

The Effects of Habitat Modifications on
Utah Prairie Dog (*Cynomys parvidens*)
Density, Survival, and Reproduction
in an Established Colony

by

James W. Mackley

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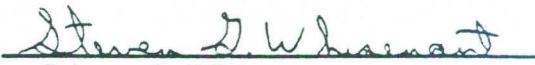
Department of Botany and Range Science

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ABSTRACT

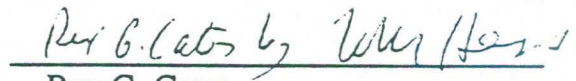
Utah prairie dog (*Cynomys parvidens* Allen) life history data were collected from 1985 to 1987 in Johns Valley, Garfield County, Utah as part of a study to evaluate the feasibility of increasing Utah prairie dog populations by modifying the habitat. Habitat treatments evaluated were: applications of 2.2 kg/ha 2,4-D for two treatments, one of which was followed by reseeding, and a mechanical treatment followed by reseeding. Response variables were: prairie dog density, litter sizes, weight gains, subcutaneous fat, forage available, shrub density and cover, and forage preference. Treatments had no significant effect on response variables. The adult sex ratio averaged 1.8 females per male. An average of 73% of all prairie dogs were juveniles in 1986. Female survival rates were 33% for juveniles, and 31% for the same cohort the second year. At least 5% of the adult females survived at least 3 years. Average litter sizes of emergent prairie dogs were 3.6 juveniles per female. An average of 97% of the adult females were in breeding condition each year. Prairie dogs migrated an average of 0.56 km per migration event.

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ABSTRACT

Utah prairie dogs (*Cynomys parvidens* Allen) are classified by the U.S. Fish and Wildlife Service as being threatened with extinction. Utah prairie dog life history data were collected from 1985 to 1987 in Garfield County, Utah as part of a study to evaluate the feasibility of increasing Utah prairie dog population densities with habitat modifications. Utah prairie dog density, litter sizes, weight gains, subcutaneous fat thickness, and their habitat's shrub density, shrub cover, and forage availability were measured for three seasons to evaluate their response to habitat modification treatments. Three 2.5 ha plots were mechanically shredded, and six plots were sprayed with 2.2 kg/ha 2,4-D, and three plots were untreated. The mechanically shredded plots, and three of the 2,4-D sprayed plots were later reseeded. The treatments had no significant effect on the response variables. However, there was a trend toward increases in all response variables following the treatment which mechanically shredded the woody vegetation on the site.

INTRODUCTION

The Utah prairie dog (*Cynomys parvidens* Allen) was first classified as an endangered species in 1968 (Pizzimenti and Collier 1975); and was listed as endangered by the U.S. Fish and Wildlife Service in 1984 (49CFR2330). In 1985 the minimum population objective of the Utah Division of Wildlife Resources (UDWR) was at least 40 colonies with 30 or more breeding individuals on each colony. Ten additional colonies were to serve as buffer groups. Ideally these 50 colonies were to be geographically dispersed and self-sustaining. Also, at least 10 colonies should have been larger than 100 adult prairie dogs (Utah prairie dog recovery plan 1980 Unpubl. manuscript). The minimum number of Utah prairie dogs required for a viable long term colony has not been empirically determined.

The U.S. Fish and Wildlife Service, and the UDWR would like to increase the density of colonies on portions of the historic range (Stanford 1931, Collier and Spillet 1972). There is a paucity of data regarding maximum population densities per unit area of excellent natural habitat. However, Utah prairie dogs are known to have great variability in population densities. Agricultural land had populations estimated as high as 68 Utah prairie dogs per hectare. Some rangeland had populations as low as 1.5 Utah prairie dogs per hectare (Collier 1975).

Collier (1973) suggested that climate, vegetation, degree of poisoning, and topography influenced the distribution of Utah prairie dogs. Although disease was recognized as a possible factor, it was not considered important. Bubonic plague is suspected of having devastated several large colonies throughout the Utah prairie dog's distribution 5 years ago (Robert Hasenyager, UDWR, personal communication 1985).

Badgers (*Taxidea taxus* Schreber) and coyotes (*Canis latrans* Say) are reported to be important predators of transplanted prairie dogs (Jacquart 1986). I (JWM) have seen weasels (*Mustela frenata* Lichenstein) moving through established prairie dog colonies, and believe them to be effective predators on young Utah prairie dogs.

Crocker-Bedford et al. (1981) stated "reductions in numbers of Utah prairie dogs resulted primarily from habitat changes and poisoning, . . .". In their study (1974 and 1975), prairie dog density was dependent on elevation, and the abundance of alfalfa (*Medicago sativa* L.) and cool season grasses. They also noted that on high elevation colonies dominated by black sagebrush (*Artemisia nova* A. Nels.), crested wheatgrass (*Agropyron cristatum* (L.) Gaertn.), and mat phlox (*Phlox muscoides* Nutt.): that succulent forage in swales was very important. These are areas with historic gullying and invasion of grassland by shrubs (Cottam and Stewart 1940, Player and Urness 1982). Increased sagebrush and other dense vegetation obstructs the view of prairie dogs and this may lead to increased losses to predation (Player and Urness 1982). Obstructing vegetation may also prevent some social interaction in the social unit--the clan (Wright-Smith 1978).

Player and Urness (1982) found that population density of transplanted Utah prairie dogs was significantly greater on sites where mechanical treatments reduced shrub height compared to herbicide treated or untreated sites. In addition, they found that prairie dogs began moving to the herbicide treated sites within three years. Cincotta, Uresk, and Hansen (1988) found establishment of black-tailed prairie dog (*Cynomys ludovicianus* Ord) towns was most likely to occur when there was a densely populated town near habitat with high visibility through the vegetation.

Vegetational structure and food availability (Garrett, Franklin, and Hoogland 1982) appear to be critical for prairie dog survival. Data collected on Utah prairie dog diets (Hasenyager unpubl. 1984, Mackley, Flinders, and Whisenant 1988) indicate a preference for certain species and kinds of vegetation. However, Utah prairie dogs are generalists, and live where many different but suitable forages are available. They apparently prefer certain grasses and forbs, but also make some use of various shrubs. Crocker-Bedford (1975) noted that "there are large, species specific, food preference differences within any type." He also reported that cool-season forages on high-elevation sites were very important. Weight gain may be correlated with prairie dog survival. He reported forage use of alfalfa on low-elevation sites allowed large weight gains by Utah prairie dogs.

The objective of this study was to evaluate the effects of three types of vegetative treatments on Utah prairie dog population density, survival, and reproduction. Treatments applied were: 1) 2,4-D (2,4-dichlorophenoxy acetic acid) application; 2) 2,4-D application followed by reseeding; 3) mechanical treatment followed by reseeding; and 4) a control. Utah prairie dog density, body weight, reproductive success, body condition, and dietary selection were monitored for three years, and subcutaneous abdominal fat was monitored for two years. Vegetation parameters measured were forage availability, shrub height, and shrub density.

METHODS

Study site. The study site is located on state lands administered jointly by the U.S. Forest Service and State of Utah in John's Valley, Garfield County. The study site contains plots located in T34SR2W; in section 32, and portions of sections 29, 30, and 31. The area involved is about 2.56 km² and was selected

by locating active prairie dog mounds within the colony known by the UDWR as "Pine View"(1985).

The colony is of moderate density in the black sagebrush type described by Crocker-Bedford (1981) as his HC colony. Preliminary investigations in May 1985 indicated 150 to 200 overwintering prairie dogs inhabited the area. Between 20 and 85% of the area in study plots is dominated by black sagebrush. There were 55 species of plants found in the study area of which 10 or 12 were common. Cattle grazed the entire unfenced area from May or June until November.

Study design. The experimental design followed a randomized complete block with three replications. Twelve 2.5 ha plots were selected and divided into 3 groups (blocks). The treatments were conducted during September and October 1985. The square plots were centered over the densest prairie dog social groups during the late spring 1985. Plot size was selected to contain most of the female's home range (Crocker-Bedford et al. 1977). Each plot was at least 0.16 km from the other plots.

Treatments. In order to increase forage production and availability, and remove vertical cover of shrubs, we selected a set of treatments that included spraying with 2,4-D; spraying with 2,4-D and reseeding; and mechanical shredding of shrubs to reduce their height, density, and visual obstruction. The mechanical treatment also involved reseeding.

The 2,4-D was applied to six plots between September 16 and 19, and the rotobearing and/or reseeding was conducted October 15-22, 1985. We sprayed in the fall to avoid killing palatable forbs. We selectively sprayed 2,4-D in the spring of 1986 to kill shrubs not killed in the fall. The 14 reseeded grass and forb species were chosen for production of green forage during various seasons. The six species that comprised $\geq 5\%$ of the mixture

were: *Oryzopsis hymenoides* R.&S. (Ricker), *Agropyron cristatum* (L.) Gaertn., *Elymus junceus* Fisch., *Melilotus officinalis* (L.) Pallas, *Sanguisorba minor* Scop., and *Sitanion hystrix* (Nutt.) J. G. Smith. Predator control was also practiced on a limited basis (we removed six badgers *Taxidea taxus* Schreber). We chose to measure treatment effects on prairie dogs by periodic measurements of the habitats, as well as monitoring parameters of the prairie dog population.

Prairie dog measurements. Parameters monitored were body weights (for weight gain and assessment of body condition), fat thickness (for hibernation fat deposition), population density, reproductive success, and diet. Prairie dogs were trapped in live-capture traps, anesthetized, weighed, marked, subjected to standard body measurements, and measured for fat deposition, aged, sexed, and released when awake. The prairie dogs were trapped by placing Tomahawk live traps baited with peanut butter, oats, and anise, or mint extract, into the burrow entrance. From 50 to 100 traps were set each day. The traps were checked at regular intervals during the day and the animals processed immediately to reduce stress. The captured animals were anesthetized with about 0.4 cc ketamine hydrochloride per kg of body weight. There were no known mortalities due to use of this anesthetic. All trapped animals were kept in the shade or under cover for protection while other trapped animals were being processed.

Each prairie dog was marked for reidentification during the first year with ear tags and a toe clip; and in the second and third years with a tattoo. Although ear tags have worked for blacktail prairie dogs (Hoogland et al. 1988), the tags did not stay in the ears of Utah prairie dogs. Approximately 50 percent of the recaptured animals lost their ear tags after the first trapping period; and 90 percent of the tags were lost by the second year.

Age and sex was recorded, although late in the year age was difficult to determine for some animals. Weight gains were calculated two ways: the first was the change in weight (grams) per day of individually marked animals, and the second was the average weight gain of all animals captured. Weights and standard measurements were used in a body condition index (CI), which was formulated (O'Neal, Flinders, and Clary 1987) using the formula:

$$CI = \frac{W_i T_i C_i Z_i}{W_m T_m C_m Z_m} \quad \text{where:}$$

Z = zygomatic arch width in mm

T = total body length in mm

W = bodyweight in kilograms

C = head length in mm

i = ith animal

m = maximum value of all animals in appropriate sex and age class

Subcutaneous abdominal fat measurements were taken in 1986 and 1987. These were taken with calipers, after gently pinching the skin and associated fat, between the hip and rib cage.

Populations densities, as well as litter sizes were reconstructed from trapping records and observations. Population densities were inferred from the number captured since we caught 70 to 95% of the animals. We estimated (our method) the % prairie dogs captured by dividing the number newly captured at the end of a trapping period by total captured, and subtracting from 100%. Litter sizes were the number of juveniles captured per adult females captured.

Habitat characteristics. Habitat structure and forage availability were sampled. Vegetation biomass in each plot was sampled using a double

sampling technique (Pechanec and Pickford 1937, Tadmor et al. 1975) in conjunction with a series of 30 randomly selected 1-m² plots (10 each on 3 random lines). The vegetation was sampled at approximately the same time each year to reduce seasonal variation. Shrub parts over 20 cm high were excluded from the biomass sampling since we considered green biomass that was 20 cm or above unavailable to prairie dogs. The vegetation was measured and trapping was conducted concurrently three times each year on each plot--once in late spring (May 15 to June 30), once in early summer (June 30 to August 1), and once in late summer-fall (August 1 to September 15). The differences between both quantity of forage, and species present on each treatment was analyzed.

Shrub height and density data collected by the point-quarter (Cottam and Curtis 1956) method were used to describe the negative values of the shrub's total horizontal cover and, vertical cover. Vertical cover is a measure of visual obstruction (m²/ha) calculated according to the area of a triangle = 1/2 (base x height). Horizontal cover is that portion of the ground covered by the plant when viewed from above. Shrub species lower than 20 cm were excluded from the point-quarter data collection since shrubs 20 cm or above are considered detrimental to prairie dogs (Player and Urness 1982).

Statistical Analysis. Forage availability, diet preference data, and subcutaneous abdominal fat thickness were analyzed with analysis of variance ($p \leq 0.10$). Repeated Measures Analysis (Winer 1971) was used ($p \leq 0.10$) to compare density of prairie dogs, weight gain, and reproduction on treatment sites as compared to the control site. The unconventional significance level was chosen because of the high expected response variation and of the fact that Utah prairie dogs are threatened with extinction.

RESULTS

Prairie dog response. Prairie dog densities on treated plots did not differ significantly from the untreated plots (Fig. 1), and ranged from 1.6 to 17.6 per ha. However, there was a positive trend for prairie dog population density (Fig. 1), weight gains (Fig. 2), subcutaneous abdominal fat (Table 3), and litter sizes (Fig. 3) on mechanically treated plots. Utah prairie dog population density on the herbicide treated plots decreased (not significant), partly because of a shooting problem which occurred on the second densest plot in late May of 1986 prior to juvenile emergence.

No significant differences between treatments were found for gains in Utah prairie dog body weights. Weight gains averaged 1.6 to 1.7 ($n = 297$ and 224) grams per day. The first mean of this range is of weight gains of marked animals (Table 1), and the second is of the average of all animals, both marked and unmarked (Fig. 2). Weight gains were significantly higher in 1987 than the other years. Juvenile prairie dogs gained more weight than adults in late spring and early summer, and more than juveniles later in the year (Table 1). Some adults never made positive weight gains during each season sampled.

We also found no significant differences in the index of Utah prairie dog fat thickness between treatments (Table 2). Fat measurements differed significantly depending on the year and time of year, and the age and sex of the animal (Table 3). The average subcutaneous abdominal fat thickness for 1986 and 1987 was 3.5 mm. Average fat thickness increased from 3.0 to 4.1 mm from 1986 to 1987. Fat increased as the growing season lengthened. Adults and males were fatter than juveniles and females (Table 3). Emergent

litter sizes averaged 3.6 per adult female, and did not differ between treatments or years (Fig. 3).

Effects of treatments on habitats. The available shrub biomass was reduced on treated plots, but grasses increased. Above-ground green biomass in 1987, exceeded the previous two years, but significantly more grass was produced on treated plots (Table 4). Availability of forbs and grasses increased from late June to mid-July, and then decreased until the end of the season. The reseeding effort was not successful. In 1987, germinated reseeded plants were found at a density of 0.086/m². The failure of the reseeding was likely due to low soil moisture during the 1986 growing season. Since we were interested in forage available to prairie dogs, only available green biomass was sampled.

Annual productivity of the shrubs on control plots, which largely consisted of black sage brush, remained relatively stable. Shrub density decreased from 33,126 per ha in 1985 to 15,676 per ha in 1986; and vertical cover (visual obstruction) was reduced from 829 to 252 m²/ha by the treatments (Table 5).

DISCUSSION

No significant differences between Utah prairie dog densities, weight gain, subcutaneous fat thickness, or litter sizes could be attributed to the habitat treatments. However, in 1987 the trend for all variables, indicated that the mechanical treatment may have benefited the prairie dogs more than the untreated plots.

Most of the adults had a high recapture rate, but the juveniles seemed to follow the pattern observed by Wright-Smith (1978); they tended to disperse out of their own clan territory. Therefore, the condition index and average

weight data presented in the tables is only directly comparable between plots when adults are considered. The 1.6 to 17.6 prairie dogs per hectare was well within the reported range (Collier 1975) for Utah prairie dog densities (1.5 to 68). The density was higher than most colonies on rangeland though. It is interesting to note that relative densities of prairie dogs remained the same through all seasons. This suggests that some characteristic of the habitat, burrow density, or a behavioral dominance hierarchy affected prairie dog density. Predation may have also caused changes in annual population densities.

Utah prairie dogs seem to be visually oriented within their habitat. Observations (1987) in John's Valley (3 colonies), Bryce Canyon National Park (4 colonies), and Panguitch Valley (5 colonies) support the idea that Utah prairie dogs prefer areas with no visual obstructions. Utah prairie dogs selected more elevated sites with lower, sparser vegetation than in surrounding areas. In our study, Utah prairie dogs on mechanically treated areas seemed to respond favorably (Figures 1 to 3), but the differences were not significant.

The mechanical and 2,4-D spray treated areas had significant decreases in shrub biomass and vertical cover, but significant increases in grass production. The reseeding was not successful, as is often the case in marginal rainfall areas such as our study site.

Utah prairie dog population densities, weight gains, litter sizes, and fat thickness were not significantly different between treated and untreated sites. However, there was an indication that mechanical treatment of shrubs had a positive effect on Utah prairie dog response. The lack of significant results may be attributed to: 1) the fact that it should take one or more years to see prairie dog responses to habitat change; 2) The habitat was not different

enough from optimum to elicit a significant response since the densest areas were chosen for larger sample sizes; 3) high natural variation; 4) or small sample sizes. The high response variation may be due to predation (natural and shooting), and/or yearly weather patterns.

It is possible that Utah prairie dog densities can be increased on other sites with lower prairie dog densities, and/or where taller species like rubber rabbitbrush (*Chrysothamnus nauseosus* (Pall.) Britt.), and big sagebrush (*Artemisia tridentata* Nutt.) dominate.

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Table 1. Mean weight gain (grams per day) of marked animals of Utah prairie dogs in John's Valley, Garfield county, Utah (N=92)¹.

Year	<u>Age</u>	
	Adult	Juvenile
	grams/day.....	
All years	0.16 b	2.48 a
1985	-0.65 b	2.79 a
1986	0.73 a	1.49 a
1987	0.19 b	3.564 a

¹Means with different lower case letters are significant at the 0.10 level.

Table 2. Mean subcutaneous, abdominal fat thickness (mm) for Utah prairie dogs in Garfield County Utah, according to year, treatment, age and sex (N=176)¹.

	1986		1987		Total
All animals	3.02 b		4.09 a		3.51
<u>Treatments</u>					
Control	3.02 a		3.88 a		.
Spray 2,4-D	3.14 a		3.92 a		.
Spray 2,4-D and reseed	3.10 a		4.37 a		.
Rotob beaten and reseed	2.80 a		4.19 a		.
<u>Sex</u>	<u>Adults</u>	<u>Juveniles</u>	<u>Adults</u>	<u>Juveniles</u>	
	3.61 a	2.49 d	5.05 b	3.22 c	.
Males	4.21 b	2.62 f	6.14 a	3.4 d	3.93
Females	3.03 d	2.35 g	4.14 c	3.07 e	3.10

¹Means within year, treatment, age, age and sex, followed by different lower case letters are significant at the 0.10 level according to repeated measures analysis.

Table 3. Mean subcutaneous abdominal fat measurements (mm) for Utah prairie dogs in John's Valley Utah, according to age, sex, and season (N=176)¹.

	<u>Age class</u>		<u>Total</u>
	<u>Adults</u>	<u>Juveniles</u>	
All animals	4.26 ± 1.38 a	2.82 ± 0.58 b	.
Female	3.55 ± 0.89 b	2.69 ± 0.53 c	.
Male	5.05 ± 1.41 a	2.95 ± 0.61 c	.
Season 1	3.81 ± 1.34 b	2.71 ± 0.62 c	3.24 ± 1.17 b
Season 2	24.71 ± 1.28 a	2.92 ± 0.53 c	3.75 ± 1.30 a

¹Means within year, sex, season, or between seasons followed by a different lower case letter are significant at the 0.10 level according to repeated measures analysis.

Table 4. Available biomass (kg/ha) of abundant species prior to and for two years after treatments for Utah prairie dog habitat improvement in Garfield County, Utah (N=36)¹.

Species and treatments	Year		
	Untreated year	Treated years.....	
	1985	1986	1987
	kg/ha.....		
<i>Agropyron smithii</i>			
Control	130 a	73 b	84 c
Spray 2,4-D	174 a	132 a	279 a
Spray 2,4-D and reseed	188 a	188 a	361 a
Rotobeat and reseed	117 a	83 b	189 b
<i>Artemisia frigida</i>			
Control	62 a	43 a	20 a
Spray 2,4-D	89 a	61 a	24 a
Spray 2,4-D and reseed	57 a	17 a	6 a
Rotobeat and reseed	51 a	40 a	32 a
<i>Artemisia nova</i>			
Control	829 a	561 a	793 a
Spray 2,4-D	811 a	205 b	307 b
Spray 2,4-D and reseed	765 a	145 b	163 b
Rotobeat and reseed	925 a	226 b	680 a
<i>Arabis pulchra</i>			
Control	3 a	4 a	6 a
Spray 2,4-D	1 a	0 a	0 a
Spray 2,4-D and reseed	1 a	0 a	2 a
Rotobeat and reseed	1 a	1 a	3 a
<i>Ceratoides lanata</i>			
Control	166 a	140 a	152 a
Spray 2,4-D	188 a	76 b	123 a
Spray 2,4-D and reseed	135 a	51 b	59 a
Rotobeat and reseed	139 a	145 a	187 a

Table 4. cont¹.

Species and treatments	1985	1986	1987
	kg/ha.....		
<i>Chrysothamnus naseosus</i>			
Control	48 a	2 a	3 a
Spray 2,4-D	28 a	4 a	8 a
Spray 2,4-D and reseed	21 a	6 a	16 a
Rotobeat and reseed	22 a	17 a	1 a
<i>Erigeron pumilus</i>			
Control	5 a	9 a	10 a
Spray 2,4-D	1 b	1 b	1 b
Spray 2,4-D and reseed	2 b	1 b	1 b
Rotobeat and reseed	3 b	3 b	3 b
<i>Gutierrezia sarothrae</i>			
Control	50 a	63 a	23 ab
Spray 2,4-D	81 a	21 a	6 b
Spray 2,4-D and reseed	85 a	18 a	7 b
Rotobeat and reseed	54 a	40 a	34 a
<i>Phlox hoodii</i>			
Control	1112 a	608 a	846 a
Spray 2,4-D	899 a	416 ab	572 b
Spray 2,4-D and reseed	561 b	256 b	285 c
Rotobeat and reseed	847 ab	549 a	800 a
<i>Sitanion hystrix</i>			
Control	12 a	5 a	10 a
Spray 2,4-D	7 a	3 a	23 a
Spray 2,4-D and reseed	9 a	7 a	89 a
Rotobeat and reseed	6 a	8 a	36 a

¹Means within a species and year followed by similar lower case letters are not significantly different at the 0.10 level according to analysis of variance.

Table 5. Shrub response to habitat modification for Utah prairie dogs in Garfield County, Utah (1985¹ to 1987)².

Treatment and Year	Shrub density	Horizontal cover	Vertical cover
	(numbers/ha)	(percent)	m ² /ha
Control			
1985	38,533	13.6	661.93
1986	18,850 a	13.0 a	490.65 a
1987	49,104 a	15.9 a	868.08 a
Spray 2,4-D			
1985	36,349	18.1	859.24
1986	8,628 b	4.2 b	196.11 b
1987	4,037 b	2.0 b	144.98 b
Spray 2,4-D and reseed			
1985	29,072	17.4	897.33
1986	19,793 b	8.1 b	474.53 b
1987	3,694 b	2.0 b	117.79 b
Rotobeen and reseed			
1985	28,549	14.6	731.86
1986	15,432 a	2.3 b	107.28 b
1987	30,653 a	8.9 b	492.89 b

¹The 1985 data was not considered in the analysis since it was a temporal control. ²Means followed with different lower case letters are significantly different for all treatment years at the 0.10 level according to analysis of variance.

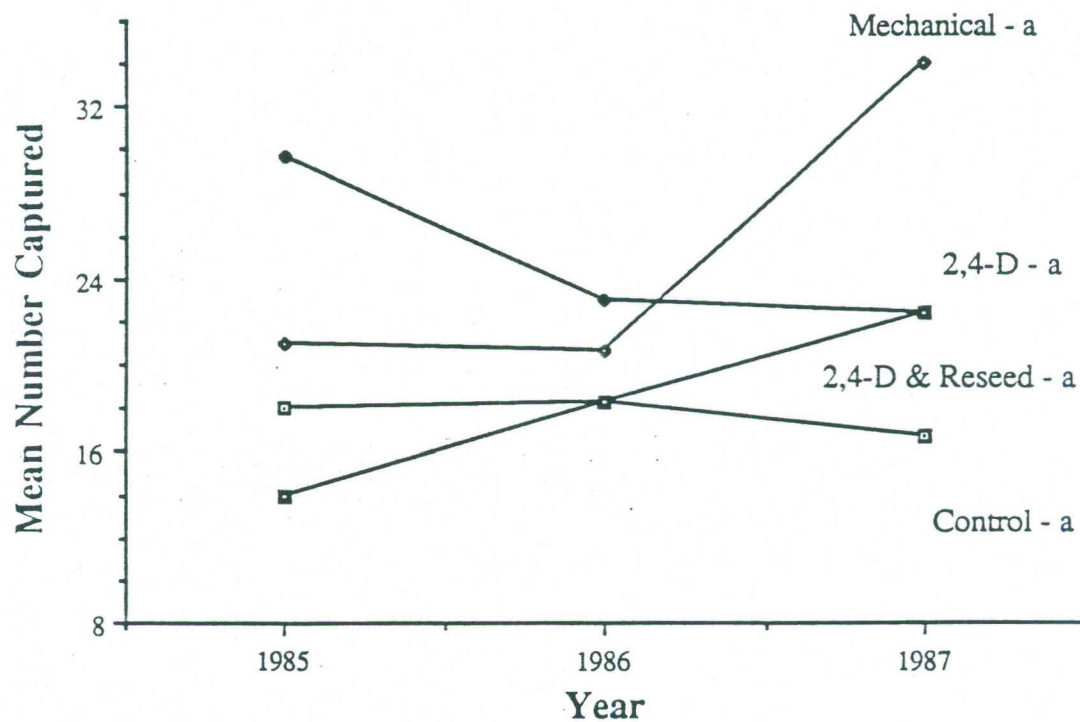


Figure 1. Mean number of Utah prairie dogs (*Cynomys parvidens*) captured per 2.5 ha plot (3 blocks) for one year, prior to, and two years following habitat modification in John's Valley, Garfield county, Utah. The same lower case numbers indicate no significant difference according to repeated measures analysis of the differences between treated and untreated years.

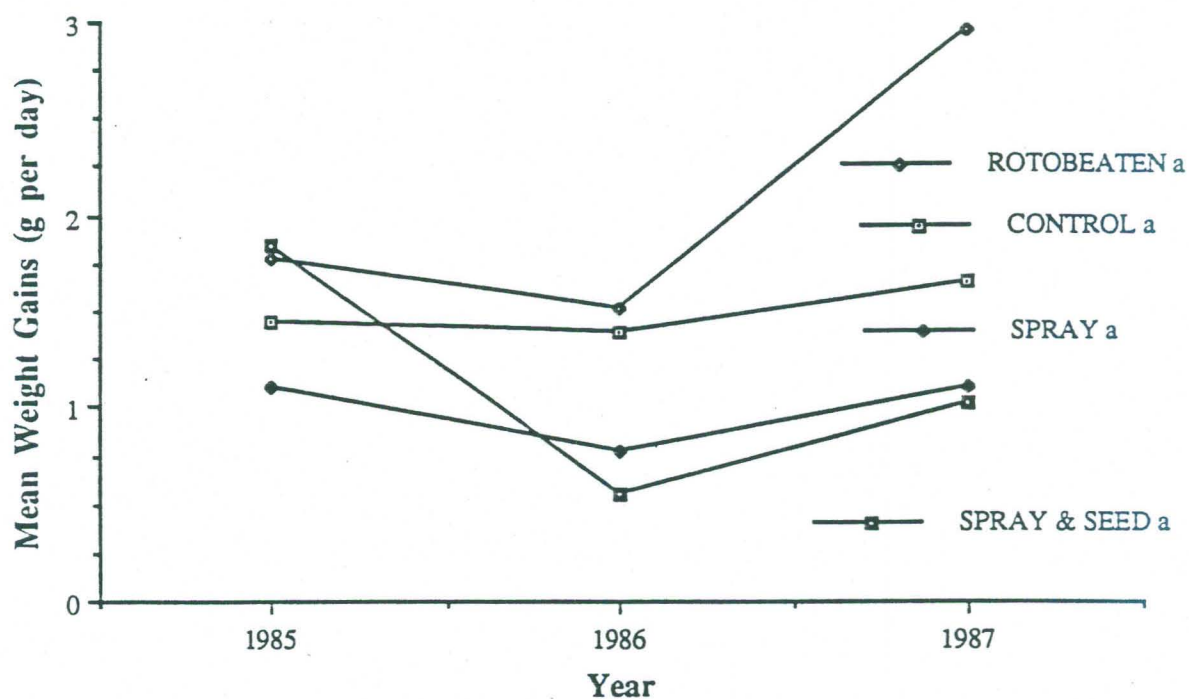


Figure 2. Average weight gains of Utah prairie dogs (*Cynomys parvidens*) in John's Valley, Garfield county, Utah from 1985 to 1987, one year prior to, and two years following habitat modification ($n = 48$). The same lower case numbers indicate no significant difference according to repeated measures analysis of the differences between untreated and untreated years.