

## OBSERVATIONS ON THE ECOLOGY OF BURROWING OWLS IN WESTERN OKLAHOMA. A PRELIMINARY REPORT

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Methods and preliminary results of research on the ecology of burrowing owls in western Oklahoma are reported. Aspects of research discussed include a census of the adult owl populations, trapping and marking, habitat utilization, production of young, nest ecology, and changes in habitat. The study is based on full-time field work conducted from May 25 to August 23, 1970 in the eastern one-third of the Oklahoma Panhandle.

The western burrowing owl (*Speotyto cunicularia hypugaea*, Bonaparte) was included in the list of rare and endangered species published by the Bureau of Sport Fisheries and Wildlife in 1966. Although the species was removed from the revised list in 1968 (1), the status of the burrowing owl, in much of its range, is quite precarious. In Oklahoma, burrowing owls are usually found in association with prairie dog towns. The total acreage of prairie dog towns in Oklahoma is less than half of what it was in 1960. The key habitat for burrowing owls will, thus, be drastically reduced if present trends continue.

Many aspects of the life history and ecology of the burrowing owl are poorly understood. There has been no single, comprehensive study of the habitat requirements for the species. Only recently have any thorough life history studies been made, and these were made in an ecological setting quite different from that of western Oklahoma (2,3). Most of the literature contains only short observational notes or brief studies of facets of life history, such as food habits.

The purpose of this study is to elucidate the life history and ecology of the burrowing owl in western Oklahoma. Presented in this paper are the methods and preliminary results of field research conducted from May 25 to August 23, 1970. Aspects of the subject investigated and reported here are trapping and marking methods, a census of the adult owl populations, and

observations on habitat utilization, including nesting territory and home range, production of young, nest ecology, and changes in habitat.

### MATERIALS AND METHODS

**Study area.** For the summer period, the study area consisted of Beaver County and the tier of sections, 7 miles wide, along the eastern border of Texas County, extending from State Highway 3 north to the Kansas line.

**Census.** Adult burrowing owls were counted in all known prairie dog towns in the study area, with information on locations of these towns being provided by Dr. Jack Tyler (4), Wildlife Services personnel of the Bureau of Sport Fisheries and Wildlife, personnel of the Oklahoma Department of Wildlife Conservation, and local landowners. Most of the census work was conducted during the first two weeks of June. An attempt was made to restrict counting to late evening, early morning, or when the temperature range was 70-85 F and the wind velocity less than 10 mph. Burrowing owls are inactive and often stay within the burrow at midday and during periods of temperature extremes or high wind velocities. The dog towns were examined thoroughly, either on foot or from a vehicle. Attempts were also made to locate all nest burrows by observing females flying from the burrow entrance, by noting other behavior characteristics of nesting owls, and by finding owl pellets, droppings, and debris (e.g., cow manure, bones, owl feathers, or parts of insects) spread about the mouths of nest burrows in typical fashion.

Sixteen of the prairie dog towns, of which all but three were less than 15 acres

<sup>1</sup> The Oklahoma Cooperative Wildlife Research Unit is supported by the Oklahoma Department of Wildlife Conservation, Oklahoma State University, the U. S. Bureau of Sport Fisheries and Wildlife, and the Wildlife Management Institute.

in size, were not discovered until late summer. In these colonies, the adult owl population was estimated on the basis of nest burrows found or broods observed. The total population may have been underestimated since some nest burrows may not have been found and a small number of owls are probably nonbreeders (3, p. 82). However, extra nest burrows, which resulted from re-nesting attempts, might compensate somewhat for any under-estimation.

In Beaver County, a survey of 54 randomly selected, square mile sections, one from each township, was made to determine burrowing owl populations living outside the influence of prairie dog colonies. Only sections at least one mile from a known prairie dog town, including those listed by Tyler (4, pp. 72, 73, 81), were considered eligible for sampling. The survey, which sampled 3.7% of 1,468 square miles, was conducted August 1 to 14, between sunup and 10:00 A.M. or from 5:30 P.M. to sunset. The sections were thoroughly viewed with a Zoom spotting scope (15X-60X) and were closely examined by walking and/or driving over them. Where coverage or sampling conditions were not optimal, enquiries regarding the existence of burrowing owls within the section were made of the person managing the land.

*Trapping and marking.* Trapping was initiated in early June, when the nesting activity of owls was at a peak. Early in the season, nest entrance-blocking devices, which favored capture of females and young, were used most. These devices included a woodcock trap (5), Tomahawk box trap (2, p. 43), mist net set over burrows, and the Anderson trap (developed by summer aide Leroy Anderson). The woodcock trap was used for only one week in early June. The Tomahawk and Anderson traps were not available until June 22. Mist netting was used sporadically throughout the nesting season.

The most successful of nest entrance-blocking devices, the Anderson trap, consisted of mist netting stretched over two wire frames which form two squares. The frames are hinged to each other on one side. The trap is set over the nest burrow entrance with the netting of the lower frame covering the entrance. The upper frame sets at an 80° angle from the ground surface and falls over the owl when it trips

a trigger wire upon attempting to enter the burrow.

Pole traps were tested for the capture of the sentinel adult males during the incubation period. Padded steel jaw pole traps (6, p. 42) proved unsuccessful as did the Verbaill pole traps (6, p. 43). However, the Verbaill traps received only limited testing during this time because they were not available until late June.

Bal-chatri traps (7), baited with grasshoppers, frogs, and mice, proved unsuccessful, apparently due to the cautious nature of the owls. Baited bal-chatri traps were sometimes used successfully as a lure which enhanced capture by padded steel jaw traps. The steel traps were set on the ground around the bal-chatri trap. Steel traps, used in this manner or set around a nest burrow containing young owls, proved to be the second most successful capture technique even though they were not utilized until after July 5.

The most successful method of capture was the nocturnal use of a bright light and a long-handled net. This method was successful only for capturing young owls (the one adult captured was flightless, apparently due to injury) and was most effective during the first three weeks of July, when young owls had begun to fly. The effective-

TABLE 1. *A comparison of capture and marking techniques for burrowing owls, Oklahoma Panhandle, summer, 1970.*

Trap Type	Owls Captured			Total
	Juve-niles	Adult females	Adult males	
Woodcock		2		2
Verbaill pole				0
Padded steel jaw pole				0
Tomahawk box	1	4		5
Bal-chatri (baited with Rana and grasshoppers)				0
Mist nets over nest burrows	3	1		4
Anderson	2	5		7
Hand net and light	24	(1 adult, sex unknown)		25
Padded steel jaw, ground sets	7	2	4	13
Captured by hand	1			1
Totals	38	14(1)	4	57 <sup>a</sup>
Total color banded	15	4(1)	3	23

<sup>a</sup> All owls captured were banded except two given to the Oklahoma Department of Wildlife Conservation for the game farm at El Reno.

ness of the night-lighting method probably would have been improved if: (a) the project leader had had an assistant; (b) the dipnet with the 12-foot-long handle had been used throughout the capture attempts; (c) the critical nights had been moonless rather than with a half to three-quarter moon.

All owls captured, with the exception of the two taken to the game farm (Table 1), were banded with U. S. Fish and Wildlife Service leg bands. Twenty-three of these owls were also color-marked. Some difficulty was encountered in developing a color-marking method. Colored plastic poncho markers, modified from those used by Pyrah on grouse and partridges (8), were tested first. They were placed on two adult owls. One owl removed it the same day it was applied. The other owl was retrapped three days later and the marker removed because she spent most of the time "fighting" it. We then tested colored plastic leg bands, with combinations of one to three colors. The color patterns made it possible to identify individual birds from a distance, using binoculars or a spotting scope. Some difficulty was experienced in obtaining suitable color bands, and this further delayed the color marking.

*Nesting territory.* Nest burrows were marked with numbered and flagged wooden stakes in all intensively studied dog towns. These were then mapped, using calibrated paces and a compass, and nest burrows were plotted on the map. The density and spatial distribution of the nests could then be determined. Territorial behavior was recorded in field notes taken while conducting the census, during trapping operations, and other such activities.

*Home range.* The extent of home ranges was determined by three basic methods. One was observation of a marked owl a measured distance from its known nest burrow. The second was by observation of a foraging owl and the return back to its "home" nest to feed young. The distance from the furthest point of foraging back to the nest was then measured. The third method was simply the observation of owls (unmarked or marks not visible) out away from any dog town. The owl was assumed to be from the nearest dog town and the distance was measured accordingly in such instances. All distances were measured by pacing or by use of the truck odometer. Unfortunately,

the third method was necessarily used much more often than was the first.

*Habitat utilization.* Utilization of abandoned dog towns was investigated as the census was being conducted. All abandoned dog towns checked had been poisoned within the past three years. Owl utilization of active dog towns was studied throughout the summer, beginning with the census operation. A dog town was rechecked periodically throughout the summer for the presence of owls or owl sign if none were found there during the initial census.

The scope of nesting outside dog towns was investigated throughout the summer period. Location of solitary nest burrows was accomplished in three ways: (a) through the random section survey; (b) through reports of local landowners; (c) through observations made while driving the thousands of miles logged throughout the summer, many on section-line and petroleum well-access roads.

*Production of young.* Average brood size was calculated from a sample of 54 broods. Each brood was observed several times during the period when young waited above ground to be fed. In addition, two active nest burrows were excavated on May 29.

Nesting success was calculated on the basis of 54 observed nesting attempts. A nest was termed successful if at least one owl was observed above ground (fledged) and unsuccessful if a pair of owls frequented an apparent nest burrow but no young were ever observed in the immediate area.

Survival of young owls from the fledgling stage through July was calculated on the basis of eight broods that were observed regularly. A rough estimate of total owl production for the study area was then possible by utilizing the total number of nesting attempts, average nest success, average brood size, and survival rate.

*Nest ecology.* Seven nest burrows were excavated—two on May 29 and five on September 12—in order to provide information on the gross ecology of nest burrows in prairie dog towns. None of the nest burrows located outside of prairie dog towns have yet been excavated.

*Habitat changes.* Acreages for the active dog towns were based on odometer reading, calibrated pacing, or rarely on "sight

estimates." Acreages for the abandoned dog towns were based largely on information provided by Tyler (4, pp. 72, 73, 81). Landowners were interviewed and personnel of Wildlife Services contacted in an attempt to determine methods used and approximate dates of recent prairie dog poisoning campaigns conducted in the study area.

## RESULTS AND DISCUSSION

### Census

Two hundred and forty-four adult owls resided in prairie dog towns in Beaver County and an additional 115 were found in eastern Texas County (Table 2).

TABLE 2. *Burrowing owl populations, Beaver and eastern Texas County, Oklahoma, June-July, 1970.*

<u>Beaver County</u>	
Number of adult owls	
In dog towns	244
At least 1 mile from dog towns	163
Number per square mile	
In dog towns	98.6
At least 1 mile from dog towns	0.11
<u>Total Study Area</u>	
Square miles sampled <sup>a</sup>	1,636.6
Total adult population <sup>b</sup>	543
Adult population in dog towns	359
Adult population per square mile	0.33

<sup>a</sup> Not including buffer zones around dog towns.

<sup>b</sup> Estimate of eastern Texas County non-dog town population based on Beaver County survey.

Two owl nests were located within the sections sampled during the inventory of owl populations residing outside the influence of prairie dog towns. In another instance, a brood of young owls was seen in the road separating a sample section from a nonsample section, but no nest burrow was found even though badger burrows were available along both road ditches. In another case, a landowner reported frequently seeing "a prairie dog owl or two" by his barn on the edge of a sample section. His observations seemed reliable, but I found no owls or nest burrows within that section. I arbitrarily decided to include one of the two unverified pairs within the survey figures. Thus, the sample total was tentatively assumed to be three pairs of owls or six adults on the 54 square mile sample area. The population of adult owls living one mile or more from known prairie dog towns was thus calculated to be 81.6 pairs

or 163 adult owls for Beaver County. Similar population densities were assumed for the Texas County portion of the study area and the computed population was 10.3 pairs or 21 adult owls. This figure may be a slight over-estimate because a higher percentage of Texas County is cultivated.

Apparently, no existing literature gives estimates of early summer owl population density in Oklahoma prairie dog towns that could be compared to the figure of one owl per 0.15 acres (98.6/sq. mi.) found in the present study (Table 2). Tyler (4, p. 44) counted 788 burrowing owls in the 9,522 acres (one owl per 0.08 acres) of prairie dog towns he found in western Oklahoma. However, this count was made during all seasons of the year, thus including young owls and possibly migrants. Hennings (3, pp. 1, 4), in her study of burrowing owls near an airport in the San Francisco Bay area, found a late spring population of about 12 pairs in the study area of 150 acres (one owl per 0.16 acres). Coulombe (2, p. 49) reported a June 1 burrowing owl population density of one owl per 0.02 acres along a census route in the Imperial Valley of southern California, and a density of one owl per 0.04 acres along a certain irrigation drain canal on the route. Neither of the California studies, however, concerned burrowing owls living in prairie dog towns.

### Trapping and Marking

Results of trapping and marking operations are summarized in Table 1.

Little published data exist concerning capturing and marking techniques for burrowing owls. Patton (9) trapped burrowing owls by putting a "gill net" over the burrow. Brenckle (10) reported that he banded 376 burrowing owls in South Dakota, another ornithologist banded 101 in North Dakota, a third banded two in Manitoba, and a fourth banded two in Colorado. Unfortunately, Brenckle made no mention of the trapping methods used. Hennings (3, p. 7) used steel traps, adapted so the jaws would not completely close, to capture 107 burrowing owls. Her owls were then marked with a combination of three or four colored plastic leg bands and an aluminum Fish and Wildlife Service band. Coulombe (2, p. 14) stated that burrowing owls were captured "easily" by placing single-doored Tomahawk live traps in the

entrance of occupied burrows. Leg bands were placed on the owls thus captured.

### Nesting Territory

The key habitat factors which determine the population density of burrowing owls are not yet apparent. Nest density was not directly related to the size of the prairie dog towns (Table 3). Next year's studies will concentrate on what constitutes attractive habitat and what influences densities of nesting owls. Considerable variation was noted in nesting densities. For example, in one 80-acre dog town, 12 of 14 nests were less than 65 meters from the edges, an arrangement which provided many nearby fence posts for perching and fields for foraging. However, this pattern of nest distribution was not present in other situations.

In eight intensively studied dog towns containing a total of 95 nest burrows, the average density was one nest per 4.4 acres. However, in another situation 12 nest burrows were found in an 8.8-acre dog town. (1 nest per 0.73 acres). Two of the 12 were in old badger burrows near the edges of the pasture and ten were within a 1.5-acre block (1 nest per 0.15 acres). Eight were 23 meters or less apart and two were 11 meters apart. In this situation practically all available burrows appeared to be used by owls; the prairie dog population was only six to eight animals. Several brief fights between adult owls were observed during June. These were observed six times when an owl was flushed and flew toward the vicinity of another nest burrow. The male usually chased the intruder for a short distance and brief skirmishes were often fought in mid-air. This fighting seemed to be a type of territorial behavior.

Published data on territoriality in burrowing owls is practically nonexistent; the following source was the only one found. Hennings (3, pp. 55, 60) found that the burrowing owls in her study area established territories at the commencement of pair formation and continued to defend these territories against other burrowing owls throughout the summer. Even though defense was less vigorous after fledging, adult males were seen to confront young owls which were not their own as late as December 5 (3, p. 60). Hennings (3, pp. 62, 63), on an admittedly shaky basis, estimated the size of six individual territories. These averaged 1.98 acres in size, with a range of 0.1 to 4.0 acres. She observed very little territorial behavior between pairs whose nest burrows were located more than 150 yards (137 meters) apart.

### Home Range

Conclusive determination of home range was difficult due to the paucity of marked owls. Early morning and late evening foraging trips of 90 to 325 meters (usually around 200 m) were commonly observed during the period in which adult males foraged for the young. Adult owls were observed hovering (food-searching behavior) on three occasions, at 9:15 to 10:00 P.M., 0.5 to 0.6 miles from their burrows during this period. Young owls were observed 1.0 to 1.5 miles from their nests in at least six instances during July. These sightings were made after 11:00 P.M. on moonless nights. Young owls were seen 0.5 to 0.8 miles from their dog towns on 13 occasions. Most of these instances were late at night when there was little or no moon. An adult owl was seen 0.7 miles from its nest at 10:00 and again at 11:30 P.M. on

TABLE 3. Population density of adult burrowing owls in prairie dog towns of various size groupings, Beaver and Texas Counties, Oklahoma, summer, 1970.

Acreage of dog towns	Dog towns without owls	Populations of adult owls per acre						Total No. towns
		<0.1	0.1-.29	.3-.49	.5-.99	1-1.9	>2	
0.1-10	2		1	1	4	8	5	21
11-20	1				4	1		6
21-40			1	1				2
41-100		2	1	2	1	1		7
>100	2	2						4
<b>Totals</b>	<b>5</b>	<b>4</b>	<b>3</b>	<b>4</b>	<b>9</b>	<b>10</b>	<b>5</b>	<b>40</b>

July 15, a moonless night. A road-killed adult owl was found 1.5 miles from any known dog town or nests. Young owls apparently have home ranges with a radius up to 1.5 miles. The summer home range of adults may be slightly smaller.

Home range was not determined by Hennings (3, p. 63). However, according to her description of the owls' foraging and activity patterns and a map (3, p. 5), owls residing at the burrow furthestmost from the foraging grounds apparently ranged at least 0.6 miles from their burrow.

#### Habitat Utilization

Dog towns which had been poisoned within the past three years were checked for the presence of burrowing owls. In three cases the entire dog town was cultivated after the prairie dogs had been exterminated. Owls were not found in or around the former prairie dog town in those instances where cultivation followed poisoning. Active owl nests were found in two abandoned burrows in a 35-acre dog town where cultivation did not follow the poisoning program. When poisoning of dog towns was not followed by drastic habitat changes, such as cultivation, small prairie dog populations often persisted, perhaps migrating in from neighboring colonies. In five such dog towns totaling 95 to 100 acres (including abandoned segments), eight owl nests were located. All were in the active parts of the dog towns even though this portion comprised less than 10% of the former acreage.

One local landowner felt that the "dog owls" increased after he had killed the prairie dogs on his land. No support for this contention, however, was found in the literature. Numerous sources, including Ligon (11, p. 148) and Tate (12, p. 44), support my preliminary findings that an increase in abandoned dog towns causes a decrease in burrowing owl numbers.

Utilization of active dog towns by owls was found to be extremely variable (Table 3). For example, whereas a 58-acre dog town contained 42 active owl nests, two other dog towns, each over 125 acres, showed no sign of owl use. One of the latter dog towns was less than 1½ miles from a 50-acre dog town containing at least nine active owl nests. No differences in habitat were apparent.

Burrowing owls commonly reside in prairie dog towns (12, p. 44; 27, p. 19; 30, p. 34). Apparently, however, no research has been conducted to determine why burrowing owl populations are not distributed more evenly throughout the dog towns of a certain area. An attempt to answer this question will be made in future months of the present study.

The six nest burrows found outside dog towns seemed to be quite similar. All were less than 90 meters from a fence and were within grazed pastures. A reliable source reported another nest burrow with young owls in a fallow wheat field "about 150 yards from the fence." In all of these situations the nest burrow was apparently an abandoned badger burrow. Two other badger burrows, not over 65 meters from the nest, were later used by the young owls at five of the six nest sites examined.

Numerous literature sources refer to burrowing owls living in burrows other than those dug by prairie dogs. These include owls living in abandoned badger burrows (13), coyote burrows (14), swift fox dens (15, 16), a ground hog burrow (17), culvert drains (18), enlarged ground squirrel dens (3, p. 16; 2, p. 11; 19), and two sources (3, p. 99; 19) reported burrows being dug by the owls themselves. Sutton (21) reported two occupied nest burrows in a sage-dotted pasture three miles from the nearest dog town; however, the original designer of the burrows was apparently not known.

#### Production of Young

The average brood contained 4.7 (range 2 to 9) owlets in a sample of 54 broods. A nest burrow excavated May 29, 1970, contained a clutch of eight eggs, the oldest containing an embryo about half developed and the others containing successively younger embryos down to one that had been incubated for only one to three days. Another nest excavated the same date contained two eggs. This was apparently an incomplete clutch because the embryos were not appreciably developed. Bailey and Niedrach (22) state that incubation begins shortly after the first eggs are laid, and results in a great variation in size of the young. Hennings (3, p. 72) also observed that owlets differ in size within a brood, and that this is especially noticeable when they first emerge.

The extent of successful renesting activities would also be expected to have considerable impact upon production of young. The paucity of owls marked early in the season made conclusive renesting data impossible to obtain. Nevertheless, it seems quite certain that at least four renesting attempts were observed. Only one of the four attempts was successful and two young were produced. Copulation was observed on June 22, indicating that renesting attempts may occur quite late in the season.

Hennings (3, p. 83) found evidence of two possible renesting attempts; both occurred after the first clutch had been laid and then abandoned or destroyed. She observed no renesting attempts if the young had reached fledgling stage before dying.

Calculated nesting success was 79%. Survival of young owls from the fledgling stage through July was 89% (34/38). A breeding population figure of 250 pairs (92% of the total adult population) was thought to represent a fairly conservative estimate, although supportive data is somewhat inconclusive. On this basis the total production of young owls surviving from fledgling stage through July was calculated for the entire study area as follows:

250 nesting attempts X 79% success =  
198 successful nests;  
198 successful nests X 4.7 young/brood =  
931 owlets fledged;  
931 X 89% survival = 829 owlets produced  
or 3.3 owlets produced per breeding pair.

Burrowing owl clutch size has been given as 6 to 11 (23), 8 to 10 (10, p. 148), 5 to 9 (24), 6 to 11 (25), and 7 to 11 (26). No average brood size at fledgling stage is given in the literature.

Hennings (3, pp. 80, 81) lists nest success as 89% for the first year of her study and only 33% for the second year. However, if the two nests deliberately destroyed by human activity were omitted, the figure for the second year would be 47%.

Hennings (3, p. 88) found survival of owls from fledgling stage through August to be 88% in 1965 and 96% in 1966. Again, however, if direct human interference were discounted, the 1965 figure would be 97%.

Hennings (3, p. 79) reports 3.1 owlets produced surviving through August per breeding pair in 1965 and 1.5 per pair in

1966. Her calculations were based on only 9 and 15 pairs, respectively.

### Nest Ecology

Examination of the gross ecology of nest burrows in prairie dog towns revealed no stereotyped burrow preference with one possible exception: no burrows with vertical entrances were utilized. This could reflect availability rather than preference since Smith (27) reported less than 3% of the prairie dog burrows had vertical entrances. Six burrows contained slopes of 15 to 25 degrees. The other burrow contained an occasional slope of 40 to 50 degrees. Five burrows curved gently to the right and another turned at a 115 to 120 degree angle. The other burrow curved sharply to the right and downward in such a manner that the nest chamber was under, and less than one foot to the right of, the burrow mouth. In all cases, the tunnel size remained fairly constant, about 15 cm wide and 12 cm high, back to the nest chamber. The nest chamber itself was usually roughly circular or oblong, about 25 cm wide and 10 to 15 cm high. It seems likely that the nest chambers were formerly "turn-around" places for retreating prairie dogs (27, p. 29). All but one burrow had a tunnel leading away from the nest chamber. Usually this tunnel was at least partially plugged and in one case it was tightly plugged with dirt and nest lining. All nest chambers were lined with very soft, crumbled cow or horse dung to a depth of 2.5 to 7.5 cm. In most burrows a slight amount of cow dung was scattered along the tunnel, increasing in quantity about 30 cm from the chamber. The nest chambers averaged about 65 cm (43 to 106 cm) in depth from the ground surface and were around 150 cm (105 to 210 cm) from the burrow entrance.

The burrowing owl nest photographed by Walker (28) was about 70 cm below the ground and 120 cm from the burrow entrance. In describing his search for a nest burrow with a straight entrance, Walker (28, p. 79) states, "Most of the tunnels turned sideways. Some rose; a few dropped and doubled back in contortions that completely baffled my probing wire." The descriptions of nest burrows given by Bent (23, p. 385) and by Bendire (29) are also quite similar to the findings of the present study.

Of interest is Hennings' (3, p. 73) observation that the nest burrows were cleaned of the nesting material (largely consisting of divots from a nearby golf course), both within and without, shortly after the young were hatched. This is directly contradictory to the present findings, as nest materials were still present on the outside of the burrows in September, besides the inner linings previously mentioned.

### HABITAT CHANGES

Prairie dog towns can be considered the primary burrowing owl habitat in the study area, as is evident from the data presented in Table 2. Although the dog towns comprised only 0.16% of the total area, 66% of the adult owls lived there. Any changes in the status of these dog towns would have a substantial impact upon the burrowing owl population. Changes in the status of active prairie dog towns since 1967 are recorded in Table 4.

TABLE 4. *Changes in the status of active prairie dog towns, Beaver County and eastern Texas County, Oklahoma, 1967-1970.*

	No. of dog towns	% of 1967 dog towns	Acreage Involved	% 1967 acreage
Total study area, 1967 <sup>a</sup>	33	100	1,609	100
Towns destroyed, 1967-1970	10	30.3	302	18.7
Remaining towns, 1967-1970	23	69.7	150	9.3
Net losses, 1967-1970	10	30.3	152	9.4
Towns not listed in 1968 <sup>a</sup>	21	63.6	265	16.4
Net dog town status, Aug., 1970	44	—	1,722	—

<sup>a</sup> Survey by Tyler (4, pp. 72, 73, 81).

Dog towns "destroyed" refers to those having less than six prairie dogs in June, 1970. These dog towns were treated by the landowner with poisoned grain or gas in an attempt to kill all the prairie dogs. Referring to the same category, the ten dog towns listed do not include three colonies, totaling 37 acres, listed by Tyler (4, p. 72) which could not be located in 1970; thus, their status remains uncertain. Of those towns listed as destroyed, three (207 acres)

are now under cultivation, including 180 acres of irrigated cropland. The other seven destroyed dog towns remain in pasture. In four of these uncultivated areas, a few prairie dogs remained and some of the old burrows were still available for use by burrowing owls. The dog towns not reported by Tyler (4, pp. 72, 73, 81) apparently represent a combination of recently formed colonies and older colonies inadvertently overlooked by Tyler. The landowners reported that seven of these were present during Tyler's survey and two were new. The history of the other 12 has not yet been determined. Most of these towns were small. It is significant that most of these additional dog towns were discovered, and their acreage estimated, in early August, whereas acreages of the previously known colonies were usually estimated in June. The August acreage estimates may be higher due to the annual increase and dispersal of young prairie dogs.

The burrowing owl habitat in prairie dog towns known to be in existence in 1967 (4, pp. 72, 73, 81) decreased at least 7.7% in acreage and 30.3% in the total number of dog towns by 1970.

Several scientists reported a decline in burrowing owl populations following prairie dog poisoning campaigns. The eradication of a dog town may directly reduce owl populations through the killing of the owls (30, p. 34). Koford (30, p. 73) indicated that a few years after destruction of a prairie dog colony the burrows and associated habitat are no longer suitable for burrowing owls.

This deterioration of habitat, especially the loss of nesting sites, is probably a more significant result of prairie dog eradication efforts than is direct poisoning. The reduction in the number of dog towns may also be more important than the decrease in acreage. The complete eradication of a dog town seems to eliminate, or reduce to a few scattered individuals, a distinct colony or segment of the burrowing owl population. The ultimate result is a reduction of numbers and a loss of distribution and ability to disperse, both being detrimental to the survival of the species.

A much larger proportion of the study area has contained prairie dog towns and associated burrowing owl colonies in times

past. This is supported by statements of several long-time residents of the area. The presently scattered owl populations, both in existing prairie dog towns and in areas without dog towns, probably represent remnants of formerly larger and more widespread owl colonies. In talking with numerous landowners, it was learned that poisoning campaigns are being planned for most of the remaining prairie dogs. Just how extensively and effectively these plans will be executed remains to be seen.

#### ACKNOWLEDGMENTS

The author is grateful to James C. Lewis for his invaluable assistance and guidance in all phases of the research and preparation of the manuscript, as well as to L. Hodges and, especially, to L. Anderson for their assistance in the early stages of the field work.

Financial support from Welder Wildlife Foundation, Oklahoma State University Research Foundation, and the National Science Foundation is gratefully acknowledged.

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