Plant Diversity and Traits Along a Sandhills Prairie Gradient

Sheridan Wilson

Nebraska EPSCoR Young Nebraskan Scientists

SBS Undergraduate Research Symposium

Working with Yuguo Yang

(PhD student in Sabrina Russo's Laboratory at University of Nebraska)

Background

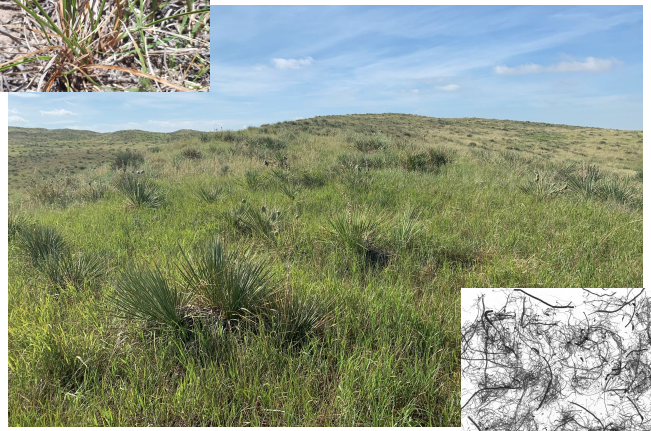
- How well matched plant phenotypes are to their environment influences the growth, survival, and reproduction of plants
- Plant productivity is limited by the availability of resources, such as soil moisture and nutrients
- This is especially true in biomes, such as prairies, where rainfall is limited and soils may be well-drained and nutrient-poor
- **Overarching research goal:** We studied the correlation between prairie plants' belowground phenotypes, productivity, and diversity along an elevation gradient in the Sandhills of western Nebraska.

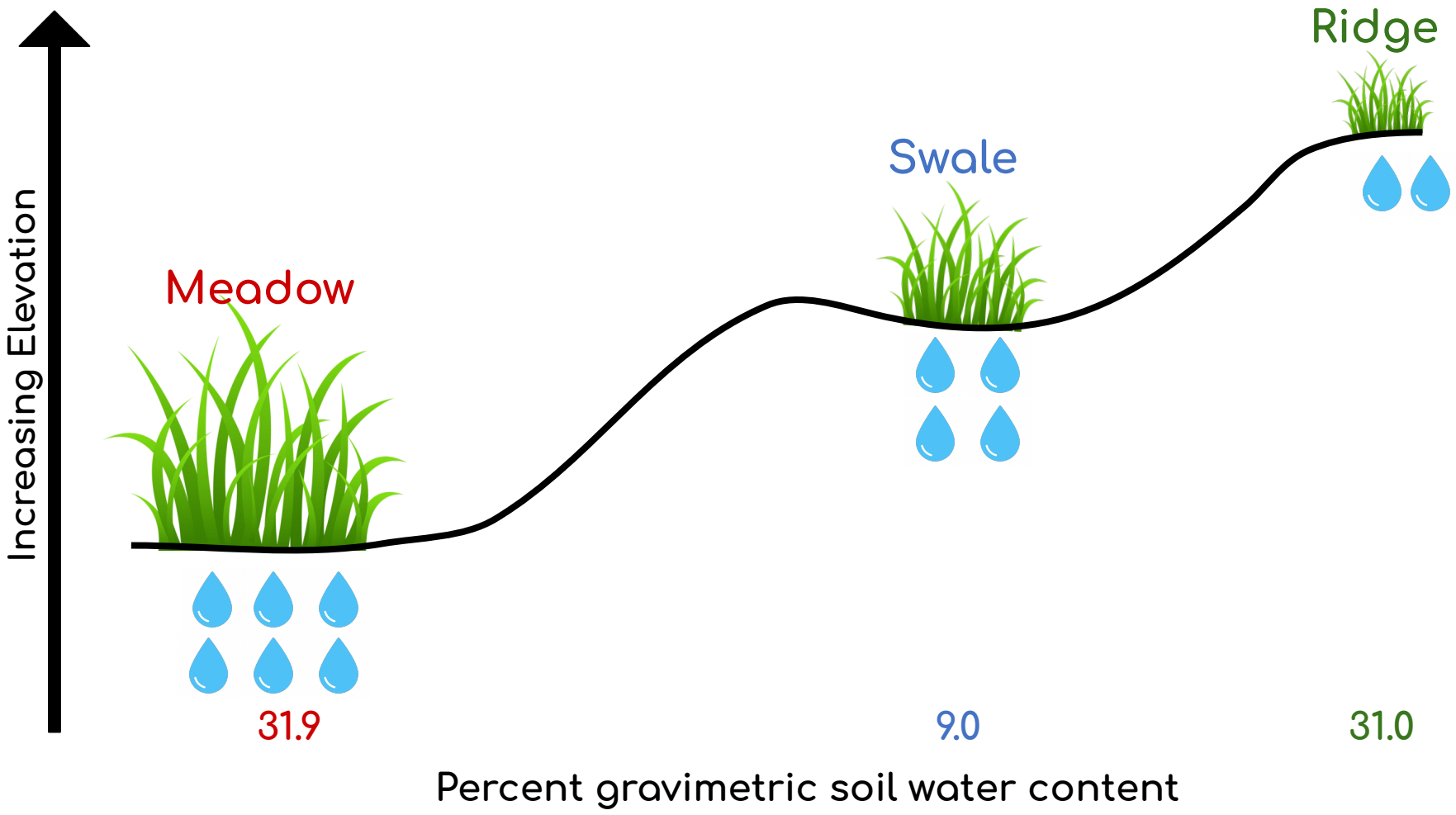
Specific Research Questions

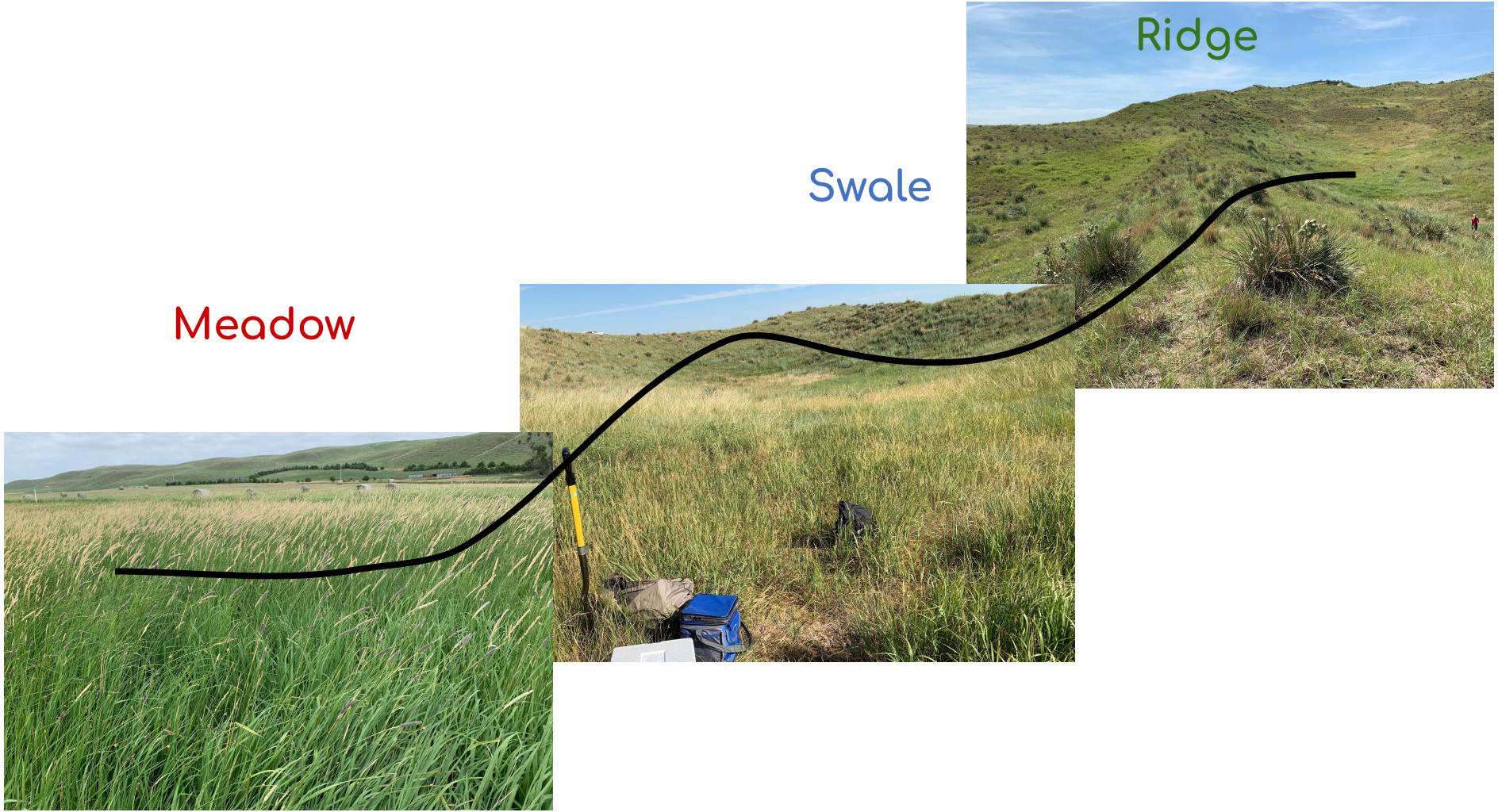
Q1: Do plant traits differ across a gradient of water availability?

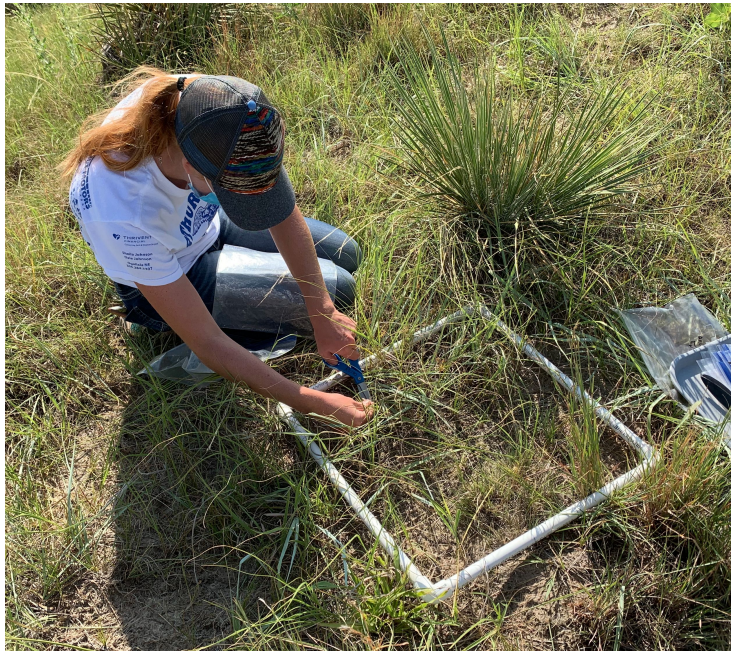
- Root traits
- Belowground biomass
- Aboveground biomass

Q2: Is there a correlation between species diversity and plant traits across a gradient of water availability?




Increasing Elevation
Meadow
Swale
Ridge
31.9
9.0
31.0
Percent gravimetric soil water content

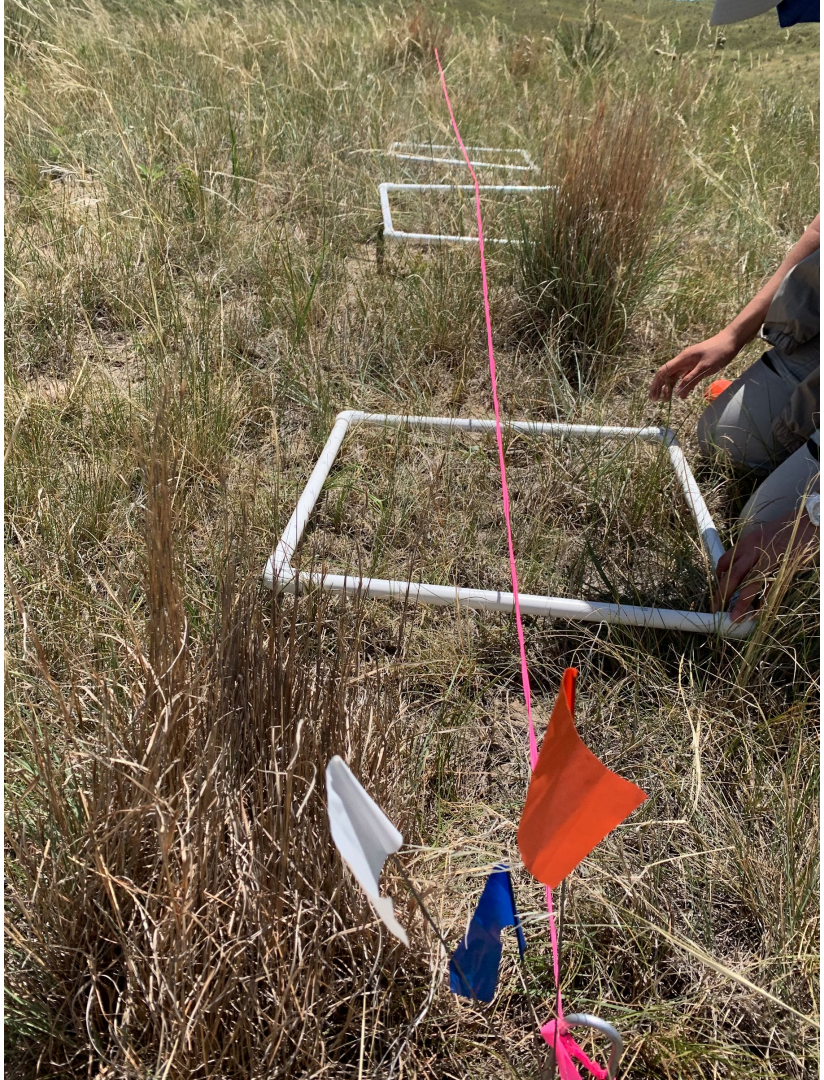

Ridge
Swale
Meadow



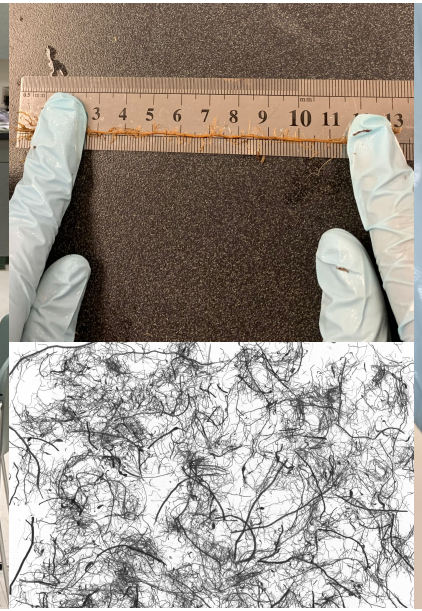
Here we identified plant species and measured their abundance and aboveground biomass

We also collected soil cores to sample roots and soil microbiota

We collected plant, root, and soil data in several quadrats in transects in each habitat type (meadow, swale, and ridge) at two different sites: Arapaho Prairie and Gudmundsen Sandhills Laboratory



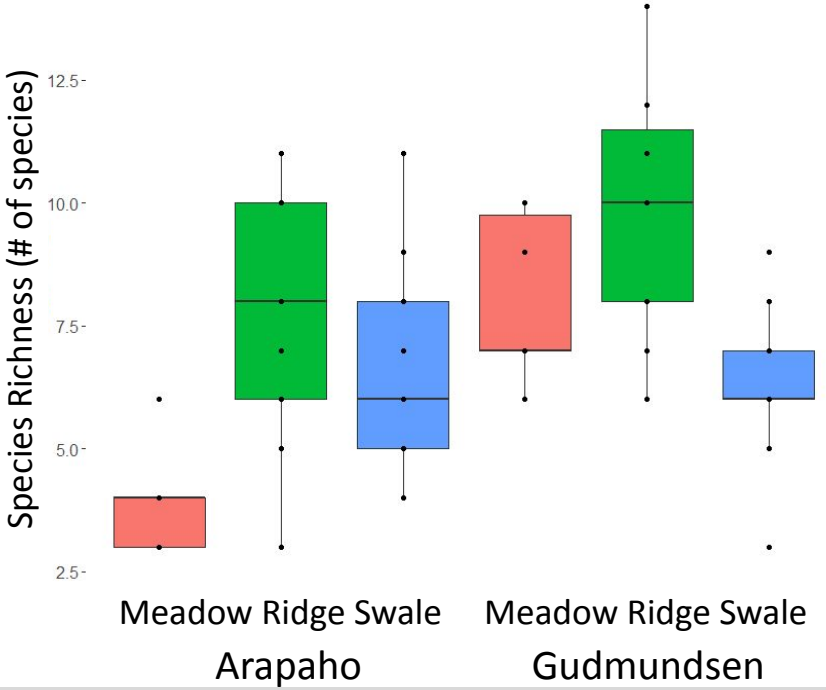
Cleaning soil from roots in the soil cores

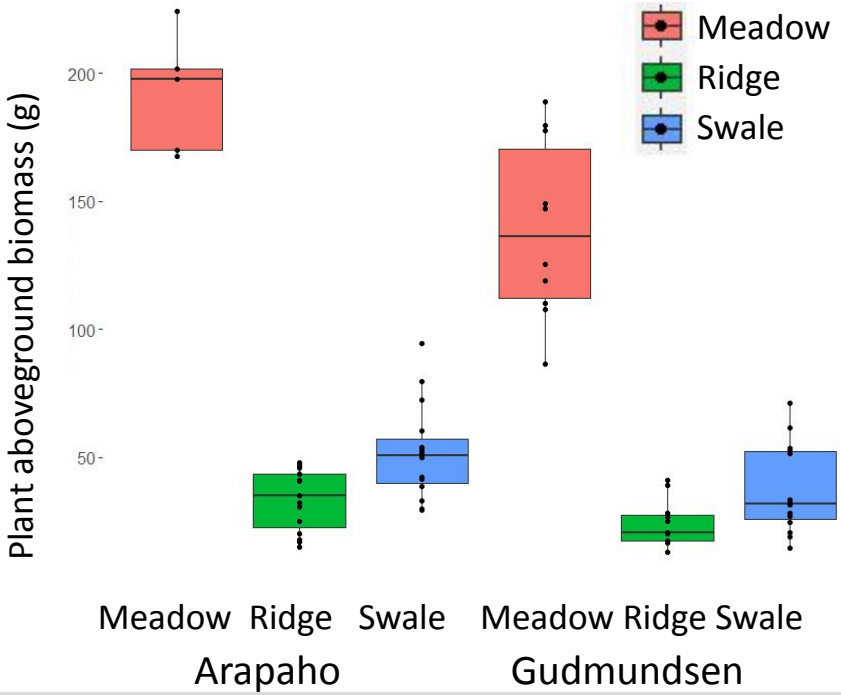


Top: measured longest root length
Bottom: measured root traits using WinRhizo scanner and software

Weighing the clean roots to estimate root biomass

Aboveground Plant Biomass and Diversity

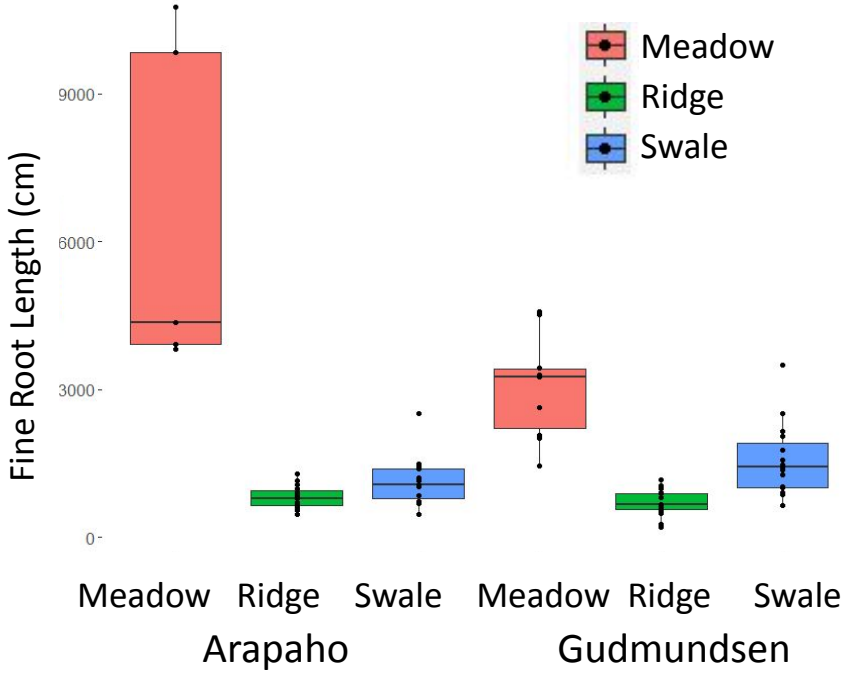


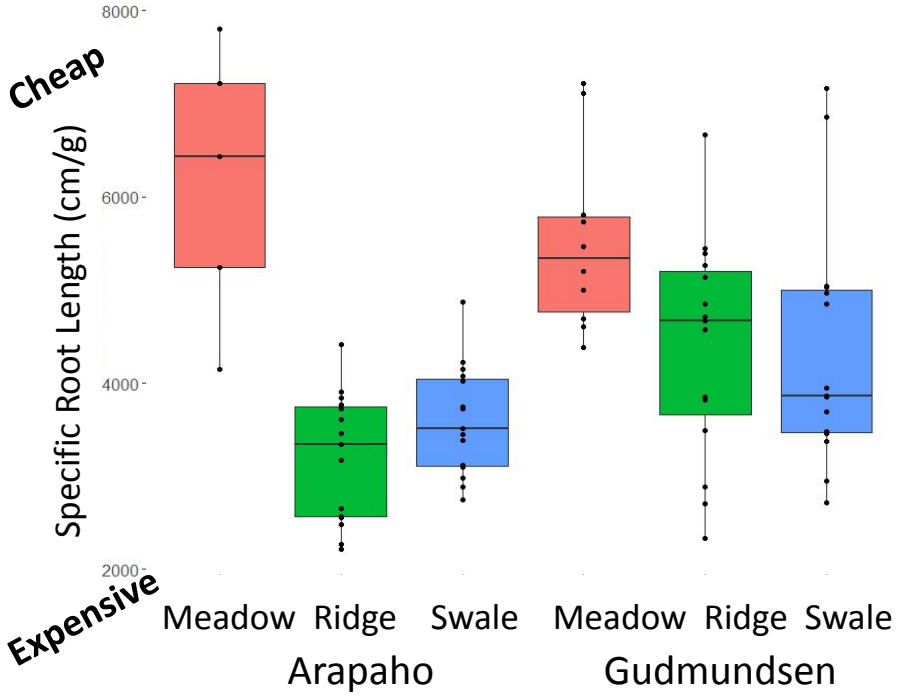


The ridge at both sites had the highest plant species diversity. However, at Arapaho, the swale was more diverse than the meadow. The opposite was true at Gudmundsen.

The aboveground biomass for each habitat was consistent at both sites. The meadow had the most biomass, followed by the swale; the ridge had the least biomass.

Total Fine Root Length & Specific Root Length

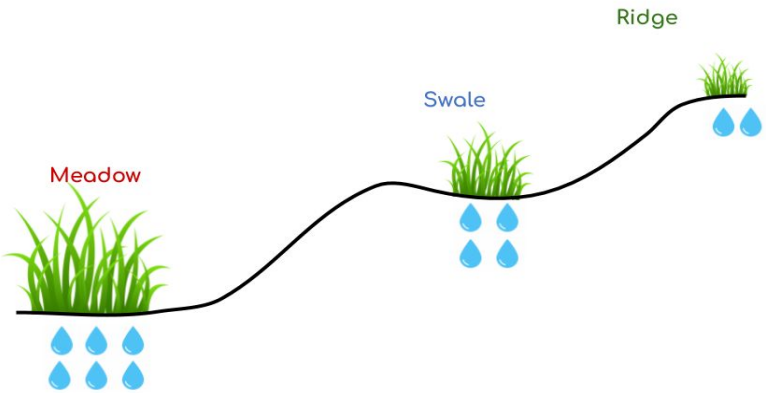




At both sites, the meadow had the greatest total root length, but at Arapaho the investment in root length was greater than at Gudmundsen. The swale had greater root length than the ridge, which had the lowest investment in roots at both sites.

At both sites, specific root length was the greatest in the meadow. Specific root length in the ridge and swale were similar, but at Arapaho the swale had slightly greater specific root length, whereas the opposite was true at Gudmundsen.

Conclusions



- Plant biomass in each habitat decreased as water availability decreased.
- The habitats with the highest aboveground mass made roots with the longest specific root length (more aboveground biomass -> “cheaper” roots)
- In habitats where belowground resources like water and nutrients were scarce, plants invested in more expensive roots that lived longer and would survive in stress, but habitats with plentiful resources allowed the plant to invest in more aboveground biomass, which increased their ability to get sugar through photosynthesis.
- How plants build their root systems may affect their interactions with soil microbiota, which will be examined in the next steps of this research project.

Acknowledgements

- The Young Nebraska Scientists program
- The Gudmundsen Sandhills Lab
- Two Bar Two Ranch Co.
- Mentors Sabrina Russo and Yuguo Yang
- Undergraduates Joevy Sum, and Justin Ho
- Funding from National Science Foundation