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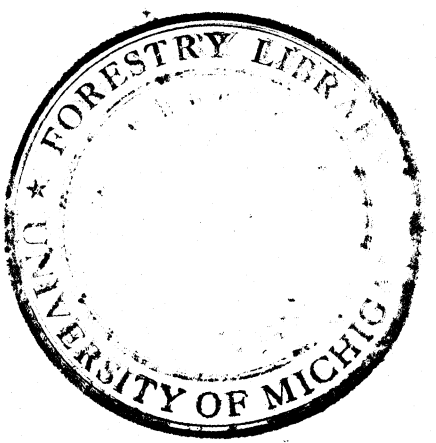
Food preferences of the raccoon in Washtenaw co. Michigan. 1947.



# FOOD PREFERENCES OF THE RACCOON IN WASHTENAW COUNTY, MICHIGAN

by
Thomas Gates Clark

A Thesis Submitted in
Partial Fulfillment of the Requirements
for the Degree of Master of Forestry to the
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ACKNOWLEDGEMENT

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# FOOD PREFERENCES OF THE RACCOON IN WASHTENAW COUNTY, MICHIGAN

## INTRODUCTION

The Eastern Raccon (Procyon lotor lotor, Linnaeus) is one of the larger and most interesting fur-bearing animals inhabiting the deciduous forests of Eastern North America. It is valuable both for its fur and for the sport it provides hunters with hound and gun. There are an estimated 10,000 "coon" hunters in Michigan and their kill is estimated to be between 25,000 to 30,000 annually. Because the raccoon is such a valuable resource it is well that more should be known of its ecology. (18, 23)

The project reported in this paper is limited to the study of foods used by the raccoon and their availability during a single spring and summer season on the Radrick Farm near Ann Arbor, in Southeastern Michigan. Because in different years varying amounts and types of fruits and other food material are produced it would have been desirable if the study could have been continued for a number of years. In the management of any animal the importance of these inevitable variegations must be kept in mind. Although not complete it is felt that the results of this study shed light on the complexities of requirements and preferences of the raccoon.

## LIFE HISTORY AND HABITS

The life history and habits of an animal have an important bearing upon the kind of food it eats. Therefore it seems fitting that a brief account of the life history of the raccoon be included. Stuewer (1943) has studied in detail the life history of this animal, and the following summary is based largely upon his report.

In the latitude of southern Michigan the mating takes place in February. In captivity the gestation period is from 60-65 days.

The young are born in a secluded nest, most often in a hollow tree, during April or the first few days in May. The average litter contains 4 young, but extremes from 1-8 are reported. (E. D. Martin Unpublished)

The winter months are hard on the raccoon as they are on most of our fur-bearers. During the coldest part of winter it remains in the den most of the time and seldom ventures forth except during the breeding season. Nevertheless it does not hibernate in the true sense of the word, but, like the skunk and opossum, ventures forth at any time the weather permits. Two years are required for full growth, when it attains an average weight of about 15 pounds. About half of the yearling females produce young in the wild but in captivity this proportion may be higher if they are mated with adult males. The yearling males are not always capable of servicing females.

The home range, according to most authorities is approximately one mile in diameter, and there is no evidence of any marked territorialism. This may result in some error in the food habit data obtained because it is obvious that scats were in part from raccoons that were denning off the area, and in part from resident animals. Scats doubtless contained the remains of some food eaten outside the study area. However, it seems logical to assume that these errors were either compensating or of little consequence.

Most of the feeding is done after sunset, but the raccoon is not strictly a nocturnal animal. For instance, one was seen during midday in a den tree, and on another occasion an adult was seen in mid-afternoon in a small oak. Only once has the author seen a raccoon feeding in the day time. That one was fishing for crayfish in the late afternoon. Its nocturnal habits are perhaps

one of the best reasons that it is able to survive the onslaught of man, for when the most of us are snug in bed "Old Zip Coon" is out about his business.

Little is known about the limiting factors that hold down a raccoon population. At the beginning of this study it was hoped that some new information might be found on limiting factors. However, it soon became evident that such a study would involve years of research. Hunting is certainly not the only reason for low populations in seemingly good raccoon habitats, and closed seasons do not necessarily result in higher numbers. For instance, the Michigan Conservation Commission (1938) declared a closed season in 1938, but there was little if any effect on the population.

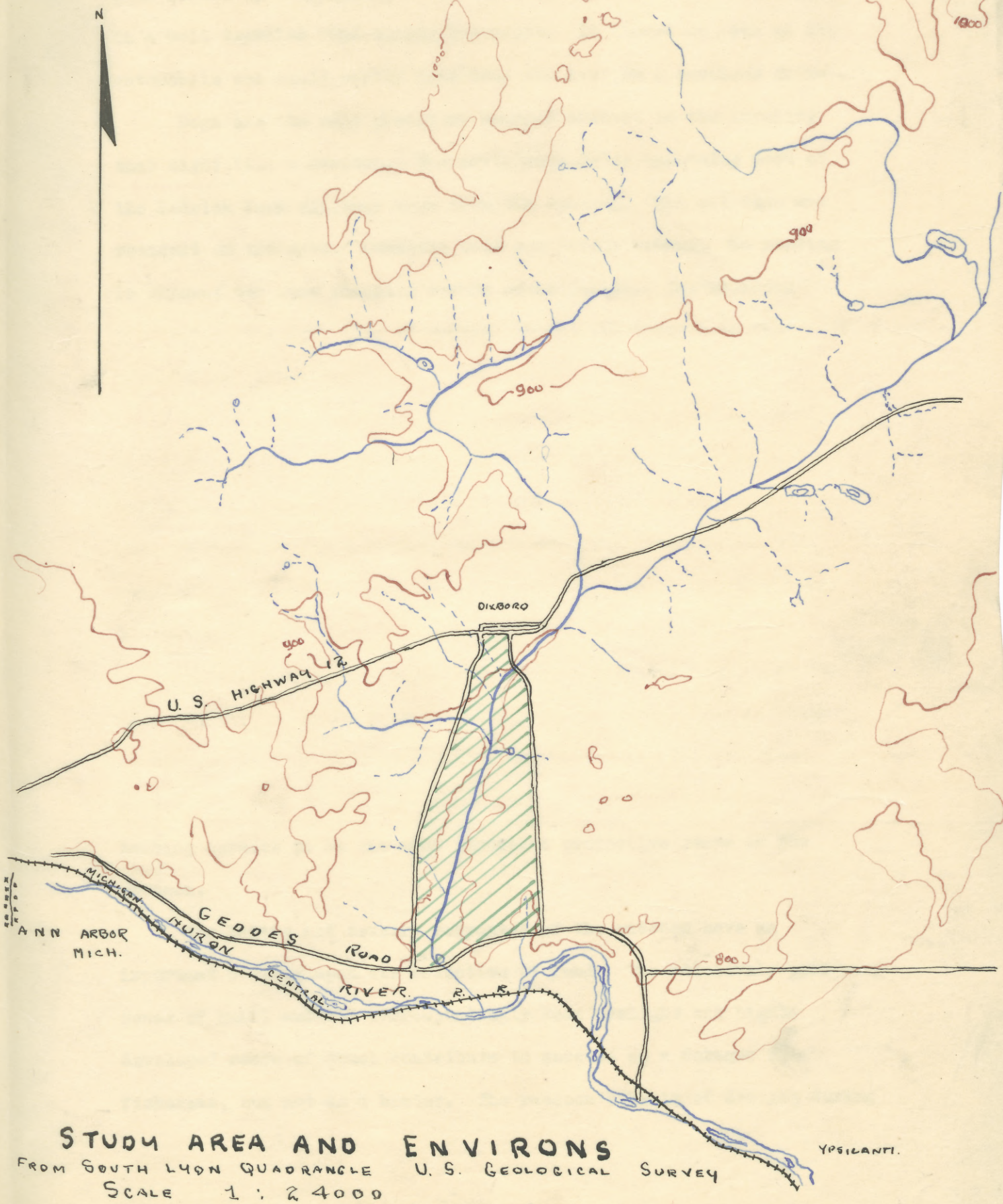
Preble (1941) attributed the population decreases in Central Ohio to the following: (1) "A 50% reduction in the permanent stream mileage during the last 75 years and a qualitative deterioration of the remaining water course habitats, (2) lowered water tables and overgrazing which have resulted in the gradual reduction of swamp and bog acreage, (3) reduction in forest acreage and adverse wood lot management practices destructive of both dens and habitats, (4) increased hunting pressure, and (5) certain prevailing hunting practices, i.e., the running of dogs in summer and the cutting of den trees." Similar conditions prevail in Michigan, and doubtless have had an effect upon the raccon population. For the past hundred years 'coon hunters have gone afield with dog, gun, and ax, and with the disappearance of den trees they wonder where our raccoons have gone. It will take several decades of strict vigilance on the part of the non-ax-swinging 'coon hunters before the den trees will again become readily available in many of our woodlots and fence rows.

Good forest practice, designed as it is to produce sound thrifty trees, tends to reduce the number of good den trees. Therefore raccoon nest boxes may be necessary, when it is desired to increase the number of raccoons.

In April and May a good red fox population was found on the study area. Several breeding dens were located and it was thought that some information could be obtained on fox-raccoon relationships. However, trapping eliminated 7 young pups and 1 female adult fox. It was evident from latrine locations and tracks that the dens where these foxes were caught had been used by raccoons in the early spring, but with the whelping of the female foxes the raccoon evidently abandoned these dens because none were caught in the process of trapping the foxes. However, on September 1, 1945, a young raccoon was caught in a den where earlier in the season 2 young foxes had been captured. The only conclusion that can be drawn from this is that red foxes tend to take over ground dens from raccoons.

Little information is available concerning the diseases of raccoons in the wild. On October 20, 1946, a dead raccoon was found, but its bloated condition made an autopsy impracticable. Fabre and Bernard (1926), Stewart (1926), Brown (1931), Zschokke and Saxer (1932), Yakimoff and Matikaschwili (1933), Morgan and Waller (1940), and Rauch (1946) along with others have made contributions to the knowledge of raccoon pathology, but none have collected enough information so that conclusions can be drawn concerning the quantitative significance of disease in limiting raccoon populations.

Raccoons sometimes are killed on the highways, but the number is relatively insignificant as a rule. During the course of the




# STUDY AREA AND ENVIRONS

FROM SOUTH LYON QUADRANGLE U. S. GEOLOGICAL SURVEY

SCALE 1 : 24000

T. G. CLARK 9/26/46

MAP I

study only 3 carcases were seen on roads and presumably all had been killed by automobiles. Once a small raccoon was seen feeding on a well traveled road during the night. It showed no fear of the automobile and could easily have been run over by a careless driver.

Dogs are the only predatory mammals present in the locality that might kill a raccoon. The woven wire fence enclosing most of the Radrick Farm excludes dogs from the outside. Two pet dogs are resident on the area. Domestic cats are fairly common. No hunting is allowed but some poaching occurs occasionally. The raccoons produced on the area are, of course, hunted and trapped on the surrounding farms.

The raccoon ranks high among animals in intelligence. Cole (1907) states "In the rapidity with which it forms associations the raccoon seems to stand almost midway between the monkey and the cat, as shown by the numerical records of these animals. In the complexity of the associations it is able to form it stands nearer the monkey."

Cole (1912) in a study of the raccoon's senses found that its most conspicuous reaction was that associated with touch. It has an especially well developed taste for sweets, but did not often employ the sense of smell. It has keen eyesight, but the sense of hearing appears to be the most important protective sense of the raccoon.

The habits and sensory responses of the raccoon have an important bearing upon its selection of food. The relatively poor sense of smell and the correspondingly keen eyesight and highly developed sense of touch contribute to success as a forager and fisherman, but not as a hunter. The raccoon's habit of denning during

the severe months of winter makes him an eater of warm weather foods. In reading the discussion of food habits these and other points in the life history should be kept in mind.

## THE STUDY AREA

The Radrick Farm is located in Southeastern Michigan in Washtenaw County, Ann Arbor and Superior Townships. Map 1 shows its location with reference to Ann Arbor and Ypsilanti, Michigan.

The topography is hummocky lying as it does on a terminal moraine. An outstanding feature is Fleming Creek, which runs some 2.5 miles of its course through the area. Springs and spring drains are common along the creek. In places the creek is bordered by marsh and some swamp, but in other parts the banks are high and the adjacent land well drained.

The climate resembles that of Detroit and Chicago. Long cold winters are the rule with minima from several to 20 degrees below zero Fahrenheit in all but the mildest winters. The summer temperature seldom exceeds 90 degree Fahrenheit, but occasionally rises above 100 degrees. The average frost free season is between May 2 and October 13 inclusive. The mean annual rainfall is 31.16 inches, giving the area a fairly humid climate. (26)

A variety of soils are represented. They are in order of area covered: Bellefontaine sandy loam, Miami loam, Berrien loamy sand, Washtenaw loam, Brookston loam, and Gilford loam. (28)

The cover is mixed agricultural and forest lands. Approximately 100 acres are in cultivation, 200 in pasture, and the remaining 300 in forest, marsh, and abandoned farmlands.

The farmed portion is managed for livestock with the cultivated

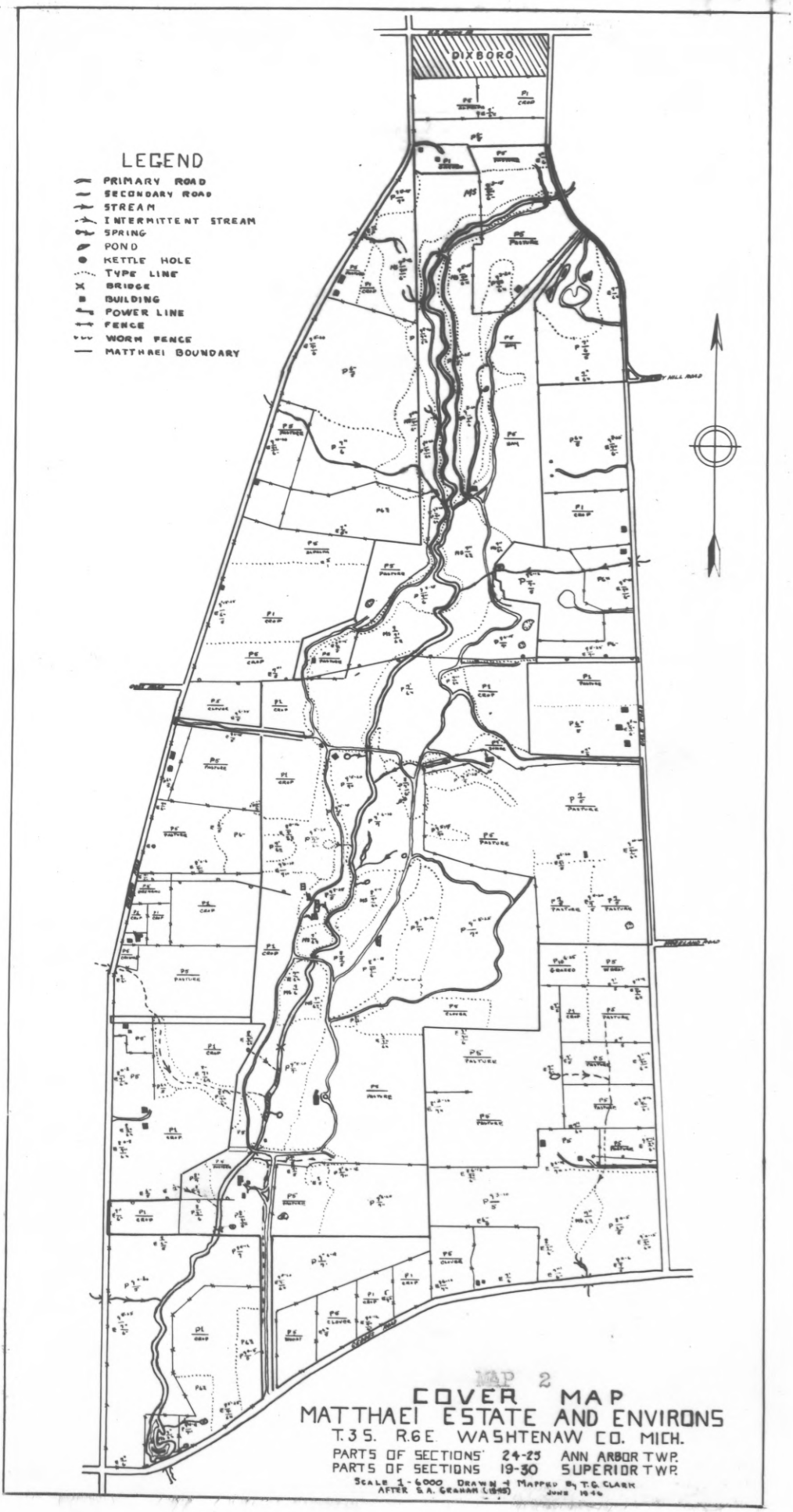
fields in oats, corn, wheat, alfalfa, clover, and bluegrass. Stock is not permitted to graze on the wild lands, except for some small wooded spots where the animals can secure shade. The forest land is of a variety of types. Of these the oak-hickory woodlands cover the largest area. The dominating tree species are white, black, and red oaks (quercus spp.), shell bark and pignut hickories (Hickoria spp.) and wild black cherry (Prunus serotina). The dominating shrubby species are grey and flowering dogwood (Cornus spp.), hazelnut (Corylus americana), and maple-leafed and downy viburnum (Viburnum spp.).

The dominating species in the abandoned fields are the poplars (Populus spp.), sumachs (Rhus spp.), crab apple (Pyrus coronaria), and wild plum (Prunus americana).

The bottomland type is characterized by elm (Ulmus americana), sugar maple (Acer saccharum), white ash (Fraxinus americana), basswood (Tilia americana), black walnut (Juglans nigra), overcup oak (Quercus macrocarpa), and cottonwood (Populus deltoides). The dominating shrubs are willow (Salix spp.) hazelnut (Corylus americana), hawthorn (Crataegus spp.) elderberry (Sambucus canadensis), nannyberry (Viburnum Lentago), and crab apple (Pyrus coronaria).

Swamp land is limited to a few acres with the dominating tree species of elm (Ulums americana), trembling aspen (Populus tremuloides), and larch (Larex laricana). The dominating shrubby species are red-osier dogwood (Cornus stolonifera), elderberry (Sambucus canadensis), ninebark (Physocarpus opulifolius), and dwarf birch (Betula pumila).

The industries of the area are limited to agriculture and some gravel pit operations. Some mention has been made of agriculture. The gravel pits cover such a limited area that they have little influence. The woodlands are kept in a wild condition. The only cutting since 1937 has been the removal of dead trees for fuel-


DIXBORO
LEGEND
PRIMARY ROAD
SECONDARY ROAD
STREAM
INTERMITTENT STREAM
SPRING
POND
KETTLE HOLE
TYPE LINE
BRIDGE
BUILDING
POWER LINE
FENCE
WORM FENCE
MATTHAEI BOUNDARY
MAP 2
COVER MAP
MATTHAEI ESTATE AND ENVIRONS
T.3S. R.6E WASHTENAW CO. MICH.
PARTS OF SECTIONS 24-25 ANN ARBOR TWP.
PARTS OF SECTIONS 19-30 SUPERIOR TWP.
SCALE 1-6000 DRAWN & MAPPED BY T.G. CLARK
AFTER S.A. GRAHAM (1938) JUNE 1946

wood. Only a few live trees have been cut since the land has been in its present ownership.

Thus we have a piece of land devoted to livestock farming and recreation. The wild lands consisting of upland forest, swamp forest, marsh, and stream provide excellent raccoon habitat, where this animal can be studied to good advantage.

## METHOD OF PROCEDURE

In order to obtain a clear, overall picture a cover map was made including the 600 acres of the study area and the surrounding 600 acres. The standard ecological classification of cover types (Graham 1945) that indicates not only present conditions but also future trends was used.

Examination of the cover map reveals that the diverse types of cover previously described are almost ideally arranged for the raccoon. The wooded strip along the entire length of Fleming Creek surrounded by farm lands is a combination that could scarcely be improved. No place on the entire farm is over ½ mile from the stream, (Map 2). Brown and Yeager (1943) say that "Forest cover and a plentiful water supply appear to be more or less inflexible requirements of the raccoon."

The character of food eaten by the raccoons was determined by fecal analysis. Some types of soft foods were undoubtedly missed in these examinations, but evidence of most kinds remained in the form of indigestible parts.

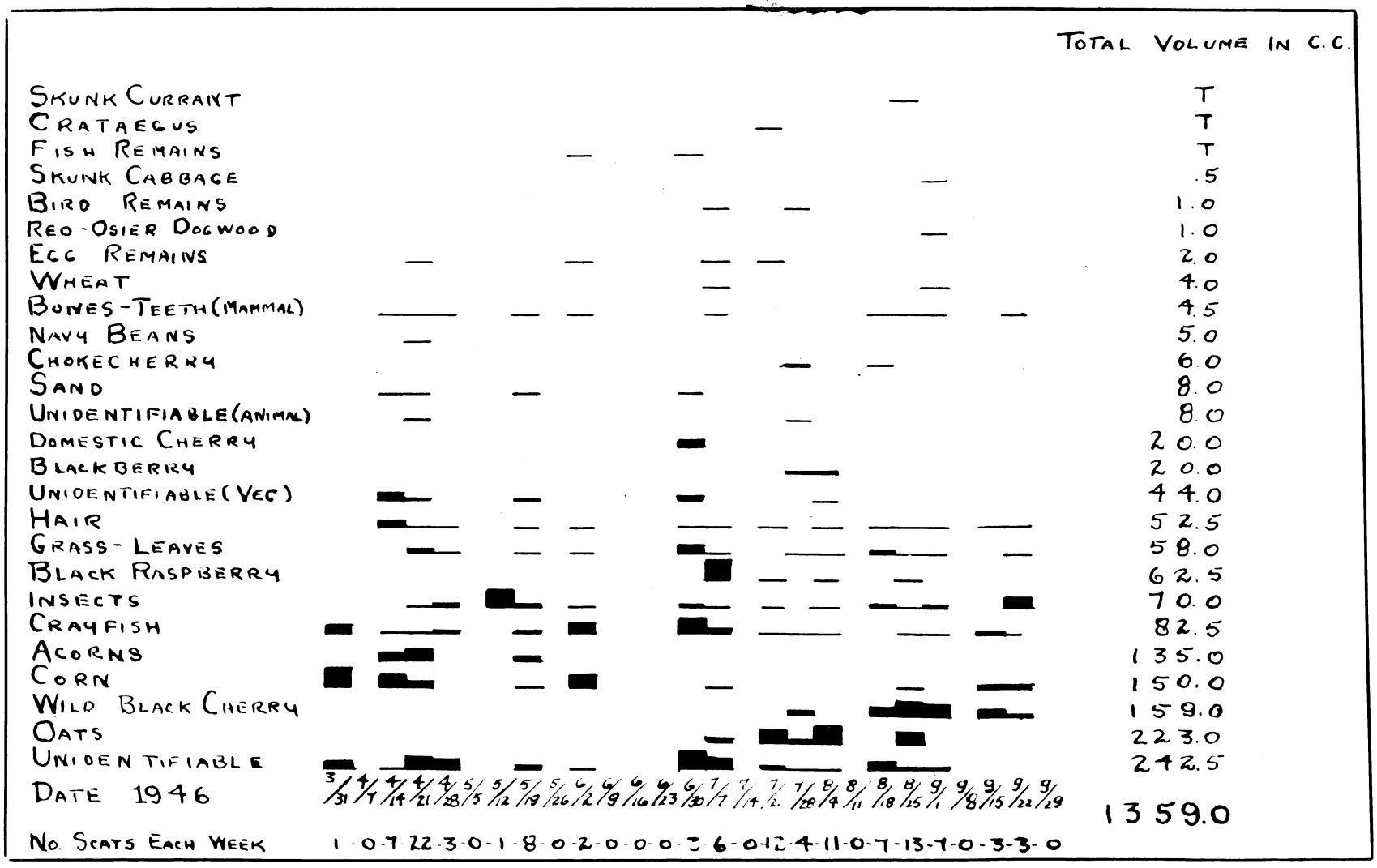
Scat collections were started on March 29. None were taken which appeared to be more than 10 days old. Several 'coon latrines were located and weekly to semi-weekly visits were made to them

to collect droppings. It was found that the raccoon usually selected a spot for defecation that was elevated above the surrounding ground although this was not invariably true. Only one of the 6 main latrines found was located in a place from which the surrounding area could not be viewed. This was located in a grape vine tangle at the foot of a large elm. The locations of the 5 others are as follows: On the washed roots of a sugar maple along Fleming Creek, on the edge of an abandoned gravel pit, on 2 separate rock piles in abandoned field, and on top of a covered spring. Seventy of the 113 scats were found at these latrines. Others were picked up at random.

It was observed that if latrines were visited in the late afternoon or evening they would be abandoned by the raccoon for several days. Presumably this was due to the human scent that lingered from the recent visit.

There was a definite correlation between location of food supply and location of a latrine. With a change in the availability of a certain food the raccoon would of course change his nightly habits. A good example of this was on August 4 and 6, when 5 scats containing oats were collected at the covered spring latrine, indicating continued feeding on oats by the raccoon. On August 10, after the oats field had been harvested and oats were no longer available, two scats containing blackberries were found at this latrine, although no blackberries were growing in the vicinity. This indicated that the raccoon had changed its food habits, but for several nights returned to the field looking for the accustomed oats and used this latrine. No scats were found here after August 10.

Identification of scats was made possible by their large size and the typical rounded cylindrical shape containing mealy well




GRAPH NO. 1. SHOWING DATES, THE NUMBER OF SCATS COLLECTED DURING EACH WEEK, AND THE AVERAGE VOLUME OF REMAINS OF EACH FOOD ITEM ■ REPRESENTS 12 CC. THE AVERAGE VOLUME OF THE 113 SCATS

chewed contents. The character and variation in appearance of scats from latrine collections helped to make reasonably certain identification of those found in other places. The presence of raccoon hair was sometimes a convenient indicator of the identity of a dropping, although it only occurred in 19 of the 113 samples collected.

Size of scats was not a safe diagnostic character especially after the young of the year left their dens. However after sufficient practice combined with a knowledge of raccoon habits little difficulty in recognizing droppings was experienced. Nevertheless an indeterminable dropping was found from time to time, and whenever there was a reasonable doubt the scat was discarded.

Contents determine to a certain extent whether or not a dropping can be found easily. A raccoon feeding on wild black cherries eats the seeds along with the pulpy part of the fruit. The resulting scat is very dark and can be seen easily. Those containing crayfish with the characteristic pink color of the indigested exoskeleton fragments can also be seen easily. Oats scats are a light shining straw color and are readily visible against a green or brown background. On the other hand, scats made up of the remains of milky sweet or field corn are very difficult to find. For example, it was known that raccoons were feeding on a small patch of sweet corn and a close watch was kept for the appearance of this food. It was finally discovered that scats made up of remains of milky corn dried up until they resembled a small pile of bran. One scat containing only corn remains weighed only 1 gram; with a volume of only 3 cubic centimeters. This was the only dropping found that contained only corn in milk stage. This experience emphasizes the importance of combining direct observation of the activities of

the animal with fecal or stomach analysis. If the raccoon's corn eating activities had not been observed directly that food item might have been overlooked entirely.

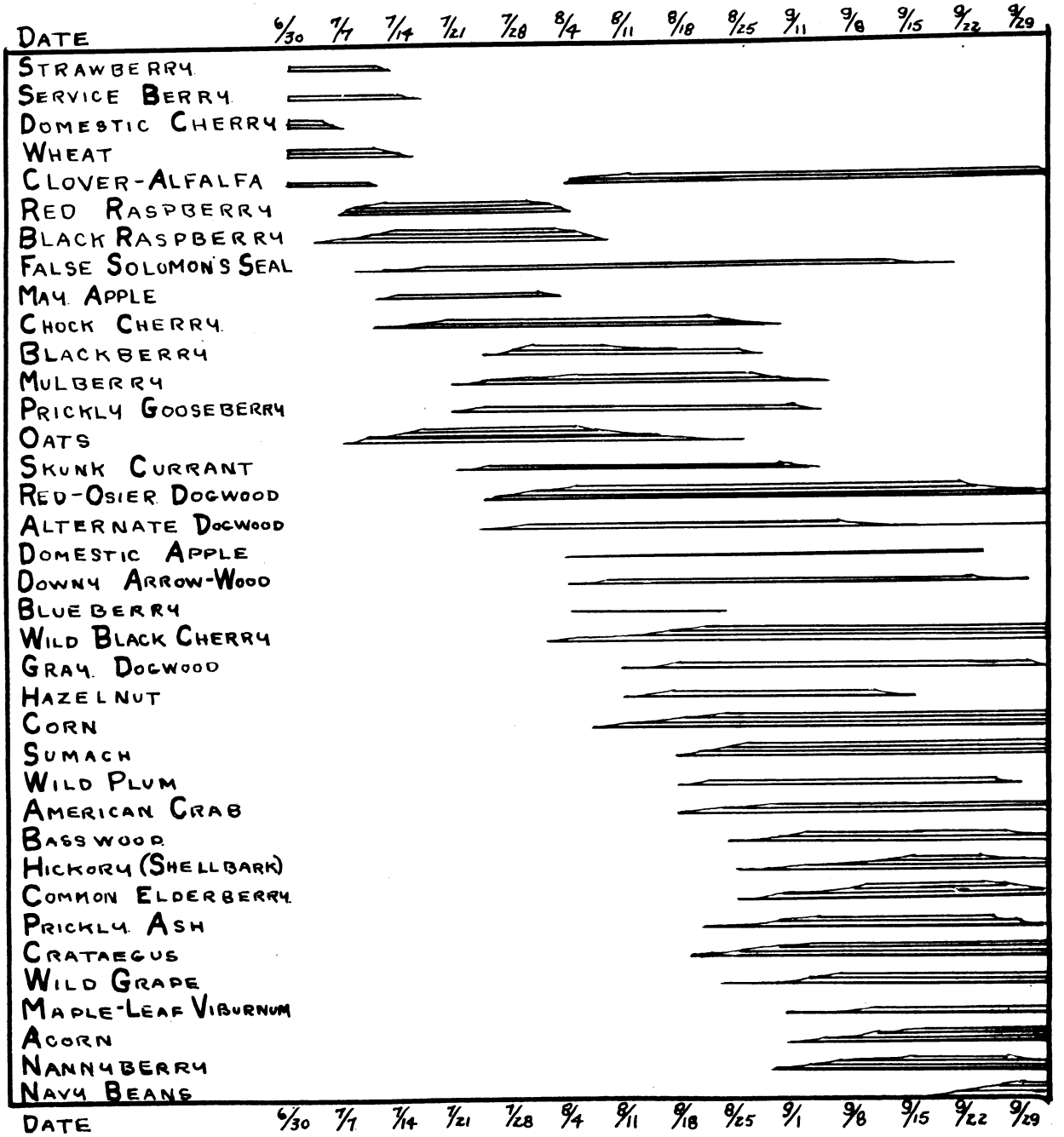
Mice sometimes tore apart raccoon scats that contained seeds. For instance at one latrine cherry seeds were invariably taken from the scats and the kernels eaten by mice.

Because of differences in the character of various food items it seems clear that the 113 scats collected do not necessarily represent the actual proportion of the different foods taken by the raccoon. Nevertheless, in combination with other evidence, the study of droppings does give a better idea of an animal's food than any other method hitherto devised.

The method of collection and analysis of this material was as follows. Scats were collected in small kraft paper bags and labeled with date and location. They were then dried out of doors in a steel 50 caliber ammunition box with the lid ajar. After drying they were removed and stored in the laboratory until analyzed.

The average air dry weight was 12.00 grams. The average volume, determined by water displacement averaged 12.02 cubic centimeters.

In preparation for analysis the dried scats were placed in trays containing water. When throughly soaked they were pulled apart and each was first examined minutely for recognizable particles that might pass through a 16 mesh to the inch sieve. They were then washed in a sieve with running water to eliminate fine unrecognizable fragments, and examined in detail. At first all items were separated carefully but it soon became apparent that such a procedure was too time consuming. Thereafter the various items of most scats were roughly separated and their volume estimated




GRAPH NO. 2 — SHOWING PLANT FOODS AVAILABLE DURING SUMMER OF 1946 ___ PRESENT
═══ RARE ═══ COMMON ═══ ABUNDANT

to the nearest cubic centimeter. But care was always taken to examine closely all portions of the scats so that all recognizable items were found.

All unknowns were placed in vials for later identification. Hair samples presented the greatest difficulty. Mathiak (1938) "A Key to Hairs of the Mammals of Southern Michigan" was useful, but it was found necessary to check all key identifications by comparing the unknown hair samples with knowns under the microscope. A few hairs, leached and worn so much from having passed through the raccoon's digestive tract, could not be identified. All insect remains were identified at least to order. A very small volume of bones and teeth were present. Some could be identified but much of this material had been reduced to such small fragments that identification was impracticable. Some minor items may have been so completely broken up during mastication and digestion that they were not recognized in the droppings but certainly all of the more important items were disclosed.

An important consideration, that is neglected in many food habit studies, is the current availability of the various possible foods. In order to interpret properly the results of any food habits research such information is essential. The accurate estimate of the amount of plant foods available is not an easy undertaking on 600 acres, and was not attempted, but each item was classified as abundant, common, rare, and present. Every week from June 30 until September 29, with the exception of September 8 and 15, a trip was made to the field to check the availability of plant foods. On each week end in July and August a plant food availability strip was run perpendicular to the topography of the area so as to cover both upland and bottomland types. These strips were one chain wide and equal to the distance between the eastwest boundaries of

| SEASON, YEAR, STATE AND INVESTIGATOR | SCATS. | VISCERAL | RATIO VEG. — ANIMAL | CORN | CORN + OATS | BUCKWHEAT | CHERRIES | CHERRIES + BERRIES | BERRIES | FRUITS + OTHER | SILKY CORNEL | RASPBERRY | GRAPES | HACKBERRY | ACORN | BEECHNUT | HICKORIA | APPLE | GRASS | CRAYFISH | INSECTS | MUSKRAT | MICE-SHREWS | EARTHWORM | FISH | SNAILS | BIRDS | PERSIMMONS | HAZELNUT | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPRING | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1940 E. IOWA GILES | 41 | | 54-96 | 5 | | | | | | | | | | | | | 11 | | 37 | 8 | 35 | | | | | | | | | 96 |
| 1939-40 L. MICH. STOEWER | 49 | | 42-58 | 9 | | | | | | | | | | | 29 | | | | | 15 | 3 | | 27 | 7 | 2 | | | | | 92 |
| 1940-42 TEXAS BAKER ET AL. SPRING - SUMMER | 110 | | 28-70 | | | | | | | | | | | | 22 | | | | | 57 | 5 | | | | 6 | 1 | 2 | | | 93 |
| 1946 L. MICH PRESENT STUDY SUMMER | 113 | | 66-16 | 11 | 16 | | 14 | | | | | 5 | | | 10 | | | | 4 | 6 | 5 | | | | | | | | | 71 |
| 1932 L. MICH DEARBORN | 500 | | 32-68 | | 20 | | | 12 | | | | | | | | | | | | 59 | 5 | | | | | | | | | 96 |
| 1940. E IOWA GILES | 44 | | 69-31 | 13 | | | | | | | | 32 | | | | | 4 | | | | 26 | | | | | | | | | 75 |
| 1940 N.Y. HAMILTON | 163 | | 80-20 | 7 | | | 38 | | | | 27 | | 4 | | | | | | | | 4 | 4 | | | | | | | | 84 |
| 1939-40. L. MICH STOEWER | 15 | | 76-24 | | | | 13 | | 9 | 13 | | | 41 | | | | | | | 2 | 20 | | | | | 2 | | | | 100 |
| 1940-42 TEX. BAKER ET AL. FALL | 120 | | 53-47 | | | | | | 5 | 3 | | | 17 | | 26 | | | | | 29 | 12 | | | | 3 | 1 | | | | 96 |
| 1939 CEN. IOWA. GILES | 67 | | 74-26 | 41 | | | | | | 10 | | | | 23 | | | | | | 25 | 1 | | | | | | | | | 100 |
| 1940 E. IOWA GILES | 2 | | 85-15 | 85 | | | | | | | | | | | | | | | | 2 | 10 | | | | | | | | | 97 |
| 1939 .40. L. MICH. STEUWER | 46 | | 92-8 | 14 | | | | | | 5 | | | 63 | | 9 | | | | | 2 | 3 | | | 1 | | | | | | 97 |
| 1940-42 E. TEX. BAKER ET AL. | 53 | | 81-19 | | | | | | | 9 | | | 14 | | 24 | | | | | 15 | 4 | | | | | | | 32 | | 98 |
| 1942 ILL. YEAGER ET. AL. FALL WINTER | 116 | | 63-34 | 21 | | | | | | | | | 19 | 2 | 8 | | 7 | | | | 30 | | | | | | 3 | | | 90 |
| 1936. N.Y. HAMILTON WINTER | 130 | | 74-26 | 8 | | 16 | | | 11 | | | | | | 6 | 14 | | 14 | 5 | 2 | 7 | | 8 | 8 | | | | | | 99 |
| 1940 E. IOWA GILES | 6 | | 79-21 | 79 | | | | | | | | | | | | | | | | 15 | | | | | | | | | | 94 |
| 1939-40 L. MICH. STEUWER | 46 | | 92-8 | 14 | | | | | | 5 | | | 63 | | 9 | | | | | 2 | 3 | | | 1 | | | | | | 97 |
| 1940-42. E TEX BAKER ET AL | 61 | 11 | 77-17 | | | | | | | 25 | | | | | 47 | | | | | 10 | 3 | | | | 3 | | 5 | | | 93 |
| 1942 ILL. YEAGER | 107 | | 23-72 | 8 | | | | | | | | | | | | | | | | | 6 | | | | | | 65 | | 8 | 87 |
| 1940-42 E. TEX BAKER ET. AL. | | 23 | 71-29 | | | | | | | | | | | | 67 | | | | | 10 | 14 | | | | | | 4 | 4 | | 99 |

TABLE 1 — GIVING SUMMARY OF KNOWN RACCOON FOOD HABIT STUDIES IN PERCENT OF TOTAL VOLUME

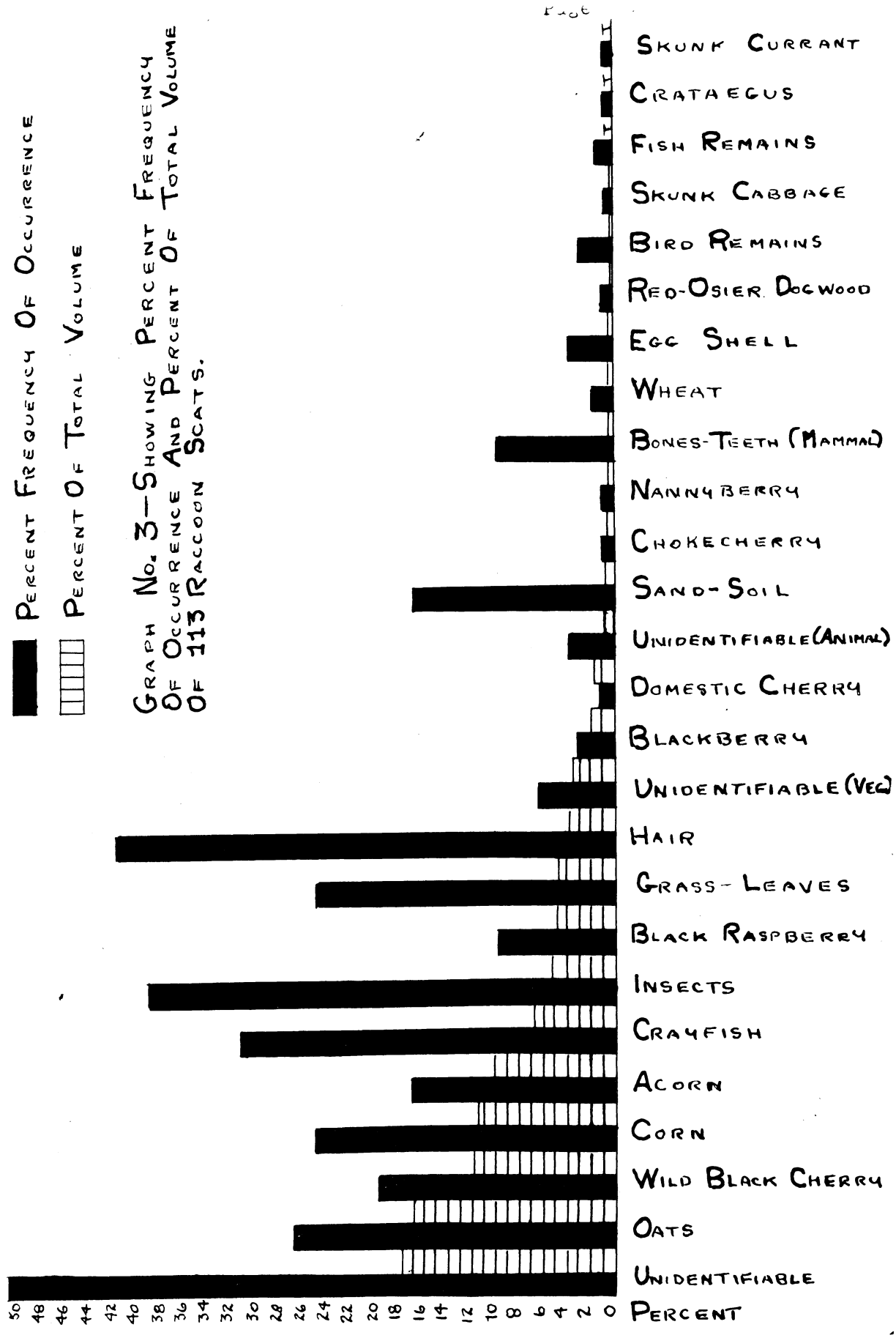
the farm. At an interval of every 10 paces an estimation was made of the fruiting plants. Only those plants actually bearing fruit were considered, for instance, apple trees were fairly common on the farm, but the crop was so light that apples were a scarce item.

By September 1 it became evident that all of the fruits were ripe, ripening, or had disappeared, and the availability surveys were discontinued. Graph 2 presents these data in a summarized form.

## RESULTS AND INTERPRETATIONS OF DATA

An inspection of Graph 3 reveals the percent of total volume and also the frequency percent of each food item. In the following pages an attempt will be made to bring out the relation between the availability of foods and the foods actually eaten.

These dates show that the raccoon is predominately a vegetarian with a ratio of 66% by bulk vegetable, 16% animal, and 18% unknown remains. These figures agree in general with the findings of other investigators, for instance Yeager and Rennels (1943) Table 1, summarizes the results of the more important food habit studies of the raccoon that have been made. The great variety is striking, but the ratio of vegetable to animal remains (Table 1) shows clearly that the raccoon is predominantly a vegetarian. However, at times they eat much animal material as shown by Dearborn (1932) and Baker et. al. (1944) who found that 59% and 57% by bulk respectively of the raccoon scats remains were crayfish. These reports also show that the raccoon is an opportunist. Yeager and Elder (1945) in a study of pre-and post-hunting season foods of the raccoon on an Illinois goose refuge found that 65% by bulk contained bird remains, presumably waterfowl that had been crippled or killed and not recovered by the hunters.


Graph No. 3—Showing Percent Frequency Of Occurrence And Percent Of Total Volume Of 113 Raccoon Scats.
Percent Frequency Of Occurrence
Percent Of Total Volume
Skunk Currant
Crataegus
Fish Remains
Skunk Cabbage
Bird Remains
Red-Osier Dogwood
Egg Shell
Wheat
Bones-Teeth (Mammal)
Nanny Berry
Chokecherry
Sand-Soil
Unidentifiable (Animal)
Domestic Cherry
Blackberry
Unidentifiable (Veg)
Hair
Grass-Leaves
Black Raspberry
Insects
Crayfish
Acorn
Corn
Wild Black Cherry
Oats
Unidentifiable
50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0
Percent

Of a total volume of 1359 cc., 242.5 cc. were classified as unidentifiable. Some unknown materials occurred in about half the specimens. It is thought that most of this was either carrion or acorns in nearly equal amounts. Graph 1 shows that the greatest amount of unidentifiable materials were consumed in the spring and early summer. The heavy use of carrion and unknown vegetable material early in July probably was caused by heavy rains that flooded Fleming Creek, drowning many young animals. Evidently for several weeks thereafter the raccoon fed, in part, on rabbits and other small mammals. As far as possible unidentifiable items were classified as animal or vegetable, but in many instances even this was impossible.

The most important single food item in percent of total bulk was oats with 16.48%. This grain was readily available from July 11 to August 14 when the harvest was completed. Raccoons showed a high preference for this food. Scats containing oats were found over the entire area and indicated that the animals traveled as much as a mile from the den in order to obtain this grain. Oats were found in 26.55% of the scats for the entire season, but during the latter half of July and the first half of August it was decidedly the predominant food item. As a rule when a sample contained oats it usually consisted of little else. Apparently oats are preferred to wheat, judging by the fact that even when easily available little wheat was eaten, however, differences in time of ripening prevented the direct comparison of these grains.

A favored late summer food was the wild black cherry. This was available over the entire area from August 15 until the study was terminated in September. Its percent by bulk of total scats was 11.78% with a percent frequency of occurrence of 19.47%. After the oats were cut this fruit became a staple item in the diet of the raccoon.

Because the raccoon consumed the whole fruit it can readily be seen that the bulk of this food is out of proportion to most other fruits. But since it also had a high frequency of occurrence it is fair to assume that it occupied a major place. It should be remembered, however, that black cherry was the most abundant wild fruit on the area, and may have been eaten most because it was most easily obtained.

Although scats containing green corn were seldom found for reasons already discussed nevertheless observations indicated clearly that, when available, corn in the milk stage is highly favored. Audubon and Bachman (1849) say of the raccoon and his love for corn--"No negro on a plantation knows with more accuracy when the corn (maize) is juicy and ready for the connosseur in roasting ears, and he does not require the aid of fire to improve its flavour, but attacks it more voraciously than the squirrel or the black bird and is the last to quit the corn field."

The raccoons found the sweet corn patch at an early date and they consumed a good third of the $\frac{1}{2}$ acre patch. It was noted, however, that when the corn turned hard the field was abandoned for the more succulent wild fruits. On the other hand little damage was done to field corn that was equally available. Although sweet corn in the milk stage was highly favored over either field corn in the milk or ripe field corn, nevertheless, some corn was eaten at all seasons regardless of kind or condition. Corn made up 11.04% of the bulk and had a percent frequency of 16.81%.

Graph 1 shows that corn consumption was high during April. This was field corn taken from pheasant feeding stations and the abrupt disappearance of this item from the droppings corresponded with the cessation of artificial pheasant feeding. As a substitute the raccoon began to eat more acrons left on the ground from the previous fall.

We may conclude, then, that hard corn is preferred to acorns, but is less desired than most succulent fruits. Milky sweet corn is a highly favored food and is taken in preference to fruits.

Acorns were eaten especially in the spring. Recognizable parts constituted 1.93% of the bulk and appeared in 16.93% of the samples. It is possible that this proportion should be larger because as previously indicated, much of the unidentifiable materials may have been acorns. The raccoon was observed to take the shells from the acorns before eating them; thus ingesting only the soft parts that were almost impossible to identify.

There was an excellent crop of black raspberries for a short time, but this source of food was cut short by a late July drought. This food item in spite of the short season comprised 4.60% of the total bulk and a percent frequency of 9.73%. But during the season of abundance black raspberries made up the greater proportion of all samples taken. They were preferred above other food items available at the time. If a raccoon found a raspberry patch, it fed on the fruit exclusively during that evening.

Grass, buds, and leaves made up a fairly important part of the food in the early spring. Grass appeared with carrion like materials and may have been taken incidentally or as a special food. Later on in the summer grass appeared with grasshoppers and, in all likelihood, it was taken incidentally with these insects. Graph 1 shows that grass was eaten in the spring until the raccoon began to feed on oats; then the consumption of grass declined.

Bud scales, presumably basswood (Tilia americana), appeared in one scat and displaced a total volume of .5 cc.
This verifies observations by Stuewer (1943) who found that raccoons eat leaf buds. Grass, leaf buds, and leaves made up 4.34% of the

total volume and occurred in 24.78% of the samples.

Blackberries made up only 1.55% of the total bulk and had a percent frequency of occurrence of 2.95%. It appeared from field observations that the raccoon preferred this fruit, but the July drought caused the berries to dry up and shortened the season except in a few scattered damp places. Therefore the low incidence was probably due to scarcity.

Domestic cherries were found in one sample. This fruit was available only in one small area on the farm, and then for only a short time. It was evident that raccoons liked this fruit because they continued to visit the cherry trees even after the fruit was gone. This was apparent from scats containing black raspberries collected under the cherry trees.

The presence of sand or soil in the scats indicated whether or not the animal was feeding on the ground or off the ground. Sand and soil appeared when the animal's main diet consisted either of acorns, crayfish, old corn, or wild black cherries, all of which were taken on the ground.

Choke cherries were fairly abundant along the fence rows and the edges of woodland; yet the raccoon showed little interest for this food. It occurred only once.

Likewise navy beans were found in only one sample. It would appear from this that when other foods, are available raccoons prefer them to beans.

Red-osier dogwood appeared in only one sample, although it was abundant along all water courses. Apparently it ranks low as a raccoon food.

Skunk cabbage fruit (Symplocarpus foetidus) appeared only once

in the samples. It is a marsh plant, and is rather rare on the area.

Hawthorns and fruit were abundant, but the raccoons did not feed upon them during the period covered by this project. This fruit was only partly ripe at the conclusion of the study, and therefore might have been used later.

A trace of skunk currant appeared in one sample. These plants were scattered throughout the lowlands, but the fruits were sparse. However, it is felt that if the raccoon liked this fruit as much as it did black raspberries or cherries it should have appeared more frequently.

A number of fruit and other possible food plants inventoried on the strips never appeared in any of the scats analyzed. The relative availability of these plants is presented on Graph 2. They will be discussed in the following paragraphs.

By the first of July service berries, strawberries, and clover-alfalfa were available but none of the remains of these plants showed in any of the collected scats. Strawberries were found in a few scattered places mainly on dry gravelly hillsides, and only 3 or 4 small groups of service berry trees were found on the farm. Under more favorable conditions it seems likely that they might have been eaten. Alfalfa fruits were abundant in several fields but it appears that these fruits were not favored because of their small size.

Red raspberry, false Solomon's Seal and May apple were available on July 15. False Solomon's Seal and May apple were scattered throughout the area, but no traces of these fruits were found in any scat. It is thought that they are not preferred as a food item. Red raspberries were abundant in the thickets and windfall areas throughout the bottomland types. It was expected that the remains of this fruit would be found in scats daily but none ever appeared.

In the laboratory care was taken to make sure that none of these fruits would be skipped over in analysis. It is felt on the basis of the high availability of this fruit that raccoons do not favor them, particularly in competition with black raspberries.

Fruits available on August 1, besides those taken and already discussed, were--mulberry, prickley gooseberry, and alternate leaved dogwood. These were scattered throughout the wooded portion of the area. None were abundant but if favored they should have occurred several times. Three mulberry trees each with a good crop of fruits were present on the farm, and one was situated adjacent to the domestic cherry trees where raccoon scats were found. Throughout the study mulberry trees were continuously checked for evidence of raccoon use but never were there any signs of feeding about these trees.

New fruits available by August 15 were apples, downy arrow-wood, blueberry, gray dogwood, and hazlenut. None of these fruits were abundant, and so their absence in the samples has little significance one way or the other. It is thought, however, that downy arrow-wood and gray dogwood remains should have appeared if favored by the raccoon.

Sumach, wild plum, American crab, basswood, shellbark hickory, common elderberry, prickley ash, maple-leaf viburnum, and nannyberry all were available by September 1. It was thought that sumach, basswood, and shellbark hickory fruits were too hard for raccoons to eat. Although all were abundant on the area no remains of these fruits were found. Frost killed the wild plum fruit in the bottomlands whereas on well drained slopes the summer drought caused these fruits to drop prematurely. American crab was not a preferred fruit in competition with so many more palatable fruits. However,

they might be taken later in the fall. Elderberries were abundant throughout the area. No trace of these fruits were found in any scat. It can be assumed that the raccoon does not eat them ordinarily. Prickly ash fruits were abundant but were eaten promptly by seed eating birds. No traces were found in any raccoon scats. Wild grapes were abundant but not ripe enough to be consumed by the raccoon before the end of this study. The only statement that can be made here considering the preference for this fruit is that green or turning grapes are not very high on the raccoon's food preference list. Maple-leafed viburnum was found on limited areas. It seemed as though the raccoon should have taken some of these fruits. Nannyberries were abundant over most of the bottomland but were not consumed by the raccoon, but Van Dersal (1938) says "Nannyberries are much eaten by raccoon."

One of the raccoon's main food items is crayfish. An examination of Table 1 reveals that they are eaten at every season. The remains of this item are easily identified because the indigestable exoskeleton passes through the digestive tract almost unmodified. Crayfish made up 6.07% of the entire bulk with a percent frequency of occurrence of 30.97%. It is without a doubt the main source of animal food for the raccoon, and occupies a spot at the top of the animal food list.

Insects were the next most important source of animal food, comprising 5.22% of the total bulk and with a frequency of 38.94%. It would seem that the percent bulk figure does not give sufficient importance to insects as a food item for the raccoon. Seventy cc. of the total volume of 1359 cc. was of insect remains. Thirty one and one half cc were Orthoptera, mostly grasshoppers with a few crickets, 33 cc. were Coleoptera, mainly June beetles, 2 cc. were

Trichoptera consisting of caddis flies, 1.5 cc. were Lepidopterous cocoons, and 2.0 cc. were unidentifiable.

Due to the dry summer grasshoppers were abundant throughout August and September. Graph 1 indicates that insects were an important part in the raccoon's diet when the June beetles emerged from pupation, and again when cold September nights made grasshopper catching easy. Insects seem to be highly preferred, but as long as they could not be gathered easily the raccoon did not concern itself with them.

All unknown hair from scats was saved and identified as heretofore mentioned. Even single hairs were saved and identified in so far as possible.

Although the volume of mammalian hair totaled 52.5 cc. there was a very small volume of bones, namely 4.5 cc. It seems, therefore, that raccoon either prefer to eat the softer portion of an animal and leave the bones or its ability to digest bone is unusually good. How scats could contain 7 and 9 cc. respectively of hair identified as that of the norway rat, and not show a single trace of a bone has not been explained.

Table 2 will give the reader some idea of what species of mammal the 49 different hair samples represent.

Table 2. - Showing distribution of 49 hair samples found in 113 scats

| ANIMAL | VOLUME FOUND | FREQUENCY |
|---|---|---|
| Norway rat *Rattus norvegicus* | 16.0 cc. | 2 |
| Cottontail *Sylvilagus floridanus* | 9.0 | 5 |
| Raccoon *Procyon lotor lotor* | 6.5 | 19 |
| Field mouse *Microtus spp.* | 6.0 | 2 |
| Weasel *Mustela fremata* | 5.0 | 1 |
| Pine vole *Pitymys pinetarum* | 4.0 | 1 |
| Unknowns and Traces | 4.0 | 7 |
| Big brown bat *Eptesicus fuscus* | 1.0 | 1 |
| Chipmunk *Tamias striatus* | 0.5 | 1 |
| Opossum *Didelphis virginiana* | Trace | 5 |
| Fox squirrel *Sciurus niger* | Trace | 1 |
| Woodchuck *Marmota monax* | Trace | 1 |
| Mink *Mustela vision* | Trace | 1 |
| House mouse *Mus musculus* | Trace | 1 |
| Silver hair bat *Lasionycteris coctivagens* | Trace | 1 |
| TOTALS | 52.5 | 49 |

Egg shells occurred only 4 times in spite of the raccoon's great reputation as an egg eater. In two of these cases the shells were identified as ringneck pheasant eggs. The data on hand indicated that the raccoon is not an egg eater. However it is possible that it gets rid of egg shells before eating the egg. If this is true it would be impossible to ascertain through fecal analysis just how much egg eating a raccoon does. This calls for further study.

Traces of fish were found in two scats. It is thought that they may have been made available by the late June flood. Fish except at

that time and during the sucker run up Fleming Creek would be unavailable to the raccoons. Other investigators have found few fish remains in raccoon scats.

Frogs were fairly abundant along all water ways. It is noteworthy that not a single trace of frog remains was found.

## CONCLUSIONS

From the results obtained it seems evident that the raccoon has definite food preferences. It has a strong tendency to concentrate at a given time on the kind of favored food that is most abundant. When one kind of food ceases to be available the animal turns to another. Although the raccoon seems to prefer plant food, especially fruits and grains, nevertheless animal remains in the feces indicate the ommivorous habits of the animal. Crayfish and insects comprise a considerable portion of the raccoon's animal food, the latter being taken in quantity only at times when they are very abundant and easily captured. The food of the raccoon, therefore, will vary from season to season, depending upon the kind of food readily available, and marked variations from year to year may naturally be expected. Perhaps the most important part of this study is the evidence indicating that in its food habits the raccoon is an opportunist and eats mostly that food which is currently most abundant and most delectable.

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