Food Habits of Ermine, *Mustela erminea*, in a Forested Landscape

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Most research pertaining to the diet of North American weasels has been conducted in agricultural areas and may not be representative of diets in forested regions. Ermine carcasses (N = 155) collected from trappers during a two-week harvest (16-30 November 1996) in forested New Brunswick were analyzed for food habits. The contents of 81 stomachs and 98 gastrointestinal tracts (N = 179) were considered as separate eating events and used in the calculation of the percent frequency of occurrence. Results suggest that soricids (28.0%), arvicolines (24.6%), and cricetines (17.3%) comprised two-thirds of their autumn diet. At a species or genus level, the Deer Mouse (*Peromyscus maniculatus*) (17.3%) and shrews (*Sorex* spp.) (28.0%) were shown to have the highest percent occurrence. Squirrels, including the Red Squirrel (*Tamiasciurus hudsonicus*) and the Eastern Chipmunk (*Tamius striatus*), comprised 11.2% of the Ermine's diet; a value higher than has previously been reported.

Key Words: Ermine, *Mustela erminea*, Long-Tailed Weasel, *Mustela frenata*, food habits, diet analysis, forest landscape.

Though a common predator in most forested landscapes, we were able to locate few studies on weasel (*Mustela* spp.) food habits in forested landscapes but numerous studies in agricultural landscapes (i.e., review in King 1990). Weasel species such as the Ermine (*Mustela erminea*) are found in fields and forests throughout the Holarctic but there are risks associated with extrapolating food habits from agricultural landscapes to forested landscapes when the availability of prey species and size differs markedly between landscapes.

Most of the literature pertaining to the Ermine indicates many species, but in particular voles, are the Ermine's principal prey (Erlinge 1983; King 1990; Hanski et al. 1991). Arvicolines (e.g., voles, lemmings) dominate consumed prey species to the extent that Ermine are considered specialist predators of voles (Simms 1979; Nams 1980; King 1990). However, this conclusion is based on studies conducted in primarily agricultural (Erlinge 1975, 1981, 1983; Raymond et al. 1984; King 1990; Oksanen and Schneider 1995), Low Arctic (Maher 1967; McLean et al. 1974), and Arctic landscapes (Simms 1978).

For studies conducted in forest-dominated landscapes prey representation is similar to studies conducted in agriculturally dominated landscapes; however, prey consumption can vary. In field-dominated landscapes, Ermine selected voles over other prey types (Simms 1979; Raymond et al. 1984; Derting 1989). This may not be true in forested landscapes where the availability of larger prey species (i.e., sciurids) and the ability to capture prey differs because of vertical structures and debris that offer different escape strategies of small mammals. In a series of trials conducted in enclosures, Derting (1989) reported that Least Weasels (*Mustela nivalis*) demonstrated an opportunistic foraging behaviour and attacked all prey offered. However, differences in escape tactics resulted in voles (*Microtus* spp.) being captured more frequently. In the presence of a weasel, voles responded by running and were quickly caught and killed, whereas Field Mice (*Apodemus sylvaticus*) made rapid and erratic escape movements and evaded capture by climbing upward and freezing (Erlinge 1975; Derting 1989; King 1990).

In forest habitats, Ermine are able to hunt in the space created by ericaceous shrubs and woody debris (Simms 1979; Edwards et al. 2001). Simms (1979) suggested that in areas where resource partitioning exists between sympatric predators, as in the boreal forest, Deer Mice might be the Ermine's most frequent prey choice. Higher availability, and habitat characterized by the presence of mosses and ericaceous shrubs carpeting the forest floor might make the Deer Mouse easier to catch. Instead of freezing and/or climbing (Erlinge 1975; Derting 1989; King 1990), Deer Mice in these regions may alter escape tactics and escape into the spaces created by mosses and shrubs, where weasels can follow with success (Simms 1979).

Our objective was to document the food habits of a common and widespread weasel species in a forest-dominated landscape to gain a better understanding of the impact weasels have on small mammal populations in forested landscapes. To do this we compared our results with other forest-based studies on weasel food habits.

Methods

Trappers submitted a total of 165 weasels during the 1996 province-wide New Brunswick harvest (16-

30 November). New Brunswick is >85% forested (Natural Resources Canada 2000) and weasels are trapped in forests along the same trap lines used by trappers for Marten (*Martes americana*) trapping (C. Libby, personal communication). Skull (N=142) and body (weight, length of body, tail, hind foot) measurements were made to separate Ermine from Long-Tailed Weasel (*M. frenata*), an uncommon species in New Brunswick (Dilworth 1984).

The stomach of an Ermine has a maximum capacity of 10 to 20 g and it is unlikely that they can consume more than the equivalent of one small rodent at one time (King 1990). Gilligham (1984) reported that the Least Weasel cannot eat more than a few grams at one time and no more than one meal within a few hours. Therefore, a single stomach or intestine will generally contain only one item (Aldous and Manweiler 1942; Heidt 1972; Simms 1978; McDonald et al. 2000). The contents of the stomach and gastro-intestinal (GI) tract constitute one meal each, consumed at separate time intervals. This allowed for two samples to be collected from each individual.

The contents of each stomach and GI tract were removed, rinsed separately in a plastic container, and then washed through a 35-grade sieve. The remaining stomach or GI tract contents were viewed through a dissecting microscope and identifiable items removed. Flesh was not identified and vegetable matter was assumed to be incidental (Erlinge 1975; Simms 1978). Hairs were imprinted on a slide treated with hair spray and identified using a compound microscope. A reference collection of study skins and various keys (Day 1966; Adorjan and Kolenosky 1969; Thompson et al. 1987) facilitated identification of prey remains. All mammalian prey was identified to species, except *Microtus* spp. and *Sorex* spp., which are difficult to identify beyond the genus level (Thompson et al. 1987). Attempts were not made to identify microscopic invertebrate remains and woody debris since such materials were considered incidental (King 1990; McDonald et al. 2000). The frequency of occurrence for each food item in the diet was determined by counting the number of times each item occurred in the total sample of stomachs and GI tracts. The percent frequency of occurrence was presented as the total percentage of prey items in the sample. This method was appropriate for reporting the diet of Ermine because it identified the smallest number of consumed prey items (McDonald et al. 2000). Empty stomachs and GI tracts were not included in the analysis.

Availability of prey was not known since the sample originated from throughout the province of New Brunswick. The most abundant shrew species available are the Short-Tailed (*Blarina brevicauda*), and the Masked Shrew (*Sorex cinereus*) (Dilworth 1984; G. Forbes, unpublished data). The common vole species in forest landscapes is the Red-Backed Vole (*Clethrionomys gapperi*) while the Yellow-Nosed (*Microtus chrotorrhinus*) and the Meadow Vole (*M. pennsylvanicus*) are relatively rare (Bowman 2001). The Deer Mouse (*Peromyscus maniculatus*) is common. The Red Squirrel (*Tamiasciurus hudsonicus*) and the Snowshoe Hare (*Lepus americana*) are common throughout the province.

Results

A collection of 165 weasel carcasses resulted in 155 (93.9%) Ermine and 10 (6.1%) Long-Tailed Weasels. Only Ermine were included in the analysis. The sex ratio was 141 (91.0%) males to 14 (9.0%) females. Seventy-four stomachs (47.7%) and 57 GI tracts (36.8%) were found to be empty and excluded from the analysis. The resulting sample included 81 stomachs and 98 GI tracts (N= 179). Species were grouped into eight categories based on taxonomic association: voles and lemmings (Microtinae), mice (Cricetidae), shrews (Soricidae), squirrels (Sciuridae), weasels (Mustelidae), feathers, other fauna, and unknown (Table 1). The category "other fauna" included prey items where the frequency of occurrence was ≤ 2.

The most commonly consumed were the Deer Mouse and *Sorex* species (likely *Sorex cinereus* because of its abundant status), and smaller amounts of several species of arvicolines (Table 1). In terms of taxonomic groupings, weasels preyed on roughly equal amounts of each group. Arvicolines comprised 24.6% of total prey while Cricetines (Deer Mice) comprised 17.3%. Shrews comprised 28.0% of the prey items. Two sciurids, Eastern Red Squirrel at 8.4% and Eastern Chipmunk (*Tamia striatus*) at 2.8% comprised 11.2% of total items. Feathers made up 5.0% of the total prey items.

Discussion

It is difficult to compare studies on weasel diet because prey proportions are dependent on the gender of the weasel, regional characteristics and prey availability (Aldous and Manweiler 1942; Simms 1978; Whitaker and French 1984). We compare only North American-based studies because Ermine body size varies greatly between continents (Banfield 1974; King 1990). Studies in either agricultural and forest landscapes, however, have comparable prey representation; deer mice (*Peromyscus* spp.) are found in forest woodlots, old fields and edges of agricultural-dominated landscapes (Banfield 1974; Dilworth 1984). Voles (*Microtus* or *Clethrionomys* spp.) are present in a range of forest and field habitat. We note that our sample was collected in late fall when Woodland Jumping Mice (*Napaeozapus insignis*) are inactive due to hibernation.

Although studies conducted in primarily agricultural areas have indicated voles are the weasel's principal prey (Erlinge 1975), our results indicated that mice and shrews are preyed on more heavily in forests. These results are similar to what Simms (1979) found in the forests of Algonquin Park. If we focus on a

TABLE 1. Diet of 155 Short-tailed Weasels trapped during the fall season (16-30 November, 1996) in New Brunswick, expressed as frequency of occurrence (N=179), and percent of occurrence.

Prey type	Frequency of Occurrence	Percent of Occurrence
Voles and Lemmings		
Clethrionomys gapperi	15	8.4
Microtus spp.	17	9.5
Synaptomys cooperi	12	6.7
Mice		
Peromyscus maniculatus	31	17.3
Shrews		
Blarina brevicauda	8	4.5
Sorex spp.	42	23.5
Squirrels		
Tamiasciurus hudsonicus	15	8.4
Tamius striatus	5	2.8
Weasels		
Mustela sp.	11	6.1
Feathers	9	5.0
Other fauna	5	2.8
Unknown	9	5.0
Total	179	100.0

single species, Deer Mice appear to be the most preyed upon species, suggesting in our study that weasels are not simply specialists of voles. We suggest that Ermine feeding habits should be defined by the relative abundance and availability of prey with different escape tactics (Aldous and Manweiler 1942; Erlinge 1975; Raymond et al. 1984; Derting 1989). Voles generally run from weasels and Deer Mice remain still after climbing. Shrews are more aggressive and require more energy to subdue (Vaudry et al. 1990). Based on a grouping of these types of behaviour, Ermine in forest landscapes appear to feed almost equally among these behaviours. This suggests a semi-generalist opportunistic feeding strategy by Ermine.

The carcasses used in this study were dominated by males. This is a common bias in trapping because body size, trap geometry and gender specific behaviour make males more susceptible to trapping (Buskirk and Lindstedt 1989). Squirrel remains were recorded in higher proportions than have previously been reported for Ermine (Aldous and Manweiler 1942; Simms 1979). The high ratio of males to females in our sample and the more opportunistic foraging behaviour of larger male weasels (Raymond et al. 1984; Derting 1989; Murphy et al. 1998) may explain the higher abundance of squirrels. Larger subspecies of *M. erminea* feed on larger prey but the subspecies in New Brunswick is comparatively small (King 1990). Evidence of feeding on Snowshoe Hare, an even larger potential prey, was not found in our study. Larger male weasels would be able to exploit larger, more aggressive prey items, like squirrels and Snowshoe Hare, which would require a higher risk of injury and higher energy expenditure (Erlinge 1975; Raymond et al. 1984; Vaudry et al. 1990). McDonald et al. (2000) found that female Stoats preyed primarily on small mammals, and male Stoats ate higher numbers of large prey items. Thompson and Colgan (1990) suggested that smaller prey requiring minimal energy costs may be taken incidentally by Marten, a larger mustelid species, while searching for larger prey items. The average biomass of a shrew is approximately half of a cricetine and quarter that of an arvicoline. Although larger prey items occur less frequently in the diet of small carnivores like the weasel, they might be more important in terms of caloric intake (Cumberland et al. 2001). The average biomass of a squirrel is approximately seven times greater than a cricetine and four times greater than an arvicoline (Dilworth 1984).

These results support research that, at a species level, shows Deer Mice and shrews (*S. cinereus*) occur more frequently than voles in the diets of weasels from forested landscapes than from agricultural and agro-forested regions. As a group voles are consumed in near-equal amounts as shrews and mice. Combined, these results do not support the notion that Ermine are vole-feeding specialists. Rather, Ermine seem to be able to prey on a range of species, implying a semi-generalist and opportunistic feeding strategy. The availability in forests of prey items of larger biomass such as squirrels could give an advantage over grassland systems where the ability to predate larger prey like the Woodchuck (*Marmota monax*), the largest and most aggressive ground-squirrel species and the only one found in New Brunswick (Dilworth 1984), is minimal. Alternatively, more food per effort obtained from squirrels may offset the energy required to pursue prey in the maze of debris found on the forest

floor. Further research on the energetic costs of pursuing a range of prey body-sizes and escape tactics in a structurally complex environment is required.

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Literature Cited

Adorjan, A. S., and **G. B. Kolenosky**. 1969. A manual for the identification of hairs of selected Ontario mammals. Department of Lands and Forests. Ontario Research Report 90. Ottawa, Ontario, Canada.

Aldous, S. E., and **J. Manweiler**. 1942. The winter food habits of the short-tailed weasel in northern Minnesota. Journal of Mammalogy 23: 250-255.

Banfield, A. W. F.. 1974. The mammals of Canada. University of Toronto Press, Toronto, Ontario, Canada. 438 pages.

Buskirk, S. W., and **S. L. Lindstedt.** 1989. Sex biases in trapped samples of mustelidae. Journal of Mammalogy 70: 88-97.

Bowman, J., G. Forbes, and **T. Dilworth**. 2001. Landscape context and small-mammal abundance in a managed forest. Forest Ecology and Management 140: 249-255

Cumberland, R., J. Dempsey, and G. Forbes. 2001. Should food habits be based on biomass? Importance of large prey to the American marten. Wildlife Society Bulletin 29: 1125-1130.

Day, M. G. 1966. Identification of hair and feather remains in the gut and faeces of stoats and weasels. Journal of Zoology 148: 201-217.

Derting, T. L. 1989. Prey selection and foraging characteristics of least weasels (*Mustela nivalis*) in the laboratory. American Midland Naturalist 122: 394-400.

Dilworth, T. G. 1984. Land Mammals of New Brunswick. T. G. Dilworth, Fredericton, New Brunswick, Canada.

Edwards, M. A., G. J. Forbes, and **J. Bowman**. 2001. Fractal dimension of ermine, *Mustela erminea* (Carnivora: Mustelidae), movement patterns as an indicator of resource use. Mammalia 65: 220-225.

Erlinge, S. 1975. Feeding habits of the weasel *Mustela nivalis* in relation to prey abundance. Oikos 26: 378-384.

Erlinge, S. 1981. Food preference, optimal diet and reproduction output in stoats *Mustela erminea* in Sweden. Oikos 36: 303-315.

Erlinge, S. 1983. Demography and dynamics of a stoat *Mustela erminea* population in a diverse community of vertebrates. Journal of Animal Ecology 52: 705-726.

Gamberg, M., and **J. L. Atkinson**. 1988. Prey hair and bone recovery in ermine scats. Journal of Wildlife Management 52: 657-660.

Gilligham, B. J. 1984. Meal size and feeding rate in the least weasel (*Mustela nivalis*). Journal of Mammalogy 65: 517-519.

Hanski, I., **L. Hansson,** and **H. Henttonen**. 1991. Specialist predators, generalist predators, and the microtine rodent cycle. Journal of Animal Ecology 60: 353-367.

Heidt, G. A. 1972. Anotomical and behavioural aspects of killing and feeding by the least weasel *Mustela nivalis* L. Arkansas Academy of Science Proceedings 26: 53-54.

King, C. 1990. The natural history of weasels and stoats. Cornell University Press, Ithaca, New York, USA. 253 pages.

Maher, W. J. 1967. Predation by weasels on a winter population of lemmings, Banks Island, Northwest Territories. Canadian Field-Naturalist 81: 248-250.

McDonald, R. A., **C. Webbon**, and **S. Harris**. 2000. The diet of stoats (*Mustela erminea*) and weasels (*Mustela nivalis*) in Great Britain. Journal of Zoology (London) 252: 363-371.

McLean, S. F., Jr., B. M. Fitzgerald, and **F. A. Pitelka**. 1974. Population cycles in Arctic lemmings: winter reproduction and predation by weasels. Arctic and Alpine Research 6: 1-12.

Murphy, E. C., B. K. Clapperton, P. M. F. Bradfield, and **H. J. Speed**.1998. Effects of rat-poisoning operations on abundance and diet of mustelids in New Zealand podocarp forests. New Zealand Journal of Zoology 25: 315-328.

Nams, V. 1980. Prey selection mechanisms of the ermine (*Mustela erminea)*. Pages 861–882 *in* Worldwide Furbearer Conference Proceedings. *Edited by* J. A Chapman and D. Pursley. Frostburg Worldwide Furbearer Conference Inc., Maryland, USA.

Natural Resources Canada. 2000. State of Canada's Forests 1999-2000. Natural Resources Canada, Ottawa, Ontario, Canada. 121 pages.

Oksanen, T., and **M. Schneider**. 1995. The influence of habitat heterogeneity on predator-prey dynamics. Pages 122–150 *in* Landscape Approaches in Mammalian Ecology and Conservation. *Edited by* W. Z. Lidicker. University of Minnesota Press, Minnesota, USA.

Raymond, M. J. , M. Bergeron and **Y. Plates**. 1984. Dimorphisme sexuel et regime alimentaire de l'hermine dans un agrosysteme du Québec. Canadian Journal of Zoology 62: 594-600.

Simms, D. A. 1978. Spring and summer food habits of an ermine (*Mustela erminea*) in the central Arctic. Canadian Field-Naturalist 92: 192-193.

Simms, D. A. 1979. North American weasels: resource utilization and distribution. Canadian Journal of Zoology 57: 504-520.

Thompson, I. D., and **P. W. Colgan**. 1990. Prey choice by marten during a decline in prey abundance. Oecologia 83: 443-451.

Thompson, I. D., **M. Porter**, and **S. L. Walker**. 1987. A key to the identification of some small boreal mammals of central Canada from guard hairs. Canadian Field-Naturalist 101: 614-616.

Vaudry, R., M. Raymond, and **J. F. Robitaille**. 1990. The capture of voles and shrews by male and female ermine *Mustela erminea* in captivity. Holarctic Ecology 13: 265-268.

Whitaker, J. O., Jr., and **T. W. French**. 1984. Foods of six species of sympatric shrews from New Brunswick. Canadian Journal of Zoology 62: 622-626.

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