Stephen J. Barnhart Internship 2016-2017:

Influence of Soil Moisture on Phenology and Species Distribution in Pepperwood Preserve

Emily Hoeft[1], Jennifer Palladini[1], Peggy Rockwood[1], Michelle Halbur[2]

[1]Santa Rosa Junior College, [2]Pepperwood Preserve

Abstract & Overview

Late in the summer of 2016, I was awarded the Stephen J. Barnhart Herbarium Internship at Pepperwood Preserve. This was an incredible opportunity for me to plan and develop my own experiment to explore the relationships between the availability of water and how plants are distributed and progress through phenological stages.

California grasslands are well known biodiversity hotspots. Many factors, including the availability of water, can contribute to this diversity and species distribution. In addition to exploring determinants of diversity, it's important to consider how plants will respond to shifting growing seasons due to climate change, which could cause an overlap of growing seasons in species that did not previously exist. This could cause competition for resources that have not been an issue in the past. This competition could lead to a disruption in grassland ecosystems and decrease biodiversity.

The purpose of my project was to execute a comprehensive study of the Barn Meadow at Pepperwood to determine how species diversity is affected by differing soil moisture levels. I also recorded the phenology of *Sisyrinchium bellum*, *Trifolium subterraneum*, *Lathyrus angulatus*, and *Vicia sativa*. The phenological data included leaf-out times, flowering times, and fruiting times, observed in a three month period. I am currently processing data to determine if there are any correlations between soil moisture, diversity, and phenology. Thus far, no significant correlations have been found.



Figure 1: Wildflowers in the Barn Meadow. From left to right: *Castilleja rubicundula ssp. Lithospermoides, Trifolium variegatum, Lupinus nanus.*

The Barn Meadow at Pepperwood Preserve

- The Barn Meadow is located within Pepperwood Preserve, which is just north and east of Santa Rosa. It contains a swale which I hoped would provide me with some plots where soil remained wet over the season.
- The study area is approximately 13.430m^2 which was divided by 5 transects roughly 35m apart.
- Meadow elevation is 1,070ft.
- Data was collected from 24 plots, each measuring 1m^2.



Figure 2: Barn Meadow with transects and plots.



Figure 3: Actual plots on site.

Methods & Materials

- Data collection started February of 2017.
- Four soil moisture readings were taken from each plot every two weeks using a Hydrosense II soil moisture reader.
- Phenology data was recorded on the alternate weeks for four different species.
- Percent cover data was recorded only from the SE quarter of the quadrat as plants bloomed to record only their maximum coverage of the area.
- Plants were collected for identification and pressed for herbarium specimens.



Figure 4: Soil moisture reading in February.

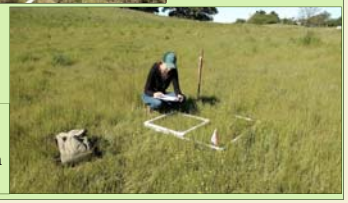


Figure 5: Phenology and Percent cover in April.

Results

- Data is still being analyzed, the graphs below represent initial analysis.

Table 1: Phenological stages are listed below with criteria used to determine what stage plants were in along with the number assigned to each stage for the purpose of data analysis. If plots contained multiple stages percentages in each stage were recorded and averaged.

Phenological Stage	Number	Criteria
Vegetative	1	Green leaves present
Bud Stage	2	Unopened flower buds
Flowering	3	Flowers open
Fruiting	4	Old flowers with fruits initiated
Mature Fruit	5	Fruits mature and enlarged
Dehisced Fruits	6	Fruits mature, seeds released

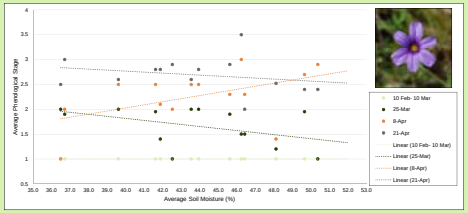


Figure 6: The average soil moisture percentage from February 10th - April 21st for each plot compared against the average phenological stage for *Sisyrinchium bellum* in each plot showed no significant correlation over time with the largest R^2 value being 0.244 for the week of April 8th with all other R^2 values significantly lower.

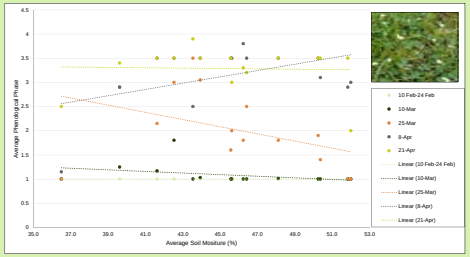


Figure 7: The average soil moisture percentage from February 10th - April 21st compared to the average phenological phase for *Trifolium subterraneum* showed no significant correlation with the highest R^2 value of 0.201 occuring the week of April 8th.



Figure 8: *Lathyrus angulatus* analysis in progress.



Figure 9: *Vicia sativa* analysis in progress.

Conclusions & Thoughts

Thus far, there is no correlation between soil moisture and the progression of plants through their phenological stages. This may be due to the fact that there was little variation between plots for soil moisture because of this years continual rains. As the seasons progress and some plots begin to dry we may see more variation. Other factors, such as soil composition should also be considered in future projects.

I am in the process of analyzing the plant percent cover data to see if there is any correlation between where plants are distributed, how densely they are distributed, and soil moisture. I would expect to see some correlation between plant distribution and soil moisture.

This experiment has allowed me to gain valuable experience with setting up a field study and collecting and interpreting data. In addition, it has given me the opportunity to start developing my plant identification skills and become more familiar with California's grassland flora. My hope is that the data I have collected from the Barn Meadow can be used by Pepperwood Preserve for future studies on diversity and the effects of climate change.

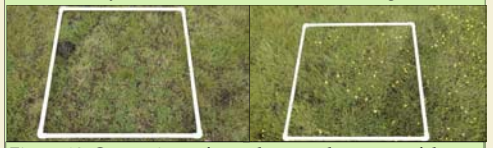


Figure 10: Comparison of one plot over the course of the season, the picture on the left was taken March 10th and the one on the right was taken April 15th.

Acknowledgements

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