Quantifying Root Trait Responses to Lethal Drought: Does Range Size Play a Role in Variability?

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1 Introduction

- Plant traits are quantifiable properties of plants that influence growth, reproduction, and survival[1].
- Plant traits generally occur along spectrums and gradients related to trade-offs, natural selection, and symbiotic relationships[2,3].
- Drought is projected to increase in frequency and intensity[12]; root traits responses to drought are variable, difficult to generalize, and underrepresented in plant trait research[4,5,6,7,8].
- Range size is defined by the area that a species occupies[9].
- While plant traits are thought to have a part in determining range size[9], there is relatively little research relating range size to trait variation[10,11].
- Understanding the mechanisms that influence range size is important for identifying conservation priorities and predicting species range shifts[9].
- Utilizing root traits in restoration has the potential to create drought resilient restoration outcomes[13].
- **We aim to measure root trait responses to lethal drought[14] in 20 California grassland species, relating trait variation to the size of each species geographic range.**

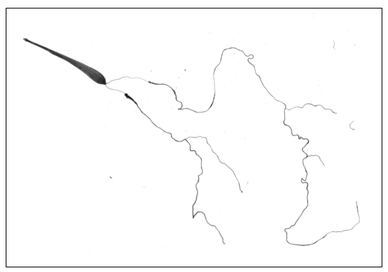

Fig 1: Root scan of *Chlorogalum pomeridianum,* which has a notably larger root diameter as a bulb-forming species

2 Hypotheses

1. **Common, widespread species will be more tolerant to drought.**
2. **Species with larger geographic ranges will exhibit more variability than species with smaller ranges.**

3 Methods

1) Lethal Drought[14] Protocol

- **Grow 20* native plant species, subject them to lethal drought conditions, and quantify root response by measuring 5 traits:**
  - Specific root length
  - Root diameter (Fig 1.)
  - Root:Shoot ratio
  - Root dry matter content
  - **Lethal Drought Index**- soil moisture content that results in 50% population mortality

Fig. 2: *Trifolium wildenovii* in drought

Fig. 3: Recording soil moisture in *Elymus glaucus*

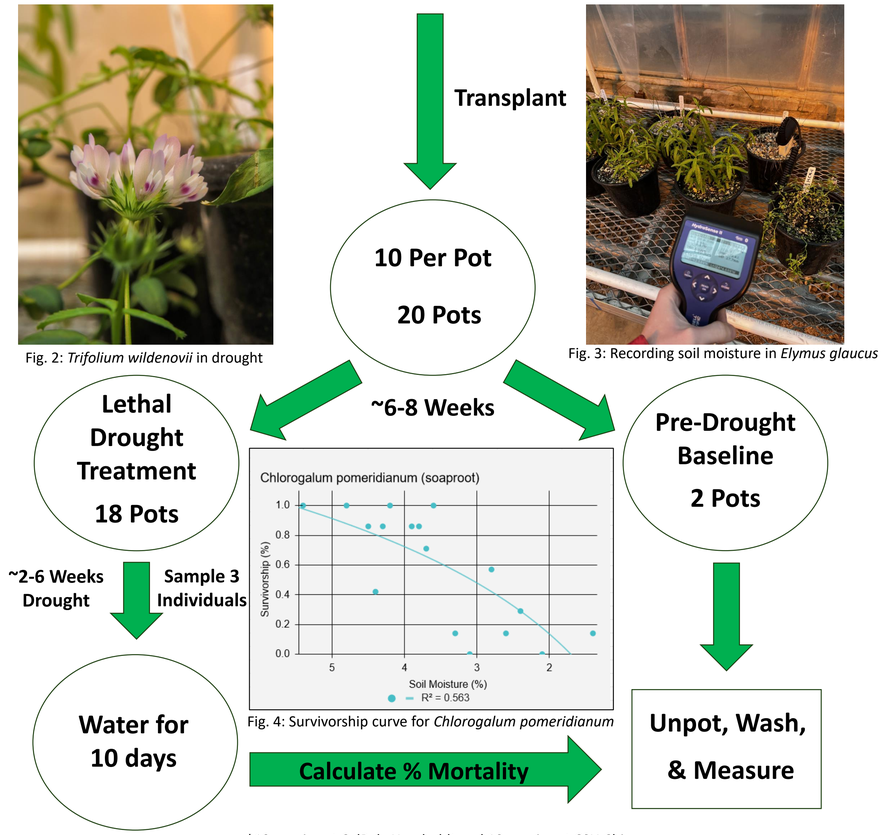

Fig. 4: Survivorship curve for *Chlorogalum pomeridianum*

*10 species at CalPoly Humboldt and 10 species at CSU Chico

Unpot → Wash Roots → Fresh Mass → Scan Roots → Dry Mass → Quantify Traits

2) Establishing Size of Geographic Range

- Utilize the Global Information Biodiversity Facility to acquire occurrence data.
- Use Area of Occupancy (AOO)[15] to define geographic range size.
- AOO is determined by placing known occurrence data into a defined grid system (i.e. 2x2km cells) and multiplying the number of occupied cells by the area of each cell [16].

4 Study Species

Table 1: 20 native grassland species across 4 functional groups that will be studied

Annual Grasses	Perennial Grasses
Muhlenbergia microsperma	*Bromus carinatus*
Deschampsia danthanoides	*Danthonia californica*
Festuca microstachys	*Elymus glaucus* (Fig. 3)
Hordeum intercedens	*Melica californica*
Hordeum depressum	*Stipa pulchra*
Annual Forbs	**Perennial Forbs**
Clarkia rubicunda	*Chlorogalum pomeridianum* (Fig. 1)
Trifolium wildenovii (Fig. 2)	*Phacelia californica*
Plantago erecta	*Achillea millefolium*
Nemophilla maculata	*Asclepias fascicularis*
Collinsia heterophylla	*Sisyrinchium bellum*

5 Next Steps

- Create species distribution maps
- Analyze root scan data
  - One-way ANOVA to test differences within and between:
    - Functional groups
    - Species
    - Range sizes
    - Treatments (pre-drought, drought)

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