Drought Influence on Chlorophyll Fluorescence in Evergreen and Drought Deciduous Plant Species of Southern California

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Introduction and Background

Figure 1: Collecting data in the field.

The plant species found in the chaparral and coastal sage ecosystems of coastal Southern California generally fall into one of two categories: drought-deciduous or evergreen (Barbour et. al 2007). As species of both life strategies make up the majority of coastal and mountainous biomes in Southern California, measuring how each responds to increased environmental stress becomes important to the ecosystem as a whole. The effects of stress can be measured using chlorophyll fluorescence, which is directly related to the chlorophyll content and rate of photosynthesis of the leaf (Maxwell and Johnson 2000). Chlorophyll fluorescence provides data on the productivity and efficiency of the photosynthetic system, and can be used to infer the health of the plant. The focus of this study was to compare chlorophyll fluorescence data between species of both life strategy categories.

We hypothesize that evergreen species will be less affected by short-term variation in environmental conditions, whereas drought deciduous species will show a higher sensitivity to these changes.

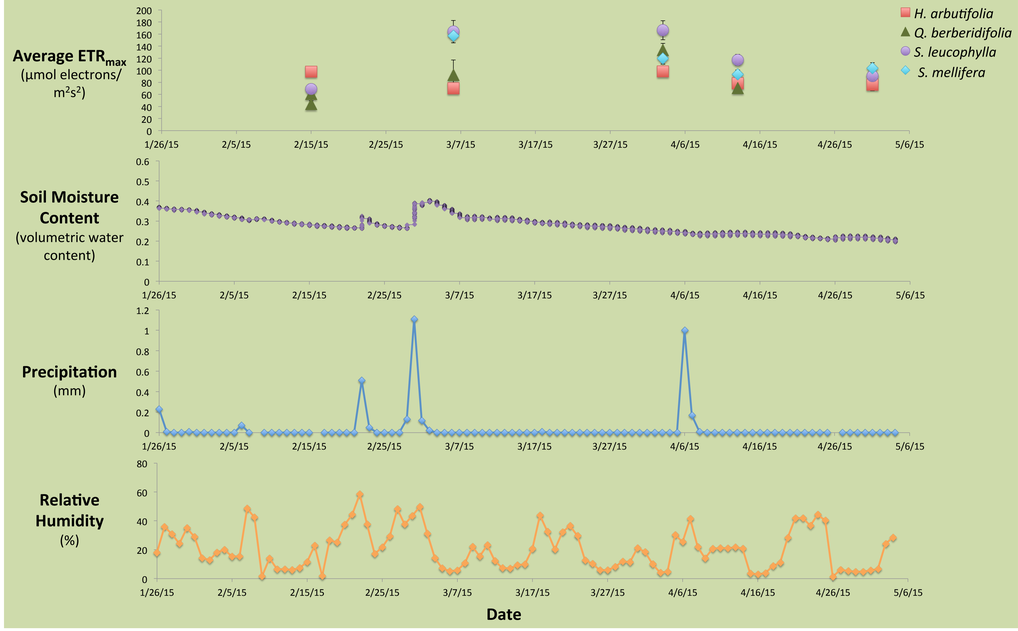
Evergreen	Drought Deciduous
• Grow year-round	• Grow generally in Winter and Spring
• Deeper root systems	• Go dormant during periods of drought
• Thicker, sturdier leaf structure (waxy outer coating)	• Shallower root systems
• Photosynthesize at low rates all year	• Photosynthesize at higher rates during growing periods
	• Thinner, less structured leaves

Measuring Chlorophyll Fluorescence in the Field

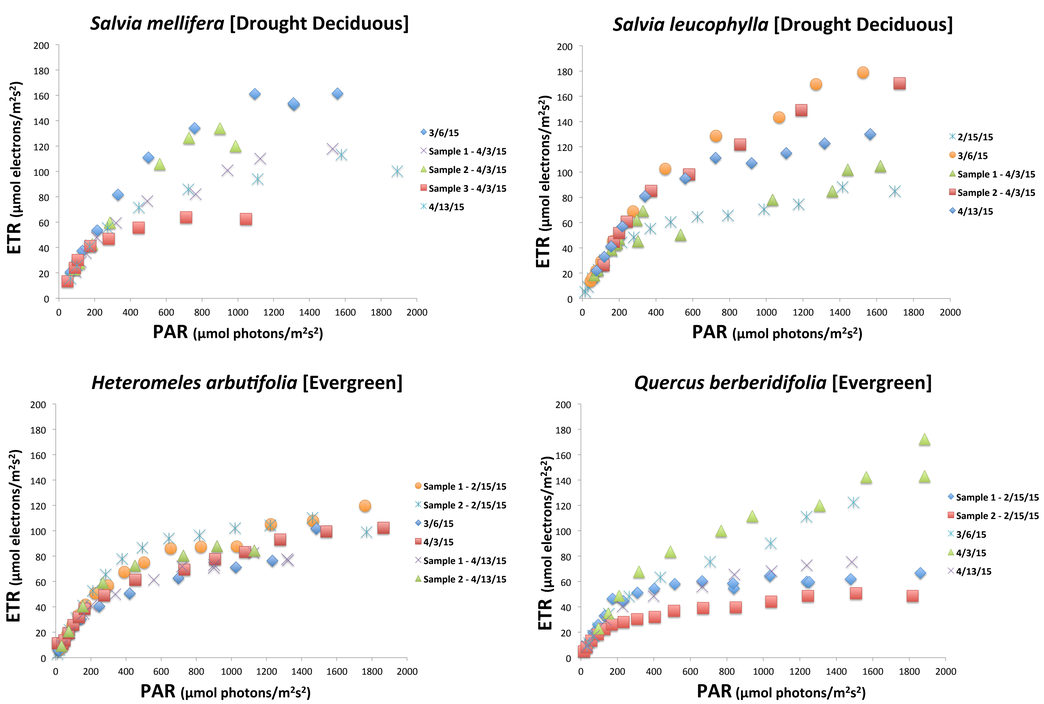
- Used the Walz PAM-2500 portable fluorometer with a handheld leaf-clip (**Figures 1, 2**)
- **Generated light curves:** Electron Transport Rate (ETR) as a function of Photosynthetically Active Radiation (PAR)
- **Trends** used averages of the maximum ETR values derived from the light curves
- Curves and samples collected on five days between February and May at the UCLA Stunt Ranch Reserve in the Santa Monica Mountains, California

Figure 2: PAM 2500 leaf clip on H. arbutifolia

Average Maximum ETR and Varied Environmental Conditions



Light Response Curves by Species



Effects of Water Stress on Evergreen and Drought Deciduous ETR_{max}

- ETR_{max} for both drought deciduous species (*S. leucophylla* and *S. mellifera*) demonstrated wide variation over the days sampled
- Notable peak in drought deciduous ETR_{max} following first rain event and soil moisture increase, whereas little change for evergreen ETR_{max}
- Confirmed predictions of overall lower ETR_{max} values for evergreen compared to drought deciduous ETR_{max}

Implications of Pronounced Variation in Drought Deciduous

- Even short-term water stress has strong, direct effects on photosynthetic capacity (ETR_{max})
- Drought deciduous species may be more affected in short term only
- Results of this and long term studies may aid in predictions of future changes in Southern California's chaparral ecosystems

Q. berberidifolia

S. mellifera

S. leucophylla

Future Directions

- Continue collecting ETR_{max} data over multiple seasons to determine possible long-term effects of water stress
- Determine how species distribution may change with extended drought
- Determine water stress threshold for drought deciduous and evergreens.

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