Investigating the Effect of Habitat Availability and Stream Morphology on the Benthic Macroinvertebrate Demographics in Red Bud/Catalpa Creek

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Watersheds and Water Quality Research Lab

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US Streams and Macroinvertebrates

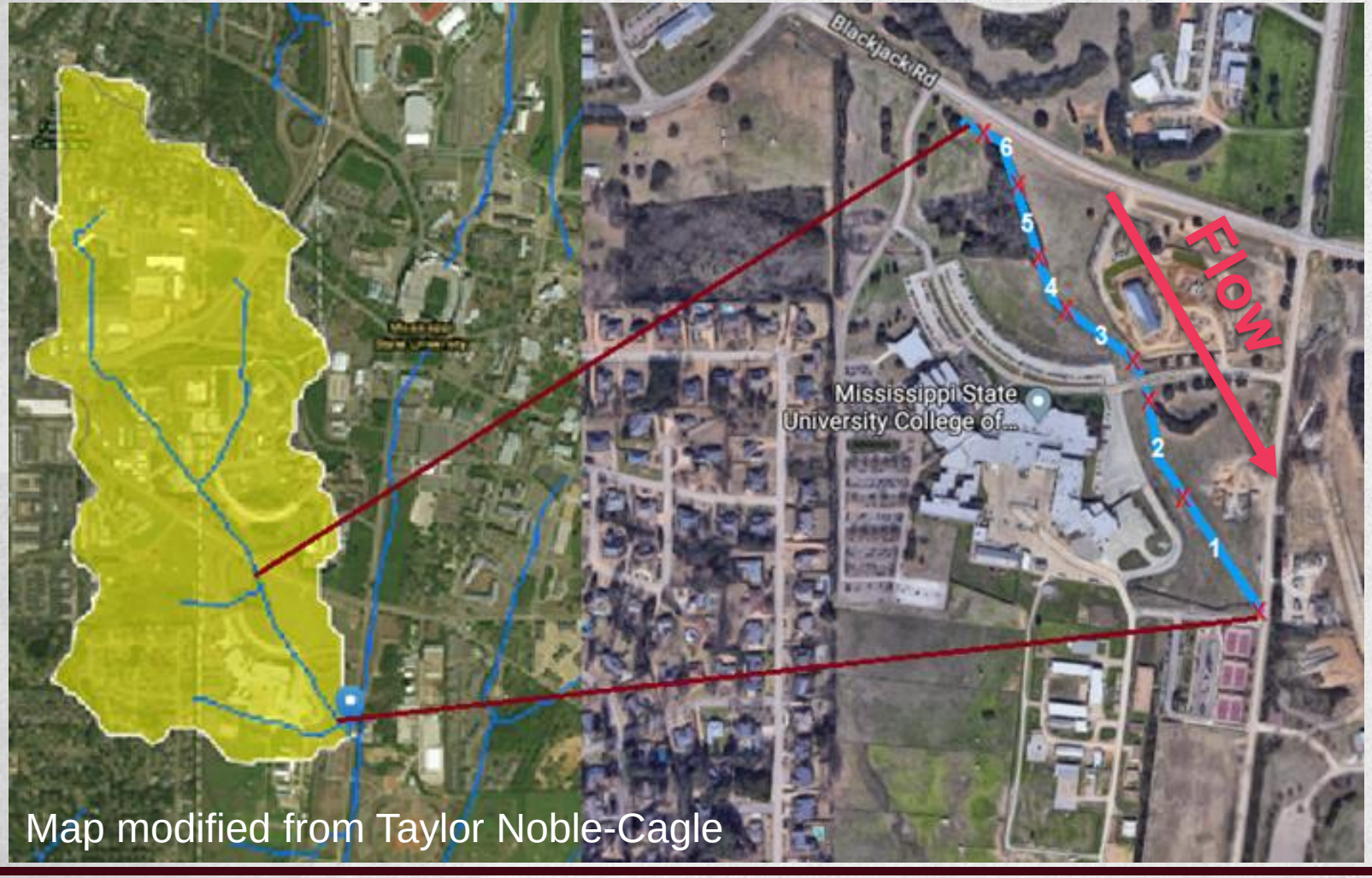
- ~90% of perennial streams are classified as "wadeable" = 1st – 5th order (EPA 2016)
- Crucial for nutrient cycling (Wallace & Webster 1996)
- Macroinvertebrates can serve as great indicators of stream health (Haweks & De Pauw 1994)
- Important food source (Huryn & Wallace 2000)

reddit.com

Study Site – CTR ("reference")

- Upper reaches armored for drainage
- Mid-reaches with canopy cover and wide, shallow streambed
- Broken Canopy cover in lower reaches

Study Site – CT (impacted)



Map modified from Taylor Noble-Cagle

- Runs through MSU campus
- Surrounded by mowed grass, roads, and parking lots
- Lower reaches incised and armored
- Flashy floods and vet school drain overflow

Objectives and Hypotheses

Objective:

- Compare macroinvertebrate community structures and dynamics between a “reference” stream and a more impacted stream to assess the need for restoration efforts

Hypothesis:

- The impacted stream would how lower values for indices of community health compared to the reference stream

Methods

- Visual Inspection of Stream Characteristics
  - Substrate matrix
    - Sand
    - Gravel
    - Boulder
    - Hard bottom

    Proportion
  - Habitat Availability
    - Leaf packs
    - Root wads

    Presence/Absence

Methods

Macroinverebrate Collection

- **Fall 2018 (late Aug – Early Sept)**
- **D-Net Sampling**
  - **20 “jabs” per site**
  - **Based on habitat availability**
- **Stored and labeled by site**
  - **Preserved in 10% formalin**

Methods

- Sample Processing
  - 2 sieved fractions – “coarse” (600 µm)* and “fine” (250 µm)
    - Removed all macroinvertebrates
  - Identified and enumerated to lowest reasonable taxonomic resolution (Merritt and Cummins 1995)

Photo credits: Taylor Noble-Cagle

Analyses

- Community indices between reaches (CT vs. CTR)
  - Richness (S)
  - Shannon Diversity (H)
  - Shannon Evenness (E_H)

- Community Ordination
  - Canonical Correlation Analysis (CCA)
  - Taxa abundances, based on habitat variables
  - Only included taxa that:
    - Possessed >10 individuals
    - Collected from >1 site

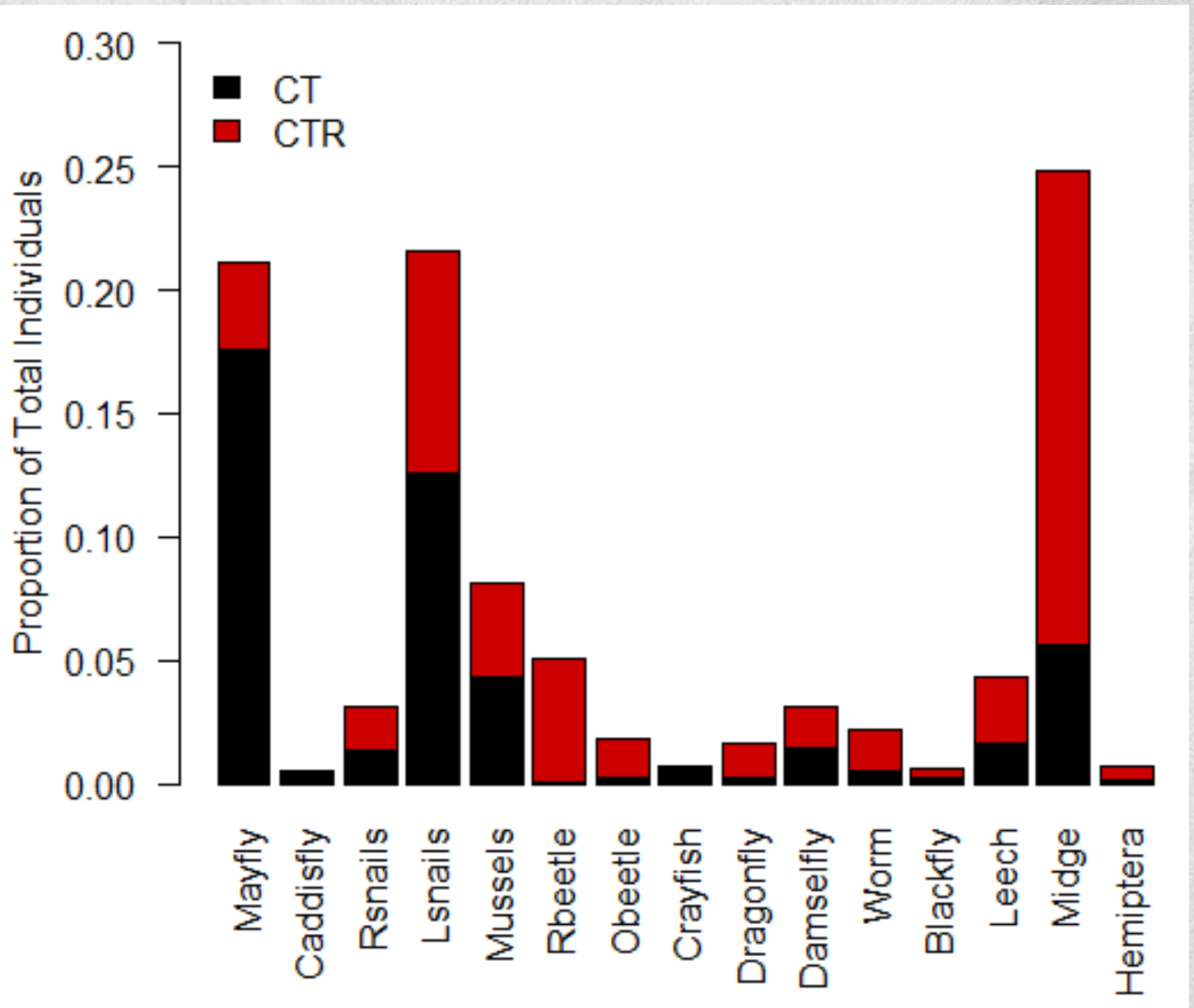
Results

		CT	CTR
Substrate	Sand	26%	67%
	Gravel	41%	31%
	Boulder	13%	0%
	Hard bottom	20%	1%
Habitat	Root wad Present	4/6	6/7
	Leaf pack Present	4/6	7/7

Results

Most individuals belong to 3 taxa (~70%)

Distribution of abundances appear to be more even across CTR

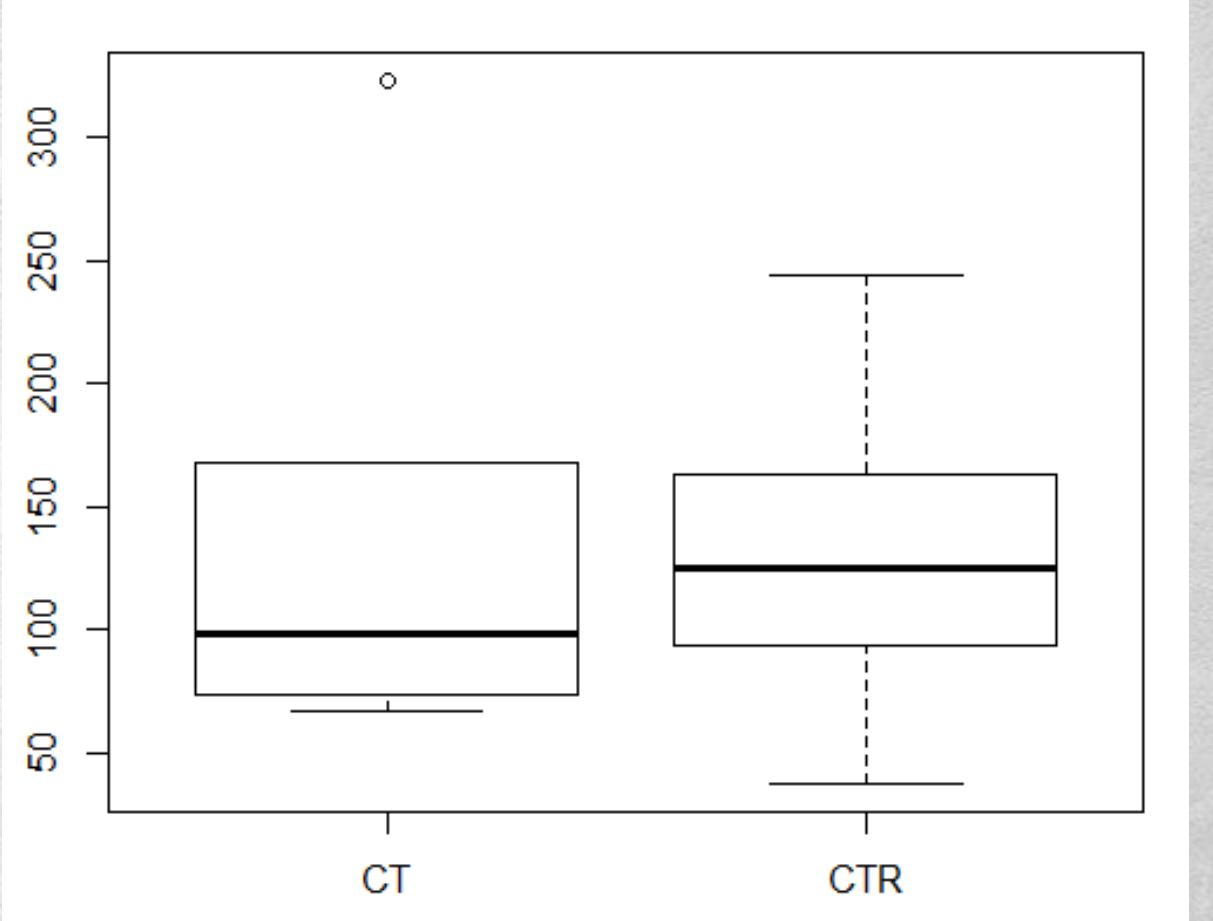


Results

- **No significant difference in mean individuals between sites**

CT = 138.1 ± 97.4 (mean ± sd)

CTR = 131.5 ± 71.0



t = 0.138, d.f. = 9.03, *p* = 0.89

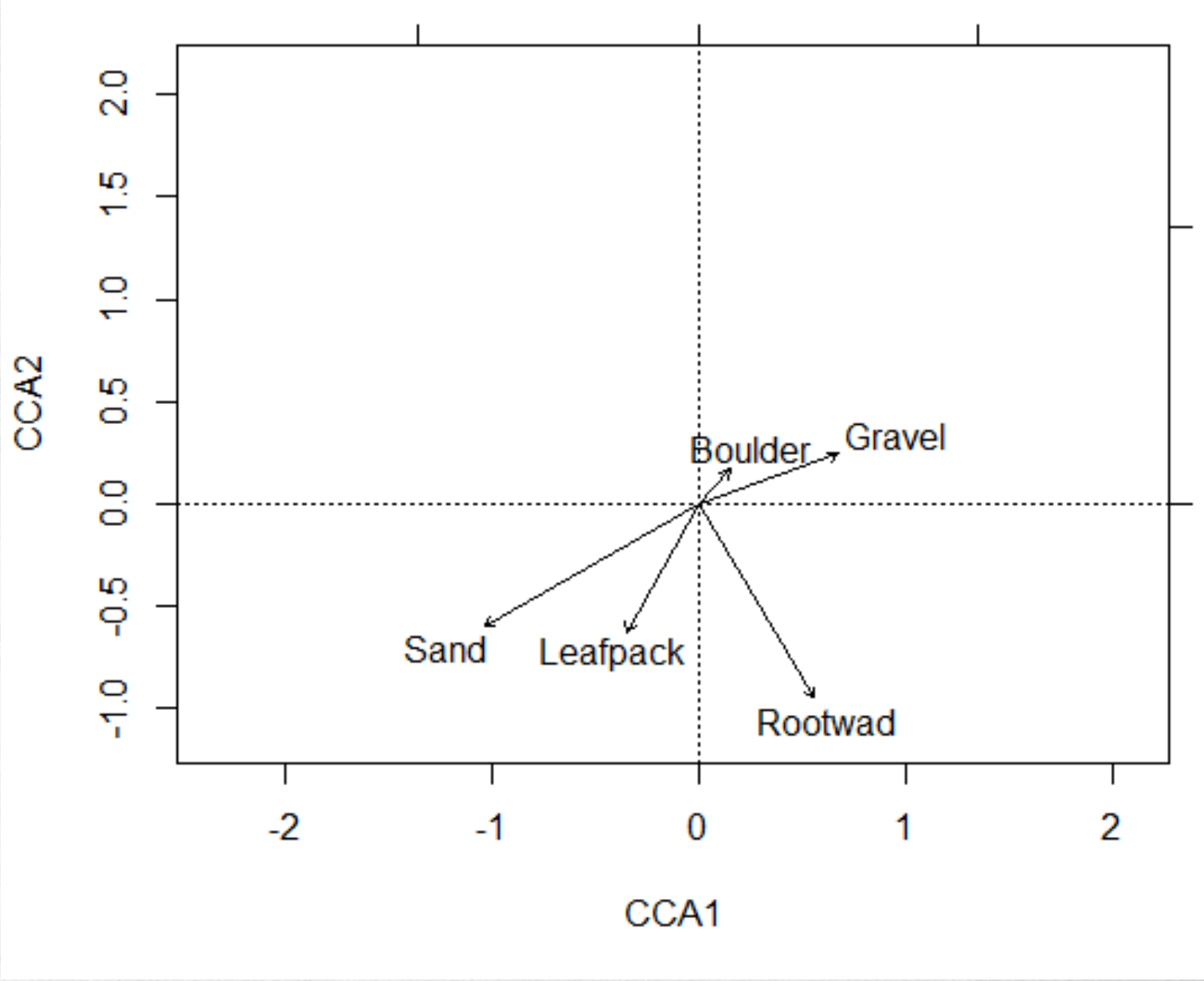
Results

	CT	CTR
Total Individuals (N)	839	660
Richness (S)	21	30
Shannon Diversity (H)	1.88	2.51
Shannon Evenness (E_D)	0.62	0.74

*34 taxon groups analyzed

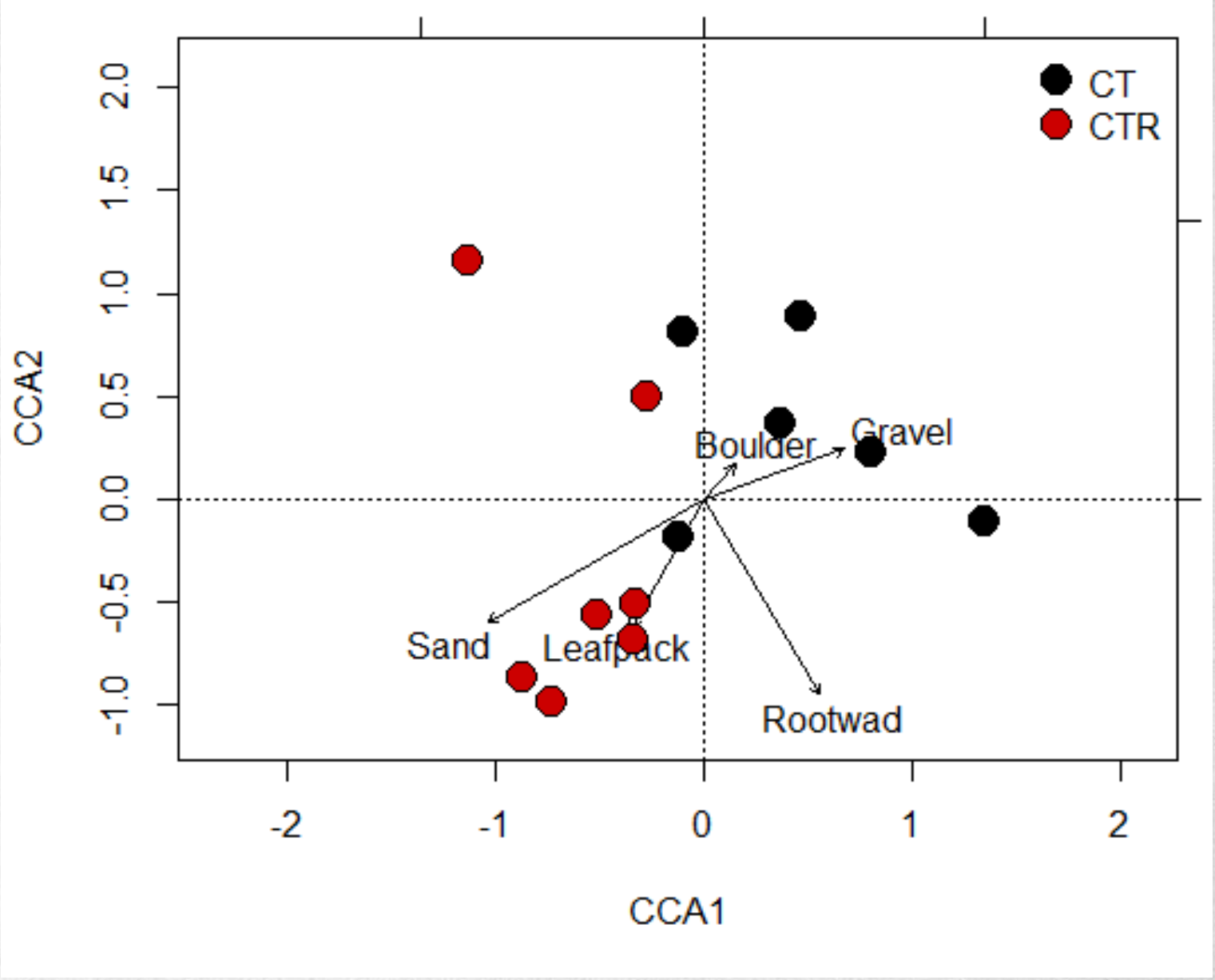
Results

Hard bottom provided no constraint – explained no appreciable variation



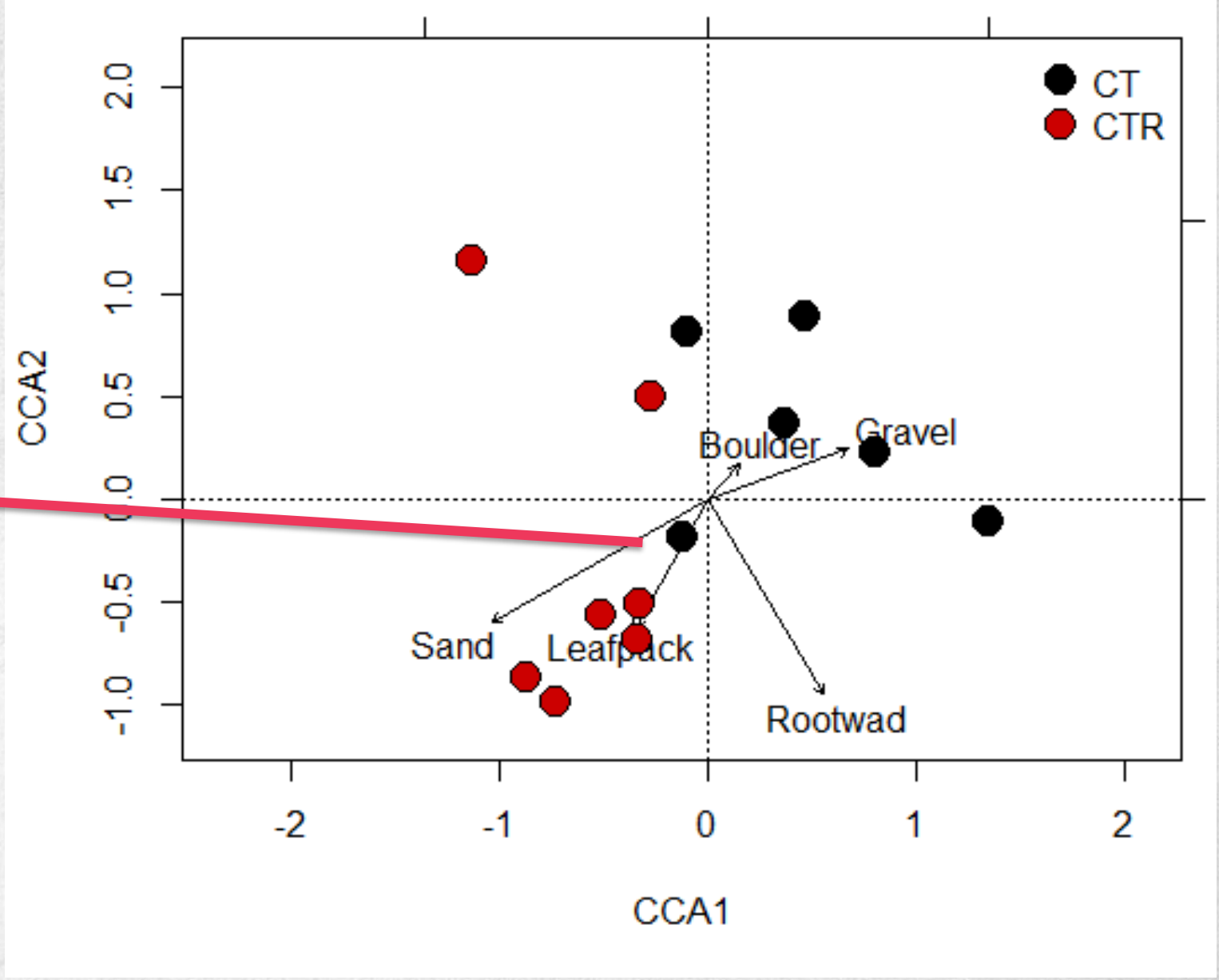
Results

Sites are grouping based on different characteristics



Results

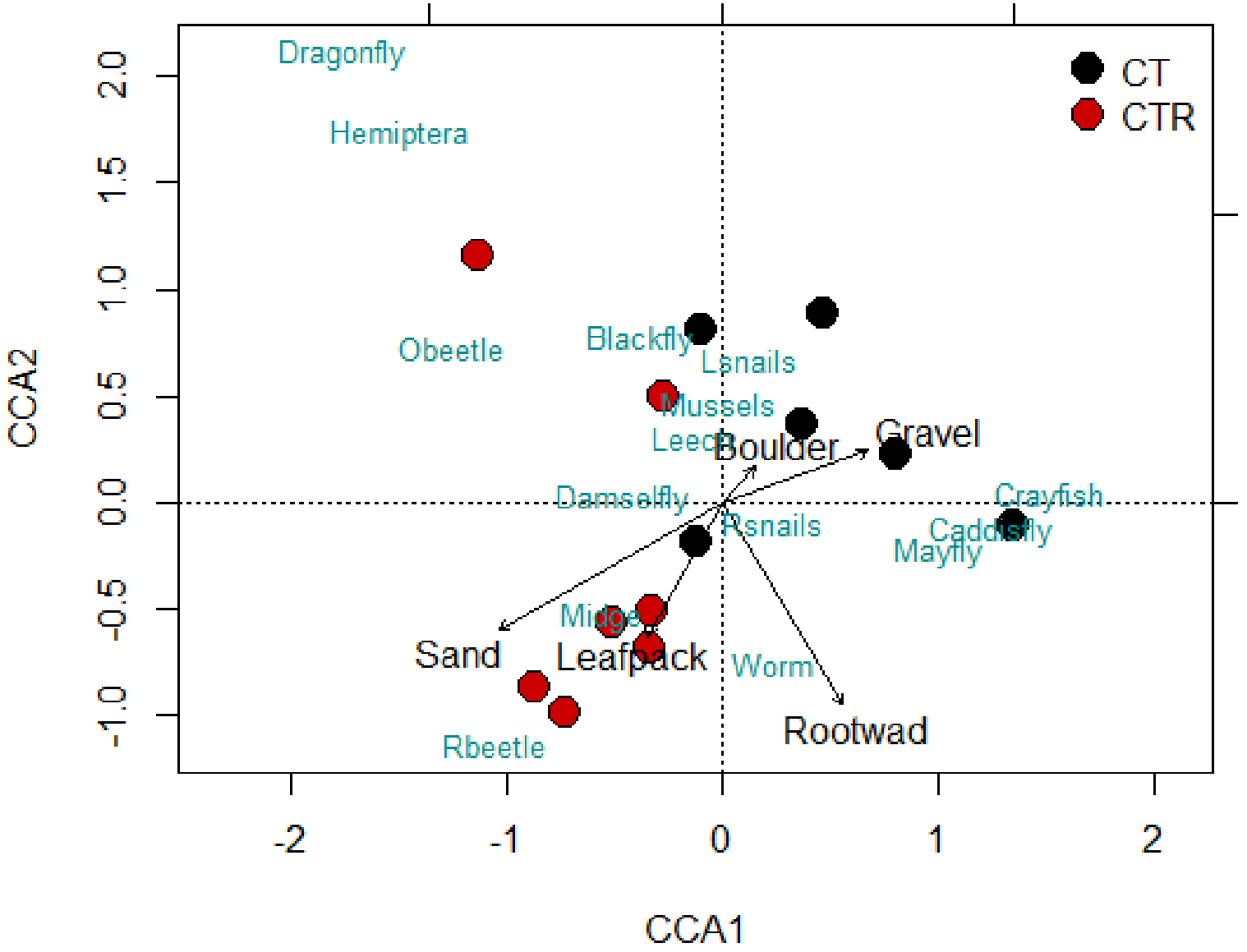
Reaches are grouping based on differences



Results

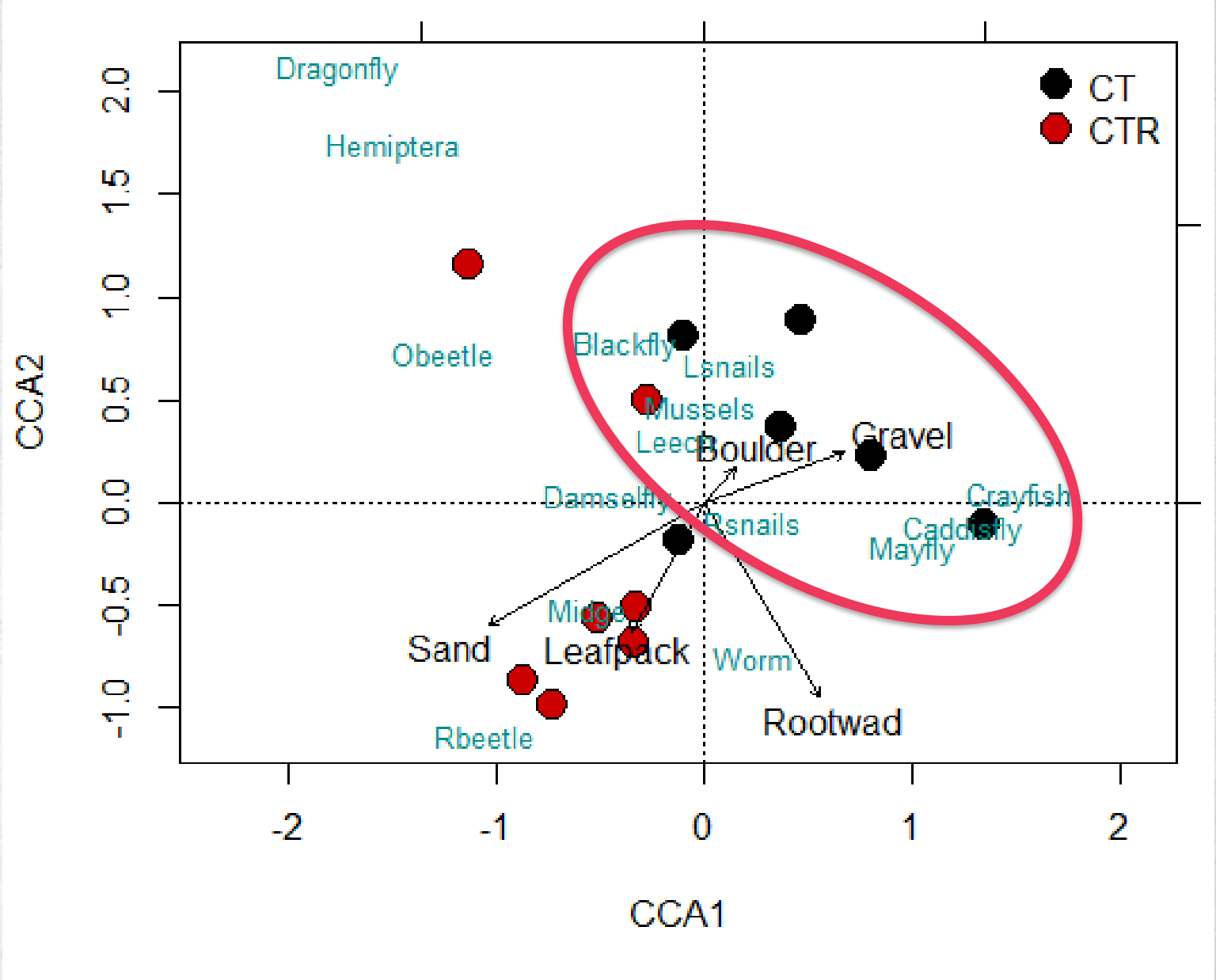
Con. inertia = 0.26
Total inertia = 0.52
“Fit” = 0.5

Approx. 37% of variation explained in 2 axes



Results

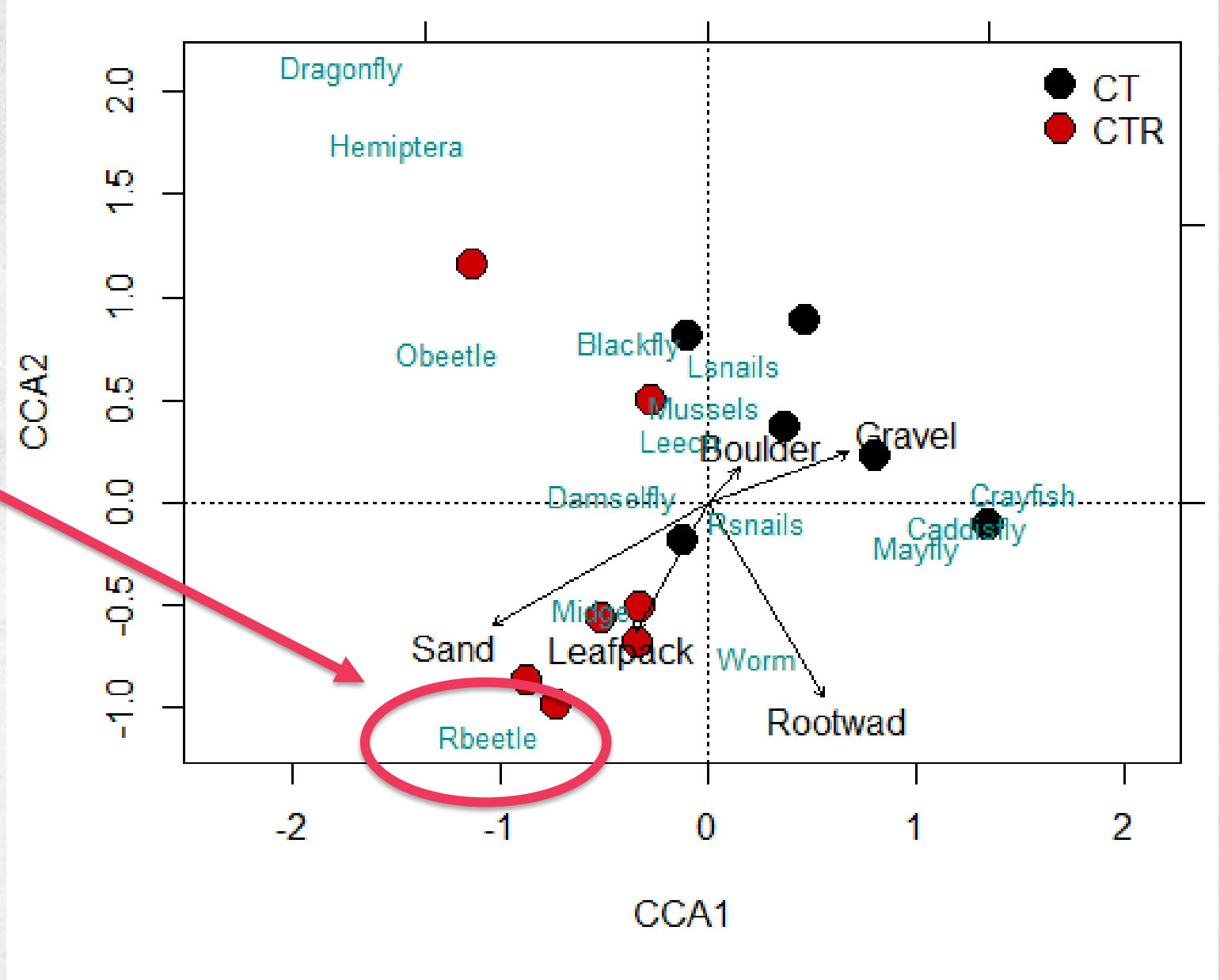
Many groups are showing up in expected places, based on behavior and life histories



Results

Others are not: Riffle Beetles

Presence of leaf packs indicate better habitat quality overall??



Conclusions/Discussion

- The macroinvertebrate community of CT has lower richness, diversity, and evenness than the less-impacted CTR reach
- Dominate taxa in both reaches are pouch snails and chironomids
- Reaches are displaying very different characteristics
  - Similarity analyses in the works
- CT shows lower prevalence of habitats (root wads and leaf packs) which may suggest one method of remediation to increase diversity in this reach

Next Steps

- Still working through “fine” fractions and new samples
- Adding additional stream characteristics for CCA
  - 37% of variation explained from 6 basal characteristics
- Re-analyzing with taxa presence/absence and using functional groups
- Continued monitoring before, during, and after stream restoration efforts

Questions?

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