Location and habitat characteristics of the breeding nests of the harvest mouse (*Micromys minutus*) in the reed-beds of an intensively used farmland

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ABSTRACT
Occurrence of harvest mouse breeding nests in relation to reed-bed structure was studied in 2000-2001. This study took place in midfield marsh patches and drainage ditches in an intensively used farmland of western Poland. A total of 88 nests was found. 98% of them were attached to reed stems at a mean height of 48 (± 41 SD) cm. Harvest mice favoured reed-beds with low, thin and sparse stalks, with a high ratio of *Carex*/grass. Areas with a high density of herbaceous vegetation were avoided as nest sites.

KEY WORDS
Micromys minutus, rodents, farmland, Poland, habitat use, nests, reed-beds.

RÉSUMÉ
Localisation et caractéristiques de l'habitat des nids de Micromys minutus dans les roselières d'une zone d'agriculture intensive.
L'abondance des nids de la souris des moissons (*Micromys minutus*) en relation avec les roselières a été étudiée de 2000 à 2001. Ce travail a été effectué dans des zones de marécages et des fossés de drainage en plein champ dans une région d'agriculture intensive de Pologne occidentale. Un total de 88 nids a été trouvé. 98 % d'entre eux étaient attachés aux tiges des roseaux à une hauteur moyenne de 48 (± 41) cm. Les souris des moissons préféraient les roselières avec des tiges basses, fines et clairsemées, avec un fort taux de *Carex* et d'herbes. Les zones avec une forte densité de végétation herbacée étaient évitées pour la nidification.

MOTS-CLÉS
Micromys minutus, Rongeurs, Campagne, Pologne, utilisation de l'habitat, nids, roselières.

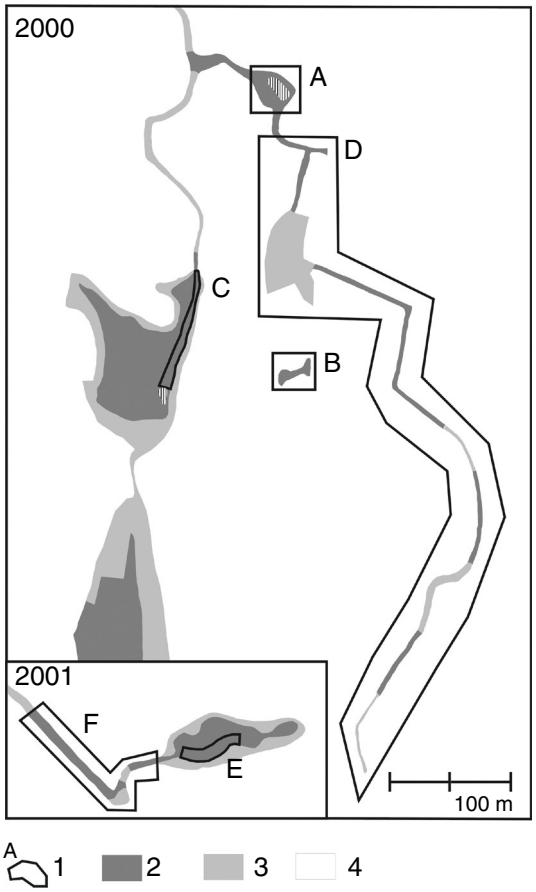

FIG. 1. — Distribution of plots surveyed in the study area. Plot E is ca. 2 km north-west from the plot A. Both maps (2000 and 2001) are in the same scale. 1 – study plots, 2 – reed-bed, 3 – meadows, herbaceous vegetation, 4 – arable fields

INTRODUCTION

The harvest mouse (*Micromys minutus*) occupies a wide variety of open habitats, such as reed-beds, grasslands, hedgerows and crops (Piechocki 1958; Dickman 1986; Ishiwaka & Mōri 1999; Nordvig *et al.* 2001). Although the biology of this species is well known, many aspects of its habitat preferences are still poor understood. The only exceptions are surveys, in which harvest mouse abundances in various habitat types were compared (Dickman 1986; Feldmann 1997).

The harvest mouse spends most of its life above the soil surface, in tall, dense vegetation (Piechocki 1958; Nordvig *et al.* 2001). There is some evidence of morphological adaptations to these habitats, e.g.: prehensile tail and small body weight (Ishiwaka & Mōri 1999). Moreover, harvest mice build above ground breeding nests attached to grass stalks. We assumed that even small differences in vegetation structure would influence harvest mouse distribution on a local scale.

In our studies we investigate how reed bed structure affects presence or absence of harvest mouse breeding nests. We chose this habitat for our study for two reasons. Firstly, reed-beds are commonly inhabited by the species. Secondly, despite one plant species being dominant (*Phragmites communis*), reed beds are structurally differentiated. We examined the influence of reed shoot sizes, floristic composition and ground coverage on harvest mouse nest presence. In addition, we describe nest placement.

MATERIALS AND METHODS

The study area is located in Wielkopolska province, western Poland (52ºN, 16ºE). Mainly cereals, oil seed rape and sugar beets are cultivated (for further details, see Tryjanowski 1999). Small midfield patches of marshes, meadows and drainage ditches are typical landscape features (Fig. 1). Dominant vegetation in these habitats was reed-beds, herbaceous vegetation and single bushes and trees.

Data on nest distribution and vegetation structure were collected after harvests, between August and October of 2000 and 2001. Nests were searched for on six different study plots. In 2000, plots on three marsh patches and one on a drainage ditch were searched (total 0.6 ha of reeds). In the following year, one plot on a marsh and the second on a ditch were searched (total 0.2 ha of reeds). In two small marsh patches (A, B see Fig. 1) of the total area 0.2 and 0.04 ha, all the reed area was searched. In marshes C and E (2.58 and 1.49 ha respectively) plots of maximum width 8 m were selected at the edge of the reeds (Fig. 1). In all plots only the reed area was searched by walking along 2 m spaced transects. Reed-beds in all study plots were not flooded.

Six vegetation variables were measured in quadrats of 50 x 50 cm placed around nests: maximum height (RH) and diameter (RD) of reed shoots, number of old (OR) and new reed (NR) shoots (*Phragmites communis*), number of herbaceous vegetation shoots (HN), percentage of *Carex* sp. or grass cover (CC).

Quadrats with nests were classified as "dry" (HD) or "wet" (HW) depending on soil humidity. Soil was described as "wet" if water occurred after having stepped on it.

To obtain information on preference or avoidance of the available habitats near nests, quadrats occupied by harvest mice were compared with quadrats without nests. Random quadrats were selected in the following way. Aerial photographs of studied reed plots (1:1000) constituted a sampling frame (cf., Thompson *et al.* 1998). Then, 105 quadrats 50 × 50 cm were selected at random to obtain a simple random sample. Only quadrats located at least 1 meter from nests were included in the survey. At random quadrats the same habitat parameters as at nest sites were measured.

Differences in the habitat features between occupied and random sites (presence/absence binary data) were analysed using backward-stepwise logistic regression (Hosmer & Lameshow 1989). The statistical significance of each variable included in the model was based on the Log Likelihood ratio with probability $p < 0.05$. Results are presented as means ± SD and all p-values in significance tests are two-tailed. Data have been analysed using the SPSS statistical package (Norusis 1986). Other statistical comparisons on the data used standard methods (Zar 1999).

RESULTS

In 2000-2001 we found 88 nests of the harvest mouse; 56 in the first and 32 in the second year of study. Average density per reed area differed significantly between the study years, being 93.4 nests/ha and 156.3/ha in 2000 and 2001, respectively ($\chi^2 = 6.36$, df = 1, $p = 0.012$, tested for number of nests).

Eighty-six of the observed nests were attached to reeds and two to *Calamagrostis* grasses. The average height of the nest was 48±41 cm (mean ± SD). Nests were located markedly higher in wet (110 ± 56 cm, N = 3) than in dry squares (mean ± SD = 45 ± 38 cm, N = 58, Mann-Whitney U-test, $z = -2.22$, $p = 0.026$). This result reflects differences in reed height under various humidity conditions (224 ± 63 vs. 276 ± 37 cm, in dry and wet places, respectively, Mann-Whitney U-test, $z = -6.54$, $p < 0.0001$).

All variables except the number of old reed shoots (OR) were included into the logistic regression model (Table 1). The coverage of *Carex*/grass

TABLE 1. — Results of the logistic regression analysis of habitat selection of the harvest mouse. The significance of each variable is based on Log Likelihood ratio (χ^2).

Variable	Nest quadrats	Random quadrats	χ^2
reed height (RH) [cm]	185.38 ± 62.11	261.76 ± 37.72	80.29**
reed diameter (RD) [mm]	5.30 ± 1.57	7.21 ± 1.14	69.52**
old reed shoots (OR) [n]	14.44 ± 13.41	23.29 ± 15.25	ns
new reed shoots (NR) [n]	10.43 ± 8.51	19.73 ± 9.92	75.97**
herbaceous vegetation (HN) [n]	4.09 ± 4.47	4.64 ± 4.63	68.85*
Carex/grass coverage (CC) [%]	51.78 ± 42.85	24.57 ± 35.52	68.39*

* $p < 0.05$, ** $p < 0.01$

influenced nest presence positively, while new tall and thick reed stems as well as a high relative amount of herbaceous vegetation reduced the probability of harvest mouse nest occurrence.

DISCUSSION

Harvest mice in the area studied showed preferences for vegetation features typical of the driest zone of reed-beds. Near to the edge of reed beds, reed shoots are small and sparse compared with the wet interior (see Báldi 1999). Moreover, the relative amount of herbs and grass rises with decreasing soil moisture in reed beds. Our results possibly indicate avoidance of wet reeds by harvest mice. In western Asia, where the subspecies *Micromys minutus ussuricus* occurs, high densities of nests were recorded in rice fields (Sleptsow 1947). Also Jüdes (1981) reported that the harvest mouse was less abundant on dry soils.

A more likely explanation is that harvest mice prefer reed habitats because these are most similar to its optimal habitat. In this species, the highest known densities of nests have been recorded in cereals (Sleptsow 1947, Piechocki 1958, Padilla 1999, Corbet & Harris 1991, Anděra 1994). After harvests however, mice are forced to migrate to marginal habitats where they continue breeding and over-winter (Koskela & Viro 1976). Shorter reed stalks have usually smaller diameters that provide mice with a firm grasp during climbing. Herbs, like stinging nettle (*Urtica dioica*) are useless for that purpose; their number at nest sites is relatively low.

Nests of harvest mice found in the study were placed at the height related to vegetation height, consistent with earlier findings (see results Piechocki 1958; Corbet & Harris 1991; Padilla 1999). Opposite results obtained by Feldmann (1997) showed that in moist habitats, harvest mice preferred to place nests high, mainly on *Phalaris arundinacea* and *Phragmites australis*.

Results of our study revealed a clear pattern of the harvest mouse nest distribution in respect of the available habitat components. The densities of nests found in the reed-beds were one of the highest known in the species. Presumably, building nests in lower reeds mixed with grass has a strong adaptive value in the harvest mouse. Understanding the ecological pressure on habitat selection in the harvest mouse, including potential biotic and abiotic factors such as predation, parasitism and weather (see also Harris 1970; Corbet & Harris 1991), should be a goal of future research.

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