HOME RANGE AND ACTIVITY OF THE COYOTE *(Canis latrans frustror)* IN ARKANSAS

By Philip S. Gipson and John A. Sealander
University of Arkansas
Department of Zoology
Fayetteville, Arkansas
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ABSTRACT

Year around tracking with radio telemetry, supplemented by winter snow-tracking, was used to determine home range sizes, major activity patterns and behavior of coyotes in Arkansas. Home ranges averaged 12.8 square miles for adult male coyotes, 5.1 square miles for adult females, and 4.6 square miles for female pups. Home ranges of some adult males, adult females and immature coyotes overlapped. Coyotes used some portions of their ranges more intensely than others and often marked their range with urine and feces. Adults were most active at night but foraged periodically during the day; pups were more active than adults during the day.

INTRODUCTION

Information concerning the home range size and activity patterns of mammalian predators is vital to wildlife management and control programs. Work concerned with coyote movements has been conducted in western and northern areas by snow-tracking (Stebler, 1951; Ozoga, 1963; Ozoga and Harger, 1966) and in the West by mark and recapture (Young and Jackson, 1951; Robinson and Cummings, 1951; Hawthorne, 1971), but little research has been reported involving radio-tracking (Anonymous, 1971).

In this study coyote home range sizes were estimated and activity patterns determined primarily by radio telemetry. Additional range and behavior data were obtained by snow-tracking.

METHODS AND MATERIALS

Coyotes were captured in number four steel traps with offset jaws. A slip noose extended through a metal pipe was used to restrain coyotes while they were weighed, measured, aged according to tooth wear (Gier, 1968), marked with metal ear tags and fitted with a collar containing a radio transmitter. Instrumented coyotes were released at the original capture site.

Transmitters were fabricated by the Research Services Department, University of Arkansas using circuit diagrams obtained from the telemetry laboratory, Cedar Creek Natural History Area, University of Minnesota. Transmitters operated in the 52.00-54.00 MHz frequency band and each was identifiable by a distinct frequency and pulse rate. Collars were made from polyethylene strips approximately two inches wide and ⅛ inch thick. Transmitters and adjacent portions of the collars were embedded in dental acrylic. Whip antennas were used to obtain maximum range. The completed radio-collars weighed about one pound.

Receivers consisted of automobile radios modified to operate in the 52-54 MHz range. Two types of receiving antennas were used; commercial five element Yagis for long distance tracking and small loop antennas for short range and portable reception.

The maximum ground-to-ground range of the telemetry equipment was approximately five miles when both the receiving Yagi and the transmitter were

situated on hill tops or on a tower. Usually, good ground-to-ground reception could be obtained at distances of two to three miles or less; from the air, reception was good at distances of ten miles. The inherent error in the system, as determined by field testing, ranged from ± two to five degrees.

Radio-tracking was conducted on the Fort Chaffee Military Reservation in western Arkansas and on the Wattensaw Game Management Area in east-central Arkansas. Five stationary tracking stations were established at Fort Chaffee, each consisting of a five element Yagi antenna mounted atop a 30 foot mast positioned on the summit of a hill. On the Wattensaw area an abandoned 100 foot forest tower was equipped with a five element Yagi antenna to serve as the primary receiving station, and a second station was established during tracking sessions by raising a Yagi and a 30 foot mast on a highway overpass. Two-way automobile radios and/or walkie-talkies were used to maintain contact between station attendants on both areas.

Attempts were made to obtain movement data from coyotes throughout two complete 24 hour periods each month from February, 1970 through February, 1971. To accomplish this, alternate six-hour tracking and resting shifts were maintained for four days. After the first two days, the sequence of tracking and resting shifts was reversed. Directional readings were taken simultaneously at two stations to permit location of coyotes by triangulation. Near the conclusion of tracking operations at Fort Chaffee a small aircraft was used to verify the locations of coyotes being tracked and to search the area for animals that might have moved outside the range of ground tracking stations.

All available location information was used to determine the home ranges of radio-tracked coyotes or wild dogs; this included capture sites, reliable visual sightings, radio-tracked fixes, and recapture or kill sites. These locations were plotted on a map of the area and their geometric center, the activity center, was calculated according to the methods of Hayne (1949) and Dice and Clark (1953). The activity center and the location farthest from it were used as reference points to determine the angle of orientation of the range. The location most distant from the activity center and the location farthest from the activity center on the side opposite the most distant location were used as reference points for determining the longest diameter of the range. Locations farthest from either side of a line representing the long axis of the range and perpendicular to it were used to determine the greatest width or short axis of the range. One-half of each of these respective axes was considered as radii of an ellipse centered at the activity center. The area of this ellipse approximates the coyotes home range and was determined by the standard formula for the area of an ellipse (π R1R2). The ellipse also provides an index to the directional orientation and linearity of the range and, therefore, does not necessarily include all observed locations. This technique is illustrated in Figure 1. Superimposed range ellipses show spatial relationships in the study areas (Figs. 2 and 3).

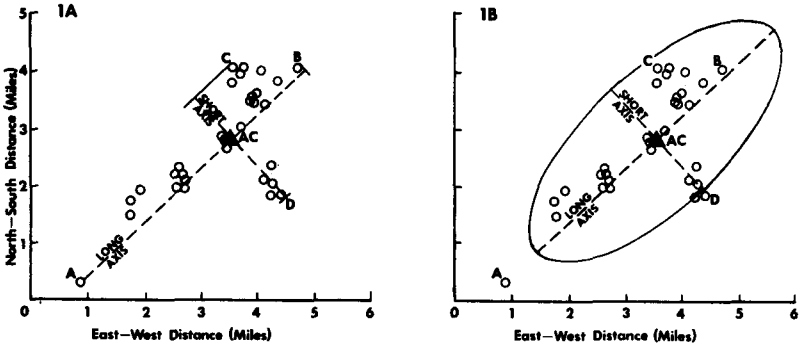

Figure 1. Radio-tracking data for coyote male 270: A) Radio fixes (O), center of activity (▲) and fixes used to determine the long and short axes (A, B, C, D). B) Radio fixes, center of activity, axes and ellipse approximating the area of 270's home range =8.81 square miles.

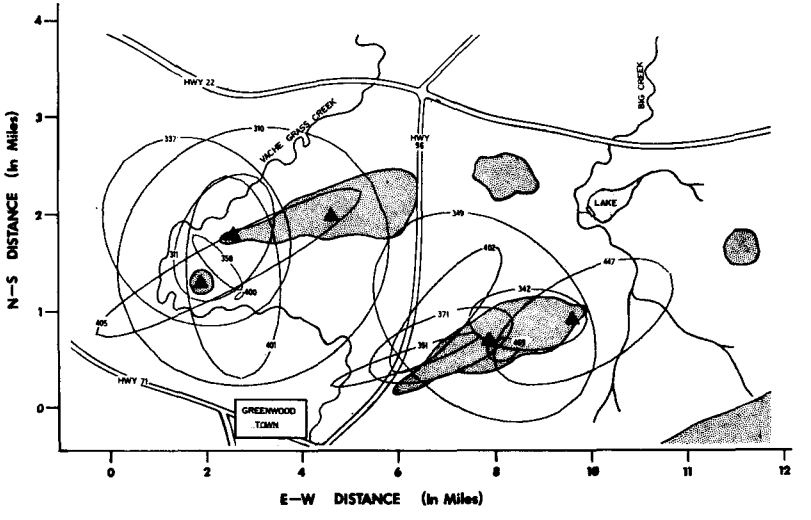

Figure 2. The Fort Chaffee study area showing overlapping range ellipses of adult male coyotes (310, 337, 349, and 371), adult females (311, 342, 350, 351*, 405 and 447) and immature females (400, 401, 402 and 469). ▦ =hills. ▲ =tracking stations.

*Dog.

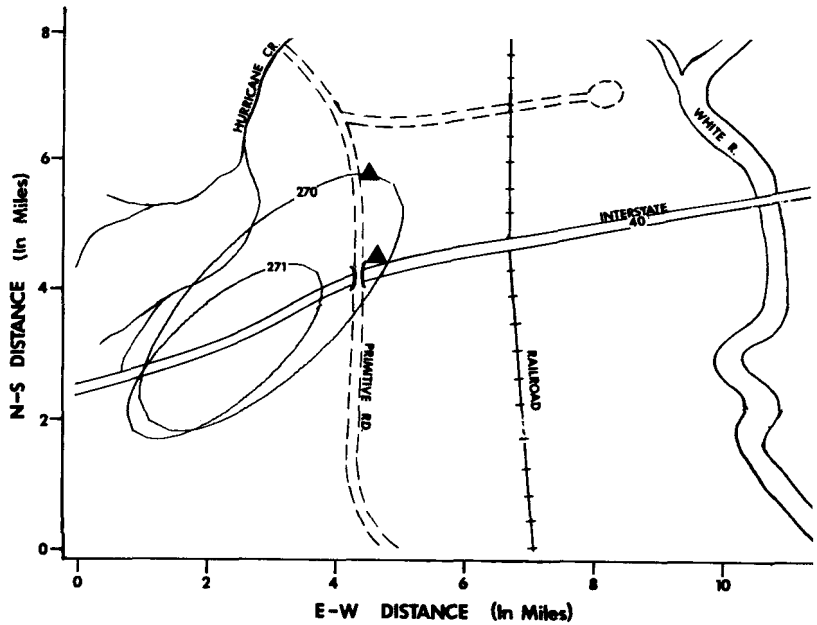

Figure 3. The Wattensaw study area showing overlapping range ellipses of adult male coyotes.

Periods of greatest and least activity were determined from the straight line distances traveled between successive fixes which were taken at 15 minute intervals. All distances determined for each of the 96 intervals of a 24 hour period were summed and averaged. The average distance traveled per 15 minute interval was used as an index to the relative amount of activity during that interval. Figures 4 and 5 show general movement patterns of an individual male and pooled activity patterns for males and females.

A IBM 360 computer and programs developed at the University of Arkansas and Texas A & M University (Inglis, Sittler and Kirby, 1968) were used to perform the above calculations. Graphs and plots illustrating the radio telemetry data were drawn by a Cal-Comp 750 plotter.

At Pea Ridge National Military Park coyote trails were followed in snow on eight days during 1969 and 1970. The route covered each day was plotted on a map of the park. This procedure was essentially the same as that used by Murie (1936) and later by Ozoga (1963). When sufficient snow accumulations permitted tracking, the first author walked north from the southern boundary of the park until intersecting the trail of one or more coyotes. This trail was then followed as long as daylight permitted interpretation of sign. Fresh trails were followed each day because of rapid melting of snow. The following information was recorded: Distance traveled as determined by pedometer, number of urinations and defecations, rest or bedding sites, and kills made or carcasses visited.

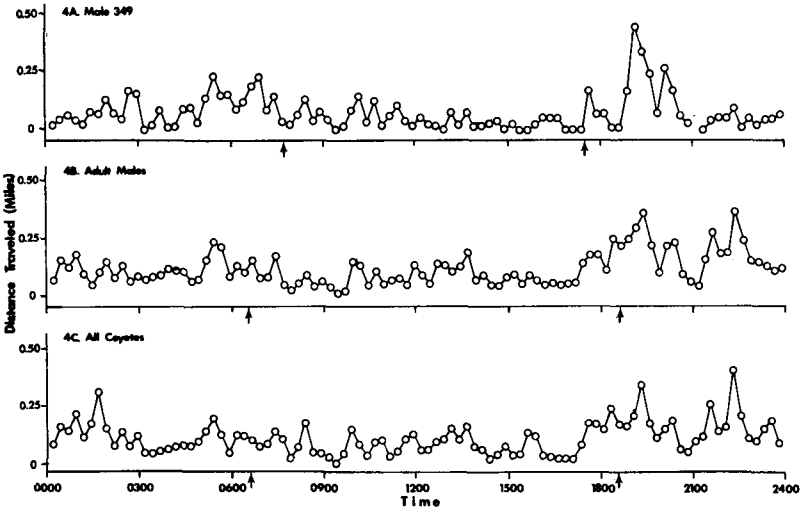

Figure 4. Activity of radio-tracked coyotes. Circles indicate the average straight line distance traveled during 15 minute intervals. Where circles are connected by lines the readings were taken 15 minutes apart. Circles not connected by lines represent readings made more than 15 minutes apart. Arrows indicate approximate times of sunrise and sunset. A) Activity of adult male 349 during winter, B) adult males, C) all coyotes.

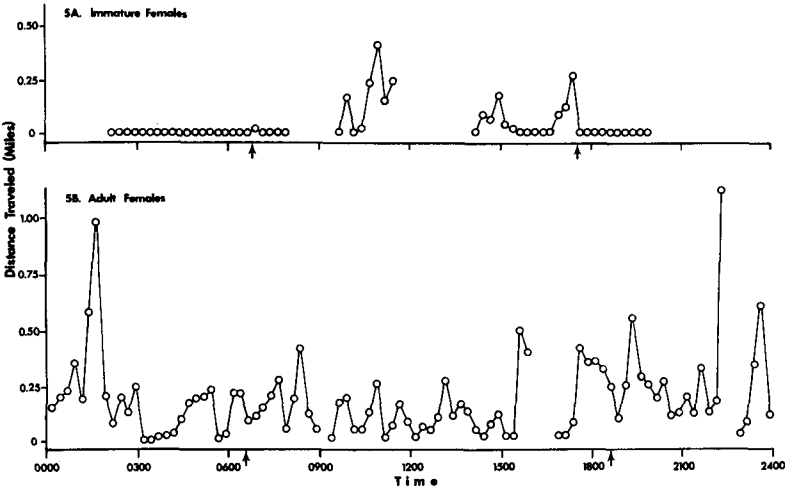

Figure 5. Composite activity graph of A) immature females, B) adult females.

RESULTS

Radio-Tracking.

The movements of 15 coyotes were monitored intermittently for periods ranging from one day to ten months. Two adult males were tracked on the Wattensaw Game Management Area (Fig. 3). Thirteen coyotes, including four adult males, five adult females and four pups were tracked at Fort Chaffee (Fig. 2). Adequate data were obtained to estimate home range sizes of ten coyotes (Table 1). Home ranges of individual coyotes overlapped at both Fort Chaffee and Wattensaw (Figs. 2 and 3).

When numerous fixes were obtained, certain areas within the ranges of coyotes appeared to be intensely used while other parts of the ranges were visited less frequently. No coyotes tracked were known to leave the general area of their capture. The farthest any coyote was known to travel from the point of capture was 5.2 miles and this individual was later located within one-half mile of the capture site.

As indicated in Figures 4 and 5, coyotes may be active at any time during the day or night, but generally are most active at night, showing principal activity peaks beginning about sunset with a minor peak near daybreak. Adult males and females showed the same general pattern, but a peak near daybreak was evident in males but not apparent in females. Activity readings for immature coyotes were not obtained during the period from 9:00 P. M. to 3:00 A. M., but available data (Fig. 5) showed activity of pups during the day and early evening.

Two adult males in breeding condition, 270 and 271 (Table 2), were radio-tracked at Wattensaw. A large portion of the ranges of these males overlapped (Fig. 3) and both were located together on at least two occasions during February, 1970.

Table 1. Apparent home ranges of radio-tracked coyotes.

Group	Animal	Area of Home Range (square miles)	Group Average (square miles)
Adult Males	270	8.8	12.8
	271	4.4	
	310	23.7	
	349 Spring a	9.0	
	349 Winter a	9.2	
	349 Pooled	15.1	
	337	11.9	
Adult Females	311	4.0	5.1
	405	5.0	
	447	6.3	
Immature Females	401	6.4	4.6
	402	2.8	

Overall Average 8.8 square miles

a Not used in calculating averages.

Table 2. Background information for coyotes radio-tracked. Males 270 and 271 tracked on the Wattensaw Game Management Area; others tracked on Fort Chaffee.

No.	Sex	Age (yrs)	Date Captured	Condition When released	Condition When recaptured	Last Date Located
270	M	1.8	Feb 10/70	Good, prime winter pelt, foot swollen, in breeding condition.	Not recaptured	Mar 4/70
271	M	1.8	Feb 12/70	Good, prime winter pelt, foot cut but no broken bones, in breeding condition.	Not recaptured	Feb 20/70
310	M	1.8	Feb 27/70	Good, shedding, right rear leg broken in trap and foot cut, in breeding condition, 311 caught across road.	Not recaptured	Mar 970
311	F	2.8	Feb 27/70	Good, prime winter pelt, foot slightly swollen, in heat, 310 caught across road.	Not recaptured	Mar 7/70
337	M	3.0	May 3/70	Fair, many ticks, shedding almost complete, foot swollen, not in breeding condition.	Not recaptured	Mar 26/71
342	F	3.0	Apr 8/70	Good, shedding slightly, no damage to foot, pregnant.	Poor foot cut to bone when retrapped, may have aborted in trap, bloody vaginal discharge.	Apr 10/70

No.	Sex	Age (yrs)	Date Captured	Condition When released	Condition When recaptured	Last Date Located
270	M	1.8	Feb 10/70	Good, prime winter pelt, foot swollen, in breeding condition.	Not recaptured	Mar 4/70
349	M	4.0	May 13/70	Good, many ticks, shedding almost complete, foot swollen with slight cut, not in breeding condition.	Good, prime pelt, old trap wound healed. Transmitter caused no irritation to skin, in breeding condition.	Feb 6/71
350	F	1.0	May 15/70	Good, right front foot broken, not pregnant or suckling.	Not Recaptured	May 17/70
371	M	1.1	Jul 10/70	Fair, summer pelt, few ticks, right front foot broken, not in breeding condition.	Poor, ear infected where tag attached, broken foot healed, killed by hunter.	Nov 27/70
400	F	0.5	Sep 22/70	Good, few ticks, foot slightly swollen, 401 caught on same path.	Not recaptured	Sep 23/70
401	F	0.5	Sep 22/70	Good, few ticks, foot slightly swollen, 400 caught on same path.	Good, no irritation from ear tags or transmitter, killed by car.	Oct 1/70

No.	Sex	Age (yrs)	Date Captured	Condition When released	Condition When recaptured	Last Date Located
270	M	1.8	Feb 10/70	Good, prime winter pelt, foot swollen, in breeding condition.	Not recaptured	Mar 4/70
402	F	0.5	Sep 22/70	Good, few ticks, foot swollen with small cut.	Good, collar getting tight, gained 6 lbs., killed by car.	Nov 30/70
405	F	2.5	Oct 21/70	Good, molting to winter pelt, no damage to foot not in heat.	Not recaptured	Oct 27/70
447	F	3.7	Nov 26/70	Good, prime winter pelt, no foot damage, not in heat.	Not recaptured	Dec 6/70
469	F	0.8	Dec 28/70	Good, prime winter pelt, foot swollen, not in heat.	Not recaptured	Dec 28/70

Table 2 page 175-76

Two adult males in breeding condition, 310 and 349 (Table 2), were tracked at Fort Chaffee. Adult female 311 and male 310 were captured the same night in traps placed about 40 feet apart along a game trail. These animals subsequently were located together several times and may have been mates. During the tracking shift from 9:00 P. M. to 3:00 A. M., February 28 and March 1, 1970, male 310 traveled at least eight miles near the eastern and southern margins of his range. This was the greatest measured distance any instrumented coyote traveled during a six hour period. At the end of this shift, a coyote and dog were heard howling together at a public dump near the town of Greenwood. A check with the portable receiver indicated that 310 was either the coyote heard or was with the animals heard howling. During this foray, male 310 moved about 5.2 miles from the place of capture. This was the greatest measured distance any radio-tracked coyote was located away from its capture site.

Male 349 was trapped May 13, 1970 and outfitted with a radio-collar. On January 15, 1971 he was recaptured in breeding condition and outfitted with a second transmitter. No apparent adverse effects resulted from wearing a radio-collar for approximately 8.5 months. His pelt was prime and a thick layer of fur had developed beneath the collar. The whip antenna was broken near its attachment to the collar, but in other respects both collar and transmitter were in good condition. During spring, 1970, male 349 ranged over an area of 9.0 square miles and was most active during the night and in the middle of the day. His range had shifted slightly to the south, occupying an area of approximately 9.2 square miles, when tracked in January and February, 1971. At this time he was most active during early evening and near daybreak (Fig. 4).

Adult male 337 was radio-tracked in May, 1970 (Table 2). He was sighted during November, 1970 and again in March, 1971. Another male, 371, was tracked during July, 1970 and later was killed by a deer hunter in November, 1970, about 2.5 miles southwest of his capture site.

Five adult female coyotes were radio-tracked. Female 311 was tracked during the breeding season of 1970 (Table 2). She was in heat and her estimated home range, covering approximately 4.0 square miles, was entirely within the range of male 310 (Fig. 2). Female 342 was captured April 8, 1970 and was recaptured April 10, 1970 approximately one-quarter mile northeast of the initial capture site. Specimen 350 was approximately one year old when trapped May 15, 1970 (Table 2). The radio-collar she carried failed after only three days and during this time she was tracked over an area of about 0.5 square miles. Adult females 405 and 447 were tracked during the fall of 1970 (Table 2). The home range of 405 extended almost across the range of male 310 and overlapped much of the range of female 311 (Fig. 2). Activity centers for 405, 310 and 311 were less than one-half mile apart. Females 405 and 447 showed the greatest amount of activity of any coyotes tracked; both were active from near 6:00 P. M. until 3:00 A. M. and intermittently throughout the day.

Two female pups (400 and 401), which appeared to be litter mates, were trapped at a road intersection and outfitted with transmitters September 22, 1970 (Table 2). When released, they traveled about 0.1 miles and bedded down together. A hard rain fell throughout the night, and before the pups became active the next day, the transmitter on 400 failed. During the next two weeks tracks of a second pup, possibly number 400, were noted at sites where 401 was located. An automobile killed pup 401 October 1, 1970 at approximately 8:00 A. M. on Highway 22 about four miles north of the capture site. On September 22 another female pup, 402, was captured and outfitted with a transmitter (Table 2). She ranged over an area of approximately 2.8 square miles before being killed by an automobile November 30, 1970 on Highway 96 about three miles north of the capture site. A yearling female, 469, was radio-tagged December 28, 1970, but the transmitter failed the same day.

Snow-Tracking.

Coyotes were tracked in snow at Pea Ridge National Military Park a total of 33.5 miles on eight days during 1969 and 1970. Accumulations of new snow or rapid melting prevented continuous tracking of the same individuals on consecutive days. Consequently it was possible to obtain data by snow-tracking only on a one-day basis.

Pairs were most often encountered, although several times trails of single individuals were noted, and on four occasions groups of four or more coyotes assembled. On one occasion, four coyotes traveled together in single file for approximately one mile. At another time two pairs of coyotes met in a persimmon thicket and bedded down within 40 feet of each other.

Certain criteria seem to be necessary for coyote resting or bedding sites. Of seven beds examined all were on knolls or other vantage points in dense vegetation such as cedar glades or persimmon thickets. The distance between beds averaged about five miles.

Several instances of play or courtship behavior were indicated by sign in the snow. Members of pairs at times chased each other and had tugs of war over bits of carrion. On February 16, after tracking a pair of coyotes for about one mile, a site where copulation may have occurred was located. The pair was tracked for one and one-half miles beyond this site and no additional signs of courtship were evident.

Coyotes trailed showed evidence of much interest in tracks and sign posts of other coyotes encountered in their travels. Scats usually were deposited on open spots at the intersection of game trails and/or roads. Such areas generally were used by several coyotes. Urine was left, usually a few drops at a time, on conspicuous objects such as stumps, or chunks of wood and where tracks of other coyotes were encountered. Trailed coyotes averaged three urinations and 0.4 defecations per mile.

Two intensely used marking sites were located while snow-tracking. During seven of the eight days of tracking, trails eventually led to one or both of these sites. One site was along a service road as it passed through a break in a rail fence. When coyotes visited this area they urinated and/or defecated at the break. The other site was located at the intersection of the Pea Ridge National Military Park tour road and an abandoned highway.

Coyotes spent most of their traveling time hunting and used the same roving, chasing, and stalk and pounce techniques described by Ozoga (1963) and Stebler (1951). In 33.5 miles of tracking only one kill was located, a bobwhite, although many rodents were probably captured and eaten without leaving sign. Deer trails were generally ignored.

On January 1, 1970 a pair of coyotes was tracked to the remains of a butchered beef. Eighteen distinct coyote and dog trails, plus tracks of two foxes, were counted leading to and from this carrion. It seems probable that some of the trails were made by the same coyotes and dogs revisiting the carcass.

A pair of coyotes sniffed a dead bird on March 18, 1970, but did not eat it. On one occasion several coyotes scratched in a persimmon thicket for fallen persimmons.

DISCUSSION

Since radio-tracked coyotes remained in the general vicinity of their capture sites they had evidently established relatively stable home ranges. Snow-tracking and radio-tracking showed that home ranges were not mutually exclusive, even among adult males during the breeding season (Figs. 2 and 3). Possibly adult coyotes, other than mates, that shared portions of their ranges were related. Other coyotes may have been offspring or litter mates of one of the pair or matured offspring of a mated pair. Similar explanations have been offered for

range-sharing in other species of *Canis;* wolves, *C. lupus* (Crisler, 1958; Mech, 1970), and the golden jackal, *C. aureus* (Van Lawick-Goodall, 1971). Overlapping range ellipses in Figure 2 seem to indicate two distinct coyote family groups with members of each group sharing their ranges. Only a slight overlap is apparent between the ranges of two adult males from the different groups.

Home ranges of coyotes in Arkansas as determined by radio telemetry were generally smaller than mark and recapture studies have indicated for western coyotes. In New Mexico, the average distance six male coyotes traveled from the site of tagging was 22.6 miles (Young and Jackson, 1951). In Wyoming, 28 male and 25 female coyotes were recovered after being tagged as pups (Young and Jackson, 1951). The average distance from the capture site was 28.3 miles for males and 25.0 miles for females. In a study conducted in and around Yellowstone National Park, average recovery distances were seven miles for adults, and 10.5 miles for 146 pups (Robinson and Cummings, 1951). The greater distances traveled by pups in the above studies may reflect dispersal following breakup of family units. In California, Hawthorne (1971) marked and released 26 adult male, 26 adult female, 28 juvenile male and 18 juvenile female coyotes. He reported average recovery distances of 4.0, 4.75, 3.25 and 4.0 miles for the respective groups. Dispersal of pups was not evident from his data, and it seems likely that pups he tagged were younger than those tagged in other studies and that family units were still intact when he made his recoveries. The greatest measured distance any coyote traveled from the capture site in our study was 5.2 miles. Dispersal was not indicated from the limited data obtained on four pups tracked at Fort Chaffee. Also it is possible that where food is in good supply older pups may share portions of the parents home ranges which would be reflected in shorter dispersal distances.

In northcentral United States, home ranges of coyotes have been measured by snow-tracking. By tracking two coyotes with missing toes, Ozoga (1963) determined that they had "minimal areas of activity" of 20-25 square miles. In another area, minimum winter ranges were estimated to be between 36 and 50 square miles (Ozoga and Harger, 1966). Stebler (1951) estimated the winter range of a pair of coyotes in northern Michigan to be 17 square miles. Only the 23.6 square mile range of male 310 tracked at Fort Chaffee was comparable to the above estimates.

In northern United States, coyotes feed largely on live-caught prey and widely scattered carrion. In poultry producing sections of Arkansas, dead birds are commonly disposed of in places where they are readily available to scavengers. This dependable food supply could be partially responsible for the smaller home ranges of coyotes in Arkansas.

Home ranges of male coyotes generally were larger than those of females. Opposite results were reported from a telemetry study in Texas which suggested that females travel farther than males (Anonymous, 1971).

We were not able to determine if coyotes are territorial. From the radio-tracking data it was evident that coyotes use certain areas of their home ranges much more intensely than others; these intensely used areas could represent either favored hunting grounds or den sites.

Activity patterns of coyotes in Arkansas were similar to those reported for northern and western coyotes (Young and Jackson, 1951; Ozoga, 1963). Coyotes were most active at night, but often foraged during the day. Male 349, was more active during daylight hours in spring than in winter. Ozoga and Harger (1966) found that most coyotes snow-tracked in Michigan bedded from 10:00 A. M. to 5:00 P. M. In summer they were more active during the day.

In Michigan snow-tracked coyotes on the average urinated once every 2.5 miles and defecated once every 6.5 miles (Ozoga, 1963), while coyotes followed at Pea Ridge marked their ranges with urine about three times per mile and defecated once every two to three miles. It is possible that coyotes mark exces-

sively to re-establish sign posts buried during the few snowfalls that occur in northern Arkansas each winter. Another possibility is that coyote populations are denser in Arkansas, requiring more frequent marking to maintain home ranges.

Captured coyotes were sometimes injured in the traps (Table 2). Such injuries rarely interfered with their movements. Even severe injuries did not prevent movement. For example, male 310 traveled at least eight miles in six hours, two days after his right hind leg was broken in a trap.

SUMMARY

Home range sizes, daily activity patterns and behavior of coyotes, *Canis latrans,* in Arkansas were determined by radio-tracking supplemented by winter snow-tracking.

Average home range sizes in square miles were as follows: Adult males -12.8, adult females -5.1, and immature females -4.6. Ranges of individual coyotes were marked with urine and feces. Home ranges of both sexes and of immature females overlapped. More intense useage of parts of their ranges was evident, but it was not possible to determine whether this was related to territoriality or to a better food supply in some portions of the range.

Adults showed a principal peak of activity which began near sunset with a smaller peak near daybreak. The latter peak was most evident in males. Pups showed more activity during the day than adults.

ACKNOWLEDGEMENTS

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LITERATURE CITED

Anonymous. 1971. Wildlife research problems, programs, progress, 1969. U. S. Fish and Wildlife Service, Resource Publ. 94, 104 p.

Crisler, L. 1958. Arctic wild. Harper and Brothers. New York, N. Y. 301 p.

Dice, L. R. and P. J. Clark 1953. The statistical concept of home range as applied to the recapture radius of the deer mouse (*Peromyscus*). Contrib. No. 62, Lab. Vert. Biol., Univ. Michigan, Ann Arbor. 15 p.

Gier, H. T. 1968. Coyotes in Kansas. Agri. Exp. Sta., Kansas State Univ. Bull. 393, 118 p.

Hawthorne, V. M. 1971. Coyote movements in Sagehen Creek basin, northeastern California. Calif. Fish and Game. 57:154-161.

Hayne, D. W. 1949. Calculation of size of home range. J. Mammal. 30:1-18.

Inglis, J. M., O. D. Sittler and J. D. Kirby. 1968. A fixed station radio tracking system. Southwestern Nat. 13:433-443.

Mech, L. D. 1970. The wolf: The ecology and behavior of an endangered species. Natural History Press. Garden City, New York. 384 p.

Murie, A. 1936. Following fox trails. Misc. Publ. No. 32, Mus. Zool. Univ. Mich., 45 p.

Ozoga, J. J. 1963. An ecological study of the coyote on Beaver Island, Lake Michigan. M. S. Thesis, Mich. State Univ., 122 p.

Ozoga, J. J. and E. M. Harger 1966. Winter activities and feeding habits of northern Michigan coyotes. J. Wildl. Mgmt. 30:809-818.

Robinson, W. B. and M. W. Cummings 1951. Movements of coyotes from and to Yellowstone National Park. U. S. Fish and Wildlife Service, Spec. Sci. Rept., Wildl. No. 11, 17 p.
Stebler, A. M. 1951. The ecology of Michigan coyotes and wolves. Unpubl. Ph. D. Dissertation, Univ. Michigan, Ann Arbor, 198 p.
Van Lawick-Goodall, H. and J. 1971. Innocent killers. Houghton Mifflin Co. Boston, Mass. 222 p.
Young, S. P. and H. H. T. Jackson 1951. The clever coyote. Stackpole Co., Harrisburg, Penn. xv + 411 p.

Pages 162-167, figures 1-3; 169-172, figures 4, 5; 174-176, tables 1 and 2, and page 187 Literature Cited
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