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Soil Bulk Density Variability in a Restored Prairie Ecosystem

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Soil bulk density variability in a restored prairie ecosystem

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Introduction

Soils serve as the foundation for all terrestrial biotic activity, and therefore have significant impact on the development of the ecosystems established upon them. In 1999, Cedarville University, established a Prairie Restoration Site. This restoration involved reseeding the area with native prairie grasses and introducing disturbances common to prairie grasslands such as fire. The goal of the Prairie Restoration Site project has been to aid a system in ecological succession. Our study was designed to evaluate one aspect of the successional process by examining the soil environment. To do this we examined the effect on soil bulk density by two factors: the specific soil series which corresponds to slope position, and prairie restoration as compared to the surround unrestored field.

Hypotheses

We expect to observe greater soil bulk density outside of the Prairie Restoration Site than we do within the site parameters, and we expect to see consistent variance in bulk density between different types of soil.



Figure 1. This image shows the Cedarville University Prairie Restoration Site.

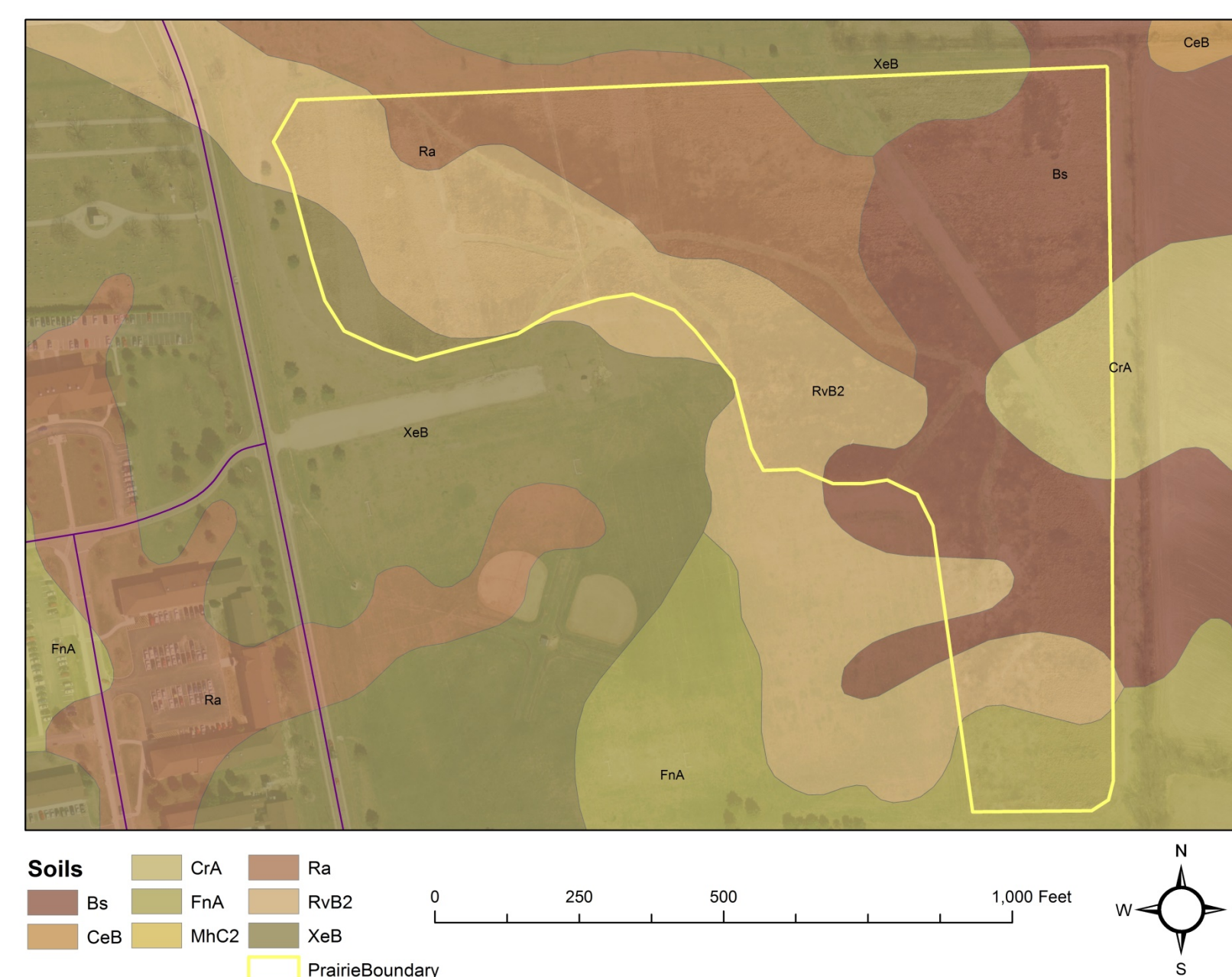


Figure 2. This image shows the map of soil types. The yellow line outlines the Prairie Restoration Site.

Methods

Site description

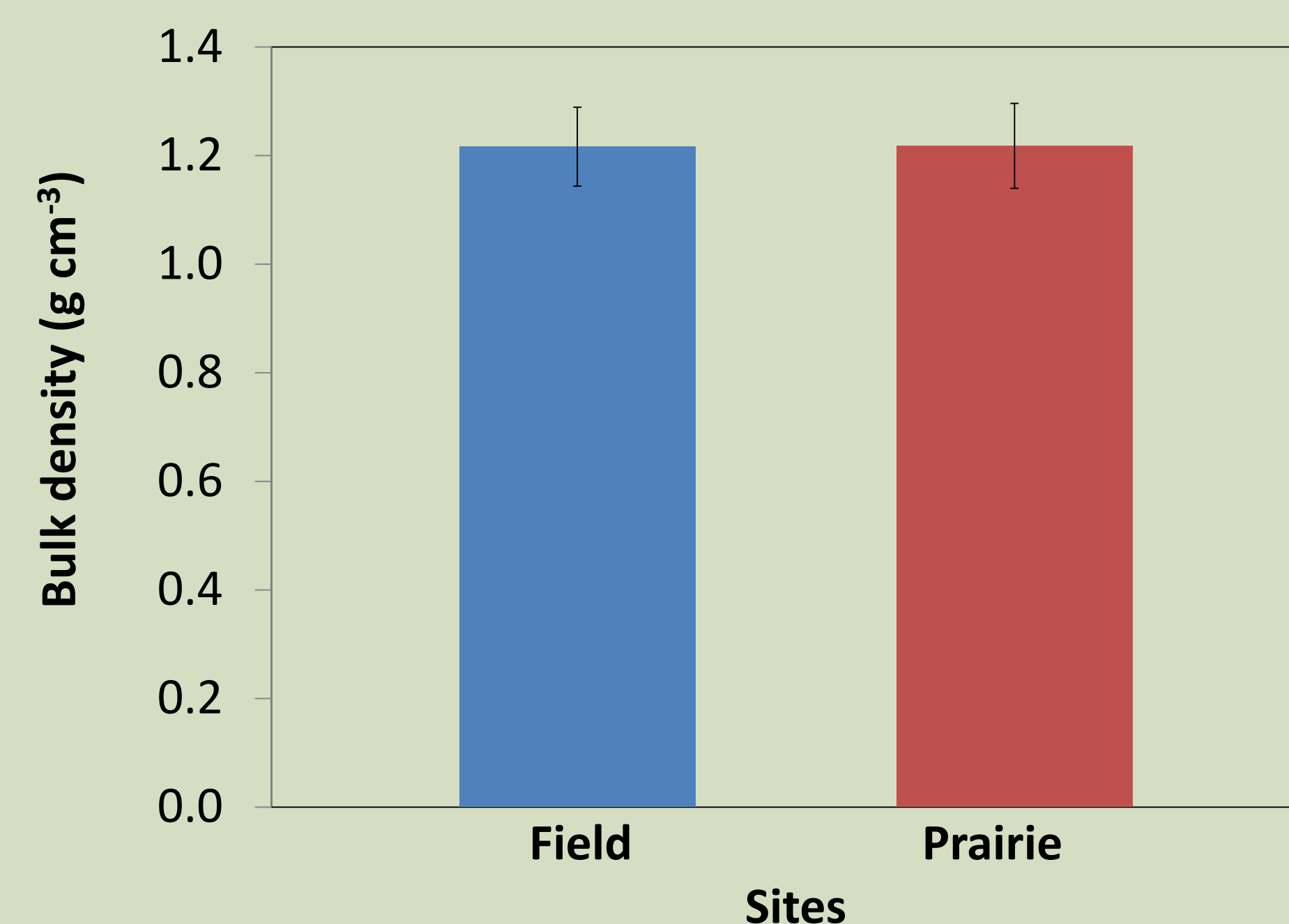
- The site used in this study are located in Greene County, Ohio
- Thirty year climate records from Midwest Regional Climate Center (at the XENIA 6 SSE, OH station) reported mean annual precipitation of 1018 mm and mean annual temperature of 11.1 °C
- The Prairie Restoration Site has been in existence since 1999
- Soil types
 - Ragsdale (Ra) – silty clay loam and poorly drained soil, Typic Argiaquoll subgroup of Mollisol
 - Xenia B – silt loam on 2 to 6 % slopes, belonging to the Aquic Hapludalfs subgroup of Alfisols
 - Russell-Miamian (Rvb2) – silt loam soils that are moderately eroded on 2 – 6 % slopes, Typic Hapludalfs subgroup of Alfisols

Field sampling & lab analysis

- Using a slide hammer, we collected fifteen samples (294.5 cm³) from each soil type inside the Prairie Restoration Site and fifteen samples from each soil type outside the Prairie Restoration Site
- Following collection we manually broke soil clods apart and allowed the soils to air dry for one week.
- Following the drying process, each soil sample was weighed, and sieved to 2mm²
- After filtering, the samples were weighed again

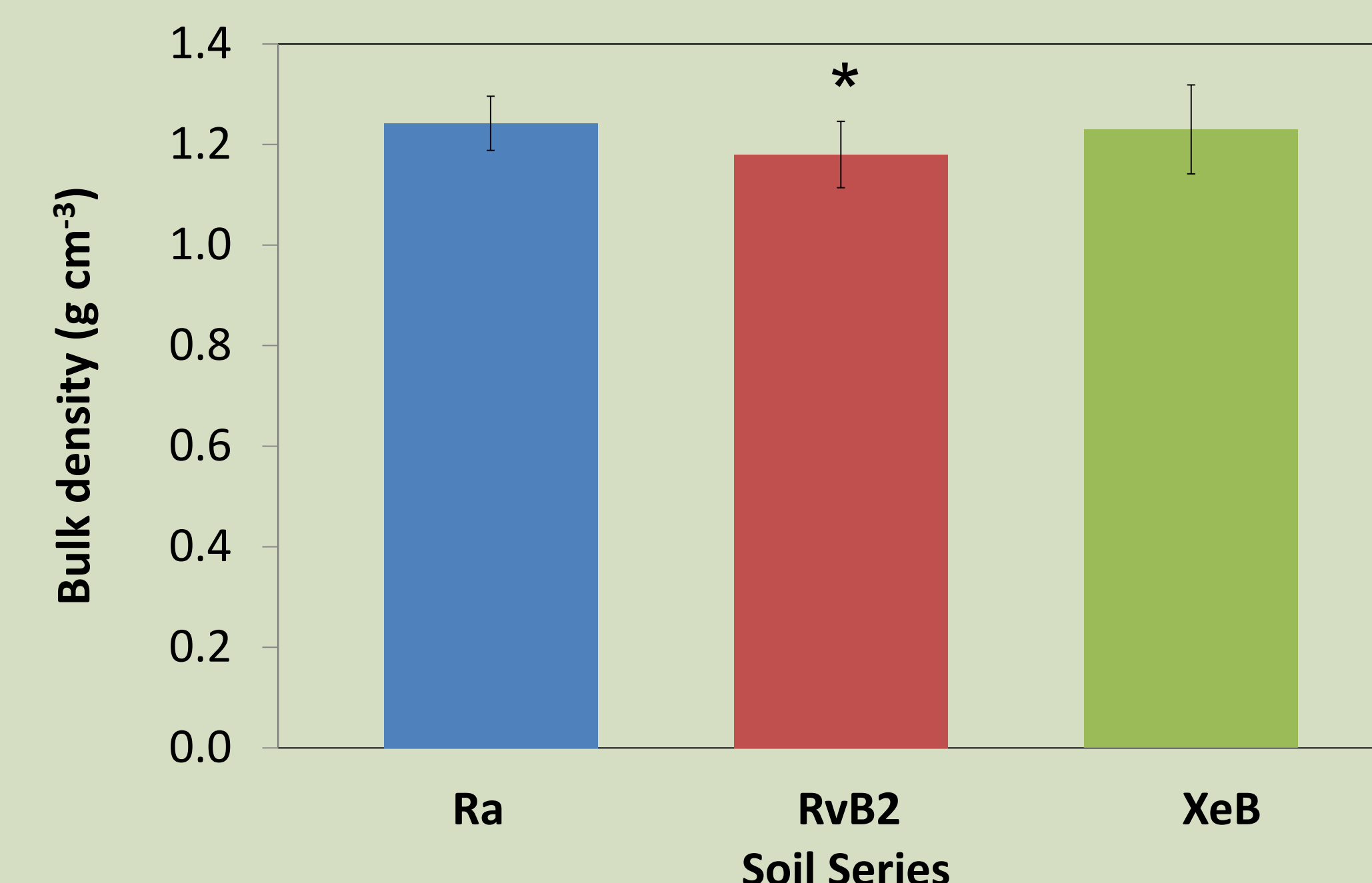
Results

Site comparison



- Means (±standard deviation) of bulk density in the field and prairie were nearly identical at 1.21 (±0.073) and 1.21 (±0.077).
- Using a two-way anova we found that sites were not significantly different (p = 0.93). There was no significant interaction between location and soil series.

Soil series comparison



- In contrast to sample locations we found that the soil series were significantly different (p = 0.003).
- Post-hoc tests (Tukey) identified that the RvB2 soil series had significantly (p < 0.05) bulk density than the XeB and Ra soils
- Soil bulk density means (±SD) of Ra, RvB2, and XeB were 1.24 (±0.05), 1.18 (±0.07) and 1.23 (±0.09), respectively.

Conclusions

Study sites

- We observed that the location (inside versus outside the Prairie Restoration Site) does not have a significant effect on bulk density
- Our hypothesis was disproved in relation to study sites, as no significant differences were observed between the Prairie Restoration site and the field.
- We conclude that while the Prairie Restoration project may affect bulk density, it has not yet had sufficient time to do so.

Soil series

- We observed that the soil type does have a significant impact on bulk density and this is independent of site location (inside and out of the Prairie Restoration Site)
- Our findings confirm our hypothesis in that the various soil series exhibited consistently different levels of bulk density.
- We surmise that the lower bulk density of the RvB2 soil is related to the erosion inherent to its classification and the slope range in which it is found.



Acknowledgements

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