EFFECTS OF WOODY PLANT ENCROACHMENT ON SOIL CHEMICAL PROPERTIES AND MICROBIAL STRUCTURE

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WOODY PLANT ENCROACHMENT

- Rapid increase in the density and growth of woody plants.[1]
- Has been an issue throughout Africa since the mid-1900s.[2]
- Affects approximately 10–20 million hectares of South African land.[1]

Figure 1 : Woody plant encroachment and thinned land near the Omatako Mountains in Namibia

[1] Eldridge et al., 2011 [2] MALAN et al., 2021

CAUSES OF ENCROACHMENT

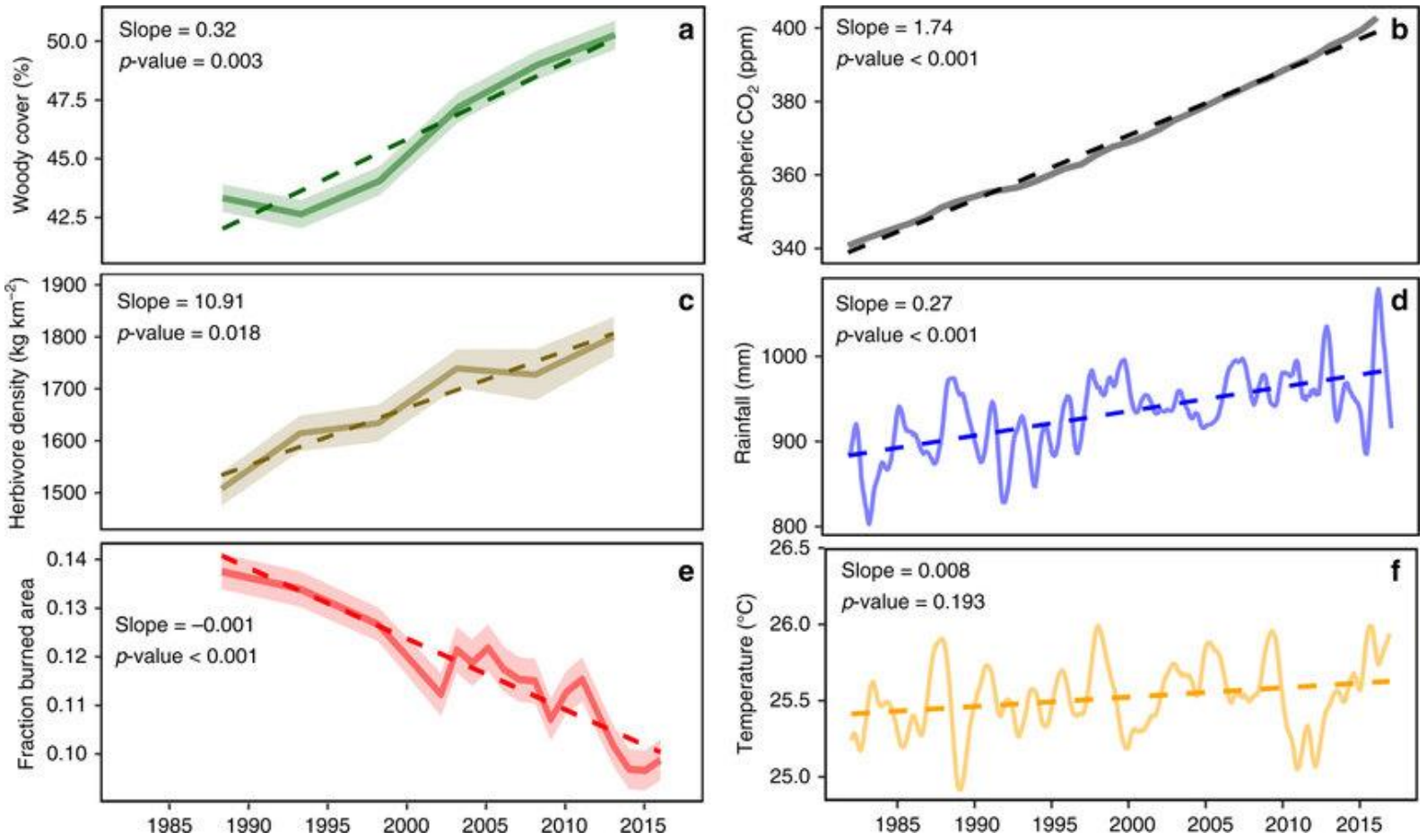


Figure 2: Time series data for woody cover and environmental variables averaged across Africa

Venter et al., 2018

TOP ENCROACHING SPECIES

senegalia mellifera

Dichrostachys cinerea

Colophospermum mopane

[1]Skhosana , 2023 [2] Malan et al., 2021

EFFECTS OF ENCROACHMENT

- *Colophospermum mopane was associated with decrease grass biomass and density.* [1]
- *C. mopane* encroachment reduced soil moisture by increasing evapotranspiration. [1]

Figure 1 : *Colophospermum mopane*

[1] Wedel et al., 2024

RESEARCH GAP

- Although the impacts *C. mopane* encroachment on soil physicochemical properties are well documented, the impacts of the species encroachment on soil microbial activity as important indicators of soil health, remain understudied.
- To investigate the effect of *C. mopane* woody plant encroachment on soil-physicochemical properties and soil microbial metabolic activity.

RESEARCH QUESTIONS

- Do soil physicochemical properties differ under *C. mopane*, dominant grass species and bare patches in both cleared and encroached sites?
- How does the metabolic activity of soil microbes differ under *C. mopane*, dominant grass species and bare patches in both cleared and encroached sites?

STUDY SITE

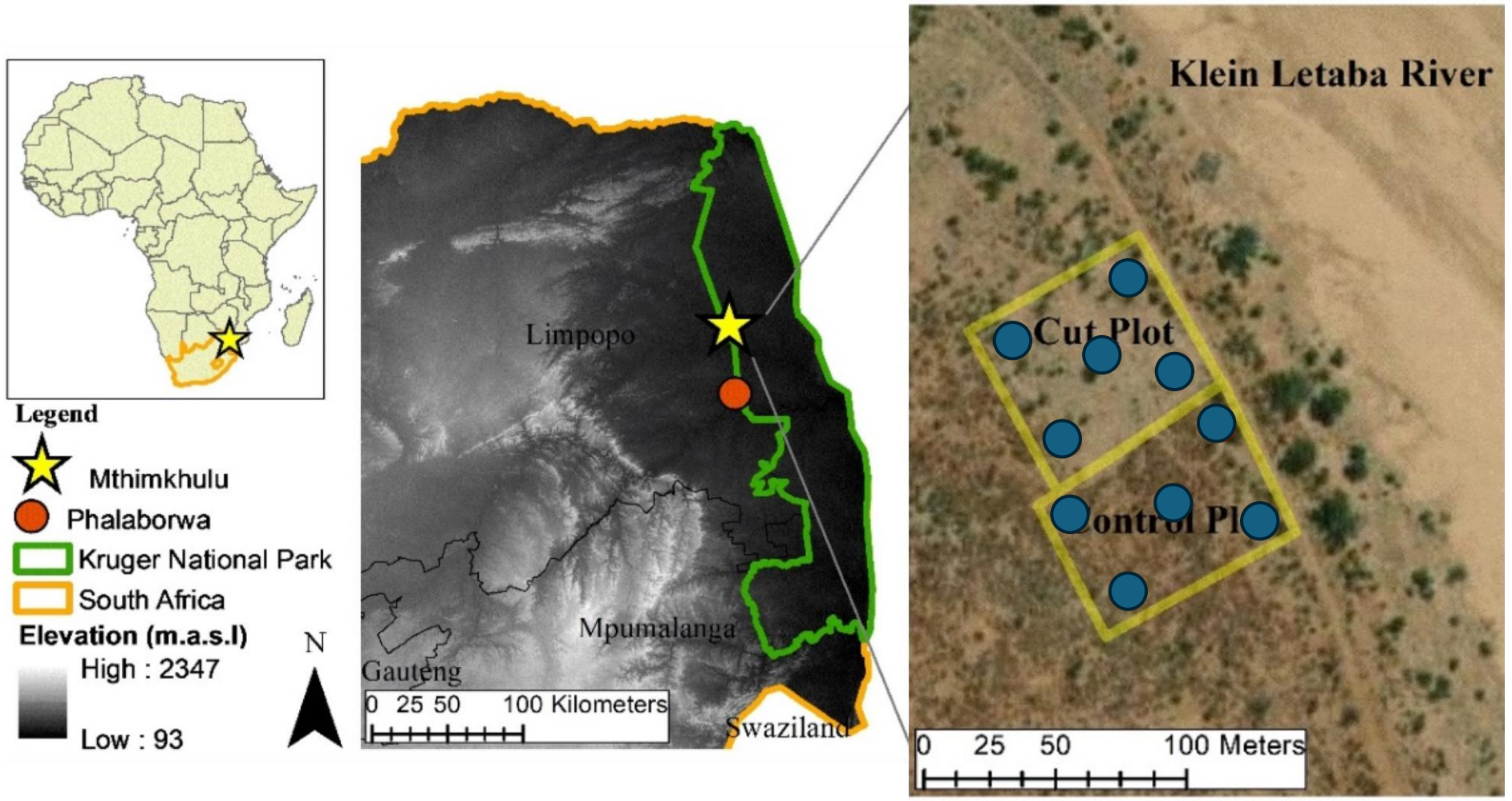


Figure 3: Location of Mthimkhulu Game Reserve in Limpopo Province, northeastern South Africa, including the positions of control and cut plots within the reserve.

Aldworth et al., 2022

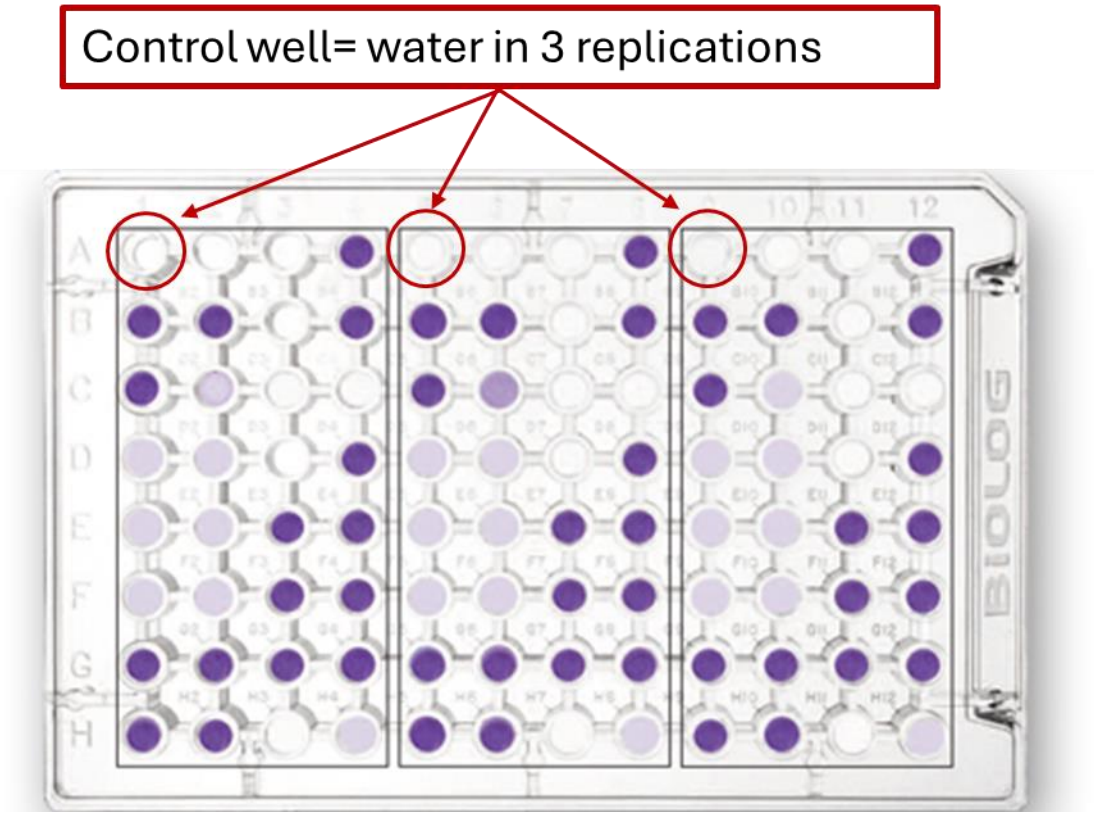
SOIL ASSAY

pH meter
Soil pH and Electrical conductivity

Oven dryer
Soil moisture content

Sieving method
Soil texture

SOIL MICROBIAL ACTIVITY



No Utilization

Minimum Utilization

Maximum Utilization

Figure 4: Biolog Ecoplate illustrating different carbon substrate utilization

pH

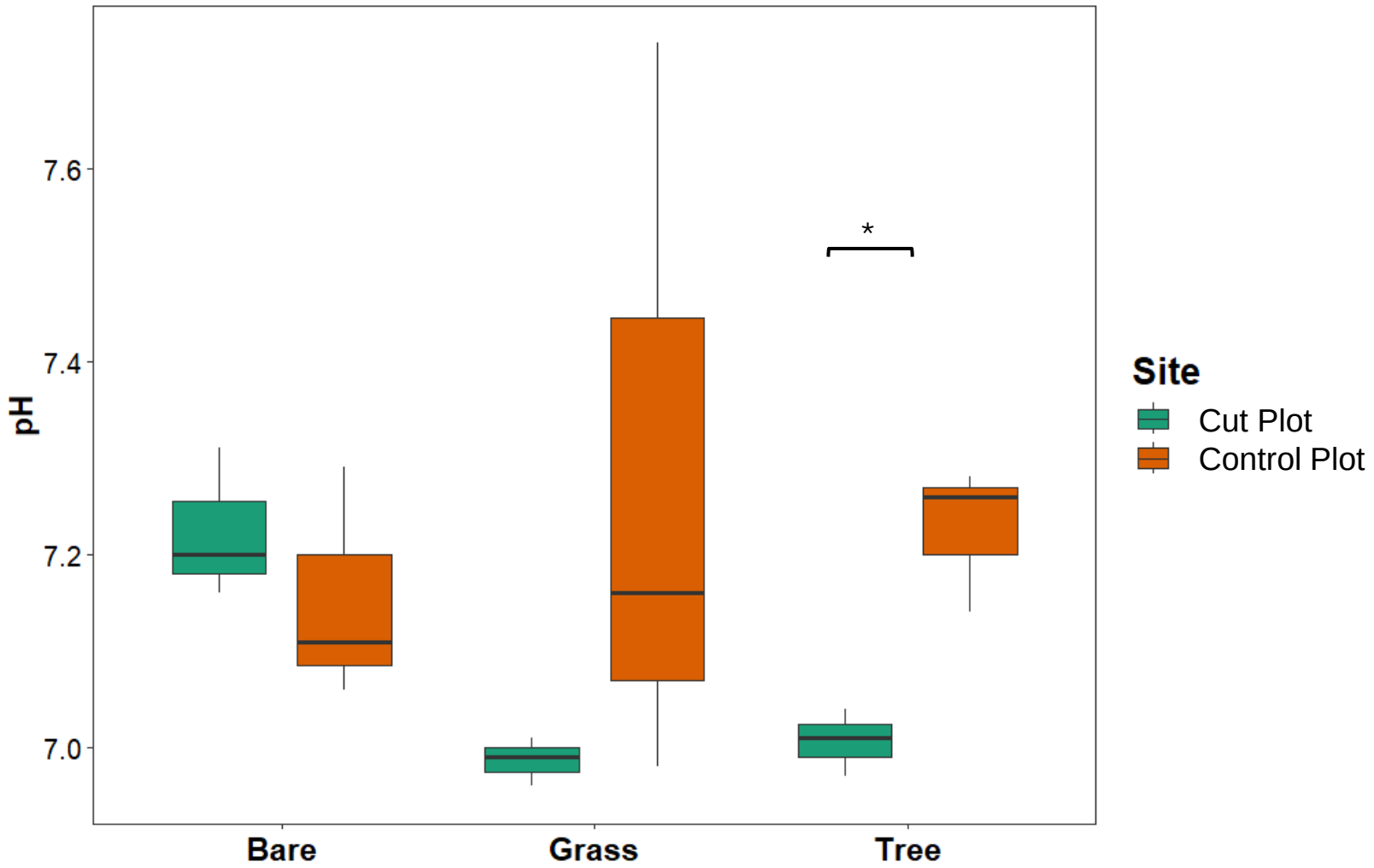


Figure 9: Bare, grass and tree soil pH in control and cut plot (n=18)

ELECTRICAL CONDUCTIVITY

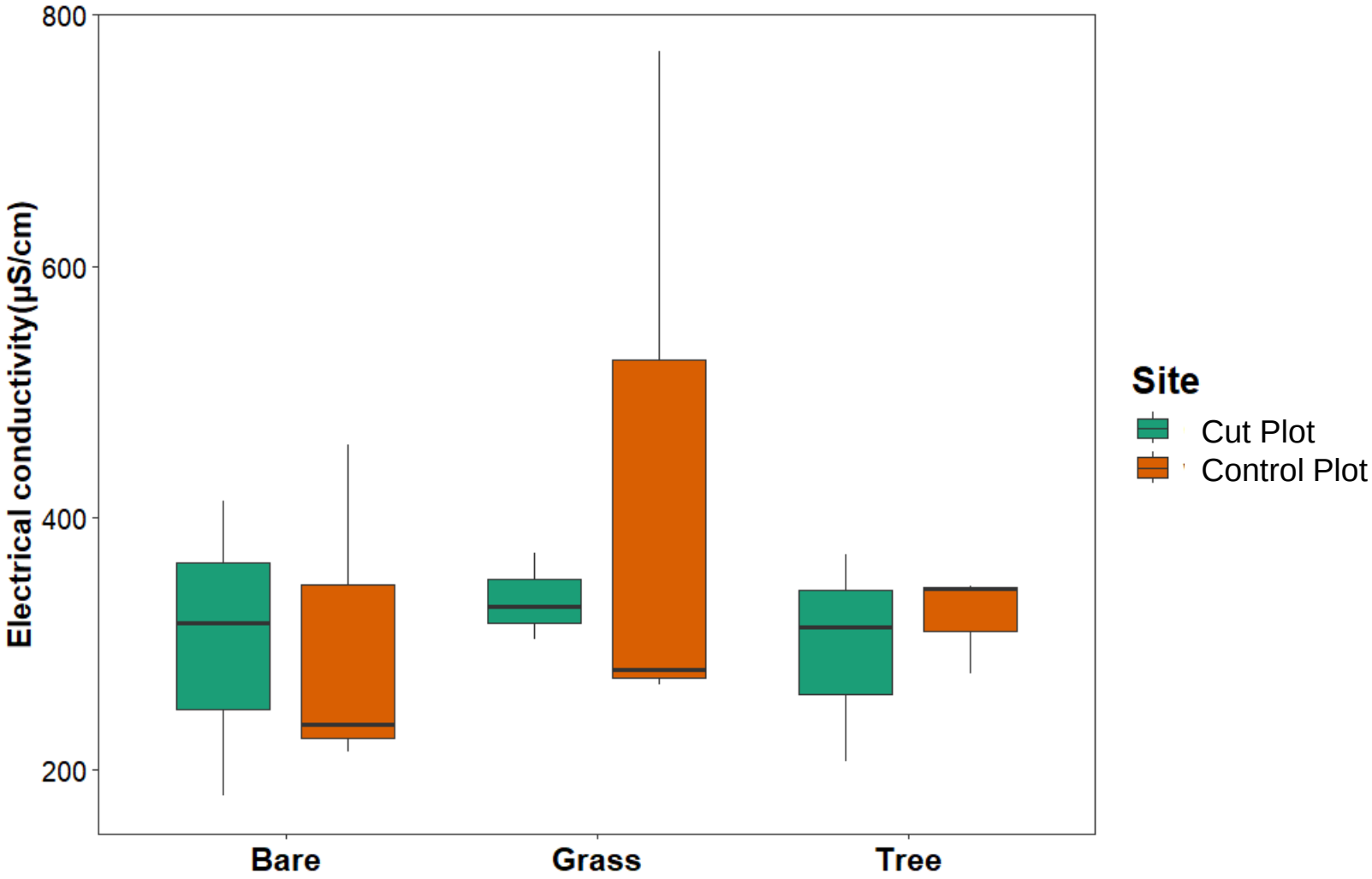


Figure 10: Bare, grass and tree soil Electrical conductivity (EC) in control and cut plot (n=18)

SOIL MOISTURE CONTENT

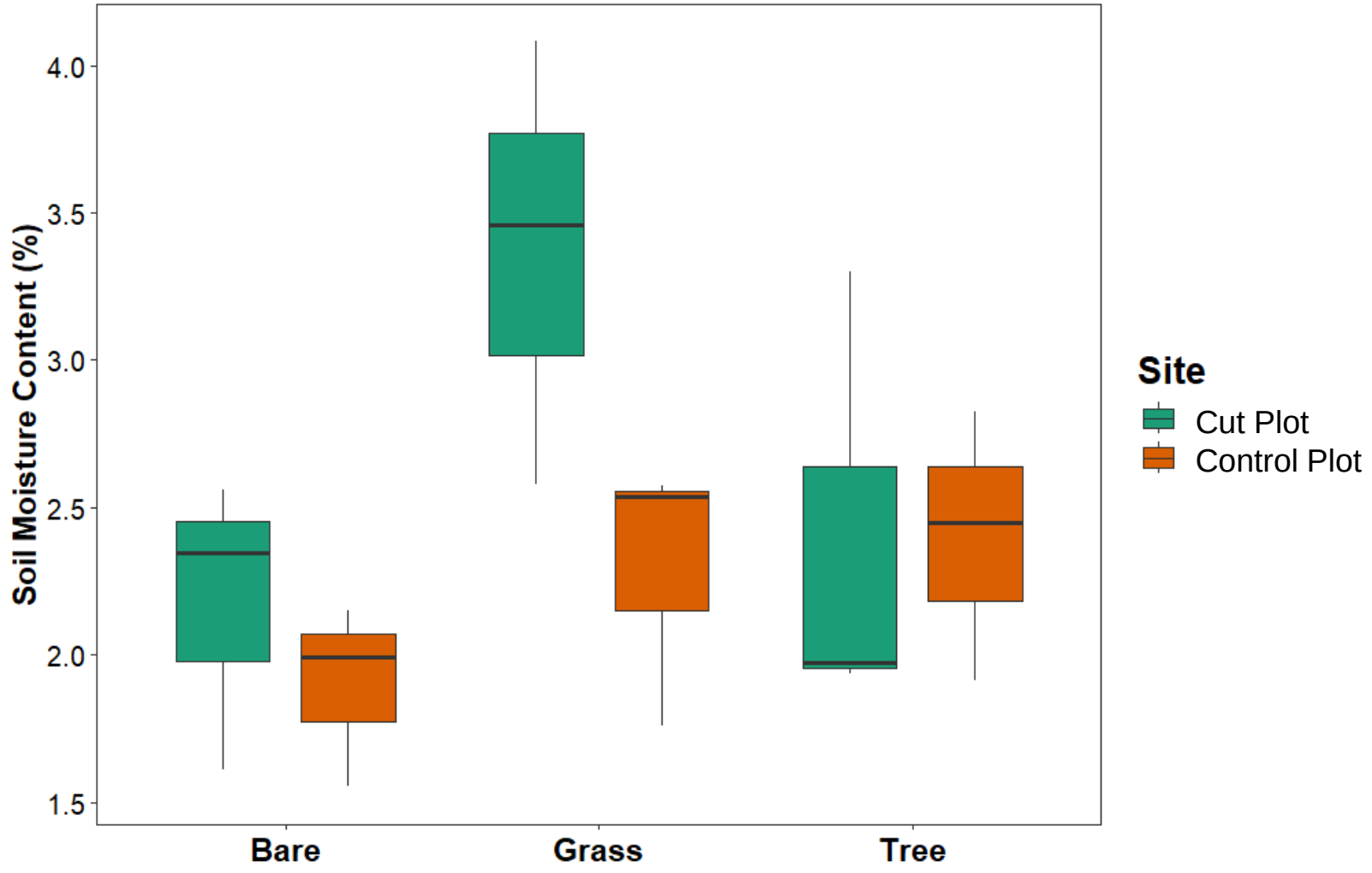


Figure 11: Bare, grass and tree soil moisture content in control and cut plot (n=18)

Soil Texture

Table 1: Bare, grass and tree soil texture in control and cut plot (n=18)

Group	Site	Sand (%)	Silt (%)	Clay (%)
Bare	**Cleared**	28.2 ± 3.64	63.8 ±3.99	8.02 ± 1.66
	Wooded	33.5 ± 2.92	62.2 ±1.36	4.30 ± 1.94
Grass	**Cleared**	28.1 ± 3.99	62.4 ±2.17	9.53 ±2.07
	Wooded	34.7± 2.93	60.4 ± 2.77	4.93 ± 2.71
Tree	**Cleared**	27.7 ± 2.50	60.9 ± 3.03	11.5 ± 0.566
	Wooded	33.2 ± 0.765	61.4 ±1.68	5.47 ± 1.18

*Mean ±SD

CARBON SUBSTRATE UTILIZATION

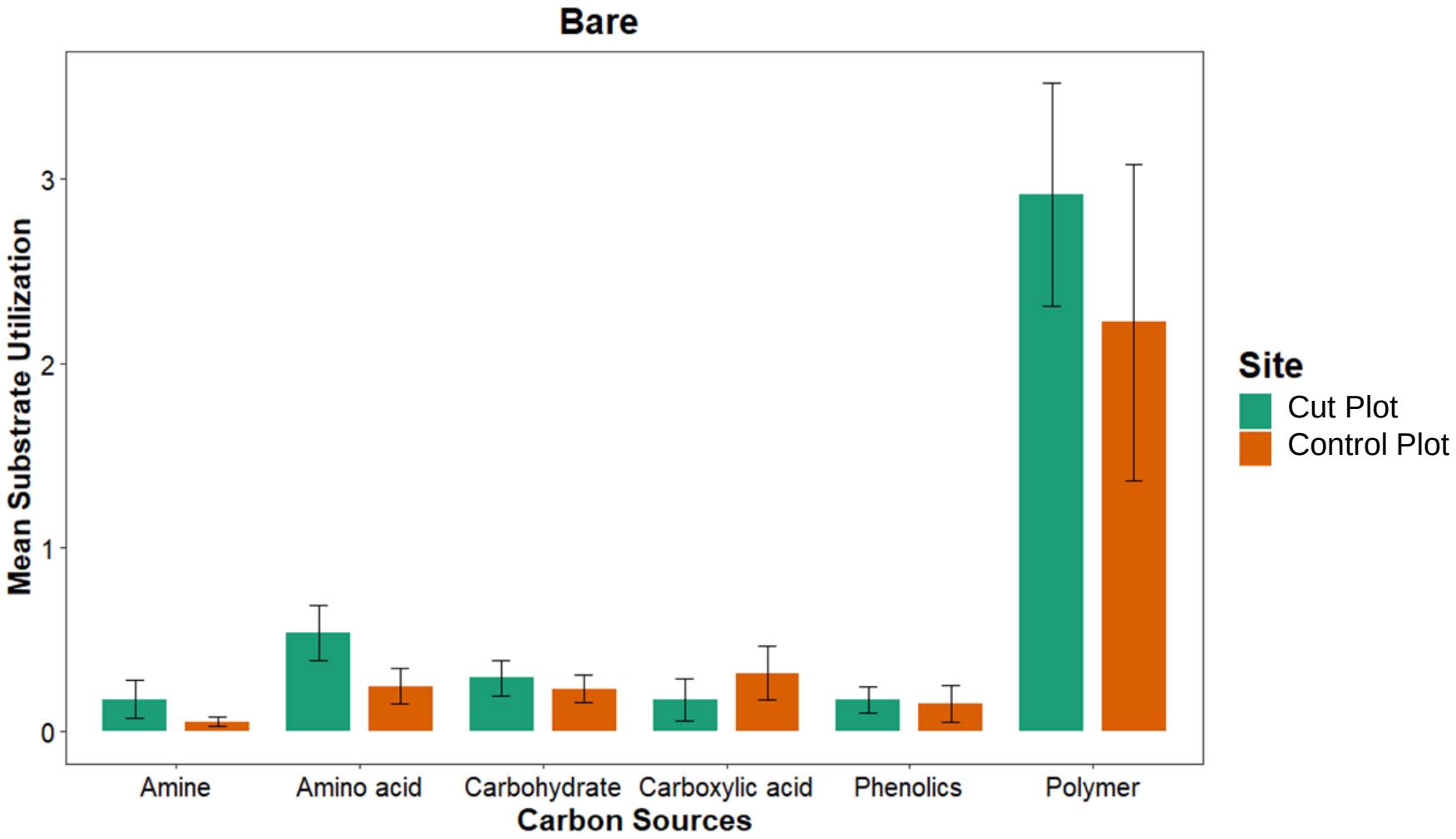


Figure 4: Carbon substrate utilization of bare soil microbiome in control and cut plot (n=18)

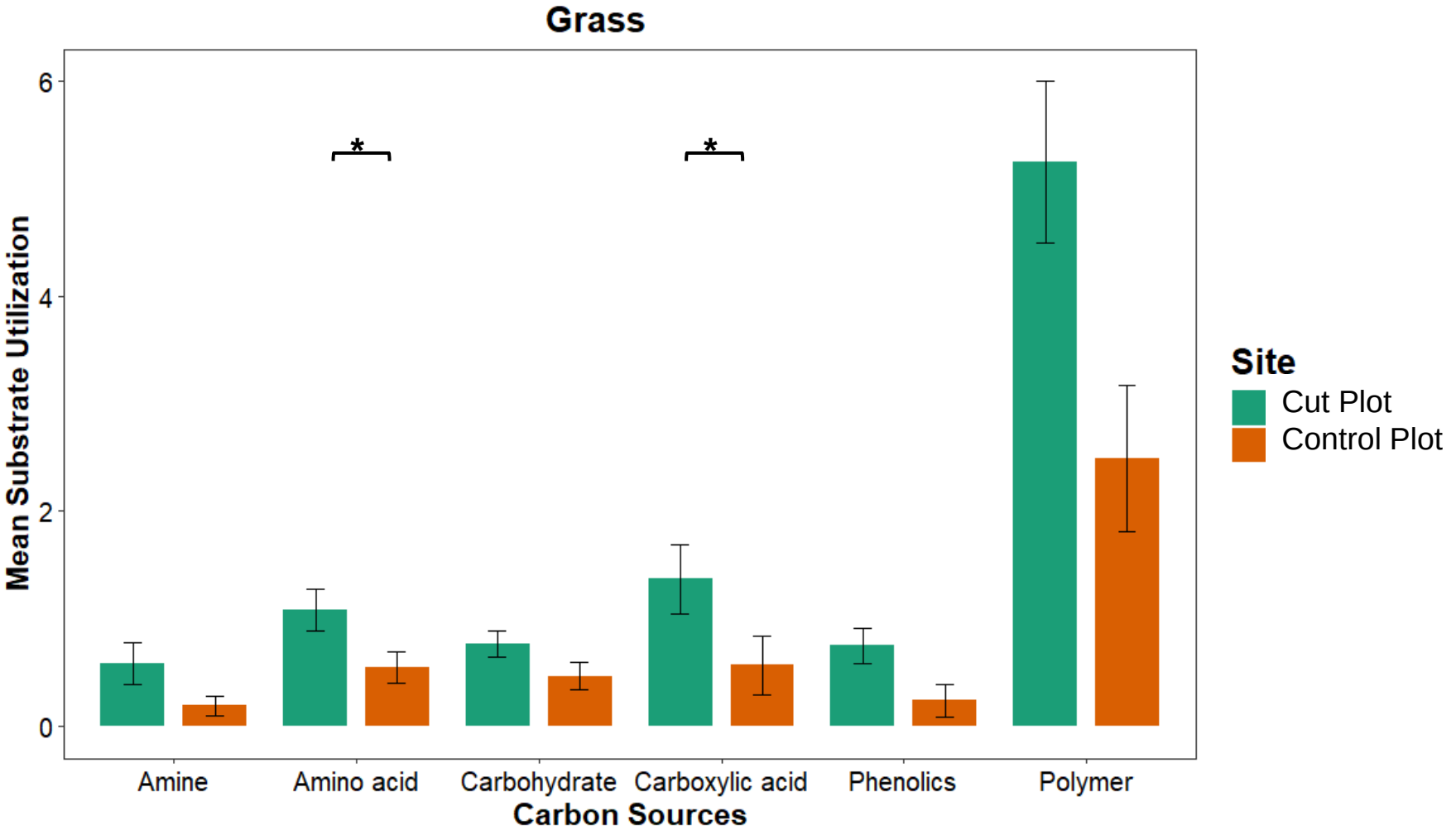


Figure 5: Carbon substrate utilization of grass soil microbiome in control and cut plot (n=18)

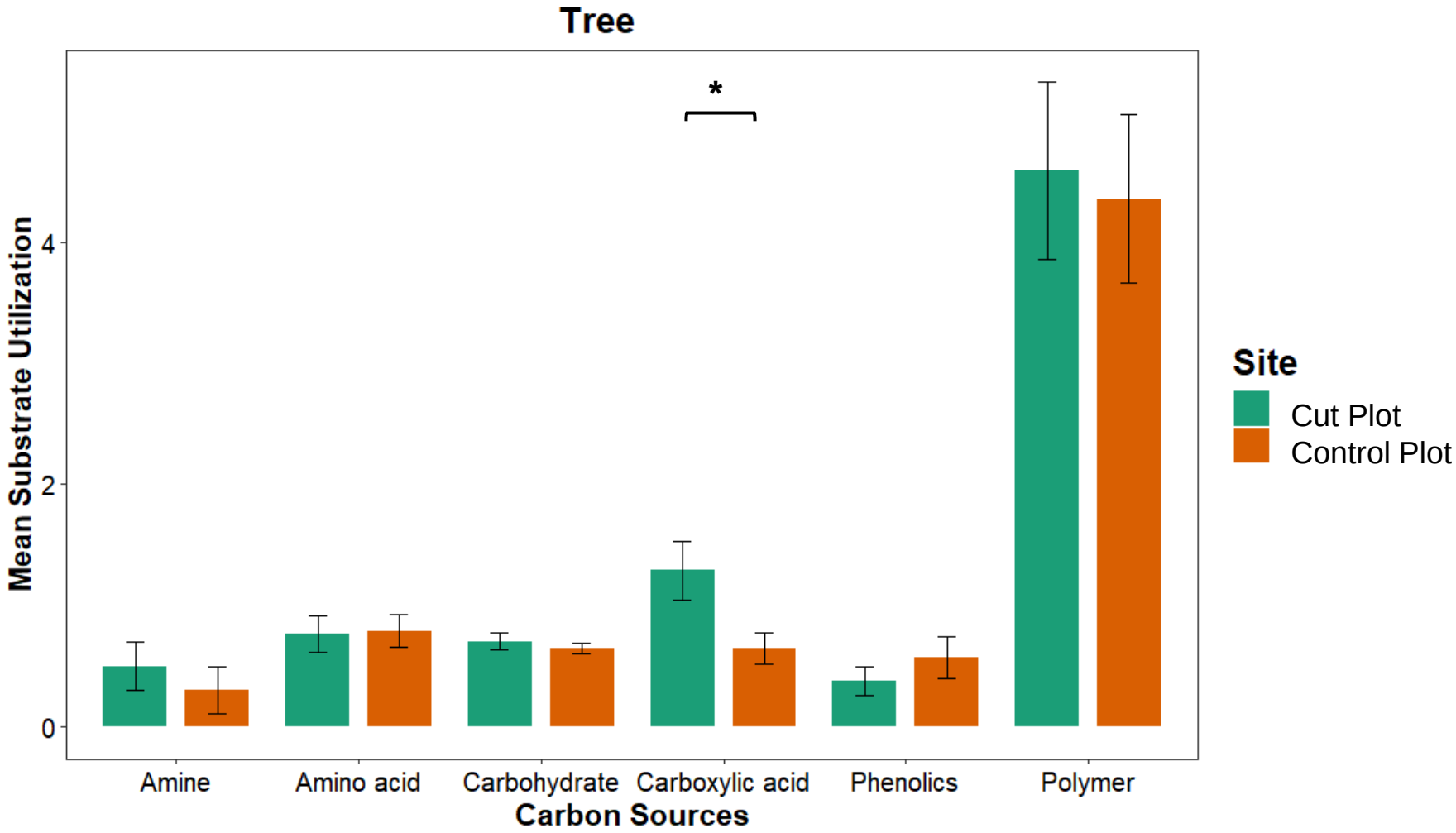
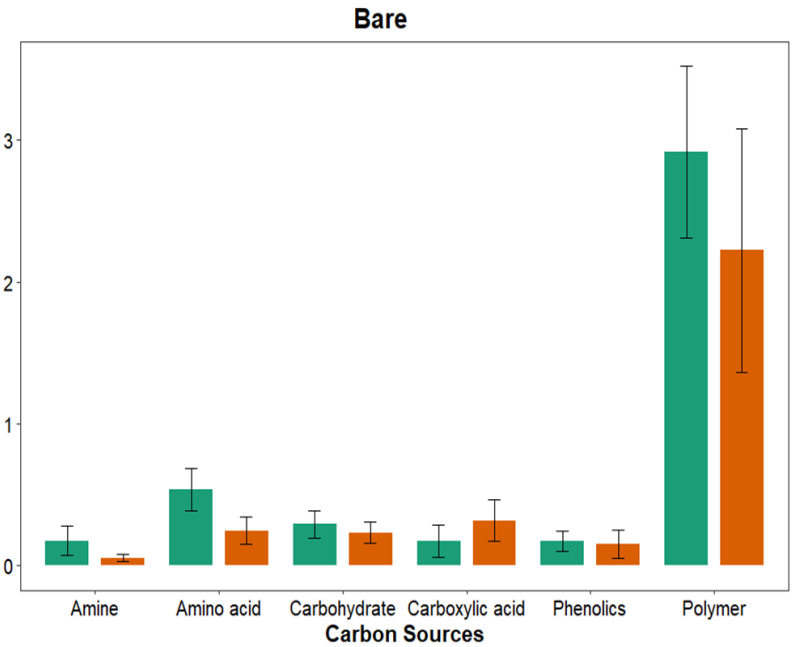
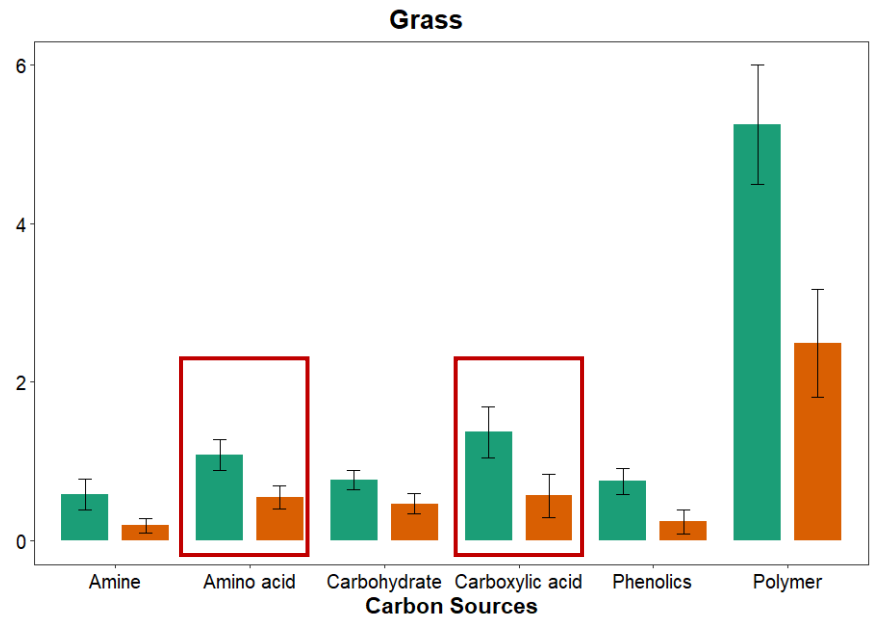
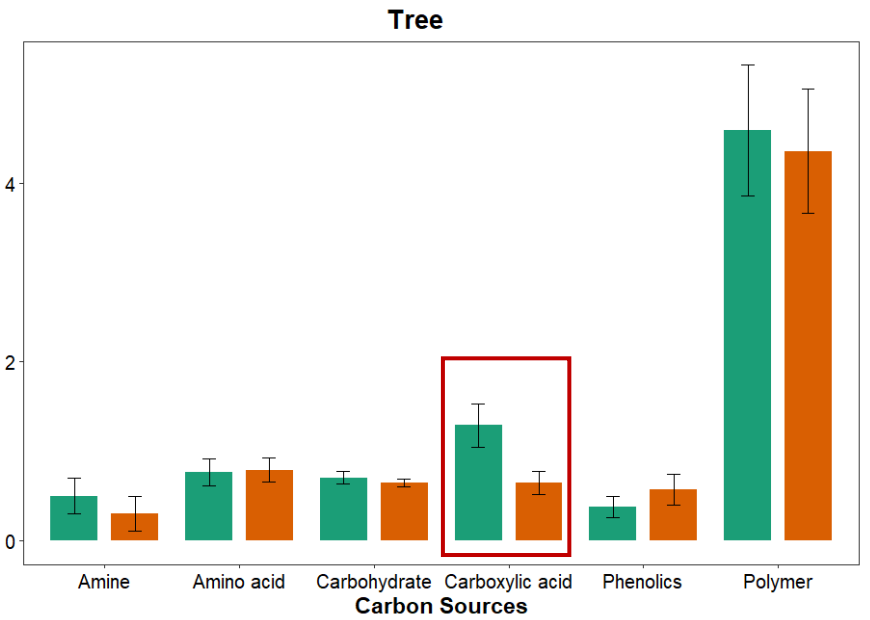


Figure 6: Carbon substrate utilization of *C. mopane* soil microbiome in control and cut plot (n=18)


Bare
0
1
2
3
Amine
Amino acid
Carbohydrate
Carboxylic acid
Phenolics
Polymer
Carbon Sources


Grass
0
2
4
6
Amine
Amino acid
Carbohydrate
Carboxylic acid
Phenolics
Polymer
Carbon Sources


Tree
0
2
4
Amine
Amino acid
Carbohydrate
Carboxylic acid
Phenolics
Polymer
Carbon Sources

SPECIES RICHNESS (S)

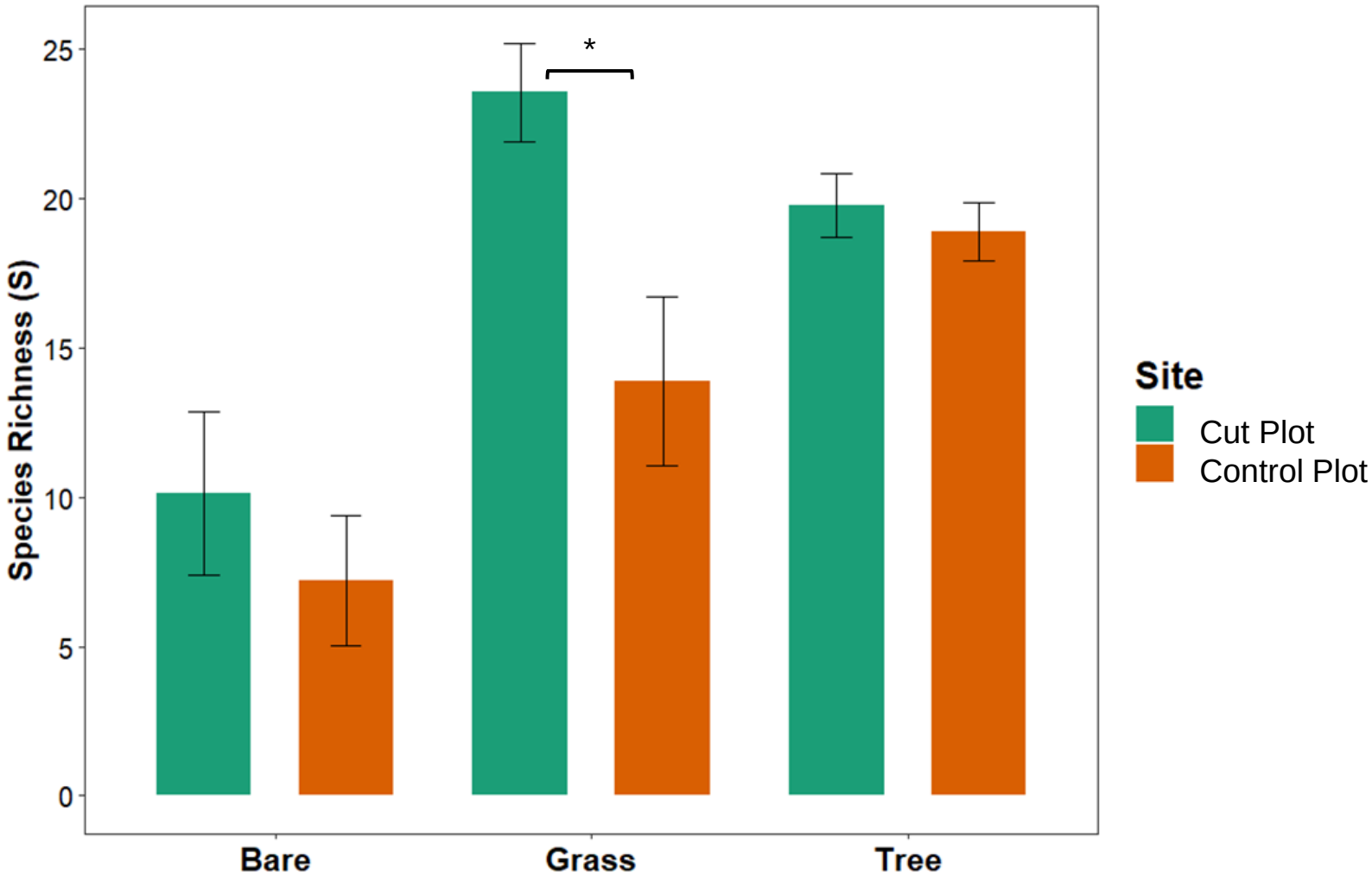


Figure 7: Richness of bare, grass, and tree soil microbes in control and cut plot (n=18)

DIVERSITY (H')

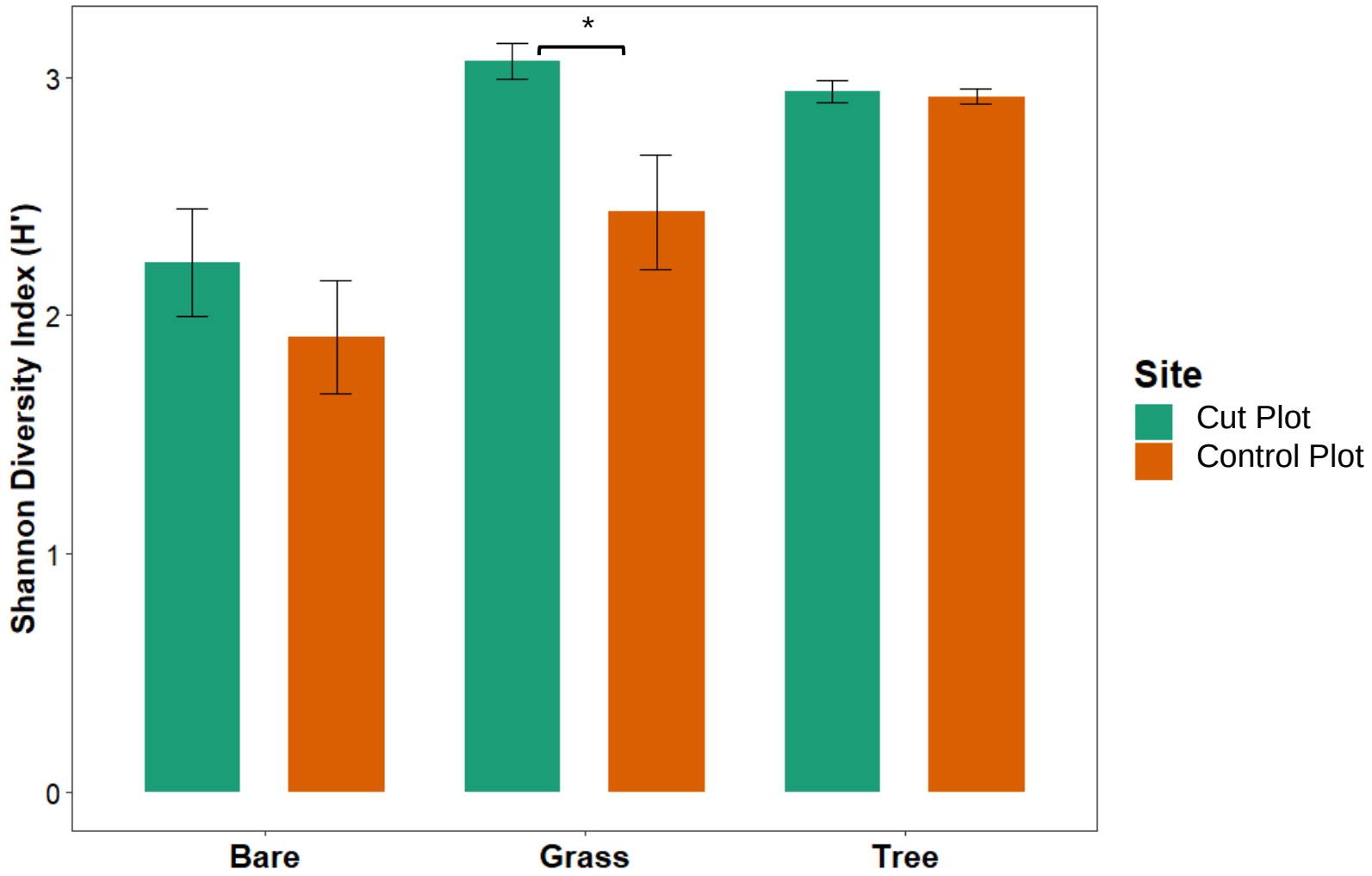
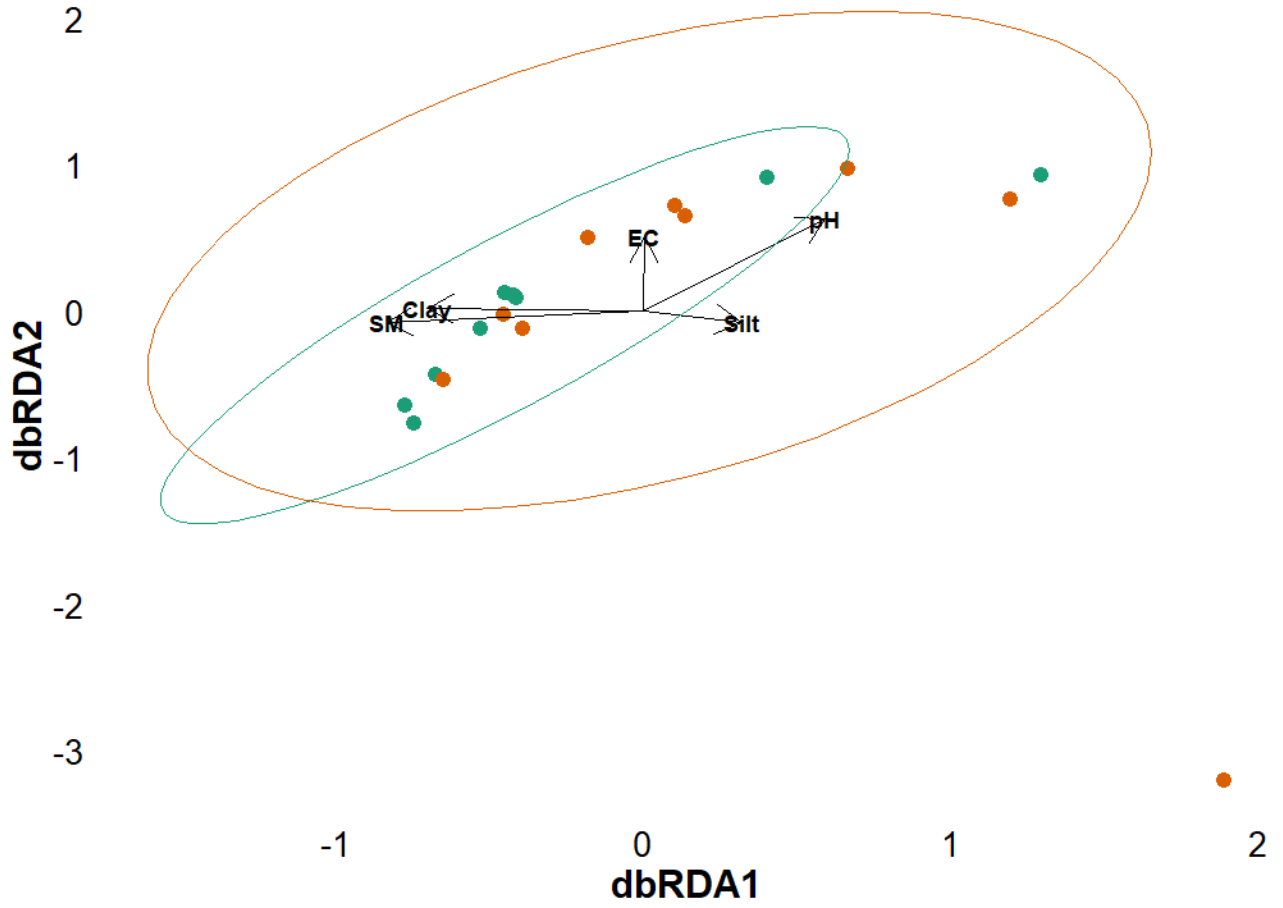


Figure 8: Diversity of the bare, grass and tree soil microbial community control and cut plot (n=18)

Multivariant Analysis



Site
- Cut Plot
- Control Plot

	Df	SumOfSqs	F	Pr(>F)
pH	1	0.25901	2.8001	0.046 *
EC	1	0.08017	0.8667	0.481
SM	1	0.16438	1.7771	0.130
Clay	1	0.12269	1.3264	0.228
Silt	1	0.13384	1.4470	0.185
Residual	12	1.11000		

Figure 12:

DISCUSSION

Do soil physicochemical properties differ under varying stages of *C. mopane* encroachment?

- *C. mopane* proliferation increased pH.
- Soil pH subsequently alters microbial composition.

How does the soil microbe's composition differ under varying stages of *C. mopane* encroachment?

- *C. mopane* proliferation changes soil microbial community composition and decreases its diversity in grass patches

IMPLICATIONS?

ACKNOWLEDGEMENT

THANK YOU!!!

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