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Comparative ecology of the Wood mouse *Apodemus sylvaticus* in two differing habitats

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Abstract

Densities, variations in body mass, sex ratios, breeding activities and size of home-range were studied in wood mouse populations living in a woodland and a reed bed. In the reed bed population: 1. spring densities were lower, 2. body mass differed, and was lower in early autumn, and 3. home ranges were larger than in the woodland population.

It is suggested that differences in food availability and quality strongly influenced the behaviour of the two populations; the main effect of these differences was that reed bed mice entered winter with a lower body mass and suffered higher winter mortality. The larger size of the home range in the reed bed suggests that mice living in a poor-food habitat will enhance their survival by patrolling a wider area than in a rich habitat.

Introduction

Habitat features such as quality and structure, spatial heterogeneity and some related environmental parameters (availability of food and shelter and of suitable nest sites) may influence certain aspects of intraspecific rodent behaviour (Niethammer 1978; Hestbeck 1982; Wiger 1982; Gurnell 1985; Gorman and Ahmad 1993). Populations living in differing habitats may be characterized by demographic parameters such as fecundity and mortality (Krohne 1980), spacing behaviour in females (voles: Bujalska and Janion 1981) and juvenile dispersal between high- and low-quality habitats (voles: Gliwicz 1989). It is also suspected that habitat heterogeneity may partially explain the observed asynchronous fluctuation in neighbouring populations of noncyclic voles (Alibhai and Gipps 1985).

The aim of this study is to investigate wood mouse populations living in two differing habitats that are characterized by different productivity and structure: a mesic woodland and a reed bed.

Material and methods

The study was performed at the "Punte Alberete" and the "Pineta di S. Vitale" Nature Reserves, located along the eastern Adriatic coast of Italy. "Punte Alberete" is a marshland covered with extensive reed beds *Phragmites* sp. and *Carex* sp. The "Pineta di S. Vitale" biotope is a mixed spruce and deciduous woodland. The general features of the two areas, which we shall call "reed bed" and "woodland", differed strongly: arboreal cover was obviously high in the woodland, whereas in the reed bed the ground cover increased continuously from May to October in relation to reed growth. The reed bed was constantly characterized by wet soils, while in the woodland the water table decreased from May to an August minimum; the water table may sometimes rise in response to meteorological factors such as storms or rain, but usually lowers rapidly.

The study was carried out from May to October 1992. A grid of 52 Sherman traps (trapped area = 1 ha) was located in each study area and one trapping session was carried out for five days every month at each study site. The traps were baited with sunflower seeds and checked at dusk and dawn; after capture mice were weighed (g), sexed and marked by toe clipping (Twigg 1978). Each individual was aged as adult, subadult or juvenile according to fur colour and reproductive condition (Gurnell

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and FLOWERDEW 1990). Reproductive conditions in males were detected by the degree of testes activity (i. e. their position in the scrotum); reproductive status for female was described as pregnant, lactating, pregnant and lactating, reproductively active (perforate vagina) or inactive (imperforate vagina).

Population abundance and home range size were estimated by the Minimum Number Alive and Minimum Area Methods (GURNELL and FLOWERDEW 1990).

Results

Population abundance and sex ratio

Seventy nine individuals were caught 172 times in the reed bed and 91 individuals were caught 187 times in woodland; the trapping effort was equal to 3120 trap checks per habitat.

Densities increased in early autumn in both habitats (Fig. 1). Throughout the study period the woodland population density was consistently higher than that of the reed bed (Mann-Whitney, U, z = 2.22, P = 0.026); however, the differences were only very marked in May and June. After June, the woodland population decreased to a minimum, while the reed bed population remained at the density attained in the late spring.

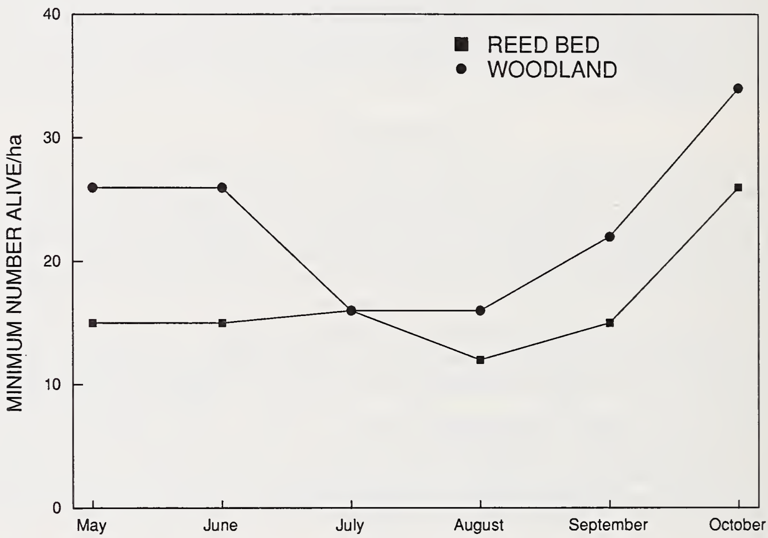

Fig. 1. Population densities in the two habitats

The adult sex ratio was biassed towards males in nearly all the months and in both habitats (Fig. 2); a slight prevalence of females was observed during June in the reed bed and in May in the woodland; only in July did the sex ratio approach parity.

Body mass variation and breeding

During the study period, variation in body mass was observed between the two populations. The weight of wood mice living in the reed bed increased rapidly from May to June and then decreased constantly up to October, whereas the woodland mice gained weight more slowly and reached their highest weight in August. The maximum weight of woodland mice was lower than that of reed bed mice and weight differences were always significant except during the July trapping session (Fig. 3).

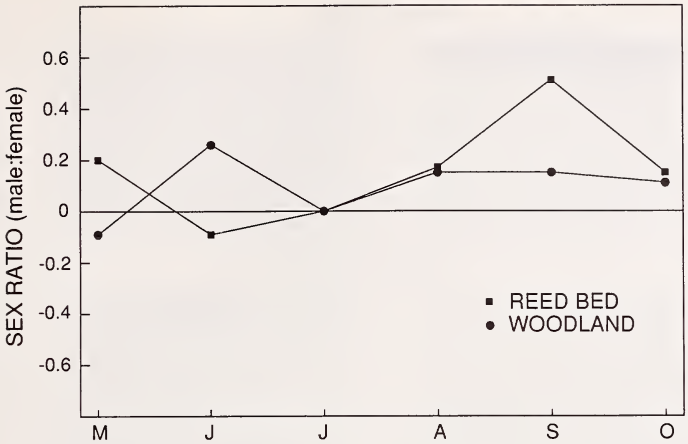

Fig. 2. Male:female sex-ratio, expressed as the logarithm of the ratio. Positive values show a male biassed ratio

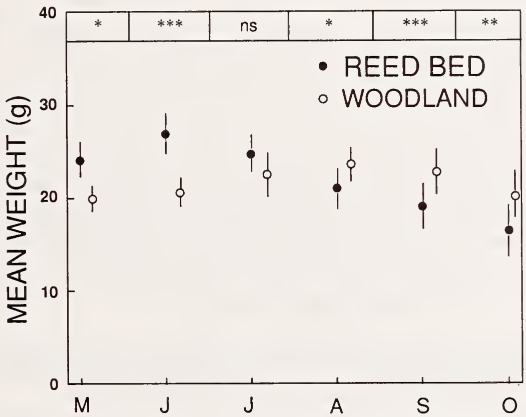

Fig. 3. Average weight (+/− SE) variations during the study period; differences were tested by Mann-Whitney U test. (* = P<0.05, ** = P<0.001, *** = P<0.001, ns = not significant)

At the beginning of the study nearly all the males were in sexual activity in both habitats (Fig. 4); however, in October nearly all of them entered a non-reproductive phase (abdominal testes) in the reed bed, whereas more than half the woodland males were still in a reproductive condition (scrotal testes).

A similar pattern was observed for females (Fig. 4): in the reed bed the proportion of females in a reproductive condition (perforate vagina, lactating or pregnant) was high from May to September, while in October nearly all the females were found to be in a non-reproductive condition (imperforate vagina); only one female showed the final phases of lactation activity. In the woodland, on the other hand, nearly all the females were imperforate in May and June; in October, however, ten out of fourteen females captured were pregnant or lactating.

Home-range size

Relative areas of home ranges by sex and habitat are given in the table. Because of the lack of recapture data for each trapping session we considered the average value for the home

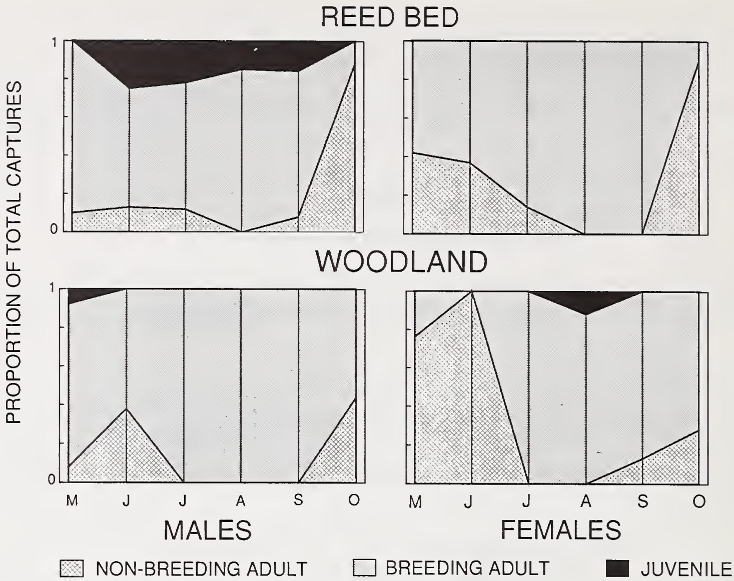

Fig. 4. Proportion of breeding and non-breeding males and females during the study period, expressed as the proportion of monthly captures

range throughout the study period. The average home-range size of reed bed mice was much higher than in woodland mice (male, Mann U, z = −4.31, $P < 0.001$; female, Mann U, z = −3.52, $P < 0.01$; from data in the table). In the reed bed the home range was significantly larger for males than for females (Mann U, z = −2.58, $P < 0.01$), whereas the home range of females was slightly larger than that of males in woodland. This latter difference, however, was not statistically significant (Mann U, z = −0.07, P = 0.93).

Home range sizes ($m^2 \pm SD$) in the woodland and the reed bed

Differences are tested by Mann-Whitney U test

Reed bed		Woodland	
Males (8070 ± 478)	Females (6670 ± 978)	Males (4080 ± 401)	Females (4120 ± 401)

Discussion

The population trend in the two habitats follows approximately the same pattern and fits with current information concerning the reproductive biology of temperate woodland rodents (Flowerdew 1985). The autumn increases may be explained by recruitment of juveniles or subadults to the adult population. A male-biased sex ratio in both habitats is a common finding in capture-recapture studies of wood mice (Flowerdew 1985; Halle 1993), probably reflecting the polygynous social system of this rodent (Wolton and Flowerdew 1985). Several studies have shown that male home ranges overlapped those of more than one female (Brown 1969; Wolton and Flowerdew 1985). In this way males improve their chance of encountering sexually active females (Brown 1966). Moreover, in covering a wider area they should encounter more traps compared to females and this should explain their prevalence in capture-recapture data sets.

The data from our study areas fit, at least for the reed bed, current information about sex-related differences in wood mouse home-range size.

The temporal pattern of body mass variation seems to fit the current picture of weight variation in wood mice living in temperate areas (TANTON 1969; GRODSZINSKY 1985). According to GRODSZINSKY (1985), seasonal changes in body weight are related to the dynamics of water, fat and protein content; and even though water loss and protein transformation are more involved in seasonal weight decreases than fat, the individuals that lost most weight were subject to higher winter mortality (GRODSZINSKY 1985). The outcome of our study may be, in conclusion, summed up as follows: in the reed bed – a habitat that may offer a lower availability of winter food since trees (and abundant seed crops) are not present – the spring density was lower, weight increased earlier, reproductive activity stopped earlier in both sexes, and male and female home-range sizes were larger than in the woodland population. In the woodland, probably as a response to better food availability, wood mice went into winter with a higher weight, stopped their reproductive activity later, maintained smaller home ranges, and reached the following spring with a higher density than the reed bed population. These last data may reflect a differential winter mortality between populations, since the October densities were not significantly different.

The differences in home-range size support the hypothesis that food availability differed between the habitats. According to a recent study (GORMAN and AHMAD 1993), differences in the home-range size of mice living in contrasting habitats are related, at least in part, to differences in food quality, availability and dispersion. Differences in food availability and quality may be then an important limiting factor for the reed bed wood mice; their main effect is that the mice will enter winter with a lower body weight and will suffer higher winter mortality. Their larger home-range size suggests that mice living in a poor-food habitat will enhance their survival by patrolling a wider area than in a rich habitat.

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Zusammenfassung

Vergleichende ökologische Untersuchungen an Waldmäusen, Apodemus sylvaticus, in zwei unterschiedlichen Lebensräumen

Einige ökologische Parameter der Waldmaus wurden in zwei unterschiedlichen Lebensräumen ermittelt: in einem Nadelmischwald und in einem Marschgebiet mit *Phragmites*- und *Carex*-Bewuchs. Die Marschpopulation zeichnete sich gegenüber der Waldpopulation durch folgende Unterschiede aus: 1. Die Populationsdichte war im Frühjahr deutlich niedriger, 2. die Körpergewichte waren im frühen Herbst geringer, 3. die mittleren individuellen Aktionsräume waren größer. Daraus wird geschlossen, daß den Marschwaldmäusen weniger Nahrung bei gleichzeitig geringerer Qualität zur Verfügung stand. Die Waldmäuse in der Marsch gehen mit einem geringeren Körpergewicht in den Winter, sie unterliegen gleichzeitig einer höheren Wintersterblichkeit, was eine geringere Frühjahrs-Populationsdichte zur Folge hat. Die größeren individuellen Aktionsräume in der Marsch werden mit knapperem Nahrungsangebot in Zusammenhang gebracht.

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