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Oskarshamn site investigation

Survey of small rodent populations in the areas adjacent to simpevarp

Results from 2004

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May 2005

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This report concerns a study which was conducted for SKB. The conclusions and viewpoints presented in the report are those of the authors and do not necessarily coincide with those of the client.

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Abstract

SKB has expressed the importance of monitoring mammal species that are of interest both in biodiversity issues and for local hunting and recreational purposes. To get relevant data on the dynamics of the mammal populations it is important to estimate the abundance and variations over time. Two of the major goals are to: 1) monitor dynamics of population density over several years; 2) obtain information that is essential for modelling of energy/carbon flows in the biosphere and ultimately calculations of the risks of exposure to radionuclides.

Data from the majority of the mammal species was obtained through intensive fieldwork in 2003. However, it was decided that small mammals should be trapped for another season in Simpevarp. Fieldwork was conducted in September – October 2004. We trapped only in the main area surrounding Simpevarp, within the same sub areas as in 2003. Based on the field experiences and recalculation of data from the previous year, trap sites were reduced and the trapping procedure was improved. In total we used four randomly selected trap sites located to forest habitat, four trap sites located to field habitat and another five trap sites along ditches (each trap site included 100 traps).

Some of the basic data presented in the report are as follows:

- Due to error in calculations of the data set from 2003 results from both 2003 and 2004 are included in the presentation in this report.
- Population density varied within year (data only from 2003) and between years (2003 vs 2004).
- As expected autumn density was higher for most of the species (2003). For example, mouse doubled the density from spring to autumn (4.8 vs 8.9 ind/0.01km^2).
- Most species tended to be more numerous in autumn 2004 compared to autumn 2003 in Simpevarp. For example, there were more than 30 animals/0.01km^2 in forest habitat in the autumn 2004 (compare with approximately 0.008 moose/0.01km^2).
- In general, density was higher in Simpevarp than in Forsmark. We suggest that it is reflecting differences in the quality of the habitat between the two areas.
- From the two years of trapping we are not able to describe the dynamics of the small mammal population over years. This has to be done in a long term monitoring program.

Sammanfattning

SKB har uttryckligen pekat på betydelsen av att erhålla data om tätheter bland olika djurarter i områdena kring de planerade borrhålen i Simpevarpsområdet. Relevanta data uppnås bäst genom att man beskriver populationsutvecklingen. Två viktiga mål är att: 1) i ett monitoringsystem beskriva variationer i tätheten över tid; 2) erhålla information som är viktig för att modellera energi/kol – flöden i biosfären samt skapa underlag för riskkalkyler av exponering av radionuklider vid eventuella läckage.

Data från ett flertal arter inhämtades genom intensivt fältarbete under 2003. Emellertid beslutades om att smågnagare skulle fångas även under hösten 2004, bl a för att komplettera bristande data från 2003. Fältarbetet utfördes under slutet av september–början av oktober. Fångstområdet, med utvalda trakter, var i stort detsamma som under 2003. Med erfarenheterna från 2003 och efter genomgång av data från detta minskade vi antalet fällor samt effektiviserade fångstarbetet. Fällor lades ut i 4 trakter i skog, i 4 trakter på fält/åker samt i 5 trakter längs diken. Varje trakt innehöll 100 fällor.

De viktigaste resultaten är följande:

- I rapporten presenteras omräknade data från 2003 samt resultaten från 2004, vilket också möjliggör jämförelser mellan åren.
- Populationstätheten varierade under året (2003) liksom mellan åren (2003 vs 2004) för de flesta arterna.
- Som väntat var tätheten under hösten högre än under våren för de flesta arterna (2003). Möss (inkluderande större och mindre skogsmus) dubblade tätheten mellan vår och höst (4.8 vs 8.9 individer/0.01km^2).
- De flesta arterna var mer talrika hösten 2004 jämfört med hösten 2003. Exempelvis fanns det totalt mer än 30 individer/0.01km^2 i skog (jämför med 0.008 älgar/0.01km^2).
- Sammantaget var tätheten i Simpevarp högre än i Forsmark. Sannolikt beror detta på att markerna i Simpevarp är rikare på födoresurser av god kvalitet jämfört med Forsmark.
- Data från de två årens fångst är inte tillräcklig för att beskriva den långsiktiga dynamiken i numerären bland mindre däggdjur i Simpevarp. För detta krävs ett fullt utvecklat monitoringprogram.

Contents

1 Introduction

SKB has expressed the importance of monitoring mammal species that are of interest both in biodiversity issues and for local hunting and recreational purposes. To get relevant data on the dynamics of the mammal populations it is important to estimate the abundance and variations over time. Data achieved can be used to specifically monitor endangered species (like wolf, *Canis lupus*, and otter, *Lutra lutra*), detect effects from e g drilling activities on mammal populations (important to hunters) and be used for assessment programs (MKB). Two of the major goals are: 1) to monitor populations over several years, and 2) to obtain information that is essential for modelling of energy/carbon flows in the biosphere and calculations of the risks of exposure to radionuclides.

This document reports the results gained by the Survey of Small Mammal Populations in the Areas adjacent to Simpevarp, which is one of the activities performed within the site investigation at Oskarshamn. The work was carried out in accordance with activity plan AP PS 400-04-114. In Table 1-1 controlling documents for performing this activity are listed. Activity plan is SKB's internal controlling document.

Table 1-1. Controlling documents for the performance of the activity.

Activity plan	Number	Version
Utfångst och populationsuppskattning av smågnagare	AP PS 400-04-114	1.0

Figure 1-1. Locations of trap sites for small mammals during 2003 and 2004 in Simpevarp. Association to habitat type is also indicated on the map.

2 Objective and scope

The main objectives includes the following:

- Obtain data on abundance and local densities of the selected species. The results from the SKB areas shall be compared both in a regional and a national perspective. It is also vital to make information available to public interests (like hunters, conservation agencies, forestry companies, county boards (länsstyrelser) etc). Furthermore, data can be used in the context of regular evaluation of the effect of the field operations on the environment (MKB).
- Gather data to design a monitoring system for population surveys that measures annual variation in density, and if possible in others parameters like body mass and reproduction. The monitoring should continue for at least 5–7 years.
- Make data available for modelling of, for example, energy/carbon flows in the biosphere and ultimately calculations of the risks of exposure to radionuclides. If necessary, specific projects could be created in order to obtain better data of the selected species, about for example distribution and dispersal or to better understand the flow of energy between trophical levels (including consumption of vegetation as well as prey species).

Data from the majority of the mammal species was obtained through intensive fieldwork in 2003. However, it was decided that small mammals should be trapped for another season in Simpevarp. Fieldwork was conducted in September – October 2004. We trapped only in the main area surrounding Simpevarp, within the same sub areas as in 2003. Based on the field experiences and recalculation of data from the previous year, trap sites were reduced and the trapping procedure was improved. In total, we used four randomly selected trap sites located to forest habitat, four trap sites located to field habitat and another five trap sites along ditches (each trap site included 100 traps).

3 Equipment

3.1 Description of equipment/interpretation tools

Trapping was done with metal snaptraps ("mouse traps") (see also Figure 3-1). The traps killed the animals instantly and were put out in the selected trap sites the day before the trapping started. Each trap was checked daily during the trapping period. Each trap position was documented with a handheld GPS device.

Figure 3-1. *A trapped water vole. Traps are baited with pieces of carrots.*

4 Execution

4.1 General

The method is well known and used frequently by many biologists all over the world /Williams et al. 2001/. For further descriptions of methods and principles of calculations, see 4.3 and 4.5.

Capturing of small mammals was accomplished between the end of September and beginning of October, which is within the period they are supposed to reach peak density of the year.

There were no attempts to catch dormouse in the areas /see Cederlund et al. 2004/.

Since we recalculated the data from 2003, the new results are presented together with data from 2004 in figures and tables below.

4.2 Preparations

The procedure did not require ordinary calibration. The function of traps was checked before set out in the terrain.

4.3 Execution of field work

In order to get sufficient data from different habitats and enough sample size to calculate total density for each of the species captured, we randomly selected 4 trap sites associated to forest and field habitat. Each site contained 100 snaptraps (similar to ordinary "mouse traps") at a distance of 10–15 m half an average home range. Each trap position contained two traps. Each trap was baited one day and checked the following 4–5 days (depending on the trapability). If necessary, the trap was baited again during the period. As bait we used oat grains and carrots. The age (adult or juvenile) and sex of the captured animals were determined.

In order to catch water voles, 25 traps (two at each position) were put out on 5 randomly chosen trap sites along streams and ditches (other species might also be captured). Distance between traps was approximately 20 m.

4.4 Data handling/post processing

Data on trap position, trap site, date, species, sex and age was recorded in the field on data sheets. All information was immediately after fieldwork transformed to a computer and later processed for database (SICADA) and calculations. All specimens were stored in a freezer in 2003, but not in 2004. Further use of the frozen animals is out of the scope of this study.

4.5 Analyses and interpretations

Snaptrapping methods are based on the assumption that all individuals in the trap site are exposed to the traps. In theory, the removal of trapped animals should reduce the population at a corresponding degree. By correlating the accumulated number (each day) to the daily trapping frequency (which should be decreasing), it is possible to calculate the total number of individuals when catching effort is constant /Skalski and Robson, 1992/.

The principles for calculating N is:

N: Estimated number of animals in the population

n_i: Number of trapped animals at day i

k: Number of trap days

p: Probability to trap an animal at day i

q: 1–p

$$N = \frac{r}{(1-q)^k}$$

where

$$r = \sum_{i=1}^{k} n_i$$

The probability to trap an animal is the solution of the equation:

$$\frac{q}{p} - \frac{kq^k}{1-q^k} = \frac{t}{r}$$

where

$$t = \sum_{i=2}^{k} (i-1)n_i$$

Variance of N och p is:

$$Var[N] = \frac{N(1-q^k)q^k}{(1-q^k)^2 - (pk)^2 q^{k-1}}$$

$$Var[p] = \frac{(1-q^k)qp^2}{N[q(1-q^k)^2 - (pk)^2 q^k}$$

Based on the data from 2003, a recalculation was done in order to validate the variation and find an optimal level for trapping effort in relation to error in the estimates (if possible leading to reduced field work). In short, the calculations were as follows:

Total variation:

$$Var[total] = Var[within\ trap\ site] + \frac{Var[difference\ between\ trap\ sites]}{Number\ of\ trap\ sites}$$

Error in calculating animals within a site:

$$Var[\hat{N} \mid \mathrm{N}] = \frac{\mathrm{N}(1-\mathrm{q}^{\mathrm{k}})\mathrm{q}^{\mathrm{k}}}{(1-\mathrm{q}^{\mathrm{k}})^2 - (\mathrm{p}\cdot\mathrm{k})^2 \cdot q^k}$$

N = Number of animals in the area.

p = Probability to trap an animal (partly correlated to number of traps and behaviour of the different species).

q = Probability not to trap an animal, i.e. 1–p.

k = Number of trap days.

Variation between sites:

$$Var[\text{ between sites}] = \frac{\sum_{i=1}^{n}(\hat{\mathrm{N}}_i - \hat{\mathrm{N}})^2}{\mathrm{n}(\mathrm{n}-1)}$$

N = Number of animals.

N i = Number of animals in site i.

n = Number of sites.

The estimates allow us to see how sensitive the trap system is to effort (days of trapping), number of traps (or trap sites) and population density. As is indicated in Figure 4-1 and 4-2 the potential error in the calculations of density increases dramatically with at low densities, few trap sites and few trapping days. The error develops along a rather similar pattern for the three variables. For example, increased effort by trapping more than 5 days contributes marginally to the reduction of the error (which levels off at approximately 20%). We also used 5 days as trapping period in the autumn 2004.

Similarly, the error is relatively independent of the probability to catch an animal when 20% error is reached.

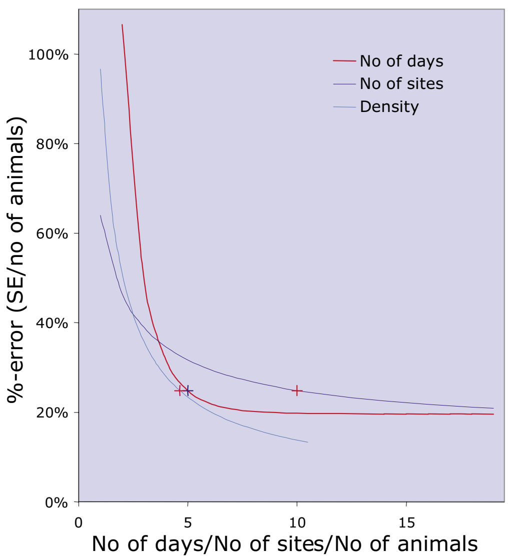

Figure 4-1. *Calculated change in error in relation to trapping intensity (number of trap sites and number of trap days and population density). Data refer to mouse.*

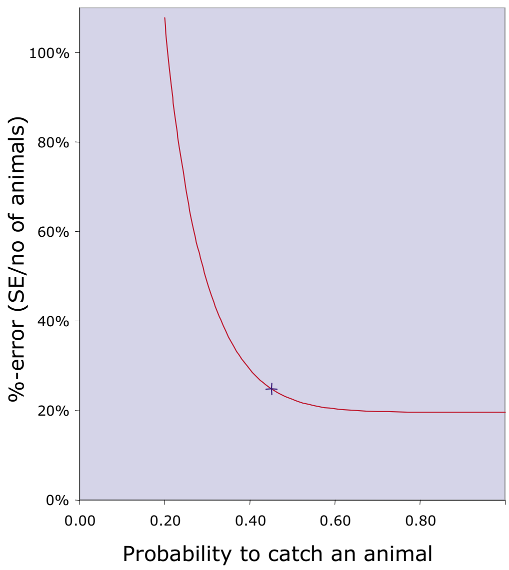

Figure 4-2. *Calculated change in error in relation to probability to catch an animal (data refer to mouse).*

4.6 Nonconformities

In the season 2004 trapping was successfully accomplished according to the plan. This contrasts to 2003 when conflicts with landowners reduced access to a number of the trap sites. Besides, early snow and frost in October forced us to inhibit the trapping along the water system and ditches in the autumn season.

Due to miscalculations in the data set from 2003 (technical error in the data program), it was recalculated together with data from 2004. Therefore, data from 2003 as well as from 2004 are presented in this report (see results).

5 Results

Trapping was done between 26 September and 4 October 2004. Seven species were captured (see the list below), but only the most common species revealed data for fair calculations of density estimates. Data from 2003 and 2004 are presented in Table 5-1.

All underlying data to the results presented here has been delivered to SKB and are stored in databases in SICADA.

The following species were captured in 2004:

Clethrionomus glareolus (Skogssork/ängssork) Bank vole.

Arvicola terrestris (vattensork) Water vole.

Microtus agrestis (Åkersork) Field vole.

Apodemus fluviatilis (Större skogsmus) Yellow necked mouse.

Apodemus sylvaticus (Mindre skogsmus) Wood mouse.

Sorex araneus (Vanlig näbbmus) Common shrew.

Sorex minutus (Dvärgnäbbmus) Pygmy shrew.

Sorex fodiens (Vattennäbbmus) Eurasian water-shrew.

The data presented in Table 5-1 clearly indicates the dynamic in density among small mammals in Simpevarp both within and between years. As expected estimated density was higher in the autumn than in the spring populations in 2003 (data were not sufficient for all species). The most plausible explanation is that autumn population includes recruitment of juveniles (see also Table 5-3). Moreover, several species were more numerous in autumn 2004 than in 2003. Mouse (includes both species listed above) was by far the most common species, both in field and forest habitats.

Males were slightly more frequent among the captured animals for the majority of the captured species (Table 5-2). The exception was Common shrew, which was permanently represented in the data set by less than 20% males. We have no good explanations to the skewed sex ratio.

Table 5-1. Estimated population density among small mammals in Simpevarp in 2003 and 2004. Number of trap sites is denoted as n. The $SE_{95\%}$ figures indicate the 95% probability to find the mean density estimates within the interval.

Simpevarp	Spring 2003 Population density (ind/0.01km²)			Autumn 2003			Autumn 2004		
	n	Mean	$SE_{95\%}$	n	Mean	$SE_{95\%}$	n	Mean	$SE_{95\%}$
Mouse – forest	5	4.8	± 0.81	10	8.9	± 0.74	4	11.5	± 0.85
Mouse – field	–	–	–	3	6.4	± 2.34	4	6.7	± 0.78
Bank vole – forest	5	4.1	± 0.83	10	4.8	± 0.56	4	3.7	± 0.59
Water vole	5	5.7	± 1.47	14	–	–	4	4.5	± 0.96
Field vole – forest	–	–	–	10	0.3	± 0.06	4	0.9	± 0.11
Field vole – field	–	–	–	3	4.2	± 0.18	4	2.3	± 0.17
Common shrew	5	0.5	± 0.29	14	1.5	± 0.26	8	4.4	± 0.38

Table 5-2. Estimated sex ratio (proportion of males to total number of adults) among the most frequently captured small mammals in 2003 and 2004 in Simpevarp. Mouse includes both Wood mouse and Yellow necked mouse.

Simpevarp	Sex ratio Spring 2003	Autumn 2003	Autumn 2004
Mouse	61%	51%	55%
Bank vole	64%	45%	50%
Water vole			68%
Field vole		59%	37%
Common shrew	20%	11%	14%

Table 5-3. Estimated juvenile/adult ratio (proportion of juveniles in relation to total number of captured animals) among the most frequently captured small mammals in 2003 and 2004 in Simpevarp. Mouse includes both Wood mouse and Yellow necked mouse.

Simpevarp	Juvenile/adult ratio Spring 2003	Autumn 2003	Autumn 2004
Mouse	6%	39%	42%
Bank vole	10%	25%	50%
Water vole			19%
Field vole		31%	19%
Common shrew	0%		65%

The proportion of juveniles varied considerably between seasons and years (Table 5-3). As mentioned earlier, it is logical to find more juveniles in the autumn population. The data set is too small to allow further conclusions about the dynamics on the demographic parameters among the small mammal species. Monitoring over several years is needed to obtain sufficient data of that kind.

The literature contains limited data on actual density estimates from different regions. Therefore, it might be of interest to compare Simpevarp with Forsmark. As indicated in Figure 5-1, Simpevarp has generally higher number of small mammals (all species together) compared to Forsmark. This is probably due to habitats of better quality (higher abundance of food resources and/or better nutritional quality of food items). Also, note the general increase in density between the two years of trapping.

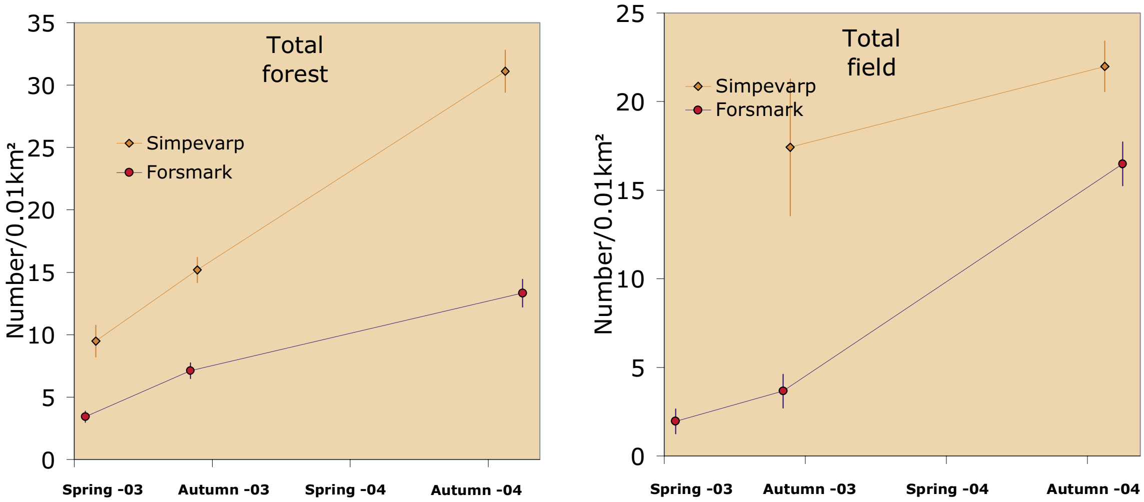

Figure 5-1. *Total density of small mammals in Forsmark and Simpevarp, including all captured species in trap sites located to the forest habitat and field habitat, respectively. Data refer to spring 2003, autumn 2003 and autumn 2004 in chronological order.*

6 Summary and discussions

This study is one of the few that has revealed actual density estimates of small mammals. Usually most trapping refer to index or other indirect measurements (see for example /Hansson and Henttonen 1988; Steen et al. 1996; Hörnfelt 1998/). However, since most small mammals may undergo dramatic changes between years and over time in long-term oscillations, and since we have only data from two years, it is not possible to relate the present data to an average. Nor is it possible to tell from where in the cycle of population development we have obtained data. Therefore, density estimates of small mammals require data from a monitoring system, which has been suggested earlier (see /Cederlund et al. 2003,2004/). It is especially important since small mammals constitute a large part of the mammal biomass and thus contributes to an essential part of the carbon flux in the ecosystem /Truvé and Cederlund, 2005/.

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