EFFECTS OF LIVESTOCK GRAZING ON A COMMUNITY OF SPECIES AT RISK OF EXTINCTION IN THE SAN JOAQUIN VALLEY, CALIFORNIA

Annual Report[1]

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Summary

This report presents results of the fifth year of plant and animal censuses on the Lokern Natural Area study site. The treatment plots have received a fourth year of grazing by cattle. Coupled with a below average year of rainfall, even the light amount of grazing on each plot was enough to keep grass cover low on treatment plots. We again went below the threshold of herbaceous plant biomass planned for on treatments. Plant studies continue with no significant effect of treatment visible yet. Only three bird species have occurred in sufficient numbers throughout the study to allow assessment of trends. Sage sparrow numbers have steadily declined since 1997 irrespective of whether areas have been grazed or not. Numbers of western meadowlarks peaked in 1999, and now are abundant on controls but not treatments. In contrast, horned lark numbers are high on treatment plots and very low on controls. Side-blotched lizards and western whiptails are generally found throughout the study area now, but both occur on treatment plots in greater numbers than on controls. Blunt-nosed leopard lizards remain scarce and only 2 adults were found in 2001, both on treatment plots, with another adult found while driving in a grazed portion of a section. Significantly, though, 15 juvenile leopard lizards were found in August and September on the treatment plot in section 27. Nocturnal rodents were spread throughout the study area in 2001. Short-nosed kangaroo rats generally were much more abundant on grazed plots, whereas Heermann's kangaroo rats and San Joaquin pocket mice were more abundant on controls. Numbers of San Joaquin antelope squirrels still remain fairly high, and now are abundant in both controls and treatments. Ground invertebrates found in pitfall traps remain scarce. We will continue to gather information on the year-to-year variation in rainfall, plot condition, and relative abundance of plants and animals. Now that population numbers of most of the focus species are relatively abundant and the grazing treatment is significant, we would like to continue the study through another wet climatic cycle, as happened from 1993 to 1998. We suspect that the lack of grass cover due to grazing will show benefit to focus species when conditions for abundant grass growth return. As we have written in the past, this study will only succeed with time, patience, and resources. The field research on the Lokern still requires $65,000 per year. This assumes that in-kind support from cooperating agencies and organizations will continue at past levels.

[1]Authors of this unpublished report are: Germano, D. J., E. Cypher, S. Fitton, L. R. Saslaw, and G. B. Rathbun.

Background

In 1995, the Bureau of Land Management (BLM) approached the US Geological Survey (then the National Biological Service) for assistance in developing a research project to help determine how livestock grazing on arid public lands in the southwestern San Joaquin Valley might be impacting several plant and vertebrate species that were listed by state and federal agencies as threatened or endangered. The Western Ecological Research Center (WERC) of the Biological Resources Division developed a research proposal to carry out the research in cooperation with several other agencies and organizations interested in the topic (see Cooperator's section below).

In 1997, a study site on the Lokern Natural Area in western Kern County was chosen and prepared for the research. This included fencing eight plots (Figure 1), four controls (62 acres or 29 hectares) each nested within four treatment pastures (one Section each or 640 acres or 259 hectares). Water was piped into each treatment plot for the cattle.

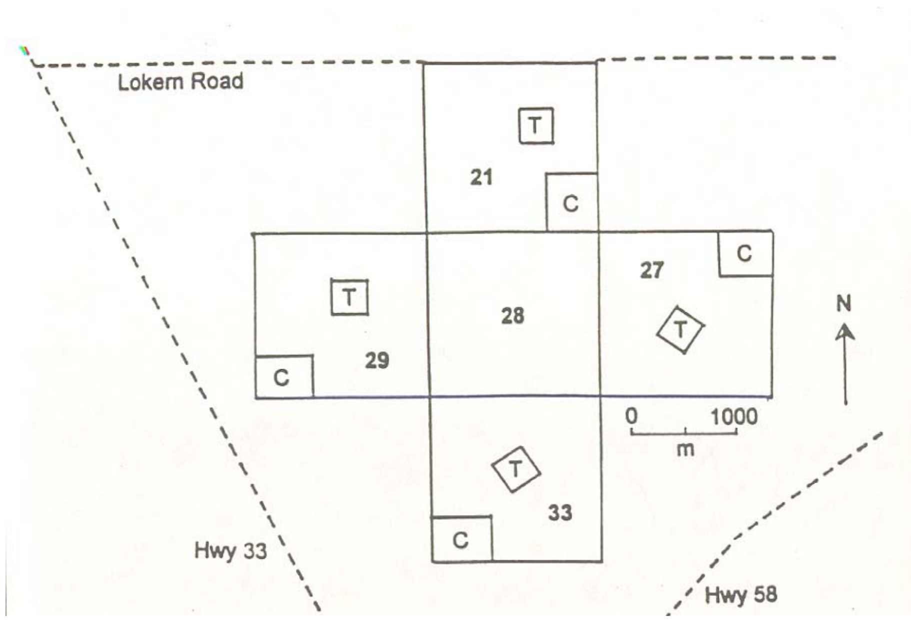


Figure 1. Lokern Study Area showing design of experimental and control plots.

Midway through the construction of cattle fencing in May 1997, an accidental wildfire burned through half of the study area. In order to reduce the confounding effect of this fire on the study design, the other half of the study area was intentionally burned in July 1997. Initial, baseline plant sampling was completed on the four treatment and four control plots before the burns in 1997, while baseline vertebrate sampling was completed on the eight plots after the burns in July and August 1997. A summary of these results, along with a copy of the research study plan, was included in the Annual Report for 1997 (http://www.werc.usgs.gov/kern/lokern.htm).

Cattle were turned out onto the newly fenced treatment plots for the first time in February 1998. The yearly plot, vegetation, and animal sampling schemes were completed as planned in 1998, and the cattle were removed in July 1998, just prior to mammal trapping. In 1999, 2000, and 2001, a similar schedule was followed, although with a progressively lower amount of grazing as conditions dried each successive year.

Results

Fire Effects

The 1997 wildfire only burned part of the study area, thus introducing a confounding factor into the study design. The unequal coverage of the fire was addressed by intentionally burning the remainder of the study area. The irony about the wildfire is that it probably would not have occurred without the abundant fuel provided by the exotic annual grasses. In addition, the fire probably would not have carried through the study area if we had started our grazing a year earlier. The fires, however, have had considerable impacts on the study.

Before we intentionally burned plots in sections 29 and 33 in 1997, we counted the number of live and dead saltbush (*Atriplex* spp.) in ten randomly selected 20 x 20 m blocks in control and treatment plots. We returned in summer 1998 and 2001 and counted the number of living saltbush in the same 10 blocks. In addition, we recorded volumes of 30 randomly selected shrubs in 2001 in plots where saltbush returned.

The most obvious and predictable effect of the fires was the death of virtually all the saltbush on the study site one year after fire (Table 1). By the 2001 field season, saltbush had reestablished in sections 21 and 29, irrespective of whether the area had been grazed or not, although numbers of saltbush were greater in the ungrazed controls (Table 1). Very few saltbush have reestablished in sections 33 and 27, irrespective of whether the area had been burned by wildfire or prescribed burning, or whether the area was grazed or not (Table 1). In areas where saltbush had reestablished, virtually all the saltbushes were spiny saltbush (*A. spinifera*), whereas much valley saltbush (*A. polycarpa*) was in the area before the burn. Finally, the volume of saltbush plants on grazed plots was only about ¼ that of the ungrazed controls (Fig. 1), showing an effect of grazing on these plants.

The effects of the fire on herbaceous plants have now been erased. The average of 30 samples of residual dry matter (RDM) from each of the four control plots (ungrazed but burned) in August 2001 was 2,160 lbs/acre. The RDM from 30 samples taken from an ungrazed and unburned area immediately adjacent to and outside of the study area was 2,190 lbs/acre.

Table 1. *The effects of fire and grazing on saltbush* (Atriplex sp.) *on the Lokern study site. Mean number (standard error) of living shrubs for ten 20 m X 20 m blocks in plots before prescribed fire (1997) and after fire (1998, 2001). Plots listed under wildfire burned before data collection began. Plots are designated by section number and whether they are grazed by cattle (T) or are ungrazed (C) (See Fig. 1).*

Plot	1997	1998	2001
Prescribed Burned			
33C	29.3 (8.81)	0.2 (0.02)	0.1 (0.10)
33T	15.1 (4.23)	0	0.1 (0.01)
29C	41.4 (3.11)	0	20.1 (4.87)
29T	48.9 (2.80)	0.2 (0.13)	7.8 (1.94)
Wildfire Burned			
27C	--	--	1.6 (0.52)
27T	--	--	0.8 (0.29)
21C	--	--	15.6 (3.84)
21T	--	--	3.4 (1.82)

Rainfall

In two rain gauges we set out on opposite ends of the study site in September 1998, we recorded 127.3 mm (5.01 inches) and 121.0 mm (4.76 inches) total rainfall for the 2000/2001 rainfall year (until 30 June 2001). This is the second lowest amount of yearly rainfall in the five years of the study (following the preceding dry year), and also was much less than the 20-year average of 168.9 mm (6.65 inches) at Buttonwillow. Rainfall at the Buttonwillow station in 2000/2001 was 140.0 mm (5.51 inches). In 2000/2001 on the study site, all but 8 or 9 mm of rain fell in January, February, and March at both gauges. Except for 0.5 mm recorded at both gauges 31 October, no rain fell until mid January.

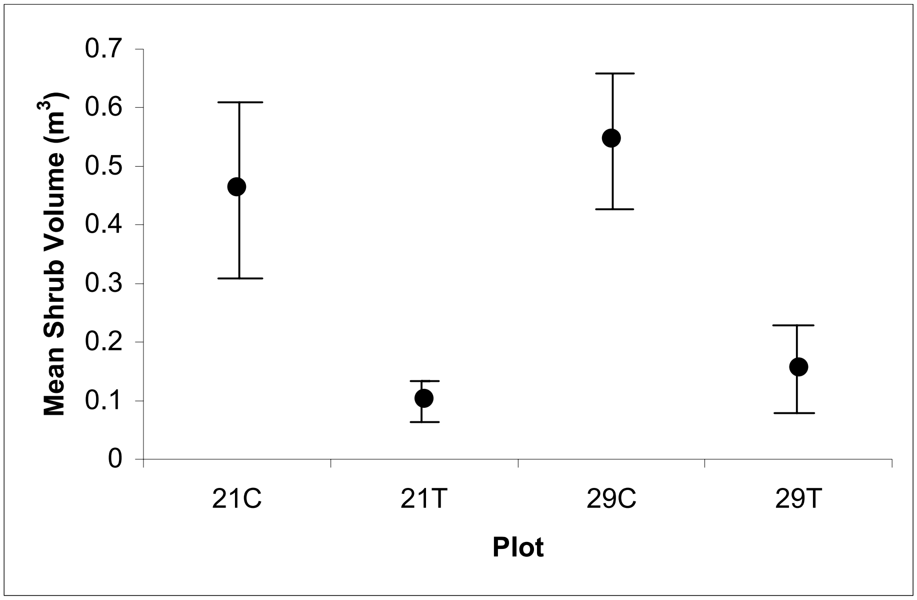


Figure 2. *Mean volumes (dots) and 95% confidence intervals (bars) of saltbush shrubs* (Atriplex spinifera) *on control (29C and 21C) and grazed (29T and 21T) plots on the Lokern study site in 2001.*

Grazing Effects on Plots

As was done last year, the target RDM level of 500 lbs/acre was reached, and, like last year, three of the four plots had RDM levels substantially lower than the target (Table 2). The average stocking rate in 2001 was 0.14 AUM (Animal Units/Month) per acre on the four treatment plots, the lowest in four years. Cattle were only on the plots a short time and were equally distributed to achieve similar RDM levels (Table 2). We found significant differences between treatment and control for three measures of summer herbaceous vegetation on the plots: RDM, height of vegetation, and cover. For RDM, there was a significant difference among plots (ANOVA, $F_{7, 237} = 16.93$, $P < 0.001$). The difference is explained by treatment plots having less RDM than controls. Similarly for height, treatment plots had shorter vegetation than controls (ANOVA, $F_{7, 239} = 29.53$, $P < 0.001$). There are significant differences among plots for summer cover (ANOVA, $F_{7, 239} = 22.41$, $P < 0.001$), but only two of the treatments have less summer cover than the controls (Table 2).

Table 2. *Cattle stocking rates and vegetation characteristics of study plots in 2001. Average cover determined by percentage cover classes (100%, 95%, 75%, 50%, 25%, 0%).*

Plots	Stocking Rates (AUM*)	RDM (lbs/acre)	Average Height (cm)	Average Cover (%)
21C	----	2170	21.2	92.7
21T	59	710	11.8	83.7
27C	----	1380	19.8	95.0
27T	68	320	9.2	50.8
29C	----	2510	30.2	95.5
29T	97	280	7.8	37.5
33C	----	2580	25.4	99.5
33T	91	260	8.3	89.7

* 1 AUM = one cow weighing 1000 lbs for one month. Stocking rate is for the entire 2000 grazing season. Cow/calf pairs used equaled 1 AUM.

Vegetation Surveys

Personnel collecting data from 10 to 19 April 2001 were Dr. Ellen Cypher of the Endangered Species Recovery Program (ESRP) and Shane Barrow, Aaron Fitch, and Jason Hlebakos of the U.S. Bureau of Land Management (BLM). Funding for these personnel was provided by their sponsoring agencies. We recorded reproductive density (the total number of buds, flowers, and fruits per meter^2) and fecundity (number of flowers per plant) of Kern mallow (*Eremalche parryi* ssp. *kernensis*) on all 80 permanent sampling belts (20 m by 0.25 m) and 896 random quadrats (0.25 by 0.25 m). We also determined the cover and composition of vegetation on all 32 permanent transects. Data were pooled for each study plot, then means for grazed and ungrazed plots were compared statistically by section via the paired-sample *t*-test. To analyze data on the number of flowers per plant, sampling belts were divided into their 0.25-m components, all samples without Kern mallow plants were omitted, and all occupied 0.25 by 0.25- m quadrats were compared by treatment via analysis of variance.

Reproductive density of Kern mallow (Table 3) did not differ statistically between the ungrazed and grazed plots in Spring 2001 (t = -0.75, 3 df, P = 0.51). The pattern observed this year was similar to the baseline year of 1998, which was before grazing began on the study area. In both 1998 and 2001, reproductive density was higher on the ungrazed area of Section 21 than the grazed area, but was higher on the grazed area of

Section 29 than the ungrazed area (Table 3). Similar results were found in 1999, after cattle grazing began on the treatment plots. Patterns were not observable in 2000 because Kern mallow was absent from much of the study area, nor in 1997 because data were available for only one section. Over all plots, reproductive density of Kern mallow in 2001 was two orders of magnitude higher than it had been in 2000 and one order of magnitude higher than it had been in 1999.

Fecundity of Kern mallow was higher in the grazed plots of Section 21 and Section 29 than in the corresponding ungrazed plots (t = -67.99, 1 df, P = 0.009) during 2001 (Table 3). However, the higher fecundity cannot be interpreted as a positive response to cattle grazing because the pattern observed in 2001 was similar to that found in the baseline year of 1997, before cattle were introduced to the study area; a similar pattern was observed in the post-treatment years 1999 and 2000. In 1997, the fecundity of Kern mallow in Section 21 averaged 5.70 on plots designated to remain ungrazed and 13.80 on plots scheduled to be grazed. Data are not available for Section 29 in 1997 because the flowers had withered by the time of data collection and Kern mallow could not be distinguished from desert mallow (*Eremalche exilis*), which also occurred in that section. The withered flowers did not affect data collection in Section 21 during 1997 because desert mallow does not grow there. For unknown reasons, the pattern of fecundity relative to area was reversed in spring 1998, following the wildfire and a season of above-average rainfall. In that year, which was before cattle were introduced to the study area, the fecundity of Kern mallow was higher on plots designated to remain ungrazed than it was on plots scheduled to be grazed.

In 2001, herbaceous cover was significantly higher (t = 3.38, 3 df, P = 0.043) on ungrazed plots than on grazed plots (Table 4). Overall, herbaceous cover has declined steadily on both grazed and ungrazed plots since the study began in 1997, probably due to a combination of the summer 1997 wildfire, cattle grazing, and a series of low-rainfall years. Other vegetation characteristics, including microbiotic crust cover, shrub cover, and the number of plant species occurring on sampling belts, did not differ between grazed and ungrazed plots (Table 4). The 1997 fire substantially reduced microbiotic crust cover and essentially eliminated shrub cover; both have begun to recover, although shrub cover is measurable only on ungrazed plots. Plant species richness varies from year to year, with the greatest number of species being observed in 1998, which was probably a response to both the record-high rainfall and the previous year's wildfire.

Table 3. *Reproductive density and fecundity (mean ± SE) of Kern mallow (*Eremalche parryi *ssp.* kernensis*) on Lokern study plots, Spring 2001.*

Study Plot/Treatment	Reproductive Density (Number of flowers/m^2)	Fecundity (Number of flowers per plant)
21C	3.60 ± 1.96 (n = 10)	6.47 ± 1.30 (n = 16)
21T	0.62 ± 0.62 (n = 10)	13.75 ± 4.89 (n = 4)
27C	0 (n = 10)	N/A
27T	0 (n = 10)	N/A
29C	0.10 ± 0.08 (n = 10)	2.50 ± 1.50 (n = 2)
29T	15.80 ± 11.22 (n = 10)	16.14 ± 6.33 (n = 28)
33C	0 (n = 10)	N/A
33T	0 (n = 10)	N/A
Overall	2.52 ± 1.48 (n = 80)	12.31 ± 3.62 (n = 50)

Table 4. *Vegetation characteristics (mean ± SE, n_i = 4) on Lokern study plots, Spring 2001.*

Study Plot/ Treatment	Herbaceous cover (%)	Microbiotic crust cover (%)	Shrub cover (%)	Number of species on belt
21C	78.3 ± 3.3	0.5 ± 0.3	1.0 ± 0.4	13.3 ± 1.3
21T	74.0 ± 4.7	0.3 ± 0.3	0	14.5 ± 2.1
27C	70.8 ± 3.5	0.3 ± 0.3	0	16.5 ± 1.6
27T	60.3 ± 0.9	2.0 ± 1.4	0	14.8 ± 0.8
29C	61.5 ± 7.5	2.3 ± 1.9	1.8 ± 0.9	9.5 ± 1.3
29T	58.8 ± 4.9	1.5 ± 1.2	0	12.0 ± 0.4
33C	79.3 ± 1.5	0	0	10.5 ± 1.9
33T	74.0 ± 3.1	0	0	10.5 ± 1.2
Overall	69.6 ± 1.9	0.8 ± 0.3	0.3 ± 0.2	12.7 ± 0.6

Red brome (*Bromus madritensis* ssp. *rubens*) and red-stemmed filaree (*Erodium cicutarium*) continued to be the dominant or co-dominant species on all plots (Table 5), as they have throughout the study period. Cover of red brome was significantly higher on ungrazed plots than grazed plots in 2001 (t = 7.19, 3 df, P = 0.006), whereas red-stemmed filaree had higher cover on grazed plots (t = -2.43, 3 df, P = 0.094). This pattern differs from the pre-treatment years of 1997 and 1998, when cover was similar on grazed and ungrazed plots. No other species differed significantly in cover in 2001. Mousetail fescue (*Vulpia myuros*) has typically been a co-dominant species on both grazed and ungrazed plots but was virtually absent in 2001, when overall cover averaged only 0.1%, compared to 23.7% overall cover in 2000. This species did not set seed during the 2000 growing season, which probably accounts for the low cover this year. However, red-stemmed filaree and Arabian grass (*Schismus arabicus*) both increased substantially in cover over 2000, when they averaged 26.4% and 0.6%, respectively. This is in contrast to red brome, which decreased substantially in overall cover from 2000, when it averaged 59.9% cover. Other than Arabian grass, the species with the next highest cover in 2001 (Table 5) was foxtail barley (*Hordeum murinum*). The native plant species with the highest overall cover was popcorn flower (*Plagiobothrys californicus*), at 1.0%. The pattern of rainfall in the 2000-2001 growing season apparently is responsible for the variation in species dominance. Little rain fell during the autumn months, which favored forbs over grasses.

Table 5. *Absolute percent cover of dominant species (mean ± SE, n_i = 4) on Lokern study plots, Spring 2001.*

Study Plot/ Treatment	*Bromus madritensis* ssp. *rubens*	*Erodium cicutarium*	*Hordeum murinum*	*Schismus arabicus*
21C	46.3 ± 3.6	39.3 ± 4.4	2.5 ± 1.3	0
21T	13.3 ± 0.8	62.0 ± 6.4	1.0 ± 1.0	2.8 ± 2.4
27C	27.5 ± 2.7	47.3 ± 6.1	0.8 ± 0.8	0.5 ± 0.5
27T	7.8 ± 0.6	49.3 ± 1.7	0.5 ± 0.3	7.3 ± 2.3
29C	41.3 ± 5.5	22.5 ± 2.4	1.5 ± 0.9	0.3 ± 0.3
29T	11.5 ± 2.3	52.5 ± 6.0	1.5 ± 1.0	1.0 ± 0.4
33C	29.0 ± 6.1	58.5 ± 6.4	3.5 ± 2.2	0
33T	10.0 ± 2.0	66.5 ± 2.1	0	0.8 ± 0.3
Overall	23.3 ± 2.7	49.7 ± 2.8	1.4 ± 0.4	1.6 ± 0.6

As was observed in 2000, trends suggest that grazing is reducing the dominance of red brome and favoring the dominance of red-stemmed filaree. Grazing has not yet had observable effects on Kern mallow or other native plants, but the abundance of Kern mallow has been so low since cattle grazing was introduced to the study area, thus reliable conclusions cannot yet be drawn. **The higher fecundity of Kern mallow on grazed plots compared to ungrazed plots in 2001 cannot be attributed to a beneficial effect of grazing because the pattern held true even in 1997, before cattle had been introduced to the study area.** Kern mallow typically is most abundant in years of above-average rainfall; at least one more year of above-average rainfall is required before actual effects of grazing can be analyzed.

Mammal Surveys

Numbers of nocturnal mammals increased across all plots, and are the greatest number caught to date (Table 6). Nocturnal rodents are now spread out across both control and treatment plots. Still the most abundant nocturnal rodent is the short-nosed kangaroo rat

(*Dipodomys nitratoides brevinasus*), and, as in past years, was generally most abundant on treatment plots. Heermann's kangaroo rats (*D. heermanni*) were caught in all sections, but generally were caught only in the controls (except in section 29). San Joaquin pocket mice (*Perognathus i. inornatus*) were also relatively abundant and were caught most often on control plots. The only other nocturnal rodents captured were deer mice (*Peromyscus maniculatus*), found only in plot 33C, and southern grasshopper mice (*Onychomys torridus*), which were only caught in section 27 (Table 6).

We did do catch any giant kangaroo rats (*D. ingens*), a focus species, this year (Table 6). Although their numbers have been increasing on a permanent study plot approximately 3 km north of section 21 (Germano and Saslaw, unpublished data), numbers of giant kangaroo rats in the study area are remaining low.

Table 6. *Numbers of nocturnal mammals captured on study plots in 2001. All numbers are of individuals captured, except for* Peromyscus maniculatus, *which are total captures*.

	Number of Individuals Captured by Species*								
Plot	DH	DN	DI	PI	PM	OT	RM	MM	Total
21C	3	6	0	24	0	0	0	0	33
21T	0	13	0	9	0	0	0	0	22
27C	2	42	0	37	0	6	0	0	87
27T	0	45	0	15	0	1	0	0	61
29C	33	11	0	7	0	0	0	0	51
29T	11	48	0	3	0	0	0	0	62
33C	3	14	0	5	16	0	0	0	38
33T	0	74	0	9	0	0	0	0	83
Total	52	253	0	109	16	7	0	0	437

*DH = *Dipodomys heermanni*, Heermann's kangaroo rat
DI = *Dipodomys ingens*, giant kangaroo rat
DN = *Dipodomys nitratoides*, San Joaquin kangaroo rat
PI = *Perognathus inornatus*, San Joaquin pocket mouse
OT = *Onychomys torridus*, southern grasshopper mouse
PM = *Peromyscus maniculatus*, deer mouse
RM = *Reithrodontomys megalotus*, western harvest mouse
MM = *Mus musculus*, house mouse

The number of San Joaquin antelope squirrels (*Ammospermophilus nelsoni*) continues to climb across the study area (Table 7). In 1999 and 2000, squirrels were caught most abundantly on treatment plots, but in 2001, squirrels were fairly abundant on all plots.

One exception was section 27, where three times as many squirrels were caught on the grazed treatment as were caught on the ungrazed control (Table 7). We suspect that the lessening of grass cover on the controls because of low rainfall the past two years, along with trails associated with vertebrate survey activities, has opened up the controls to squirrels. It is also possible that squirrels using the controls are transients coming in from the surrounding grazed areas. The radio-telemetry study of squirrels that we will begin in July 2002 should help resolve how the controls are being used.

Table 7. *Number of individual San Joaquin antelope squirrels captured on study plots by year.*

Plot	1997	1998	1999	2000	2001
21C	4	5	2	1	4
21T	9	2	5	4	5
27C	3	8	2	5	13
27T	4	2	15	17	38
29C	5	0	0	1	9
29T	1	2	6	0	10
33C	6	5	7	9	26
33T	5	9	23	19	20
Totals	37	33	60	55	125

Bird Surveys

Five species were found on point counts in 2000: horned larks (*Eremophila alpestris*), morning doves (*Zenaida macroura*), sage sparrows (*Amphispiza belli*), western meadowlarks (*Sturnella neglecta*), and red-winged blackbirds (Table 8). The trend for both the horned lark and mourning dove continues upward, whereas sage sparrows have almost disappeared from the study site and numbers of western meadowlarks are declining (Table 9, Figure 3). The savannah sparrow (*Passersculus sandwichensis*), which was found abundantly in 1998 and 1999, was absent in 2000 and 2001. Horned larks were found only in treatment areas during point count plots in 2001. Other species were detected rarely, and were not clearly related to either the burn or treatment.

Table 8. *Average point count values for bird species at the Lokern study site in 2001.*

Species[1]	21C	21T	27C	27T	29C	29T	33C	33T
HOLA	0	0.75	0	2.25	0	3.25	0	2.25
MODO	0.5	0	0.5	0	0	0	0	0
RWBL	0	0	0	0	0	0	0.25	0
SAGSP	0.25	0	0	0	0	0	0	0
WEME	1.5	0	0.75	0	1.5	0.25	1.25	0

[1]HOLA, Horned Lark; MODO, Mourning Dove; RWBL; Red-winged Blackbird; SAGSP, Sage Sparrow; WEME, Western Meadowlark.

Birds detected in point count plots mainly are breeding in the study area. Birds have also been counted that have been detected flying over point count plots, but could not be considered to be within point count detection area. This category shows species that are making some use of the study area, but may not breed on site. This count shows that a few more species make use of the area than are found on point count plots, especially common ravens (*Corvus corax*, Table 10).

Another census method used in this study to detect birds was to record species found within a 300 X 300 m area beyond point count plots. This method should add larger species of birds to the list because the area of detection is larger than the other two census methods. However, these larger species do not necessarily breed on site, such as the common raven (Table 10). Of special interest is the Le Conte's thrasher (*Toxostoma lecontei*), a species of special concern, which has not been sighted since 1997. It inhabits shrubs, such as saltbush, and the fire in 1997 seems to have eliminated this species from the study area.

Table 9. *Average (standard deviation) point count values for birds by year and for control plots (C), and treatment plots (T).*

1997	1998	1999	2000	2001

Species[1]	C	T	C	T	C	T	C	T	C	T
BRBL	0	0	0.06 (0.13)	0	0	0	0	0	0	0
BUOW	0	0	0	0	0.13 (0.25)	0	0	0	0	0
CORA	0	0	0	0.06 (0.13)	0	0	0	0	0	0
HOLA	0.19 (0.24)	0.06 (0.13)	0.5 (0.68)	2.25 (0.87)	0.31 (0.47)	2.44 (0.94)	0.38 (0.48)	2.63 (0.25)	0	2.13 (1.031)
LOSH	0	0	0	0	0.06 (0.13)	0	0	0	0	0
MODO	0.06 (0.13)	0.06 (0.13)	0.25 (0.35)	0	0.13 (0.14)	0	0.81 (0.56)	0	0.25 (0.289)	0
RWBL	0	0	0.5 (0.58)	0	0	0	0	0	0.063 (0.125)	0
SAGSP	2.38 (1.51)	2.13 (1.16)	1.5 (1.24)	1.69 (1.42)	0.94 (0.80)	0.63 (0.78)	0.5 (0.46)	0	0.063 (0.125)	0
SAVSP*	0	0	0.63 (0.32)	0.19 (0.24)	1.25 (1.31)	1.88 (2.15)	0	0	0	0
TRBL*	0	0	0.06 (0.13)	0	0	0	0	0	0	0
WCSP*	0	0	0.94 (1.09)	0.06 (0.13)	0	0	0	0	0	0
WEME	0.69 (0.31)	1.06 (0.55)	1.31 (0.85)	0.85 (0.72)	2.56 (0.52)	2.19 (0.55)	1.38 (0.52)	0.25 (0.25)	1.25 (0.354)	0.063 (0.125)

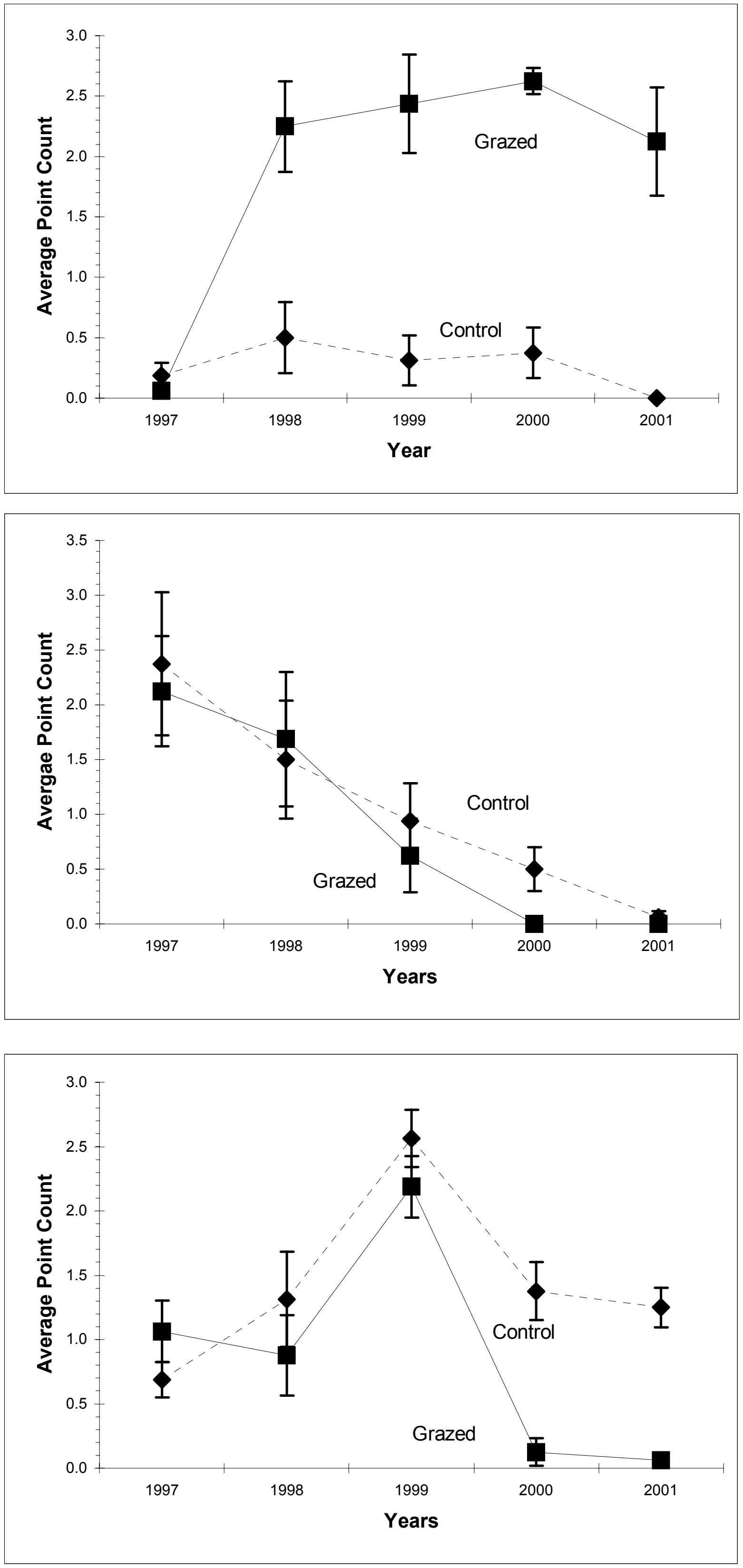
* Breeding unlikely.
[1] BRBL, Brewer's Blackbird; BUOW, Burrowing Owl; CORA, Common Raven; HOLA, Horned Lark; LOSH, Loggerhead Shrike; MODO, Mourning Dove; RWBL, Red-winged Blackbird; SAGSP, Sage Sparrow; TRBL, Tri-colored Blackbird; WCSP, White-crowned Sparrow; WEME, Western Meadowlark.

Table 10. *Number of times a species was detected in 2001 within a 300 X 300 m area (out of a possible 16 per treatments), but not in point count plots. Birds not seen this year have been seen in past years.*

Species	Control	Treatment

American Kestrel	0	0
American Crow*	0	0
Barn Swallow*	1	0
Black-headed Grosbeak*	0	0
Brewer's Blackbird	0	0
Brown-headed Cowbird	0	0
Burrowing Owl	1	0
Cliff Swallow*	0	0
Common Raven	1	3
European Starling*	0	0
Horned Lark	1	1
House Finch	0	0
Killdeer	0	0
Le Conte's Thrasher	0	0
Lesser Nighthawk	0	0
Loggerhead Shrike	1	0
Long-billed Curlew*	0	0
Mourning Dove	1	0
Northern Mockingbird	0	0
Northern Harrier	1	1
Prairie Falcon	0	0
Red-winged Blackbird	1	0
Sage Sparrow	2	0
Sage Thrasher*	0	0
Savannah Sparrow*	1	0
Tricolored Blackbird*	0	0
Unknown Blackbird Species	0	0
Unknown Hummingbird Species	0	0
Western Kingbird	0	0
Western Meadowlark	2	8
White-crowned Sparrow*	0	0

* Breeding in area unlikely


3.0
2.5
2.0
1.5
1.0
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0.0
Average Point Count
Grazed
Control
1997
1998
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3.5
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Average Point Count
Control
Grazed
1997
1998
1999
2000
2001
Years

Figure 3.

Lizard Surveys

The numbers of blunt-nosed leopard lizards (*Gambelia sila*) remain extremely low. Only two adult leopard lizards were found, and both of these were on treatment plots (Table 12). We also found one other adult leopard lizard in May on the grazed portion of section 33 while driving in to census a plot. The number of adults in this portion of the Lokern remains remarkably low. Numbers of leopard lizards southeast of Highway 58 on the Lokern are much higher (Gwynne Corrigan, personal communication). Encouragingly, though, we caught and marked 15 juvenile blunt-nosed leopard lizards on treatment plot 27. The first one of the hatchlings was caught in a pitfall trap in early August. Three others were caught in the following days while conducting censuses for San Joaquin antelope squirrels. One of us (DJG) made additional searches throughout August and September, capturing 11 more individuals. All were caught along the small wash that runs through the front of the plot. Based on sizes of lizards when first captured, we suspect at least two periods of egg laying by lizards. Although we found one female leopard lizard in the area where the young were caught, it is unlikely that this one female was responsible for all 15 hatchlings.

Table 12. *Total number of sightings of adult blunt-nosed leopard lizards during a non-consecutive 10-day survey in May and June each year on the study plots.*

Plot	1997	1998	1999	2000	2001
21C	4	1	1	0	0
21T	2	0	0	0	0
27C	1	0	0	0	0
27T	3	0	2	6	1*
29C	3	0	0	0	0
29T	0	2	1	2	0
33C	0	0	0	0	0
33T	1	0	1	0	1
Totals	14	3	5	8	2

* 15 individual hatchlings and juveniles were found on this plot in August and September.

The only other lizards that have been found on the study area, side-blotched lizards (*Uta stansburiana*) and western whiptail lizards (*Cnemidophorus tigris*), were found even more abundantly this year than in past years (Table 13). Side-blotched lizards were much more abundant on the treatment plots than on controls, except in section 29. The western whiptail also was more abundant in treatment plots than in controls in sections 27 and 33, but was relatively evenly spread across controls and treatments in sections 21 and 29.

Table 13. *Total number of sightings of side-blotched lizards and western whiptails on the study plots during a 10-day survey in May and June each year.*

	Side-blotched Lizards					Western Whiptails				
Plot	1997	1998	1999	2000	2001	1997	1998	1999	2000	2001
21C	3	2	0	8	18	1	7	0	1	7
21T	5	2	1	5	72	1	10	7	3	1
27C	5	2	5	7	33	1	4	5	5	11
27T	3	0	11	21	170	5	16	14	33	73
29C	2	0	1	3	35	2	1	7	5	42
29T	3	2	10	15	33	2	2	4	34	37
33C	1	0	0	0	3	0	1	0	0	0
33T	5	0	0	2	21	1	0	1	1	13
Totals	25	9	28	61	385	13	41	38	82	184

Mean number of grasshoppers counted per day during censuses for lizards increased greatly compared to the past two years, and were similar to the high numbers counted in 1998 (Table 14). Differences in abundances across plots were not related to whether the plot was grazed or not.

Table 14. *Mean number (standard deviation) of grasshoppers counted per day on plots during 10-day surveys for blunt-nosed leopard lizards.*

	Average Number Counted Per Day				
Plot	1997	1998	1999	2000	2001
21C	5.2 (4.85)	611.2 (563.1)	69.4 (68.33)	18.2 (10.50)	156.0 (66.16)
21T	6.4 (6.62)	654.4 (437.9)	77.4 (59.66)	38.6 (8.76)	203.1 (110.1)
27C	4.3 (3.40)	139.6 (50.35)	54.1 (53.98)	23.2 (4.39)	521.3 (129.0)
27T	4.9 (4.70)	192.0 (64.96)	211.2 (189.5)	33.1 (5.17)	239.7 (52.08)
29C	10.6 (5.15)	136.7 (130.9)	329.5 (248.2)	19.2 (5.94)	968.8 (469.0)
29T	11.9 (7.84)	473.8 (475.8)	39.1 (15.44)	41.8 (8.64)	466.6 (133.9)
33C	11.2 (12.8)	55.3 (53.11)	27.1 (12.21)	5.6 (4.01)	139.9 (85.75)
33T	12.7 (11.1)	131.0 (114.6)	65.6 (36.28)	16.5 (9.22)	166.3 (64.00)

Invertebrate Studies

Terrestrial invertebrates were sampled with arrays of ten pitfalls on each of the eight plots, as in the past five years (see Annual Report for 1997). These traps were monitored during the same six days that mammals were trapped in July/August, also as done before. The average number of invertebrates found per day in pitfall traps increased compared to the past two years (Table 15). There was a difference among plots (ANOVA, $F_{7, 47}$ = 4.08, P = 0.002), with plot 21T having higher numbers of invertebrates than all other plots, although most of that number was due to ants.

Table 15. *Average number of invertebrates/pitfall/day on study plots by year. Numbers in parentheses are averages without including ants.*

Plots	1997	1998	1999	2000	2001
21C	3.9 (3.3)	11.1 (6.1)	1.3	1.5	2.4 (1.7)
21T	4.2 (2.7)	15.0 (11.7)	4.7	1.4	6.7 (0.9)
27C	4.2 (3.0)	24.7 (4.2)	2.9	1.4	1.6 (1.3)
27T	3.9 (2.9)	9.4 (2.2)	1.3	0.8	2.7 (0.5)
29C	5.0 (3.5)	5.8 (3.7)	1.5	2.7	4.5 (2.0)
29T	12.9 (5.1)	7.4 (3.9)	1.8	1.6	1.3 (1.0)
33C	4.5 (4.3)	5.8 (5.0)	1.4	3.6	3.2 (1.9)

33T	4.4 (3.0)	21.8 (9.5)	1.3	2.0	4.2 (1.0)

Twenty San Joaquin pocket mice were caught in pitfall traps in all plots except 29C and 33C. In addition, one southern grasshopper mouse was caught in a pitfall trap on plot 27T. As mentioned previously, one hatchling blunt-nosed leopard lizard was caught in a pitfall trap on plot 27T. Sixty-nine side-blotched lizards, and 22 western whiptails were caught in pitfall traps, and both were generally caught more abundantly on treatment plots than on control plots.

As we have said in past reports, there still are several reasons why the capture results for terrestrial vertebrates should be examined with caution, and conclusions drawn sparingly. Although the fire in 1997 no longer affects herbaceous ground cover, rainfall varies widely from year to year, which greatly affects numbers of annual plants and animals. Numbers of many focus animals are relatively high now, but we believe that we will not see the suspected benefits of grazing until there is another wet cycle. The controls need to thicken up with grasses, which occurred throughout the San Joaquin in the 1990s, to really test what effect grazing has on the species at risk that we are studying.

Additional Studies

We had planned to start radio-telemetry studies of blunt-nosed leopard lizards and San Joaquin antelope squirrels in 2001, but we were not able to hire a person in time to initiate these studies. We will start these studies in May 2001.

Funding

We have raised nearly $270,000 in cash for this research since 1997. This figure does not include nearly an equal amount of in-kind contributions from cooperators. It costs about $65,000 in cash per year (see below) to maintain the study site and carry out the sampling, which does not include on-going commitments for in-kind support. At present, we have funds to cover costs through 2002. We do not yet have sufficient funds for 2003 and beyond. As in the past, we will be relying on contributions from all of the participants to meet future funding needs.

Yearly Expenditures (does not include in-kind contributions):

Item	Cash Amount
Calif. State Bakersfield Foundation	$35,000
End. Species Recovery Program; Plant Studies	$15,000
WERC, Riverside	$7,000
Vehicle	$3,000
Travel	$3,000
Field Supplies/Repairs	$2,000
Total	$65,000

Cooperators

The Bureau of Land Management (BLM) has been the principal "client" of the Lokern Project, and their needs have driven much of the planning and design of the study. Numerous other agencies and organizations have realized that the research has broad applicability to their lands and interests, and they have participated in various aspects of the project.

In addition to WERC and BLM, the main supporters and participants in the Lokern Project include the Endangered Species Recovery Program (ESRP); the US Fish and Wildlife Service (USFWS); the California Department of Fish and Game (CDFG); the California State University, Bakersfield (CSUB); the Center for Natural Lands Management (CNLM); The National Fish and Wildlife Foundation (NFWF); the California Department of Water Resources (CDWR); Chevron Oil Company; ARCO Oil Company; Occidental of Elk Hills, Inc.; Safety Kleen Environmental Services; and Eureka Livestock Company.

The following investigators have been responsible for implementing the different aspects of the Lokern research. These scientists have also contributed summaries of data for this annual report:

Dr. William Boarman, Wildlife Biologist, Western Ecological Research Center, US Geological Survey, San Diego, CA 92123. Phone 858/637-6880. William_Boarman@usgs.gov. ***Project coordination.***

Dr. Ellen Cypher, Research Ecologist, Endangered Species Recovery Program, PO Box 9622, Bakersfield, CA 93389-9622. Phone 661/398-2201. Ecypher@tscn.net. ***Vegetation and rare plant studies.***

Mr. Sam Fitton, Wildlife Biologist, Bureau of Land Management, 20 Hamilton Court, Hollister, CA 95023. Phone 831/830-5000. Sfitton@ca.blm.gov. ***Bird studies.***

Dr. David Germano, Associate Professor, Department of Biology, California State University, Bakersfield, CA 93311-1099. Phone 661/589-7846. Dgermano@csub.edu. ***Lizard, mammal, and invertebrate studies. Report coordination and preparation.***

Dr. Galen Rathbun, Research Biologist, Department of Ornithology and Mammalogy, California Academy of Science, Golden Gate Park, San Francisco, c/o P.O. Box 202, Cambria, CA 93428. Phone 805/927-3893. Grathbun@calacademy.org. ***Mammal and invertebrate studies.***

Mr. Larry Saslaw, Wildlife Biologist, Bureau of Land Management, 3801 Pegasus Drive, Bakersfield, CA 93308. Phone 661/391-6086. Lawrence_Saslaw@ca.blm.gov. ***Plot and cattle studies.***

In addition, the following people and agencies assisted with field work: Kathy Sharum, Shane Barrow, Aaron Fitch, and Jason Hlebakos, BLM; Greg Warrick, Center for Natural Lands Management; Lisa Lyren, Greta Turschak, and Eric York USGS; Vida Germano, Damien Germano, Alex Brown, and Michael Zaroutski, CSU Bakersfield Foundation. We greatly appreciated the assistance from the following volunteers that participated in fieldwork: William Vanherweg, Bob Brown, Rochelle Germano, Melanie Germano, and Joel Saslaw. Funding for Dr. Cypher was provided by ESRP and a LEGACI grant from the Great Valley Center.

Publications

We published two articles in 2001 based on work done for this study. Following are the first pages of both. If you want to receive a reprint of either, please email or write to David Germano.