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FOOD HABITS OF THE RACCOON *(PROCYON LOTOR)* IN TENNESSEE

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ABSTRACT

Food habits of the raccoon *(Procyon lotor)* were examined from 21 counties in Tennessee. Forty–four food items were identified. Important foods (those occurring in greatest frequency and volume) were found to vary across seasons and among geographic regions but not between sexes. Minor foods (those occurring in lesser frequency and volume) varied between sexes and across geographic regions. Persimmon, corn, insects, crayfish, pokeberry, and sugar hackberry were among the most important food items recorded.

INTRODUCTION

Food habits of the raccoon *P. lotor* have been studied in several states (see Lotze and Anderson, 1979; Kaufmann, 1982). However, at present, little information is available concerning feeding strategies of this species in Tennessee. With the exception of Smith, et al. (1987), there have been no formal studies of raccoon food habits in the state. Smith et al. (1987) examined raccoons from Land Between The Lakes in Stewart County, Tennessee and Trigg and Lyon counties, Kentucky. Since food utilization tends to vary among geographic areas, food habits information gathered in one area may not be applicable to others (Smith et al., 1987). Additional investigations of the food habits of raccoons are needed in Tennessee in order to more completely understand the natural history of this species in the region. The purpose of the present study was to examine food habits of *P. lotor* collected from several localities throughout Tennessee.

MATERIALS AND METHODS

From 1976 to 1982, the digestive tracts of 238 raccoons were collected and examined. Analyses were based only on digestive tracts that contained food (31 were empty); therefore, analyses were conducted using 207 samples (111 males and 96 females). Region (portion of Tennessee), county, and sample sizes were as follows: *western*—Fayette (4), Gibson (2), Hardin (14), Haywood (6), Lake (3), Lauderdale (3), Madison (8), Shelby (22); *central*—Marshall (9), Moore (2), Overton (9), Robertson (1), Rutherford (11), Stewart (4), White (22), Wilson (9); *eastern*—Bradley (16), Claiborne (39), Cumberland (11), Jefferson (1), Moore (5), and Union (6). Most specimens were collected by trappers, hunters, and Tennessee Wildlife Resources Agency personnel. Animals were transferred to the Department of Biology at Memphis State University where they were stored and later examined. Procedures for analyzing food content followed those of Martin et al. (1946). Data were analyzed on the basis of percent volume and percent occurrence. Food volumes were measured by water displacement techniques and were recorded to the nearest 0.1 ml. Hair samples were identified using

Table 1. Foods eaten by raccoons *(Procyon lotor)* in Tennessee[1].

Food Item	Male (n=111)		Female (n=96)		Combined	
	%Freq.	%Volume	%Freq.	%Volume	%Freq.	%Volume
persimmon (*Diospyros virginiana*)	34.2	42.8	37.5	43.8	35.7	43.1
corn (*Zea mays*)	20.7	15.7	15.6	16.7	18.4	16.0
sugar hackberry (*Celtis laevigata*)	13.5	11.1	12.5	6.1	13.0	9.4
summer grape (*Vitis aestivalis*)	10.8	6.7	5.2	1.9	8.2	5.1
acorns (*Querqus* spp., *Fagus grandifolia*)	12.6	1.9	17.7	6.8	15.0	3.5
pokeberry (*Phytolacca americana*)	6.3	2.1	5.2	5.7	5.8	3.2
Alabama supplejack (*Berchemia scandens*)	0.9	2.8			0.5	1.9
greenbrier (*Smilax* spp.)			4.2	3.9	1.9	1.3
Virginia creeper (*Parthenocissus quinquefolia*)	3.6	1.5	1.0	0.7	2.4	1.2
peppervine (*Ampelopsis arborea*)		4.2	0.8	1.9	0.3	
pawpaw (*Asimina triloba*)	0.9	0.4			0.5	0.3
muscadine grape (*Vitis rotundifolia*)	1.8	0.4			1.0	0.2
blueberry (*Vaccinium* spp.)	1.8	0.1			1.0	0.1
flowering dogwood (*Cornus florida*)	0.9	0.1			0.5	T
cherry (*Prunus* spp.)			2.1	T	1.0	T
herbaceous materials	3.6	T	5.2	0.1	4.3	0.1
wood	10.8	1.0	10.4	1.2	10.6	1.1
bread	0.9	1.5	2.1	2	1.4	1.7
beetles	21.6	0.7	20.8	0.7	21.3	0.7
wasps	1.8	T	6.2	2.1	3.9	0.7
grasshoppers	18.0	0.5	19.8	0.5	18.8	0.5
moth larvae	4.5	0.1	5.2	0.4	4.8	0.2
fly larvae	5.4	T	5.2	T	5.3	T
bugs			3.1	T	1.4	T
cicada			1.0	0.1	0.5	T
caddisfly			1.0	T	0.5	T
earthworms	3.6	0.1	1.0	0.1	2.4	0.1
snails	1.8	T			1.0	T
clams	3.6	T	2.1	0.1	2.9	T
crayfish (*Procambarus* spp.)	17.1	1.3	18.8	1.6	17.9	1.4
centipede			2.1	0.1	1.0	T
fish	1.8	0.1	4.2	0.3	2.9	0.1
frogs (*Rana* sp., *Hyla* spp.)	2.7	2.4			1.4	1.6
slimy salamander (*Plethodon glutiinosus*)	0.9	T			0.5	T
lizards	0.9	T			0.5	T
blue racer snake (*Coluber constrictor*)			1.0	0.5	0.5	o.2
birds	10.8	3.9	8.3	1.1	9.7	3.0
bird eggs	0.9	T	1.0	T	1.0	T
voles (*Microtus* spp.)	1.8	1.6	3.1	0.5	2.4	1.3
rabbits (*Sylvilagus* spp.)	4/5	0.4	7.3	2.1	5.8	1.0
deer mice (*Peromyscus* spp.)	1.8	0.8			1.0	0.6
shrew (*Cryptotis parva*)	1.8	0.1	2.1	T	1.9	0.1
woodchuck (*Marmota monax*)	1.8	T			1.0	T
muskrat (*Ondatra zibethicus*)			1.0	0.1	0.5	T
canid (*Canis* spp.)			1.0	T	0.5	T

[1]Trace amount

representatives of known species and the keys of Moore et al. (1974) and Moore and Braun (1983). Plant material was identified using locally collected plant samples and taxonomic keys (pictorial) in Martin and Barkley (1973) and Schopmeyer (1974). Common names of plants follow Scott and Wasser (1980). Food materials present in trace amounts (<0.1 ml) were not included in volumetric tabulations. Data analyses included a separate examination of male and female foods, assessment of male and female foods combined, and examination of foods by seasons with

Table 2. Summary of selected seasonal food eaten by raccoons (*Procyon lotor*) in Tennessee[1].

	Spring		Summer		Fall		Winter	
	n=11		n=18		n=104		n=74	
Food Type	%Vol[2]	%Frq[3]	%Vol	%Frq	%Vol	%Frq	%Vol	%Frq
persimmon			35.8	12.0	57.3	39.0	27.4	21.0
corn	57.6	28.6			10.0	8.0	25.9	27.0
grapes			T	17.0	10.2	13.0		
pokeberry			20.5	38.0	4.5	7.0		
acorns					5.4	13.0	4.2	10.0
sugar hackberry					5.5	7.0	18.4	18.0
cherry			29.5	83.0				
insects	22.0	85.7	3.5	100.0	2.4	55.0	T	15.0
crayfish	1.6	57.0	4.0	38.0	1.5	14.0	1.4	17.0
frogs	8.1	7.2	T	12.0				
fish	1.2	14.4						
birds	T	14.4			T	4.0	8.4	15.0
mammals	1.7	7.2			1.4	10.0	7.1	35.0

[1]T=trace amount
[2]Vol=Volume
[3]Frq=Frequency

samples from both sexes combined, and regional (western, central, and eastern Tennessee) comparisons of raccoon foods using each sex separately. Comparisons between sexes and among regions were conducted using Ellenberg's (IS_E) and Jaccard's (IS_J) similarity indices (see Mueller–Dombois and Ellenberg, 1974; Bartonek and Hickey, 1969). Ellenberg's index was based on the comparison of percent food volumes and Jaccard's on the presence or absence of food items.

Results

A total of 45 food items were identified from raccoon digestive tracts (Tables 1–3). Both animal and plant materials were important food items (those occurring in greatest frequency and volume) for raccoons. In general, results from separate analyses of male and female foods corresponded to results derived from analysis using combined sexes (Table 1). Persimmon, beetles, and crayfish occurred in greatest frequency, and corn occurred in the greatest volume in these groups.

Foods varied across seasons (Table 2). However, important food items among seasons were similar for males and females (Table 2). Foods with greatest frequency (given first) and volume were: *spring*—insects; corn, insects; *summer*—insects, cherry, crayfish, pokeberry; persimmon, cherry, pokeberry; *fall*—persimmon; persimmon; *winter*—mammals, corn, persimmon, sugar hackberry, crayfish; persimmon, corn, sugar hackberry.

Food items varied across regions (Table 3); however, important foods were similar for both sexes (Table 3). Food items with greatest frequency (given first) and volume across regions were: *western*—persimmon; persimmon; *central*—persimmon, corn, sugar hackberry; beetles, grasshoppers, crayfish; *eastern*—persimmon, corn; persimmon, corn, acorns, beetles, grasshoppers, crayfish. Only persimmon was found to occur in both high frequency and volume in all regions for males and females. Similarity indices (IS_E and IS_J) indicated differences between foods of males and females and differences in food items across regions (Table 4).

Discussion

Small sample sizes (e.g., among age classes and regions) prevented some statistical comparisons between sexes and among seasons and regions in the present study. However, results clearly showed raccoons to be omnivorous and opportunistic, and that, in general, plants were more common than animals in the raccoon's diet. These findings follow those of many food habit studies relating to this species (see Kaufmann, 1982). Raccoons eat a wide range of foods and are selective when food is abundant; however, they eat whatever is available when food is scarce

Table 3. Foods eaten by raccoons (*Procyon lotor*) in geographic regions (western, central, and eastern) of Tennessee[1].

Food	Western				Central				Eastern			
	Male n=35		Female n=27		Male n=36		Female n=31		Male n=40		Female n=38	
	%Frq[2]	%Vol[3]	%Frq	%Vol	%Frq	%Vol	%Frq	%Vol	%Frq	%Vol	%Frq	%Vol
persimmon	51.4	74.0	44.4	57.4	19.4	27.1	32.3	41.6	32.5	22.0	36.8	37.0
corn	8.6	1.0	7.4	17.9	30.6	22.2	22.6	18.9	22.5	25.9	15.8	15.0
sugar hackberry	5.7	T	3.7	0.3	25.0	29.6	25.8	11.8	10.0	6.4	7.9	6.6
summer grape	20.0	11.0	3.7	4.5	2.8	T	12.9	3.1	10.0	8.1		
acorns	5.7	0.3	11.1	5.5	11.1	1.0	12.9	1.3	20.0	4.6	26.3	9.9
pokeberry	2.9	1.9			2.8	0.1	3.2	0.1	12.5	4.1	10.5	11.3
Alabama supplejack									2.5	8.5		
greenbrier			3.7	1.2							7.9	7.3
Virginia creeper	2.9	0.2							7.5	4.3	2.6	1.5
peppervine			11.1	3.0			3.2	0.1				
pawpaw									2.5	1.2		
muscadine grape									5.0	1.1		
blueberry									5.0	0.3		
flowering dogwood					2.8	0.2						
cherry				3.7	0.1						2.6	T
herbaceous material	5.7	0.1	7.4	T			3.2	0.3	5.0	T	5.3	0.1
wood	8.6	1.0	7.4	3.1	11.1	0.8	16.1	1.4	12.5	1.0	7.9	0.1
bread							6.5	8.5	2.5	4.0		
beetles	20.0	0.3	14.8	0.7	22.2	1.6	25.8	2.0	22.5	0.2	21.1	0.1
wasps			3.7	T			9.7	0.1	5.0	T	5.3	4.2
grasshoppers	14.3	0.2	18.5	0.1	16.7	0.3	25.8	1.1	22.5	1.0	15.8	0.5
moth larvae	2.9	T	3.7	0.3	8.3	0.2	3.2	T	2.5	T	7.9	0.5
fly larvae	2.9	0.1	7.4	T	8.3	T	3.2	T	5.0	T	5.3	T
bugs			3.7	T			3.2	T			2.6	T
cicada		3.7	0.4									
caddisfly										2.6	0.1	
earthworms						3.2	0.6	10.0	0.4			
snails	5.7	T										
clams					5.6	T	3.2	0.2	5.0	T	2.6	0.1
crayfish	11.4	0.2	14.8	2.6	16.7	2.9	19.4	0.3	22.5	1.1	21.1	1.7
centipede							3.2	T			2.6	0.1
fish	2.9	0.1			2.8	0.1	9.7	1.2			2.6	T
frogs					5.6	7.5			2.5	0.3		
slimy salamander									2.5	0.1		
lizards									2.5	T		
blue racer snake											2.6	1
birds	14.3	9.0	11.1	1.5	8.3	T	16.1	3.1	7.5	1.9		
bird eggs			3.7	T	2.8	T						
voles					5.6	5.3	3.2	2.0			5.3	0.1
rabbits	2.9	T	11.1	1.4	8.3	0.8	9.7	2.2	2.5	0.5	2.6	2.6
deer mice	2.9	0.2							2.5	2.4		
shrew			3.7	T	5.6	0.2	3.2	0.1				
woodchuck	2.9	T							2.5	T		
muskrat											2.6	0.3
canid											2.6	T

[1]T=trace amount

[2]Frq=Frequency

[3]Vol=Volume

(Hamilton, 1951; Wood, 1954; Johnson, 1970; Harman and Stains, 1979).

Smith et al. (1987) reported insects, corn, persimmons, crayfish, and mussels as important foods for *P. lotor* in Stewart County, Tennessee, and two adjacent counties in Kentucky. They explained the utilization of these foods in relation to resource availability on their study area which included the shorelines of Kentucky Lake and Lake Barkley,

Table 4. Comparisons of raccoon (*Procyon lotor*) food habits between sexes (overall), between sexes among regions (western, central, and eastern), and combined sexes across regions using Ellenberg (IS_E) and Jaccard (IS_J) similarity indices[1].

Group	IS_E	IS_J	Group
Male	88.22	52.17	Female
Western (male)	93.24	50.00	Western (female)
Central (male)	89.30	60.71	Central (male)
Eastern (male)	68.21	41.03	Eastern (female)
Western	87.60	60.00	Central
Western	91.37	54.55	Eastern
Central	86.64	58.14	Eastern

[1]Indices range between 0 and 100; greatest similarity is represented by 100.

old and agricultural fields, and large stands of mature forest. The present study indicated persimmon, corn, insects, and crayfish as important to raccoons across the state. Fish and mussels are utilized more commonly in areas with aquatic habitats as in Stewart County.

There are no reports of sexual differences in the foods (those occurring in greatest frequency and volume) eaten by raccoons. Results of the present study follow this same pattern. Even among different seasons where shifts in food availability are evident, males and females retain their omnivorous and opportunistic nature with no apparent partitioning of important foods.

Patterns of seasonal variation in raccoon food habits have been summarized by Kaufmann (1982). Mostly crayfish, insects, and small vertebrates are eaten in the spring. In summer, foods are primarily fruits (with corn important in some areas) and some animal foods (mainly crayfish, insects, and small vertebrates). Fall foods are primarily plants, especially fruits and corn; crayfish and fish are important in some areas. Acorns are the most important food in winter (supplemented by corn and fruits). Results of the present study follow the pattern, in general, described by Kaufmann (1982). Results of most studies, including the present investigation, indicate that raccoons start to feed on fruits in summer and continue this utilization into winter. Only in spring do most raccoons eat more animal than plant foods (see Lotze and Anderson, 1979; Kaufmann, 1982).

Smith et al. (1987) reported percent occurrence of insects, corn, persimmons, and acorns to vary significantly across seasons for raccoons examined in their study. They reported only insects to vary significantly in percent volume across seasons. While not statistically tested, these foods obviously varied among seasons in the present study.

Results presented in Table 3 suggest regional differences in most foods eaten by raccoons. An examination of studies conducted in various parts of the range of *P. lotor* (e.g., Stuewer, 1943; Baker et al., 1945; Schoonover and Marshall, 1951; Tester, 1953; Stains, 1956; Johnson, 1970; Fleming et al., 1978; Harman and Stains, 1979) indicate geographic variation in foods eaten by raccoons. Raccoons in various habitats and regions have varying diets. Therefore, it is not surprising to find variation in foods eaten by raccoons in different regions of Tennessee. However, general patterns of variation in food habits across Tennessee are not apparent. It should be pointed out that only 22 of 96 counties were represented in the regional comparisons of the present study. Additional investigations are needed in several areas of the state in order to better understand the overall patterns of feeding strategies of *P. lotor* in Tennessee.

Results of the comparisons between sexes, between sexes among regions, and combined sexes across regions using similarity indices are of interest. Little attempt has been made to assess raccoon foods in this manner. These results indicated differences between feeding strategies of males and females, differences in food habits between sexes within region, and differences in foods eaten among combined sexes across regions. Since important food items are relatively similar between and among these groups (Tables 1–3), differences indicated by the similarity indices (Table 4) are probably due to the presence of food items in small amounts and in low frequencies (minor foods). Previous investigations have given little attention to these items (see Lotze and Anderson, 1979; Kaufmann, 1982). The importance of such differences in minor foods is unclear and needs additional study.

Food items reported in the present study, and seasonal and regional variation in foods eaten by raccoons have been noted previously. However, foods identified in the present study illustrate local strategies for taking advantage of available resources. Smith et al. (1987) indicated that an awareness of food utilization at a local level appears critical to decisions relating to questions of raccoon food habits. Since foods eaten by raccoons have not been investigated in some areas of Tennessee, future studies could add to the understanding of the feeding strategies of this species in the state by assessing *P. lotor* in portions of Tennessee not yet studied and by focusing on minor foods as well as important foods.

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