

LATE FALL FOODS OF THE GRAY FOX IN SOUTHERN ILLINOIS

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ABSTRACT

Contents of digestive tracts from 169 gray foxes (*Urocyon cinereoargenteus*) collected during October, November and December from 1954 through 1963 in five southern Illinois counties were analyzed. Plants such as persimmons (*Diospyros virginiana*), wild grapes (*Vitis* spp.), and corn (*Zea mays*) were the most important food items by percent volume and frequency of occurrence. Plants decreased in the diet from October to December; the reverse was true for animal foods. Mammals were the most important animal foods in the diet. Comparison of stomach and large intestine contents suggest that it may be feasible to consider them separately for the most complete analysis of the diet of this canid. Comparison of gray fox diets in Virginia, Pennsylvania, Missouri and Iowa with the present study indicated that mammals provided the primary food in all other studies.

The diet of gray foxes (*Urocyon cinereoargenteus*) is highly omnivorous in Iowa (Scott 1955), Virginia (Nelson 1933), Pennsylvania (Kozicky 1943) and Missouri (Korschgen 1957). Foods in Illinois gray foxes have been little studied. The objectives of this research were to: (1) determine the dietary pattern of gray foxes during October, November and December; (2) examine the feasibility of considering the stomach and intestine as separate samples; and (3) compare southern Illinois data with those of gray fox food studies in other states.

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METHODS AND MATERIALS

Available from Southern Illinois University Cooperative Wildlife Research Laboratory collection were 29 gray fox digestive tracts (stomachs and intestines) collected in October, 56 in November, and 84 in December during 1954 to 1963. Contents of stomachs and intestines had been previously segregated and preserved in jars of 10 percent formalin solution. The volume of this material was calculated to the nearest ml by water displacement in a 1000 ml graduated cylinder. Subsequently, individual items were sorted and their volume determined.

RESULTS

Plant foods including persimmons (*Diospyros virginiana*), wild grapes (*Vitis* spp.), and corn (*Zea mays*), were the most important items in the digestive tracts by both percent volume and percent frequency of occurrence (Table 1). One hundred sixty-seven plant foods, constituting 70 percent by volume, appeared in 99 percent of the complete digestive tracts. A total of 164 animal foods comprising 30 percent by volume showed 97 percent frequency of occurrence. Mammals made up the highest percentage of animal food; rabbits ranked high (Table 1). Possibly both swamp rabbits (*Sylvilagus aquaticus*) and cottontails (*S. floridanus*) were included, but they could not be distinguished in the sample. Representatives of Insecta found in 54 percent of all digestive tracts, comprised a 2 percent volume. The temporary cicada (*Magicicada* spp.) was the only insect which occurred in measurable quantities.

Based on analysis of complete digestive tracts (stomachs and intestines combined), trends in utilization of major food groups were evident during the 3 months (Figure 1). The volume of persimmons dropped from

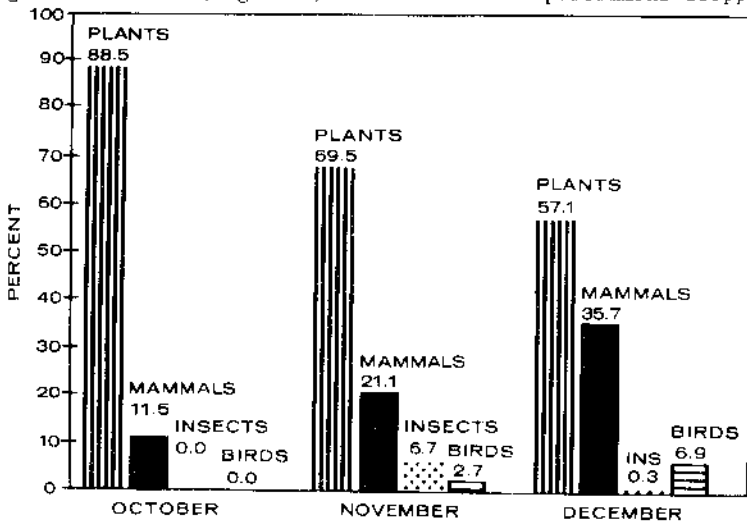


Fig. 1. Trend in food utilization (% vol.) by gray foxes in southern Illinois, October-December, 1954-1963.

TABLE 1. Major food items found in complete digestive tracts of 169 gray foxes collected during October, November and December, southern Illinois, 1954-1963.

Foods	Percent Frequency of Occurrence	Percent Volume
Plants	99	70
Persimmon (<u>Diospyros virginiana</u>)	70	52
Grapes (<u>Vitis</u> spp.)	22	6
Corn (<u>Zea mays</u>)	15	5
Pokeweed (<u>Phytolacca americana</u>)	11	2
Apples (<u>Pyrus</u> spp.)	7	2
Animals	97	30
Mammals	73	24
Deer mice (<u>Peromyscus</u> spp.)	30	4
Rabbits (<u>Sylvilagus</u> spp.)	27	10
Prairie vole (<u>Microtus ochrogaster</u>)	25	6
Gray fox (<u>Urocyon cinereoargeneus</u>)	22	1
House mouse (<u>Mus musculus</u>)	7	2
Unidentified mammal	4	T*
Insects	54	2
Short-horned grasshopper (<u>Melanoplus</u> spp.)	40	T
Unidentified insect	11	T
Stink bugs (Pentatomidae)	8	T
Temporary cicadas (<u>Magicicada</u> spp.)	1	2
Birds	18	4
Unidentified bird	17	1

*T = trace = less than 1%.

85 percent in October to 43 percent in December. Conversely, during the same period, the occurrence of mammals increased in the digestive tracts. Rabbits were the most important animal food represented, appearing during October at 1 percent by volume and 17 percent by frequency. By December, consumption of lagomorphs had increased to 17 percent by volume and 37 percent by frequency of occurrence. A change in food utilization occurred during December, when portions of skunk (Mephitis mephitis), raccoon (Procyon lotor) and opossum (Didelphis marsupialis) were recorded.

Contents of stomachs and intestines taken from 169 gray foxes for the combined months of the study were compared (Table 2). The major

TABLE 2. Comparative importance of major food items as recorded in stomach and intestine contents from 169 gray foxes, collected in southern Illinois during October, November and December, 1954-1963.

	Stomachs		Intestines	
	Percent Volume	Percent Frequency of Occurrence	Percent Volume	Percent Frequency of Occurrence
Plant Foods	66.8	97.0	77.4	99.5
<u>Diospyros virginiana</u>	49.1	63.7	55.8	70.2
<u>Vitis</u> spp.	4.9	15.9	7.0	20.5
Grasses	5.9	35.0	6.3	32.9
<u>Zea mays</u>	5.7	15.9	5.2	11.8
<u>Phytolacca americana</u>	.8	3.8	3.6	10.6
Animal Foods	33.2	97.4	22.6	96.8
Mammalia	25.9	67.0	20.0	68.6
Lagomorpha	10.4	20.4	9.6	23.0
Rodentia	15.4	44.6	9.4	38.9
Aves	4.4	20.4	2.2	16.0
Invertebrata	2.9	46.5	.4	48.8
Insecta	2.9	44.0	.4	48.2
<u>Magiciada</u> spp.	2.9	.6	.4	.6

differences were in terms of percent volume of individual plant and animal materials. Persimmons (*Diospyros virginiana*) and pokeweed (*Phytolacca americana*) exhibited the major percent volume differences in plant foods, while rodents, invertebrates and insects constituted the greatest percent volume differences among animal foods.

Foods utilized by gray foxes in Virginia (Nelson 1933), Pennsylvania (Kozicky 1943), Missouri (Korschgen 1957) and Iowa (Scott 1955) were compared to those utilized by foxes in this study (Table 3). While these studies did not all encompass the same time period as this study, except for the data from Iowa (Scott 1955), there was overlap of at least a month. In Missouri, Korschgen (1957) noted that the volume of plant foods utilized during September through November (19 percent) decreased to 9 percent during December through February. A corresponding increase in animal foods was noted during these periods with the cottontail being the primary food (57 percent by volume). A higher volume of animal foods (81 percent) was recorded for studies in Missouri and in Pennsylvania (Kozicky 1943).

DISCUSSION

Several explanations may be given for the appearance and frequency of various foods in the gray fox diet. Temporary cicadas, found in clusters within the digestive tracts, gather in large groups during their final larval instar stage (Borror and DeLong 1954); they could be readily eaten in large quantity by foxes. Scott and Klimstra (1955) found red foxes to be opportunistic in feeding, capitalizing on sudden occurrences of cicadas.

The frequent appearance of persimmons in the diet may be attributed to their high seasonal availability; according to Sargent (1905), the fruits ripen in the fall and may persist on the branches during winter. The majority of persimmon fruits found in the digestive tracts were ripe, indicating that they had been eaten after falling to the ground. The availability of rabbits may have been enhanced as a result of the hunting season in November, which could have produced crippled or dead rabbits.

A shift in utilization of larger mammals during December may have been a result of fewer, more easily available foods, causing gray foxes to attack larger prey; on the other hand, higher early winter mortality for skunks, opossums, and raccoons may have created a source of carrion for scavenging foxes.

Some differences in the food items may be attributed to seasonal variation in availability, which may have been even more evident if studies were conducted at other times of the year. For example, lagomorphs may have been highly available in Missouri because of the high rabbit population and the long hunting season (Wight 1959), as well as the September to November period of study when mortality was high.

TABLE 3. Major foods of gray foxes as indicated by stomach contents or scats collected from five localities in United States.

Locality	Time of Study	Rank in Diet					Sample Size	Data Recorded As
		1	2	3	4	5		
Southern Illinois (Present Study)	Oct.-Dec. 1954-63	Plants (67)	Mammals (26)	Birds (4)	Invert. (3)	Reptiles (0)	169 ^a	% Vol.
Virginia (Nelson 1933)	Dec.-Mar. 1931-32	Mammals (58)	Plants (23)	Birds (17)	Reptiles (1)	Invert. (1)	82 ^a	% Vol.
Pennsylvania (Kozicky 1943)	Sept.-Nov. 1941-42	Mammals (42)	Invert. (38)	Plants (19)	Birds (1)	Reptiles (0)	186 ^b	% Vol.
Missouri (Korschgen 1957)	Sept.-Nov. 1948-54	Mammals (61)	Plants (19)	Invert. (11)	Birds (9)	Reptiles (0)	25 ^a	% Vol.
Iowa (Scott 1955)	Jan.-Mar. 1948	Mammals (43)	Plants (29)	Birds (26)	Fishes (2)	Invert. (0)	19 ^a	% Total Occur.

^aStomach analysis.

^bScat analysis.

The present study indicated that stomachs and large intestines represented reasonably distinct samples; but, small intestines reflected an intergrade. Scott (1955) concluded there was little reason for analyzing samples from the stomach separately from those of the intestine. Our study revealed that differences in percent volume of plant and animal foods (Table 2) were evident between these two digestive tract segments. Foods in the stomach which had undergone varying degrees of digestion were readily identified and usually permitted volumetric determination. In contrast, items from the large intestine, which were of lesser volume than stomach items, consisted largely of nondigestible items similar to those found in scats. Therefore, percent frequency of occurrence was more appropriate for indicating importance of food items in this segment. Thus, by evaluating the contents of stomachs and intestines by appropriate criteria (percent volume versus percent frequency of occurrence), a more meaningful picture of the fox's diet was established. However, care must be taken in evaluating scat and intestinal analyses as suggested by Lockie (1959). He found frequency of occurrence to be erroneous in determining the amount of a given food eaten and the order in which it was eaten.

Based on this study, it appeared that the gray fox was extremely opportunistic and fed on most any item that it could ingest. Seasonal shifts in diet from plants to mammals appeared to reflect seasonal changes in abundance of these plants.

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