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Population Characteristics of the Gray Fox (*Urocyon cinereoargenteus*) in Southern Illinois during the Late 1970s

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ABSTRACT

We obtained 217 gray fox carcasses from fur buyers in southwestern Illinois during the winters of 1978-79 and 1979-80, a time of comparatively high fur prices and harvests. Individuals with an upper canine pulp cavity width ratio >.40 were identified as juveniles (0-1 year old); remaining specimens were aged by cementum annuli counts. For the 2 years combined, there were 106 (48.8%) males and 111 (51.2%) females; the sex ratio did not differ from 1:1 (x^2=0.074, P>0.05). The mean number of placental scars for female gray foxes was 3.24, and the reproductive rate was 81.1%. Juveniles comprised 56.2% (n=122) of the 2-year sample; remaining animals were 1 to 8 years old with the mean age of 1.69 years. The percentage of juveniles we found was slightly higher, but similar to 2 previous studies in southern Illinois during the mid-1950s and early 1960s when more moderate fur prices and harvests existed. Survivorship curves and mean ages from the earlier time period and our sample were similar. Increased harvests of gray foxes during the late 1970s did not appear to alter the population characteristics of the species in southern Illinois from those of the mid-1950s and early 1960s when more moderate harvests occurred.

Key words: age structure, demographics, gray fox, reproduction, sex ratio, *Urocyon cinereoargenteus*

INTRODUCTION

Anthropogenic factors such as harvest levels can affect sex and age ratios of foxes (Cypher 2003). Layne (1958) and Lindenfelser (1978) provided demographic information for gray foxes (*Urocyon cinereoargenteus*) collected in southern Illinois during the mid-1950s and early 1960s. No official harvest records were kept at that time, but based on the limited information available, Lindenfelser (1978:19) considered harvests to be "relatively light." One fur buyer cooperating with our study told of purchasing only a few hundred gray foxes each winter in the mid-1950s and early 1960s (C. Zanders, personal communication).

Fur prices and harvest levels increased dramatically for most furbearers, including gray foxes, from the mid- to late 1970s. The mean price per gray fox pelt in the 1975-76 fur season was $16.00 (Hubert 1976). In 1979-80, the mean price was $43.80, an increase of >170% (Hubert 1980). At the same time, the statewide harvest of gray foxes increased from 7,132 to 10,547 (Hubert 1976, 1980). During this time period, the same fur buyer cited above indicated that he purchased over 2,000 gray fox pelts annually from hunters and trappers.

Our objectives were to determine population characteristics of gray foxes in southern Illinois during this time of high annual harvests and to compare them to that of the mid-1950s and early 1960s.

MATERIALS AND METHODS

We obtained gray fox carcasses from three fur buyers in Randolph County, Illinois during December – January 1978-79 and 1979-80. Cooperating fur buyers purchased gray foxes harvested in southern Illinois, including counties from which both Layne (1958) and Lindenfelser (1978) had collected specimens.

Each specimen was assigned an identification number and its sex was recorded. The animal's rostrum containing the upper canine teeth was removed from the carcass with a hand saw and placed in a plastic bag. The uterus of each female was removed, similarly bagged, and frozen for later analysis.

Canine teeth were removed from the rostrums after boiling for about 20 minutes. A canine from each gray fox was sawed off at the gumline with a Dremel™ Roto-drill equipped with a 1-mm thick, 25-mm diameter carborundum saw, a dental "separating disk." (Mention of a product or company does not imply endorsement.) Each crown's maximum pulp cavity width (a) and maximum tooth width (b) was measured with a calibrated binocular dissecting scope, and a pulp cavity width ratio (a/b) was calculated for each specimen. Individuals with a pulp cavity width ratio >.40 were identified as juveniles (0-1 year old) (Root and Payne 1984). Matson's Laboratory, LLC (P.O. Box 308, Milltown, MT 59851) sectioned the remaining teeth and provided cementum annuli counts.

After thawing, each uterus was split longitudinally and placental scars (PS) were counted. To prevent counting the PS of aborted or the previous year's pups, only the darkest scars were counted (Lindstrom 1981).

Reproductive rates for females 1-2 years of age (subadults) and >2 years of age (adults) were calculated. Survivorship curves and mean ages were also calculated, and along with various age and sex groupings of our data, the results were compared to those provided by Layne (1958) and Lindenfelser (1978).

RESULTS

We examined 217 gray fox carcasses; 106 males and 111 females. The ratio of males to females, 0.95:1, did not differ from 1:1 (x^2=0.074, P>0.05). Most (n=122; 56.2%) of the

animals were juveniles; the remainder ranged from ≥1 to 8 years of age (Table 1). The sample's mean age was 1.69 years based on 0-1 year = 0.75, 1-2 years = 1.75, etc.

PS were found in 43 (81.1%) of 53 subadult and adult females; the mean PS count was 3.24 (range 1-5). The mean number of PS for 19 of 25 subadults, 3.05, was not significantly different from that for 22 of 26 adults, 3.41 (t=2.023, P>0.05). Two specimens, both adults, had PS, but exact counts were not possible; they were excluded when determining and comparing means.

DISCUSSION

Past studies have reported lower fecundity for subadult foxes than for adults (Wood 1958, Storm, Andrews, Phillips, Bishop, Siniff, and Tester 1976). In our study, a greater proportion of adult females had PS than did subadults (85.7% versus 76.0%, respectively). While adults had a higher mean number of PS than subadults, the difference was not significant.

Coyotes (*Canis latrans*) are known to respond to increased harvest pressure with compensatory reproduction, i.e., larger litter sizes (Knowlton 1972, Jean and Bergeron 1984). We did not detect this phenomenon in our sample of gray foxes from the late 1970s. The mean PS count of our combined subadult and adult female gray foxes was 3.24, similar to that reported by Layne (1958) in the mid-1950s (3.62). Our mean PS count was also similar to that reported for a protected population in South Carolina (3.6; Weston and Brisbin 2003). Means for harvested populations in other parts of the United States, as summarized by Weston and Brisbin (2003), varied from 3.7-4.6 PS.

We found no PS in nearly 19% of females ≥1 year of age. While Layne (1958) recorded 2% of the females ≥1 year of age in his sample as barren, he included females which had been collected through June and those with either PS or embryos when determining this figure. If only winter-harvested females and PS counts alone had been considered, it is probable that the percent of barren females in his sample would have been larger. Weston and Brisbin (2003) reported a barren rate of 11.1% for a protected population in South Carolina; this rate was determined from counts of both PS and embryos.

Our sample of 217 gray foxes from the late 1970s had a male-female sex ratio of 0.95:1 (Table 2). Layne (1958) noted 114 males from the 218 gray foxes in his mid-1950s study and Lindenfelser (1978) recorded 133 males among the 204 gray foxes he examined. The latter study's male-female sex ratio was significantly different from 1:1 (Table 2).

Other than 2 road-killed foxes, hunters supplied all the specimens for both of the previous southern Illinois studies (Layne 1958, Lindenfelser 1978). During a study of red foxes (*Vulpes vulpes*), Storm et al. (1976) noted that more males were harvested via hunting than females and more females were trapped than males, but neither difference was significant. Lindenfelser (1978) speculated that he collected more male gray foxes (Table 2) because of their higher susceptibility to hunting.

Hubert (1978, 1979) recorded the sex of 94 gray foxes obtained from fur buyers in north-central Illinois concurrent with our study. He noted that greater than two-thirds of his

specimens had been killed by hunters with the remainder harvested by trappers. He reported a greater percentage of males (60.6%) than our study, but the sex ratio did not differ significantly from 1:1 (x^2=3.84, P>0.05).

Our sample consisted of both trapped and hunted gray foxes, probably mostly hunted. Although we noted a lower percentage of males in our study than did Layne (1958) and Lindenfelser (1978), like Layne's study, our male-female ratio did not differ significantly from 1:1 (Table 2) indicating little apparent effect from the increased harvests of the late 1970s.

Lindenfelser (1978) aged his specimens by counting cementum annuli in the animal's first lower premolar; he noted the oldest specimen was 9 years of age. The mean age of Lindenfelser's (1978) specimens and that of our sample were 1.72 years and 1.69 years, respectively. Despite higher fur prices and thus, increased harvests of the late 1970s, the mean ages from the two studies were not significantly different (t=1.966, P>0.05).

Layne (1958) did not age most of his specimens, but determined that 28 of 54 (51.9%) females collected from December – February were juveniles based on the appearance of their reproductive organs and teats. The age structure for Lindenfelser's (1978) sample was 49.0% juveniles, 28.4% subadults, and 22.5% adults. Overall survivorship curves were similar for both studies despite differences in harvest levels during the two time periods (Figure 1).

Age structure differed markedly for a protected population in South Carolina, where juveniles comprised 37.2% of the population, subadults 10.3%, and adults 52.6% (Weston and Brisbin 2003). An earlier study at the same site, conducted soon after harvest was suspended, showed age ratios closer to ours: 62.5% juveniles, 21.7% subadults, and 15.8% adults (Wood and Odum 1964). While changes in habitat might have contributed to this shift in age structure, Weston and Brisbin (2003) considered differences in harvest regimes as a plausible explanation. We concluded that relative differences in harvest regimes had little impact on age structure of gray foxes in southern Illinois during the 1950s and 1960s, when harvest was moderate, and the late 1970s, when harvest peaked.

Among red foxes, Storm et al. (1976) found a lower percentage of juveniles taken by hunting and a higher percentage harvested by trapping. Lindenfelser (1978) speculated that during a time of increased harvest pressure, more juveniles would be taken due to their greater vulnerability to trapping. A portion of the animals in our sample was from trappers, possibly leading to a slightly higher percentage of juveniles in our sample than the previous southern Illinois studies (Table 2).

Jean and Bergeron (1984) and others have noted that increased harvest pressure on coyotes leads to more juveniles within the population. Although we observed a greater percentage of juveniles in our sample of gray foxes, the age ratio was similar to those of the earlier southern Illinois studies (Layne 1958; x^2=0.59, P>0.05 and Lindenfelser 1978; x^2=1.82, P>0.05).

Higher fur prices of the late 1970s led to increased harvests of all furbearers, including gray foxes. It appears that such harvests did not dramatically alter the southern Illinois

gray fox population characteristics from those of the mid-1950s and early 1960s when more moderate harvests occurred.

Our findings provide the most recent description of gray fox age, sex, and reproductive characteristics in Illinois. Statewide harvest of gray foxes has declined from a peak of 10,547 during 1979-80 (Hubert 1980) to approximately 100 during recent years (Illinois Department of Natural Resources, unpublished data). This dramatic change creates an interesting basis for comparison to our study. However, collecting an adequate sample size is not logistically feasible in the foreseeable future.

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Figure 1. Survivorship curves of a sample of 217 gray foxes collected 1978-79 and 1979-80 and of a previous study in southern Illinois (Lindenfelser 1978).

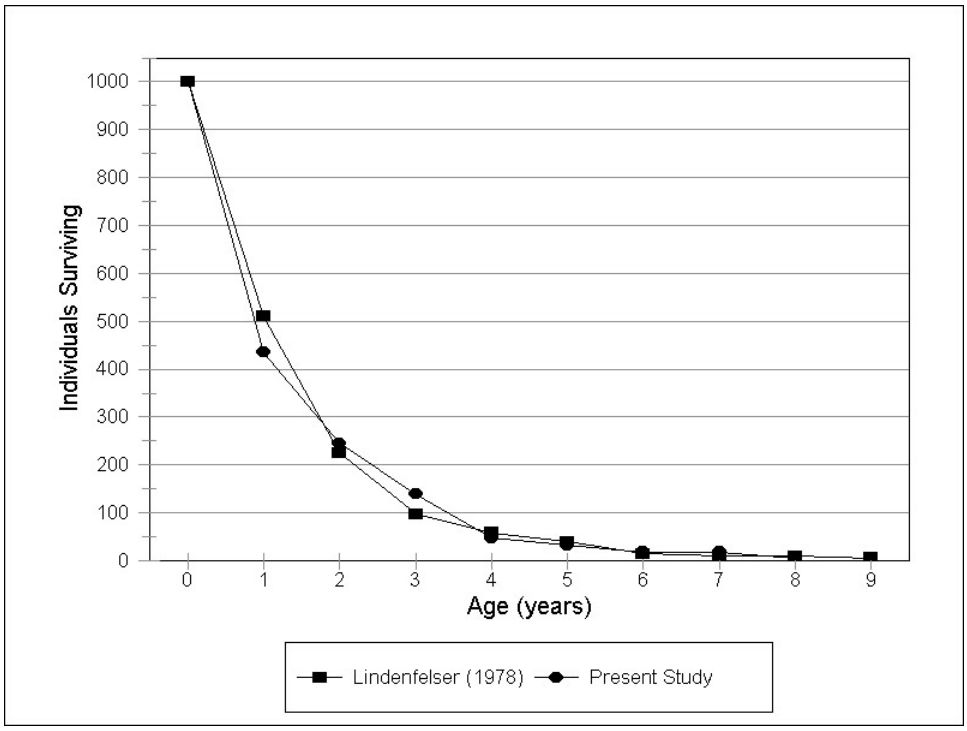

Table 1. Age classes of 217 gray foxes collected 1978-79 and 1979-80 in southern Illinois.

Age Class	1978-79	1979-80	Combined Sample
0-1	43	79	122
1-2	10	31	41
2-3	4	19	23
3-4	3	17	20
4-5	0	3	3
5-6	0	3	3
6-7	0	0	0
7-8	2	1	3
8-9	1	0	1
	63	153*	216*

* One specimen, >1 year old aged via pulp cavity width ratio (see text), not included

Table 2. Male-female and juvenile-adult ratios of 217 gray foxes collected 1978-79 and 1979-80 and of two previous studies in southern Illinois.

	Sample Size	Male-Female Ratios	Juvenile-Adult[a] Ratios
Present study	217	0.95 : 1	1.29 : 1
Layne (1958)	218	1.10 : 1	1.08 : 1
Lindenfelser (1978)	204	1.87 : 1[b]	0.98 : 1

[a] Juvenile = 0-1 year old; Adult = >1 year old

[b] significantly differs from 1 : 1 (x^e=18.24, P<0.05)