The Influence of Cattle Grazing on California Ground Squirrels in a Blue Oak Savanna[1]

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Abstract: *This experiment compared California ground squirrel (*Spermophilus beecheyi*) activity on replicated grazed and ungrazed pastures in a blue oak (*Quercus douglasii*) savanna. During the 4-year study, squirrel activity, measured as the number of active burrows, generally declined in grazed and ungrazed pastures without oak canopy. Squirrel activity declined least in grazed pastures with blue oak canopy, and by the end of the experiment those pastures had significantly highest squirrel activity. Livestock management has only moderate potential for influencing squirrel abundance on grazed blue oak rangeland.*

The California ground squirrel (*Spermophilus beecheyi*) is a native rodent common on rangelands (Lidicker 1989). As an agricultural pest on annual-dominated range, it damages structures, eats crops, serves as a disease vector, and competes with livestock for forage. As an indigenous component of rangeland ecosystems, ground squirrels are an important prey species and help support a diversity of predators.

Studies at the San Joaquin Experimental Range near Fresno suggested that squirrels compete with livestock for forage, and that livestock grazing increases squirrel populations (Howard and others 1959, Fitch and Bentley 1949). Heavy livestock grazing was proposed to reduce litter and favor the germination of broadleaved plants more desirable to squirrels (Howard 1953). Linsdale (1947) observed, at the Hastings Reservation in Carmel Valley, that both light and heavy grazing favored squirrels, presumably through changes in species composition and litter, and that removal of grazing leads to disappearance of squirrels.

I compared moderate cattle grazing and grazing removal on replicated pastures in oak savanna and annual grassland at Del Valle Park in southern Alameda County to determine the effects on ground squirrel abundance.

Methods

Del Valle Park is normally moderately grazed year-round by cattle but had not been grazed for 3 years before the study because of an extended drought. Livestock grazing was reintroduced to the park in early 1991.

California ground squirrels are abundant on the annual grasslands and oak (*Quercus* spp.) savannas that characterize the park's vegetation. I selected three locations (blocks) within the southeastern portion of the park according to the following criteria: (1) vegetation annual grassland or blue oak dominated savanna with about 50 percent tree canopy coverage, (2) at least nine active squirrel colonies within a contiguous 4 ha (the minimum block size) of either annual grassland or oak savanna, (3) slope less than 40 percent, and (4) an area with likely moderate livestock use. Each location was divided into randomly assigned grazed and ungrazed treatments with fencing constructed in fall 1991. Each location included four experimental units, a paired grazed and ungrazed grassland and a paired grazed and ungrazed oak savanna.

Within each experimental unit three active squirrel colonies were located and marked with steel rebar at the center of colony activity. All burrow openings

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within a 10-m radius of the colony center were mapped and rated for activity from fall 1991 through 1994. To determine colony activity, I rated each hole with scores of "0" (no evidence of a previously mapped hole), "1" (hole filled with dirt, vegetation growing on filled surface, paths to other holes not evident), "2" (hole filled in or partially filled, no evidence of recent use but vegetation not yet reestablished on fill), "3" (hole open but no evidence of recent use, sticks or cobwebs in the hole, no recent soil disturbance, paths may be present to other holes), and "4" (hole open, evidence of recent use, soil disturbance, active use of paths to other holes).

A wire cage with 5- by 10-cm mesh (squirrels easily travelled under and through the cages) was randomly located near the colony center and 1/16-m^2 plots clipped outside and inside in spring to determine forage production and cattle utilization. Results were analyzed by ANOVA and mean separation with differences judged significant if $P < 0.05$.

Results and Discussion

Forage productivity was considerably higher in the grassland than in the oak savanna (*table 1*). Production and apparent livestock utilization varied significantly among years in the grassland, and 1993 was the only year with satisfactory utilization near 50 percent. In the oak savanna, apparent utilization was close to the desired 50 percent, and production varied little among years. Although livestock ranged throughout the study area, they preferred areas within the tree canopy, especially in spring.

***Table 1—Weight (grams/m^2) of standing biomass as measured in spring inside and outside of cages excluding livestock grazing* (n=9 clipped quadrats per data point).**

Year	1992	1993	1994
		g/m^2	
Grassland (grazed, outside cage)	402	230	303
Grassland (ungrazed, inside cage)	387	392	247
Savanna (Grazed, outside cage)	121	95	166
Savanna (ungrazed, inside cage)	212	201	210

In grassland, ungrazed biomass in 1993 differs significantly ($P < 0.05$) from grazed biomass and ungrazed biomass was significantly higher in 1992 and 1993 than in 1994. In oak understory, grazed biomass was significantly lower than ungrazed biomass in 1992 and 1993.

The overall density of active squirrel holes (ratings of 3 or 4) generally declined over the course of the study (*table 2* and *fig. 1*). Three years of cattle grazing had little effect on changes in squirrel activity in grassland. This result is not surprising given the lack of grazing pressure and relatively high amounts of standing biomass with and without grazing on those sites.

In the oak savanna, squirrel activity increased significantly during the study in one grazed block and averaged significantly higher for grazed savanna than the other treatments (*fig. 1*). Interpretation of the reasons for this result is difficult because the significant effect results primarily from a treatment × block

Table 2—Density of active ground squirrel holes (holes/m²) in fall (n=9 colonies/plots per data point).

	1991	1992	1993	1994
	holes/m²			
Ungrazed grassland	0.026	0.023	0.019	0.014
Grazed grassland	0.032	0.018	0.013	0.012
Ungrazed savanna	0.024	0.025	0.012	0.014
Grazed savanna	0.055	0.056	0.031	0.034

Differences between 1991 and 1994 are significant at $P < 0.05$ for all treatments. Within 1994, the grazed savanna differs significantly from the other treatments.

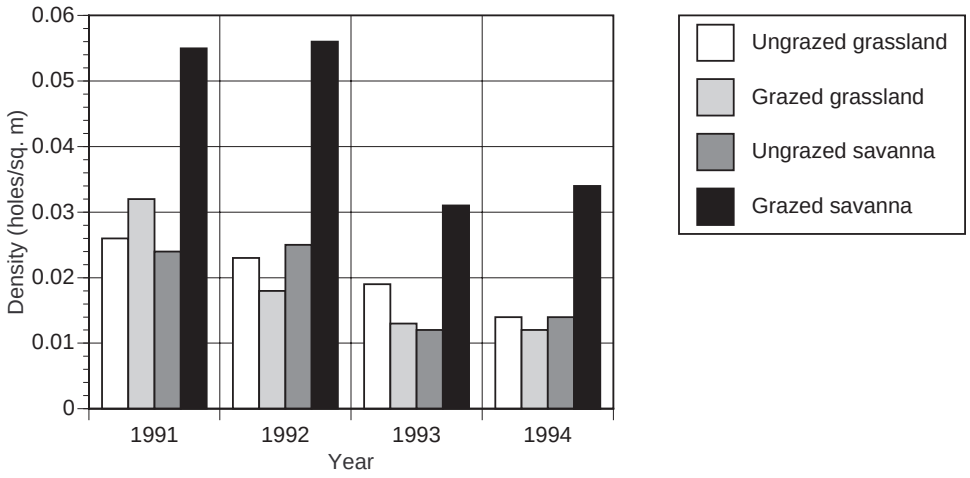

Figure 1—Density of active squirrel holes (ratings of 3 or higher, see text for explanation) in fall. Within 1994, the grazed savanna differs significantly ($P < 0.05$) from other treatments.

"interaction" (squirrel activity in two of the three savanna blocks did not change significantly). Production and utilization appeared similar among blocks, and there were no obvious differences in forage species. The major reasons proposed for squirrel reactions to grazing, amount of litter and changes in plant species composition, did not appear important. Grazed or not, savanna areas had only about half the forage productivity and standing biomass of grasslands.

Ground squirrels, despite 3 years of modest decrease in activity, are still very abundant on the study site. Grazing at the moderate levels used in this study did not affect squirrel activity in open grassland and had a variable effect in oak savanna. Proposals to change grazing, based on the presumed impact on squirrels, need to consider two points. If grazing affects squirrel numbers at all, it is likely to be at high grazing intensity, and any effects on the squirrels will differ considerably among and within sites.

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