

## Food of the Bank Vole in Northern Finnish Spruce Forests

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Viro P. & Sulkava S., 1985: Food of the bank vole in northern Finnish spruce forests. *Acta theriol.*, 30, 15: 259—266 [With 2 Tables & 1 Figs.]

The diet of the bank vole, *Clethrionomys glareolus* (Schreber, 1780) in spruce forests in northern and central Finland is found to consist typically of small amounts of seeds (0.5—2.0% of the stomach contents at different seasons), berries (0.1—4.6%) and animal material (0.2—2.3%) and a high percentage of beard lichens, *Alectoria* spp. and *Bryoria* spp., at all seasons (27.9—53.7%). The tree lichens replace the seeds of deciduous trees consumed in many forests further south. The large amounts of epiphytic beard lichens in the diet at times of increasing population are evidence of the importance of this food item in northern coniferous forests.

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### 1. INTRODUCTION

The results of studies on the food biology of the bank vole, *Clethrionomys glareolus* (Schreber 1780), in many European deciduous forests (Miller, 1954; Drożdż, 1966; Holišová, 1966, 1971, 1972; Watts, 1968; Hansson, 1971, 1979; Novikov, 1970; Zemanek, 1972; Obrtel & Holišová, 1974, 1978; Andrzejewski, 1975; Gębczyńska, 1976; Flowerdew & Gardner, 1978; Smal & Fairley, 1980a, 1980b) suggest that some of their food has to consist of high-energy items, e.g. large seeds from deciduous trees or animal material. Within the coniferous zone of northern Europe, however, where such large seeds are lacking, the diet of the bank vole has been studied largely in the Soviet Union (Koshkina, 1957; Ivanter, 1975) and Sweden (Hansson, 1969, 1979; Hansson & Larsson, 1978), only a few observations or results of feeding experiments being available from Finland (Kaikusalo, 1972; Nyholm, 1978; Pulliainen, 1978; Sulkava, 1978; Pulliainen & Keränen, 1979; Henttonen *et al.*, 1983). The main object of this work was therefore to analyse the diet of bank voles in spruce forests in the province of Oulu at different seasons and during different phases of population fluctuation.

### 2. MATERIAL AND METHOD

The bank voles studied here were captured in 1967—1981 in four localities in northern and central Finland: Kuusamo, Taivalkoski, Hyrynsalmi and Kempele

(Fig. 1). The distribution of the material by season and trapping site is indicated in Tables 1 and 2.

The onset of winter (mean daily temperatures below 0°C) occurs in October at all these sites and the snow cover remains in the forests for 6—7 months, the maximum depth, 60×80 cm, being reached in March (Atlas of Finland, 1960), Kuusamo and Taivalkoski lie in the northern boreal climatic zone, where the spruce forests are of the *Hylocomium-Myrtilus* type, and Hyrynsalmi and Kempele in the middle boreal zone, where the corresponding spruce forests are of the *Vaccinium-Myrtilus* type (Ahti *et al.*, 1958; Havas & Kubin, 1983).

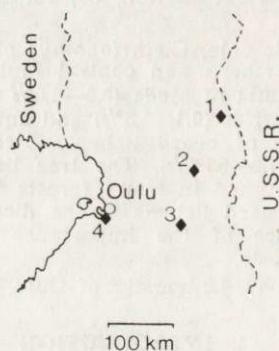


Fig. 1. The trapping sites. 1 — Kuusamo, 2 — Taivalkoski, 3 — Hyrynsalmi, 4 — Kempele.

The biotopes concerned are old coniferous forests dominated by spruce. The main dwarf shrubs are *Vaccinium myrtilus* and *Vaccinium vitis-idaea*, the amounts of berries available remaining fairly consistent from year to year. Only a few forb and grass species are found, e.g. *Solidago virgaurea* and *Deschampsia* spp. The uninterrupted moss layer consists mainly of *Pleurozium*, *Hylocomium* and *Dicranum* species. The branches and trunks of the trees carry large amounts of epiphytic lichens (*Parmelia*, *Alectoria*, *Bryoria*).

The total content of the stomach of each vole was mixed and washed in a sieve (mesh 0.15 mm). After staining with methylene blue, 2—4 slides were made from each stomach. Five ocular fields were examined on each slide, estimating the area occupied by each food item (as a percentage of all food particles). The area occupied gives an accurate enough result, although the thin food particles are slightly overestimated relative to the thick ones (Gębczyńska & Myrcha, 1966; Hansson, 1970). The mean calculated from the five ocular fields gives the composition of the food in the stomach. Ten types of food item were recognized: animal material, seeds, berries, beard lichens, other lichens, fungi, mosses, vegetative parts of grasses and sedges, vegetative parts of forbs and unidentified particles.

The phases of the bank vole population in Kuusamo and Taivalkoski in 1977—78 are shown by the catches at Oulanka in 1976—79 per 100 trap-nights: these were 0.2 (2), 2.9 (15), 6.9 (24) and 1.4 (10) respectively (the numbers of bank vole caught are indicated in parentheses). The catches were performed in June in 1976—77 and in August in 1978—79. The phases at Kempele, Tupos Hyrynsalmi and Paljakka in 1967—67 are shown by Viro (1974).

## 3. RESULTS

Seasonal variation. In spite of the clear differences in ambient conditions between the seasons, the seasonal variation in the diet is rather small (Table 1). The amount of animal material is very small (0.2—2.3%) and there are no differences between the seasons. Similarly only small amounts of seeds and mosses were found. There is also only a rather small quantity of berries even in the autumn and winter diet (0.1—5.3%) and none in the spring and summer. There are significantly more berries in the diet in early winter than at any other season ( $t=2.48$ ,  $p<0.025$ ).

Table 1

Seasonal variations in the diet of the bank voles. Numbers are percentages of total stomach contents.

Food items	Spring IV—V	Summer VI—VIII	Autumn IX—X	Early winter XI—XII	Late winter I—III
Animal material	1.4	2.1	2.3	0.2	0.5
Seeds	5.2	4.8	0.5	0.9	2.2
Berries	0.0	5.3	0.8	4.6	0.1
Beard lichens	47.2	41.6	27.9	53.7	37.0
Other lichens	2.3	0.3	5.1	2.4	16.2
Fungi	0.0	10.4	8.3	0.7	4.3
Mosses	1.8	3.5	2.7	1.2	3.0
Vegetative parts of grasses and sedges	2.5	1.1	6.8	15.1	8.3
Vegetative parts of forbs	36.6	28.8	39.6	19.6	18.5
Unidentified	2.6	2.2	5.9	1.9	9.8
Number of stomachs	22	39	30	29	11

Beard lichens make up a considerable part of the diet (27.9—53.7%). The proportion is smaller in autumn, but is still about 1/3, and is significantly greater by early winter ( $t=3.13$ ,  $p<0.005$ ). There are often great differences between individuals.

The proportion of other lichens is very much smaller (0.3—16.2%), and there are significantly more of them in late winter than during the other seasons ( $t=2.50$ ,  $p<0.05$ ). It therefore seems that lichen species other than *Bryoria* or *Alectoria* serve as emergency food of some kind. It is natural that the quantities of fungi should be greatest in autumn, and there are none in spring and summer.

If the beard lichens, other lichens and fungi are taken together, this group shows no seasonal variation in occurrence. The vegetative parts of grasses and sedges (*Carex*) are only found in small amounts (2.0—15.1%), there being significantly more of these items in winter than

during the other seasons ( $t=2.71$ ,  $p<0.01$ ). The vegetative parts of forbs make up an important item (18.5—45.6%) alongside the beard lichens, with the reverse pattern from that of the grasses and sedges. The difference between the winter and the other seasons is highly significant ( $t=3.426$ ,  $p<0.001$ ).

Variation in autumn and winter diet between the trapping sites. It is obvious that there is plenty of food available in spruce forests during spring and summer, but winter may be a critical period for the voles. Thus a comparison was made of the autumn and winter material at the different trapping sites (Table 2). There are no significant differences in the following food items: animal material, seeds, berries, lichens other than *Bryoria* and *Alectoria*, fungi, mosses and forbs. Only in the amounts of beard lichens, grasses and sedges do we find significant differences between the trapping sites, the proportion of beard lichens being lowest in Kempele and greatest in Kuusamo ( $t=2.476$ ,  $p<0.025$ ).

Table 2

Autumn and winter diet (IX—III) of the bank voles at the various trapping sites. Numbers are percentages of total stomach contents.

Food items	Kuusamo	Taivalkoski	Hyrnsalmi	Kempele
Animal material	0.0	0.4	0.2	5.4
Seeds	2.3	0.2	0.4	0.1
Berries	4.8	1.3	2.6	0.0
Beard lichens	52.9	36.4	42.3	26.1
Other lichens	6.7	8.3	3.1	4.8
Fungi	0.0	5.6	2.0	12.9
Mosses	0.7	3.2	1.1	4.4
Vegetative parts of grasses and sedges	0.4	3.0	19.7	15.4
Vegetative parts of forbs	29.4	35.7	22.8	23.0
Unidentified	1.9	5.7	4.2	7.9
Number of stomachs	15	18	24	13

This result is to be expected, since there is more beard lichen available in the old spruce forests in Kuusamo and Taivalkoski than in the younger forests in Kempele. Grasses and sedges show significantly smaller percentages in Kuusamo and Taivalkoski than in Hyrnsalmi and Kempele (Table 2,  $t=2.23$ — $4.20$ ,  $p<0.05$ — $0.001$ ).

A clear difference exists between the amounts of lichens in the stomachs of the bank voles during autumn and winter at the increasing stage in population fluctuation (58.7%) and at the population peak (42.8%). The difference is significant for the beard lichens (54.4% and 36.0%,  $t=2.30$ ,  $p<0.025$ , numbers of stomachs examined 31 and 38). A similar difference also seems to exist in summer (in August 1980 and 1981 50.9% and 36.6%,  $n=10$  and 10).

No significant differences in diet were found between the sexes. The proportion of the beard lichens in the total material, for example, was almost the same in both sexes: males 41.9% and females 41.2% (40+40 ind.).

#### 4. DISCUSSION

Beard lichens make up the most important part of the diet of the bank vole in northern spruce forests at most seasons. At the sites studied here they account for a mean of 41.5% (28—54% at different seasons). Even larger percentages (mean 48.3%, in spring-autumn 61.8—23.5%) have been found by Koshkina (1958) in Soviet Lapland (Kola peninsula), but much smaller ones (mean 2.5% lichens and mosses) by the latitude of southern Soviet Karelia (Ivanter, 1975). In more southerly, mostly deciduous forests the lichens are very rare food items (Drożdż, 1966; Holišová, 1966, 1971; Watts, 1968; Gębczyńska, 1976; Smal & Fairley, 1980a). The percentages of the vegetative parts of grasses, sedges and forbs are practically the same in these biotopes as in the spruce forests, but the amounts of seeds, berries, animal food and fungi are clearly greater.

The quantities of beard lichens available in spruce forests has not been measured. Concerning the voles' preference for beard lichens over other plants, it is significant that they will eat them in summer as much as in winter (Table 1). This indicates very high palatability since they are able to compete with the new shoots of many green plants. The large percentages of beard lichens found in the bank vole's diet in Finland at times of increasing populations are also evidence of their importance, as is the bank vole's habit of making and storing balls of beard lichen. Several such stores have been found in thrushes' nests, in holes in trees and under tree trunks (Nyholm, 1978; Sulkava, 1978; Pulliainen & Keränen, 1979). Tracks in the snow often suggest that bank voles have been moving beard lichen from trees to their holes and eating it from fallen branches. Beard lichens are obviously a preferred food item for the bank vole (not only a secondary food used at times of high population density because of competition, for example).

Beard lichens are obviously a good source of energy for the bank vole. They contain easily digestible carbohydrates and their crude protein content (6—7%) is double that found in ground lichens (Pulliainen & Keränen, 1979). They obviously serve to replace the energy gained from the seeds of deciduous trees by bank voles in more southerly forests. Their mineral, protein and sugar content is nevertheless relatively low

(Pulliainen & Keränen, 1979), and the source of these will require further study.

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## POKARM NORNICY RUDEJ W LASACH IGLASTYCH PÓLNOECNEJ FINLANDII

## Streszczenie

Nornice rude, *Clethrionomys glareolus* (Schreber, 1780) pochodziły z czterech, dość od siebie odległych, punktów centralnej i północnej Finlandii: Kuusamo, Taivalkoski, Hyrynsalmi i Kempele (Ryc. 1). Zwierzęta łowiono w różnych sezonach wegetacyjnych, w latach 1967—1981 (Tabela 1, 2). Przy użyciu standardowych metod analizy autorzy porównali skład pokarmu w sezonach oraz określili jego zmienność w diecie jesiennej i zimowej (Tabela 1, 2). Dieta nornic składała się z niewielkich ilości nasion (0,5—2,0% masy pokarmowej w różnych sezonach), jagód (0,1—4,6%) i fragmentów zwierzęcych (0,2—2,3%) oraz z dużych ilości porostów krzaczastych, takich jak np. *Alectoria* spp. i *Bryoria* spp. (27,9—53,7%).

Autorzy stwierdzają, że porosty te stanowią najważniejszą część pokarmu nornic w północnych lasach, we wszystkich sezonach roku. Są dobrym źródłem energii, zawierają łatwo strawne węglowodany i dużo białka. Z powodzeniem mogą zastępować nasiona chętnie jedzone przez nornice w bardziej południowych lasach liściastych.