FOOD HABITS OF THE RACCOON, *PROCYON LOTOR HIRTUS* N. AND G., IN CENTRAL IOWA

by

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INTRODUCTION

In order to evaluate the carrying capacity of any area it is imperative that all of the influencing factors be known. One of the important factors affecting that capacity is food. The availability and abundance of the proper food may determine the abundance of game species. An investigation into the food habits of a game species, therefore, is essential to effective management.

Such investigation may also aid in determining when artificial feeding, if economically feasible, should be undertaken. In the case of the raccoon, Procyon lotor hirtus N. and G., this period seems to be most often in late winter and early spring. In autumn the raccoon gorges itself upon corn and is fatter than at any other time of the year. During winter, a period of almost dormancy, most of that food in the form of stored fat is utilized. Early spring, therefore, finds the raccoon eager for food again. In those areas where mechanical corn-pickers have been used approximately three bushels of waste corn per acre is left on the ground (Allen, 1949). On those farms the raccoon may fare very well. However, in other areas where cattle and hogs have been permitted access to these fields the quantity of corn left on the ground is reduced considerably. It is chiefly on those areas that the raccoon may assume his role as the "masked prowler" to make occasional raids on corn bins and chicken houses.

This investigation was undertaken partly to ascertain whether or not a marked difference in food usage occurs during periods of high and low populations. When Giles (1939b) made his investigation into the food habits of the raccoon in eastern Iowa, the population was considered to be very low. During the investigation reported in this thesis, which began October, 1950, and ended September, 1951, the raccoon population was at a high level throughout the state. According to the Iowa State Conservation Commission (1951) the raccoon population reached an all-time high during the 1949-1950 bienium and there were no indications that the population was declining.

This research was conducted to show the seasonal aspect of the foods eaten. It was in progress the entire year and the writer visited the research areas periodically every month. Since the raccoon is quite inactive during the weeks of late December, January and February — foraging only occasionally on mild days — no winter report is available.

The main objectives of this investigation were to add to the existing knowledge of the year-round food habits of the raccoon and to determine the use made of agricultural crops in years of high raccoon populations.

HISTORICAL REVIEW OF LITERATURE

Many, such as Godman (1846), Burroughs (1902), Stone and Cram (1904) and Seton (1929), who have written about the foods of raccoons based their information only on casual field observations. Only within the last two decades has any real scientific study been made of the food habits by means of fecal and visceral content analyses. Not until the late 1930's did studies of bird droppings and mammal scats become important (Martin, Zim and Nelson, 1951).

One of the earliest investigations into the food habits of the raccoon was done by Dearborn (1932), who analyzed about 500 summer scats which were collected in Michigan. That was the first time the food habits of the raccoon were studied through fecal analysis. The two most significantly important fecal remains were found to be crayfish and grain, in the form of oats and corn. By volume crayfish composed 59 percent of the entire fecal bulk while grain ranked second with 20.20 percent of the mass.

Whitney (1931), another early investigator, based his reports of raccoon foods on the contents of the viscera of captured animals. His examination of the viscera of 128 raccoons taken in the New England states was the first study of raccoon foods conducted in this manner. Although no quantitative data were reported, he stated that the fall and winter foods most often taken were corn, oats, nuts, wild cherry, apples, grapes, pears, crickets, white grubs and trout.

In a similar investigation conducted by Hamilton (1936) in New York, viscera of 130 raccoons were examined. Beechnuts were found to be the most important food during fall and early winter. They were found in 21.3 percent of all stomachs and accounted for 14.17 percent of the visceral contents. Fruit and berries, apple, and buckwheat were equally important in their respective order. Earthworms, found in 19.9 percent of the stomachs for a bulk of 8.44 percent, were thought to be a much more important food source than actually was apparent.

From a study of 67 autumn scats collected in central Iowa, Giles (1939) found corn to be the predominant food. Corn portions formed 41.05 percent of the total fecal bulk. The animal portion of the autumn diet was approximately 26 percent, of which crayfish, the most important animal inclusion, accounted for 25 percent.

Hamilton (1940) revealed that the summer food of the raccoons in the Montezuma Marsh in New York consisted primarily of wild fruit. Of the 163 scats analyzed 84.66 percent contained fruit remnants which compromised 72.12 percent of the total bulk. Cherries ranked first quantitatively.

Reports of those investigations, it will be noticed, dealt only with one season or a period of time less than a year. Few investigations have been carried on concerning the seasonal yearly variations in raccoon feeding. One of the first attempts to do so was started by Giles (1939), who analyzed 357 scats collected during spring, summer and autumn in eastern Iowa. It was found that a seasonal variation occurred in the following manner. During spring, corn compromised 11.73 percent of the

total fecal volume and occurred in 38.78 percent of the scats, while insects occurring in 87.86 percent of them provided for 27.07 percent of the total fecal bulk. In the autumn, however, corn occurred in 93.63 percent for a total bulk of 85.59 percent of the fecal mass, whereas, insects now occurring in 80 percent of the scats compromised only 7.99 percent of the total fecal bulk. Summer data varied considerably from either the spring or autumn periods. Quantitatively, insects, raspberries and corn were of almost equal importance in their respective order. Insect remains constituted 28.47 percent of the total fecal volume and appeared in 43 of the 44 scats. Raspberries occurred in 42 percent of the scats and made up 25.05 percent of the total fecal bulk. Corn was third in importance quantitatively, with a volume of 23.76 percent of the total fecal inclusions.

One of the most recent studies into the seasonal food habits of the raccoon was conducted by Baker, Newman and Wilke (1947). This study included fecal, stomach and intestinal tract examinations. A total of 378 scat units — 344 scats, 23 stomachs and 11 intestines — were examined. Throughout the year 60 percent of the raccoon's diet was found to be plant material and 40 percent was of animal products. Acorns made up one-third of the bulk of examined materials and occurred in 193 of the 378 scat units. According to Martin, Zim and Nelson (1951), the dietary main stay of raccoons, in regions other than the prairies, is acorns. Crayfish, making up one-fourth of the total bulk of examined units, occurred in 234 scat units. The summer plant-animal ratio varied considerably from that of the other seasons, with a 50:50 ratio existing.

Acorns, crayfish, and grape were of importance. During autumn 81 percent of the diet was plant material with ripening autumn fruits dominating. The winter diet consisted of 75 percent plant material of which acorns were more than one-half of the total remains. Spring likewise showed a high plant content of 71 percent with acorns accounting for one-fifth of the total volume and crayfish amounting to one-half of the total animal remains by volume.

THE INVESTIGATION

Method of Procedure

To determine the food habits of the raccoon, its scats were collected in various areas and analyzed in the laboratory. During the period of October, 1950 until September, 1951, excluding the winter months, these areas were visited at least once a week for purposes of collection. On many occasions they were visited twice a week.

The raccoon has the habit of mounting and running on fallen trees in its path. Coincidently, there one will find its excrements. This tendency to continually defecate at a particular spot makes it easy for one to collect scats especially when they are numerous as in latrine trees. A latrine tree is a tree that is used regularly for defecation purposes by one or more raccoons (Fig. 1). At such trees large accumulations of scats were found. One large latrine tree discovered in the autumn of 1950 contained 45 scats.

Characteristically defecation sites seemed to be on large logs near water courses. In general a marked preference seemed to be present for fallen trees. Large fallen trees with diameters of 24 inches or more were apparently used more often than smaller ones. Large fallen trees entirely surrounded by water contained scats on many occasions. Soil mounds, rocks and other such objects were used seldom. Those fallen trees devoid of bark seemed to be utilized much more frequently

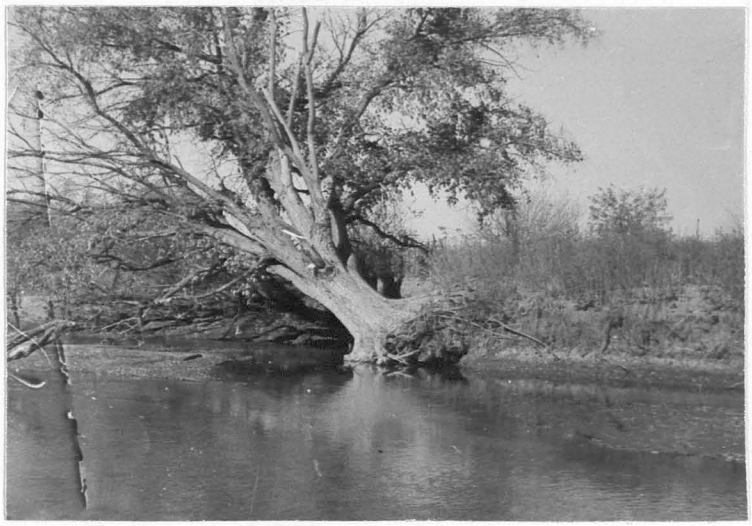

Fig. 1. A large standing latrine tree inclined over the water. This site had an accumulation of 45 scats during the autumn of 1950.

Fig. 2. A raccoon using the above latrine tree.

(Photos by J. Cabalka)

than those with the bark intact. Of 15 fallen trees used for defecation purposes not one was less than 24 inches in diameter and in 10 of those 15 trees the bark was absent. Ordinarily, standing trees when used were of a latrine nature with large accumulations of scats. Most of them were large living trees situated very close to the stream and in most cases inclined at an angle over the water. Frequently trees which had fallen into the water were used as defecation sites and many times assumed latrine proportions (Fig. 3 and 4).

Aside from the use of fallen and standing trees, scats were found on stumps, at the base of trees on their roots, on cattle pathways and on a gravel bluff. The gravel bluff site yielded as many as 25 scats in one collection but after a dense growth of staghorn sumac, Rhus typhina, covered the hill, no scats were ever found there again. This led to another assumption that the choice of a site for defecation purposes was probably influenced in some manner by the density of the existing vegetation. Many areas that had been excessively grazed, yet contained what appeared to be ideal defecation sites, entirely lacked raccoon sign. Areas so dense that walking through the thick undergrowth was difficult, produced negative results. Moderately grazed areas seemed to be used most often as was evidenced not only by the large accumulation of scats in latrine trees and the greater use of fallen trees, but by a higher incidence of visible raccoon tracks.

During the autumn of 1950 the field investigation was limited to an area of Squaw Creek immediately northwest of the Iowa State College Golf Course. This area, at that time, produced many scats which were

Fig. 3. An uprooted tree fallen across a stream. Many scats were collected at such sites.

Fig. 4. A commonly used site for defecation purposes was on trees that had piled up in a stream.

apparent on almost every fallen tree. The topography consisted of rolly hills on each side of the narrow creek valley (Fig. 5). The hills were quite wooded with elm, Ulmus; oak, Quercus; and maple, Acer, trees predominating. Farming was restricted, in most cases to the hill tops and high grounds. Willows, Salix, were the predominant tree of the creek bottom lands and were used as defecation sites more often than any other tree.

After the winter period had passed the Squaw Creek area was again surveyed but with little success in finding scats. No fresh scats were found until March 3. The previous two weeks had been periods of heavy rains and were accompanied by a high rise in the water level of the streams. At that time it was supposed that scats were scarce because they were washed away after disintegrating. Even after the rainy period ended relatively few scats were found and defecation sites that had previously been heavily used were abandoned. Coincident with this decrease in scat deposition was a decrease in the number of tracks seen for on April 24, 1951, only six sets of tracks were discovered throughout the entire length of the stream. Earlier in the autumn of 1950 as many as 12 sets were found in an area of the creek bottom only 150 feet long.

That situation forced a retreat to the surrounding wooded area of the higher hills. There raccoon sign was not conspicuous for only one set of animal tracks was observed. Not a single track was found along 6 miles of road ways and fence rows, which were visited after a rain with the hope that the wet ground would aid in producing visible tracks. Farmers were interviewed at that time to learn whether or not they had

Fig. 5. Typical view of the research area showing the narrow creek surrounded by the wooded hills.

seen raccoons and were experiencing any attacks on poultry and corn bins. The interviews produced no positive information as to the movements of the raccoons at that time.

Finally, on May 30, 1951, almost one month after the finding of the April scats, 16 scats were picked up in three locations. Each of those locations was a latrine tree, which had been inspected regularly on every trip during April without success. Those scats were entirely composed of May beetles, Phyllophaga spp., and fell apart upon touching. It is easy to imagine the fate of such a scat if it were deposited on the ground or any other unsheltered place and subjected to rain, wind and other climatic conditions.

The ability to determine the age, relative freshness and identity of a raccoon scat was acquired through practice. Size, composition, odor, shape and place of deposition aided in determining whether or not it was raccoon material. The odor often was that of the particular food that appeared in the scat. In determining the age the investigator depended on the rate of disintegration, the constituents present, the area of deposition and other related details. The rate of disintegration can be significantly affected by the composition (Yeager and Rennels, 1943).

Once an area was suspected to be a defecation site of raccoons, it was cleared of old accumulated material. Thus, within the period of the next visit only the freshly deposited feces were available for collection. When in doubt as to the relative freshness of a scat it was discarded. If fresh it was collected, intact when possible, and placed in a glassine

bag, upon which was written the date, area of collection and any other vital information deemed necessary. Distances from nearest corn fields, fruit trees or shrubs were recorded thereon and from such information the range that a raccoon had traveled to obtain sweet corn, Zea mays, was calculated. The nearest and only sweet corn field in the area was seven-eighths of a mile from where the scats containing fresh sweet corn were found. On another occasion it was similarly suspected that a raccoon traveled three-quarters of a mile to obtain the wild cherries, Prunus serotina, that appeared in its scats.

Other evident raccoon signs, partially eaten crayfish, Cambarus spp., were recorded. Many times, even though no scats were present on the logs examined, parts of crayfish were encountered. Characteristically, they always seemed to be without their tails and the claws were lacking. This was also observed by Tevis (1947) who watched raccoons eating in the field. When a crayfish was caught and the claws had been torn off and discarded, it was eaten tail first or simply the tail alone. Such remains were noted around small bodies of water that were left when the level of the stream receded. A concentration of raccoon tracks around such areas was very apparent (Figs. 6 and 7).

In order to facilitate the collection of scats, a new area, approximately 11 miles north of the autumn collecting area was chosen. The topography of this area was very much like that of the Squaw Creek area, except for the lower hills. Farming was carried on as close as possible to the bottom lands. Elms and oaks were the predominating trees and gooseberries, Ribes spp., grew profusely on the stream banks. Elms were used more often as defecation sites than any other trees in the area.

Fig. 6

Fig. 7

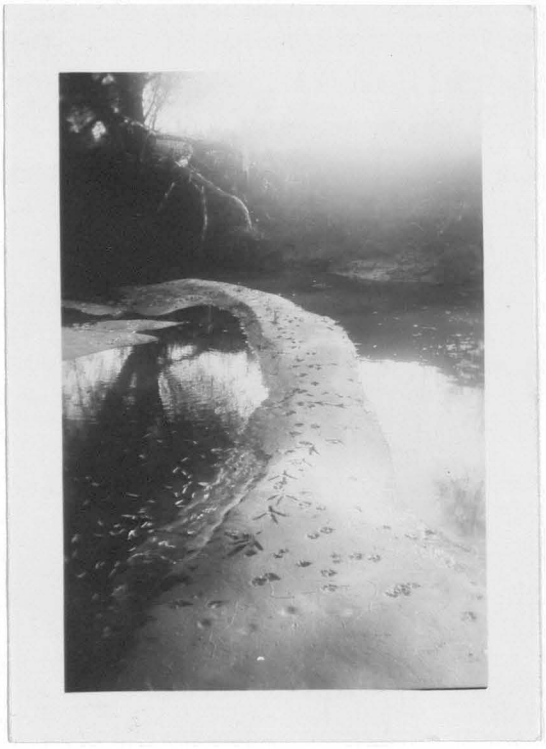

Fig. 6. Concentration of raccoon tracks around a puddle of water.

Fig. 7. Use of a sand bar by raccoons to gain access to the small pools of water.

As the season progressed scats became easier to find. The many fruiting plants of the late summer period were very conspicuous. Gooseberries, wild cherry, and wild grape, Vitis, fruited and inevitably appeared in the scats. Still later corn began to mature and its appearance in the scats gave evidence of the sweet corn damage that had begun.

Scats that were collected in the field were brought into the laboratory to dry. On April 12, 1951, the first phase of fecal analysis took place. It consisted of taking a thoroughly dried scat, crushing it manually and separating its component parts. No positive identification as to species was made at that time. The constituents were placed in glassine bags, each labelled with a corresponding number and season symbol. Not until August 8 was a final identification of the components begun and 300 scats were eventually examined.

The various food remains of each scat were separated and the quantity of each kind was measured in cubic centimeters. In order to determine the relative importance of organisms, the number of each kind was counted. Identification was made possible by a comparison with various collections of insects, seeds, feathers, hair and bones available in the Department of Zoology and Entomology. Invaluable aid was given by various members of the department in identifying remains of such organisms as insects and snails.

Once the constituent parts of a scat were positively identified and quantitatively determined, a record of each was made on an index card 3 inches by 5 inches. Every season had cards of a particular color upon which the separate record of each scat was maintained. Spring

records were placed on white cards, autumn records on pink cards and summer data on blue ones. The tabulated data along with the complete history of each scat were recorded thereon. In that form the information was readily available and was easily arranged by the shifting and shuffling of cards. The evaluation of the data was also greatly facilitated in this manner.

DATA

The Interviews

Many questions concerning the extent of crop damage occurred. Did the rise in raccoon population cause a marked increase in crop damage? If so, then to what extent did this take place? Did an increase of poultry predation occur during periods of low corn availability? In order to obtain the answers it was necessary to secure information from farmers living in areas where raccoons were known to be numerous. The interviews with them plus surveys of crop damage whenever evident helped to arrive at some answers.

When interviewed, the farmers were asked the following questions: Have you had any corn damage last year (1950) that was caused by raccoons? Have you ever had any corn damage by raccoons at any time? Have you had any chickens stolen or killed by raccoons, this or any year?

Those questions were asked of 17 persons and a record of their answers is in Table 1. Only five persons reported any significant corn damage while four attested to poultry predation by raccoon. All of the other persons agreed that corn was taken by the raccoons on their farms but never in amounts which they considered to be damaging.

Those reporting corn damage by raccoons had experienced much crop destruction. Mrs. Neilson revealed that, because of numerous attacks on her sweet corn fields, in past years, she had given up such plantings entirely. The Noland farm was the scene of much crop damage during the

period of this survey. The only other area experiencing corn damage was the Rhiner Honderd farm, although Mr. Honderd reported that no crop or poultry damage ever occurred on his farm.

Table 1. Results of Interviews Concerning Raccoon Damage

Person interviewed	Corn damage 1950?	Corn damage any year?	Poultry damage any year?
Joseph Bailey	Yes	Yes	Yes
Mrs. Cody	No	No	No
Nancy Dixon	Yes	Yes	Yes
Martha Fisher	Yes	Yes	Yes
Rhiner Honderd	No	No	No
J. E. Houts	No	No	No
Mr. Mathews	No	No	No
Mr. Moore	No	No	No
Mrs. Neilson	Yes	Yes	Yes
Pat Noland	Yes	Yes	No
Ralph Oliver	No	No	No
Orville Oliver	No	No	No
Arthur Zenor	No	No	No
Donald L. Hunter	No	No	No
Donald Fessler	No	No	No
Anderson Bros.	No	No	No
D. E. Hunter	No	No	No

Crop Damage Survey

On July 25, 1951, the Pat Noland farm was visited to survey raccoon damage to a 0.05 acre sweet corn patch. The field was approximately 0.4 miles from the wooded portion of the Skunk River. Mrs. Noland had noticed the damage the previous day and had accused her husband of "peeking" into the ears. The field was planted with an early variety of Golden Bantam

sweet corn. The ears had developed around July 20 and the stalks were 4 to 5 feet high. Within that area 14 partially eaten ears of corn had been pulled from the plants and were lying on the ground. Another patch of sweet corn, bordering the wooded area of the river had been planted later in the season, and as of July 25 had not reached the "milk" stage.

On August 1, the field was again surveyed for further damage. At that time 101 ears of corn were counted as damaged on that same plot of land. Twenty-five of the ears were in the first row which adjoined a patch of undamaged field corn. Apparently, the raccoons had moved from the woods through the field corn area to gain access to the sweet corn.

The second sweet corn field of the Noland farm, on August 1 contained mature ears. That field bordered the wooded area of the river and measured 12 feet by 270 feet. One week previous not one ear was taken from that area but on August 1 more than 157 ears had been damaged. On this same Noland farm 10 percent of the 20 acres of tasseling and silking field corn contained dry silk. A survey of those acres revealed no damage that was attributable to raccoons.

Another case of corn damage appeared on the Rhiner Honderd farm. The field was located on a hill bordered by a wooded portion of the river. On August 10 the start of raccoon damage was noticed, especially in the first two rows that bordered the woods. In those two outside rows 36 ears of corn were damaged in an area of 1260 square feet.

Six field corn patches and 3 soybean fields were canvassed but produced no evidence of raccoon damage.

Raccoon destruction to corn was characterized by damage to both stalks and ears. Many stalks were pulled down and broken and the ears

stripped of their husks were partially eaten (Fig. 8-11). After the ears were sampled by taking three or four bites from each, they were discarded. The many scattered and partly eaten ears left on the ground revealed the destruction and waste that was possible.

Spring Foods

Corn, both qualitatively and quantitatively, was the most important spring food item. It appeared in 82 percent of the spring scats and constituted 62.13 percent of the total volume of scat materials. As stated previously, corn was one of the few food items available during early spring when other natural foods were scarce or entirely lacking. Giles (1939) also considered corn to be a very important early spring staple although it ranked second in importance as a spring food. Every one of the 22 scats collected during the months of March and April contained corn. Aside from the occurrence of a few seeds and insects, those 22 scats were mixtures of corn, crayfish or some vertebrate remains (Table 2).

Because of this high incidence of animal remains during the early part of spring, the animal proportions were extremely high. The plant-animal ratio of the spring foods for the months of March to June inclusive, was 63:37. The animal proportion was higher during the spring season than either the summer or autumn periods.

Fig. 8. Raccoon damage to corn by pulling down and breaking of corn stalk.

Fig. 9. Ear of corn husked and partially eaten by raccoon. (Posed by photographer).

(Photos by Frank Buxton)

Fig. 10. An ear of corn husked by raccoon.

Fig. 11. An ear of corn removed and husked by raccoon.

(Photos by Frank Buxton)

Table 2. Fecal Remains Present in 22 March-April Scats

Month	Total volume in c. c.	Corn	Mammals	Crayfish	Fish	Birds
March	25	15	10			
March	45	Trace			45	
March	47	4	33			
March	41	40		1		
March	60	33	21		6	
March	52	43	6			3
March	49	48	1			
March	49	35	8			6
April	22	22				
April	77	55	20	2		
April	48	43		5		
April	33	20	10			3
April	30	Trace	30			
April	29	17	12			
April	26	Trace	26			
April	37	2			35	
April	46	45	1			
April	52	37	15			
April	23	20	3			
April	49	45	4			
April	21	20	1			
April	34	32	2			

Vertebrate inclusions provided for 12.10 percent of the total bulk of scat materials and quantitatively was the second most important fecal remains. Mammal remains were the most important vertebrate inclusions, appearing in 32 percent of the scats for a total volume of 5.36 percent. Meadow mice, Microtus, occurred more frequently and in larger quantities than any other mammal remnants, with the Pennsylvania meadow mouse, Microtus pennsylvanicus, accounting for the bulk of the mammal remains.

The Pennsylvania meadow mouse occurred in 18 of the 23 scats which contained undigested portions of the meadow mice.

Other mammal occurrences such as the cottontail, Sylvilagus floridanus mearnsii, and fox squirrel, Sciurus niger rufiventer, were probably carrion. Many times only fragmentary parts such as bones were present and identification beyond class was difficult.

Bird remains in the form of feathers, bones and feet appeared in 20 scats accounting for 3.69 percent of the total fecal bulk. On three occasions woodpeckers, Dryobates spp., formed the bulk of those scats. Hamilton (1936) felt that the woodpecker was easy prey for a tree dwelling animal like the raccoon and thus accounted for its appearance in the viscera of the raccoons he examined. The principal avian remains were those of chicken, Gallus gallus, which accounted for most of the total percentage by volume.

Fish occurred in four scats but provided for 3.05 percent of the total fecal volume. Identification of fish was made possible through the use of scales which in most cases remained intact. The quillback, Carpiodes cyprinus, was taken on two occasions and because of the high degree of decomposition apparently was carrion.

The many vertebrates taken during the spring and the number of occurrences are found in Table 3. At no other season was the vertebrate composition so high as in the spring. This was probably due to the lack of plant materials, which when present seemed to be the most utilized food, especially in early spring (Table 2).

Table 3. Vertebrate Inclusions of the Spring Scats

Food item	Number of occurrences
Mammals:	
Pennsylvania meadow mouse, Microtus pennsylvanicus	18
Prairie meadow mouse, M. ochrogaster	5
White-footed mouse, Peromyscus maniculatus	4
Fox squirrel, Sciurus niger rufiventer	1
Cottontail, Sylvilagus floridanus mearnsii	3
Birds:	
Woodpeckers, Dryobates spp.	4
Chicken, Gallus gallus	11
Owl, Strigidae	1
Passeriformes	1
Meadowlark, Sturnella sp.	1
Robin, Turdus migratorius	1
Fish:	
Quillback, Carpiodes cyprinus	2
Darter, Percidae	1
Osteichthyes	1
Reptile:	
Turtle, Testudinidae	1

Crayfish remains were common occurrences and were found in 68 of the 100 scats. A count of separate individuals showed 46 crayfish were taken to form a bulk of 10.80 percent of the total fecal mass. After the middle of April crayfish became increasingly important as it appeared more frequently. Sixty-six of the 78 May and June scats contained crayfish remains in varying amounts.

Insect remains compromised 9.87 percent of the total scat volume and occurred in 73 percent of the scats. Qualitatively and quantitatively,

Coleoptera was the most important order. Of the 770 beetles present, 570 were May beetles. Near the peak of the May beetle season entire scats were found to be composed of these scarabids. The predominance of May beetles in spring scats was also recorded by Giles (1939). Various members of the Carabidae accounted for 75 individuals with Geopinus incrassatus numerically the most important (Table 4).

It is interesting to note the habits of both the Carabidae and the May beetles, both of which are principally night feeders. This habit along with the raccoon's nocturnal activities may very well account for the predominance of these insects.

Snail shell remnants accounted for 2.34 percent of the total volume and appeared in 14 of the 100 scats. Most snail inclusions were of such composition as to make any real identification impossible. Two genera that commonly occurred were Lymnaea and Physa, both common snails of the wooded streams.

The spring scats contained unusually large quantities of materials that were of a nature that made identification impossible. Those substances were termed debris and amounted to 2.02 percent of the bulk of the fecal materials. Other inclusions present were a bivalve mollusk, one spider case and seeds of smartweed, Polygonum sp., and greater ragweed, Ambrosia trifida, each appearing in one scat.

Table 4. Seasonal Occurrence of Insects in 300 Scats

Species	Scats containing		Number of individuals		
	Number	Percent	Spring	Summer	Autumn
Order Odonata (total)	4	1.30	2	1	1
Suborder Anisoptera (total)	4	1.30	2	1	1
Order Orthoptera (total)	105	35.00	14	12	205
Locustidae (total)	104	34.60	14	12	204
Melanoplus sp.	2	.66		2	
M. differentialis	40	13.33	7	5	75
M. femur-rubrum	62	20.66	7	5	129
Order Hemiptera (total)	1	.33	1		
Order Hymenoptera (total)	22	7.33	16	3	17
Apidae (total)	3	1.00	3	2	
Bombus sp.	3	1.00	3	2	
Formicidae (total)	4	1.33	5	1	
Camponotus sp.	4	1.33	5	1	
Halictidae (total)	1	.33	1		
Halictes radiatus	1	.33	1		
Vespidae (total)	8	2.66	6		10
Polistes sp.	3	1.00	1		2
Vespula sp.	5	1.66	5		8
Order Coleoptera (total)	163	54.33	770	55	42
Carabidae (total)	67	22.33	75	37	37
Anadaptus discoideus	5	1.66	1	6	
Calosoma sp.	1	.33	1		
C. calidum	7	2.33	6	1	
C. externum	6	2.00	5	2	
C. pergrinator	2	.66	2		
Carabus serratus	7	2.33	4	2	1
C. sylvosus	9	3.00	5	2	2
Chlaenius sp.	4	1.33	8	1	
C. tomentosus	4	1.33	4		1
Evarthrus sp.	2	.66	1	1	
Galerita janus	4	1.33			4
Geopinus incrassatus	22	7.33	6	7	5
Harpalus caliginosus	17	5.66	10	3	5
H. erraticus	7	2.33	4	3	2
Pasimachus elongatus	5	1.66	4		1
Patrobius longicornis	5	1.66	7	1	1
Pterostichus obscurus	2	.66	5		
Scarites substriatus	1	.33		2	

Table 4. (Continued)

Species	Scats containing		Number of individuals		
	Number	Percent	Spring	Summer	Autumn
Order Coleoptera (continued)					
Cicindelidae (total)	6	2.00	3	3	
Cicindela sexguttata	6	2.00	3	3	
Dytiscidae (total)	6	2.00	4	1	1
Dytiscus sp.	1	.33	1		
D. fasciventris	5	1.66	3	1	1
Elateridae (total)	1	.33	1		
Histeridae (total)	1	.33	1		
Hydrophylidae (total)	1	.33	1		
Lucanidae (total)	12	4.00	91	3	
Dorcus parallelus	1	.33	1		
Lucamus dama	11	3.66	90	3	
Nitidulidae (total)	1	.33			1
Scarabeidae (total)	68	22.66	594	11	
Bolbocerosoma bruneri	4	1.33	2	2	
Canthon laevius	2	.66	7	1	
Copris sp.	4	1.33	4		1
C. anaglypticus	6	2.00	7		1
Cotalpa lanigera	3	1.00	3		
Phyllophaga spp.	48	16.00	570	8	

Summer Foods

Quantitatively the most important food group of the summer season — July, August and September — was berries, which constituted 55.22 percent of the total fecal volume. Wild cherry, gooseberry, and wild grape remains as an aggregate formed 53.10 percent of the total bulk. Wild cherry appeared in 27 percent of the summer scats accounting for 22.56 percent of the total volume. Although wild cherry quantitatively appeared as the largest single food item, its prime importance was exaggerated by the presence of the undigested pits. Similarly, grape appearing in 19 percent of the scats to account for 13.50 percent of the total scat contents, consisted mostly of undigested seeds. Giles (1939b) believed grape to be an important food source when available in large quantities.

Gooseberries became increasingly important during July and early August to occur in 62 percent of the scats collected during that period. Many of the scats at that time were composed entirely of gooseberries. As long as fruiting gooseberry bushes were present in the area their fruits were consistently found in the scats. Their appearance continued until the end of the second week in August when the fruiting period had ended. During the short period that gooseberries were available their remains occurred in 36 percent of the summer scats and constituted 16.83 percent of the total fecal bulk. It is interesting to note that Giles (1939b) concluded that gooseberries were not one of the more preferred foods. His conclusion was based on the fact that

although gooseberry bushes were numerous, berry remains appeared in 17.74 percent of the scats but accounted for only 6.12 percent of the fecal volume.

Cherries, likewise, were present almost to the exclusion of other food items, during the cherry fruiting season (Table 5). Seemingly, the large utilization and availability of berries and fruits reduced corn usage considerably. Corn during the summer period showed the smallest percentage occurrence, 41 percent, of any season and made up but 18.03 percent of the total volume of fecal contents. The plant-animal ratio was 76:24 remaining heavily a plant diet chiefly due to the high incidence of berries and wild fruits.

Table 5. Composition of 16 Scats During the Cherry Fruiting Season.

Scat	Cherry	Crayfish	Grape	Insects	Corn	Total volume in c.c.
1	30	Trace				30
2	40	Trace	Trace			41
3	26	Trace				26
4	25				72	42
5	30				Trace	30
6	47	Trace			Trace	48
7	34	Trace	2	Trace		37
8	40	Trace	Trace			41
9	40	Trace				40
10	25				Trace	25
11	30				Trace	30
12	38	Trace				38
13	50					50
14	35	Trace		Trace		36
15	45					45
16	42	2				44

Crayfish, occurring in 62 percent of the scats for a bulk of 17.19 percent, was the most common animal food item. During the summer period many crayfish were available and their partially eaten remains were testimony to raccoon activity of a previous night. Scats collected at that time, in many cases, contained only crayfish remains. This was not found to occur at any other season. A count of individuals revealed at least 32 had been taken and one scat contained as many as five crayfish.

Insects were quite commonly found in the summer scats, occurring in 33 percent of them. However, when present they were always in quantities less than one cubic centimeter and were considered as traces. The Coleoptera, as in the spring, was the most important insect group.

Snails were utilized more frequently during the summer period than either autumn or spring. Occurring in 23 percent of the scats, the snail remains constituted 5.44 percent of the total fecal mass. The common Physa and Lymnaea were present along with various species of Pomatiopsis, Heliosoma, Aplexa and Goniobasis. One scat contained 68 whole snail shells of the genus Goniobasis.

Vertebrates, taken in relatively few cases during the early part of the summer season, accounted for 1.69 percent of the total scat materials. Only one scat contained mammal remains of the Pennsylvania meadow mouse. Birds, the most important vertebrate inclusions, were present in 7 percent of the scats but provided for only 0.84 percent of the fecal mass. Chicken occurred six times and woodpecker, Dryobates sp., once. The only fish remains were those of a darter which appeared in one scat.

Other inclusions were present in small quantities, mostly appearing in one or two scats as traces. Grass, leaves, hackberry, Celtis sp., and spider egg cases appeared twice. Oats, Avena, were found in five scats for a total fecal volume of 2.01 percent. Three honey locust seeds, Gleditschia triacanthos, were found in one scat and blackberry, Rubus sp., also was present.

Autumn Foods

Because of the prevalence of corn, which appeared in 92 percent of the October, November and December scats and formed 81.34 percent of the total fecal volume, the autumn period was practically a one-food season. Corn was more important during autumn than any other season of the year. It became increasingly more important as the season advanced and every scat collected after October 10 contained corn. Giles' (1939) percentage figures for occurrence and volume of corn remains closely parallel those of this investigator. Corn occurred in 93.65 percent of the scats to account for 85.59 percent of the fecal remains by volume. The eight of the 100 scats which did not contain corn were collected during early October when small amounts of berries and wild fruits were still available (Table 6).

Berries and wild fruits made up 9.16 percent of the total fecal volume with grape forming 6.52 percent of the total and occurring in 11 percent of the scats. Giles (1939) commented that grape probably was an important source of food when available. When present grape

is readily taken in large quantities and many times was the only remains present in the scat. Hackberries were of more importance during the autumn season than either summer or spring, and were found in 11 scats to form 1.88 percent of the total fecal bulk. Elderberries, Sambucus canadensis, appeared in small quantities in six scats for a total bulk of 0.68 percent of the fecal remains.

Table 6. Composition of the Eight Variant October Scats

Scat	Grape	Crayfish	Elderberry	Hackberry	Total volume in c.c.
1	35	3			38
2	30	2			32
3	38	Trace			38
4	30	4			34
5			14		14
6			12		12
7				11	11
8				15	15

During this season the animal proportion was the lowest of any season. The animal-plant ratio for the autumn period was 9:91, of which 81 percent was corn.

A total of 24 crayfish appeared in 36 scats to provide for a volume of 3.02 percent of the bulk of fecal materials. In volume and percentage of occurrence, crayfish remains during the autumn season ranked far below those of spring and summer.

Vertebrates compromised but 1.69 percent of the total fecal volume, with fish occurring in 3 percent of the scats, mammals in

6 percent and birds in 5 percent. Table 7 shows the vertebrate inclusions and occurrences in the autumn scats.

Table 7. Vertebrate Inclusions of the Autumn Scats

Food item	Number of occurrences
Mammals:	
Meadow mouse, Microtus sp.	1
Pennsylvania meadow mouse, M. pennsylvanicus	2
White-footed mouse, Peromyscus maniculatus	3
Cottontail, Sylvilagus floridanus mearnsii	1
Birds:	
Passeriformes	1
Chicken, Gallus gallus	3
Robin, Turdus migratorius	1
Fish:	
Osteichthyes	1
Darter, Percidae	2
Reptile:	
Turtle, Testudinidae	1

Insects appeared quite frequently and were present in 69 percent of the scats for a total of 2.63 percent of the fecal mass. Numerically, members of the order Orthoptera were the most important insect inclusions. Two common species of grasshoppers, Melanoplus differentialis and M. femur-rubrum, provided for the bulk of the insect remains. M. femur-rubrum occurred twice as frequently as M. differentialis. Grasshoppers were more important during this season primarily because of their abundance during the later part of the autumn period.

Small quantities of various plant and animal remains appeared in the autumn scats but seldom amounted to more than a trace. Grass leaves were found in eight scats; oats in one; smartweed seeds in one; gooseberry in one; hickory shell, Carya sp., in four; and greater ragweed seeds in four. Snail remnants were present in eight scats for 0.18 percent of the total fecal bulk.

Table 8. Seasonal Distribution of Raccoon Foods in 300 Scats

Food group	Percent of total scats containing	Percent of total fecal remains by volume
SPRING		
Corn	82	62.13
Vertebrates	47	12.10
Crayfish	68	10.80
Insects	73	9.87
Snails	14	2.34
Berries and Fruits	10	1.03
SUMMER		
Berries and Fruits	70	55.22
Corn	41	18.03
Crayfish	62	17.19
Snails	23	5.44
Vertebrates	8	1.43
Insects	33	1.06
AUTUMN		
Corn	92	81.34
Berries and Fruits	25	9.16
Crayfish	36	3.02
Insects	69	2.63
Vertebrates	13	1.69
Snails	8	0.18

SUMMARY

1. The investigation was undertaken to add to the existing knowledge of the year-round food habits of the raccoon and to determine the use made of agricultural crops by the raccoon.

2. Scats were collected during the period of October, 1950, to September, 1951, excluding the winter months of late December, January and February.

3. In the laboratory, 300 scats were analyzed dry and the individual items were identified. One hundred scats were analyzed for each of the spring, summer and autumn seasons.

4. The contents of each scat were determined both qualitatively and quantitatively.

5. Seventeen farmers were interviewed to determine whether or not corn damage and poultry predation had ever occurred on their farms. Only five persons attested to any significant corn damage while four reported poultry predation by raccoon.

6. Two farms experienced corn damage by raccoons during the period of this study.

7. Six other corn fields were canvassed but produced no evidence of raccoon destruction. The three soybean fields that were examined during this period also failed to produce any evidence of raccoon damage.

8. Corn, qualitatively and quantitatively, was the most important spring food item. It appeared in 82 percent of the scats and constituted 62.13 percent of the total fecal remains by volume. Giles (1939b) found corn the second most important spring food and recognized its importance as an early spring staple. The plant-animal ratio of the spring foods was 63:37. The vertebrate inclusions amounted to 12.10 percent of the total fecal volume with the Pennsylvania meadow mouse, quantitatively, the most important vertebrate remain.

9. Berries and fruits constituted 55.22 percent of the fecal bulk by volume and quantitatively were the most important food group of the summer season. The plant-animal ratio for this season was 76:24. Crayfish was the most common animal food item and occurred in 62 percent of the scats for a total bulk of 17.19 percent of the fecal constituents by volume.

10. Autumn was practically a one-food season with corn appearing in 92 percent of the scats for a fecal bulk of 81.34 percent. Giles (1939b) found corn remains in 93.65 percent of the scats for a fecal bulk of 85.59 percent. The plant-animal ratio of this season was 91:9. Crayfish by volume was the most important animal remain, constituting 3.02 percent of the total fecal mass.

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