

Research Report No. 20
(Game)

WINTER FOOD HABITS OF WISCONSIN FOXES

By

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STATEWIDE
WISCONSIN CONSERVATION DEPARTMENT

Research and Planning Division

December, 1966

"A predator is any creature or thing
that has beaten you to another creature
you wanted for yourself."

Werner O. Nagel

ABSTRACT

Winter diets of Wisconsin foxes were studied through an analysis of stomach contents from 1955-56 to 1964-65 to document feeding habits and relate them to current fox density levels, upland game population trends, and varying winter weather conditions. Fox carcasses were obtained from rural fox hunters between December 1 and March 31 each year.

During the study 2,343 red and 43 gray fox carcasses were collected from 30 counties, with the majority of foxes obtained from southeastern and east central Wisconsin. A total of 1,737 red and 30 gray fox stomachs contained measurable amounts of food; 619 stomachs (26 percent) were empty.

Twenty-eight different identifiable mammals, 13 birds, 4 species of insects, a minimum of 15 plants and numerous miscellaneous items of low or no food value were eaten by foxes. Small rodents, mainly meadow and deer mice, occurred most frequently in the fox diet and were found in 53 percent of the stomach sample. Cottontail rabbits ranked second among the animal foods consumed, occurring in 46 percent of the stomachs examined. Game birds were found in low frequency (9 percent) in the winter diet.

Fox feeding habits were compared with upland game population trends and winter weather conditions in southeastern Wisconsin for a 10-year period. Pheasants were found in 9 percent of the stomachs examined. Generally, the highest frequency of occurrence of pheasants in the diet was during severe winters when below normal temperatures and a heavy snow cover persisted for long periods of time. These adverse weather conditions provided the fox with greater opportunity for preying on pheasant populations. Cottontails were quite vulnerable to fox predation regardless of the type of winter and occurred in an average of 50 percent of the stomachs examined from southeastern Wisconsin. The percentage occurrence of game animals in the diet of Wisconsin foxes is quite similar to that obtained through food habits studies in other states.

Winter weights were obtained on a sample of 915 male and 774 female red foxes. Males averaged $1\frac{1}{2}$ pounds heavier than females with the heaviest males and females obtained from northern Wisconsin. All foxes appeared in good physical condition.

The relatively low percentage of game birds in the winter diet of Wisconsin foxes suggests that on a statewide basis, the long-term predatory influence of the fox may not be great. The high percentage of cottontail rabbits in the fox diet even in marginal range may indicate that the fox does exert some influence on annual rabbit population trends. A long-term ecological study of the entire predator-prey community is necessary if we are to fully understand the effects of predators on the prey population.

ACKNOWLEDGEMENTS

Wisconsin sportsmen supplied the entire collection of fox carcasses. Many were interested in the findings and continued their support throughout the study.

Eugene E. Woehler assisted in collecting and in the rather unpleasant task of dissecting carcasses each spring. District game managers provided valuable assistance by locating concentrations of carcasses in rural areas and in requesting permission to obtain them for this study. Frank Iwen, Joseph Stegner and Ted Dillion assisted me in analysing the stomach contents.

Cyril Kabat reviewed the manuscript and provided valuable suggestions during its preparation.

Edited by Ruth L. Hine

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INTRODUCTION

This study was begun in 1955 to document winter feeding habits of foxes in prime upland game range in southeastern Wisconsin and relate them to current fox density levels, upland game population trends, and varying winter weather conditions. Prior to this study, limited fox food habits data were available for only the south central and southwestern sections of the state (Errington, 1935; Chaddock, 1939; Richards and Hine, 1953). Much of the earlier information was collected at a time when upland game birds were becoming established in southern Wisconsin and fox populations were relatively low.

Data were obtained from analyses of stomachs gathered from foxes shot by hunters between December 1 and March 31. Our study was limited to the winter months because fox hunters were most active at this time of year and a large sample of stomachs was readily available.

Our original objective was to study fox diets in southeastern Wisconsin for a maximum of four years. However, from the accumulation of several year's data, it was evident that fox feeding habits were being influenced by several factors. Thus, the study was expanded to other parts of the state in 1959 and continued through the winter of 1964-65. Although the study was conducted over a 10-year period, less than 7 man-months time was required to collect, dissect, and analyse the entire stomach sample and prepare the final report.

TECHNIQUES

Sampling Procedures

In Wisconsin, fox hunters in rural areas generally make a practice of accumulating the foxes they shoot during the winter months and displaying the carcasses in some conspicuous place in the farmyard. These carcasses are usually disposed of during the latter part of March when the weather begins to warm up. In early spring, fox carcasses can readily be obtained by cruising rural areas, locating carcasses in farmyards, and asking landowners for the carcasses.

Between 1955 and 1958, research personnel collected foxes in southeastern Wisconsin. Beginning in 1959, with collection efforts expanded to other parts of the state, district game managers assisted in locating and collecting carcasses. No special efforts were made to collect foxes from each of the state's 72 counties, although we attempted to collect them from as many different ecological areas as possible. In some counties, carcasses were secured from the same groups of hunters each winter.

Fox carcasses were either picked up directly from rural fox hunters at the end of the season's hunt, or obtained from various collection points designated by the district game manager. Carcasses were taken to the State Game Farm, Poynette, Wisconsin, and stored in the walk-in freezer for later examination.

Each year's sample of carcasses was removed from the freezer in early May, thawed in the open air for approximately 12 hours, and examined. Carcasses were weighed and checked for general physical condition. Weights were taken from

only fully intact carcasses. Stomachs from all foxes and female reproductive tracts were removed, securely wrapped in gauze, labeled by location of kill, and preserved in gallon jars containing a 10 percent formalin solution. During the summer months of each collection year, stomach contents were examined in the laboratory using standard food habits analysis techniques (Martin, 1949).

Female reproductive tracts were examined to determine pregnancy and number of embryos per pregnant female. We were unable to gather reliable reproductive data. Some of the foxes were gut-shot which often destroyed much of the uterus. Reproductive tracts of other foxes were often in various stages of decomposition. Rate of pregnancy or percentage of pregnant females could not be determined because data were not available on the exact dates these foxes were shot. Thus, the reproductive data were of limited value and are not included in this report.

Problems in Food Habits Analysis

The variety of items eaten by a fox can only be estimated from stomach analyses. It is often impossible to determine how many individuals of a particular prey species are represented in a stomach and how many items were eaten which left no indigestible trace. Foods such as fruits and flesh are rapidly digested and egg shells are usually dissolved by gastric juices in approximately 4 hours (Lever, 1959).

The amount of food in the stomach depends on the length of time between the last meal and the time the fox was killed. In a controlled feeding experiment, Lever (1959) found that most of the food eaten by a fox was eliminated within 48 hours. Scott (1950) indicated a definite rhythm in daily feeding habits. Foxes shot in the afternoon had little food remaining in the digestive tract.

Post-mortem digestion of food occurs in foxes maintained in a frozen condition for several months (Lever, 1959; Englund, 1965b). Thus, readily digestible foods often become unidentifiable if the stomach is not promptly removed after the fox is shot. However, fur, feathers and bony material are little affected by gastric juices and remain to be identified although on occasion with difficulty. These materials were the basis for this food habits analysis.

With changes occurring in the proportion of food in the stomach even after death, delayed volumetric analyses of stomach contents are not likely to give an entirely reliable indication of total amounts of food actually consumed (Martin, 1949). No volumetric measurements were made in this study because of the 3-4 month delay in removing stomachs from fox carcasses. However, a visual estimate was made of the percentage of each food item occurring in the stomach at time of analysis.

I used the "frequency of occurrence" method -- how often does a particular food item occur in the stomach sample -- to analyse and interpret food habits of Wisconsin foxes. While this method has disadvantages (e.g. equating one feather fragment with a whole mouse or large portion of rabbit) I believe it is a reasonable approach to a difficult analysis problem.

Several workers have attempted to estimate the number of animals eaten each year by the fox to evaluate its total impact on a prey population (Richards and Hine, 1953; Korschgen, 1959). This estimation requires several assumptions: (1) The fox consumes the entire animal carcass during a single meal; (2) Each animal is eaten by the fox at the same rate; and (3) The digestion rate for each food item is the same. These assumptions are not valid and most workers are aware

of interpretation problems. Foxes frequently bury larger animals such as rabbits and return to eat them on several occasions (Murie, 1936). Feeding and digestion rates are not constant. Foxes will eat what is readily available and each food item has a different rate of digestion (Lever, 1950; Englund, 1965a). Englund (1965a) concluded that it is impossible to accurately estimate the number of animals eaten each year by a fox using data from food habits analysis. I have reached this same conclusion and thus have not made such calculations.

Although food habits studies have limitations, they do give an indication of what the animal was eating at a particular time. And when used in conjunction with other information, food habits data are basic statistics necessary for interpreting the effects of predators on a prey population.

FINDINGS

Statewide Sample

During our study, 2,343 red and 43 gray fox carcasses were collected from 30 Wisconsin counties for the food habits study (Fig. 1). Most of the foxes were obtained from the southeastern and east central counties where a considerable collection effort was made. Fox carcasses were difficult to find in northern counties and few contacts were made in southwestern Wisconsin.

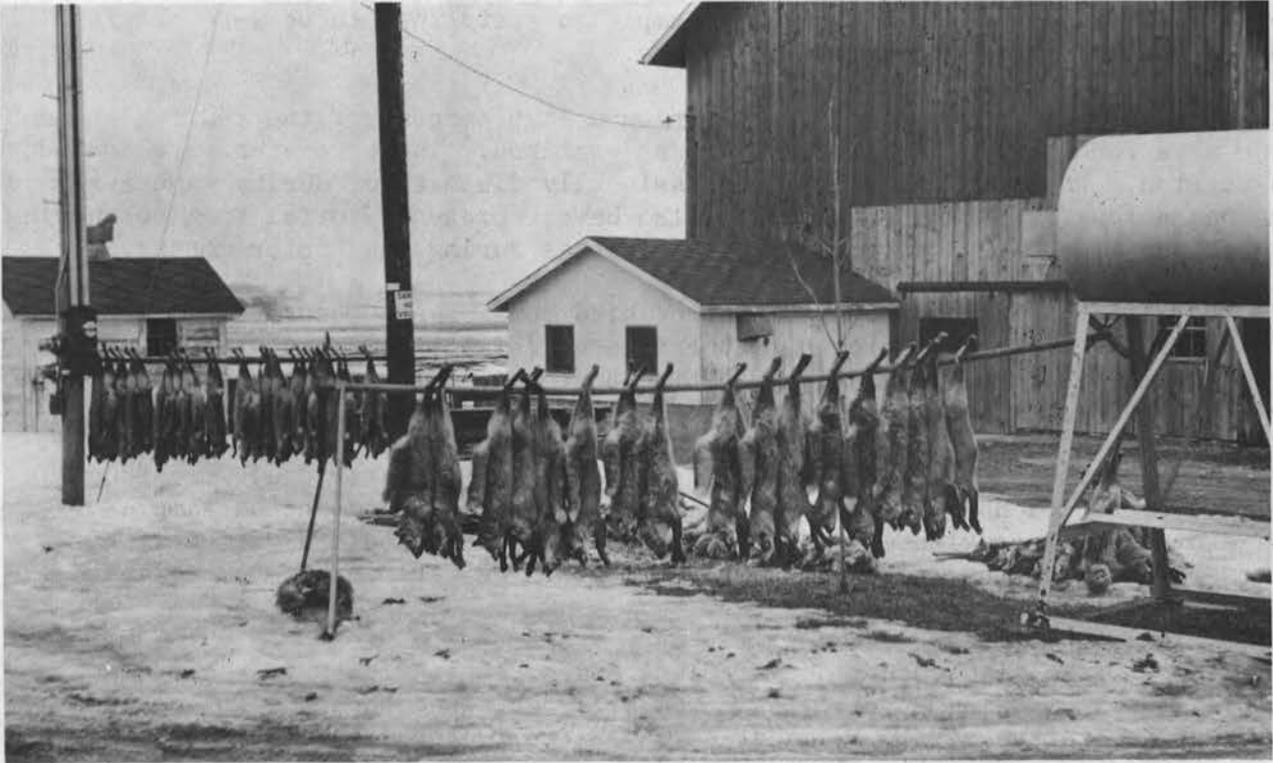
Of the total sample, 1,737 red (Table 1) and 30 gray (Table 2) fox stomachs contained measurable amounts of food. The remaining 619 stomachs (26 percent) were either empty or contained only traces of nonfood items. The percentage occurrence of food items in this study is based only on those stomachs which contained measurable amounts of food.

Scott (1950) and Englund (1965a) found no significant difference in the diet of male and female foxes during the winter months. Thus, we did not segregate male and female stomachs in the food habits analysis.

The red and gray fox stomachs contained 28 different identifiable mammals, 13 birds, 4 species of insects, a minimum of 15 plants and numerous miscellaneous items generally of low or no food value. Small rodents (mice - mainly Microtus sp. and Peromyscus sp.) occurred most frequently in the diet of both red and gray foxes and were found in 53 percent of the total stomach sample. Mice made up the greatest amount of consumed food determined by visual estimate.

Rabbits, mainly cottontails, ranked second among the animal foods consumed by the fox. They also ranked second in amount of food eaten. Cottontails occurred in equal proportions (approximately 46 percent) in the diet of both the red and gray fox.

Remains of numerous other mammals, but in low frequency of occurrence, were found in the total stomach sample. White-tailed deer occurred in 2 percent of the stomach sample. Since healthy deer are seldom attacked by fox, we concluded that most of the deer in the stomach sample represented hunting season cripples, weather-killed or road-killed animals. Few shrews were eaten by the fox. Their glands are strongly repellent to predators (Lever, 1959). Fox fur was occasionally present and usually represented by large guard hairs suggesting these were ingested while the fox was grooming itself. The occurrence of 73 gray and fox squirrels in the fox diet probably represents squirrels which were caught ranging some distance from protective tree cover. The low frequency of occurrence of



A winter's fox hunting ...



Dissecting out a stomach



Stomach contents ... field mice



... pheasant feathers

several other mammals in the stomach sample suggests that these were obtained and eaten by chance rather than by choice.

Domestic cow and pig remains were found in 5 percent of the red fox stomachs. None were found in stomachs of gray foxes examined. These remains were considered as carrion. Dead farm animals are occasionally disposed of during manure-spreading operations. This material could also have represented offal from butchering operations frequently carried on in rural areas during the winter months.

Domestic chicken topped the list of bird remains and occurred in 15 percent of the stomach sample. Chicken feathers were frequently manure-stained and accompanied by straw fragments suggesting that many chickens had been picked up as carrion through manure-spreading operations.

Game birds (pheasant, ruffed grouse and Hungarian partridge) were found in 157 red fox stomachs (9 percent). No game birds were found in the sample of gray fox stomachs. Approximately 74 stomachs (4 percent) contained unidentified feathers usually found as singles or fragments. We were unable to segregate these into game and nongame birds.

There was a high occurrence of plant and grass fragments in the stomach sample. Some of this material is incidentally obtained when the fox makes a kill in heavy vegetative cover. Some grass may be deliberately eaten by wild animals and utilized as a diuretic (Lever, 1959).

Over 6 percent of the stomachs contained such miscellaneous nonfood items as paper, string, cloth, and small stones. Obviously these materials were not preferred foods but were items which found their way into the stomach when preferred foods were eaten. Soil, sand and grit were frequently found in small amounts in the stomachs. Lead shot was occasionally found in combination with rabbit fur suggesting the rabbits were hunting season casualties.

During the food habits analysis, a visual estimate was made of the total amount of food present in each stomach. Stomachs were recorded as being: (1) empty; (2) light - trace of food to stomach 1/3 full; (3) medium - average of 2/3 full; and (4) full. Of the 2,120 stomachs examined using this subjective approach, 496 (23 percent) were empty; 806 (38 percent) were light; 447 (21 percent) were medium; and 371 (18 percent) were full. Because no records were kept on time of day the foxes were shot, we cannot relate these data to daily feeding habits.



Figure 1. Distribution of 2,343 red and 43 gray foxes collected during the winters of 1955-65 for food habits analysis. (Excludes 39 foxes where county was not determined.)

TABLE 1

Occurrence of Food Remains in 1,737 Red Fox Stomachs

in Wisconsin, 1955-65*

Food Item	Number of Stomachs	Percent by Occurrence
<u>ANIMAL MATTER</u>		
<u>Mice and Rats</u>		
Meadow mouse (<u>Microtus</u> sp.)	464	26.7
White-footed mouse (<u>Peromyscus</u> sp.)	419	24.1
Mouse, unclassified	28	1.6
House mouse (<u>Mus musculus</u>)	9	0.5
Lemming mouse (<u>Synaptomys cooperi</u>)	2	0.1
Red-backed vole (<u>Clethrionomys gapperi</u>)	2	0.1
Norway rat (<u>Rattus norvegicus</u>)	2	0.1
<u>Rabbits and Hares</u>		
Cottontail (<u>Sylvilagus floridanus</u>)	784	45.1
Snowshoe (<u>Lepus americanus</u>)	16	0.9
<u>Other Mammals</u>		
Red fox (<u>Vulpes fulva</u>)	65	3.7
Mammal, unclassified	49	2.8
Fox squirrel (<u>Sciurus niger</u>)	45	2.6
White-tailed deer (<u>Odocoileus virginianus</u>)	34	2.0
Gray squirrel (<u>Sciurus carolinensis</u>)	28	1.6
Raccoon (<u>Procyon lotor</u>)	22	1.3
Muskrat (<u>Ondatra zibethica</u>)	16	0.9
Skunk (<u>Mephitis mephitis</u>)	11	0.6
Short-tailed shrew (<u>Blarina brevicauda</u>)	6	0.3
Red squirrel (<u>Tamiasciurus hudsonicus</u>)	6	0.3
Porcupine (<u>Erethizon dorsatum</u>)	3	0.2
Opossum (<u>Didelphis virginiana</u>)	2	0.1
Prairie mole (<u>Scalopus aquaticus</u>)	1	0.06
Flying squirrel (<u>Glaucomys</u> sp.)	1	0.06
Masked shrew (<u>Sorex cinereus</u>)	1	0.06
Beaver (<u>Castor canadensis</u>)	1	0.06
House cat (<u>Felis domestica</u>)	1	0.06
Gray fox (<u>Urocyon cinereoargenteus</u>)	1	0.06
<u>Poultry and Domestic Ducks</u>		
Chicken	263	15.1
Ducks, unclassified	6	0.3
Domestic duck	3	0.2
<u>Game Birds</u>		
Ring-necked pheasant (<u>Phasianus colchicus</u>)	143	8.2
Ruffed grouse (<u>Bonasa umbellus</u>)	13	0.7
Hungarian partridge (<u>Perdix perdix</u>)	1	0.06

Table 1 (Cont.)

Food Item	Number of Stomachs	Percent by Occurrence
<u>Livestock</u>		
Pig	66	3.8
Cow	19	1.1
<u>Birds, Unclassified</u>	74	4.30
<u>Nongame Birds</u>		
Songbirds, unclassified	23	1.3
Slate-colored junco (<u>Junco hyemalis</u>)	7	0.4
Grackle or blackbird	5	0.3
White-breasted nuthatch (<u>Sitta carolinensis</u>)	2	0.1
Domestic pigeon (<u>Columba livia</u>)	2	0.1
Meadowlark (<u>Sturnella</u> sp.)	1	0.06
Tree sparrow (<u>Spizella arborea</u>)	1	0.06
Blue jay (<u>Cyanocitta cristata</u>)	1	0.06
Crow (<u>Corvus brachyrhynchos</u>)	1	0.06
<u>Invertebrates</u>		
Grasshopper (<u>Melanoplus</u> sp.)	2	0.1
Grasshopper (<u>Lubber</u> sp.)	1	0.06
Wasp, unclassified	1	0.06
Beetle, unclassified	1	0.06
<u>VEGETABLE MATTER</u>		
<u>Plant Foods</u>		
Grass fragments	501	28.8
Plant fragments	293	16.9
Straw	129	7.4
Wood fragments	45	2.6
Corn kernels	42	2.4
Apple seeds	14	0.8
Oat kernels	14	0.8
Weed seeds, unclassified	10	0.6
Cherry pits	3	0.2
White spruce needles	2	0.1
Barley kernels	1	0.06
Buckwheat kernels	1	0.06
White cedar fragments	1	0.06
Corn cob fragments	1	0.06
Jack pine needles	1	0.06
Soybeans	1	0.06
<u>MISCELLANEOUS</u>		
(paper, string, soil, stones, lead shot, BB, cloth)	110	6.24

* An additional 606 red fox stomachs were examined but these were empty.

TABLE 2

Occurrence of Food Remains in 30 Gray Fox Stomachs
in Wisconsin, 1958-62*

Food Item	Number of Stomachs	Percent by Occurrence
<u>ANIMAL MATTER</u>		
<u>Mice and Rats</u>		
Meadow mouse	10	33.3
White-footed mouse	7	23.3
Mouse, unclassified	1	3.3
House mouse	1	3.3
<u>Rabbits and Hares</u>		
Cottontail rabbit	14	46.7
<u>Other Mammals</u>		
Fox squirrel	2	6.7
White-tailed deer	2	6.7
Raccoon	1	3.3
Gray fox	1	3.3
<u>Poultry and Domestic Ducks</u>		
Chicken	7	23.3
<u>Nongame Birds</u>		
Birds, unclassified	1	3.3
<u>VEGETABLE MATTER</u>		
<u>Plant Foods</u>		
Plant fragment	10	33.3
Grass fragment	9	30.0
Apple seeds	5	16.7
Corn kernels	4	13.3
Straw	4	13.3
Wood fragment	2	6.7
Cherry pit	1	3.3
Weed seeds, unclassified	1	3.3
<u>MISCELLANEOUS</u>		
(soil, lead shot)	2	6.7

* An additional 13 gray fox stomachs were examined but these were empty.

Regional Variations

Prey as well as predators are not evenly distributed throughout the state because of habitat requirements. Thus, we divided the state into five groups of counties with each representing a different ecological area to examine regional differences in game population numbers and winter feeding habits of the fox: North (N) - northern forest and forest fringe; Central (C) - central sand plain; Southeast (SE) - southeastern prairie-oak opening; East Central (EC) - northeastern red clay area; and Southwest (SW) - southwestern Driftless Area (Fig. 2). The occurrence of food remains in red and gray fox stomachs by county groupings for individual years is listed in Tables 6-16, Appendix A .

Kill per square mile figures were used as indices of game distribution and abundance within each ecological group (Table 3). Population data were not available for buffer species, but Peromyscus and Microtus occur throughout the state.

TABLE 3
Game Harvest Per Square Mile*

Species	Ecological Group					Statewide
	N	C	SE	EC	SW	
Pheasant	1.9	3.6	41.4	7.5	7.5	9.9
Hungarian Partridge	0.03	0.03	1.7	3.5	0.02	0.7
Ruffed Grouse	16.8	7.4	0.8	3.0	5.6	9.8
Cottontail Rabbit	10.6	13.9	86.6	27.8	30.7	27.5
Red and Gray Fox	0.3	0.7	0.5	0.6	1.5	0.7

* Figures are representative of the mid 1950's. Data from Game Management Division Annual Harvest Records.

Red and gray foxes are found throughout Wisconsin. The red fox is the most abundant and contributes over 80 percent to the annual kill. Greatest densities of both red and gray foxes occur in the western half of the state with the largest concentrations found in the southwestern counties along the Mississippi and Wisconsin Rivers where the severely dissected topography provides excellent habitat (Richards and Hine, 1953). Within the ecological groups, foxes were most abundant in the Southwest and least abundant in the North. Because of the small gray fox sample, we limited further food habits analysis to red foxes.

Of the upland game animals represented in the red fox sample, pheasants and rabbits are distributed throughout most of the state but are most abundant in the Southeast, Wisconsin's primary upland game range (Table 3). Hungarian partridge are generally confined to the southern and eastern counties. They reach their greatest densities in the East Central group of counties. Ruffed grouse prefer forest cover types and thus are scarce in the Southeast and are most common in the North.

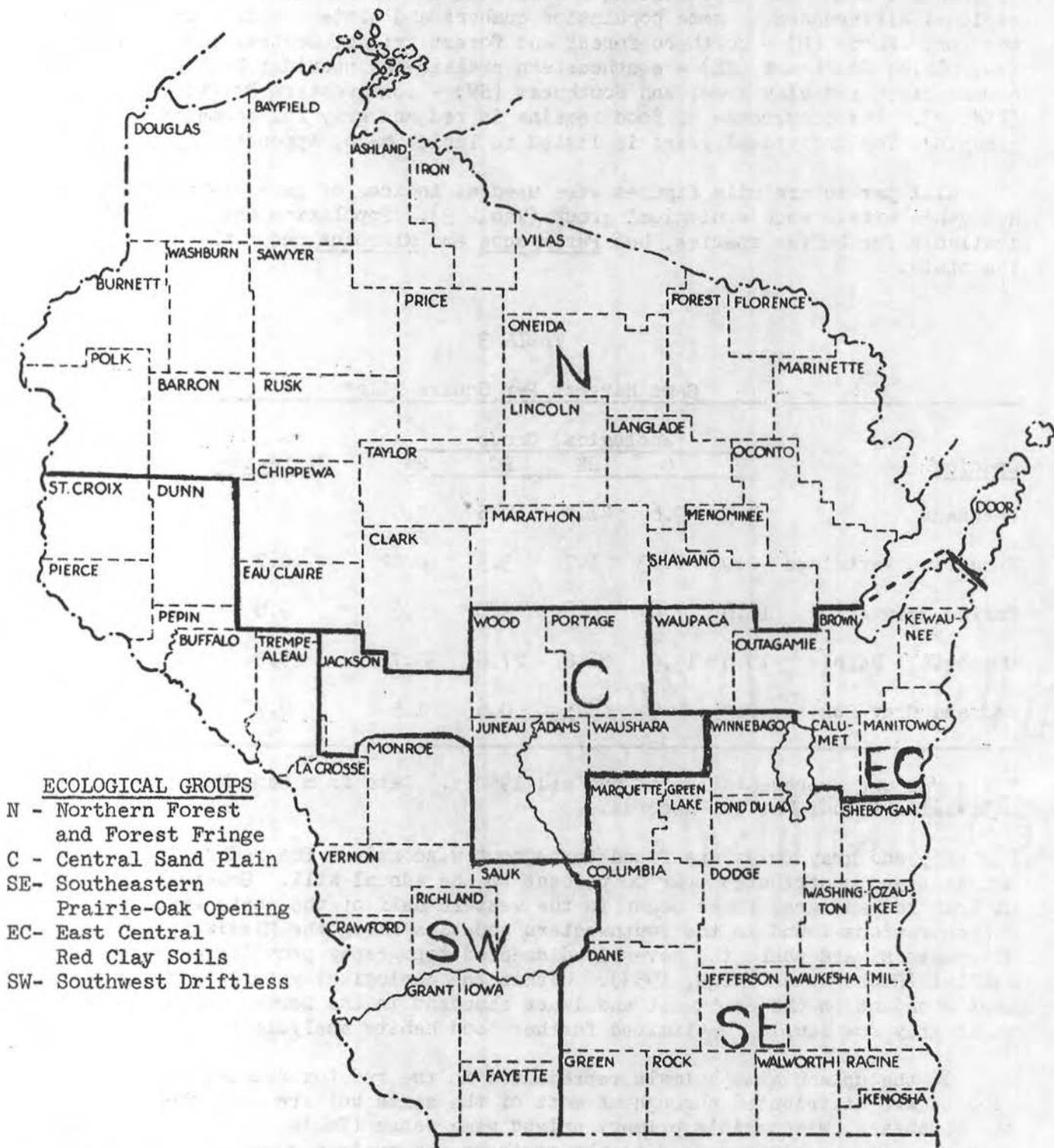


Figure 2. Ecological groups of counties used in analysing regional variations in fox food habits.

During the 3-year winter period of 1959-60 to 1961-62, the red fox sample was fairly representative of the Northern, Central, Southeastern and East Central ecological groups (Table 8-10, Appendix A). In other years, most of the stomach sample came from the Southeast. No winter food habits data were obtained from the Southwest.

Of the mammals eaten, mice occurred most frequently in the diet during the winters of 1959-60 and 1960-61 (Table 4). In 1959-60, the frequency of occurrence of mice varied from 39 percent in the Central counties to 65 percent in the East Central counties, averaging 55 percent for the entire sample. The white-footed mouse was consumed most frequently in the North, Central and East Central counties. The meadow mouse was eaten most frequently in the Southeastern counties. In 1960-61, mice varied from 50 percent in the North to 72 percent in the Central counties averaging 65 percent for the entire sample. Meadow mice ranked first in all county groups.

Cottontail rabbits ranked first in the fox diet in the North, Southeast, and East Central counties in 1961-62. Approximately 50 percent of the fox stomachs in the North and East Central counties contained rabbit, while 66 percent contained rabbit in the Southeast. In 1959-60 and 1960-61, rabbits averaged 31 and 17 percent, respectively, the Southeast containing the highest percentage.

During the 3-year period, 5 percent of the red fox stomachs contained pheasant. While the frequency of occurrence varied between years and between ecological groups, pheasants occurred most frequently in the fox diet in the Southeast in 1959-60 and 1961-62. Pheasants occurred most frequently in the diet in the East Central counties in 1961-62. Only one Hungarian partridge was identified in the entire fox stomach sample (Southeast 1961-62).

Ruffed grouse occurred in less than 2 percent of the stomach sample. Only fox stomachs from the North, the best grouse range, contained grouse remains. Deer were found in 4 percent of the fox stomachs and occurred in all four ecological groups at sometime during the 3-year period. Most of the deer were found in fox stomachs obtained from the North and Central counties -- the more heavily forested areas of the state.

Chicken occurred in 15 percent of the stomach sample. They occurred most frequently in the Central counties and were fairly evenly distributed percentage-wise in the other groups.

TABLE 4

Summary of Major Buffer and Game Species Found in Red Fox Stomachs
 (North, Central, Southeastern and East Central County Groups)

		<u>Mice</u>		<u>Cottontail</u>	<u>Pheasant</u>	<u>Ruffed</u>
		<u>White-</u>	<u>Meadow</u>	<u>Rabbit</u>		<u>Grouse</u>
		<u>Footed</u>				
N	1959-60	33.7	24.0	22.4	1.0	4.1
	1960-61	27.1	27.1	12.5	2.1	4.2
	1961-62	15.2	12.1	51.5	0	9.1
C	1959-60	22.9	15.7	24.2	0	0
	1960-61	31.0	48.3	13.8	0	0
	1961-62	-	-	-	-	-
SE	1959-60	25.9	32.3	48.3	9.5	0
	1960-61	31.7	32.4	23.2	2.1	0
	1961-62	14.0	17.9	66.3	13.4	0
EC	1959-60	38.5	23.1	30.8	3.8	0
	1960-61	26.7	48.9	15.6	0	0
	1961-62	25.0	29.8	50.0	20.2	0

Southeastern Wisconsin

Fox food habits data for the period 1955-56 to 1964-65 for the Southeast were compared with upland game population trends and winter weather conditions (Table 5). During this 10-year period, we experienced two very severe winters (1958-59 and 1961-62) characterized by prolonged, below normal temperatures and heavy snow cover which persisted most of the winter. The winters of 1956-57, 1959-60 and 1962-63 were considered moderate to severe with occasional periods of below normal temperatures and heavy snow cover for short periods. The remaining winters were mild to moderate with average temperatures and little snow cover.

A downward trend in pheasant numbers began in the late 1950's and continued through 1960. This trend was attributed in part to severe winter weather and cold, wet springs. Since 1961, pheasant population trends have generally been upward. The cottontail rabbit population fluctuated considerably during the 10-year period with low populations indicated by kill figures in 1958-59, 1959-60, and 1963-64. There has been some recovery in 1964-65.

Bounty records, while not entirely reliable indicators of fox abundance, have suggested a relatively high and stable fox population since the mid-1950's. Over 50,000 foxes were bountied in Wisconsin annually between 1960 and 1962. Bounties were discontinued on September 15, 1963, but other surveys conducted by the Wisconsin Conservation Department have indicated that a high fox population remains although trends were downward in the past two years.

The occurrence of white-footed mice in the fox diet remained fairly stable throughout the 10-year period with the exception of 1961-62, 1963-64 and 1964-65 when less than 20 percent of the fox stomachs in the Southeast contained this buffer species. The white-footed mouse is little affected by winter weather and is readily available to the fox. Its frequency of occurrence in the diet is mainly related to local abundance in any one year. The meadow mouse usually receives protection from a heavy snow cover. In severe winters when the ground is covered with a good snow mantle for prolonged periods, fewer meadow mice are available to the fox. During mild and moderate winters, a larger percentage of the diet contains meadow mice.

Pheasant remains were found in an average of 9 percent of the fox stomachs from southeastern Wisconsin between 1955-56 and 1964-65 (Table 5). Generally, the highest frequency of occurrence of pheasant in the diet was during moderately severe to severe winters especially when the ground was covered with a thick snow mantle for prolonged periods. These adverse weather conditions provided more opportunity for the fox to prey on pheasants.

Cottontail rabbit remains occurred in an average of 50 percent of the fox stomachs from southeastern Wisconsin during the 10-year period. Our data indicate the cottontail was quite vulnerable to fox predation regardless of the type of winter weather although its frequency of occurrence in the diet increased in winters characterized by long periods of heavy snow cover.

Whether a threshold of security is arrived at when game populations reach a certain low point is not definitely known. However, if we assume the pheasant and cottontail harvest figures reflect population levels, then our data might suggest less security in low game populations when fox populations are high. An exception to this would be the winter of 1960-61.

TABLE 5

Fox Food Habits, Small Game Harvests and Winter Weather Conditions in Southeastern Wisconsin, 1955-65

Year	Number of Stomachs	Percent Occurrence in Fox Stomachs				Annual Harvest*		Winter Weather Conditions**
		White-footed Mouse	Meadow Mouse	Pheasant	Rabbit	Pheasant	Rabbit	
1955-56	19	37	63	11	63	364,300	702,300	Mild
1956-57	43	42	14	14	72	346,600	733,900	Moderate - Severe
1957-58	--	--	--	--	--	369,500	771,500	Moderate
1958-59	77	34	13	23	64	316,600	455,100	Very Severe
1959-60	232	26	32	10	48	192,000	220,100	Moderate - Severe
1960-61	142	32	32	2	23	171,100	250,000	Moderate
1961-62	486	14	18	13	66	212,800	339,100	Very Severe
1962-63	68	24	34	6	50	247,600	272,600	Moderate - Severe
1963-64	72	19	53	3	32	208,300	226,900	Mild
1964-65	<u>41</u>	<u>15</u>	<u>42</u>	<u>0</u>	<u>32</u>	<u>339,800</u>	<u>348,300</u>	Moderate
Total	1,180					2,768,600	4,319,800	
Average		27	33	9	50			

* Compiled from Game Management Division Annual Harvest Records.

** Based on a subjective evaluation of temperatures, depth and duration of snow cover, and general field observations. Basic weather records from Wisconsin Climatological Data for Southeastern Wisconsin.

Trapped Sample

During the fall of 1959, we collected 36 stomachs from red foxes trapped in 4 counties as part of another study (Table 17, Appendix A). While the sample is small, it does show a seasonal difference in feeding habits with the addition of insects (unavailable in winter) and a red-winged blackbird which normally migrates south in fall. Small mammals were still prominent in the diet with mice occurring most frequently.

Winter Weights

Weights were obtained on a sample of 925 male and 774 female red foxes (Tables 18-20, Appendix B). Males averaged $1\frac{1}{2}$ pounds heavier than females. The heaviest males and females were obtained from Northern Wisconsin (primarily the northwestern part of the state). Lightest foxes came from the East Central counties.

There was some weight change between years. Male foxes in the North averaged $1\frac{1}{4}$ pounds lighter during the winter of 1961-62 (severe winter) than during the two previous winters. The other areas did not show any significant changes. Females did not exhibit this weight change in 1961-62. All foxes appeared to be in good physical condition throughout the 10 years of collection.

DISCUSSION

Foxes prefer animal matter to vegetable matter as their main source of food with the amount and variety of animals eaten largely governed by availability. When one food is abundant and readily accessible, the fox has more opportunity to include it in his diet (Errington, 1935). Carrion and sick or crippled animals often form an important part of a predator's diet and there is virtually no way of separating these materials from fresh kills (Grondahl, 1958; Korschgen, 1959; Englund, 1965b).

The variety of foods in the fox diet changes with the season. However, small mammals and comparatively slow-moving prey generally constitute the major foods throughout the year. Normally there is little selection for birds although some ground-feeding birds will supplement the fox diet if they fail to take flight. Our study corroborates other studies which show mice and cottontail rabbits are the staple foods of the fox (Errington, 1935; Latham, 1950; Richards and Hine, 1953; Scott and Klimstra, 1955; Korschgen, 1959).

Caution must be exercised in drawing conclusions on the effects of predation on prey populations from food habits data. Such data must be interpreted in relation to: (1) availability and density of the prey species; (2) density of the predator populations; and (3) abundance or scarcity of buffer species. Fragments of bone, fur, or feathers in the stomach is positive evidence that a particular animal was eaten, but there is no way of determining if it was originally killed by the fox or how many meals the fox made of a particular prey species.

Frequency of occurrence of a prey species in a predator's diet is often assumed to indicate the degree to which a predator affects the prey population. Actually the most important statistic in determining the degree of effect of a predator on a prey population is the percentage of the prey population taken. This percentage depends not only upon the frequency of kill per predator, but also on the number of predators and prey (Leopold, 1933:232; Latham, 1951; Wagner, Besadny and Kabat, 1965). It is a difficult statistic to obtain.

The relatively low percentage of game birds in the winter diet of Wisconsin foxes suggests that on a statewide basis, the long-term predatory influence may be minor. Under severe winter weather conditions and in local situations, however, fox predation can have a short-term impact on game bird population trends. The high percentage of cottontail rabbits in the fox diet even in marginal rabbit range suggests that the fox could influence annual rabbit population trends, but without adequate data, the degree of influence is not known.

Foxes have been bountied in Wisconsin for over 85 years with periodic lapses in annual payments. Bounties were discontinued in 1963 by the Wisconsin legislature because of their ineffectiveness in controlling fox numbers. With or without bounties, upland game populations have continued to fluctuate annually. And there have been noticeable increases in game populations in spite of continued high fox populations and the discontinuation of bounties. Whether total fox control would give substantial increases in game is speculative since the influence of fox predation on game populations is not fully understood, and also since the fox is but one of a host of predators having an impact upon the prey community.

Studies in other states to determine effects of fox control on upland game showed no significant gains in pheasant population levels (Robeson, 1950; N. Y. State Cons. Dept., 1951). The few total predator control studies conducted also failed to give conclusive evidence of game population response although the researchers believed there were some increases (Einarsen, 1950; Hart, Glading, and Harper, 1956:145).

A carefully designed, long-term ecological study of the entire predator-prey community is necessary if we are to fully understand the effects of predators on the prey population. Such a study would be extremely difficult to execute and it would be expensive. Furthermore, there is no assurance that this type of study would give conclusive results. And in the light of other more pressing game research problems there is some doubt whether such a study should be undertaken. However, as long as there is reasonable doubt on the effects of predation, serious thought should be given to a predator-prey community study.

APPENDIX A: Stomach Analyses

Data for individual years of the fox food habits study are appended to document changes by ecological groupings in winter diets of the red and gray fox. These data should provide the researcher with basic information for making other types of statistical analyses and in making periodic comparisons of winter feeding habits of Wisconsin foxes.

TABLE 6

Occurrence of Food Remains in Red Fox Stomachs,

Winter of 1955-56 and 1956-57

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	43	69.3
White-footed mouse	25	40.3
Meadow mouse	18	29.0
House mouse	1	1.6
Mouse, unclassified	1	1.6
<u>BIRDS</u>		
Pheasant	8	12.9
Song bird, unclassified	8	12.9
Chicken	3	4.8
Bird, unclassified	3	4.8
Grackle or Blackbird	1	1.6
Tree sparrow	1	1.6
<u>PLANT MATERIAL</u>		
Plant fragments	8	12.9
Grass fragments	7	11.3
Corn kernels	1	1.6
Weed seeds, unclassified	1	1.6
<u>MISCELLANEOUS</u>		
(Lead shot)	1	1.6
<u>STOMACH EMPTY</u>	52	45.6

* Dane, Green and Racine Counties.

** Sample of 62 stomachs with food.

TABLE 7

Occurrence of Food Remains in Red Fox Stomachs,

Winter of 1958-59

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	49	63.6
White-footed mouse	26	33.8
Meadow mouse	10	13.0
Pig	5	6.5
Mammal, unclassified	3	3.9
Skunk	1	1.3
House mouse	1	1.3
Mouse, unclassified	1	1.3
Short-tailed shrew	1	1.3
<u>BIRDS</u>		
Pheasant	18	23.4
Chicken	17	22.1
Slate-colored junco	5	6.5
Bird, unclassified	4	5.2
Meadowlark	1	1.3
<u>PLANT MATERIAL</u>		
Plant fragments	18	23.4
Grass fragments	16	20.8
Corn kernels	3	3.9
Wood	1	1.3
Apple seeds	1	1.3
Weed seeds, unclassified	1	1.3
<u>MISCELLANEOUS</u>		
(Lead shot, BB, cloth)	5	6.5
<u>STOMACH EMPTY</u>	76	53.1

* Dane and Rock Counties.

** Sample of 77 stomachs with food.

TABLE 8

Occurrence of Food Remains in Red Fox Stomachs

Winter of 1959-60

Northern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
White-footed mouse	66	33.7
Meadow mouse	47	24.0
Cottontail rabbit	43	22.4
Mammal, unclassified	11	5.6
Mouse, unclassified	10	5.1
Snowshoe hare	9	4.6
Red fox	4	2.0
White-tailed deer	7	3.6
Raccoon	6	3.1
Pig	5	2.6
Red squirrel	4	2.0
Fox squirrel	2	1.0
House mouse	2	1.0
Bog lemming	2	1.0
Short-tailed shrew	2	1.0
Cow	2	1.0
Gray squirrel	1	0.5
Flying squirrel	1	0.5
Skunk	1	0.5
Porcupine	1	0.5
Muskrat	1	0.5
Red-backed vole	1	0.5
Prairie mole	1	0.5
<u>BIRDS</u>		
Chicken	17	8.7
Ruffed grouse	8	4.1
Bird, unclassified	4	2.0
Pheasant	2	1.0
Songbird, unclassified	2	1.0
Blue Jay	1	0.5
<u>PLANT MATERIAL</u>		
Grass fragments	76	38.8
Plant fragments	60	30.6
Wood fragments	13	6.6
Straw	12	6.1
Corn kernels	4	2.0
Oat kernels	3	1.5
Barley kernels	1	0.5
Weed seeds	1	0.5
White spruce needles	1	0.5
White cedar needles	1	0.5

Table 8 (Cont.)

Northern Counties* (Cont.)

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MISCELLANEOUS ITEMS</u>		
Small stones	3	1.5
Paper	2	1.0
Copper BB	1	0.5
Lead shot	1	0.5
Rubber hose fragments	1	0.5
<u>STOMACH EMPTY</u>	28	12.5

* Northern Door, Price, Rusk, Taylor, Chippewa, and Marinette Counties.

** Sample of 196 stomachs with food.

Table 8 (Cont.)

<u>Central Counties*</u>		
<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	17	24.2
White-footed mouse	16	22.9
Meadow mouse	11	15.7
White-tailed deer	5	7.1
Red fox	4	5.7
Gray squirrel	3	4.3
Fox squirrel	3	4.3
Mammal, unclassified	3	4.3
Raccoon	2	2.9
Snowshoe hare	1	1.4
Pig	1	1.4
Red-backed vole	1	1.4
Mouse, unclassified	1	1.4
Short-tailed shrew	1	1.4
Masked shrew	1	1.4
<u>BIRDS</u>		
Chicken	14	20.0
Songbird, unclassified	3	4.3
Slate-colored junco	1	1.4
Bird, unclassified	1	1.4
<u>PLANT MATERIAL</u>		
Grass fragments	41	58.6
Plant fragments	27	38.6
Wood fragments	8	11.4
Straw	3	4.3
Corn kernels	1	1.4
Corn cob fragments	1	1.4
Weed seeds	1	1.4
Jackpine needles	1	1.4
<u>INSECTS</u>		
Beetle	1	1.4
Grasshopper	1	1.4
<u>MISCELLANEOUS ITEMS</u>		
Paper	1	1.4
<u>STOMACH EMPTY</u>	6	7.9

* Jackson, Portage, Waushara, and Wood Counties.

** Sample of 70 stomachs with food.

Table 8 (Cont.)

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	112	48.3
Meadow mouse	75	32.3
White-footed mouse	60	25.9
Mammal, unclassified	9	3.9
Red fox	7	3.0
Pig	7	3.0
Fox squirrel	6	2.6
Mouse, unclassified	5	2.2
House mouse	2	0.9
Skunk	2	0.9
Raccoon	2	0.9
Opossum	2	0.9
Gray squirrel	1	0.4
<u>BIRDS</u>		
Chicken	32	13.8
Pheasant	22	9.5
Songbird, unclassified	10	4.3
Bird, unclassified	4	1.7
Duck, unclassified	2	0.9
Grackle or Starling	2	0.9
Nuthatch	1	0.4
Slate-colored junco	1	0.4
<u>PLANT MATERIAL</u>		
Grass fragments	90	38.8
Plant fragments	49	21.1
Straw	11	4.7
Corn kernels	6	2.6
Wood fragments	5	2.2
Weed seeds	2	0.9
Oat kernels	1	0.4
Soybeans	1	0.4
<u>MISCELLANEOUS ITEMS</u>		
Lead shot	6	2.6
Small stones	3	1.3
Copper BB	1	0.4
<u>STOMACH EMPTY</u>	65	21.9

* Dodge, Fond du Lac, Green Lake, Kenosha, Racine, Rock, Sheboygan, and Winnebago Counties.

** Sample of 232 stomachs with food.

Table 8 (Cont.)

East Central Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
White-footed mouse	10	38.5
Cottontail rabbit	8	30.8
Meadow mouse	6	23.1
Mouse, unclassified	2	7.7
Mammal, unclassified	1	3.8
<u>BIRDS</u>		
Chicken	3	11.5
Duck, unclassified	2	7.7
Bird, unclassified	2	7.7
Pheasant	1	3.8
<u>PLANT MATERIAL</u>		
Grass fragments	15	57.7
Plant fragments	4	15.4
Wood fragments	2	7.7
Oat kernels	2	7.7
Apple seeds	1	3.8
Straw	1	3.8
<u>MISCELLANEOUS ITEMS</u>		
Lead shot	1	3.8
<u>STOMACH EMPTY</u>	3	10.3

* Brown, Southern Door, and Manitowoc Counties.

** Sample of 26 stomachs with food.

TABLE 9

Occurrence of Food Remains in Red Fox Stomachs,

Winter of 1960-61

Northern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Meadow mouse	13	27.1
White-footed mouse	13	27.1
Red fox	8	16.7
Cottontail rabbit	6	12.5
Snowshoe hare	4	8.3
White-tailed deer	4	8.3
Muskrat	4	8.3
Fox squirrel	2	4.2
Cow	2	4.2
Mammal, unclassified	2	4.2
Mouse, unclassified	1	2.1
Short-tailed shrew	1	2.1
Skunk	1	2.1
Porcupine	1	2.1
Beaver	1	2.1
<u>BIRDS</u>		
Chicken	5	10.4
Ruffed grouse	2	4.2
Bird, unclassified	2	4.2
Pheasant	1	2.1
<u>PLANT MATERIAL</u>		
Grass fragments	24	50.0
Straw	9	18.8
Plant fragments	7	14.6
Wood fragments	4	8.3
Corn kernels	2	4.2
Weed seeds	2	4.2
Cherry pit	1	2.1
<u>MISCELLANEOUS ITEMS</u>		
Soil particles	6	12.5
Lead shot	3	6.3
Brass nut	1	2.1
Baling twine	1	2.1
<u>STOMACH EMPTY</u>	8	14.3

* Rusk and Taylor Counties.

** Sample of 48 stomachs with food.

Table 9 (Cont.)

Central Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Meadow mouse	14	48.3
White-footed mouse	9	31.0
Cottontail rabbit	4	13.8
Red fox	3	10.3
Pig	2	6.9
Mammal, unclassified	2	6.9
White-tailed deer	1	3.4
Red squirrel	1	3.4
Fox squirrel	1	3.4
House mouse	1	3.4
Cow	1	3.4
Porcupine	1	3.4
<u>BIRDS</u>		
Chicken	8	27.6
Starling	1	3.4
Domestic pigeon	1	3.4
Crow	1	3.4
<u>PLANT MATERIAL</u>		
Grass fragments	15	51.7
Straw	8	27.6
Plant fragments	4	13.8
Corn kernels	2	6.9
White spruce needles	1	3.4
<u>INSECTS</u>		
Grasshopper	1	3.4
Wasp	1	3.4
<u>MISCELLANEOUS ITEMS</u>		
Stones	2	6.9
Soil particles	1	3.4
Rubber tire fragments	1	3.4
Baling twine	1	3.4
<u>STOMACH EMPTY</u>	7	19.4

* Portage and Waushara Counties.

** Sample of 29 stomachs with food.

Table 9 (Cont.)

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Meadow mouse	46	32.4
White-footed mouse	45	31.7
Cottontail rabbit	33	23.2
Red fox	9	6.3
Pig	9	6.3
Fox squirrel	7	4.9
Gray squirrel	5	3.5
Mammal, unclassified	5	3.5
Cow	4	2.8
Raccoon	4	2.8
Mouse, unclassified	3	2.1
Muskrat	3	2.1
White-tailed deer	1	0.7
Red squirrel	1	0.7
House mouse	1	0.7
<u>BIRDS</u>		
Chicken	11	7.7
Bird, unclassified	4	2.8
Pheasant	3	2.1
Domestic duck	1	0.7
<u>PLANT MATERIAL</u>		
Grass fragments	54	38.0
Straw	16	11.3
Plant fragments	15	10.6
Wood fragments	5	3.5
Corn kernels	1	0.7
Weed seeds	1	0.7
<u>MISCELLANEOUS ITEMS</u>		
Soil particles	6	4.2
Stones	2	1.4
Newspaper	1	0.7
Lead shot	1	0.7
Baling twine	1	0.7
<u>STOMACH EMPTY</u>	43	23.2

* Columbia, Dane, Fond du Lac, Green, Green Lake, Rock and Winnebago Counties.

** Sample of 142 stomachs with food.

Table 9 (Cont.)

East Central Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Meadow mouse	22	48.9
White-footed mouse	12	26.7
Cottontail rabbit	7	15.6
Red fox	3	6.7
Pig	2	4.4
Muskrat	2	4.4
Mammal, unclassified	2	4.4
Snowshoe hare	1	2.2
Cow	1	2.2
Gray squirrel	1	2.2
Skunk	1	2.2
<u>BIRDS</u>		
Chicken	7	15.6
Bird, unclassified	1	2.2
Domestic duck	1	2.2
Starling	1	2.2
<u>PLANT MATERIAL</u>		
Grass fragments	24	53.3
Straw	6	13.3
Plant fragments	2	4.4
Wood fragments	1	2.2
Corn kernels	1	2.2
Oat kernels	1	2.2
Weed seeds	1	2.2
<u>MISCELLANEOUS ITEMS</u>		
Stones	1	2.2
Soil particles	1	2.2
<u>STOMACH EMPTY</u>	12	21.1

* Outagamie and Waupaca Counties.

** Sample of 45 stomachs with food.

TABLE 10

Occurrence of Food Remains in Red Fox Stomachs,

Winter of 1961-62

Northern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	17	51.5
White-tailed deer	6	18.2
White-footed mouse	5	15.2
Meadow mouse	4	12.1
Red fox	3	9.1
Cow	2	6.1
Mammal, unclassified	2	6.1
Snowshoe hare	1	3.0
Pig	1	3.0
<u>BIRDS</u>		
Bird, unclassified	6	18.2
Chicken	5	15.2
Ruffed grouse	3	9.1
<u>PLANT MATERIAL</u>		
Grass fragments	14	42.4
Plant fragments	6	18.2
Straw	5	15.2
Wood fragments	1	3.0
Oat kernels	1	3.0
<u>MISCELLANEOUS ITEMS</u>		
Stones	1	3.0
<u>STOMACH EMPTY</u>	16	32.7

* Rusk County.

** Sample of 33 stomachs with food.

Table 10 (Cont.)

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	322	66.3
Meadow mouse	87	17.9
White-footed mouse	68	14.0
Pig	23	4.7
Fox squirrel	11	2.3
Gray squirrel	11	2.3
White-tailed deer	7	1.4
Red fox	6	1.2
Cow	6	1.2
Muskrat	6	1.2
Mammal, unclassified	5	1.0
Rat	2	0.4
Mouse, unclassified	1	0.2
Raccoon	1	0.2
House mouse	1	0.2
Short-tailed shrew	1	0.2
Skunk	1	0.2
<u>BIRDS</u>		
Chicken	72	14.8
Pheasant	65	13.4
Bird, unclassified	34	7.0
Mallard duck	1	0.2
Duck, unclassified	1	0.2
Hungarian partridge	1	0.2
Domestic pigeon	1	0.2
<u>PLANT MATERIAL</u>		
Grass fragments	80	16.5
Straw	44	9.1
Corn kernels	16	3.3
Plant fragments	14	2.9
Apple seeds	5	1.0
Wood fragments	3	0.6
Oat kernels	3	0.6
Buckwheat kernels	1	0.2
<u>MISCELLANEOUS ITEMS</u>		
Lead shot	9	1.9
Soil particles	5	1.0
Stones	2	0.4
Paper	2	0.4
Copper shell casing fragment	2	0.4
Burlap material	1	0.2
Baling twine	1	0.2
<u>STOMACH EMPTY</u>	196	28.7

* Columbia, Dane, Dodge, Fond du Lac, Marquette, Racine, Rock, Sheboygan, Walworth, Waukesha and Winnebago Counties.

** Sample of 486 stomachs with food.

Table 10 (Cont.)

East Central Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	42	50.0
Meadow mouse	25	29.8
White-footed mouse	21	25.0
Pig	3	3.6
Fox squirrel	2	2.4
Mammal, unclassified	2	2.4
Red fox	1	1.2
White-tailed deer	1	1.2
Gray squirrel	1	1.2
House cat	1	1.2
<u>BIRDS</u>		
Pheasant	17	20.2
Chicken	14	16.7
Bird, unclassified	3	3.6
White-breasted nuthatch	1	1.2
Duck, unclassified	1	1.2
<u>PLANT MATERIAL</u>		
Grass fragments	13	15.5
Straw	10	11.9
Plant fragments	2	2.4
Apple seeds	2	2.4
Oat kernels	2	2.4
Corn kernels	1	1.2
Cherry pit	1	1.2
<u>MISCELLANEOUS ITEMS</u>		
Stones	3	3.6
Soil particles	2	2.4
Lead shot	1	1.2
Paper	1	1.2
Burlap material	1	1.2
<u>STOMACH EMPTY</u>	33	28.2

* Brown, Door, Kewaunee and Manitowoc Counties.

** Sample of 84 stomachs with food.

TABLE 11

Occurrence of Food Remains in Red Fox Stomachs,

Winter of 1962-63

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	34	50.0
Meadow mouse	23	33.8
White-footed mouse	16	23.5
Pig	4	5.9
Fox squirrel	3	4.4
Red fox	3	4.4
Mouse, unclassified	2	2.9
Gray squirrel	2	2.9
Raccoon	2	2.9
Mammal, unclassified	1	1.5
Skunk	1	1.5
<u>BIRDS</u>		
Chicken	17	25.0
Pheasant	4	5.9
Bird, unclassified	2	2.9
<u>PLANT MATERIAL</u>		
Plant fragments	19	27.9
Grass fragments	19	27.9
Oat seeds	1	1.5
<u>MISCELLANEOUS</u>		
(Stones, soil, lead shot)	6	8.8
<u>STOMACH EMPTY</u>	29	29.9

* Columbia, Dane and Green Counties.

** Sample of 68 stomachs with food.

TABLE 12

Occurrence of Food Remains in Red Fox Stomachs,

Winter of 1963-64

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Meadow mouse	38	52.8
Cottontail rabbit	23	31.9
White-footed mouse	14	19.4
Red fox	10	13.9
Pig	3	4.2
Fox squirrel	3	4.2
Gray squirrel	2	2.8
Raccoon	2	2.8
Cow	1	1.4
Skunk	1	1.4
Mammal, unclassified	1	1.4
<u>BIRDS</u>		
Chicken	18	25.0
Pheasant	2	2.8
Bird, unclassified	3	4.2
<u>PLANT MATERIAL</u>		
Plant fragments	25	34.7
Grass fragments	3	4.2
<u>MISCELLANEOUS</u>		
(Stones, soil)	12	16.7
<u>STOMACH EMPTY</u>	21	22.6

* Dane, Fond du Lac and Green Counties.

** Sample of 72 stomachs with food.

TABLE 13

Occurrence of Food Remains in Red Fox Stomachs,
Winter of 1964-65
Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent of Occurrence**</u>
<u>MAMMALS</u>		
Meadow mouse	17	41.5
Cottontail rabbit	13	31.7
White-footed mouse	6	14.6
Red fox	4	9.8
Fox squirrel	3	7.3
Raccoon	2	4.9
Skunk	2	4.9
Pig	1	2.4
Gray squirrel	1	2.4
White-tailed deer	1	2.4
<u>BIRDS</u>		
Chicken	15	36.6
<u>PLANT MATERIAL</u>		
Plant fragment	29	70.7
Apple seeds	1	2.4
<u>MISCELLANEOUS</u>		
(Soil, BB)	5	12.2
<u>STOMACH EMPTY</u>	4	8.9

* Dodge, Fond du Lac, Green Lake and Jefferson Counties.

** Sample of 41 stomachs with food.

TABLE 14

Occurrence of Food Remains in Gray Fox Stomachs,
Winters of 1958-59 and 1959-60*

<u>Food Item</u>	<u>Number of Stomachs**</u>
<u>MAMMALS</u>	
Cottontail rabbit	3
Meadow mouse	2
House mouse	1
White-tailed deer	1
<u>BIRDS</u>	
Chicken	2
<u>PLANT MATERIAL</u>	
Plant fragments	3
Grass fragments	2
Apple seeds	1
Weed seeds, unclassified	1
<u>MISCELLANEOUS</u>	
Lead shot	1
<u>STOMACH EMPTY</u>	3

* Dane, Rock, Waushara Counties.

** Sample of 4 stomachs with food.

TABLE 15

Occurrence of Food Remains in Gray Fox Stomachs,

Winter of 1960-61

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
White-footed mouse	6	42.9
Meadow mouse	4	28.6
Cottontail rabbit	4	28.6
Fox squirrel	2	14.3
Raccoon	1	7.1
Gray fox	1	7.1
Mouse, unclassified	1	7.1
<u>BIRDS</u>		
Chicken	3	21.4
<u>PLANT MATERIAL</u>		
Grass fragments	6	42.9
Plant material	3	21.4
Corn kernels	2	14.3
Straw	2	14.3
Wood	2	14.3

* Rock, Columbia and Dane Counties.

** Sample of 14 stomachs with food.

TABLE 16

Occurrence of Food Remains in Gray Fox Stomachs,

Winter of 1961-62

Southeastern Counties*

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence**</u>
<u>MAMMALS</u>		
Cottontail rabbit	7	58.3
Meadow mouse	4	33.3
White-footed mouse	1	8.3
White-tailed deer	1	8.3
<u>BIRDS</u>		
Chicken	2	16.7
Bird, unclassified	1	8.3
<u>PLANT MATERIAL</u>		
Grass fragments	4	33.3
Apple	4	33.3
Corn kernels	2	16.7
Straw	2	16.7
Cherry pit	1	8.3
Plant fragments	1	8.3
<u>MISCELLANEOUS ITEMS</u>		
Soil particles	1	8.3
<u>STOMACH EMPTY</u>	7	36.8

* Columbia, Dane, Marquette, Racine, Rock, Sheboygan, Walworth and Waukesha Counties.

** Sample of 12 stomachs with food.

TABLE 17

Occurrence of Food Remains in 36 Red Fox Stomachs
(Foxes Trapped During the Fall of 1959)

IOWA COUNTY

<u>Food Item</u>	<u>Number of Stomachs</u>	<u>Percent by Occurrence*</u>
<u>MAMMALS</u>		
White-footed mouse	9	33.3
Meadow mouse	5	18.5
Cottontail rabbit	5	18.5
Mouse, unclassified	4	14.8
Red fox	2	7.4
Fox squirrel	2	7.4
Mammal, unclassified	2	7.4
<u>BIRDS</u>		
Chicken	4	14.8
Songbird, unclassified	3	11.1
Bird, unclassified	1	3.7
Red-winged blackbird (Agelaius phoeniceus)	1	3.7
<u>PLANT MATERIAL</u>		
Grass fragments	24	88.9
Plant fragments	12	44.4
Wood fragments	8	29.6
Apple seeds	3	11.1
Weed seeds	2	7.4
Corn kernels	1	3.7
<u>INSECTS</u>		
Grasshopper	5	18.5
Grasshopper (Locustidae sp.)	1	3.7
Ground beetle (Harpalus caliginosus)	1	3.7
Diptera larvae	1	3.7
<u>MISCELLANEOUS ITEMS</u>		
Small stones	2	7.4
<u>STOMACH EMPTY</u>	3	10.0

* Sample of 27 stomachs with food.

Table 17 (Cont.)

JACKSON COUNTY

<u>Food Item</u>	<u>Number of Stomachs*</u>
<u>MAMMALS</u>	
Mouse, unclassified	1
<u>PLANT MATERIAL</u>	
Grass fragments	4
Plant fragments	1

* Sample of 5 stomachs with food.

WAUSHARA COUNTY

<u>Food Item</u>	<u>Number of Stomachs*</u>
<u>PLANT MATERIAL</u>	
Grass fragments	2
Plant fragments	2
<u>INSECTS</u>	
Grasshopper	1
Cricket (Gryllus sp.)	1
<u>STOMACH EMPTY</u>	1

* Sample of 2 stomachs with food.

BARRON COUNTY

<u>Food Item</u>	<u>Number of Stomachs*</u>
<u>MAMMALS</u>	
White-footed mouse	1
Meadow mouse	1
Red fox	1
<u>BIRDS</u>	
Songbird, unclassified	1

Table 17 (Cont.)

BARRON COUNTY (Cont.)

<u>Food Item</u>	<u>Number of Stomachs*</u>
<u>PLANT MATERIAL</u>	
Grass fragments	1
Weed seeds	1
<u>STOMACH EMPTY</u>	3

* Sample of 2 stomachs with food.

APPENDIX B: Red Fox Weights

TABLE 18

Red Fox Weights -- Winter of 1959-60

Area*	Male		Female	
	Number of Specimens	Avg. Weight (lbs.)**	Number of Specimens	Avg. Weight (lbs.)**
(1) North	100	10.75	54	9.50
(2) East Central	11	9.75	7	8.50
(3) Central	30	10.00	32	8.75
(4) Southeast	<u>138</u>	<u>10.50</u>	<u>122</u>	<u>8.75</u>
Total and Average	279	10.50	215	9.00

- * (1) Chippewa, Marinette, Northern Door, Price, Rusk, and Taylor Counties.
 (2) Brown, Manitowoc, and Southern Door Counties.
 (3) Jackson, Portage, Waushara, and Wood Counties.
 (4) Dodge, Fond du Lac, Green Lake, Kenosha, Racine, Rock, and Sheboygan Counties.

** Carcasses weighted to the nearest quarter-pound.

TABLE 19

Red Fox Weights -- Winter of 1960-61

Area*	Male		Female	
	Number of Specimens	Avg. Weight (lbs.)**	Number of Specimens	Avg. Weight (lbs.)**
(1) North	31	10.75	28	9.25
(2) Central	38	9.75	49	8.25
(3) Southeast	<u>104</u>	<u>10.25</u>	<u>88</u>	<u>8.25</u>
Total and Average	173	10.25	165	8.50

- * (1) Rusk and Taylor Counties.
 (2) Outagamie, Portage, Waupaca and Waushara Counties.
 (3) Columbia, Dane, Fond du Lac, Green, Green Lake, Rock and Winnebago Counties.

** Carcasses weighted to the nearest quarter-pound.

APPENDIX B (Cont.)

TABLE 20

Red Fox Weights -- Winter of 1961-62

<u>Area*</u>	<u>Male</u>		<u>Female</u>	
	<u>Number of Specimens</u>	<u>Avg. Weight (lbs.)**</u>	<u>Number of Specimens</u>	<u>Avg. Weight (lbs.)**</u>
(1) North	27	9.50	18	9.25
(2) Southeast	395	10.25	304	8.75
(3) East Central	<u>51</u>	<u>9.50</u>	<u>42</u>	<u>8.25</u>
Total and Average	473	10.25	364	8.75

* (1) Rusk County.

(2) Columbia, Dane, Dodge, Fond du Lac, Marquette, Racine, Rock, Sheboygan, Walworth, Waukesha and Winnebago Counties.

(3) Brown, Door, Kewaunee and Manitowoc Counties.

** Carcasses weighted to the nearest quarter-pound.

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