Desiccation tolerance of western sword fern (*Polystichum munitum*) gametophytes across the coast redwood forest ecological gradient

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INTRODUCTION

Ferns are an integral component of biodiversity and productivity in the coast redwood understory and canopy (Fig. 1B). Given that summer fog is expected to decrease and winter precipitation patterns are predicted to change, it is vital to understand the role of microclimates and adaptation strategies utilized by ferns in the coast redwood ecosystem in order to gauge how distribution and community dynamics may be affected. While fern sporophyte water relations are well studied, research is still needed to understand how microclimates influence the water retention abilities of gametophytes.

The specific aims of this study are:

1. **Compare desiccation tolerance (DT), recovery rates, and morphology of western sword fern (*Polystichum munitum*) gametophytes from different biogeographic regions and**
2. **Examine microclimatic differences of *P. munitum* in the coast redwood forest.**

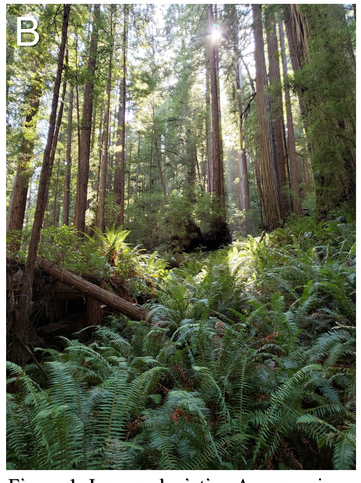

Figure 1. Images depicting A. a massive western sword fern (*P. munitum*), B. a sloped grove of *P. munitum* at Prairie Creek Redwoods SP, and C. a gametophyte and sporophyte of lady fern (*Athyrium filix-femina*).

METHODS

Desiccation tolerance (DT) in plants is the ability to lose all internal water from vegetative structures, shut down metabolic activity, and enter as well as recover from anhydrobiosis [1]. DT has not been well studied in lineages with two independent life stages [2]. Our research question will test whether there is a difference in DT and recovery rates for gametophytes related to biogeography.

Spore Collection & Germination: Fertile fronds of *P. munitum* were collected from ten individuals from each of the five locations (Fig. 2). After drying, spores will be sown on media in shallow dishes in controlled environmental chambers.

Desiccation Experiments: Gametophytes will be subjected to desiccation events of varying intensity (80, 50, and 25% RH) as well as undergo repeated cycles to determine the mean percentage of recovery. Sample wet weight and variation of photochemical efficiency (F_v/F_m) will be measured over the course of each drying event. F_v/F_m emissions will be measured using a LI-COR leaf chamber fluorometer (Model LI-6400) to assess rates of recovery. These methods will also be used to test the effects of desiccation intensity and repeated desiccation events on rates of recovery.

The second aim of this study will explore how *P. munitum* gametophytes utilize microclimates to inhabit a broad range of conditions exhibited across the redwood forest ecosystem. A HOBO environmental data logger was placed at each of the five sites (Fig. 3). The data loggers will record temperature, RH, and dew point every hour for a full year. Microclimate data will be plotted against geographic sampling location to compare against DT experiment results.

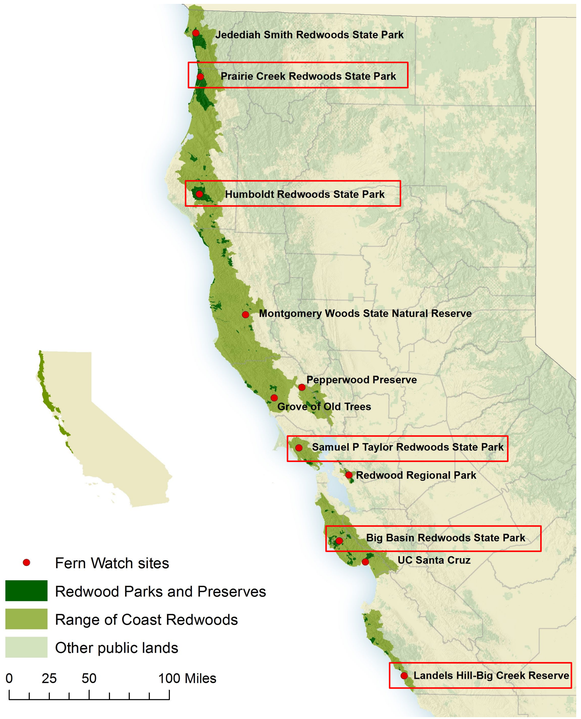

Figure 2. Location of study sites highlighted by a red box, Prairie Creek Redwoods State Park, Orick; Humboldt Redwoods State Park, Weott; Samuel P. Taylor State Park, Lagunitas; Big Basin Redwoods State Park, Boulder Creek; and Landels-Hill Big Creek Reserve, Big Sur.

Figure 3. HOBO data logger placed at Humboldt Redwoods State Park.

EXPECTED RESULTS

Desiccation Rates: We expect to see a significant difference in mean drying rates with location. Southern gametophytes are expected to exhibit a greater ability to recover from desiccation events. Meaning gametophyte DT and recovery ability relates to sporophyte habitat preference.

Climate Data: Positive significant results will show landscape scale microclimatic differences between the five park locations related to latitude.

DISCUSSION

Climate in the coast redwood forest varies across its distribution -- this gradient creates a variety of morphological and physiological traits in the gametophyte. Gametophyte physiology is closely tied to population dynamics and distribution [3].

Future Studies:

- Document morphological variations of *P. munitum* throughout the coast redwood ecosystem (Fig. 4).
- Examine additional spore and HOBO sample sites, especially those of the southern extent such as Henry Cowell Redwoods SP, Santa Cruz or Limekiln SP, Big Sur.

Figure 4. Pressed and dried *Polystichum* spp., (left to right) *P. dudleyi*, *P. californicum*, and *P. munitum*. Collected from Big Basin Redwoods State Park, Santa Cruz.

LITERATURE CITED

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Photo Credits:

Figure 1. (A, B, & C). Photo taken by Lacey Benson at Prairie Creek Redwoods SP
Figure 2. Fern Watch Plot Locations. Save the Redwoods League. https://doctorfern.org/fern-watch-sites/
Figures 3. & 4. Photos taken by Lacey Benson

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