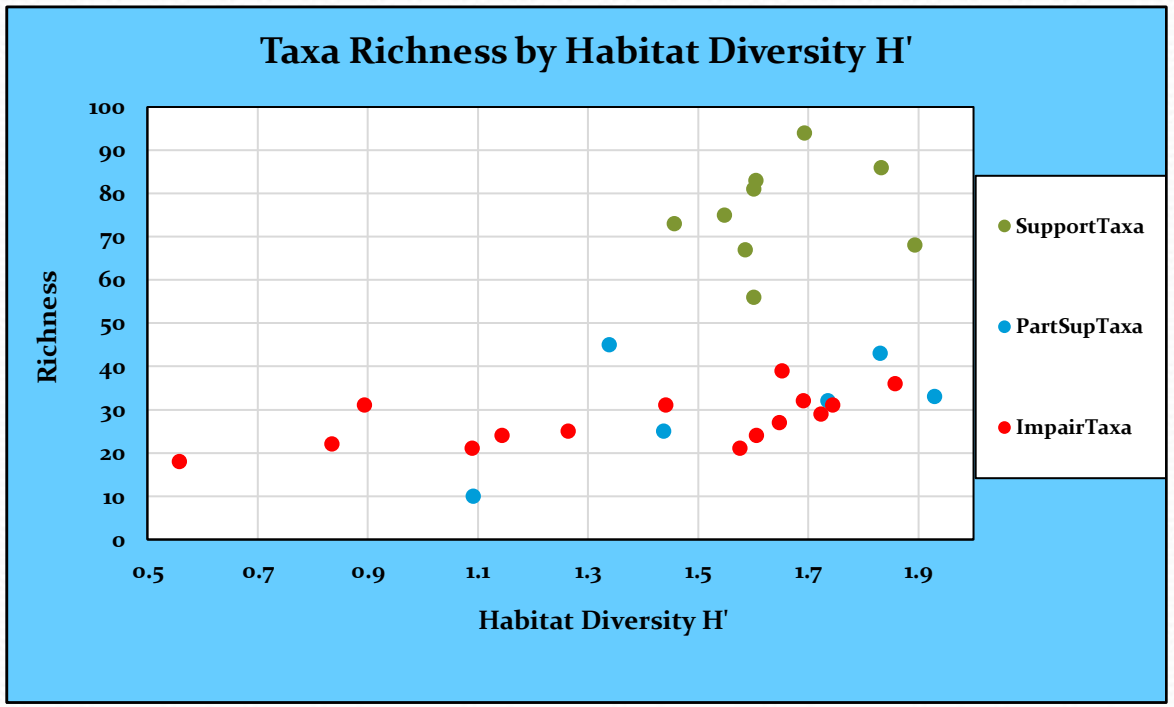
Stream Habitat Condition Decreases as % Impervious Cover Increases Resulting in a Decrease in Taxa Richness



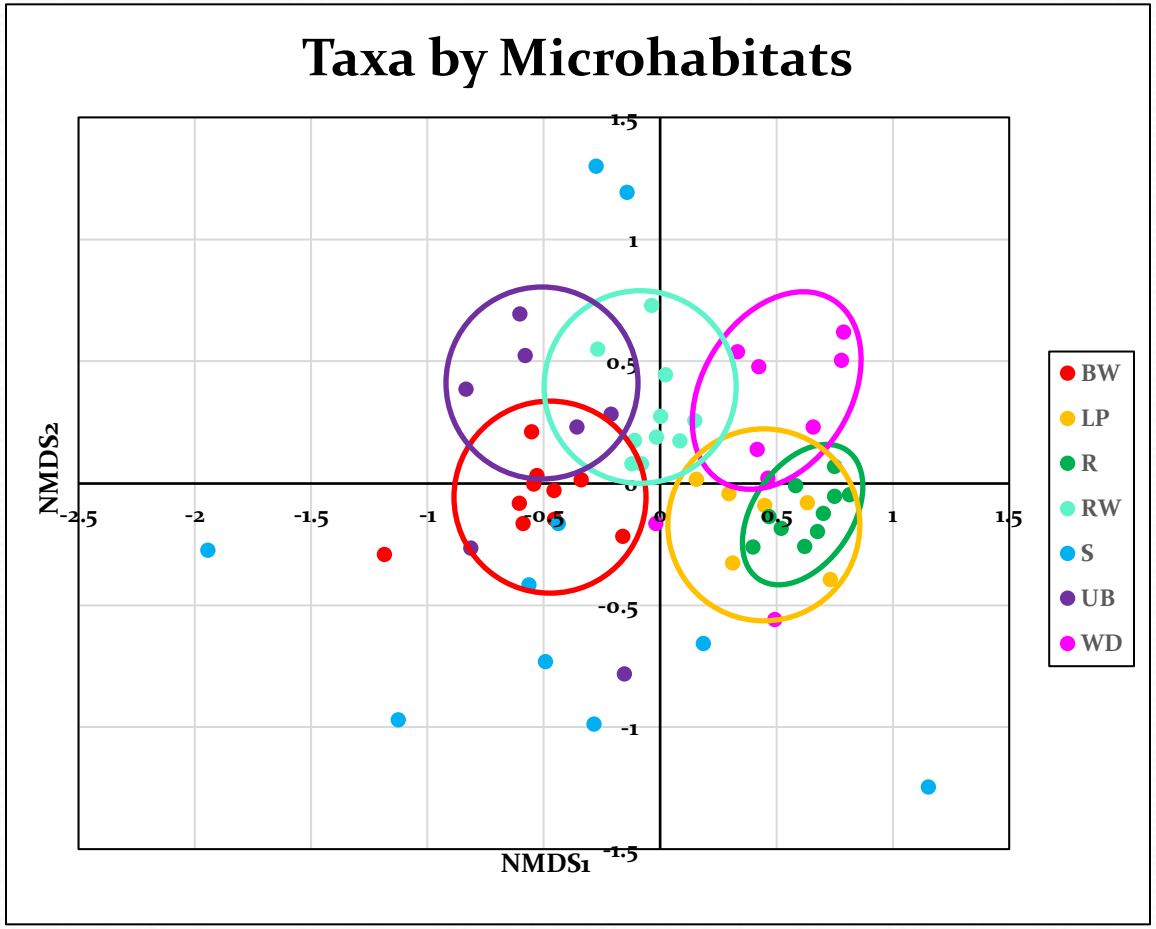


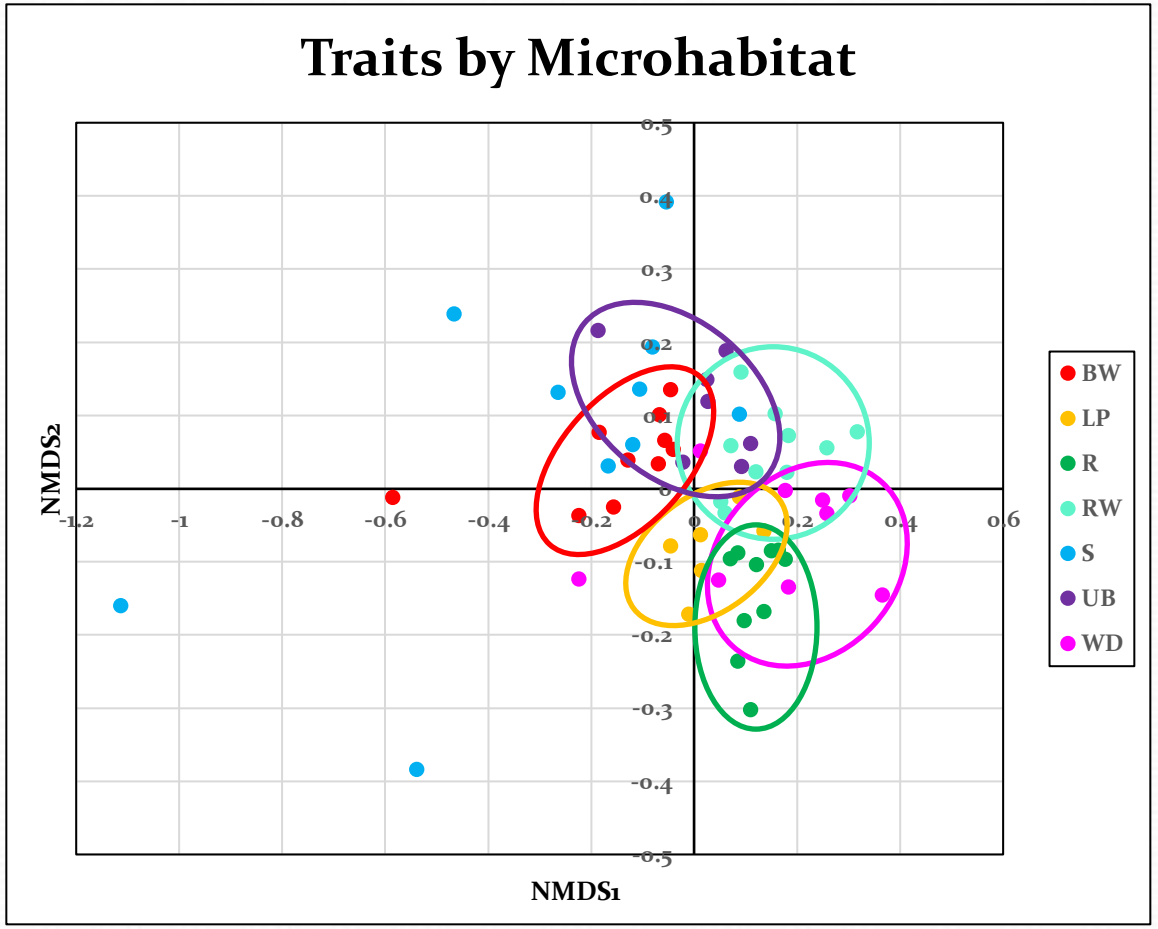
Habitat Diversity Increases with Stream Habitat Condition Resulting in Greater Taxa Richness



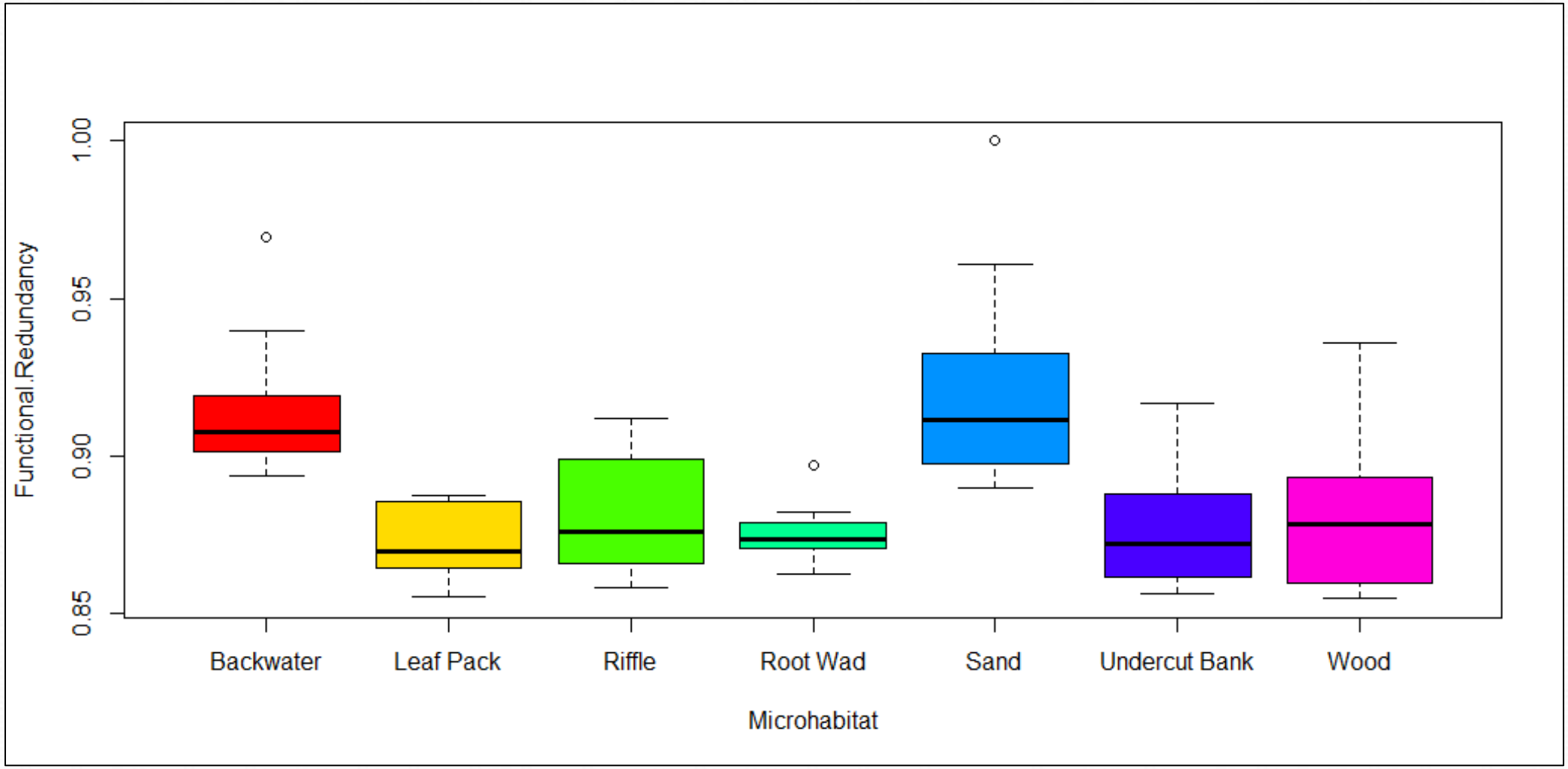


Taxa and Traits Differ Across Microhabitats

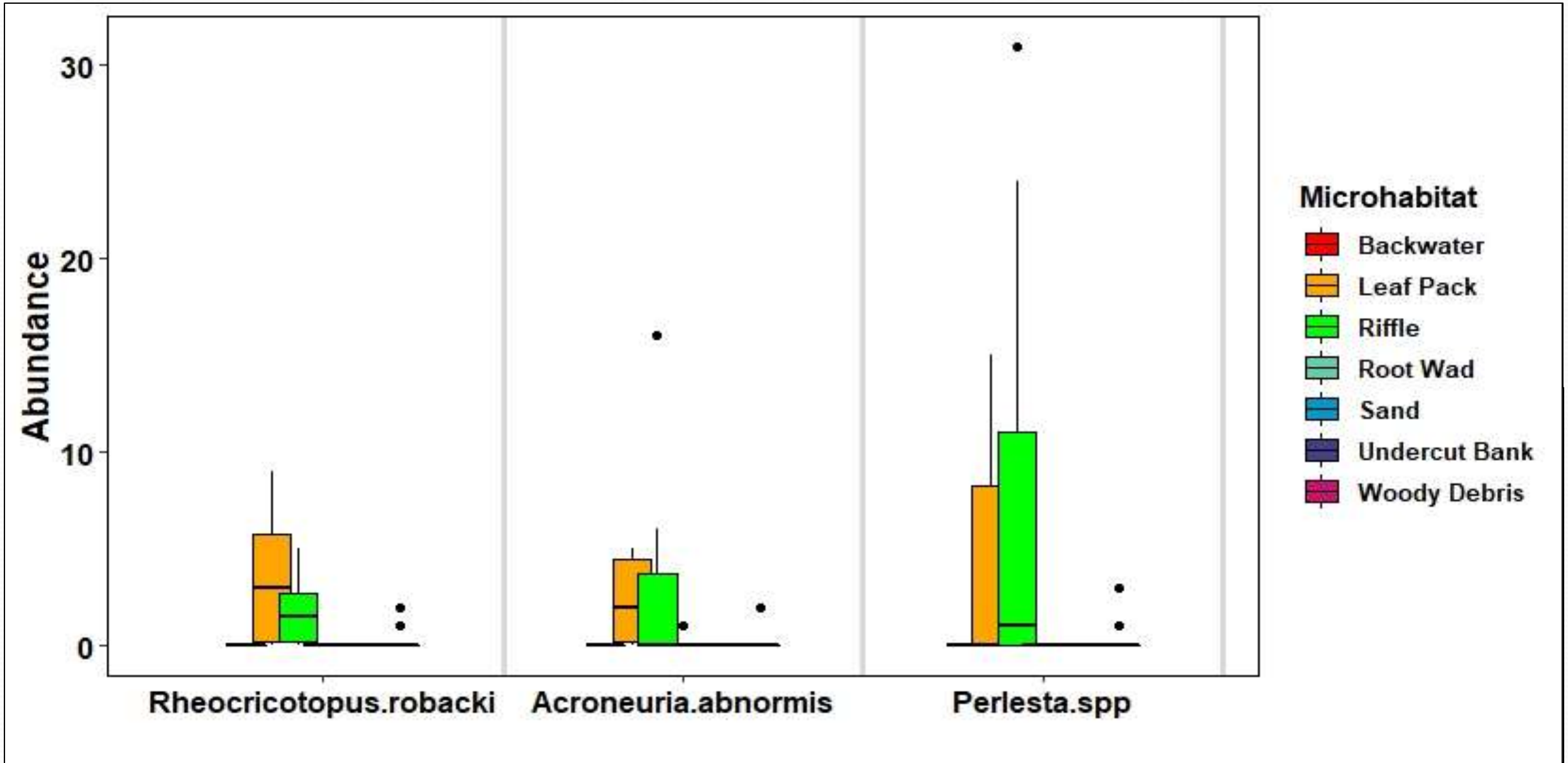




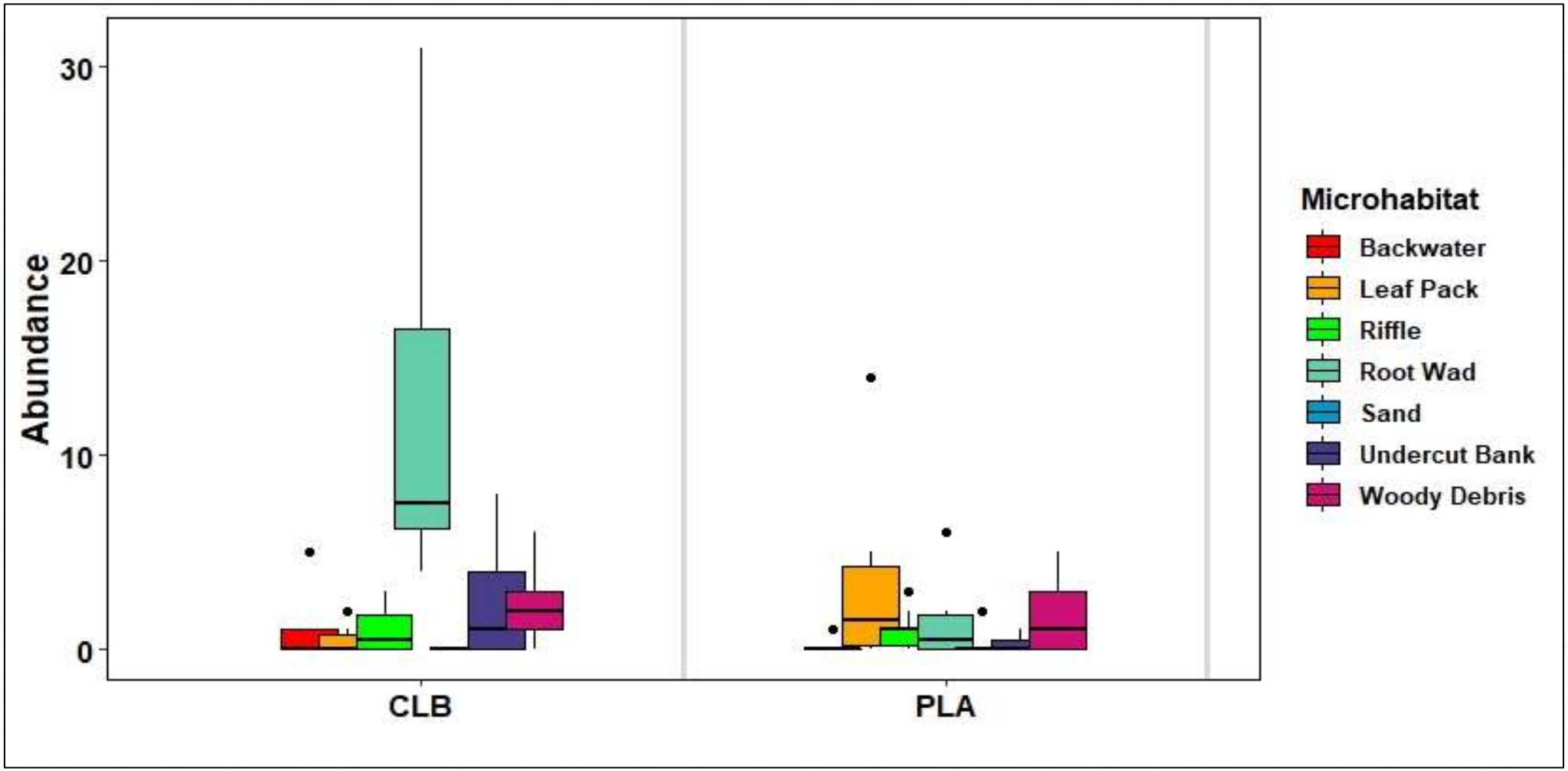
Trait Functional Redundancy is Highest in Microhabitats with Lower Diversity of Taxa and Traits



Specific Taxa Associated with Specific Microhabitats



Specific Traits Associated with Specific Microhabitats



Conclusions

1. Taxa diversity was similar in the riffle, leaf pack, backwater and root wad microhabitats with undercut banks, woody debris and sand microhabitats having lower taxa diversities.

2. Trait diversity in all microhabitats was similar except for in the sand microhabitat.

3. Functional Redundancy varied among the microhabitats.
   - The highest FR was seen in microhabitats with the lowest taxa and trait richness and diversity.

4. Specific taxa and traits were found to be associated with specific microhabitats or groups of microhabitats.
   - Several taxa and traits - associated with microhabitats not normally enhanced by stream restoration practices.

Applications to Stream Restoration Design

1. Natural Channel Design (NCD) generally focuses on riffle-pool sequences and may include wood as part of various structures
   - lacks enhancement of other microhabitats - undercut banks, root wads and leaf packs.

2. All microhabitats contributed to the overall stream biodiversity and ecosystem function.
   - Without the fringe microhabitats, several taxa and their associated traits may not be present in the restored stream ecosystem.

3. NCD focuses on improving habitat conditions for the larval stages of aquatic insects overlooking habitat required by adult insects.
   - To ensure restoration results in a self-sustaining ecosystem, the design should include structures that enhance other life cycle stages such as adult emergence and oviposition. (Merten et al. 2014; Jordt and Taylor 2021).

Questions?