Carbon, Nitrogen, and pH Analysis in Bulk Soil and Rhizosphere Samples in CSUSM Wetlands

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Introduction

- Differences in vegetation composition can significantly impact soil carbon (C), nitrogen (N), and pH levels.
- This research focused on measuring how C, N, and pH levels vary with bulk and rhizosphere wetlands soil samples at CSUSM.
- It was hypothesized that the rhizosphere was going to have higher C and N levels compared to bulk soil, and that the pH would be acidic.

Methods

- Three different vegetation types were studied in the CSUSM wetland habitat **(Figure 1)**.

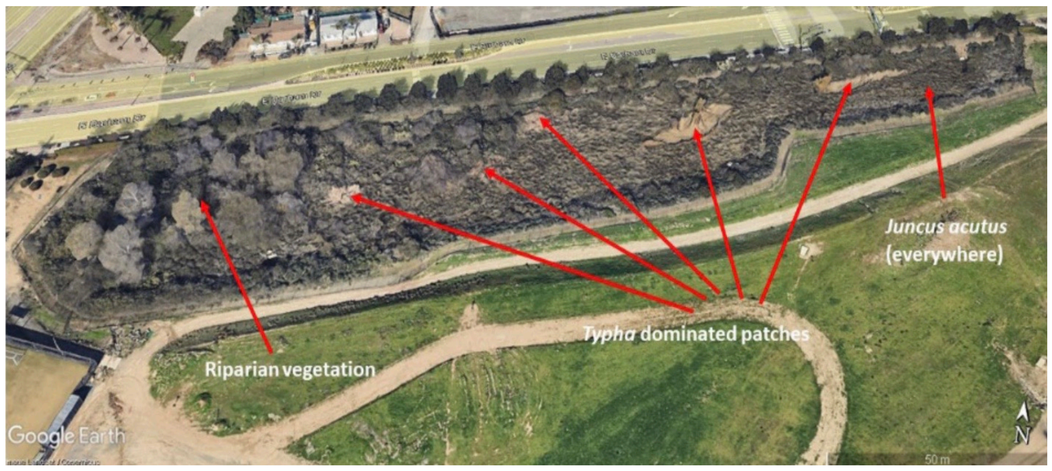

Figure 1. Google Earth image of the CSUSM wetland in 2022. The red arrows highlight the different vegetation types that were sampled for the current study: sedge, riparian, and lowland.

- Soil samples were randomly taken from the upper 20 cm soil layer from the three main vegetation types in the wetland, Lowland (L), Riparian (R), and Sedge (S). From each site, 8 samples were collected.
- Rhizosphere samples were extracted from the bulk soil samples collected in the wetland. The samples were dried, ground to fine powder, then analyzed using a pH meter, as well as analyzed by dry-combustion using a CHN analyzer.
- Data were analyzed using a non-parametric paired t-test, non-parametric independent samples t-test, and Levene's test. Data was tested for normality using a Shapiro-Wilkes test.
- Statistical analysis was conducted through Jamovi and graph creation through Excel. Non-parametric tests were conducted on data samples where transformations did not accommodate for the normality.

Figure 2. Students clearing a space on site to gather samples that would later be extracted in the lab.

Results

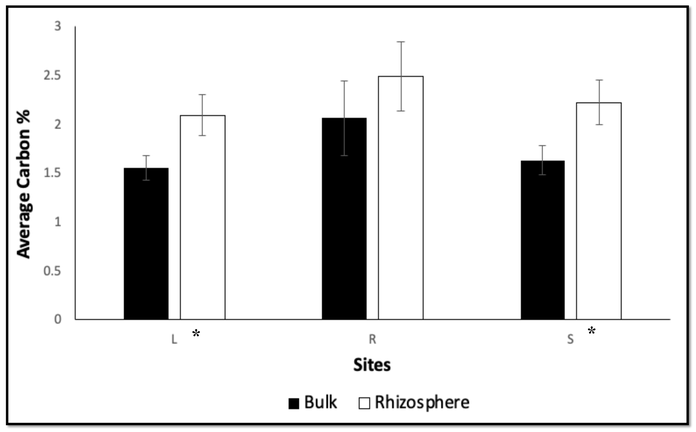

Figure 3. Depicts the average Carbon percentage from bulk and rhizosphere soil type (mean ± Standard Error) for different sites, L, R, and S. Significant sites were noted for site L and S (n=8 for each site).

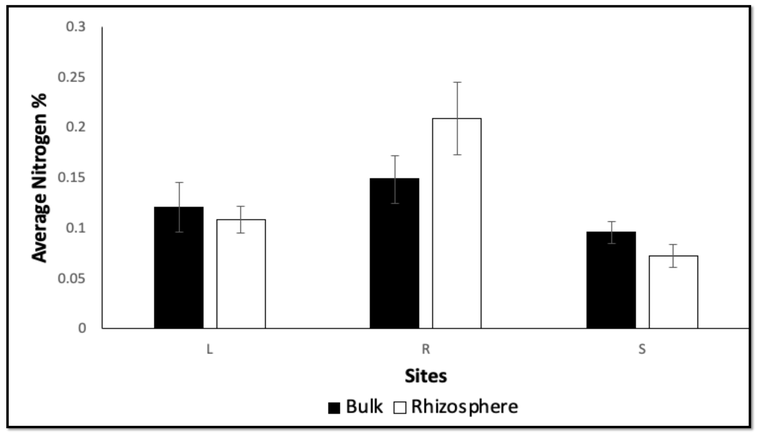

Figure 4. Depicts the average Nitrogen percentage from the bulk and rhizosphere soil type (mean ± Standard Error) for different sites, L, R, S (n= 8 for each site).

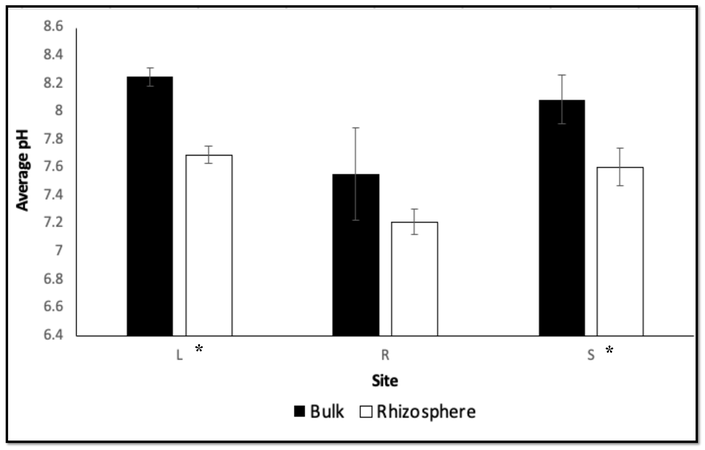

Figure 5. Depicts the average pH from bulk and rhizosphere soil type (mean ± Standard Error) for different sites, L, R, and S. Significant sites were noted for site L and S (n=8 for each site).

Table 1. Independent samples t-test for Lowland and Sedge C:N content and pH between rhizosphere and bulk soils

Independent Samples T-Test

		Statistic	df	p	Mean difference	SE difference
L-Carbon %	Welch's t	−2.208	11.3	0.049	−0.5396	0.2444
L-Nitrogen %	Welch's t	0.431	10.7	0.675	0.0123	0.0284
S-Carbon	Welch's t	−2.16	11.8	0.052	−0.5908	0.2729
S-Nitrogen %	Welch's t	1.43	14.0	0.174	0.0232	0.0162
L-pH	Welch's t	6.25	14.0	<.001	0.558	0.0892
S-pH	Student's t	2.19	14.0	0.046	0.483	0.220

- There were significant differences in total C and pH between the bulk and rhizosphere soils in Lowland and Sedge habitats, but not in Riparian (**Table 1**).

Conclusions

- It was found that there was a significant difference between the Lowland carbon % ($p = 0.049$) and Sedge carbon ($p = 0.052$). Analysis of pH samples revealed that there was a significant difference in Lowland bulk and rhizosphere samples ($p = <0.001$). Significant difference was also seen in Sedge location bulk and rhizosphere samples ($p = 0.046$).
- pH analysis for Lowland showed a significant difference between the bulk and rhizosphere soil ($p = <0.001$). The pH analysis for Sedge depicted a significant difference in the independent sample t-test between bulk and rhizosphere ($p = 0.046$). No significant difference was found in the Riparian pH analysis ($p = 0.346$).
- This analysis revealed that that our hypothesis regarding C:N content between rhizospheres and bulk was partially true. We expected that the rhizosphere would overall contain a higher carbon-nitrogen as well as a more acidic pH.

Acknowledgements

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