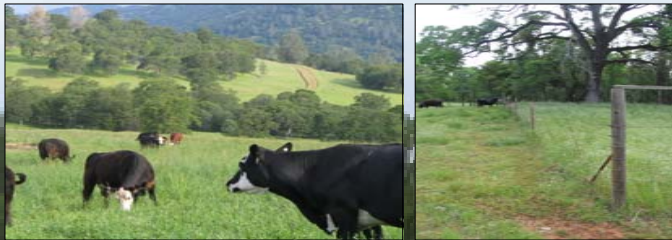


Landscape-scale Relationships between Oak Recruitment and Livestock Management

W. Stanley Harpole, Katharine Suding, Mitch McClaran, and Rebecca Aicher

University of California, Irvine and University of Arizona

ABSTRACT: There is concern that natural oak recruitment in California is not sufficient to maintain current populations. In particular, the inability of oak seedlings to transition to sapling and adult stages may often constrain recruitment. Grazing by cattle is often implicated as having potentially positive or negative effects on recruitment that may be dependent on the season of grazing. Grazing, in general, by removing litter, might promote seedling establishment. But grazing could also decrease survival and transitions to sapling and tree stages depending on whether grazing occurs during the dormant season or the growing season. Thus, we hypothesize that appropriately timed grazing may play a necessary role in the recruitment of oaks in this system. Here we present results from a landscape-scale survey of blue oak (*Quercus douglasii*) seedlings and saplings at the Sierra Foothills Research and Extension Center. We found similar sapling density in dormant season grazed, growing season grazed, and ungrazed pastures. Seedling density, however, was greater in grazed pastures than in ungrazed pastures. We also present preliminary results exploring seedling survival in relationship to grazing season and plant community composition.



INTRODUCTION:

The long-term establishment and success of California oaks is a major conservation concern. Adult trees are abundant but suffer losses due to land use and disease. Seedlings are common but saplings are frequently absent. **There is concern that seedlings and saplings are unable to transition into later stages. Is there a demographic bottleneck?**

Livestock and non-native annual grasses are implicated as main factors harboring stage transitions. Grazing impacts may play a positive or negative role in oak recruitment dependent on the timing of grazing. We hypothesize that there is a demographic bottleneck between the seedling and sapling stages, and that this bottleneck is strongest in dormant season grazed pastures (through direct effects of herbivory) and less strong in growing season grazed pastures (through indirect effects of competitive reduction with the herbaceous species).

METHODS:

Sierra Foothills Research and Extension Center

- Located 20 adult *Quercus douglasii* trees at least 50 m apart in 3 different grazing pastures (ungrazed, dormant, and growing season)
- Established 8 1m² subplots (4 cardinal directions, 2m or 5m from the base of each adult tree)
- All seedlings were counted and 1 seedling tagged in 1m² subplots



- All saplings within 20 m radius of trees were tagged
- Estimated percent cover of top 4 herbaceous species and bare ground in 1m² subplots



RESULTS:

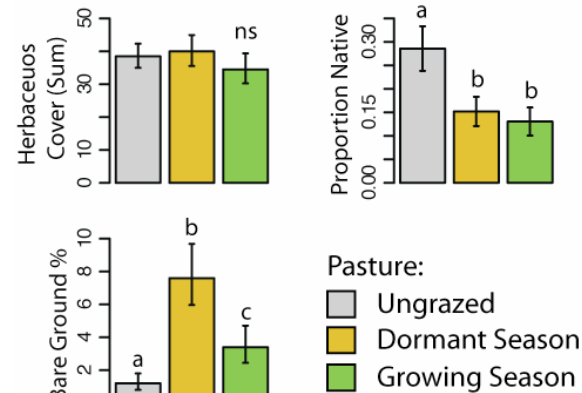


Figure 1. While there were not differences in overall cover, grazed pastures had proportionately less native species and more bare ground than the ungrazed pasture. Bare ground was also greater in the dormant-season grazed pasture compare to the growing-season grazed pasture. Results from ANOVA, log-transformed response variables. Different letters indicate significant differences at $P < 0.05$.

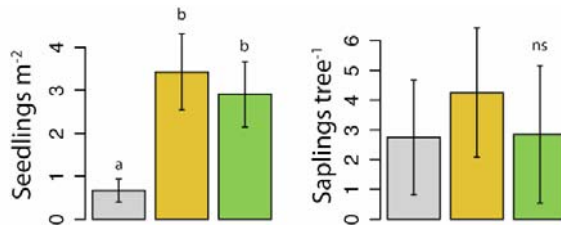


Figure 2. Grazed pastures had more seedlings but similar sapling numbers compared to the ungrazed pasture. There were no differences between the pastures grazed in different seasons. Results from a generalized linear model with Poisson error.

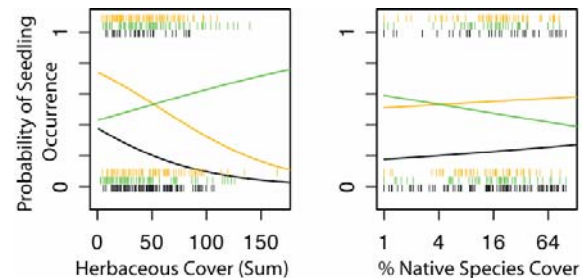


Figure 3. Probability of oak seedling occurrence decreased with herbaceous cover and increased with percent native species in ungrazed (black line) and dormant grazed (yellow) pastures; growing season grazed pasture (green) had opposite response (significant pasture x cover interactions, $P > 0.05$). Results from generalized linear model with binomial error, pasture as covariate, and blocked by tree

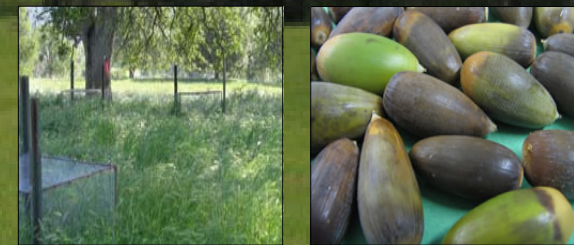
CONCLUSIONS:

Seedlings were more frequent in grazed pastures, without regard to season of grazing. Sapling density was relative constant across all three pastures.

There was some evidence that high vegetation cover in pastures grazed in the growing-season may benefit oak seedlings, perhaps because cattle have a harder time finding them or had other food choices. However, in ungrazed and dormant-season grazed pastures, oak seedlings were less frequent in areas of high vegetation cover, perhaps indicating competition or herbivory was more intense in these areas.

While sapling numbers were similar across all pasture types, we cannot say whether seedling survival and transition rates (to sapling stage) are consistent across pastures. We are following marked seedlings and saplings to begin to estimate survival and transition probabilities.

Several factors may be playing a role in oak population dynamics in these pastures. For instance, it is difficult to tell whether cattle are directly affecting oaks via herbivory or whether they are indirectly affecting oaks via changing the herbaceous community, residual dry matter, or soil conditions. We are in process of conducting greenhouse and field experiments to separate the effects of grazing and competition on oak performance. This will allow us to tease apart several factors that may be playing a role in the recruitment patterns we have measured here.



Acknowledgements:

This research is funded by Integrated Hardwood Rangeland Management Program of University of California. We thank Sierra Foothills Research and Extension Center, Dustin Flavell, Doug McCreary, and the Research Advisory Committee for their logistical support and advice, and Loralee Larios for field assistance.