Introduced annual grasses, not native species, benefit from successful removal of yellow starthistle from a California grassland

Sheherezade N. Adams, sherry@egret.org

Modini Mayacamas Preserves of Audubon Canyon Ranch

Introduction

- Yellow starthistle (*Centaurea soltitialis*) was introduced in the mid-1800s to California and currently occupies over 10 million acres in the state
- While significant research has identified control methods and ecological impacts, land managers still lack information about long term impacts of control actions on other management targets.

Question

After several years of successful control of *C. soltitialis*, how is plant community composition impacted?

Question

Where *C. soltitialis* is not controlled, how is plant community composition impacted?

Question

Specifically, what is the impact on native plant diversity in these two scenarios?

Methods

- NE Sonoma Co., California grassland, elevation ~1,000', partially invaded with *C. soltitialis*
- Delineated macroplots-- homogeneous invaded and uninvaded areas
- 1 m^2 plots located randomly within macroplots; plots separated by a buffer zone of 5 m with same treatment
- Half of invaded plots randomly designated for removal with glyphosate using backpack sprayer; removal maintained for 4 years
- Percent cover of all species recorded for all plots early May of 2011-2014
- Total of 54 plots can be used for analysis after 4 years. JMPIN 4.0 (SAS Institute) used for ANOVA

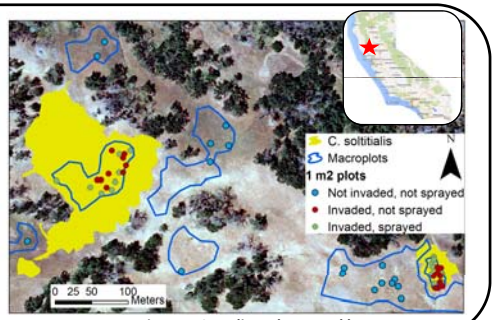

Figure 1: Sampling scheme and locator map

Results

Removal was effective…

***C. Solstitialis* cover**

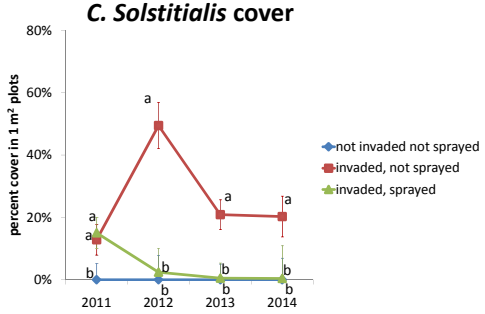

Figure 2: *C. solstitialis* cover through time by treatment Letters indicate a difference at P<.05 level within each year. Average and 95% confidence interval shown. Removal was effective, *C. solstitialis* levels in treated plots shifted from similar to other invaded plots to similar to uninvaded plots.

…however both removal plots and other invaded plots have no increase in native species…

Native richness

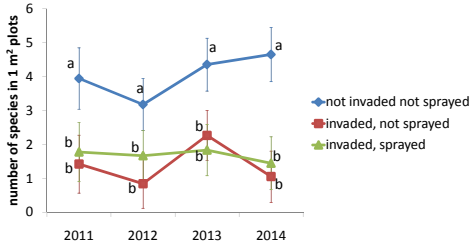

Figure 3: Number of native species per 1m² plot through time by treatment Letters indicate a difference at P<.05 level within each year. While native richness is higher in uninvaded areas than invaded areas, removing *C. soltitialis* does not, within three years, result in an increase in native species.

…but removal plots have a significant increase in introduced annual grasses

Annual grasses

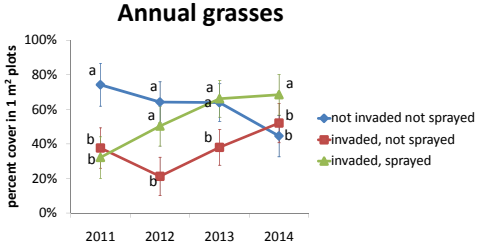

Figure 4: Percent cover of annual grass through time by treatment Letters indicate a difference at P<.05 level within each year. With the removal of *C. solstitialis*, cover of introduced annual grasses shifts from similar to other invaded plots to significantly higher.

Conclusions

As with other aspects of land management, goals and objectives must drive invasive species management. Where invasive species management is seen as a means to accomplish other goals such as diversity, abundance or persistence of native species, these need to be specifically monitored.

Some questions land managers may wish to consider before initiating an invasives control project:

- What are the non-target impacts of the control program?
- What are the impacts of no action?

Acknowledgements

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Sherry Adams, Sherry@egret.org, Preserve Biologist and Manager, 707-433-1217
Modini Mayacamas Preserves of Audubon Canyon Ranch, egret.org, 9500 Pine Flat Rd, Healdsburg, CA 95448

ABSTRACT

- For managers of natural areas contemplating an invasive species control program it is important to understand how the removal of an invasive species will impact management targets such as native plants. Even where presence of an invasive coincides with a reduction in native diversity, the impacts of removal on native diversity may be untested. Additionally, the trajectory of the invasive if left untreated is often unknown. Post-removal monitoring can provide insight into drivers of community structure and inform future control programs.

- In a Sonoma County California grassland, 60-1m2 plots were placed randomly within four homogeneous areas -- 20 plots each within two areas invaded by *Centaurea solstitialis* (Asteraceae; yellow starthistle), and 10 plots placed within each of two similar, nearby, uninvaded areas. Half of the plots within each invaded area were randomly selected for *C. solstitialis* removal, by glyophosate applied to each plot plus a 1 meter buffer with a backpack sprayer in early June in 2011 and 2012. What little *C. solstitialis* remained in these removal plots was hand pulled in 2013. As the buffer strips became progressively reinvaded, herbicide was again used in 2014 to maintain removal plots. All plots were visited in early May of 2011, 2012, 2013 and 2014 and percent cover of all vegetation was recorded.

- Untreated, *C. soltitialis* cover increased in already infested areas. Initially, cover of introduced annual grasses and richness of native species were both about twice as high in the uninvaded plots than in either the treated or untreated invaded plots. Two years after removal cover of introduced annual grasses in the removal plots had increased to levels no different from the uninvaded plots. In contrast, native species richness remained about twice as high in uninvaded plots than in either removal or untreated plots.

- While higher levels of *C. solstitialis* may be correlated with depressed native diversity, simply removing *C. solstitialis* does not, within three years, result in an increase in native diversity. In contrast, it appears to be introduced grasses which respond to the resources made available from *C. solstitialis* removal. Where management goals include native species increases, controlling the invader may not be sufficient to achieve this goal.

- While present, *C. solstitialis*'s effective competition for water may be an important driver of community structure. However existing sources of seed along with reproductive plant traits such as seed production and dispersal mechanisms may best explain community composition post-removal.