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 fourth year of plant and animal censuses on the Lokern Natural Area study site. The treatment plots have received a third year of grazing by cattle. We finally have had a significant effect on grass cover on treatment plots, and actually went below the threshold of herbaceous plant biomass on three of the four sections. Plant and bird studies continue with no significant effect of treatment visible at this early stage of the research. Lizard numbers continue to be extremely low throughout the study area. Nocturnal rodents were lower overall than in 1999, but are showing up on all the treatment plots. It still is too early to determine if grazing treatment is having a consistent effect. San Joaquin antelope squirrels numbers remain fairly high, and generally were greater on treatment plots than controls. We will continue to gather information on the year-to-year variation in rainfall, plot condition, and relative abundance of plants and animals. As population numbers of focused species increase across the study area and as the grazing treatment increases with time, it will become possible to develop a better understanding of grazing effects. If this study is to succeed it will take 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[1]Authors of this unpublished report are: Germano, D. J., E. Cypher, S. Fitton, L. R. Saslaw, and G. B. Rathbun.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.

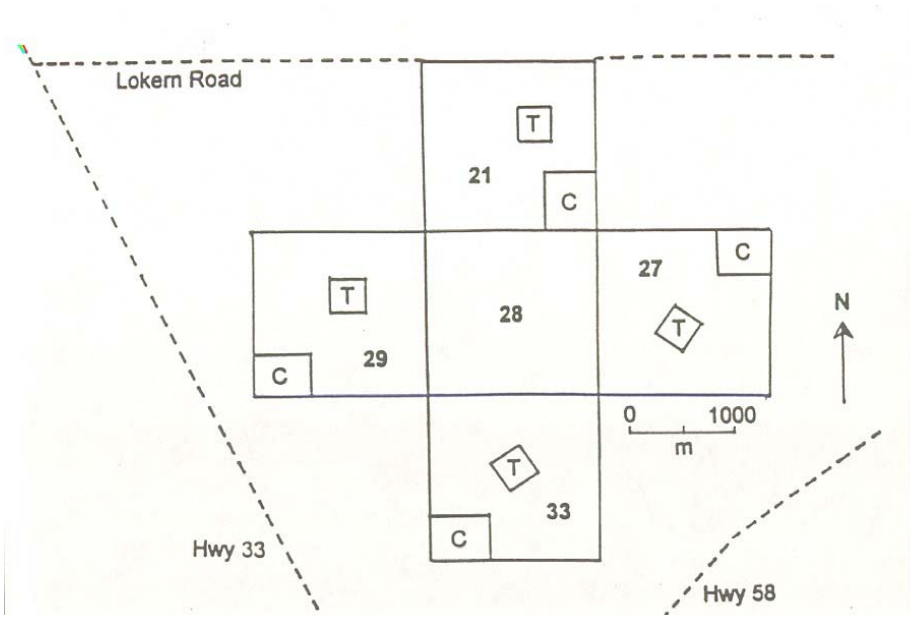

Figure 1. Lokern Study Area showing design of experimental and control plots.

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 (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 and 2000, a similar schedule was followed.

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.

Still the most obvious and predictable effect of the fires was the death of virtually all the saltbush (*Atriplex* spp.) on the study site (See 1998 Annual Report). By the 2000 field season, there still were few live saltbushes of large size in the fenced study area. However, seedling saltbushes were beginning to show up throughout much of the site, but they are still relatively inconspicuous.

The effects of the fire in 1997 are lessening, but some effect still remains. The average of 30 samples of residual dry matter (RDM) from each of the four control plots (ungrazed but burned) in August 2000 was 2,524 lbs/acre, lower than the average of 3,216 lbs/acre found last year, but about the same as the 2,439 lbs/acre recorded on the controls in 1998. The RDM in 2000 on the controls is higher, though, than the 2,102 lbs/acre average from 30 samples taken from an ungrazed and unburned area immediately adjacent to and outside of the study area.

Rainfall: In November 1998, we put out two rain gauges at opposite ends of the study site. Both gauges were on the ground and not functioning during a November rain event that produced 4.3 mm at Buttonwillow (about 11 km, or 7 mi, from the study site). However, based on these gauges, we recorded 91.4 mm (3.60 inches) and 85.9 mm (3.38 inches) total rainfall for the year (until 30 June 2000). This is the lowest amount of yearly rainfall in the four years of the study, and also much less than the 20-year average of 168.9 mm (6.65 inches) at Buttonwillow. Rainfall at the Buttonwillow station in 1999/2000 was 123.4 mm (4.86 inches), also less than the 161.0 mm (6.34 inches) recorded at Buttonwillow in 1998/1999 or the 412.5 mm (16.24 inches) recorded in 1997/1998. In 1999/2000, one bout of rain fell in early November, little rain fell from mid November to late January, and then small amounts of rain fell from late January through mid April.

Grazing Effects on Plots: For the first time of this study, the target RDM level of 500 lbs/acre was reached, and in fact, three of the four plots had RDM levels substantially lower than the target (Table 1). We finally have reached a significant grazing effect. The average stocking rate in 2000 was 0.35 AUM (Animal Units/Month) per acre on the four treatment plots, the lowest in three years. The cattle were fairly equally distributed on the four treatment plots to achieve similar RDM levels, and this was fairly successful (Table 1). We found significant differences between treatment and control for three measures of summer herbaceous vegetation on the plots: RDM, height of vegetation, and cover (6 classes, lowest = least 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, $F_{7, 238} = 34.61$, $P < 0.001$). There are significant differences among plots for summer cover (ANOVA, $F_{7, 238} = 11.46$, $P < 0.001$), but only three of the treatments have less summer cover than the controls (Table 1).

Table 1. *Cattle stocking rates and vegetation characteristics of study plots in 2000. 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	----	3292	37.2	94.0
21T	158	920	10.3	78.0
27C	----	2046	32.3	89.0
27T	293	415	12.5	59.2
29C	----	2156	30.7	92.0
29T	165	202	9.9	62.5
33C	----	2709	30.4	99.5
33T	192	454	11.5	91.5

* 1 AUM = one cow weighing 1000 lbs for one month. Stocking rate is for the entire 2000 grazing season. Rate adjusted by 0.6 because of use of light heffers and yearlings.

Vegetation Surveys: We recorded data from 28 March to 6 April 2000 on reproductive density (defined as the total number of buds, flowers, and fruits per meter^2) of Kern mallow (*Eremalche parryi* ssp. *kernensis*) on all 80 permanent sampling plots. We also determined the cover and composition of vegetation on all 32 permanent transects. Data were pooled for each study plot, and means for grazed and ungrazed plots were compared statistically using the paired-sample *t*-test.

Reproductive density of Kern mallow (Table 2) did not differ statistically between the ungrazed and grazed plots in Spring 2000 (t = -1.10, 3 df, P = 0.35). Over all plots, reproductive density of Kern mallow in 2000 was an order of magnitude lower than it had been in 1999 (X = 0.7) and three orders of magnitude lower than it had been in 1998 (X = 38.4). However, general trends were similar among years, with no apparent effect of grazing on the abundance of Kern mallow.

Herbaceous cover and plant species richness were somewhat lower in 2000 (Table 3) than in 1999, when herbaceous cover had averaged 88.2% and the number of plant species per belt had average 13.7. Microbiotic crust cover remained similar between years. For the first time since the 1997 fire, shrubs constituted measurable cover in 2000 (Table 3). The only shrub species hit on transects was spiny saltbush (*Atriplex spinifera*). In 2000, ungrazed plots had significantly more herbaceous plant cover than did grazed plots (t = 5.77, 3 df, P = 0.01), but the two treatments did not differ significantly with regard to other vegetation characteristics.

Table 2. *Reproductive density (mean ± SE, n_i = 10) of Kern mallow (*Eremalche parryi *ssp.* kernensis*) on Lokern study plots, Spring 2000.*

Study Plot/Treatment	Reproductive Density
21C	0
21T	0.1 ± 0.3
27C	0
27T	0
29C	0
29T	1.3 ± 4.1
33C	0
33T	0
Overall	0.04 ± 0.03

Table 3. *Vegetation characteristics (mean ± SE, n_i = 4) on Lokern study plots, Spring 2000.*

Study Plot/ Treatment	Herbaceous cover (%)	Microbiotic crust cover (%)	Shrub cover (%)	Number of species on belt
21C	93.3 ± 2.3	0	0.8 ± 0.3	11.3 ± 0.9
21T	85.5 ± 3.5	0.5 ± 0.3	0	11.3 ± 1.2
27C	95.3 ± 2.4	0.3 ± 0.3	0	8.8 ± 0.9
27T	79.5 ± 3.1	1.8 ± 1.0	0	10.5 ± 0.6
29C	82.5 ± 1.9	1.8 ± 1.4	0.5 ± 0.5	9.8 ± 1.1
29T	74.3 ± 5.7	0.3 ± 0.3	0	10.0 ± 0.8
33C	77.8 ± 3.4	0	0	7.8 ± 0.9
33T	67.3 ± 2.3	0	0	5.3 ± 0.3
Overall	81.9 ± 1.9	0.6 ± 0.2	0.2 ± 0.1	9.3 ± 0.4

Despite the decrease in overall herbaceous cover between 1999 and 2000, absolute cover of red brome (*Bromus madritensis* ssp. *rubens*) and red-stemmed filaree (*Erodium* *cicutarium*) increased slightly (Table 4) from 1999 levels of 57.8% and 20.2%, respectively. The most notable change was in cover of red-stemmed filaree on ungrazed plots, which more than doubled from 9.9% in 1999 to 20.8% in 2000; its cover remained similar on grazed plots. In 2000, overall cover of annual fescue (*Vulpia* spp.) decreased slightly to 23.7% (from 25.9% in 1999), and overall cover of Arabian grass (*Schismus arabicus*) decreased by an order of magnitude (from 2.7% in 1999 to 0.6% in 2000). Red brome had significantly greater (t = 8.25, 3 df, P < 0.01) absolute cover in ungrazed plots (75.3%) than in grazed plots (44.5%) during 2000, as in the previous year. Cover of the other common plant species did not differ statistically between grazed and ungrazed plots in 2000. Red brome was the sole dominant species on 14 out of 16 (87.5%) ungrazed plots but dominated only on 5 of 16 (31.3%) grazed plots in 2000. The other two (12.5%) ungrazed plots were co-dominated by annual fescue (*Vulpia* spp.). Annual fescues could not be differentiated to species in 2000 because the plants did not flower or set seed. Of the remaining 11 grazed plots, red brome co-dominated with red-stemmed filaree on 5 (31.3%), co-dominated with annual fescue on 1 (6.3%), and all three species co-dominated on 5 (31.3%) plots.

The low rainfall undoubtedly was responsible for the low reproductive density of Kern mallow during Spring 2000, the lack of flowering in annual fescues, and the reduced number of species observed on transects. The reproductive density and the overall abundance of Kern mallow were so low in 2000 that the presence of Kern mallow on some grazed plots and its absence on ungrazed plots cannot be attributed to any grazing effect, especially because the mean reproductive density did not differ statistically. However, significantly lower cover of red brome in grazed plots compared to ungrazed plots during both 1999 and 2000 suggests that grazing was responsible for the observed difference in that species. Grazing also may be inhibiting regrowth of shrubs, but additional years of data will be necessary to draw reliable conclusions. The confounding effects of rainfall necessitate a long-term study of 5 to 10 years to reveal trends and to determine which responses are due to grazing.

Table 4. *Absolute cover of dominant species (mean ± SE, n_i = 4) on Lokern study plots, Spring 2000.*

Study Plot/ Treatment	Bromus madritensis ssp. rubens	Erodium cicutarium	Schismus arabicus	Vulpia species*
21C	87.3 ± 2.9	23.8 ± 3.9	0	16.5 ± 3.2
21T	48.3 ± 4.4	44.0 ± 3.6	0.5 ± 0.5	30.8 ± 1.4
27C	78.5 ± 3.9	34.8 ± 1.5	0.8 ± 0.5	41.3 ± 7.9
27T	51.3 ± 3.3	28.0 ± 3.1	2.8 ± 1.6	25.8 ± 5.0
29C	78.8 ± 2.5	9.3 ± 1.4	0	0.5 ± 0.3
29T	44.3 ± 4.9	28.3 ± 4.1	0.8 ± 0.5	25.0 ± 6.6
33C	56.5 ± 4.1	15.5 ± 6.8	0	24.8 ± 8.8
33T	34.3 ± 1.5	27.5 ± 1.7	0	25.3 ± 3.0
Overall	59.9 ± 3.4	26.4 ± 2.1	0.6 ± 0.3	23.7 ± 2.6

* *Vulpia* could not be differentiated to species during 2000, and thus data may represent a combination of *Vulpia myuros, V. microstachys*, and *V. bromoides.*

As in past years, the 2000 vegetation results are preliminary and must not be construed as representative of grazing effects. Data collection in future years will reveal whether there are long-term trends in Kern mallow abundance or vegetation relative to grazing.

Mammal Surveys: Numbers of nocturnal mammals decreased in five of the eight plots in 2000 compared to 1999. We caught 181 individual rodents (Table 5) compared to 271 in 1999. However, these numbers still are much higher than the 3 rodents caught in 1997 and the 43 caught in 1998 (see 1997 and 1998 annual reports). As in 1999, most rodents captured were short-nosed kangaroo rats (*Dipodomys nitratoides brevinasus*) and they were now caught in all of the treatment plots. With the exception of plot 27C, short-nosed kangaroo rats were virtually absent from control plots (Table 5). Short-nosed kangaroo rats continue to be trapped abundantly on both plots of section 27.

Giant kangaroo rats (*D. ingens*) were trapped on plot 29T (Table 5) for the first time in the study area since 1998, when one was caught on plot 33T. The few that we have caught have only been on treatment plots, and we also found several other locations of giant kangaroo rat activity this year off plots in areas grazed by cattle. Populations of giant kangaroo rats have been increasing in the past year on a permanent study plot approximately 3 km north of section 21 (Germano and Saslaw, unpublished data). Heermann's kangaroo rats (*D. heermanni*) were only caught on Plot 29T (Table 5).

Various species of mice declined greatly from captures in 1999, particularly San Joaquin pocket mice (*Perognathus i. inornatus*) and deer mice (*Peromyscus maniculatus*).

As we have stated in past reports, we still are not at the point that we can carry out any meaningful statistical tests or draw any meaningful conclusions about nocturnal rodent numbers because of the low numbers of rodents. However, numbers of rodents are much greater than when we first began. With one exception, treatment plots support more nocturnal rodents than control plots. Also we are encouraged that giant kangaroo rats may be spreading on the study site. It may still require several more years of trapping to determine the effects of grazing on nocturnal rodents on the Lokern.

Table 5. *Numbers of nocturnal mammals captured on study plots in 2000. 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	0	1	0	3	0	0	0	0	4
21T	0	3	0	0	0	0	0	0	3
27C	0	62	0	1	0	2	0	0	65
27T	0	49	0	2	0	0	0	0	51
29C	8	0	0	2	2	0	0	0	12
29T	0	18	2	0	0	0	0	0	20
33C	0	0	0	0	0	0	0	0	0
33T	0	26	0	0	0	0	0	0	26
Total	8	159	2	8	2	2	0	0	181

*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*) held fairly steady in 2000 compared to 1999. In 1997 and 1998, antelope squirrels were as abundant on the control plots as the treatment plots (perhaps an effect of fire disturbance), but squirrels were captured in substantially higher numbers on treatment plots than on controls in 1999 and 2000 (Table 6). A surprising development this year was the lack of squirrels on plot 29T. Squirrels were seen in the area, but none were trapped. Except for plot 33C, control plots support almost no squirrels, and those caught may not be resident. All five squirrels caught on plot 27C were young of the year that moved great distances between captures and likely came into the plot along the dirt road. None of these individuals had been found on this plot before.

Table 6. *Number of individual San Joaquin antelope squirrels captured on study plots by year.*

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

Bird Studies: Only four species were found on point counts in 2000: horned larks (*Eremophila alpestris*), morning doves (*Zenaida macroura*), sage sparrows (*Amphispiza belli*), and western meadowlarks (*Sturnella neglecta*), which is the lowest number seen on plots and is the same as in 1997 (Table 7). 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 8). The savannah sparrow (*Passersculus sandwichensis*), which was found abundantly in 1998 and 1999, was absent in 2000. Horned larks were found substantially more often on point count plots in 2000 in treatment areas. Other species were detected rarely, and were not clearly related to either the burn or treatment.

Table 7. *Average point count values for each bird species for 2000*.

Species[1]	21C	21T	27C	27T	29C	29T	33C	33T
HOLA	0.5	2.25	0	2.75	0	2.75	1	2.75
MODO	1	0	0	0	1	0	1.25	0
SAGSP	1	0	0.75	0	0.25	0	0	0
WEME	1.5	0.5	0.75	0	1.25	0	2	0

[1]HOLA, Horned Lark; MODO, Mourning Dove; 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 9).

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 8. *Average (standard deviation) point count values for birds by year and plot*.

	1997		1998		1999		2000	
Species[1]	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment

BRBL	0	0	0.06 (0.13)	0	0	0	0	0
BUOW	0	0	0	0	0.13 (0.25)	0	0	0
CORA	0	0	0	0.06 (0.13)	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)
LOSH	0	0	0	0	0.06 (0.13)	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
RWBL	0	0	0.5 (0.58)	0	0	0	0	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
SAVSP*	0	0	0.63 (0.32)	0.19 (0.24)	1.25 (1.31)	1.88 (2.15)	0	0
TRBL*	0	0	0.06 (0.13)	0	0	0	0	0
WCSP*	0	0	0.94 (1.09)	0.06 (0.13)	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)

* 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, Tricolored Blackbird; WCSP, White-crowned Sparrow; WEME, Western Meadowlark.

Table 9. *Total counts of birds observed flying over point count plots.*

	1997		1998		1999		2000	
Species	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment

Brewer's Blackbird	0	0	0	2	0	2	0	0
Brown-headed Cowbird	0	0	4	0	0	0	0	0
Cliff Swallow	0	0	2	2	0	1	3	4
Common Raven	1	10	0	10	6	1	10	10
European Starling	0	2	3	1	0	0	0	0
Horned Lark	4	5	0	1	0	0	1	0
House Finch	0	0	0	0	0	0	3	1
Loggerhead Shrike	1	0	1	0	0	0	0	0
Long-billed Curlew*	0	0	0	1	0	0	0	0
Mourning Dove	1	3	3	0	0	2	4	0
Northern Mockingbird	1	0	0	0	0	0	0	0
Northern Rough-winged Swallow	0	0	2	0	0	0	0	0
Red-winged Blackbird	5	0	3	0	0	0	0	2
Sage Sparrow	1	0	0	0	0	0	0	0
Tricolored Blackbird*	0	0	0	9	0	0	0	0
Unknown Blackbird Species	0	0	0	0	0	4	0	0
Western Meadowlark	0	1	0	0	1	1	0	0
White-crowned Sparrow*	0	0	0	1	0	0	0	0

* Breeding unlikely for Tricolored Blackbird, and extremely doubtful for Long-billed Curlew and White-crowned Sparrow.

Table 10. *Number of times a species was detected within a 300 X 300 m area (out of a possible 16 per treatment per year), but not in point count plots.*

Species	1997		1998		1999		2000	
	Control	Treatment	Control	Treatment	Control	Treatment	Control	Treatment
American Kestrel	1	0	0	0	0	0	1	0

American Crow*	0	0	0	0	1	0	2	0
Black-headed Grosbeak*	0	1	0	0	0	0	0	0
Brewer's Blackbird	0	0	1	1	0	1	0	0
Brown-headed Cowbird	0	0	0	1	0	0	0	0
Burrowing Owl	0	1	0	0	0	0	0	2
Cliff Swallow	1	2	0	1	0	0	3	0
Common Raven	9	6	6	6	6	10	4	6
European Starling	0	0	0	1	0	0	0	0
Horned Lark	4	3	3	0	4	3	0	0
House Finch	0	0	0	0	0	0	0	1
Killdeer	0	0	0	1	0	0	0	0
Le Conte's Thrasher	6	6	0	0	0	0	0	0
Lesser Nighthawk	0	0	0	1	0	0	0	0
Loggerhead Shrike	7	7	1	1	5	1	1	0
Long-billed Curlew*	0	0	1	4	1	1	1	0
Mourning Dove	6	6	3	2	3	1	2	0
Northern Mockingbird	3	0	1	1	0	0	0	0
Northern Harrier	0	0	0	1	0	0	0	0
Prairie Falcon	0	0	0	0	1	0	1	0
Red-winged Blackbird	0	0	1	0	0	0	0	0
Sage Sparrow	1	1	1	1	1	0	3	0
Sage Thrasher*	0	1	0	0	0	0	0	0
Savannah Sparrow*	0	0	0	0	0	1	0	0
Tricolored Blackbird*	0	0	1	0	0	1	0	0
Unknown Blackbird Sp.	0	0	0	0	0	1	0	1
Unk. Hummingbird Sp.	1	0	0	0	0	0	0	0
Western Kingbird	0	0	1	1	0	0	0	0
Western Meadowlark	7	6	6	6	2	5	6	14
White-crowned Sparrow*	0	0	0	0	1	0	0	0

* Breeding unlikely for Tricolored Blackbird, and extremely doubtful for Long-billed Curlew and White-crowned Sparrow.

Lizard Surveys: The numbers of lizards, in general, are increasing, especially on two of the treatment plots (Table 11). However, numbers of blunt-nosed leopard lizards (*Gambelia sila*) remain low. There are increasing signs for optimism, though, as several other leopard lizards were found in other parts of the study area. We also found a hatchling blunt-nosed leopard lizard (male, snout-vent length = 51 mm, mass = 3.5 g), the first seen in the four years of the study. The hatchling was found 8 August on Plot 29T during the rodent trapping sessions. Two other leopard lizards were seen on this plot in the early summer (Table 11), and other leopard lizards have been seen in this section previously. We also found two leopard lizards on Plot 27T, one male and one female, and these were found two more times each on the plot (unlike other plots, leopard lizards are permanently marked on this plot). When first captured, the adult female was carrying 3 eggs. Except for one lizard seen in 1998 and 1999 on Plot 21C, no leopard lizards have been seen on control plots since 1997 (just before the wildfire). Side-blotched lizards (*Uta stansburiana*) and western whiptail lizards (*Cnemidophorus tigris*) were found more abundantly on most plots during censuses this year than in past years. Few lizards have been seen in either plot on section 33 in any year.

Table 11. *Number of lizards counted on the study plots by year.*

	Species* Numbers by Year											
	BNLL				SBL				WWL			
Plot	1997	1998	1999	2000	1997	1998	1999	2000	1997	1998	1999	2000
21C	4	1	1	0	3	2	0	8	1	7	0	1
21T	2	0	0	0	5	2	1	5	1	10	7	3
27C	1	0	0	0	5	2	5	7	1	4	5	5
27T	3	0	2	6	3	0	11	21	5	16	14	33
29C	3	0	0	0	2	0	1	3	2	1	7	5
29T	0	2	1	2	3	2	10	15	2	2	4	34
33C	0	0	0	0	1	0	0	0	0	1	0	0
33T	1	0	1	0	5	0	0	2	1	0	1	1
Totals	14	3	5	8	25	9	28	61	13	41	38	82

* BNLL = Blunt-nosed leopard lizard, *Gambelia sila*
SBL = Side-blotched lizard, *Uta stansburiana*
WWL = Western whiptail lizard, *Cnemidophorus tigris*

Mean number of grasshoppers counted per day during censuses for lizards continued to decline from a high in 1998 (Table 12), although means were not as low as during 1997 (which was just after the wildfire). Even though numbers are lower than either 1998 or 1999, mean numbers are greater on the grazed (treatment) plots than on the ungrazed control plots (Table 12).

Table 12. *Grasshopper numbers (± standard deviation) counted on plots during surveys for blunt-nosed leopard lizards.*

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

<u>Invertebrate Studies</u>: Terrestrial invertebrates were sampled with arrays of ten pitfalls on each of the eight plots, as in the past three 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 remained low compared to 1998, similar to what we found in 1999 (Table 13). There was a difference among plots (ANOVA, $F_{7, 47} = 6.46$, $P < 0.001$), with plot 33C having higher numbers of invertebrates than all other plots.

Table 13. *Average number of invertebrates/pitfall/day on study plots by year. Numbers in parentheses from 1997 and 1998 are averages without including ants.*

Plots	1997	1998	1999	2000
21C	3.9 (3.3)	11.1 (6.1)	1.3	1.5
21T	4.2 (2.7)	15.0 (11.7)	4.7	1.4
27C	4.2 (3.0)	24.7 (4.2)	2.9	1.4

27T	3.9 (2.9)	9.4 (2.2)	1.3	0.8
29C	5.0 (3.5)	5.8 (3.7)	1.5	2.7
29T	12.9 (5.1)	7.4 (3.9)	1.8	1.6
33C	4.5 (4.3)	5.8 (5.0)	1.4	3.6
33T	4.4 (3.0)	21.8 (9.5)	1.3	2.0

No rodents were captured in pitfall traps in 2000, but we caught more lizards than in preceding years. In 2000, we caught 26 side-blotched lizards and 8 western whiptails. In 1997, we caught one side-blotched lizard and five whiptail lizards, while in 1998 the pitfalls yielded one San Joaquin pocket mouse, 10 side-blotched lizards, and 13 whiptails. In 1999, we found 19 San Joaquin pocket mice, 3 deer mice, 4 side-blotched lizards, and 8 whiptails. In general, more lizards were caught on treatment plots than on control plots.

There are several reasons why the capture results for terrestrial vertebrates should be examined with caution, and conclusions drawn sparingly this early in the study. First, it will take another year or two for the major effects of the fires on RDM to disappear on the control plots. Secondly, because of relatively low reproductive rates there is an inevitable lag time for these populations to respond to environmental changes – including grazing. Thirdly, the populations certainly respond to more environmental variables than just grazing, and it will require several years of monitoring relative numbers in the different plots to begin to understand these factors.

Publications

Germano, D. J., G. B. Rathbun, and L. R. Saslaw. 2001. Managing exotic grasses and conserving declining species. Wildlife Society Bulletin: In Press.

Abstract: The southern San Joaquin Valley, as with much of western North America, has been invaded by exotic plant species during the past 100-200 years. The herbaceous cover of these introduced grasses and forbs often creates an impenetrable thicket for small ground-dwelling vertebrates. Contrary to some earlier descriptions of upland habitat of the southern and western San Joaquin Valley as perennial grasslands, recent evidence suggests that most of this area was a desert vegetated by saltbush scrub with sparse cover of native annual grasses and forbs. Many of the small vertebrates that evolved in these habitats, some of which are listed as threatened or endangered, are desert-adapted. These species evolved in sparsely-vegetated habitats and rely on open ground to forage and avoid predation. Preliminary research indicates that populations of giant kangaroo rats (*Dipodomys ingens*), San Joaquin kangaroo rats (*D. nitratoides*), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), and blunt-nosed leopard lizards

(*Gambelia sila*), all listed as threatened or endangered, are affected negatively by thick herbaceous cover. This cover also may affect several listed plant species adversely. Removing anthropogenic disturbances does not reduce or eliminate these exotic plants. Fire is effective in reducing herbaceous cover, but kills native saltbush and often is costly to implement or control. Although livestock may originally have contributed to habitat destruction and the introduction of exotic plants, we believe that in some years, moderate to heavy grazing by livestock is the best way to decrease the heavy cover created by these exotics. Recent decisions to decrease or eliminate livestock grazing on conservation lands in the absence of definitive studies of grazing in these habitats may lead to further declines of native species and possible local extinction of some listed plants and animals.

Germano, D. J. 2001. Geographic note. *Salvadora hexalepis*. Herpetological Review: In Press.

This paper concerns the finding of only the second western patch-nosed snake (Salvadora hexalepis) on the west side of the San Joaquin Valley. The snake was captured by Kathy Sharum and Rochelle Germano on plot 29T. It turns out that this location is less than 2 km from where the other record is located.

Additional Studies

We plan to expand our data gathering by starting radiotelemetry studies of blunt-nosed leopard lizards and San Joaquin antelope squirrels. Radiotelemety will help us to more precisely determine the effects of cattle grazing on these species.

Funding

We successfully raised nearly $200,000 in cash to prepare the study site for the research, and to implement plant and animal sampling in 1997-2001. 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 2001. We do not yet have sufficient funds for 2002 and beyond. As in the past, we will be relying on contributions from all of the participants to meet future funding needs.

Yearly Budget (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 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. Doug Barnum, Research Biologist, Kern Field Station, Western Ecological Research Center, US Geological Survey, Delano, CA 93216-0670. Phone 661/725-1958. Doug_Barnum@usgs.gov. ***Plot studies, Project coordination.***

Dr. William Boarman, Wildlife Biologist, Riverside Field Station, Western Ecological Research Center, US Geological Survey, Riverside, CA 92507. Phone 661/725-1958. 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@csubak.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: John Moule and Kathy Sharum, BLM; Scott Blackburn, Center for Natural Lands Management; Michelle Morton and Martin Potter, CDFG; Vida Germano, Damien Germano, and Miles Georgi, CSU Bakersfield Foundation; Dan Rosenberg, JB?, EG?, Oregon State University. We greatly appreciated the assistance from the following volunteers that participated in field work: Alex 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. Mr. Moule was funded by a National Fish and Wildlife Foundation grant to BLM.