Sampling and dynamics of small rodents under snow cover in northern Sweden

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Introduction

The snow cover makes small mammal studies difficult in winter. There have been some suggestions about methods for trapping the animals under snow (Pruitt 1959; Fay 1960), but there have been few or no thorough studies on density variations, population structure, reproduction or food during winter. In northern Scandinavia the ground is normally snow-covered half the year so such studies are evidently needed.

In connection with a comprehensive study on habitat selection, dynamics of and damage caused by small mammals in northern Sweden, methods of trapping in snow were compared. Furthermore, by these methods a peak population of voles was surveyed during three winters until the "crash". Here information will be given on reproduction and population structures while the winter food of the animals will be described elsewhere.

Methods

One method consisted of placing wooden 0.50 × 0.50 m boxes with lids but no floor at trapping sites already before the advent of snow ("the box method"). The boxes had 0.2 m legs sunk into the soil, so there was a 0.1 m space between the box and the ground. The boxes were recognized by sticks projecting above the snow. At trapping the snow was taken away just over the boxes and was not replaced. In this method sites are fixed in advance so it is difficult to apply in winter to new circumstances.

The other method consisted simply of digging 0.50 × 0.50 m holes in the snow ("the hole method"). Traps were placed on the soil (or in "slash" or between roots) and the snow holes were not covered. The latter method is uncomplicated but laborious, especially if the traps are covered by new or drifting snow. Cover, as used by Fay (1960) might not be applied when there are many holes or if remote areas are to be trapped, i.e. this second method was supposed to be more suitable for extensive studies.

The two methods were compared on reforestation areas at Lidsjöberg (64°20′ N, 15°15′ E) and Garpenberg (60°20′ N, 16°10′ E). Trapping was performed according to the Small Quadrat Method (Myllymäki et al. 1971) with 100 m between the small quadrats (SQ). In each SQ there are four trap stations in the corners of a 15 × 15 m area. Three snap traps are placed in best situations (at vole runways, burrows, along branches and roots) within a radius of 1.5 m from each corner. The traps were placed out for a period of two days. Half of the quadrats were randomly chosen to be trapped with the first method, the remainder with the second. The usual size of the trap stations at SQ trapping was thus about 7 m², but both boxes and holes were only 0.25 m². To examine the effect of the difference in trap station size some trapping was also performed during snow-free periods. Then box area was still 0.25 m² but the SQ's with snow holes during winter had standard trap stations with traps placed within a radius of 1.5 m.

In some areas in northern Sweden (north of 63° N) where small rodent studies were carried out during the snow-free part of the year, trapping was performed using the hole method in the winters 1972—75 to examine density, reproduction, and population structure of the animals. About half of the traps were placed in abandoned fields (or afforestations) and the remainder on reforestation areas. The snow depth was about 1 m. The small rodent population increased in summer — autumn of 1972 (especially *C. glareolus*).

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Animals trapped were separated into the categories juveniles, subadults and adults. Juveniles had still remnants of the juvenile fur (being at most six weeks old), subadults had got the fur of adult animals but had still undeveloped gonads (e. g. testes about 3 mm in length) and adults were fecund (females with embryos and/or corpora lutea or lactating, males with c. 8 mm testes and tubular cauda epididymidis).

Results

In the two series of comparisons of the two methods (Tab. 1; totally 336 specimens caught) there was in no single case a significant difference in the mean number of animals caught per SQ. This was also the case at "summer" trapping (viz. in July

Table 1

Small Quadrat catches

With the hole (or during snow-free time periods standard) method and with the box method at Lidsjöberg, northern Sweden and at Garpenberg, middle Sweden. For each method ten SQ's were distributed over a large reforestation area at Lidsjöberg and eight SQ's on abandoned fields at Garpenberg. The snow depth was around 1 m at Lidsjöberg and 0.25—0.50 m at Garpenberg

Date	Ground	Method	$\bar{x}$ (± SE)		
			Clethrionomys glareolus (Schr.)	*Clethrionomys rufocanus* (Sund.)	*Microtus agrestis* (L.)
			Lidsjöberg		
1973 October	Snow	Box	3.1 ± 0.6	0.2	0.3
		Hole	2.0 ± 0.6	0.2	0.0
November	Snow	Box	1.5 ± 0.4	0.0	0.0
		Hole	2.0 ± 0.4	0.0	0.0
December	Snow	Box	1.2 ± 0.4	0.2	0.3
		Hole	0.7 ± 0.3	0.1	0.5
1974 January	Snow	Box	1.3 ± 0.3	0.0	0.4
		Hole	1.4 ± 0.7	0.0	0.3
July	Bare	Box	1.7 ± 0.8	0.4	0.6 ± 0.2
		Standard	2.0 ± 0.6	0.1	1.6 ± 0.5
1975 October	Bare	Box	2.3 ± 0.4	0.5	1.3 ± 0.7
		Standard	2.2 ± 0.3	0.3	0.5 ± 0.2
January	Snow	Box	0.0	0.0	0.0
		Hole	0.0	0.0	0.0
February	Snow	Box	0.0	0.0	0.0
		Hole	0.2	0.0	0.0
May	Bare	Box	0.0	0.0	0.0
		Standard	0.0	0.0	0.0
			Garpenberg		
1973 November		Box	0.1		1.8 ± 0.6
		Hole	0.5		1.3 ± 0.4
December		Box	0.3		1.0 ± 0.4
		Hole	0.1		0.4 ± 0.3

$\bar{x}$ = mean number of animals caught per SQ during two days.

and October 1974 in Tab. 1), so there was no evidence that the size of the trap station area affected catch numbers.

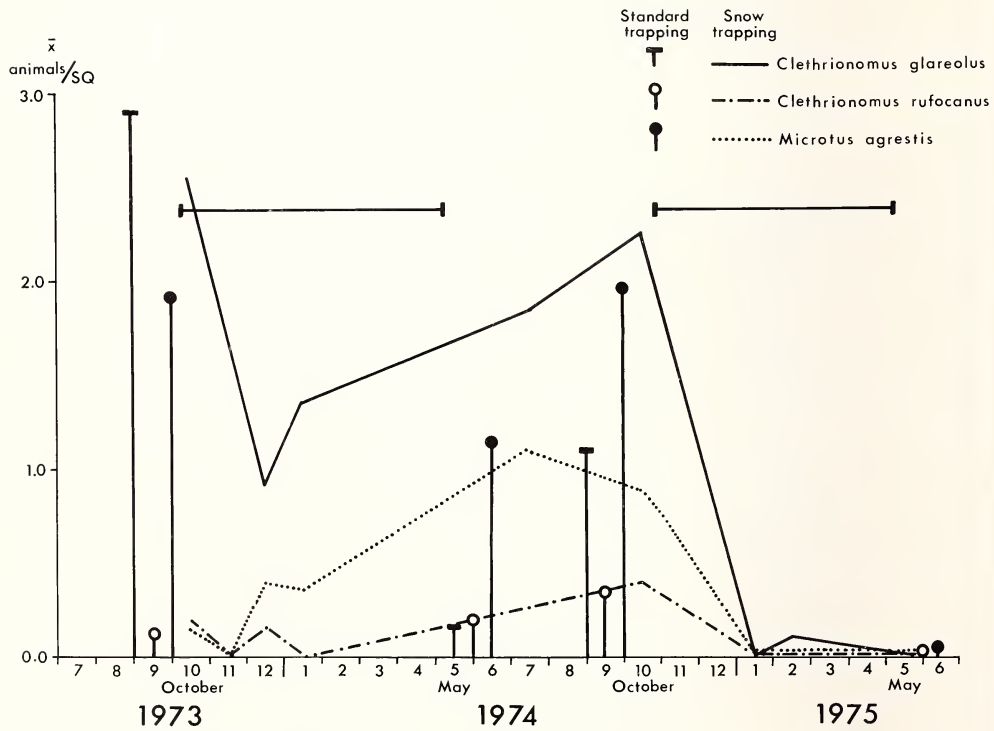
The population structures of the animals caught by the two methods were very similar. There were no significant differences in weight distribution or means, and in the autumn and winter all specimens trapped were subadults. Only in July 1974 was there a tendency for fewer adult animals with the box method (Tab. 2).

Table 2

An example of population structures in samples from trapping with the box and standard Small Quadrat method. *Clethrionomys glareolus*, Lidsjöberg, in July 1974

Sample composition	Box method	Standard method
Adults	5	11
Juveniles	12	9
Total number	17	20

The mean SQ catches of box and hole trapping combined on reforestations at Lidsjöberg were compared with mean numbers caught in spring and autumn in surrounding reforestations with a large number of SQ's (Larsson 1976). The winter catches of *C. glareolus* followed well the variations established by trapping on snow-free ground (Fig. 1) but the mean values were generally higher. For *C. rufocanus* the agreement was still better, while *M. agrestis* was taken in lower numbers during winter, especially in winter 1973–74. However, the experimental reforestation was



Mean number of animals caught per Small Quadrat in two days during snow trapping (curves, including trapping with the same methods during summer) in relation to means obtained by standard Small Quadrat trapping in spring and autumn (vertical lines). The thick horizontal lines denote the time for continuous snow cover. Reforestation areas in northern Jämtland, northern Sweden in 1973—74

generally drier and had poorer vegetation than surrounding ones, which may explain the species differences. Still the variations in the indices of population density showed similar rhythm during winter and snow-free periods. From Fig. 1 it is also clear that the small rodents had disappeared almost completely in late autumn — early winter 1974 (i. e. before January 1975), a fact which would not have been established by trapping on snow-free ground alone.

Table 3

Population structure in winter samples of small rodents from northern Sweden during three winters

Date	*C. glareolus*				*C. rufocanus*				*M. agrestis*					
	♂ Ad	♂ Subad	♀ Ad	♀ Subad	♂ Ad	♂ Subad	♀ Ad	♀ Subad	♂ Ad	♂ Subad	♂ Juv	♀ Ad	♀ Subad	♀ Juv
1973 February—March	0	69	0	44	3	2	0	2	12	15	1	15	7	0
1974 January—February	0	24	0	23	0	1	0	8	0	40	0	1	30	0
1975 February—March	0	9	0	6	0	3	0	3	0	9	0	0	13	0

Population structures of all small rodents caught during three mid-winters in northern Sweden (340 specimens) indicated differences both between species and years (Tab. 3). Most specimens obtained belonged to the species *C. glareolus* but all these were in a subadult state. Some adult (reproductive) individuals of both *C. rufocanus* and *M. agrestis* were found but only in *M. agrestis* were pregnant females detected. The fecund animals were caught in the middle of February and in the middle of March in 1973 and in the beginning of February 1974. In the winter of population increase (1972—73) five pregnant *M. agrestis* were found with 2, 4, 4, 4 and 8 embryos respectively. The presence of one juvenile *M. agrestis* indicated recruitment to the population at that time. Three male *C. rufocanus* were also in reproductive condition. In the peak winter one *M. agrestis* female bore 3 embryos. During the crash no adult animal was found but the number caught was also somewhat smaller than in the two previous winters.

Discussion

The box and hole methods appear to be suitable for intensive and extensive studies respectively. Despite the differences in the nature of these studies, the results nevertheless appear to be fully comparable. This means that it will be possible to modify the winter trapping widely to suit the local conditions.

The observations made during this study indicate the importance of further winter research. Winter reproduction may be an important factor in the dynamics of northern small rodents. On the other hand *C. glareolus* evidently did not reproduce during winter but showed similar (or even more pronounced) density variations to the other two species. Furthermore, the litter sizes of *M. agrestis* were

generally below the summer ones. Small rodent peaks are generally assumed to crash during late winter but this was clearly not the case 1974—75. Most animals seemed to have disappeared before the end of 1974, which may have been one reason for the rather small damage inflicted to forest seedlings that winter (Larsson 1976). However, the small rodent cycle studied lasted over two peak years, 1973—74, and the early disappearance in 1974—75 might have been due to the prolonged peak. Most cycles probably have only one peak year. Thus, there may be differences between three and four year cycles, which may only be observed by winter studies.

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Summary

A comparison was made between winter trapping of small rodents in either holes dug through the snow or in wooden boxes placed in the area in advance. No significant differences were found between the methods regarding either mean number caught per trapping unit nor in population structures of the samples or in weight distribution. Winter indices of rodent density agreed rather well with indices of the dynamics obtained during snow-free periods.

Trapping during three winters in northern Sweden revealed winter reproductions in two years in *Microtus agrestis*, winter reproductive conditions in *Clethrionomys rufocanus* but no evidence of winter reproduction in *Clethrionomys glareolus*. The "crash" after two peak years fell in late autumn — early winter and most animals had disappeared in early January.

Zusammenfassung

Fang und Dichteschwankungen von Kleinnagern unter dem Schnee im nördlichen Schweden

Die Ergebnisse aus zwei Methoden zum Fang von Kleinnagern im Winter wurden miteinander verglichen. Klappfallen wurden entweder in hierzu gegrabene Schneelöcher gestellt oder unter bereits vor dem Schneefall plazierte, umgedrehte Holzkisten geschoben. Im Fangerfolg, der Altersgliederung oder der Gewichtsstruktur der Fänge ergaben sich zwischen den beiden Verfahren keine Unterschiede. Die unter dem Schnee geschätzten Dichten schlossen gut an die in der schneefreien Zeit bestimmten Dichten an.

In zwei von drei Wintern wurde bei *Microtus agrestis* Fortpflanzung gefunden (gravide ♀♀). Unter den *Clethrionomys rufocanus* befanden sich im Winter drei fortpflanzungsfähige ♂♂. Hingegen waren alle *Clethrionomys glareolus* im Winter subadult. Zwischen Oktober 1974 und Januar 1975 erfolgte nach hoher Wühlmausdichte ein Zusammenbruch.

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