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Dispersal movements of edible dormice *Glis glis* between small woods in a fragmented landscape in Thuringia (Germany)

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Abstract

Dispersal movements of edible dormice *Glis glis* between 10 small woods in a fragmented landscape in the south of Altenburg (Thuringia, Germany) were investigated from 1999 to 2003. The size of these woods ranged from 0.6 ha to 21 ha and the distance between them varied from 20 m to 1 km. Woodlots were surrounded by cultivated fields and meadows. Field data were obtained using the mark-recapture method by conducting bimonthly nest box checks between May and October. A total of 1042 edible dormice were marked. No movements were recorded between the most distant woods (1 km). However 18 dormice moved between woods which lied 20 to 270 m apart. Dispersers were exclusively males. Most dispersal events involved both juvenile and subadult individuals. It could be assumed that dispersal events were associated with a high population density in small woodlands.

Keywords: Gliridae, habitat mosaic, migration, traveled distances

1. Introduction

The edible dormouse *Glis glis* is characterized as an arboreal mammal that avoids moving on the ground and crossing areas without vegetation. Indeed, radio-tracked animals preferred to cross gaps in forests by moving from branch to branch (Hönel 1991, Müller-Stieß & Herrmann 1997). Dormice took a longer route through the tree canopy to cross a forest road instead of using a shorter way on the ground. Therefore, it was assumed that forest roads or large-scale clear-cuttings could impede the exchange between edible dormouse populations in a forest. Negro et al. (2011) investigated the impact of ski pistes on dormice and other small mammals in the Italian Alps and found that these treeless areas are rarely crossed by small woodland mammals. Their results showed that ski pistes act as ecological obstructions to local movements of edible dormice.

In contrast to these results Bieber (1995a, b) recorded by mark-recapture studies that edible dormice crossed treeless agricultural areas in a fragmented landscape in Germany. She found that adult, but particularly subadult, individuals moved between several isolated habitats (forest, shrubs and hedges), thereby crossing a minimum distance of 46 m of treeless agricultural land.

The results of a study of edible dormice in 10 isolated small woods in the east of Thuringia (Germany) are presented here. The historical map of 1813 already characterized the study area as fragmented landscape with many small woodlots (Thümmel 1813). These are the remnants of earlier, once larger, forests. They are usually located in areas that, because of the slope or rocky terrain, could not be used for agricultural purposes. The occurrence of the edible dormouse in two of these woods has been known for more than 60 years (Grosse & Sykora 1967,

collection of Natural History Museum Mauritianum Altenburg). In the 1990s, edible dormice were recorded by nest box checks carried out in all 10 woods (Worschech et al. 2004). These woods were separated by agricultural areas. In the present study, conducted from 1999–2003, was used the mark-recapture method to investigate whether there are movements of dormice between the woodlots across treeless areas. The results offer further information on the dispersal behaviour of edible dormice.

2. Material and methods

The study was carried out in the far east of Thuringia (Central Germany) in the district of Altenburger Land. This region is sparsely wooded: the forest areas occupy only about 8% of the total area of the district (Hiekel et al. 2004). The study area with a mosaic of small woods and agricultural areas was located in the south of Altenburg where the landscape is very intensively used for agriculture.

The study area was subdivided into two parts: Part A consisted of eight adjacent woods, which were 0.6 to 4.8 ha in size and 20 to 270 m apart (Tab. 1). These woods were surrounded by cultivated fields and meadows. Two of them (no. 2 and 5) were separated from each other by a railway. Linear connecting structures (trees or shrubs), but not over the whole distance, lay between the woods no. 7 and no. 8 and between no. 2 and no. 5. Part B of the study area was located east of part A at a distance of approximately 1 km. It consisted of two woodlots, sized 1 ha (no. 10) and 21 ha (no. 1).

The vegetation type of all the woods was natural mixture of oak (*Quercus robur*) and hornbeam (*Carpinus betulus*) with some lime (*Tilia cordata*), maple (*Acer platanoides, Acer pseudoplatanus*) and ash (*Fraxinus excelsior*). The understorey was composed of elder (*Sambucus nigra*), hazel (*Corylus avellana*), European birdcherry (*Padus avium),* hawthorn *(Crataegus sp.)* and blackberry (*Rubus fruticosus)*. Some of the woodlots in the study area were not used, but most were extensively managed for forestry.

Field data were obtained by a mark-recapture study using nest boxes. Three wooden nest boxes per hectare were placed irregularly in the ten woodlots. The study period lasted from 1999 to 2003, but in 1999 only a few checks were carried out in the autumn. From 2000 to 2003 the nest boxes were checked twice a month from May until October. No checks were carried out during the breeding time in August. Individuals were weighed, sexed and marked individually by ear tattooing. Dormice were divided into the following age groups: juvenile = before the first hibernation (2–3 months old), subadult = survived the first hibernation (11–14 months old) and adult = after second hibernation.

3. Results

A total of 1042 edible dormice (part A = 700 and part B = 342) were marked. The number of marked individuals was highest in the oak-mast year 2000. Juveniles were recorded in every year, except in wood no. 8 in 2002. Altogether 20 movements of dormice between woods were registered, involving a total of 18 dormice (2.6% of the marked dormice in part A). No dispersal movements of dormice were detected between part A and the more distant woods (1 km) of part B, although the railway with tall herb vegetation along it could act as a connecting feature. Edible dormice moved exclusively between the woodlots of part A (Fig. 1). Thereby they crossed distances of at least 150 m. Both emigration and immigration could be observed in the woodlots no. 2, 3, 4, 5, 6 and 9 (Tab. 2).

To determine whether there is a correlation between population density of dormice and dispersal events, the woods of part A were according to the population size divided into 'optimal habitats' and 'suboptimal habitats'. Most dormice were marked and recorded on average per year (recorded/year means: marked individuals plus recaptured individuals, which have been marked in previous years) in the 'optimal habitats': woods no. 4, 7 and 9 (Fig. 2). These were also characterized by a high species and age diversity of trees, as well as a high proportion of oaks and many hazels in the understorey.

Tab. 1 Size of woods in part A and distances from each other.

No. of woods	Size (ha)	Distance to adjacent woods ( ) = no. of adjacent wood [see Fig. 2]
2	4,8	270 m (5), 215 m (3)
3	1,8	140 m (4), 150 m (6)
4	4,7	50 m (9), 20 m (6)
5	1,4	20 m (6)
6	3,2	see no. 3, 4, 5
7	0,6	20 m (4), 100 m (8)
8	2,6	240 m (9)
9	2,1	see no. 4, 8

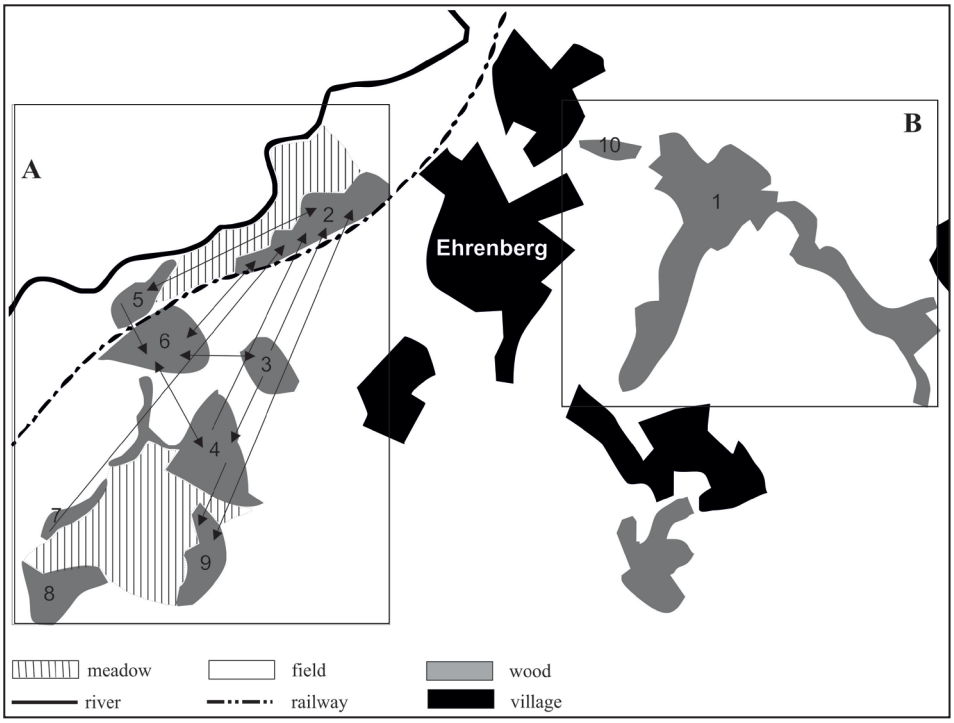

Fig. 1 Overview of dispersal movements in the study area (**A** – part A; **B** – part B).

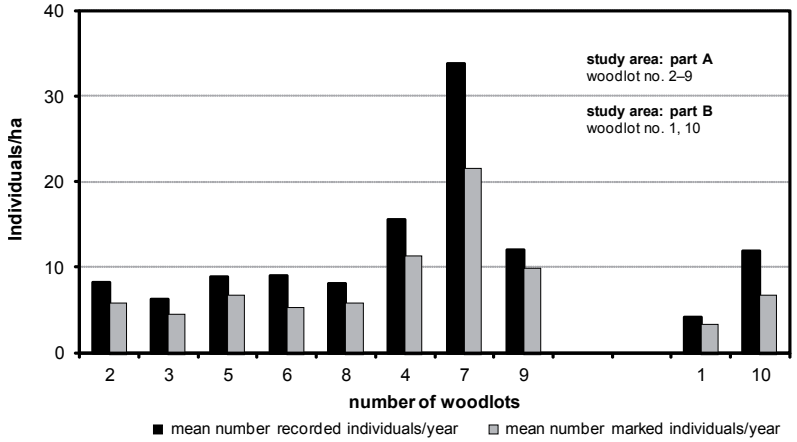

Fig. 2 Mean number of marked and recorded (marked and recaptured) individuals per year (2000–2003).

Tab. 2 Comparison of number of emigration and immigration events in optimal (no. 4, 7, 9) and suboptimal woodlots (no. 2, 3, 5, 6, 8).

No. of woods	Number of emigration events	Number of immigration events
4	4	2
7	2	0
9	1	2
total	7	4
relation	1.75 : 1	
2	4	7
3	3	1
5	3	2
6	3	6
8	0	0
total	13	16
relation	0.81 : 1	

Lower population densities were found in the 'suboptimal habitats', woods no. 2, 3, 5, 6 and 8 (Fig. 2). But the mean numbers of marked individuals/ha and recorded individuals/ha per year did not differ significantly between optimal and suboptimal habitats (Welch-test, recorded individuals/ha: $t = 1.83$, $p = 0.21$; marked individuals/ha: $t = 2.31$, $p = 0.14$).

Woodlots with higher population densities (optimal habitats) had significantly more emigrating and less immigrating dormice than woodlots with lower population densities (suboptimal habitats) (Tab. 2, $\chi^2 = 41.14$, $p < 0.0001$). A conspicuously high number of dormice which were marked as juveniles in the autumn 2000 (an oak-mast year) left their birth woods.

Sixteen individuals changed their woodlot once. Two animals moved twice, one of which went back to the woodlot which it had left two years ago. Dispersing dormice were all males. The age of individuals at the time of their dispersal movement could not usually be determined exactly because there was a long period of time between marking and recapturing. Only eight dispersing dormice could be aged exactly: one juvenile, four subadults and three adult males. Another six dormice moved either as juvenile or as subadult individuals.

4. Discussion

Edible dormice, especially males, can travel more than 400 m per night and have home ranges up to 7 ha within large forests (Morris & Hoodless 1992, Müller-Stieß & Herrmann 1997, Schlund et al. 1997, Jurczyszyn 2006, Scinski & Borowski 2008). However they are reluctant to cross open areas, for instance clear-cuttings, roads and ski pistes. The results of Bieber (1995b) and of the present investigations show that edible dormice frequently migrated between small woods in a fragmented landscape. On the way to other habitats they crossed meadows, fields and railways. In the study area in the south of Altenburg dispersal events of dormice took place between adjacent woods annually. These results indicate that movements between small woods are quite normal behavior of edible dormice in a fragmented landscape. Büchner (1997, 2008) drew the same conclusion from his investigations of hazel dormice (*Muscardinus avellanarius*) in a habitat mosaic in Saxony (Germany). This species, which has also been characterized by numerous authors as an arboreal specialist species (Bright & Morris 1989, Müller-Stieß & Herrmann 1997, Bright 1998, Morris 2003), crossed distances of more than 250 m over open areas in order to reach other woods. In contrast to Bieber (1995b) and Büchner (2008), who both found males as well as females among dispersing edible and hazel dormice, in the present study exclusively males were recorded. In agreement with these both authors, most dispersers were juvenile and subadult individuals. Bieber (1995b) established that juveniles dispersed during autumn, the time of highest population density. In the present study, the exact time (month or even year) of most dispersal events could not be determined, but it seems that more emigration took place in the autumn of 2000. This could be related to a high population density as a result of that oak mast year. The higher rate of emigration from woods with the highest number of dormice recorded per year also indicates a relationship between population density and dispersal behavior. In small woods dormice could be more likely induced to migrate by the limited availability of tree holes rather than by a shortage of food.

In the fragmented landscape in the south of Altenburg there are many small woodlands. The complex of woods (part A) in the present study is a permanent habitat for edible dormice due to the good habitat quality and the short distance between woods. A different situation is probably found in areas with more distant and isolated woods. In four other woods (more than 400 m away from part A) nest boxes were checked sporadically in 2007. No dormice were found. But from villages (e.g. Greipzig), which lie between part A and these woods, the author received a report of a dead dormouse (cat's prey; R. Naumann, personal communication 2004). This could indicate that dormice also travel from the woodland complex of Part A to more distant, isolated woods. Of course, the chances of successful migration decrease with increasing distances between woods. Connecting structures, which are rare in this landscape, could allow easier exchange of dormice between more distant woodlands.

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