

The Effect of Season and Stock Density on Blue Oak Establishment¹

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Abstract: Cattle have been faulted as a possible cause for poor oak regeneration in California's hardwood rangelands. This study sought to determine the effects of stock density and season of grazing on blue oak (*Quercus douglasii*) establishment. Year-old blue oak seedlings were transplanted into annual grass/rose clover pastures at the Sierra Foothill Range Field Station. Steers were allowed to graze one plot per week at low, medium, and high stock densities (1, 3, and 6 steers/acre, respectively) during the months of January and April. Results from January indicate that low stock density does not have a significant impact on oak establishment. Grazing damage by the steers and browsing damage by deer increased substantially in April. Trampling damage was usually minimal.

In recent years the fate of native oaks has become the subject of much public concern in California. Studies have shown that blue oaks in particular are not regenerating sufficiently to maintain existing stand densities (Mayer and others 1986; Muick and Bartolome 1986). In the most recent and comprehensive inventory of California's hardwoods, Bolsinger (1988) reports that "seedling and sapling stocking in the blue oak type was usually sparse" and that "blue oak is one of the woodland species generally considered to be declining because regeneration is not keeping up with the removal and natural mortality." There are indications that the transition from seedling to sapling and tree stages is more critical in limiting regeneration than acorn germination and early seedling survival (McClaran 1986).

In the controversy over the future of oaks in California's hardwood rangelands, livestock production has been pointed to as a probable cause of poor oak regeneration (Twisselmann 1967; Franco 1976). Livestock can damage oak seedlings in several ways. They may consume part or all of a seedling while investigating available food sources. Cattle may actively seek blue oaks as a preferred feed or may accidentally consume oak seedlings while eating the surrounding herbaceous material. Seedlings can be nipped, girdled, or completely uprooted. Likewise, cattle can trample and break young trees.

No studies have investigated the effects of stock density and season of grazing on oak seedling establishment. The purpose of this study is to determine the extent of grazing and trampling

damage as a result of low, medium, and high stock densities during the winter, spring, and summer seasons. The eventual goal of the project is to be able to give technical recommendations to cattlemen who desire to enhance the regeneration of oaks on their ranches.

METHODS

The study area is an open, rolling site of annual grass/rose clover pastures at the Sierra Foothill Range Field Station, located 17 miles east of Marysville, California. In December 1989, 720 one year-old blue oak seedlings were transplanted into three replicates in three adjacent three-acre pastures. Each replicate contained ten plots corresponding to three seasons by three stock densities and one ungrazed control to determine deer effects. Plots were completely randomized within each replicate. In each plot twenty-four seedlings were planted on ten-foot centers into three feet deep augered holes in which slow-release fertilizer tablets (20-10-5) had been placed. Twelve of the twenty-four tree locations in each plot received a herbicide application of Glyphosate prior to transplanting to eliminate grass competition. Plots were divided by electric fencing.

In both seasons three 700 lb. steers were placed in each three-acre field and were given access to one plot per week as well as the pasture. Grazing pressure was increased by reducing the pasture size each week with portable electric fencing. Week one (low stock density) had the three steers grazing the entire three-acre field which included the 50 foot by 90 foot plot of oak trees for a stock density of one animal per acre. The following week to increase the grazing intensity the field was reduced to one acre to equal a stock density of three steers per acre. Week three, with the highest grazing pressure, the field was further reduced to one-half acre for a stock density of six steers per acre.

Prior to the introduction of the steers, tree seedling height and forage levels (in lbs/acre) were measured using a capacitance probe. Following grazing any grazing or trampling damage was recorded and forage levels were re-measured. After each three week grazing period the steers were completely removed from the fields until the next grazing season. Between grazing seasons all trees were covered with aluminum wire mesh cages to prevent browsing by deer. In spring of 1991, all trees will be evaluated and tree survivability between groups will be compared and analyzed.

Stock densities, seasons, and the herbicide sub-factor were analyzed as a completely randomized design with herbicide

¹Presented at the Symposium on Oak Woodlands and Hardwood Rangeland Management, October 31-November 2, 1990, Davis, California.

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application as a split plot. Least significant differences were calculated where significant collective grazing and trampling effects were detected. Significant differences were declared at .05 alpha levels.

RESULTS AND DISCUSSION

Season

Grazing and trampling damage was significantly greater ($P < 0.05$) in April than in January (table 1). January damage averaged 34 percent while April damage averaged 65 percent. Most grazing damage was caused by nipping off the top of the seedling; often leaving behind several buds. Uprooting in both seasons was not significant (2 percent).

It was hypothesized that when forage is growing and in adequate supply cattle will not be attracted to the young oak seedlings and, therefore, grazing damage would be minimal particularly at the low stock densities. This hypothesis was confirmed in the January grazing season when at low and medium stock densities grazing damage were 6 percent and 25 percent, respectively. Only at the high stock density, when forage selection and space in which to maneuver were drastically reduced, did grazing damage reach 19 percent and trampling damage reach 33 percent for a total of 52 percent. Due to the relatively low grazing damage indices it appears that the steers are grazing the oaks incidentally.

Contrary to the hypothesis, the April damage at all stock densities was much higher contrary to the hypothesis. The April results were surprising because it was thought that the damage to oaks would decrease due to the abundance of tall grasses for the steers to eat. However, during that grazing season the steers were not attracted to the lush grasses. Instead they sought out patches of rose clover, frequently leading them into the oak plots which hadn't been grazed in several months and therefore contained an abundance of clover. It is suspected that the presence of rose clover attracted the steers resulting in greater damage compared to January. This increase could, however, be attributable to the increased activity of deer as well.

Since the area has a resident deer population, control plots to differentiate deer browsing from cattle grazing were essential. Control plots were fenced from cattle and accessible only to deer and other wildlife. The presence of deer in the area, confirmed by deer pellets, hoof prints, occasional sightings, and the amount of browsed oak seedlings in the control plots, may have inflated the amount of grazing damage in the experimental plots attributed to steers during the April grazing season. In January, both deer and cattle grazing indices were low (0 and 19 percent respectively). However, in April, while cattle grazing of seedlings rose from 16 to 59 percent, deer browsing of control plot oaks rose from 0 to 46 percent. It is possible that deer also

Table 1—Percent damage according to season and stock density

Stock density	Winter			Spring		
	Grazed	Trampled	Total	Grazed	Trampled	Total
Low density	6	6	12(d)	39	1	40(c)
Medium density	25	13	38(c)	61	3	64(b)
High density	19	33	52(bc)	79	14	93(a)
Control	0	0	0(d)	46	0	46(c)

Note: Numbers in columns followed by the same letter are not significantly different.

browsed in the experimental plots, whereby inflating grazing indices.

Although the amount of total damage was quite high, it is worth noting that of the January trees that were grazed or trampled, the damage was usually not fatal. Three months later 95 percent of the seedlings had leafed out. Some researchers suspect that defoliation actually aids oak seedlings during drought years because they have less leaf surface from which to transpire (Welker and Menke 1990).

Stock Density

Analysis of variance revealed a high F value for stock density. The low stock density had an average of 26 percent total damage as opposed to 51 and 72 percent for medium and high stock densities, respectively. Mean separation indicated no significant difference between the ungrazed control and the low stock density, nor between medium and high stock densities. In January at the low stock density, both grazing and trampling damage were minimal. Total damage was evenly divided between grazing and trampling. At medium stock density, total damage rose from 11 to 38 percent with grazing accounting for two-thirds of the damage. At the high stock density, grazing accounted for a little over one-third of the total damage, and trampling damage was responsible for the majority of the affected trees. Thus, there was an apparent shift between the kind of damage inflicted as stock density rose from medium to high.

During the April grazing season, trampling damage was always less than grazing damage. The apparent shift from mainly grazing to mainly trampling as stock density increased did not occur in the spring grazing season.

The results from these two preliminary grazing trials indicate that cattle do indeed feed on young oak trees and that as stock density increases so does the probability that oak seedlings will be either grazed or trampled. Intensity of grazing can influence seedling damage and is a function of two interrelated variables: livestock density and forage levels. As density increases cattle are more likely to accidentally trample trees. Moreover, with higher intensity the preferred forage will become less available and cattle will resort to new and/or less preferred feedstuffs.

Season and Stock Density

Six treatments were statistically analyzed. A treatment is the combination of a season and a stock density. Treatments were denoted winter-low (WL), winter-medium (WM), and winter-high (WH), and the equivalent for the three spring levels. Analysis of variance showed statistical significance for treatment. Mean separation for treatment showed a significant difference between treatments WL and SH, the two extremes, and all other treatments. Treatments WM, WH, and SL were not significantly different nor were treatments WH and SM. Furthermore, no significant difference was found between seedlings which received a herbicide application at planting and those that did not. Replicates and the interaction between treatment and replicate also showed significant F values, but not as high as season, stock density and treatment. There was no correlation between forage levels and grazing damage indices.

CONCLUSIONS

From the results of the initial phases of this three season study, it is clear that cattle damage oak seedlings at medium and high stock densities particularly in the month of April. At low densities, however, it is quite possible that oak regeneration and livestock production are not mutually exclusive. Individuals concerned about the future of blue oaks in California's hardwood rangelands should acknowledge that it is not cattle per se that inhibit oak establishment, but rather the way in which cattle

are managed which is the crucial point in this controversy. The detrimental effects of deer at critical times of the year can be just as significant as cattle damage and should not be underestimated. Further investigation representing other seasons will help clarify the effect of livestock on oak seedlings throughout the year so that technical recommendations can be made to ranchers interested in preserving what many consider to be an integral part of California's heritage.

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