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DEMOGRAPHY OF A COYOTE POPULATION IN WESTERN TENNESSEE

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ABSTRACT--Population features of the coyote (*Canis latrans*) were studied in the winters of 1989 and 1990 in Gibson and Carroll counties, Tennessee. In 1989, 55 coyotes (24 males, 31 females) were captured. Total length, tail length, hind foot length, and ear length averaged 1,269, 349, 202, and 104 mm, respectively, for males. Mean weight was 14.0 kg, and average age was 2.1 years. For females, external measurements were 1,186, 318, 191, and 99 mm, respectively. Weight averaged 11.9 kg, and age averaged 1.8 years. Mean litter size was 3.9 offspring/female; sexes were 44% male and 56% female. Minimum density was 0.56 coyote/km². In 1990, 49 coyotes (25 males, 24 females) were captured. For males, external measurements averaged 1,241, 338, 200, and 101 mm. Mean weight was 13.5 kg, and average age was 1.8 years. For females, external measurements averaged 1,219, 322, 189, and 97 mm. Mean weight was 11.8 kg, and average age was 1.5 years. Mean litter size was 3.4 young/female; sexes were 51% male and 49% female. Minimum density was 0.50 coyote/km².

The occurrence of coyotes (*Canis latrans*) in the southeastern United States, east of the Mississippi River, has been well established (Smith and Kennedy, 1983*a*; Lydeard et al., 1986, 1988; Hill et al., 1987), and the colonization of this region by coyotes represents a documented case of a major predator expanding its distribution into a new area (Lydeard and Kennedy, 1988). Studies relating to food habits (Smith and Kennedy, 1983*b*; Wooding et al., 1984; Lee and Kennedy, 1986; Blanton, 1988), parasites (Smith and Kennedy, 1984; Van Den Bussche et al., 1987), home range and movements (Sumner et al., 1984; Babb and Kennedy, 1988), litter size (Kennedy et al., 1990), and morphologic variation and taxonomy (Smith and Kennedy, 1983*a*; Lydeard et al., 1986, 1988; Kennedy et al., 1986; Lydeard and Kennedy, 1988) have been conducted in this region. Additionally, siren-elicited responses of coyotes (Sharp, 1981; Blanton, 1988) and human influences on range expansion of this species have been studied in parts of the Southeast. Several studies (see Bekoff, 1977, 1982) conducted in more established parts of the range have reported much demographic information for coyotes. However, at present, population parameters for newly founded populations in the Southeast are not well documented. Because demographic information tends to vary between geographic areas (see Bekoff, 1982), management data obtained for one region may not be applicable to management programs in others. Therefore, the purpose of this investigation was to examine selected demographic features (external measurements, weight, age structure, sex ratio, litter size, percentage of breeding females, and abundance) of a coyote population in western Tennessee.

MATERIALS AND METHODS

Study Area--Fieldwork was conducted in an area of 24.25 km² near Milan in Gibson and Carroll counties, Tennessee. The site was surrounded by a well-established chain-linked fence. Habitat throughout was mainly open pasture and agricultural fields interspersed with upland forest common to the area. Terrain was of gently rolling hills transversed by streams and associated riparian habitat. The study site has been described in more detail by Babb and Kennedy (1988, 1989).

Methods--We captured coyotes during two sampling periods (4 January to 17 March 1989 and 9 January to 16 March 1990). Animals were collected using number 4 snares (Gregerson, Roundup, Montana) placed at culverts or at holes under the chain-link fence surrounding the site. Other openings in the fence were closed off in an attempt to have snares at all passages into and out of the site; this was in general successful. We attempted to supplement collections on approximately 4 nights each year by shooting coyotes (using a rifle) after calling with a predator call. During 1989, we set 200 snares/night over 47 nights (snare nights = 8,236). In 1990, we set 110 snares/night over 58 nights (snare nights = 5,913). Since many passages were unproductive in 1989, more openings were closed off in 1990. We checked snares for captures $\geq$1 time/day. Upon capture, coyotes were dispatched. External measurements (total length, tail length, hind foot length, ear length) were recorded in millimeters, and weight was taken in pounds and converted to kilograms. Some weights were omitted from analysis because animals were wet at the time of capture. Sex was recorded for each specimen, and coyotes were aged by annual wear on incisor and canine teeth following the method of Gier (1957). Reproductive tracts were removed from females. Litter size was estimated based on the number of placental scars recorded for each female.

Density estimates were derived by dividing the total area of effect by the number of coyotes collected during each sampling period. We used the total area of effect (98 km²) reported by Babb and Kennedy (1989) for this same site during the winter of 1986. We felt justified in using this value because our purpose was only to calculate a minimum estimate of abundance. Because the number of animals caught at this site increased after the work of Babb and Kennedy (1989) and coyote home ranges tend to generally get smaller as densities increase (Andelt, 1985), there seems little chance that the area of effect in our study would have been larger than that determined by Babb and Kennedy (1989). Therefore, our estimates are conservative and, we feel, useful for general comparisons with other investigations.

RESULTS

In 1989, 55 coyotes (24 males, 31 females) were collected. Fifty-three were taken with snares, and two were shot with a rifle after calling with a predator call. Mean external measurements (total length, tail length, hind foot length, and ear length) were 1,269, 349, 202, and 104

mm for males (n = 24) and 1,186, 318, 191, and 99 mm for females (n = 31). Weight averaged 14.0 kg (n = 19, range of 10.2 to 17.7 kg) for males and 11.9 kg (n = 22, range of 8.9 to 15.2 kg) for females. Males averaged 2.1 years (n = 24, range of 1.0 to 6.0 years), and females averaged 1.8 years (n = 31, range of 1.0 to 5.0 years). For males, 88% of the population was ≤3.0 years (1 year = 38%, 2 years = 42%); for females, 91% was ≤3.0 years (1 year = 52%, 2 years = 32%). Sexes were 44% male and 56% female. Fifteen of 31 females (48%) showed placental scars and were considered to have bred. No yearling female was found to have bred; all females ≥2 years exhibited placental scars. The average litter size (n = 15) was 3.9 offspring/female. Minimum density was 0.56 coyote/km².

During 1990, 49 coyotes (25 males, 24 females) were collected using snares only. Mean external measurements were 1,241, 338, 200, and 101 mmfor males (n = 24) and 1,219, 322, 189, and 97 mm for females (n = 24). Males averaged 13.5 kg (n = 17, range of 11.1 to 16.5 kg) and females 11.8 kg (n = 20, range of 9.5 to 15.0 kg). Mean ages for males and females were 1.8 (n = 24, range of 1.0 to 3.0 years) and 1.5 years (n = 24, range of 1.0 to 4.0 years), respectively. For males, 100% of the population was ≤3.0 years (1 year old= 42%, 2 years old = 42%); for females, 97% was ≤3.0 years (1 year old = 71%, 2 years old = 13%) Sexes were 51% male and 49% female. Eight of 24 females (33%) showed placental scars. Two yearlings and 86% of the females ≥2 years old were found to have bred. The average litter size (n = 8) was 3.4 young/female. Minimum density was 0.50 coyote/km².

DISCUSSION

External measurements and weights reported in this study are within the range generally noted for the species (Young and Jackson, 1951; Hall, 1981; Jones et al., 1985; Sealander and Heidt, 1990). Such features vary among geographic regions, but adult males are usually reported as larger and heavier than adult females (Bekoff, 1977, 1982). Size of coyotes in western Tennessee appears to be somewhat intermediate in comparison with other regions of the southern United States (Lydeard and Kennedy, 1988). Kennedy et al. (1986) suggested that sizes of coyotes east of the Mississippi River in the Southeast may be best explained by morphologic adjustments to local environmental conditions which are closely related to actual evapotranspiration (a measure of net primary productivity).

As in our investigation, previous studies (e.g., Knowlton, 1972; Crowe and Strickland, 1975; Adams, 1978; Jean and Bergeron, 1984) have noted a population structure characterized by a high percentage of coyotes ≤3 years old and a high proportion of juveniles. High percentages of juvenile coyotes has been associated with populations under heavy harvesting pressure (Mathwig, 1973) or expanding populations (see Jean and Bergeron, 1984).

Sex ratios of about 1:1 in our study correspond to that usually reported for coyotes (Knowlton, 1972; Nellis and Keith, 1976; Berg and Chesness, 1978). However, some investigations have shown sex ratios that favor males (Young and Jackson, 1951; Gier, 1968; Hawthorne, 1971; Nellis and Keith, 1976) while other studies have noted higher percentages of females (Wetmore et al., 1970; Knowlton, 1972). Sex ratios that favor females are usually in areas of intense exploitation (Knowlton, 1972). Nellis and Keith (1976) indicated that the high percentages of females are explainable because juvenile females are more mobile than juvenile males and are expected to infiltrate vacuum areas in greater numbers; in areas of less intense exploitation, the slight preponderance of males is explained by this same tendency of females to be more mobile than males.

The percentage of females that breed each year may vary from 33 to 90% (Gier, 1968; Knowlton, 1972; Gipson et al., 1975; Nellis and Keith, 1976). For both sampling periods, we found a relatively low number of breeding females (48 and 33%). Gier (1968) and Knowlton (1972) indicated that the number of breeding females each year depended on local environmental conditions and the intensity of coyote control practices. Most of the annual variation in numbers of breeding females is due to the number of juveniles that become sexually mature as was the case in our study. However, Gipson et al. (1975) found no yearling females to breed in Arkansas. Additionally, Hilton (1978) reported that eastern coyotes do not breed as yearlings. In our study, the two yearlings that bred during 1990 indicated that coyotes in the Southeast resemble western coyotes (see Silver and Silver, 1969) in that some individuals are capable of breeding as yearlings.

Average litter size is usually reported as 6.0 young/female with a normal range of 2.0 to 12.0/female (Bekoff, 1977, 1982). However, litters containing 19 young have been noted (Young and Jackson, 1951). The two main factors acting on reproductive success of coyotes are food supply and population density (Jean and Bergeron, 1984). No estimate of food availability is available for western Tennessee; however, given the density value reported by Babb and Kennedy (1989) for this site and the estimates of abundance determined in the present study, the below-average litter sizes indicated in this study appears best explained by a high population density.

In 6,203 snare nights and 2,218 trap nights, Babb and Kennedy (1989) harvested 34 coyotes from our study site in the winter of 1986. They reported a minimum density of 0.35 coyotes/km². Only an occasional individual was removed from the site over the next 2 years. Our collection of 55 coyotes in 1989 (with a minimum density estimate of 0.56/km²) would indicate that the population increased from 1986 to 1989. Results of the sampling in 1990 suggest an approximately equal abundance for 1989 and 1990 despite the fact that many individuals were removed from the area in 1989. Because litter sizes are below average and the number of females breeding is low, the approximately equal density between years is best explained by a remaining resident population in 1989, despite the removal of 55 individuals, and the presence of a reservoir of transient animals available to occupy vacant areas following removal of resident coyotes. Our results support the conclusion of Windberg and Knowlton (1988) that, with methods currently available, extirpation of coyotes over large areas is not feasible or practical. Connolly and Longhurst (1975) have indicated that where removal efforts are limited in duration or scope, they have only transitory effects (Connolly and Longhurst, 1975). This seems to have been the case in the present study.

During both sampling periods (1989, 1990), we continued to sight tracks and individuals immediately following the trapping effort. An expected drop in trap success due to removal of individuals from the site never occurred. There were no indications that all coyotes on the study area had been captured. Therefore, our study presents minimum density estimates similar to that reported by Babb and Kennedy (1989). Determinations of coyote abundance vary substantially (Bekoff, 1977, 1982; Babb and Kennedy, 1989), and a lack of standardization in techniques makes direct comparisons of density difficult. However, Knowlton (1972) suggested that approximations from 0.2 to 0.4/km² would be reasonable over much of the coyote's distribution. Our minimum density estimates are within this range of values and support the conclusion of Babb and Kennedy (1989) that managers in the southeastern United States can expect coyote densities as high or higher than those reported for coyotes in other parts of its range.

Given the population parameters of our study and the results of previous ecologic investigations relating to coyotes in the southeastern United States (e.g., Sumner et al., 1984; Wooding et al., 1984; Lee and Kennedy, 1986; Van Den Bussche et al., 1987; Babb and Kennedy, 1988, 1989), it seems clear that there are many similarities between the more recently founded populations in the Southeast and those from the more traditional areas of the species' range. Such information should be

useful to managers in the Southeast. As suggested by Lydeard and Kennedy (1988), it appears that coyotes gradually extended their distribution eastward and southeastward over a period of 25 to 30 years while retaining many natural-history traits characteristic of the species in established parts of its range.

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