Drought Stress and Cattle Grazing Effects on Prairie Species Growth and Reproduction

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Motivation

Our research is focused on how drought stress and cattle grazing effect how prairie grasses and forbs devote resources to growth and reproduction. The ecosystem has diverse plant community and can lead to a loss in ecosystem services. The type of plants that are most vulnerable to drought and grazing.

Background

- Chronic drought throughout Colorado can cause some prairie species to be lost from the system (Svejcar et al. 2014).
- These conditions are called drought stressors. They affect plants in multiple ways from biological, physiological, biochemical, and cellularly(Hoover et al. 2017). Some plants have resistance mechanisms to combat this by drought avoidance in annual plants and placing plant cell life into homeostasis during water shortage.
- However, due to rising temperatures in the last 14 years and the frequency of drought in Colorado (Udall, Overpeck 2017). These mechanisms may be not enough to combat especially during seasonal cattle grazing
- **We have hypothesized that conditions of drought stress and the timing of cattle grazing will cause the plants to dedicate more resources into reproduction than growth. We analyzed the effects of grazing by comparing plant leaf height and coverage in drought cover, dry, and water added plots.**

References

Hoover, D.L., Duniway, M.C. and Belnap, J. (2017), Testing the apparent resistance of three dominant plants to chronic drought on the Colorado Plateau. J Ecol, 105: 152-162. https://doi.org/10.1111/1365-2745.12647

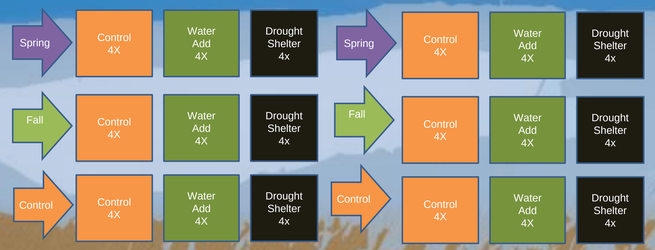
Udall, B., & Overpeck, J. (2017). The twenty-first century Colorado River hot drought and implications for the future. Water Resources Research, 53(3), 2404–2418. https://doi.org/10.1002/2016wr019638

Salehi-Lisar, S. Y., & Bakhshayeshan-Agdam, H. (2016). Drought Stress in Plants: Causes, Consequences, and Tolerance. Drought Stress Tolerance in Plants, Vol 1, 1–16. https://doi.org/10.1007/978-3-319-28899-4_1

Methods

Plant Growth

- Growth and ground coverage of one annual grass and three perennial species are measured throughout a growing season.
- Plants are randomly selected from an inner plot within the treated plot, each tracked plant is marked and measured throughout the season.
- Plants are tracked in 6 Seasonal plots for Fall, Spring, and Control Grazing, within each plot are 12 tracked square plots:



- Seasonal control plots are not grazed on, and control plots receive no extra water, are not under drought shelters.
- Each week, leaf height is measured form the base of the plant to its highest point.
- Every other day the tracked plants are assessed for new buds or flowers.
- A Weed whacker is used to cut grass to simulate cattle grazing on off seasons.

Plant Reproduction

- The life stage of the plants are recorded, to capture the phenology of the plants.
- Researchers take samples of the plants of each plot at or near the end of the plant's reproduction cycle.
- Collected plants are labeled to which plot and which seasonal plot they belong to. The collected plants seeds are separated from the plant, seeds are counted by hand. The amount of filled seeds present for each sample is recorded.

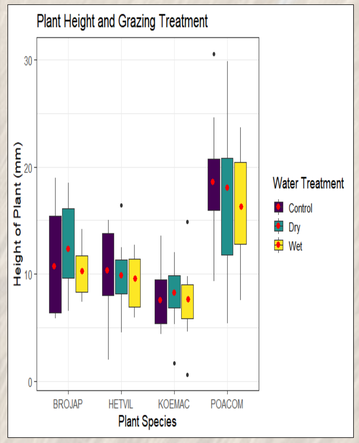
Data Set

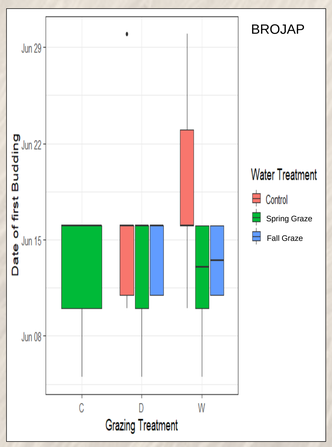
Data was collected semi arid xeric tallgrass prairie 8 miles South of Boulder, CO.

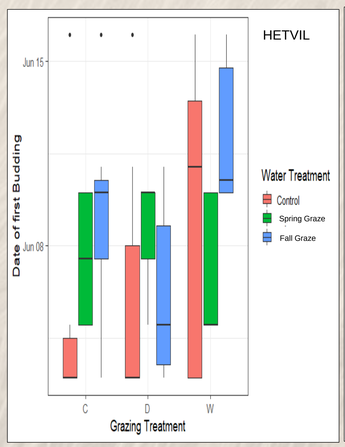
Recorded the plants reproductive stages weekly for budding, flowering, and seeding

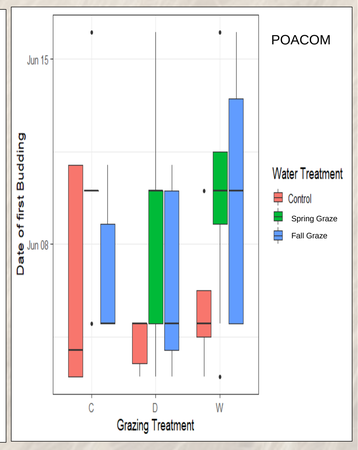
We collected measurement, phenology and seed data from Heterotheca villosa (HETVIL), Koeleria macrantha (KOEMAC), Bromus japonicus(BROJAP), Poa compressa (POACOM).

Results









KOEMAC, HETVIL POACOM, BROJAP were tracked from 5/20/2021 to 6/16/21

- There were not many significant differences in the growth of the plants under drought conditions between different species of plants that weren't under the same treatment.
- While some plants grew almost similar average height some of the plants grew slightly less under water addition plots.
- The likelihood of plants budding under fall graze in control plots were far more likely than plants control plots under control treatments.
- Plants that were under Fall Graze conditions were far more likely to bud sooner than control and spring graze treatments.
- Plant budding across all control conditions ranged differently than plants that were disturbed during seasonal grazing.

Discussion

- Drought may play a small role in how plants respond to the timing of budding.
- The timings of grazing has great importance of how to predict the best time that plant communities will reproduce more.
- Under wet conditions some plants budded later or sooner depending on the plant specifically Heterotheca villosa.
- Across all conditions fall graze had more early buddings than other spring and control grazing.
- While our data does not have a longer observation period to pull from, early modeling has shown that observing the timing of grazing may have greater effects than drought.

Conclusions

While plant drought may not had had a more obvious difference in the growth of the plants or reproduction of the plants, grazing will have major differences in when plants start their reproductive cycles.

Continued Research

- Recording the timing of flowering and seed count from this year.
- Recording the number of filled and unfiled seed pods of the plants against this year's growth.
- Compare Soil moisture data against growth and phenological data throughout the growing period of plants.

Acknowledgements

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