The small mammal fauna in an agricultural landscape in southern Sweden, with special reference to the wood mouse *Apodemus sylvaticus*

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Summary. — Wood mice and house mice were found in cropped fields, the latter at least during summer and autumn, the former throughout the year. Yellow-necked mice, norwegian rats, field voles, bank voles, water shrews, common shrews, and pygmy shrews were only found in non cropped habitat islands. Wood mice burrow systems and stores are not destroyed by ploughing and wood mice are found in cropped fields throughout winter. However, mice densities, in both autumn and spring, are highest in fields that are currently ploughed (following e.g. direct sowing).

Résumé. — Les mulots et les souris ont été capturés dans les champs cultivés, les souris au moins en été et en automne, les mulots toute l'année. *Apodemus flavicollis, Rattus norvegicus, Microtus agrestis, Clethrionomys glareolus, Neomys fodiens, Sorex araneus* et *Sorex minutus* ont été seulement trouvés dans des îlots d'habitats non cultivés. Les réseaux de galeries et les réserves des mulots ne sont pas détruits par le labourage et les mulots vivent dans les champs cultivés tout l'hiver.

Cependant, les densités de souris en automne et au printemps sont plus élevés dans les champs qui ne sont habituellement pas labourés.

Most of the agricultural areas in southern Sweden are covered by cropped fields. In these fields distinct patches of non cropped land are found. The aim of the present study is to describe the species composition and habitat distribution of the small mammal (rodents and shrews) fauna in a site of this landscape.

STUDY AREA

The study was carried out in an area about 10 km south of Lund in southern Sweden (55°35'N, 13°12'E) (Fig. 1). The study area is a typical agricultural district. The main crops grown are wheat, rye, rape and sugar beats. Small habitat islands are formed by abandoned marl pits, steep grassy slopes, small marsh areas and the surroundings of farm houses. Representatives of the three former types are included in the eleven habitat islands considered in this study. The areas of the study plots are 0.03, 0.04, 0.05, 0.15, 0.20, 0.21, 0.25, 0.35, 0.70, 3.0 and 5.0 ha. The most distant study plots are 3 km apart.

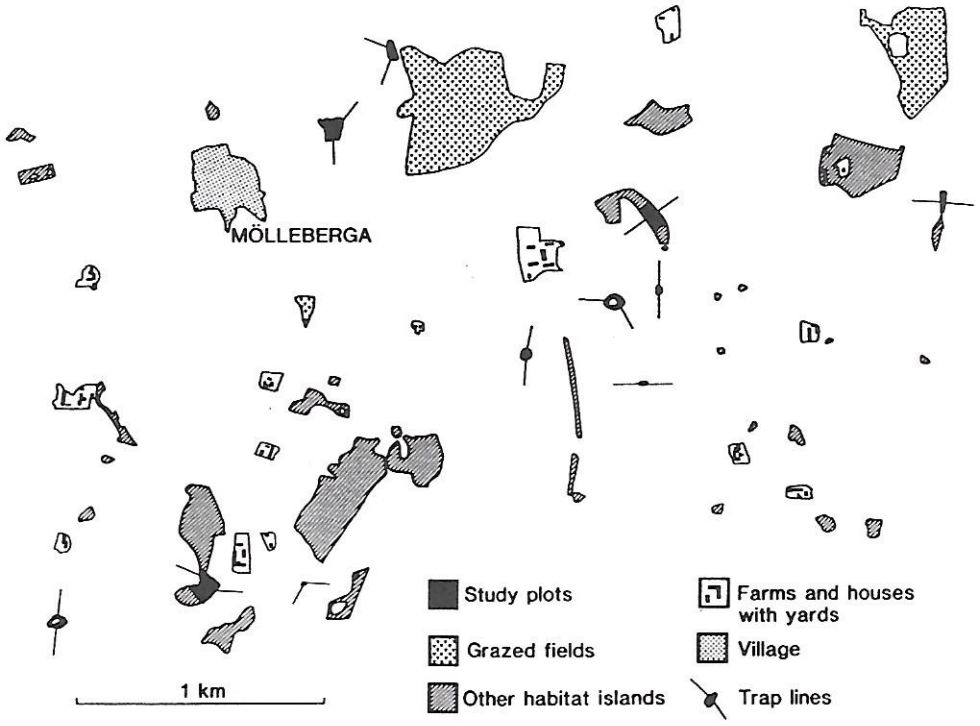

Fig. 1. — The study area.

METHODS

The study was carried out from autumn 1983 until spring 1986. In the years 1984 and 1985 there were three study periods each, spring, summer, and autumn. In 1983 and 1986 there were only one study period each, autumn and spring respectively. The autumn study period fell as soon as possible after harvest, usually in late September or October. The spring period fell in April and the summer period as late as possible before harvest. As the timing of harvest can not be predicted with certainty I had to undertake the captures before there was any possibility of harvesting beginning. This meant in late July or early August.

During each study period a small mammal inventory was carried out by live trapping with multiply catching traps (''Ugglan special''). The traps were set on day 1 and emptied on days 2, 3, 4, and 5. All captured animals were individually marked by toe clipping, sexed, weighed, and immediately released. The number of different individuals captured per species serves an index of its density in the different seasons.

In the habitat islands I arranged the traps in a gird with 10 m between the traps, thus the trap density was 100 traps per ha. In the two largest patches, 3 and 5 ha in area, I only trapped in grids with 60 and 64 traps respectively.

The other patches were completely covered by the grid. From each patch there were also two trap lines out into the surrounding field. Each trap line contained 10 traps with 10 m intervals, beginning 10 m from the patch. Because of the border effects this trap layout means that I trap more animals per trap in the fields than in the island at equal animal densities. Thirteen burrow systems were excavated in December 1985. The depth and contents of nests and stores was noted.

RESULTS

Except for single individuals, only wood mice *(Apodemus sylvaticus)* and house mice *(Mus musculus)* were found in the fields (Tab. 1). In the habitat islands there were also regular captures of yellow-necked mice *(Apodemus flavicollis)*, bank voles *(Clethrionomys glareolus)*, field voles *(Microtus agrestis)*, water shrews *(Neomys fodiens)*, common shrews *(Sorex araneus)*, and pygmy shrews *(Sorex minutus)*. There were occasional captures of brown rat *(Rattus norvegicus)*.

During spring and autumn there was a positive correlation between trap distance from patch and number of captures of wood mice ($r_s = 0.710$, d.f. = 9, $P < 0.05$ and $r_s = 0.754$, d.f. = 9, $P < 0.05$, respectively). There was no such correlation for the summer captures ($r_s 0.067$, d.f. = 9 $P > 0.10$) (Fig. 2).

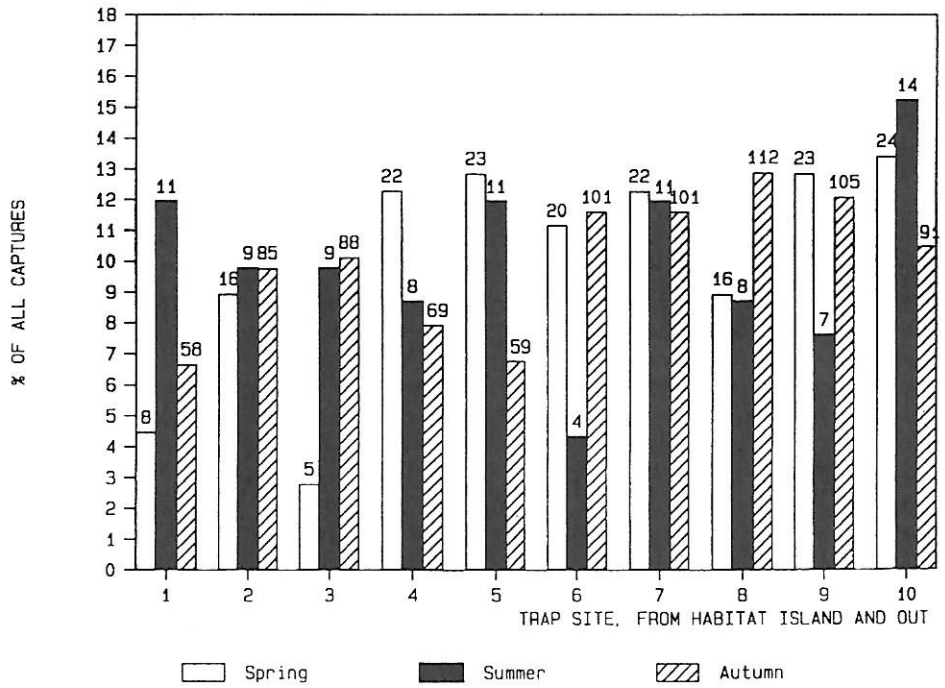

Fig. 2. — The total number of wood mouse captures per trapping period for the different trapsites. 1 represents the traps closest to a habitat island and 10 those farthest away. There is 10 m between the trap sites.

During summer there were more captures (15) of house mice in the five distant traps sites than in the five traps sites close to a patch (3 captures). The corresponding figures during autumn were 6 and 7 captures.

The recaptures of wood mice that had been marked during an earlier trapping period did not suggest there were seasonal migration from fields into patches or vice versa.

The number of wood mice captured in trap lines during the autumn was significantly affected by the current treatment of the field ($F = 11.09$, d.f. $= 3 : 59$, $P < 0.001$) (Fig. 3). The density was highest on fields with stubble, including those burnt, less if the fields had been ploughed, and least if they also had been harrowed and autumn crop sown before the trapping period. During spring there were no significant differences between fields with different treatments ($F = 1.10$, d.f. $= 4.58$, $P = 0.30$) (Fig. 4). The distribution of subadults was not different from that of adults (Figs. 2 and 3).

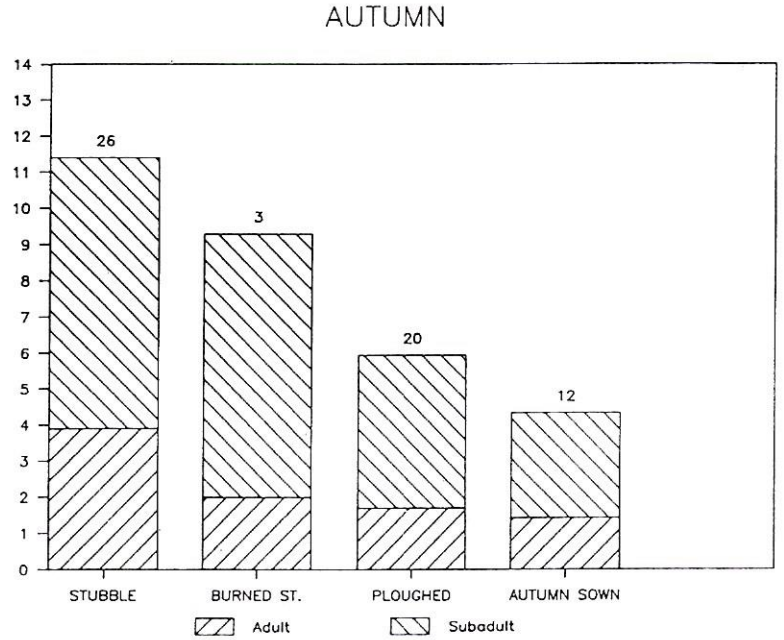

Fig. 3. — Mean number of individual wood mice captured per trapping period and trap line in the different field types. The numbers above the bars give the number of trap lines.

Four of the 13 burrow systems contained stores ; 1 kg and 0.3 kg of wheat grain, 1.5 kg and 0.7 kg of chestnuts respectively. These nests were relatively complex with a maximum length of 2 m. The greatest depth of these four systems was on average 44 cm (span 30-60 cm). The average depth of six nests in these was 37 cm (20-60 cm) and the average depth of the stores 39 cm (20-60 cm). The fields were ploughed to a depth of about 25 cm.

The greatest depth of the nine burrows without stores was on average 20 cm (10-30 cm). These burrows were short with a nest in the bottom.

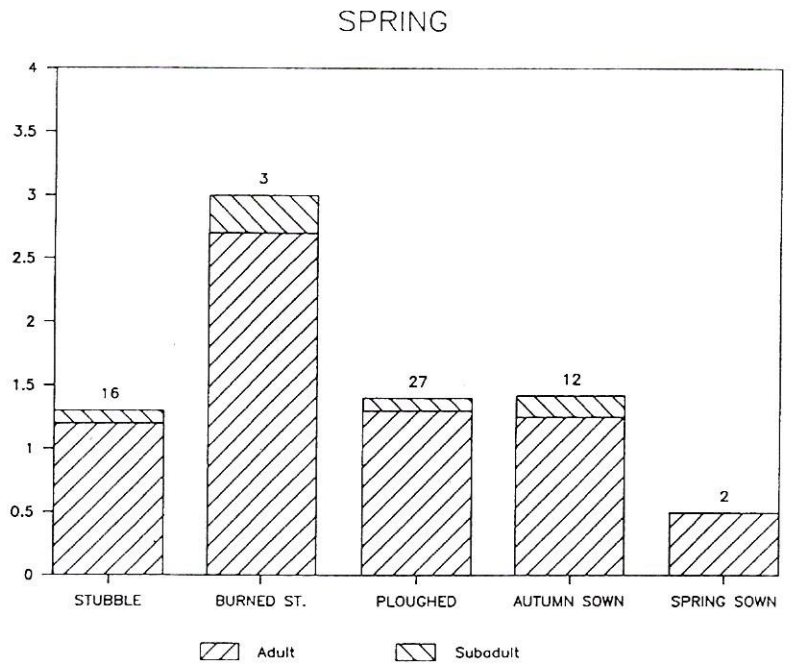

Fig. 4. — As fig. 2 but data from the spring trapping period. The stubble fields were such that had been sowed by the direct method during the previous autumn.

DISCUSSION

Interpreting the pattern.

For all species, except the wood mouse and the house mouse, this landscape can be characterized as extremely patchy, with small habitable islands in a desert that only is used for dispersal movements. House mice are found in the fields, at least during summer and autumn. There were none captured at all during spring so it can not be decided whether they occur in the fields throughout the year. Green (1979) state that they disappear from fields soon after harvest. Wood mice were found in the fields at all capture seasons, this agrees with the results of Green (1979). There were more captures per trap in the field than in the patches during spring and summer. However, as trap pattern differed it is not possible to state which habitat support the highest densities. They are likely to be of the same magnitude. However, during autumn capture rate was almost equal which (because of the border effect on trap lines) suggests that density was somewhat higher in the patches than in the surrounding fields.

The relatively low capture success in the field traps close to a habitat island (resulting in positive correlations between trap success and distance from patch) could be because traps were set simultaneously in the islands. These traps thus

competed for mice that lived on the border between field and island. Important is the fact that the catch of wood mice and house mice was not clearly higher close to the habitat islands than farther away. Reasonable hypotheses that may be refuted by this data are thus (1) that mice caught in the fields actually live in a nearby habitat island and (2) that mice living in fields depend on regular foraging trips into the islands.

Fields as wood mouse habitat.

The wood mice are probably able to surviving permanently in the fields due to their well developed burrow systems. The systems are extensive and most nests and stores seem to be located at depth were they are not affected by ploughing. Also Pelz (1979) described a population of wood mice permanently in ploughed fields with stores and nests at a depth below 25 cm. Montgomery and Gurnell (1985) suggest that the systems are used by several generations. Grains are left on the field after harvest and are probably a major source of food (Green 1979). The grains are partly available even after ploughing.

However, farming activity during autumn may well have some detrimental effects, reducing availability of grains and partly destroying the nest entrances. This is probably the background to the differences in density in different types of fields (Fig. 3). Such a difference (between ploughed fields and fields with winter wheat) was however not found by Green (1979). It is possible that any differences in his study area were masked by the fact that he pooled trapping sessions from the whole period October to March.

The differences in density between field types had disappeared by spring. This may suggest a concentration of mice predators to fields with high mouse density.

Thus, from an ecosystem point of view, the practice of direct autumn sowing, without previous ploughing and harrowing, is beneficial in the respect that it supports higher winter population of mice and thus more raptors and mammalian predators. The food used by these mice is likely to be waste grains mainly.

ACKNOWLEDGEMENTS

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