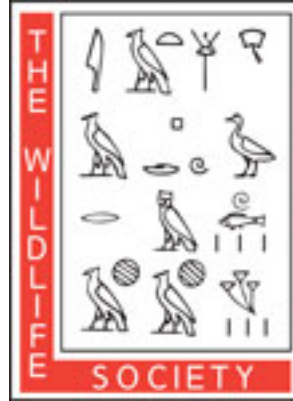


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FOOD HABITS OF THE LYNX IN NEWFOUNDLAND

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Abstract: The food habits of the lynx (*Lynx canadensis*) on the Island of Newfoundland were investigated during the period 1956–61. Results are based upon analyses of the contents of 206 digestive tracts, 116 identified lynx scats, and 104 presumed lynx scats. Snowshoe hares (*Lepus americanus*) occurred in 73 percent of the total tracts and scats in all seasons. Birds, especially smaller species, occurred in 21 percent of the material but were taken most in spring and summer. Mice occurred in 14 percent of the material during snow-free periods of years when they were abundant. Carrion resulting from big game hunting occurred in 20 percent of the tracts and scats, principally during fall and winter. Little evidence of predation upon domestic animals was found. Information on hunting habits of lynx, obtained from tracking studies, is presented.

A large population of lynxes in western Newfoundland between 1953 and 1956 prompted the investigation of the status of the lynx. This report presents information on food habits, which was obtained between 1956 and 1961.

The paucity of terrestrial vertebrate prey species on the Island of Newfoundland is worthy of note. Amphibians and reptiles are not native to the Island. The green frog (*Rana clamitans*) has been successfully introduced and is locally abundant in the southeastern part of the Island.

The extant terrestrial mammalian fauna consists of the following: masked shrew (*Sorex cinereus*), little brown bat (*Myotis lucifugus*), brown bat (*Myotis keenii*), arctic hare (*Lepus arcticus*), snowshoe hare, beaver (*Castor canadensis*), meadow vole (*Microtus pennsylvanicus*), muskrat (*Ondatra zibethicus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), red fox (*Vulpes fulva*), black bear (*Ursus americanus*), marten (*Martes americana*), short-tailed weasel (*Mustela erminea*), mink (*Mustela vison*), otter (*Lutra canadensis*), lynx (*Lynx canadensis*), moose (*Alces alces*), woodland caribou (*Rangifer caribou*), and domestic dogs, cats, cattle, sheep, and goats. All are widely distributed and common, except the shrew, arctic hare, and the marten. The shrew

was introduced recently near the village of St. Georges. The marten is restricted to timbered areas, and the animal and its sign are seldom seen. The arctic hare is restricted to barren areas and mountain-tops not readily accessible to man. The arctic fox (*Alopex lagopus*) and the polar bear (*Thalarchos maritimus*) are occasional visitors.

I wish to acknowledge the cooperation of the Newfoundland Department of Mines and Resources where I was employed during the study period and where the staff of the Wildlife Division gave assistance in planning the study and in collection of materials. Drs. G. A. Swanson, W. J. Hamilton, Jr., and LaMont C. Cole of Cornell University gave helpful criticism and editorial assistance.

MATERIALS AND METHODS

Intestinal Tracts

Wildlife Division personnel collected 206 lynx digestive tracts during control and collection programs between March, 1956, and June, 1960. These were primarily from western and central parts of the Island, but four were from eastern Newfoundland.

The esophagus and rectum were tied off with string; the sample was tagged and preserved in 10 percent formalin. In most

cases the entire tract was placed in a wide-mouthed jar, but in a few cases it was necessary to put the stomach in a separate container.

Since most of the tracts were obtained from animals killed in traps, 166 stomachs contained only trap debris or a few hairs from the last meal. An entire tract was rarely devoid of evidence of food items. The volumes ranged from 10 to 1,180 ml. Sizable quantities of food were contained in 40 stomachs; of these, 17 with volumes more than 200 ml averaged 580 ml. The small intestine rarely contained identifiable food items and was of little value in the analysis. I recognize that occasionally additional information might have been gained by treating the stomach and lower intestine as separate units for analysis, but the biological assumption for doing so is that the contents of each represent different meals. Examination of the contents of the tracts, with the knowledge that a lynx would consume an entire snowshoe hare (except stomach, cecum, and occasionally feet or pelt) at a feeding, indicated that such an assumption would frequently be in error. Several tracts were examined in which the stomach and large intestine were partially full of snowshoe hare, probably the same one. Except for small birds and mice, most prey animals utilized were found also in both the stomach and large intestine. Although the three portions of each tract were examined separately, the tract was treated as one unit. Stomach contents were evaluated by separating food items and estimating the percentage of the total volume for each species eaten. Volumetric analysis of small and large intestine contents was not attempted. Food remains in all digestive tracts were evaluated by frequency of occurrence of species. Remains of several mice or birds were recognized, but the occurrence of the spe-

cies or group only was included in the analysis, as suggested by Greer (1955).

A reference collection of skeletal material and hair samples was accumulated from wild animals to facilitate the analysis. Representative hair specimens were mounted on permanent microscope slides. Photomicrographs of the hairs were made to aid in making composite comparisons. The variability of the hair structure, especially medulla, and diameter throughout its length required use of microscope slides to obtain accurate determinations.

Bones, claws, teeth, and hair of mammals were readily separated and identified from the tract contents. These parts showed few signs of having been digested. The comparable structures of birds were readily separated, but specific determination of species usually was not attained.

Scats

Scats were collected on trails, in forests, and at trap sites. The scats were placed in envelopes; the locality, description of the site, date of collection, approximate age of the scat (usually the season dropped), species that dropped it if positively known, and the collector's name were recorded on the envelope.

An accurate field method for distinguishing lynx scats from fox scats was not developed. Dodds (1955) reported that a differentiation was possible on the basis of size and smell. Most lynx scats are larger than fox scats, but the overlap is great enough to cause considerable confusion. I was unable to detect any difference by smell.

A total of 116 identified lynx scats were collected, and analyzed in the laboratory. Laboratory analysis of 304 unidentified scats revealed the presence of lynx guard hair or paw hair in 104. Only known lynx scats or ones with lynx hair in them were

Table 1. Occurrence of food items in 206 lynx digestive tracts, 116 lynx scats, and 104 presumed lynx scats, Newfoundland, March, 1956–August, 1960. Sample sizes appear in parentheses.

FOOD ITEMS	SPRING (139)		SUMMER (92)		FALL (43)		WINTER (152)		TOTAL (426)	
	Times Repre- sented	Percent of Sample	Times Repre- sented	Percent of Sample	Times Repre- sented	Percent of Sample	Times Repre- sented	Percent of Sample	Times Repre- sented	Percent of Sample
Mammals										
Snowshoe hares	100	72	60	65	24	56	129	85	313	73
Meadow mice	20	14	28	30	4	9	7	5	59	14
Muskrats	2	2	2	2	2	5	2	1	8	2
Beavers	3	2	2	2			1	tr	6	1
Lynxes*	111	80	88	96	15	35	77	51	291	68
Moose	25	18	3	3	18	42	19	13	65	15
Caribous	10	7	4	4			7	5	21	5
Cow					1	3			1	tr
Sheep	3	2			2	5	3	2	8	2
Birds	38	28	44	47	9	22	10	3	101	21
Insects	1	tr	3	3	1	3			5	tr
Grasslike plants	16	12	6	7	3	7	14	7	39	9

* Not considered as food.

used in this report. Most of these scats contained only one or two lynx hairs, but several scats collected in the spring molting season were made up largely of lynx hair.

Of the digestive tracts, 63 percent contained lynx hair, often in large amounts. This probably was the result of the lynx licking its trapped foot. Licking and preening the fur was often seen in the captive lynxes and resulted in hair being swallowed, as examination of the scats showed. It is possible that foxes might feed on a lynx carcass and pass lynx hair in their scats, but I believe the error resulting from misidentification of such scats is negligible.

Limited information on food preferences, availability of prey, and methods of hunting by lynxes was acquired by tracking lynxes on snow and by foot travel in the vicinity of study areas. Four Wildlife Division staff members, all excellent woodsmen, with detailed instructions on observing lynx signs and interpreting them, provided notes and maps of their observations while

tracking lynxes. I have included these with my own.

The months were grouped into seasons: summer (June, July, August, and September), fall (October and November), winter (December, January, February, and March), and spring (April and May). Frosts are uncommon from mid-June until mid-September, and most ground vegetation and trees are leafed out during this period. During the fall most leaves have fallen, and sporadic snow cover occurs. Snow cover is essentially continuous during winter, with the first heavy snows usually appearing the first week of December. The woods are free of snow and deciduous leaves during most of April and May.

The food data do not warrant a separation by ecological units or individual years. Local or yearly differences are mentioned when they occur.

RESULTS

Spring

The results of the analyses of intestinal tracts and scats were combined in Table 1, those of stomach analyses in Table 2. The

Table 2. Results of the analyses of the contents of 40 lynx stomachs, Newfoundland, March, 1956–June, 1960. All areas and years of collection are combined. Sample sizes appear in parentheses.

FOOD ITEMS	SPRING (5)	SUMMER (5)	FALL (9)	WINTER (21)
Mammals				
Snowshoe hares	60.0*	44.5	29.0	71.0
Meadow mice		20.0		9.0
Moose			71.0	5.0
Caribous				5.0
Sheep	2.5			tr
Birds				
Black ducks	20.0			
Green-winged teals	17.5			
Chickens				5.0
Unknown		20.7		
Fish				
Brook trouts		4.2		
Vegetation				
Trap debris		10.3		5.0

* Figures are percentages of total volume for season.

analyses for this season were based almost equally on scats and intestinal tracts.

Snowshoe hares were the most frequently taken prey. Meadow mice, moose, and caribous were next in order of mammal occurrence.

The mouse population was very large in 1956, declined during 1957 (Dodds 1960), remained small in 1958, increased during 1959, and reached high numbers again in 1960. Analysis of data by years reflected this; mice occurred in 13 percent of 94 units (scats or intestinal tracts) in 1956–57, in none of 18 units in 1958, and in 66 percent of 33 units in 1959–60.

Moose and caribous provided food for lynxes as carrion resulting from the fall hunting season and from poaching in late winter, and possibly as a result of predation. All moose and caribou remains in the material analyzed were from adult animals.

The next most frequently taken prey was birds. Only 12 of 34 bird remains were

identified to species. In order of numbers identified, these were fox sparrows (*Passerella iliaca*), ptarmigan (*Lagopus lagopus*), green-winged teal (*Anas carolinensis*), and black ducks (*Anas rubripes*). Most other bird remains appeared to be from small passerines.

Grass or grasslike plants were found in 12 percent of the units. None of this material showed signs of having been digested and frequently appeared to be dry grass. Captive animals ate green grass, which passed through the digestive tract with no apparent change. Leaves, twigs, and other detritus in digestive tracts and scats were picked up by the animals in traps or accidentally while eating and were not recorded as food.

Summer

In summer the information was gained predominantly from scats, as few intestinal tracts were collected. Mammals remained the most common food, with snowshoe hares occurring most frequently. The meadow mouse was found most often in years of greatest abundance. The feeding on beaver was determined from large quantities of hair and, in one case, phalangeal bones and claws in scats. Moose and caribous declined somewhat in importance in the summer. Mink was found in one instance.

The occurrences of bird remains increased sharply during late spring and continued numerous until late summer. Since most resident species are migratory, this would be expected. Microscopic feather fragments often provided the only clue to the presence of birds. Ptarmigan, flicker (*Colaptes auratus*), and fox sparrows were identified.

A small piece of cooked fish (*Salvelinus fontinalis*) was found in the stomach of an emaciated lynx killed at a garbage dump.

Fall

The data indicated a marked change in food habits. Snowshoe hares and birds declined in importance, moose increased sharply. The change was undoubtedly influenced to a great degree by the sampling, as few scats were collected, and the data largely represented digestive tracts of trapped and hunter-killed lynxes collected mostly where intensive moose hunting occurred. Fall data may represent the food habits quite accurately for localized areas but are not representative of remote areas not penetrated by hunters. The sheep, cow, and two of four chicken remains were found in two lynxes taken in barnyards and one taken from a garbage dump. In all cases these foods were available as carrion.

Winter

Winter data were compiled largely from digestive tracts taken in early and late winter and from known lynx scats collected throughout the winter. Snowshoe hares were the most available food. Moose were second in importance, a result of carrion from the fall hunting season. Mice were usually unavailable to lynxes during the winter because of deep snow. The domestic animal remains were found in digestive tracts from lynxes collected close to farms, where carrion was available. Caribou remains might have resulted from lynxes feeding on carrion or from direct predation.

HUNTING HABITS

Tracking lynxes on snow in 1960 and 1961 provided some insight into the animals' methods of hunting and their food requirements. Approximately 160 miles of lynx tracks were followed. These tracks were made by about 12 different lynxes, but most of the mileage was made by 2 adult males and 1 adult female with 2 kit-

tens. These five animals were trapped and identified after the tracking.

The adult female with two young-of-the-year were tracked 24 miles during January, February, March, and April of 1960. The kittens often flanked the adult 15–40 paces when hunting through wooded areas. Upon entering clearings they would rejoin the mother and frequently follow in her footprints. On other occasions the mother left the young bedded or playing while she was hunting, and once she was separated from them by nearly 1 mile. The young did not attempt to make their own kills until late in March. Kills made by the adult must have been shared with the young.

A pair of lynxes, either yearlings or a 2-year-old litter separated from the mother, were followed about 3 miles. They hunted abreast several yards apart in the wooded areas but followed one another in the open.

Of 43 lynx attempts to capture snowshoe hares, 18 were successful. One hare was caught, lost, and recaptured 35 yards away. Successful chases ranged from $\frac{1}{2}$ yard to 50 yards, unsuccessful ones from 10 to 150 yards. All the hares were moving when attacked by lynxes. In one case the lynx apparently heard the hare feeding and stalked to the immediate area before the final chase. A lynx usually would stop while hunting near recent hare activity and would make a rest or hunting bed. One kill was made when a hare ran within a yard of a bedded lynx. Of the kills, 11 were made from these hunting beds and 7 resulted from capture of flushed animals.

One of the males took two hares from snares in 3 days but made no other kills. Lynxes frequently take snowshoe hares from snares, preferring live animals to dead. Rabbit catchers often reported 5–10 percent losses.

One lynx attempted to dig a mouse out

of the snow, and another fed on a dead moose. One male visited but did not feed on a caribou carcass which had already been mostly consumed.

A lynx was observed stalking a group of female caribous with young in June, 1957, but it did not attack. An attack by two lynxes on three or four caribous lying next to a wooded area was shown by tracks in winter. One lynx managed to spring onto a caribou; but, after a struggle, the caribou escaped, and the lynx left the area. The caribou was found 1 mile away bleeding profusely from wounds on the neck and shoulder, but it was able to walk away from the observer.

Two calf caribous (one 2 weeks old, the other 5 months old) were found dead of wounds probably caused by a lynx, as the spacing of the toothmarks approximated measurements of lynx canines. Part of the head and neck of the younger one had been eaten. The other apparently had escaped the immediate attack but died later of the wounds received and had not been fed upon. A lynx trapper reported finding a caribou which, judging from the tracks, had been killed and fed upon by a lynx.

Tracks of ptarmigan, gray jays (*Perisoreus canadensis*), chickadees (*Parus atricapillus* and *Parus hudsonicus*), and woodpeckers (*Dendrocopos* sp.) were frequently seen, but lynxes showed no interest in them. When lynx tracks crossed fresh ptarmigan tracks on two occasions, the lynxes did not deviate from the course they were following.

The small sample of kill records obtained while tracking single lynxes for 2 or more days indicated that lynxes make a kill about every other day. In three instances the tracks suggested that the lynxes continued hunting after the kills were eaten. Interpretation was difficult, because the kill was consumed at a site which could

also have served as a bed. Scats were dropped at the rate of two to four between kills.

Many lynxes were seen along a road east of Red Indian Lake during the 1957 and 1958 fall hunting seasons. The moose kill approximated 100 animals along 40 miles of road, and most kills were within 1 mile of the road. The lynxes apparently dispersed after carrion became unavailable under deep snow, because few signs were seen along the road during the winter seasons. This suggested a concentration of lynxes in an area with abundant carrion food.

DISCUSSION

On the mainland, the lynx has been reported to eat most of the smaller mammals available within its range. In addition, Seton (1925) pointed out its ability to kill caribous, deer, and perhaps moose. Bailey (1936) mentions an instance of lynxes killing mountain sheep in Alaska. Murie (1957) reports the lynx as feeding largely on ground squirrels and ptarmigan, and Seton (1925) numbers Canadian grouse or spruce partridges as common foods. Seton also reports that foxes are commonly killed. These writers all mention snowshoe hares as the principal food.

The data presented here confirm these earlier reports for the prey species resident in Newfoundland, but an obvious exception is the lack of predation on foxes. Fox tracks were rarely seen in areas frequented by lynxes. Foxes showed a definite tendency to stay in open areas and near edges of burns and bogs, while lynxes preferred timbered areas.

The analyses revealed little evidence of predation upon livestock and poultry, although many instances have been reported in Newfoundland. Small flocks of sheep are pastured untended in wooded areas

within lynx habitat. In several cases of poultry predation by lynxes, the birds were not kept in fenced enclosures.

The food consumption of two captive lynxes was determined for a 7-month period. The lynxes, a male weighing 22 pounds and a female weighing 18 pounds, were confined in separate 10-foot-square enclosures. Each animal consumed monthly an average of 41 pounds of a mixture of fresh meat and commercial mink meal of high protein content. Both animals were in good condition but not excessively fat.

Dodds (1960) determined the average weight of snowshoe hares to be 54 ounces. Examination of kill sites revealed that lynxes did not eat the stomach or cecum of hares, and occasionally one or two paws and a part of the pelt were not eaten. Allowing 8 ounces for the unconsumed part, the hare provides a 46-ounce (2.8 pounds) meal for the lynx. Therefore, 14 hares would approximate the 41-pound average monthly consumption by the captives.

This is approximately the rate of kill suggested by the tracking studies. In 1 year a lynx might consume about 170 adult hares, plus a few birds and mice. This amount might be increased to 200 to allow for young hares eaten during the summer.

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MOVEMENTS AND ACTIVITIES OF THE LYNX IN NEWFOUNDLAND

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Abstract: An investigation of the lynx (*Lynx canadensis*) was conducted on the Island of Newfoundland between 1956 and 1961. Information on movements, home range, and activities was obtained from tagging studies and from tracking in snow. Fifty lynxes were tagged; 31 were recaptured a total of 52 times. Movements of tagged animals averaged 2 miles and ranged from 0 to 64 miles. Tracking studies revealed a cruising radius of 2.6 miles. Three home ranges determined from tracking studies were 6, 7, and 8 square miles in area. The shape of the home ranges apparently was influenced by topography.

The movements and activities of the lynx were investigated during 1956-61, as part of a study of the status of the animal on the Island of Newfoundland. The

area in which the work was conducted is located in the Humber River watershed of western Newfoundland (Fig. 1). This area is forested but has numerous large open