Summer root and soil water distribution under annual grasses and *Stipa pulchra*.

Kenny R.[1], Loik M.[1]
rjkenny@ucsc.edu [1]UC Santa Cruz, 1156 High Street, ISB 4th Floor, Santa Cruz, CA 95064

Introduction:

We hypothesized that the differing drought tolerance adaptations of *Stipa pulchra*, a California native perennial grass, and European annual grasses and forbs would result in unique soil moisture profiles at the end of the summer drought. Specifically we predicted that patches of *S. pulchra* would uptake soil moisture throughout the summer and produce a drier soil profile. Although *S. pulchra* has been shown to increase the rate of rainfall infiltration we believed that this would not offset the summer water use.

Methods:

Study Site: Hastings Natural History Reserve, Carmel Valley, approximately 30km inland from the Big Sur coastline, average annual rainfall of 53 cm, 15-20 fog events per year.

Fig 1. Areal imagery of Hastings reserve. *S. pulchra* patches were grouped in 3 main areas, two were selected from each marked waypoint

We non-randomly selected six 2m diameter patches with a relative cover of at least 50% *S. pulchra* and the closest 2m patch where S. pulchra relative cover was less than 1% to create a paired design.

In early September we collected soil samples with an 5cm diameter augur down to a depth of 155cm from the center of each patch. Soils were stored in Ziplock bags and kept cool until the gravimetric water content was obtained.

Fig 2. Soil samples out from the drying oven, note the variability.

Fig 3. Collecting soil samples, hard work!

A sub sample of about 40g was used to find the gravimetric water content using standard methods.

We extracted the roots from the soil samples by suspending the samples in water. The roots could then be floated off the top and poured through a size 60 USDA sieve. The resulting mix of roots and other organic matter was dried and the roots were further extracted using static electricity and manual extraction methods.

Fig 4. Cleaned root sample

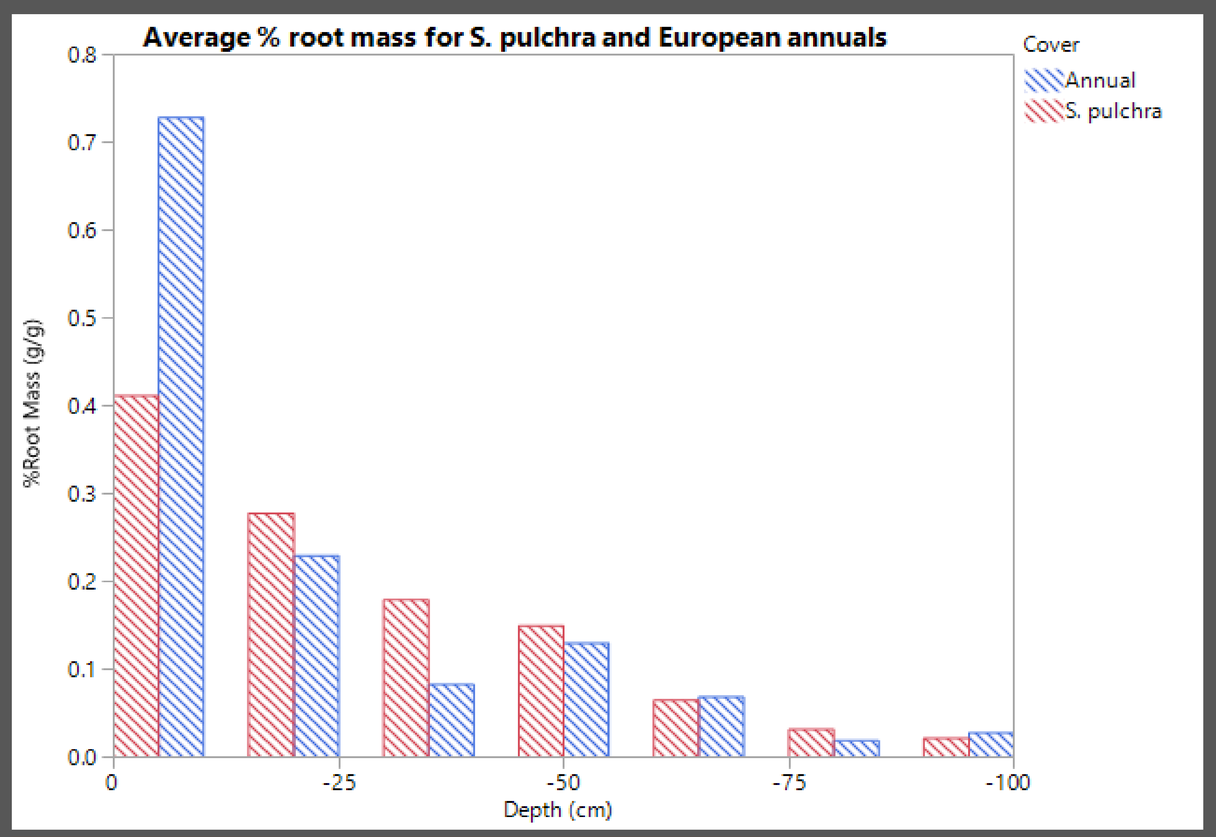

Fig 5. Average percent of total root mass across all depths for *S. pulchra* and European annuals. European annuals invest much more in shallow roots. Root investment was significantly different across all depths ($F_{(.05,18)}$=22.2, p=.0001).

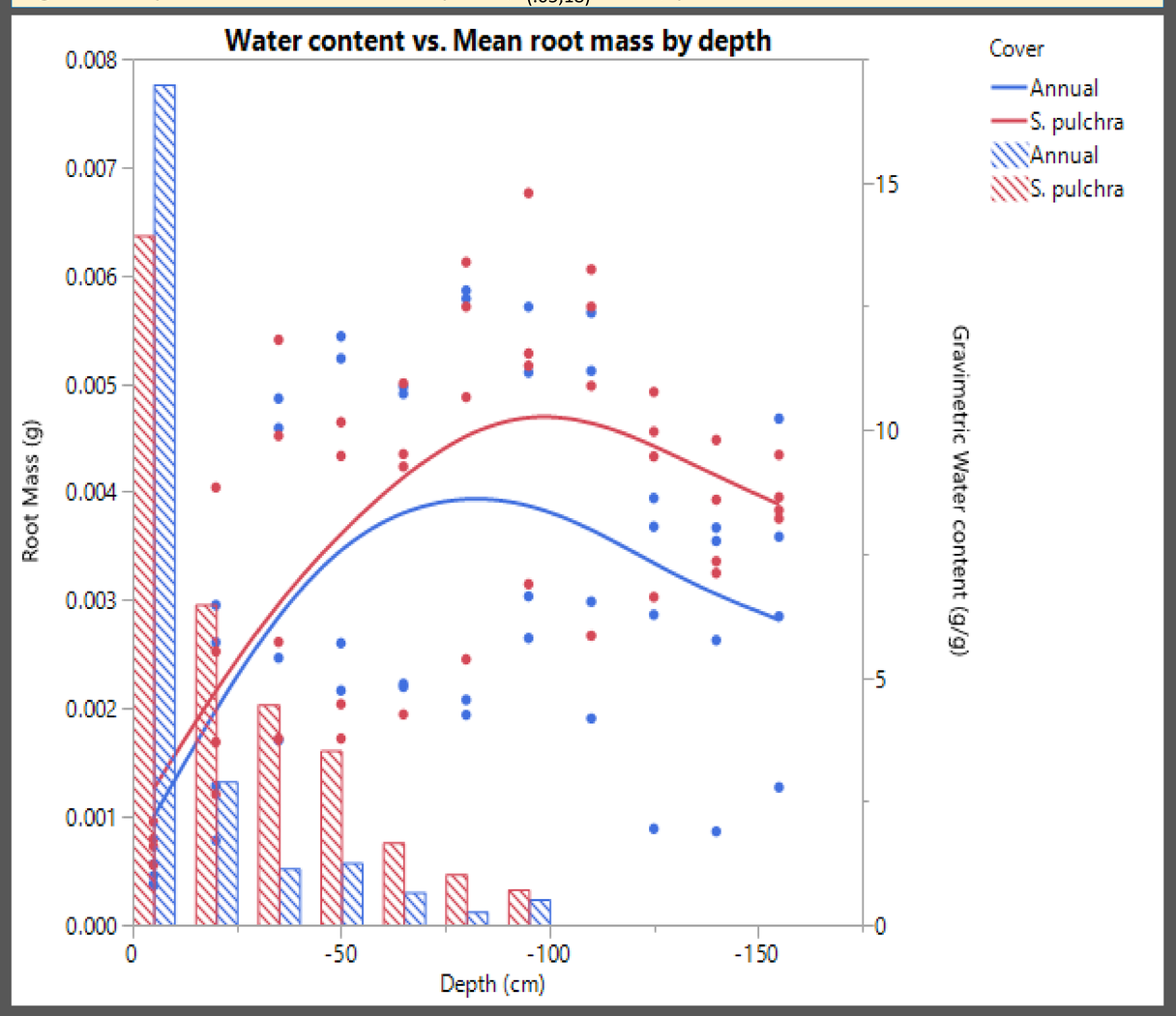

Fig 6. Average root mass and percent soil water content at each depth. The trend lines denote soil moisture and the bars depict root mass. *S. pulchra* is in red and European annuals in blue. Avg. water content across all depths was 0.8% greater under *S. pulchra* ($t_{(0.05,65)}$=2.5, p= 0.0149). Root mass was also greater under *S. pulchra* by 6.2e10^{-5}g/cm^3 ($t_{0.05,18)}$ = -2.69, p= 0.0148). Ln root mass and Ln soil moisture had an inverse relationship across both groups down to 95cm (S.pulchra r^2 = .68 and European annuals r^2 = .77)

Conclusions:

- We observed increased soil moisture , and decreased root mass with depth. Soil moisture was highest at about 75 cm under the European annual grasses, and at about 100 cm under *S. pulchra*.
- There was almost no difference in soil moisture above 65 cm for annuals and *S. pulchra* . This may suggest that there is root competition between *S. pulchra* and the European annuals.
- If *S. pulchra* does significantly increase the amount and depth of winter rainfall infiltration, it could be used by land managers as a tool for ground water management.

S. pulchra may increase the amount and depth of rainfall infiltration, but further studies are needed to mechanistically test this hypothesis

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