Managing yellow starthistle in California grasslands: The role of a native tarweed in invasion resistance

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Research Questions

1. How is starthistle invasion of a simplified CA grassland affected by the abundance of the native tarweed, *Hemizonia congesta* subsp. *Luzulifolia* (Hayfield tarweed)?

3. How can land managers use this information to control starthistle invasions?

Background

Currently California grasslands are being extensively invaded by the late season annual forb, *Centaurea solstitialis* (yellow starthistle) (1). Because of this, many groups are interested in developing strategies to slow starthistle invasions and restore lands that are already infested. A first step in reaching these goals is to understand what makes grasslands systems more resistant to starthistle invasion.

Yellow Starthistle Infestation

Past studies indicate that certain plant species reduce starthistle growth and seed production. One such species is the native late-season forb, *Hemizonia congesta* subsp. *luzulifolia* (Hayfield tarweed) (2,3).

Hayfield tarweed (Hemizonia Congesta)

Hayfield tarweed is considered a common grassland species, however, tarweed densities can vary greatly and populations can be patchily distributed throughout systems.

More information about how starthistle invasion is affected by Hayfield tarweed density may highlight new control methods and grassland management strategies.

Approach

Our experiment took place at Jasper Ridge Biological Preserve in Stanford, CA. We used PVC tubes, 1m deep x 30cm in diameter, and located tubes outdoors, exposed to ambient conditions.

The species composition in the tubes was simplified to allow for isolation of tarweed effects, and consisted of two species – Hayfield tarweed and *Bromus diandrus (ripgut brome).* Ripgut brome is a functionally contrasting, exotic annual grass common in CA grasslands. Ripgut brome abundance was adjusted according to tarweed abundances so that total resident biomass was kept constant (Fig 1). Equal total biomass across treatments ensured that effects seen were due to tarweed abundance rather than any differences in total pot biomass.

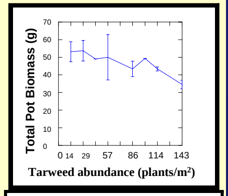

Figure 1: Total Resident Biomass (g): Starthistle final biomass is not a result of total resident biomass because resident biomass remains fairly constant across all tarweed treatment levels.

We invaded half the microcosms with starthistle & measured plant biomass, soil moisture, nutrient availability, & starthistle flower and tarweed seed numbers.

Results

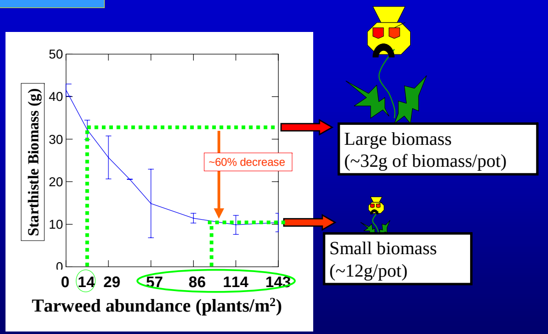

Figure 2: **Starthistle biomass** was negatively correlated with tarweed abundance.

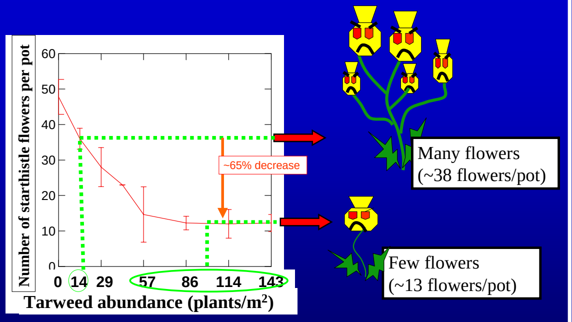

Figure 3: **Total starthistle flower number** per pot was negatively correlated with tarweed abundance.

Conclusions

1. **Hayfield tarweed abundance affects starthistle invasion into simplified grassland microcosms.**

2. **Even small abundances of Hayfield tarweed provide some protection against invasion.** If this pattern is also found in real grassland systems, even rare species may contribute to invasion resistance.

3. **Hayfield tarweed alone most likely cannot protect CA grasslands from starthistle invasion.** At high tarweed abundance levels, the protection offered by tarweed plateaus, and in these cases, more tarweed does not translate into lower starthistle biomass or flower production.

4. **Managing grassland systems so that they contain greater abundances of late season forbs,** particularly Hayfield tarweed**, may make California's grasslands more resistant to invasion by yellow starthistle.**

Your Input!

1. What strategies do you use to manage starthistle on your reserve?
2. Is **native species seeding** something you have tried in managing for invasions (esp. starthistle)? What results have you gotten?
3. Have you worked with Hayfield tarweed, other tarweeds, or other late season forbs as part of a management strategy?

What's Next?

1. I am moving out of pots and starting a **field study at McLaughlin Reserve** to determine if the relationship between Hayfield tarweed abundance and starthistle invasion holds under field conditions.

2. Conduct a **reverse-invasion experiment**, where tarweed is seeded into starthistle infestations. I will measure starthistle growth, biomass, and flower production in seeded and un-seeded areas to determine if seeding can help reduce infestations, and possible help restore these areas.

3. I have collected data on soil moisture, light, and nutrient availability in the different tarweed abundance treatments. I will analyze these data to determine the **mechanisms** driving the relationships seen in figs 2&3.

Literature cited

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