

Resistance of Restored Central Valley Grassland Communities to Yellow Starthistle Invasion

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Introduction

Yellow starthistle (*Centaurea solstitialis*) is a highly invasive weed of Mediterranean origin which is spreading rapidly in California (Pitcairn et al. 1998). It displaces other vegetation and degrades the quality and economic utility of rangeland, public wild lands, roadsides, and recreational areas. This study explores the effectiveness of planting competitive native grassland species to reduce yellow starthistle populations and mitigate future weed invasions.

Potential benefits of restoring native grassland to reduce weed populations include:

- 1) Weed reduction through resource competition with the restored community.
- 2) Increased soil stabilization; decreased runoff and nutrient losses.
- 3) Irrigation is normally not required for establishment or maintenance.
- 4) Reduced fire hazard due to the relatively low thatch production of native grasses.
- 5) Forage production for livestock.
- 6) A diverse, established community may resist future weed invasions.

Our objectives are to 1) quantify and compare yellow starthistle reduction in different communities and 2) understand how light and water availability relate to a given community's resistance to invasion. The design simulates control of yellow starthistle for one year (using herbicides, tillage, or an integrated method), restoration of the native community on the cleared site, and subsequent reinvasion from the remaining yellow starthistle seed bank in the second year.

Materials and Methods

In December 2000, we planted different communities in 4 x 4 m plots on an agricultural field (sandy loam) in Davis, California. Each community contained six species, all of which were available from local native seed growers, are native to the region, and showed good potential for establishing on our site.

The communities were

Late season bunchgrasses and forbs.

- 1) Early season annual forbs.
- 2) A mixture of late season and early season species.
- 3) Exotic annual grasses (to be planted in 2002).

Yellow starthistle was seeded into the communities in December 2001 at a rate of three million seeds/acre. Our treatments included the four communities with yellow starthistle, the same communities without yellow starthistle, yellow starthistle alone, and bare ground. The design is a randomized complete block with five replicates.

The experiment will last three years. To quantify the effect of the restored communities on yellow starthistle and the effect of yellow starthistle on the communities, we will measure density, percent cover, and reproductive potential of each species in spring and summer. Biomass data will be collected after the third year. Soil moisture will be measured by inserting a neutron probe into a PVC tube in the center of each plot. Soil moisture measurements will be taken at

depths of 30, 60, 90, 120, 150, and 180 cm below the soil surface. Light availability will be measured by inserting a ceptometer under the plant canopy.

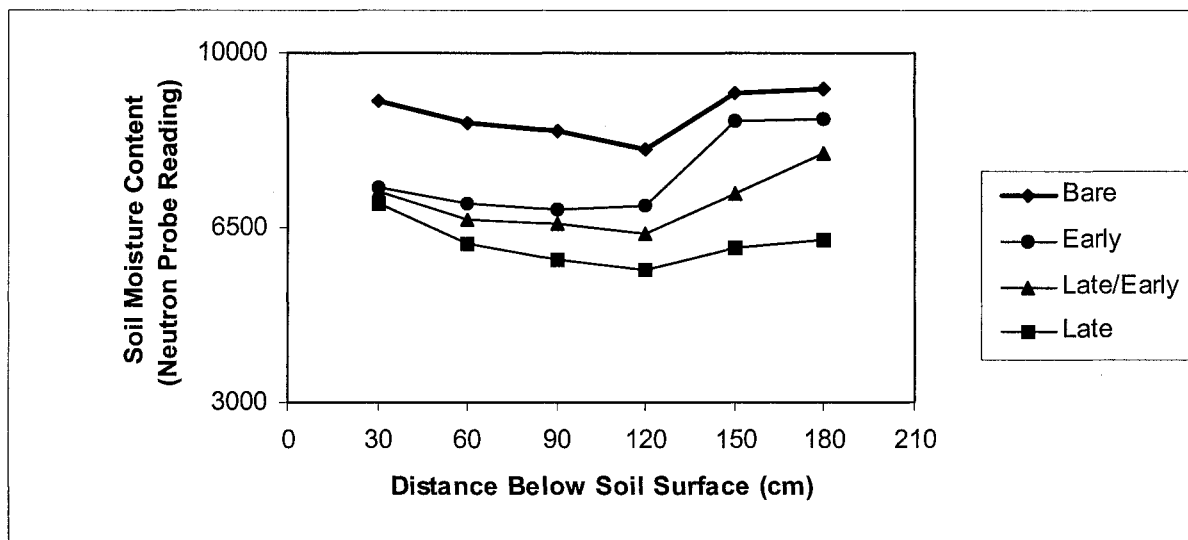
Results and Discussion

Initial data (yet to be analyzed) indicate differences in water utilization between the communities. In September 2001, soil moisture under the late season community appeared to be lower at depths below 30 cm than beneath the early season community, with this difference appearing to increase at greater depths. Under the mixed community (containing both late and early season species), soil moisture appeared to be intermediate between the late season community and the early season community. Light measurements taken in December 2001 indicate an apparent reduction in light availability compared to bare ground in all communities, with the greatest reduction appearing to occur in the late season community.

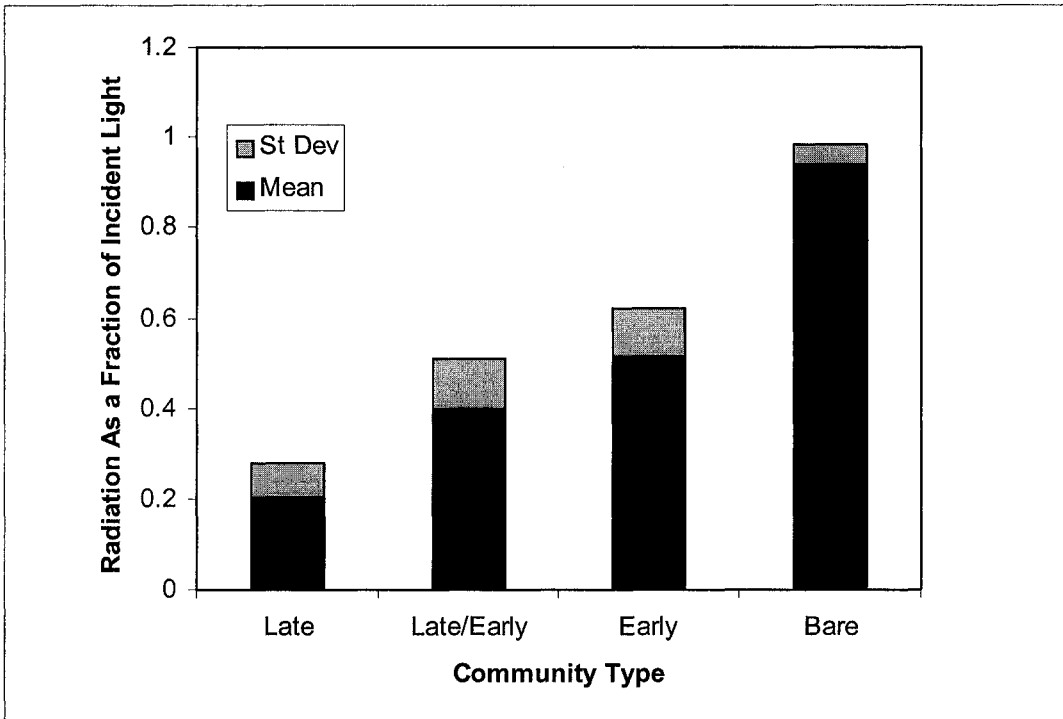
The apparent reduction in deep soil moisture and light in the late season community compared to the early season communities indicates that late season species may be more effective competitors with yellow starthistle and other deep-rooted weeds than are early season species. Future data from this study will be combined with information from other studies to develop a cost-effective, site-specific protocol for reducing current and future weed invasions in California grassland.

References

Pitcairn, M.J., R.A. O'Connell, and J.M. Gendron. 1998. Yellow starthistle: survey of statewide distribution. In Woods, D.M., Ed. Biological Control Program Annual Summary. Sacramento. California Department of Food and Agriculture, Plant Health and Prevention Services. p. 64-66.



Community soil moisture profiles, 9/6/01 (error bars omitted).



Light penetration through community canopies, 12/4/01.