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## DECEMBER FOOD HABITS OF MINK IN MISSOURI

BY LEROY J. KORSCHGEN

This study was conducted during the years 1951 to 1953, inclusive, with three principal objectives: (1) to learn the general winter feeding habits of mink in Missouri, as an aid to management; (2) to learn the extent of predation upon other managed species during the winter when foods are most difficult to obtain; and (3) to obtain information of value in appraising good mink habitat.

The mink, *Mustela vison*, ranks first in value among the furbearers of Missouri. An average annual take of about 16,775 pelts during the years 1950 to 1954, inclusive, brought more than a quarter of a million dollars each year to trappers and hunters. Prices for mink pelts have remained relatively stable at about \$15.00 each, but annual take has declined in recent years (Sampson, 1956).

Materials for this study were collected with the cooperation of other Commission biologists, hunters, trappers, and fur buyers. Names of successful mink takers were obtained from fur harvest records. These and selected fur buyers were requested to save mink carcasses for study. Volunteer cooperators were supplied with one-gallon wide-mouthed jars or lard cans which contained a 10 per cent formaldehyde solution for preserving materials. Seventy-one of 89 cooperators who volunteered saved 362 carcasses for study during the 1951 (December) season. Sixty-three from essentially the same group saved 403 carcasses during December, 1952, while 36 of 50 cooperators saved 263 carcasses for study during December, 1953.

Collected materials were assembled each year and the stomachs removed for food habits study. Stomachs were opened, the contents washed in a fine-mesh sieve, and partially dried. Food items were separated by kind and identified, and the volume of each was ascertained.

Identification of food items was aided by use of a 10× binocular dissecting microscope. A compound microscope with 440× magnification also was used occasionally to check hair identifications. Other items used were standard laboratory equipment.

Percentages were calculated both for occurrence and volume of each identified food item, each year, and for the three-year total.

Reports from six other states show great variation in amounts of specific foods taken by mink. Dearborn (1932), reporting the winter diet of 297 Michigan mink, found that mammals, principally muskrats, occurred in 55.6 per cent of the samples. Fish, frogs, crayfish and birds were found frequently. Sealander (1943) also reported muskrat as the most important prey item of Michigan mink, as determined from the examination of 102 stomachs and 101 intestine samples. Hamilton (1936) found from the examination of 70 visceral samples that New York mink in winter fed principally upon mice, fish and crayfish, with muskrat fourth in importance. He later (1940) found from the examination of 300 scats that muskrat was most important in the summer diet of mink, while fish and aquatic beetles were next. These three items totaled 79.1 per cent of the bulk.

Errington (1954) reported the truly staple foods of mink in the north-central states as crayfish and frogs. He concluded, after examination of 13,176 mink scats, that mink preyed upon muskrats much more under conditions of drought or overpopulation. Stollberg and Hine (1952) also related predation by mink to muskrat density, after examination of 45 mink stomachs from Wisconsin. Guilday (1949), from analyses of 105 mink stomachs from southwestern Pennsylvania, concluded that mice, fish, crayfish and insects were the most important foods. Examination of 335 mink stomachs or intestines in North Carolina showed that fish, small mammals, arthropods, birds and frogs were the principal foods (Wilson, 1952).

*Results and analyses.*—The results of this investigation are shown in tabular form in Table 1. Foods are listed under major headings, in order of importance by volume.

Nearly two-thirds (63.8 per cent) of 1,028 stomachs examined were empty. The 372 which contained food served as a basis for this report and were collected as follows: 145 during 1951, 134 in 1952, and 93 during the 1953 season. There seems no ready explanation for the high proportion of empty stomachs, which was several times greater than that found for any other predatory species. Method of take possibly was a factor, since the majority of the animals were trapped.

Two methods of take were legal during the 1951 season—by traps, or by gun and dog. A comparison of stomachs collected by the two methods showed a great divergence in numbers which contained food. More than two-thirds (68.4 per cent) of the animals taken by dog contained food, as compared to 41.3 per cent of those taken by trap. Only trapping was legal during the 1952 and 1953 seasons, so no further comparisons could be made. The percentage of stomachs containing food dropped from 40.1 per cent for the combined take during 1951, to 33.3 and 35.4 per cent, respectively, for the trapped animals of 1952 and 1953.

Stomachs of female mink contained food more often than did stomachs of males. Percentages of the samples which contained food, for the three years, were as follows: 37.6 per cent males and 44.4 per cent of the females during 1951; 31.6 per cent males and 36.1 per cent of the females during 1952; and 30.2 per cent males and 43.6 per cent of the females during 1953.

*Principal foods.*—Data in Table 1 shows the principal foods of mink to be frogs, mice and rats, fish, rabbit, crayfish and birds, in order of importance by volume. Unlike the larger predators which consume their food in chunks or bolt smaller items whole, the mink thoroughly masticates what is eaten. Mastication adds to the difficulties of specific identification.

Frogs, the principal food group, were largely unclassified as to species. It is probable that the bulk of this category was made up of bullfrogs (*Rana catesbeiana*) and leopard frogs (*Rana pipiens*) which could not be positive identified without very laborious and time-consuming study. In only two instances were nearly whole frogs found. One of these was a medium-sized leopard frog; the other, five spring peepers (*Hyla crucifer*) in a single stomach.

Frogs as a group occurred in 25.5 per cent of the stomachs and comprised 24.9 per cent of the total volume of food. Both occurrence and volume of frogs varied little from 1951 to 1952, and utilization was nearly the same in the northern and southern parts of the state. Consumption of frogs during 1953 was only about one-half that of the preceding two years. Most small streams were dry during the fall and winter, except for intermittent pools, which limited opportunities for mink to find frogs.

Mice and rats were the second most important source of food and comprised nearly one-fourth (23.9 per cent) of the diet, by volume. Five species of mice and two of rats were identified in the stomach contents. White-footed mice (probably all *Peromyscus maniculatus* and *P. leucopus*) were the most important and made up 8.5 per cent, by volume. Meadow mouse (*Microtus ochrogaster*) comprised 5.9 per cent; cotton rat (*Sigmodon hispidus*), 4.5 per cent; house mouse (*Mus musculus*), 3.7 per cent; lemming mouse (*Synaptomys cooperi*), 0.6 per cent; harvest mouse (*Reithrodontomys* sp.), 0.4 per cent; unclassified mice, 0.2 per cent; and barn rat (*Rattus norvegicus*), 0.1 per cent of the mink diet. Only about one-half the amount of mice and rats were utilized in 1952, as compared to the 1951 take. A still smaller amount was found in the 1953 samples. These data corroborate evidence of a low mouse population during 1952 and 1953, except for localized areas. The lower utilization of mice and rats during 1952 appeared to have been compensated for largely by the greater utilization of fish. Greatest use of mice and rats occurred in the northern part of the state.

Fish were the third most important source of food. They were found in 30.9 per cent of the samples and comprised nearly one-fifth (19.9 per cent) of all food. The take of fish was least during 1951 when frogs and mice were taken in abundance. Consumption of fish more than doubled during the last two years of the study, accompanied by continuously lower water levels which probably increased the availability of fish. No attempt was made to identify the species of fish involved, except that the identification of bullhead catfish was obvious. Fish scales and bones normally were found, but with approximately 250 species known in Missouri, specific identification was considered impractical. A great variety of scale sizes and shapes was noted, indicating no preference for any particular kind of fish. Size of scales and bones showed that only small fish were taken regularly as food. Utilization of fish was general throughout the state.

Cottontail rabbit (*Sylvilagus floridanus*), the largest of the prey species found, occurred in 5.9 per cent of the samples and comprised 10.2 per cent of the total diet, by volume. The percentages of this item show that rabbit serves as at least a secondarily important mink food. Most of the occurrences of rabbit were in northern Missouri where this prey species was most abundant.

Crayfish (*Cambarus* sp.) were the fifth most important source of food. They were found in 19.9 per cent of the stomachs and comprised 9.3 per cent of the three-year December diet. Small amounts of crayfish commonly were found in stomachs with other foods, although often this food constituted the entire con-

TABLE 1.—*Foods of 372 mink in Missouri, by year, 1951–1953*

FOOD ITEM	Year:	PERCENTAGES BY OCCURRENCE AND VOLUME							
		1951		1952		1953		Total	
		No. stomachs:	145	134	93	372			
Frogs _____	(30.3)	(25.2)	(29.1)	(28.6)	(12.9)	(14.9)	(25.5)	(24.9)	
Frogs, unclassified _____	29.0	22.7	29.1	28.6	12.9	14.9	25.0	23.6	
Leopard frog, <i>Rana pipiens</i> _____	0.7	1.7	-	-	-	-	0.3	0.9	
Spring peeper, <i>Hyla crucifer</i> _____	0.7	0.8	-	-	-	-	0.3	0.4	
Mice and rats _____	(33.1)	(32.2)	(17.9)	(16.3)	(12.9)	(15.9)	(22.6)	(23.9)	
White-footed mouse, <i>Peromyscus</i> spp. _____	14.5	12.7	6.7	6.0	4.3	1.1	9.1	8.5	
Meadow mouse, <i>Microtus ochrogaster</i> ____	10.3	10.2	3.7	2.2	1.1	0.6	5.6	5.9	
Cotton rat, <i>Sigmodon hispidus</i> _____	3.4	6.4	-	-	1.1	9.1	1.6	4.5	
House mouse, <i>Mus musculus</i> _____	3.4	2.6	3.7	6.1	2.2	1.5	3.2	3.7	
Lemming mouse, <i>Synaptomys cooperi</i> ____	0.7	0.1	0.7	0.4	1.1	3.0	0.8	0.6	
Harvest mouse, <i>Reithrodontomys</i> sp. ____	-	-	1.5	1.2	-	-	0.5	0.4	
Mouse, unclassified _____	-	-	1.5	0.4	3.2	0.6	1.3	0.2	
Barn rat, <i>Rattus norvegicus</i>	0.7	0.1	-	-	-	-	0.3	0.1	
Fish _____	(18.6)	(11.9)	(30.6)	(27.5)	(50.5)	(27.4)	(30.9)	(19.9)	
Fish, unclassified _____	17.9	11.7	30.6	27.5	48.4	26.7	30.1	19.7	
Bullhead catfish, <i>Ameiurus</i> sp. _____	0.7	0.2	-	-	2.2	0.7	0.8	0.2	
Rabbit, <i>Sylvilagus floridanus</i>	6.9	13.3	6.0	5.0	4.3	12.4	5.9	10.2	
Crayfish, <i>Cambarus</i> sp. _____	17.9	6.4	17.2	7.8	26.9	22.5	19.9	9.3	
Birds _____	( 6.2)	( 5.1)	( 9.0)	( 8.5)	( 1.1)	( tr. )	( 5.9)	( 5.6)	
Songbirds (flicker, cardinal, bluebird, etc.) _____	2.1	1.6	7.5	8.1	1.1	tr.	3.8	3.7	
Birds, unclassified _____	3.4	3.1	1.5	0.5	-	-	1.9	1.7	
Quail, <i>Colinus virginianus</i>	0.7	0.3	-	-	-	-	0.3	0.2	
Fox squirrel, <i>Sciurus niger</i> ____	1.4	2.8	0.7	0.4	2.2	4.8	1.3	2.2	
Muskrat, <i>Ondatra zibethica</i> ..	1.4	1.0	0.7	1.9	1.1	1.1	1.1	1.3	
Undetermined meat and blood _____	4.1	0.4	3.7	2.3	3.2	0.3	3.8	1.0	
Invertebrates _____	( 2.8)	( 0.3)	( 3.0)	( 0.5)	( 7.5)	( 0.6)	( 4.0)	( 0.4)	
Spiders _____	2.1	0.1	1.5	0.5	5.4	0.6	2.7	0.3	
Tarantula _____	0.7	0.2	-	-	-	-	0.3	0.1	
Ground beetle, cricket, scarab beetle, etc. _____	-	-	1.5	tr.	2.1	tr.	1.3	tr.	
House cat, <i>Felis domestica</i> ..	-	-	0.7	0.8	-	-	0.3	0.3	
Least shrew, <i>Cryptotis parva</i>	-	-	1.5	0.5	1.1	0.1	0.8	0.2	

TABLE 1.—*Continued*

FOOD ITEM	Year:	PERCENTAGES BY OCCURRENCE AND VOLUME							
		1951		1952		1953		Total	
	No. stomachs:	145		134		93		372	
Snake, unclassified _____		0.7	0.2	—	—	—	—	0.3	0.1
Plant foods _____		( 4.1)	( 1.2)	—	—	( 1.1)	( tr. )	( 1.9)	( 0.7)
Horsetail, <i>Equisetum</i> sp. —		1.4	1.0	—	—	—	—	0.5	0.5
Grass _____		0.7	0.1	—	—	—	—	0.3	0.1
Plant stems and leaves _____		2.1	0.1	—	—	1.1	tr.	1.1	0.1
Total volume _____		1,429.2 cc.		1,059.0 cc.		439.5 cc.		2,927.7 cc.	
TOTAL _____		100.0%		100.0%		100.0%		100.0%	

tents. The occurrence of crayfish in the diet remained nearly constant during the first two years of this study, but showed greatly increased use during the third year. Drought conditions, mentioned previously, made this food more readily available in the nearly dry streams during 1953. Heaviest utilization of this item was in southern Missouri, where crayfish appeared in stomachs about three times as frequently as in stomachs from northern Missouri.

Birds as a group, but principally songbirds, were taken with sufficient frequency and volume to comprise a secondarily important source of food. Birds were found in 22 of the samples and comprised 5.6 per cent of the total bulk. Many items in this category could not be positively identified. Tentative identifications included three flickers, two juncos, a cardinal, bluebird, quail, and starling.

Fox squirrel (*Sciurus niger rufiventer*) was found occasionally, but could not be considered a staple food. Five occurrences of this item during the three years made up 2.2 per cent of the total volume of food.

Muskrat (*Ondatra zibethica*) occurred in four stomachs and made up 1.3 per cent of the December diet. This represents a very low percentage of the mink diet, as compared to the findings of investigators in other states. However, material for other reports often was collected from marsh areas where concentrations of mink and muskrats occurred together. Animals for this Missouri study came from a variety of habitats—streams, marshes, ponds and lakes. The small number of muskrats eaten could have represented trap-bound animals, since the trapping seasons for mink and muskrat were concurrent during the three years of this study.

Other items in the mink stomach contents occurred infrequently, or in such small amounts as to eliminate them from the list of important foods. Fourteen occurrences of animal matter and blood were found, the nature of which could not be distinguished. These foods were listed as undetermined, and collectively comprised 1.0 per cent of the total volume.

Invertebrates of six kinds, in addition to crayfish, were found in 15 samples. There were 10 spiders and one each of tarantula (*Eurypelma* sp.), ground beetle (Carabidae), cricket (Gryllidae), beetle larva (Coleoptera) and scarab beetle (Scarabaeidae). The collective volume of these items was insignificant at only 0.4 per cent of the total.

Other unimportant animal foods consisted of a young kitten (*Felis domestica*), three least shrews (*Cryptotis parva*) and an unclassified snake, which comprised only minor portions of the diet.

Plant items seldom were found. Seven occurrences of plant material included horsetail (*Equisetum* sp.), grass, and plant stems and leaves which probably were ingested incidentally or by trap-bound animals.

*Effect upon wildlife.*—These data reveal no seriously detrimental predation by mink upon other managed species of wildlife during December. Several species were utilized as food, but not in alarming proportions. Bullfrogs undoubtedly figured heavily in the frog portion of the diet, but the high potential of bullfrog reproduction, plus the limited number of mink in any area, make it doubtful that predation by mink seriously limits the bullfrog population. The same is true for fish, which are heavily utilized by mink; but fish, like frogs, have a high reproductive potential. This category, too, includes many rough fish and minnows not of particular interest to sportsmen. Rabbits, squirrels, muskrats and quail were not taken by mink with enough frequency to have affected the populations appreciably.

It appears evident that the small detrimental effect of mink predation upon other game species during December is amply compensated for by beneficial traits. The kill of rodents alone might be considered a balance to detrimental feeding. Fur value, as a cash crop to trappers, is an added benefit.

*Habitat appraisal.*—The information resulting from this study does not point clearly to a practical method of managing the mink food supply. A check of the important foods does, however, reveal a clue to the appraisal of good mink habitat. Frogs, mice, fish, rabbits, crayfish and birds were shown to be the principal foods. These foods normally are found most abundantly in and near water. Land areas adjacent to water and from which the vegetation has not been overgrazed, burned or cut, therefore, seem to provide excellent habitat for the terrestrial prey species. Water areas in such locations, too, usually are more productive of the aquatic foods—frogs, fish and crayfish.

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#### SUMMARY

A study of the food habits of mink in Missouri was conducted to learn: (a) the general winter feeding habits of mink in Missouri, to secure knowledge for management; (b) the



extent of predation upon other managed species of wildlife during winter when other foods are most difficult to obtain; and (c) information of value in appraising good mink habitat.

Mink stomachs from carcasses saved by cooperating hunters, trappers and fur buyers were used as study materials. Results include data from the examination of 372 mink stomachs from all parts of the state. In addition, 656 stomachs were empty.

Principal foods, by volume percentages, were: frogs, 24.9; mice and rats, 23.9; fish, 19.9; rabbit, 10.2; crayfish, 9.3; birds, 5.6; fox squirrel, 2.2; muskrat, 1.3; and undetermined meat and blood, 1.0 per cent.

The data indicate that mink predation is not seriously detrimental to other managed species of wildlife during winter.

Good mink habitat would seem to include land adjacent to water from which vegetation is not overgrazed, burned or cut. Such areas are productive of the foods most utilized by mink.

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## FOOD HABITS OF THE SWIFT FOX IN NORTHERN TEXAS

BY WILLIAM L. CUTTER

Swift foxes, *Vulpes velox velox*, are present in many parts of their range where they were once considered to be extinct. Little has been learned about the natural history of swift foxes, probably owing to the scarcity of the species until recent years. Twelve stomachs and 250 scats were obtained at six localities in Hansford County, Texas, and were studied to determine the feeding habits of swift foxes.

Most of the land in Hansford County is farmed or overgrazed. Swift foxes and their dens have been found in both cultivated and uncultivated fields (Cutter, 1958). Growers of livestock and poultry are not now (1956) troubled by predators, but perhaps formerly were since government trappers have set