Activity and Movements of Coyotes in Mississippi and Alabama[1]

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Abstract: Daily activity, home-range size, and seasonal and dispersal movements of 13 coyotes (*Canis latrans*) were studied in eastern Mississippi and western Alabama using telemetry techniques. Coyotes were most active and traveled the greatest distances between 1800 hours and 0600 hours. The highest movement rates occurred near sunset and sunrise. Mean distances traveled during 12-hour full-night periods were greatest for adult females (9.5 km) followed by adult males (8.6 km) and juveniles (5.6 km). Average distance traveled by all coyotes during full-night periods was shortest during fall (5.3 km) and longest during winter (12.2 km). Two juveniles and 1 adult dispersed 20 km, 140 km, and 20 km respectively, between November and January. The mean home range of adult females (41.2 km^2) was about twice the size of adult males (20.0 km^2) and nearly 4 times the size of juveniles (11.8 km^2). Adult male and female mean home ranges were smaller than those reported in most previous studies where similar methods were used.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 38:174-181

[1] A contribution of the Mississippi Cooperative Fish and Wildlife Research Unit, Mississippi Department of Wildlife Conservation, Wildlife Management Institute, U.S. Fish and Wildlife Service, and Mississippi State University, Department of Wildlife and Fisheries cooperating; funded in part through Federal Aid in Wildlife Restoration W-46 Alabama Department of Wildlife Conservation, Game and Fish Division: MAFES publication No. 5969.

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The coyote is a mobile and adaptable, high trophic-level carnivore whose distribution has been extended from its original range in the plains and mountains of western North America. An eastward change in distribution began around 1930 in the southern United States (Young and Jackson 1951; Paradiso 1968). Population foci have existed for more than 10 years in portions of some southern states east of the Mississippi River, and coyote distribution is expanding in others. As populations continue to increase and expand, it will become more important for resource managers to have baseline information for making decisions concerning coyote management, control, and harvest. Two studies have reported coyote home range size and movement activity in recently inhabited areas in the southcentral United States (Gipson and Sealander 1972, Hall 1979). However, research has not addressed these issues in southern states east of the Mississippi River. The purpose of this paper is to report activity periods, daily and seasonal movements, home ranges, and dispersal of coyotes from eastern Mississippi and western Alabama.

The authors acknowledge the cooperation and assistance of personnel at Noxubee National Wildlife Refuge and many landowners who provided access to study areas. Randy Tucker assisted with the computer analysis of home range and movement data.

Methods

The Noxubee study area in east central Mississippi occupies portions of Winston, Oktibbeha, Lowndes, and Noxubee counties. The center of this 105,430-ha area was approximately 43 km southwest of Columbus, Mississippi, between Crawford, Mississippi, and the Noxubee National Wildlife Refuge (NNWR). The Blackland Prairie and Interior Flatwoods physiographic regions roughly divide the Noxubee area. Primary land uses were pasture-rowcrops (47%) and wood products (43%).

The Sumter County area (27,000 ha) was located in the Blackbelt Prairie physiographic region of west-central Alabama. Approximately 70% of the area was in pasture, soybeans, and wheat. Some of the larger wooded tracts were managed for softwood timber production. These areas were chosen primarily because they contained a wide range of habitat types typical of much of the southeastern United States.

Coyotes were captured with coilspring leghold traps (size 1.5 through 3) at dirt-hole and scent-post sets. All traps were staked short (15 cm) and checked daily soon after sunrise to minimize restraint time. Coyotes were anesthetized with ketamine hydrochloride and xylazine hydrochloride (Mulder 1978) to facilitate handling and attachment of radio transmitter collars. Juveniles were collared if head and neck proportions seemed adequate to retain collars.

Transmitter units (Telonics, Inc., Mesa, Ariz.[1]), operated in the 164–166

[1] Use of product does not constitute a recommendation.

MHz range and were equipped with a motion sensing device that altered the pulse rate from 90 to 95 pulses per minute (ppm) to 65 to 70 ppm when the coyote's head was lowered 10 degrees or more below a level position. Attempts were made to monitor each animal hourly for a continuous 12- to 18-hour period every 10 days and for a 24-hour period monthly. Initial contact with radio-collared coyotes and directional readings were made using standard techniques.

Data Analysis

A computer program calculated coyote location coordinates and measured the distance between successive hourly locations. Times of greatest and least movement during a tracking period were determined from means of distances traveled (km/h) by all coyotes for each 1-hour interval (Altoff 1978, Gipson and Sealander 1972). Coyote activity, expressed as the percentage of actively moving radio fixes, was determined by signal fluctuations or changes in pulse rate caused by movement of motion sensing transmitters. Student's *t*-test was used to detect differences ($P < 0.05$) in hourly distances traveled over a 24-hour period (Steel and Torrie 1980). Confidence intervals ($P < 0.05$) were established using signal fluctuations to determine hourly differences in mean percent activity by sex, age, and solar season (Snedecor and Cochran 1967).

Minimum daily movements were estimated by adding the straight line distances between 12 consecutive hourly radio locations during a full-night's radio tracking session (Smith et al. 1981). Student's *t*-test was used to detect movement differences by sex, age class, and season (Steel and Torrie 1980). Convex polygon home range estimates based on all radio locations were made using a modification of the TELEM program described by Koeln (1980). Adults with more than 59 radio locations and juveniles with more than 40 radio locations were used to compute weighted mean home ranges (Smith et al. 1981, Springer 1982).

Results and Discussion

Of 20 coyotes captured, 16 were radio-tagged and released, 1 was ear-tagged and released, and 3 died from conditions related to their capture. One radio-tagged juvenile slipped its collar within 24 hours after release. Forty or more locations were recorded for 5 adult males, 3 adult females, and 4 juveniles (Table 1). One pup was located on 16 occasions.

Hourly Activity

Activity patterns determined by the motion sensing transmitters for combined sex and age classes indicated that coyotes were more active ($P < 0.05$) from 1800 to 0500 hours than from 0600 to 1700 hours (Fig. 1). They moved occasionally during daylight, but distances were usually less than 400 m.

Table 1. Composite convex polygon home range estimates for 13 coyotes and mean annual home ranges for sex and age classes in east Mississippi and west Alabama (1981–1983).

Coyote number sex/age[a]	*N* locations	Period radio-tracked	Home range sizes (km²)
800 M/A	80	8 Jan 84–19 Mar 84	13.4
785 M/A	83	18 Jul 81–24 Jan 82	6.2
710 M/A	231	30 Apr 82–27 May 83	26.8
700 M/A	219	23 Apr 83– 2 Apr 84	18.5
679 M/A	59	25 Apr 82– 9 Sep 82	33.3
784 F/A	432	23 Oct 81–12 Apr 83	52.6
690 F/A	108	7 Jan 84– 9 Apr 84	11.0
782 F/A	105	30 Mar 82– 6 Nov 82	48.2
620 M/J	61	18 Oct 82–14 Feb 83	20.8
621 M/J	65	18 Oct 82–14 Dec 82	6.9
749 M/J	40	31 Aug 81– 5 Jan 82	6.2
720 M/J	85	4 Nov 83–25 Jan 84	12.5
650 M/P	16	18 Aug 82– 1 Sep 82	0.1
Adult male	672		20.0[b] ± 11.8[d]
Adult female	645		41.2[b] ± 66.8
Adult	1,417		29.0[b] ± 33.5
Juvenile	251		11.8[b] ± 16.0

[a] M = Male, F = Female, A = Adult, J = Juvenile, P = Pup.
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[b] Weighted mean (Springer 1982).
[c] Excluding the pup.
[d] 90% confidence internal.

Crepuscular peaks of activity were usually separated by 1 to 3 hours of inactivity near midnight.

As indicated by the percentage of radio locations in which coyotes were in motion, both adult and juvenile coyotes were less active ($P < 0.05$) in fall (50%) than during spring (63%), summer (60%), or winter (62%). Activity indicated by distances traveled (km/hour) between hourly locations during full-night, 12-hour periods closely paralleled that detected from motion-sensing switches with respect to times of least and greatest activity and seasons (Fig. 1).

Daily Movements

Adults traveled greater distances and maintained higher movement rates than juveniles. The linear distances traveled by coyotes during 47 full-night tracking periods averaged 8.59 ± 0.72 km. An adult male traveled the greatest distance (6.0 km) within an hourly period. Adults moved greater distances than juveniles ($P < 0.05$) during the 2200- to 2300-hour time interval, and adult females moved further than juveniles ($P < 0.05$) from 0100 to 0300 hours. No difference ($P > 0.05$) in mean hourly distance traveled was detected between adult males and adult females for any time interval.

All monitored coyotes made evening (1800–2400) movements at consistently higher rates in winter than during other seasons. This difference may

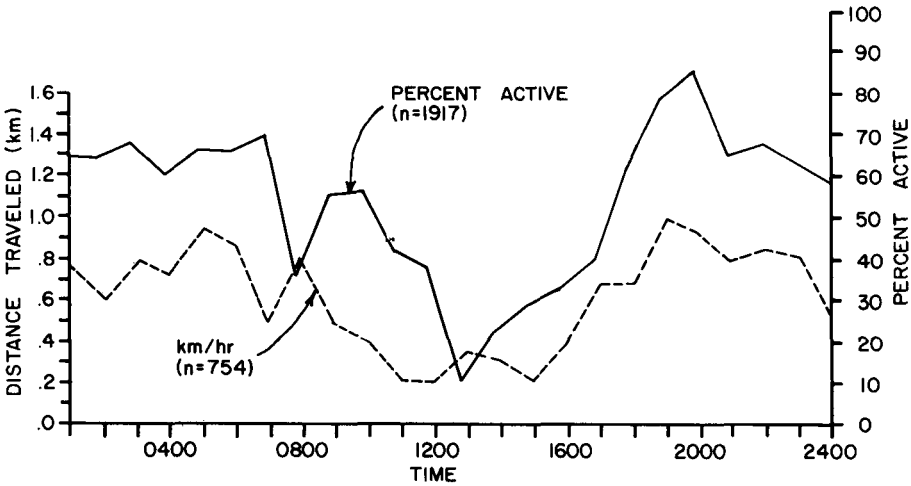

Figure 1. Diel activity patterns of combined sex and age classes of radio-tagged coyotes expressed as percentages of total locations and average minimum distance traveled between hourly intervals.

have been associated with reproductive behavior, social interactions, foraging, or other influences. Social interactions were most frequently observed during this period. Winter was the only season when radio-collared coyotes were frequently located near groups of vocalizing coyotes or were observed traveling with others.

During 12-hour, full-night monitoring periods, adult females traveled greater average distances (9.5 ± 0.9 km, $N = 28$) in all seasons than adult males (8.6 ± 1.40 km, $N = 10$). The average distance traveled by all juveniles (5.6 ± 1.24 km, $N = 9$) was smaller than that of adults. Litvaitis and Shaw (1980) reported smaller average movements for adult females (6.0 km) and adult males (6.3 km) in Oklahoma, but their data were based on locations taken at 2.5-hour intervals.

The mean minimum linear distances traveled by all coyotes by season during full-nights were 7.91 ± 2.02 ($N = 7$) in spring, 8.61 ± 0.80 ($N = 12$) in summer, 5.33 ± 0.81 ($N = 14$) in fall, and 12.16 ± 1.49 km ($N = 14$) in winter. Distances traveled in fall differed significantly ($P < 0.05$) from summer and winter regardless of coyote age. Reduced fall movement and reduced activity mentioned earlier may have been associated with a change in food habits. Persimmons (*Diospyros virginiana*) occurred frequently in fall scats collected on the study areas (Wooding et al. 1984). The authors believe that the seasonal availability of a food source at a few trees reduced movements required for foraging. Hall (1979) found similar use of persimmons and associated reduction in movements in Louisiana coyotes during the fall compared to other seasons. In contrast, Andelt and Gipson (1979) found that the shortest daily movements in Nebraska coyotes occurred during gestation.

An adult female made exceptionally long moves (8 to 23 km) during 9 full-night winter tracking periods. Andelt and Gipson (1979) reported that female coyotes in Nebraska made longer movements during the breeding period than at other times. The increased movements in this study may have been related to mate selection and pair formation which occur in winter (Gier 1968).

Home Range

A total of 1,668 locations, 63% of which were recorded between 1800 and 0600 hours, was used to determine annual home range of 13 coyotes in this study (Table 1). The adult home ranges varied from 6.2 to 52.6 km^2. The largest home ranges were estimated for the individuals with the highest number of recorded locations, but this apparent correlation was not significant when tested among all adults.

Average annual home range size (41.2 km^2) for 3 adult females in this study was smaller than most estimates reported from other areas using similar methods. Most previous studies have reported smaller average home ranges for adult males than adult females. The mean annual home range found for 5 adult males in this study was 20.0 km^2. This range was also smaller than those reported for adult males in other studies using similar methods in more westernly states (Gipson and Sealander 1972, Edwards 1975, Hibler 1977, Althoff 1978, Berg and Chesness 1978, Andelt and Gipson 1979, Danner and Smith 1980, Litvaitis and Shaw 1980, Bowen 1982, and Springer 1982). Hall (1979) reported a home range of 24 km^2 for 1 adult male in Louisiana that was comparable to the average found in this study. The average home range of 4 juvenile males was 11.8 km^2. Coyote 784, an adult female, had the largest seasonal home range, an estimated 41.7 km^2 during winter. This large range was believed related to social behavior, pair formation, and breeding. Only during January and February did this coyote move rapidly to areas near the southeastern periphery of her home range and engage in "group yip-howling" as described by Lehner (1978). Springer (1982) also found the largest coyote home ranges in Washington during winter.

Seasonal mean home-range size for adult coyotes was largest in winter (24.5 km^2, $N = 3$). Means for spring (18.7 km^2, $N = 5$), summer (14.2 km^2, $N = 6$), and fall (15.8 km^2, $N = 4$) were similar. The mean of the seasonal home ranges of adult males was similar during spring (13.5 km^2) and summer (12.9 km^2), but smaller than adult female home ranges in spring (25.2 km^2) and summer (16.1 km^2). The mean winter home range (7.2 km^2) of adult males was the smallest area recorded for any sex and age class for 1 season.

A juvenile mean home range estimate (10.8 km^2) was calculated only for fall and was similar to the 11.0 km^2 area determined for adult females. Although the 0.1 km^2 home range for 1 male pup may not be representative because of the limited number of observations, it was similar to the home

ranges for 4 radio-tagged pups in Oklahoma (Litvaitis and Shaw 1980). Those ranged from 0.5 km^2 to 2.0 km^2 and averaged 1.0 km^2.

Dispersal

Three coyotes exhibited winter dispersal movements. After extensive aerial searching, 1 instrumented juvenile coyote could not be located. It was killed 10 months later approximately 140 km southeast of its previous home range area. The radio transmitter was functional except for a broken antenna.

A juvenile female captured on 19 October 1982 was radio-tracked until 6 November 1982. It was located during an aerial search approximately 20 km southeast of its previous home range and its position was verified on 4 different occasions during the next 4 months.

An adult female was located approximately 8 km east of its previous home range area. This coyote was later located approximately 20 km southeast of its former home range on 3 additional occasions during the succeeding 5 months. A juvenile male also moved 11.3 km southwest of its calculated home range where it remained for 4 months before returning to its previous area. These dispersal movements were similar to those reported in studies from western states (Robinson and Grand 1958, Nellis and Keith 1976, Andrews and Bogess 1978, Berg and Chesness 1978, Bowen 1982).

Conclusions

The seasonal movements and daily rhythms of the coyote in southeastern states should be considered by state and Federal agencies responsible for its recreational hunting, management, and control, particularly in areas where it is expanding into previously unoccupied habitat. Moreover, consideration should be given to the influence that the coyote will have on other species if it becomes fully distributed throughout the southeastern states.

The period of greatest daily coyote activity, as detected through motion-sensing switches, and distances traveled between hourly radio fixes seemed concentrated near sunrise and sunset. Although their movements and home ranges varied with season, sex, age, and individual, knowledge of the general patterns will be useful if control programs are needed.

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