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COYOTE (*CANIS LATRANS*) MOVEMENTS RELATIVE TO CATTLE (*BOS TAURUS*) CARCASS AREAS

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Abstract.—Use of 2 cattle carcass areas was determined for radio-collared coyotes (*Canis latrans*) in northwest Texas from January 1999 to January 2000. When 0–3 dead cattle were located at the carcass areas, resident and transient coyotes visited the carcass areas 4% and 8% of the time, respectively. However, when 30–35 dead cattle were located at 1 carcass area due to a disease epizootic, resident and transient coyotes had increased visitation rates of 19% and 63%, respectively. Resident coyotes traveled as far as 12.2 km from the center of their home ranges, suggesting that carcass areas influenced residents over a 468-km^2 area. Transient coyotes traveled from as far as 20.5 km away, suggesting that carcass areas influenced transients over a 1320-km^2 area. Our results indicate that carcass areas can influence coyotes over large areas and may concentrate both resident and transient coyotes in relatively small areas, at least for short periods.

Key words: coyote, Canis latrans, *cattle, carrion, home range, movements, Texas.*

Coyotes (*Canis latrans*) have omnivorous diets and are opportunistic feeders (Bekoff 1982). Carrion is often an important part of coyote diets, especially in more northern areas (Camenzind 1978, Bekoff and Wells 1980, Bowen 1981). Large amounts of carrion have been shown to concentrate coyote numbers in winter (Camenzind 1978, Bekoff and Wells 1980, Bowen 1981). However, little information exists concerning the influence of carrion concentrations on movements of local coyote populations. Furthermore, coyotes have been classified in their social organization as residents and transients (Messier and Barrette 1982, Andelt 1985, Gese et al. 1988, Kamler and Gipson 2000), and the effects of carrion concentrations on different social classes are not known. For example, residents that have established territories may be less influenced by carrion concentrations than transients. Residents cannot leave their defended territories to obtain carrion (Hein and Andelt 1996), as excursions leave their territory vulnerable to other coyotes (Kamler and Gipson 2000).

Coyotes can be effective predators of livestock, especially calves and sheep (Gier 1968, Andelt 1987, Gilliland 1995, Knowlton et al. 1999). Therefore, data concerning the effects of particular ranching practices on coyote populations can be useful information. Although many large-scale livestock operations and cattle feed yards dispose of dead livestock in carcass areas, the use of carcass areas by coyotes has rarely been reported (Danner and Smith 1980). We conducted a study of coyote ecology in northwestern Texas, where many private ranches contain cattle carcass areas. We attempted to assess the influence of 2 carcass areas on the surrounding coyote population, especially when an unusually high number of dead cattle ($n > 30$) were located at 1 of the carcass areas. We determined visitation rates and distances traveled to carcass areas for both resident and transient coyotes.

Study Area

Our study site is a 9000-ha area of Rita Blanca National Grasslands that is interspersed with private lands in west central Dallam County, Texas. Rangeland vegetation consists of short-grass prairie species dominated by blue grama (*Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) that was moderately to intensively grazed by cattle (*Bos taurus*). The site is adjacent to an 11,000-ha private cattle ranch to the northwest and a 3400-ha private cattle ranch to the south. Both cattle ranches

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contained a shallow pit where dead cattle were placed to be scavenged (hereafter, carcass area).

Potential mammalian prey that occurred on the study site include pronghorn (*Antilocapra americana*), black-tailed jackrabbits (*Lepus californicus*), desert cottontails (*Sylvilagus audobonii*), black-tailed prairie dogs (*Cynomys ludovicianus*), Ord's kangaroo rats (*Dipodomys ordii*), ground squirrels (*Spermophilus* spp.), gophers (*Geomys* and *Cratogeomys* spp.), prairie voles (*Microtus ochrogaster*), hispid cotton rats (*Sigmodon hispidus*), northern grasshopper mice (*Onychomys leucogaster*), woodrats (*Neotoma* spp.), pocket mice (*Chaetodipus* and *Perognathus* spp.), harvest mice (*Reithrodontomys* spp.), and *Peromyscus* spp. (Lemons 2001).

METHODS

We captured and radio-collared 12 coyotes (6 male, 6 female) from January to April 1999, using No. 3 Victor Soft Catch® traps (Woodstream Corp., Lititz, PA) equipped with the Paws-I-Trip™ pan tension system (M-Y Enterprises, Homer City, PA). Trap sets were baited with a variety of baits, urines, and lures and checked once daily. We immobilized coyotes with an intramuscular injection of ketamine hydrochloride and xylazine hydrochloride (10:1 ratio; dosage = 1 mL · 10 kg^{-1} of body weight). At time of capture we classified coyotes as adult (>2 years), yearling (1–2 years), or juvenile (<1 year) based on body size, reproductive condition, and wear on teeth (Gier 1968). Coyotes were equipped with radio-transmitter collars (Advanced Telemetry Systems, Inc., Isanti, MN) and released at their capture sites. Due to an early death, 1 female coyote was not monitored long enough to be used in analyses.

We classified coyotes as resident or transient based on the following criteria: resident coyotes, which consisted of breeders (mated pair) and often pack associates (yearling offspring that have not dispersed but do not breed), lived in family groups with relatively small home ranges that overlapped little with other resident groups (Andelt 1985, Gese et al. 1988, Kamler and Gipson 2000); transient coyotes were solitary with relatively large, poorly defined home ranges that overlapped those of other coyotes (Andelt 1985, Gese et al. 1988, Kamler and Gipson 2000). For resident females, breeders were distinguished from pack associates by inspection of their nipples and reproductive tracts after death. All resident males were considered breeders because all were >2 years and appeared reproductively active (e.g., had descended testes) when captured.

We recorded telemetry locations for each coyote 1–2 times per week and >12 hours apart to establish independence (White and Garrott 1990). Coyote locations were triangulated using 2–3 bearings obtained <5 minutes apart. We radio-tracked from a vehicle using a null-peak telemetry system, which consisted of dual, 4-element Yagi antennas. We conducted radio-tracking primarily during 1800–0900 hours, when coyotes were likely to be most active (Andelt 1985). We calculated location estimates using the maximum likelihood estimation option in the program Locate II (Pacer, Inc., Truro, Nova Scotia, Canada). Mean errors for reference collars (known locations) were 84 m (95% of errors were <145 m).

We determined home range sizes of resident coyotes using the 95% minimum convex polygon (MCP) method (Mohr 1947), as calculated by the Animal Movement program (Hooge and Eichenlaub 1997). We calculated home ranges of resident coyotes with >40 locations and >9 months of radio-tracking. Because 2 resident coyotes were killed before 40 locations were obtained, we estimated their minimum home ranges with 22 and 23 locations, respectively. We did not calculate home ranges for transient coyotes because they were not radio-tracked continuously throughout the year and had <30 total locations.

We determined the frequency of each coyote's visits to the carcass areas by dividing the number of times they were located at the carcass areas by total number of locations. We calculated frequencies for 9 months of the year (mid-January to September 1999) when 0–3 dead cattle were at the carcass areas at any given time (R. Wyatt and B. Burnacki, Dalhart, TX, personal communication), and for 3 months of the year (mid-October 1999 to mid-January 2000) when approximately 30–35 dead cattle were at the carcass area on the southern ranch (B. Burnacki personal communication). Approximately 50–60 cattle died because of a disease epizootic over that 3-month period on the southern cattle ranch, and approximately 30–35 carcasses were in the carcass area at any given time. We determined distances that resident coyotes traveled to the carcass areas by measuring the distance from

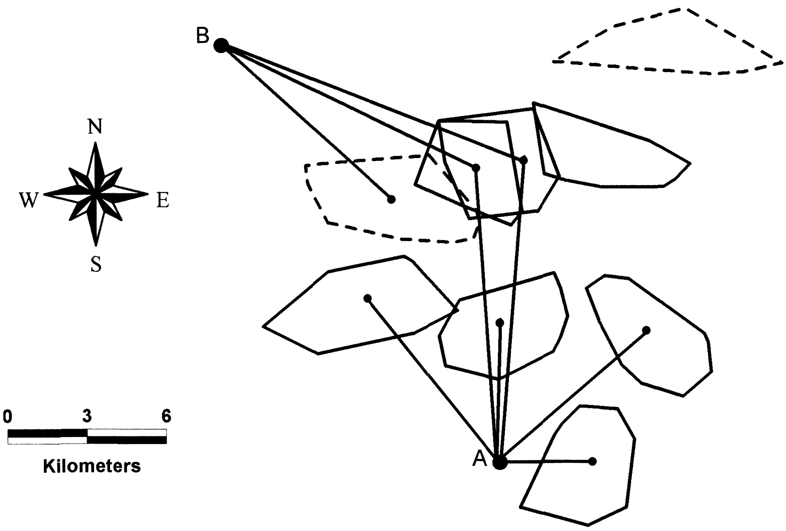

Fig. 1. Home ranges of 7 resident coyotes (solid polygons) and estimated home ranges of 2 resident coyotes (dashed polygons) on public and private lands in Dallam County, Texas, January 1999–January 2000. Two large dots represent the carcass areas on private lands to the south (A) and north (B). Smaller dots represent centers of coyote home ranges and lines represent straight-line distances to the carcass areas.

the center of their home ranges to the carcass areas. We determined distances for transient coyotes by measuring the distance between their farthest locations and the carcass areas. We estimated total areas that carcass areas may influence resident and transient coyotes by using the maximum distance traveled as the radius in the area-of-circle equation (area of circle = πr^2).

RESULTS

The mean ($\pm s_{\bar{x}}$) home range size of 7 resident coyotes (3 females, 4 males) was 12.5 ± 0.4 km^2. We also estimated minimum area of use for 2 additional residents (1 female, 1 male) with 20–25 locations (Fig. 1). One resident female was classified as a pack associate, whereas all other residents were classified as breeders. Two resident coyotes, including the pack associate, changed social status and became transients, similar to changes reported by others (Andelt 1985, Kamler and Gipson 2000). From the center of their home ranges, 3 resident coyotes traveled a mean ($\pm s_{\bar{x}}$) distance of 10.6 ± 1.0 km (range = 8.7–12.2 km) to the northern carcass area, whereas 6 resident coyotes traveled a mean distance of 7.9 ± 1.3 km (range = 3.7–11.5 km) to the southern carcass area (Fig. 1). Two resident coyotes never traveled to either the northern (14.8 and 16.9 km away) or southern (12.2 and 17.2 km away) carcass areas (Fig. 1). Because resident coyotes traveled a maximum distance of 12.2 km, the carcass area affected resident coyotes over a 468-km^2 area.

Five transient coyotes traveled a mean distance of 15.9 ± 1.8 km (range = 12.8–20.5 km) to the southern carcass area, whereas no transient coyotes were recorded traveling to the northern carcass area. Because transient coyotes traveled a maximum distance of 20.5 km, the carcass area affected transient coyotes over a 1320-km^2 area.

When 0–3 dead cattle were in the 2 carcass areas during a 9-month period, both residents and transients had relatively low mean visitation rates of 4% and 8%, respectively (Table 1). When >30 dead cattle were placed in the southern carcass area during a 3-month period, both resident and transient coyotes had increased mean visitation rates of 19% and 63%, respectively (Table 1). The highest visitation rate among residents (16%) was exhibited by the only known pack associate. This pack associate dispersed and became a transient in October and subsequently spent a majority of her time (76%) at the southern carcass area.

TABLE 1. Visitation rates[a] (%) of resident and transient coyotes to cattle carcass areas in Dallam County, Texas, 1999–2000.

Social class	Jan.–Sept. (0–3 dead cattle)		Oct.–Jan. (>30 dead cattle)	
	n	Mean ± $s_{\bar{x}}$ (%)	*n*	Mean ± $s_{\bar{x}}$ (%)
Resident	9	4.4 ± 1.8	6	19.3 ± 7.5
Transient	2	7.7 ± 1.8	2	63.1 ± 13.1

[a]Visitation rate = number of visits / total locations.

DISCUSSION

Cattle carcass areas can influence coyotes over relatively large areas. Visitation rates of both resident and transient coyotes were relatively low during most of the year when few, if any, dead cattle were in carcass areas. However, during periods when large amounts of carrion were present, visitation rates increased more than fourfold for resident coyotes and more than eightfold for transient coyotes. Additionally, during early January 2000, the United States Department of Agriculture's Wildlife Services initiated a coyote control program at our study site for another research project. During 2 days of aerial-shooting coyotes from a fixed-wing aircraft, 44 coyotes were killed in an approximately 2-km^2 area surrounding the southern carcass area. Thus, large amounts of carrion caused coyotes to congregate in relatively high numbers around the carcass area. Although >30 dead cattle may be unusual for most private ranches, this number is not unusual for cattle feed yards that commonly dispose of dead cattle in carcass areas (Danner and Smith 1980).

The pack associate had the highest visitation rate of all residents, and she later became a transient, subsequently spending most of her time at the southern carcass area. This was not surprising, as previous research indicates that pack associates are more fluid than breeders in their resident status (Sacks et al. 1999). Pack associates often make more forays away from territories than breeders, probably as a precursor to finding their own territory (Sacks et al. 1999, Kamler and Gipson 2000). More surprisingly, though, was that resident breeders (mated pairs) periodically left their home ranges to visit cattle carcass areas during our study. Resident breeders rarely leave their home ranges, as excursions put their territory at risk to other coyotes (Kamler and Gipson 2000). The relatively high frequency of visitations by resident coyotes in our study suggests that benefits of obtaining large amounts of carrion must have outweighed the risk of losing their territory to other coyotes.

Previous research indicates that resident coyotes might temporarily leave their home ranges to obtain carrion (Bekoff and Wells 1980, Bowen 1981). However, Hein and Andelt (1996) found that resident coyotes did not visit carrion when it was placed outside their home ranges. Reasons for differences among studies are unknown, although they might have been due to local food resources. Consumption of carrion by coyotes generally increases when local food resources decrease (Bekoff and Wells 1980, Bowen 1981, Todd and Keith 1983). Thus, although we did not determine abundances of local prey species on our study site, relatively low numbers of local prey might have encouraged resident coyotes to temporarily leave their home ranges to obtain additional food resources.

Transient coyotes may have benefited more from carrion than residents, as transients were influenced over a larger area and had higher visitation rates than residents. Additionally, when large amounts of carrion were present, transients spent a majority of their time near the carcass area, most likely because of the abundant food resources and lack of territoriality by other coyotes. Transient coyotes, which can be old, disabled, or young coyotes that have just dispersed, generally have lower survival than residents and are often excluded from optimal resources by territorial residents (Kamler and Gipson 2000, Gese 2001). However, large amounts of carrion can break down social structure of local resident coyotes, as local family groups cannot defend their territories against high numbers of intruding coyotes (Camenzind 1978). Thus, lack of territoriality around large amounts of carrion allows transients access to abundant and easily accessible food resources (Camenzind 1978), which could potentially increase their fitness and survival. This likely occurred at our study site, as the high numbers of coyotes killed near the carcass area and high visitation rates of radio-collared coyotes suggest that territoriality broke down in areas immediately surrounding the carcass site.

Our results were similar to those found by Danner and Smith (1980), who reported that a continual supply of livestock carrion from a feed yard influenced coyote movements over a 380- to 700-km^2 area, as radio-collared coyotes traveled from as far as 15.3 km. In that study, immature coyotes, which are often transients, visited the carrion site 5 times more often than adults, which are often residents. Although the supply of carrion near our study site was not continual, our results indicate that even short-term supplies of carrion have an immediate impact on the surrounding coyote population, at least with respect to overall movements. Additionally, our results demonstrate that carcass areas may influence coyotes over larger areas more than previously reported.

Our results also have implications for livestock producers because large amounts of carrion can increase livestock losses in 2 ways: by habituating coyotes to feed on livestock flesh and by increasing and concentrating local coyote densities around livestock (Green et al. 1994). Habituating coyotes to feed on livestock carrion can lead to coyotes' developing a taste for livestock and could consequently lead to actual predation instead of scavenging (Fichter et al. 1955, Gier 1968, Phillips and Hubert 1980). Green et al. (1994) indicated that where carrion is generally not available, livestock losses are lower, and they concluded that carrion removal is an important method of damage prevention to reduce livestock losses to coyotes. Our results support those of Green et al. (1994), inasmuch as large amounts of carrion increased and concentrated local numbers of coyotes on a private ranch south of our study site. Whether coyotes became habituated to feeding on livestock flesh and consequently increased livestock predation was unknown. If coyotes did become habituated to cattle flesh, then increases in livestock losses could have occurred over a relatively large area, as coyotes traveled from as far as 20.5 km to consume cattle carrion.

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