# Climate Change Impacts on the Productivity and Community Dynamics of Pacific Northwest Prairie Systems

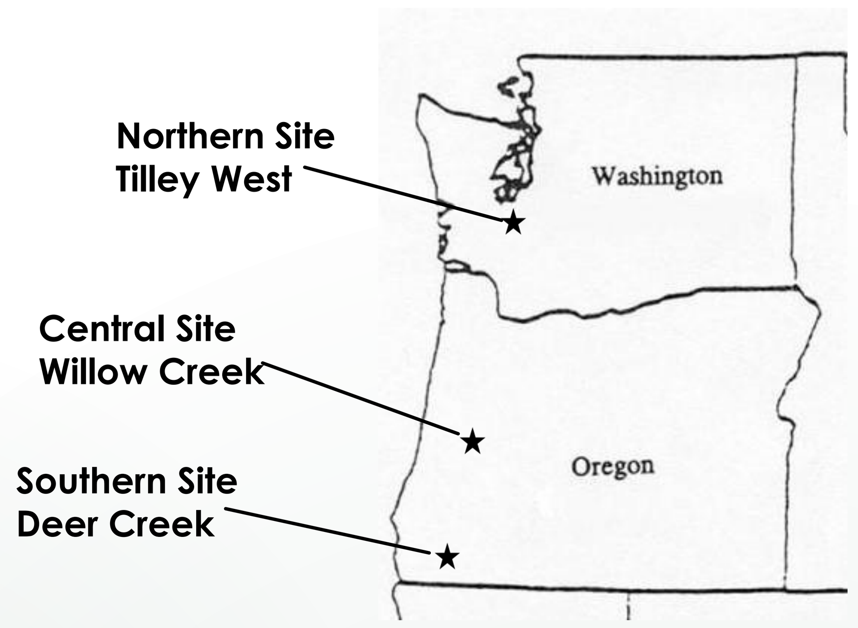
Aimee O. Okotie-Oyekan[1], Paul Reed[2], Laurel Pfeifer-Meister[2], Scott D. Bridgham[2]
[1]University of Georgia; [2]University of Oregon

## Background

Functional ecology is the link between species diversity and ecosystem diversity. Currently, increasing global temperatures due to accumulation of greenhouse gases in the Earth's atmosphere are altering climate on a global scale. As a result, biodiversity is declining rapidly, hindering ecosystem function. However, the mechanisms by which climate change impacts ecosystems on a regional scale are yet to be fully illuminated.

For the Pacific northwest, a predicted 2.5° C increase in annual temperatures and 20-40% reduction of summer precipitation is expected to have various impacts on the rates of ecosystem processes. **Our study aims to answer how experimental climate change will affect the productivity and community composition of Pacific Northwest Prairies.**

## Methods




**Heat: increase ambient temperature by 2.5° C using 6 infrared heaters**

**Heat & Precipitation: heating by 2.5°C with added irrigation to match soil moisture of control plot**

**Drought: Acrylic shingles cover plot area and reduce precipitation by 40%**

**Control: ambient temperature and precipitation**

-At all 3 sites, each treatment had 5 replicates, yielding 60 plots in total. Each site was initially seeded with a mixture of native prairie species.

-At peak biomass I collected above ground biomass from a 25 x 25 cm area within each plot. I then sorted each plot into the following functional groups:

- Annual grass
- Annual forb
- Perennial grass
- Perennial forb
- Nitrogen fixing legume

-Dried samples at 60 °C for 48 hours, and weighed each plot

-Statistical analysis was performed using Analysis of Variance (ANOVA) and subsequent Post Hoc Tukey test to assess significant differences among treatments and sites

## Results

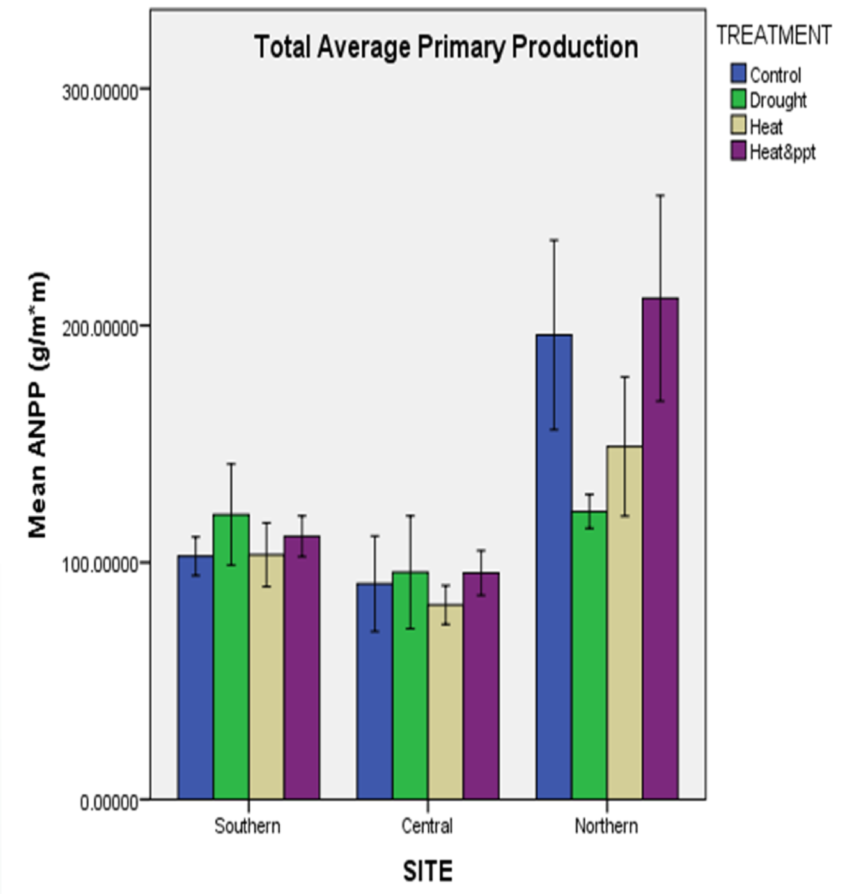
**Hypothesis 1 : Trend of decreasing overall primary productivity from north to south:** **Southern sites that are drier and experience less precipitation will exhibit lower levels of productivity compared to northern sites with moister, Mediterranean climates.**
-Northern site has significantly greater mean primary production than both Southern (p=0.004) and Central (p=0.0002), southern and central are not different from one another

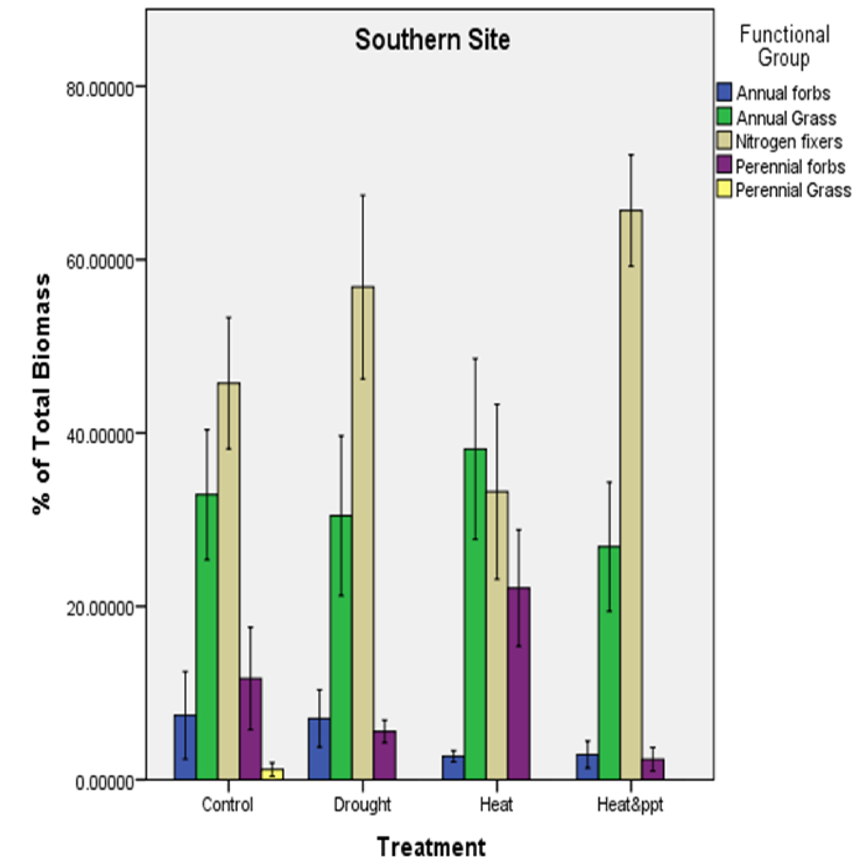
**Hypothesis 2: Heating and heating with added irrigation will have a positive effect on productivity, drought will have a negative impact**
-Across the three sites, significantly greater annual grass biomass under heat than control (p=0.05) and drought (p=0.02)

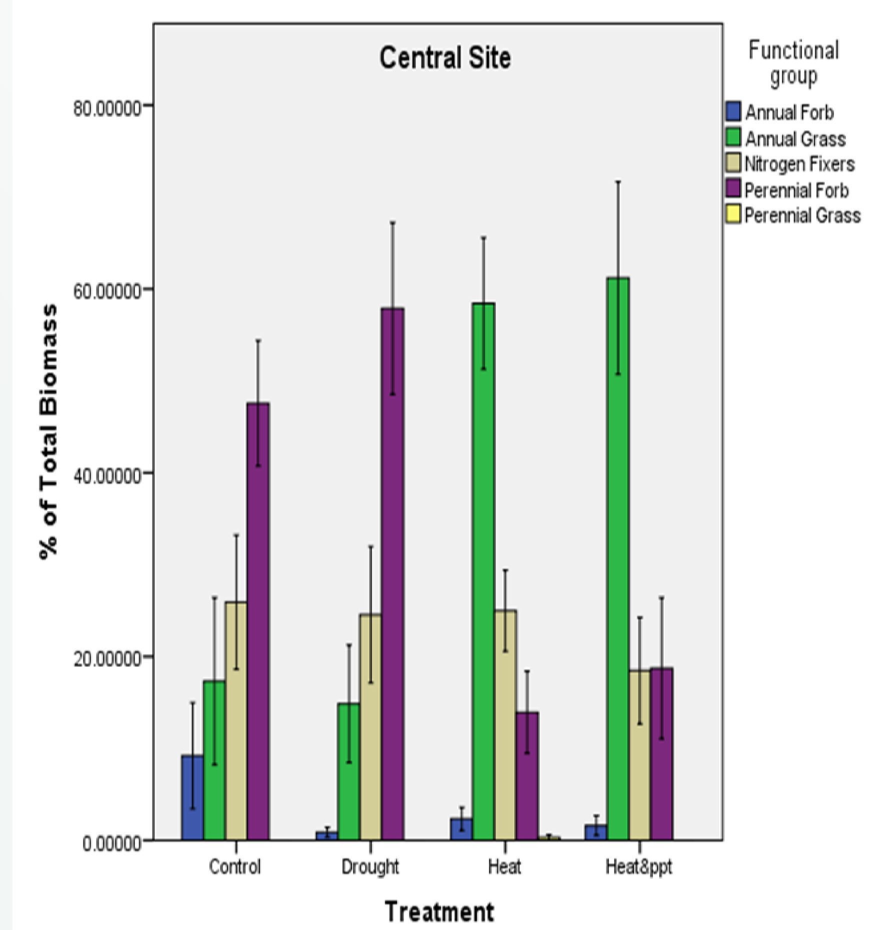
-For annual grasses at the central site, heat (p=.02) and heat & ppt (p=.01) significantly greater than control

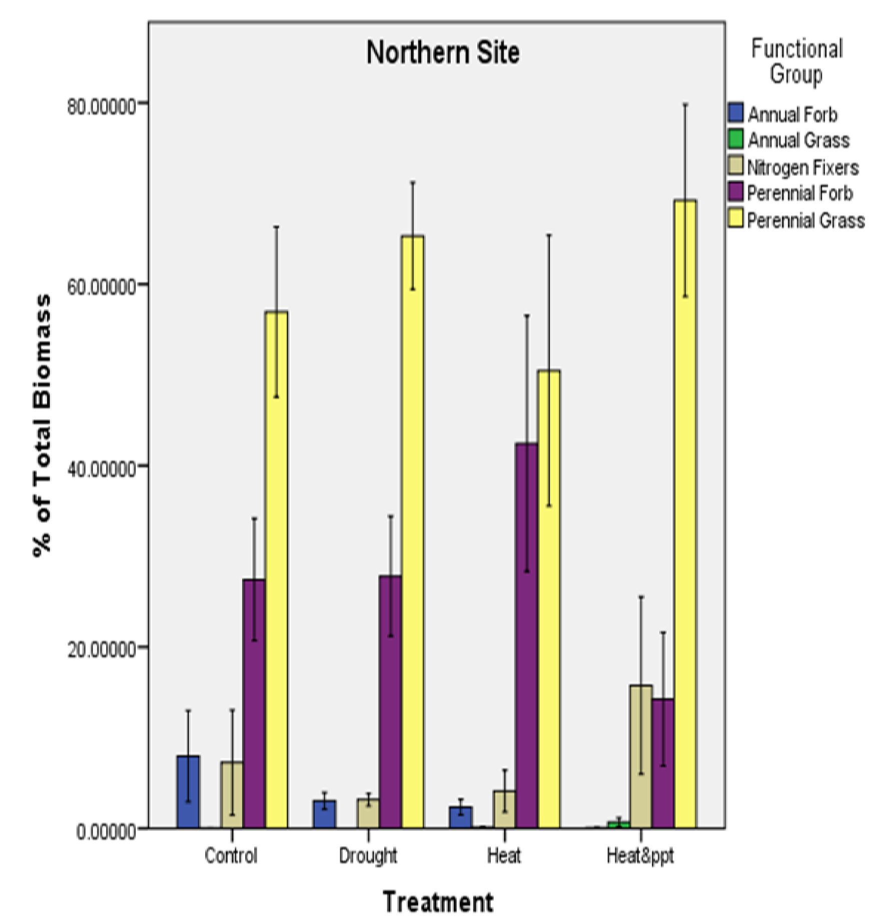
**Hypothesis 3: Greater annual plant productivity in heated treatments compared to perennials,**
-For annual grasses at the central site, heat (p=.02) and heat & ppt (p=.01) significantly greater than control

-Across all three sites, percent perennial forb significantly less under heat & ppt (p=.03) compared to control




## Discussion

The Northern site had significantly greater productivity compared to the central and southern site, lending support to productivity gradient hypothesis.

In addition, annual grass productivity was the only functional group to show a significant positive response to the heated treatment compared to control across all three sites, supporting that heating treatments have a positive effect and that annuals fare better in high temperature conditions compared to perennials.

The levels of variation between plots were large and may explain why the majority of the results were statistically insignificant or refuted my hypotheses
Lastly, the PNW experienced an unusually cold winter with higher precipitation levels this year. Further research should be done to explore interannual differences in responses to treatments

## Moving Forward

Variability arising from both functional group distinction and factors associated with site location created a wide range of responses to experimental climate change. Using what we learn from studying community dynamics, organismal life histories, and biotic-abiotic interactions, we can attempt to piece together a narrative of how ecosystems will be impacted by climate change effects on a regional scale. We can apply these findings to region and ecosystem specific conservation programs in an effort to prevent biodiversity loss.

Annual Grass (Genus *Vulpia*)

Nitrogen fixer (Genus *Lotus*)

Perennial Forb (Genus *Achillea*)

Annual Forb (Genus *Collinsia*)

Perennial Grass (Genus *Schedonorus*)

## Acknowledgements

**The Bridgham Laboratory: Katie Nock, Laura McCullough, Megan Sherritt, Graham Bailes ,Aaron Nelson, Matt Schultz, Cory Leeway, Kylea Garces, Bitty Roy, Anya Hopple and Bart Johnson.**
**University of Oregon SPUR Program, Dr. James Hollibaugh and the Hollibaugh Laboratory at the University of Georgia, Capitol Land Trust, Siskiyou Field Institute, The Nature Conservancy, and the National Science Foundation**

This material is based upon work supported by the National Science Foundation award #1460735. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.