

THE IMPORTANCE OF PRAIRIE DOG TOWNS TO BURROWING OWLS IN OKLAHOMA

K. O. Butts* and J. C. Lewis[†]

Oklahoma Cooperative Wildlife Research Unit,[‡] Oklahoma State University, Stillwater, Oklahoma 74078

Burrowing owl populations are low or nonexistent in areas of central and western Oklahoma where prairie dogs have been eradicated. In 1970 and 1971, we studied habitat requirements of burrowing owls (*Athene cunicularia hypugaea*), in the eastern third of the Oklahoma Panhandle, to determine the extent that the owls are dependent on the existence of black-tailed prairie dog (*Cynomys ludovicianus*) colonies. Sixty-six percent of the adult owls lived in dog towns even though this habitat composed only 0.16% of the area. Most owls nested in prairie dog burrows and dog towns were the only area where the owls had nesting colonies. The use of satellite burrows by the male, and of multiple burrows (all in a small area) by individual owl families, indicates a requirement met only in dog towns. We found no evidence that owls ever dug their own burrows. Field observations of individual owls indicated that dog town habitat was the source of almost half the owls' midsummer and late summer diet and was particularly suitable for ground feeding behavior. Owls that nest in nonprairie dog habitat in Oklahoma are utilizing marginal habitat and may consist primarily of population overflow from the preferred habitat. To maintain healthy populations of burrowing owls in Oklahoma, safe from possible extinction, prairie dog towns should also be maintained.

INTRODUCTION

The western burrowing owl historically occupied grasslands west of a hypothetical line extending from northwestern Louisiana through Minnesota and into Manitoba but is now absent from many of these areas, especially in the eastern and central Great Plains. This owl is not nationally listed as endangered or threatened. However, its status may be more precarious than previously suspected, especially in those areas where it lives in association with prairie dogs.

Black-tailed prairie dog towns, referred to hereafter as dog towns, were extensive and numerous in western Oklahoma and the Texas Panhandle when white settlers first arrived (1, 2). In Texas a single dog town reportedly covered 6.5 million hectares (1). By 1968, from the millions of hectares of dog towns historically found in Oklahoma, the area had declined to 3,856 ha (3).

Poisoning techniques for prairie dogs are effective and it is relatively simple and inexpensive to eliminate large colonies or to reduce colony size. In areas where prairie dogs have been eradicated, burrowing owl populations have diminished drastically or are now nonexistent. Thus, circumstantial evidence indicated that these owls were highly dependent on dog towns for suitable habitat.

In 1970 and 1971, we studied habitat requirements of burrowing owls. This paper describes the close association, in terms of life history activities and habitat use, that burrowing owls have with dog towns in Oklahoma.

STUDY AREA

The study area encompassed 5,114 km² in Beaver and eastern Texas Counties, Oklahoma, which is the eastern third of the Oklahoma Panhandle, including part of the High Plains, breaks in the plains, erosional uplands, and valleys. Fifty to 60% of the area was cultivated (mainly wheat and sorghum) and the remainder was used primarily for cattle grazing. A large percentage of the grazing land was located in linear strips along major drainages and most dog towns were located within these strips. Daily summer high temperatures are

*Present address: Manager, Washita National Wildlife Refuge, Butler, OK 73625

[†]Present address: Georgia Cooperative Wildlife Research Unit, School of Forest Resources, Univ. of Georgia, Athens 30602

[‡]Oklahoma State University, Oklahoma Department of Wildlife Conservation, U.S. Fish and Wildlife Service, and Wildlife Management Institute, cooperating.

often above 32 C and occasionally exceed 38 C. The area is semiarid with an average annual precipitation of 49 cm and mean annual snowfall of 43 cm (4).

General studies of prairie dog life history were concentrated in 44 dog towns. Most dog towns were in short grass prairie but a few were in overgrazed sand-sage (*Artemisia filifolia*) grasslands. Shortgrass soils are 25 cm or more in depth and include sandy loams, clay loams, and lime soils.

METHODS

Nine months were spent in field work during the period May 1970 to August 1971. Seventy-seven owls were captured in dog towns (mainly in 1970) and banded with aluminum leg bands; of these, 35 were also marked with colored plastic leg bands that permitted individual identification from a distance. A spotting scope and binoculars were used to observe behavior. About 75% of the observations of behavior were made from a vehicle, usually at a distance of at least 100 m. In a relatively short time owls became accustomed to the presence of a stationary vehicle.

Adult burrowing owls were censused in June of 1970 and 1971. We made a total count of all owls living in known dog towns because literature and personal observations indicated that owls concentrated in this particular habitat. To acquire an estimate of the population of burrowing owls living outside the influence of dog towns, we censused 54, randomly selected, 259-ha tracts, each located at least 1.6 km from any dog town.

Notes were recorded on various ecological factors including distance between nest burrows, surrounding vegetation, soil types, topography, and the original designer of the burrow. Owl nest burrows are relatively easy to find because the owls place dried cow or horse manure around the burrow entrance. Eleven nest burrows within dog towns and 2 burrows outside dog towns were excavated to provide data on burrow characteristics. We also excavated 19 burrows used by owls in winter.

In 1970, nest burrows were marked with numbered wooden stakes and maps were prepared showing locations of nest burrows in all intensively studied dog towns. Home ranges were determined by recording the movements of individual owls.

RESULTS

Owl Populations

In June, 1970, there were 359 adult owls residing in or within 1.6 km of a dog town (1.9 ha of dog town per owl). Observations of color-marked adult owls indicated that, in spring and summer, flights more than 1.1 km from nests were uncommon. The owls nesting in dog towns were meeting all of their spring-summer habitat needs within a 1.6-km radius of the dog town. Three, and possibly five, pairs of burrowing owls resided in isolated badger burrows outside, but within 1.6 km of, dog towns. These owls shared some feeding areas with owls in nearby dog towns and were included in our population estimate for owls associated with dog towns.

While censusing the 54 sample tracts located 1.6 km or more from a dog town, we found 2 owl nests and another pair of owls was seen on the edge of a sample tract. We assumed the 6 owls, on the 13,986 ha sampled, were representative of the 3,002 km² of the study area located 1.6 km or farther from dog towns. The total calculated population of adult owls living away from dog towns was 92 pairs (a pair per 4,604 ha).

Winter and Spring Prenesting Activities

Most burrowing owls migrate from Oklahoma in October and some spend the winter as far south as west-central Mexico (5). About 0.05% of the total owl population overwintered in the study area; they occupied the same dog town habitat year round. During severe winter weather these owls remained in burrows for several days in succession.

The migratory owls returned to their nesting habitat in the second or third week of March. Owls remained inactive in late morning and afternoon, often staying within the burrow or in the burrow mouth. The first indication of pair formation was 10 March when a pair was observed together in a burrow mouth, and the male exhibited sexual excitement as evidenced by the "white and tall" posture (6).

Owls usually selected a nest site after formation of pair bonds. We do not know

if burrowing owls appropriated active prairie dog burrows for their own use or only selected unoccupied burrows. Few behavioral interactions were observed between burrowing owls and prairie dogs. The direct confrontations observed always indicated that prairie dogs were submissive to the owls.

Cleaning the burrow was the first step in nest building. The male members of two pairs were observed cleaning burrows on the evening of 2 April. Male owls constructed the nests primarily of broken and shredded particles of cow and horse manure and maintained a supply of manure around the mouth of nest burrows. Dry manure at burrow entrances may have helped prevent some water runoff into nests (7). In March, 1971, an observer could still distinguish nests used in 1970 unless prairie dogs had scratched away the manure when they reoccupied and cleaned the burrow.

We found no evidence that burrowing owls ever dug their own nest burrows on the study area. All burrows used in dog towns were originally constructed by prairie dogs. Judging from the size and shape of the burrows, badgers (*Taxidea taxus*) had originally dug those burrows used by owls outside dog towns.

Some owls used the same nest burrow for two consecutive years. A male, banded as an adult at his nest in 1970, chose the same burrow for a nest site in 1971. Several nest burrows marked in 1970 were used again in 1971 but we could not confirm that the individual owls involved were the same in both years. One female, banded as a nesting adult in 1970, nested in the same dog town but in a different burrow in 1971; prairie dogs occupied her former nest burrow. Bailey and Niedrach (7) noted that owls in Colorado often returned to nesting holes used the previous year.

Territorial Behavior

Burrowing owls exhibited intraspecific territorial behavior during the reproductive season. The owl's burrow(s) and a portion of the surrounding ground surface constituted the defended area, but air space above the territory was seldom defended. The establishment of territories and pair formation occurred at roughly the same time. Territorial defense by adults was not observed after the owlets became active above ground.

The spacing of nests should indicate territory size. Twelve nests were found in a 3.6-ha dog town (1 nest per 0.3 ha). Ten were within 0.6 ha (1 nest per 0.06 ha); 8 of the 10 were 25 m or less apart, and 2 were only 13 m apart. Therefore, assuming that territories were roughly circular with radii representing one half the distance between adjacent nests, in some instances the territory of an individual pair would have been less than 0.04 ha.

Owl Nest Burrow Ecology

The distribution of nest burrows within dog towns was highly variable: randomly distributed, concentrated along the dog town edge, or clumped. Topography surrounding the nest burrow and orientation of the entrance were both highly varied. Nest burrows were on flat or gently sloping terrain. Burrow entrances faced virtually all points of the compass. We did not observe owls using any burrows where height of surrounding vegetation exceeded 10 cm. Only 6 of about 300 burrows used by owls were located in vegetation other than grazed short grasses. Five of the exceptions were in field edges where prairie dogs kept the vegetation clipped short, and the other was in a mowed pasture.

The owls did not show preference for any particular soil type when selecting prospective burrows. We found owl burrows in hard clays, sand, gravelly soil, and various mixtures of these. Internal characteristics of nest burrows were presumably determined mainly by what the original designer excavated because the owls apparently made few modifications. However, nest burrows never had vertical entrances although such entrances occur in some prairie dog burrows. Most of the excavated nest burrows contained tunnels with slopes of 15 to 25° and some curved gently to the right or left.

In all nest burrows in dog towns, tunnel size remained fairly uniform, about 14-15 cm wide and 11-13 cm in height, back to the nest chamber. Occasionally the mouth of the burrow was slightly larger than the tunnel. The nest chamber was roughly circular or oblong, about 25 cm wide and 10 to 15 cm in height. The nest chambers may have been former "turn-around" (8) places for prairie dogs; however, excavation of 19 burrows used by wintering owls revealed that only 2 contained such turn-arounds. Thus, owls may have modified tunnels to

make nest chambers, or they may have selected burrows that contained such turn-arounds. Owls modified existing burrows of bannertailed kangaroo rats (*Dipodomys spectabilis*) in New Mexico to form circular, domed nest chambers 33 cm in height and 55 cm in diameter (9). Presumably the sandy soils of the New Mexico area permitted greater ease of digging and modifying burrows than did soils in the Oklahoma study area.

The floor of the nest chamber was always covered with soft, crumbled cow or horse dung 3-7 cm deep. In most burrows a slight amount of this dung was scattered along the tunnel, increasing in quantity about 30 cm from the chamber. Nest chambers averaged 69 cm (38-107 cm) below the ground surface and 150 cm (107-213 cm) from the burrow entrance. A tunnel led away from the nest chamber of all but two nest burrows we examined. Usually this tunnel was at least partially plugged, and in one burrow it was tightly plugged with dirt and nest lining.

Burrows used by owls wintering in dog towns were quite similar to those in which they nested except they were longer and, as previously noted, without enlarged chambers.

Two owl nests in abandoned badger burrows, located away from dog towns, were 165 and 216 cm from the entrance. Tunnel dimensions were 18 and 22 cm wide by 15 and 19 cm in height. The first burrow terminated in a circular nest chamber with dimensions similar to those in prairie dog burrows. The other burrow was 22 cm wide and 19 cm in height at its terminus, but a chamber was not present. Crumbled cow manure was near the end of both burrows, but not in quantities as large as in nests in dog towns.

Nesting And Care Of Young

Females were seldom active above ground during egg laying and incubation. They remained in or near their burrows and were seen only occasionally in the evening and morning when their mates brought food. After the eggs hatched, females remained near the nest until owlets emerged above ground.

Males were usually quite sedentary during midday and rested in the mouth of a satellite burrow or on a perch. A satellite burrow was usually within 10-30 m of the nest and the male regularly sat on the burrow mound or crouched in the burrow entrance. Males stood watch there while their mates were in the nest burrow, especially during incubation and before owlets emerged from their nest, and warned their mates with an alarm call when intruders appeared.

Owlets usually were brooded within the nest for 10 days or more. They were first observed outside their burrow, in morning or evening, the second or third weeks of June. Adults became more active when young emerged from the burrow. During midday, owlets were normally within their nest burrow, adult females were in the mouth of the nest burrow or an adjacent burrow, and males remained in the mouth of a satellite burrow or on a perch near the nest.

Owl families began utilizing other burrows, along with the nest burrows, soon after owlets first appeared above ground. In several situations, the oldest two to four owlets moved to a burrow 4 to 16 m from the nest burrow where their younger brood mates remained. This arrangement probably allowed better distribution of food among young of unequal size and relieved crowded conditions within nest burrows, thus potentially increasing survival rates for younger members of broods. Brood mates usually remained separated for less than 1 week; then the younger owlets joined their brood mates at a burrow in the vicinity of the nest.

This use of multiple burrows by each owl family indicates another habitat requirement uniquely provided only by dog towns. Entire owl families continued to switch burrows, remaining at each burrow for 5 to 15 days. They seldom returned to the original nest burrow, but remained in the general vicinity. The reason(s) for the owls moving from one burrow to another were unknown. Perhaps they moved in response to a concentration of ectoparasites and ants at the abandoned burrow. Ants were abundant at burrows used by owl families. The numerous prey remains and other debris probably attracted ants and ectoparasites.

Owls reduced their diurnal activities in August and early September, perhaps due to high temperatures in the study area, which usually were more than 32 C and

occasionally exceeded 38 C. Most owls then spent the day in the mouth of a burrow or in the shade of a clump of vegetation, usually in the general vicinity of the nest burrow.

Use Of Abandoned Dog Towns

Burrowing owl use of abandoned dog towns for nesting was shortlived as indicated by results of the census in 10 dog towns (122 ha) cultivated or poisoned between 1967 and 1970. Three dog towns had been cultivated and contained no prairie dogs or owls. Two active nests were found in 1970 in a 14-ha dog town poisoned in 1968, but owls were not present in 1971. One pair of owls nested in 1971 in an abandoned 2.5-ha dog town poisoned in 1968. This nest was in a pipeline right-of-way, a disturbed area having less vegetation than the surrounding mid-grass and sand-sage pasture.

Small populations of prairie dogs persisted after 5 dog towns (38-40 ha) were poisoned; some of these prairie dogs may have immigrated from neighboring dog towns. Eight owl nests were present in the five dog towns. All owl nests were in segments of the towns where prairie dogs still resided; these segments composed less than 10% of the former dog town area.

For burrowing owls, the most damaging result of eradicating prairie dogs was the rapid decline in numbers of burrows available for owl nest sites. Burrows of abandoned dog towns were soon filled with soil, debris, and grass. Nearly all burrows had lost their identity within 3 years after disappearance of the prairie dogs. In the absence of grazing by prairie dogs, and with light use by cattle, mid-grasses in abandoned dog towns sometimes became fairly tall. These areas lost their attractiveness to owls and were used only occasionally for feeding and escape habitat.

Use Of Habitat Outside Dog Towns

Burrowing owls were seldom found in habitat that was distant from dog towns. As noted earlier, our 1970 census indicated an owl pair per 4,600 ha in that portion of the study area at least 1.6 km from any dog town. All nests found outside dog towns were in burrows originally dug by badgers as dens rather than the more common and less extensive diggings resulting from badger feeding activity. Owls did not use the more numerous burrows of thirteen-lined (*Spermophilus tridecemlineatus*) and spotted ground squirrels (*S. spilosoma*), and Ord kangaroo rats (*Dipodomys ordii*), perhaps because the badger burrows were larger and possessed other characteristics that made it unnecessary for the owls to modify the burrows.

DISCUSSION

Active dog towns were definitely the preferred breeding habitat for burrowing owls in our study area because 66% of the adult owls were associated with this habitat even though it composed only 0.16% of the study area. This habitat preference is apparently not unique to Oklahoma (2, 8, 19, 11, 12). One primary factor in this habitat preference was the availability of vacant burrows with dimensions and characteristics generally suitable for use by burrowing owls. We found no evidence that burrowing owls ever dug their own burrows; they depended upon other animals for their nesting sites. The fact that these owls were uncommon or absent from non-prairie dog habitat, despite the presence of kangaroo rats and ground squirrels, indicated that most owls were unwilling or unable to make extensive modifications of smaller and less suitable burrows.

Goss (13) stated that western burrowing owls in Kansas dug their own burrows, but provided no supportive evidence for his statement. Palmer (14) said Florida burrowing owls dug their own burrows. In contrast, Thomsen (15) indicated that burrowing owls in California rarely dug their own burrows; instead they used those of Beechey ground squirrels (*Spermophilus beecheyi*). There is little evidence that any burrowing owls can dig their own nest burrows except in some sandy soils.

Olendorff (16) stated that burrowing owls in northeastern Colorado were definitely dependent upon prairie dogs for nest hole "starts". Coulombe (17) believed the major factor controlling the abundance of burrowing owls in the Imperial Valley of California was the availability of burrows and, that the burrow was the key to the ecology of the species.

Another attraction that active dog towns apparently had for the owls was openness

and short vegetation. Prairie dogs maintained the openness by clipping off any vegetation that exceeded 15-20 cm in height. The short vegetation supported populations of arthropods that were among the main food resource for the owls. The dog town habitat provided almost half the owl's diet during middle and late summer, and was particularly suitable for ground feeding behavior (6).

Numerous authors have noted burrowing owls nesting in non-dog town habitat in other states. These include owls living in modified dens of banner-tailed kangaroo rats (9); modified dens of round-tailed, California, and rock ground squirrels (*S. tereticaudus*, *S. beecheyi*, *S. variegatus*) (15, 17, 18); swift fox (*Vulpes velox*) dens (19, 20); burrows dug by coyotes (*Canis latrans*) (21); abandoned badger burrows (22); a woodchuck (*Marmota monax*) den (23); and culvert drains (24). Other than prairie dogs, presumably the main source of burrows for owls in central and western Oklahoma would be coyote, fox, and badger. Of the latter three, only the coyote is still relatively common over a large area and none of these carnivores tend to select den sites in the short grass habitat preferred by the owls. Consequently, where prairie dogs are eradicated, little suitable nesting habitat remains for burrowing owls.

Most burrowing owls in Oklahoma nest in colonies. Only prairie dog towns provided a sufficient number of burrows, in a small area, to support a nesting colony of owls. The use of satellite burrows by the male, and of multiple burrows (all in a small area) by individual owl families, indicates a requirement met only in dog towns. Other researchers have noted similar use of multiple burrows. Owl families used 2 to 10 burrows in North Dakota (25) and a family of owls occupied two burrows in Colorado (7).

In Oklahoma, abandoned carnivore dens provide less favorable habitat for owl nests because the dens are too few in number in a small area, and they are located where the surrounding vegetation is denser and taller than burrowing owls prefer. We conclude that burrowing owls nesting in non-dog town habitat in Oklahoma are using marginal habitat. If residents of Oklahoma wish to maintain safe population levels of burrowing owls, then prairie dog populations also must be maintained.

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