

Ranging and movement of the Common dormouse *Muscardinus avellanarius* in Lithuania

Rimvydas JUŠKAITIS

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Adult *Muscardinus avellanarius* (Linnaeus, 1758) were found to be sedentary, showing small home ranges. The mean range area for males ($n = 46$) throughout their active season was 1.0 ± 0.05 ha, whereas for females ($n = 33$) it was 0.8 ± 0.05 ha. Male home ranges partially overlapped those of females and each other, whereas female home ranges hardly ever overlapped. In separate years adult dormice were sometimes found to change their home ranges. Dispersal was a necessary stage in the life of the young. The mean distance travelled from the birth place by young born in May–July ($n = 65$) was 360 ± 30 m, whereas the distance travelled by young born in August–September ($n = 109$) was 130 ± 10 m. The greatest travelled distance was 1200 m. About 90% of the young that survived the first winter became sedentary in the first autumn of their life, the remainder during the following spring.

Institute of Ecology, Akademijos 2, LT-2600 Vilnius, Lithuania

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Introduction

Although a lot of literature is available on *Muscardinus avellanarius* (Linnaeus, 1758) biology, not all questions have been answered. Little information exists on the ranging and movements of this species. Pielowski and Wasilewski (1960), Gaisler *et al.* (1977), Catzeflis (1984), Schulze (1973, 1987) investigated the movements of marked individuals together with other questions on the dormouse biology. However, attention was paid solely to the distances travelled by dormice from where they were marked to where they were recaptured.

Special investigations on ranging and movements of *M. avellanarius* were carried out in the Moscow and Tula regions (Likhachev 1967). In recent years study of ranging, movements and use of three-dimensional space by dormice in Great Britain have yielded good results based on radiotracking (Bright and Morris 1991, 1992). Ranging and movements of dormice were studied only in certain places and some questions, especially quantifying ranging and movements of the young, are still far from fully elucidated. Investigations carried out by the present author in Lithuania during 1984–1993, supplement this knowledge.

The aim of this paper is to present a general and quantified description of ranging and movements of *M. avellanarius* in Lithuania based on results of multiple captures of marked dormice in nestboxes.

Material and methods

Investigations were carried out in two locations: site A (southwestern Lithuania, Šakiai district) in 1984–1990 and site B (eastern Lithuania, Moletai district) in 1984–1993.

Site A, with an area of 60 ha and 262 nestboxes, covered approximately 22% of the whole area occupied by the *M. avellanarius* population in that locality. Forest here was middle-aged, with a great diversity of species stands. Prevailing tree species were birch *Betula pendula*, Norway spruce *Picea abies*, black alder *Alnus glutinosa*, and in some places aspen *Populus tremula* and ash *Fraxinus excelsior*. The understorey contained many hazels *Corylus avellana* and in some places buckthorn *Frangula alnus*.

Site B, with an area of 85 ha and 341 nestboxes, covered approximately 17% of the area occupied by the *M. avellanarius* population in that locality. In most of this site mature oaks *Quercus robur* grew with Norway spruce, aspen and maple *Acer platanoides*. The aspen forest dominated in some places. Hazel prevailed in the understorey.

The methods used to study *M. avellanarius* were based on three main principles: (1) even spacing of nestboxes in large forest areas, (2) regular checking of the boxes, (3) marking of all dormice caught.

In both sites, standard wooden nestboxes for small hole nesting birds were placed every 50 m, at a height of 1.5–2.0 m. The density was four nestboxes in 1 ha. The boxes were checked once a month from April until October, and twice a month in May and September. All dormice caught were marked with aluminium rings (the straightened plate is 2.5 × 8.0 mm). Suckling young weighing less than 10 g were marked by toe amputation, and ringed when caught again subsequently. All the animals were weighed and their sex and age determined. The dormice were treated as adult if they had survived at least one hibernation.

Home range size of adult dormice was determined following the Manville (1949) method using no less than 6 captures. Taking into account the location of nestboxes, 0.25 ha was taken as the area sampled by one nestbox.

During the entire study period all nestboxes in site A were checked 59 times and 627 dormice were marked. The nestboxes in site B were checked 84 times and 1142 dormice were marked. Of all the dormice marked, 342 (58.0%) and 489 (42.8%), respectively, were recaptured from 1 to 26 times. Total number of recaptures was 2256. In site A average population density in spring was 1.0 individual/ha and in autumn – 3.0 ind./ha, in site B – 0.7 ind./ha and 2.4 ind./ha, respectively (Juškaitis 1994).

Results

Based on the marking of dormice and their numerous recaptures, we may state that adults are sedentary and have fixed home ranges. Mean home range size for females ($n = 33$) was 0.8 ± 0.05 ha area, ie throughout their active season they were most frequently captured in 3 or 4 (from 1 to 5) adjacent nestboxes (Fig. 1). Females with their litters generally lived in one nestbox though occasionally they carried or led the whole family to a neighbouring nestbox 50–70 m away. The second brood was usually produced in a neighbouring nestbox 50–70 m away (19 cases of 27), occasionally in the same nestbox (4 cases of 27). Mean distance

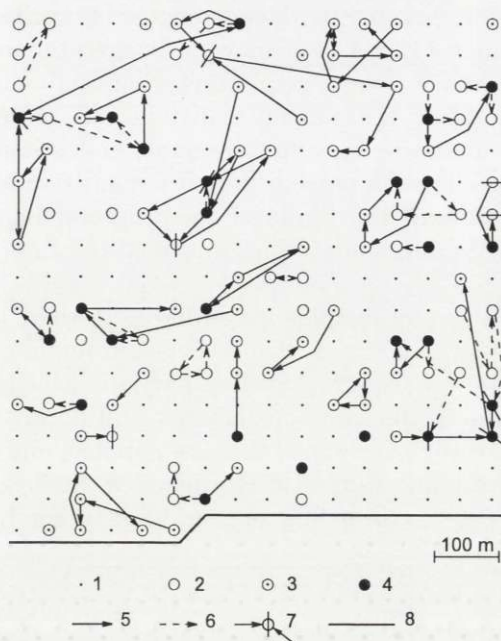


Fig. 1. The results of the capture of marked adult *Muscardinus avellanarius* in site A (April–October 1987). 1 – nestboxes, 2 – capture of females, 3 – capture of males, 4 – capture of males and females, 5 – movements of males, 6 – movements of females, 7 – overlapping home ranges of males, 8 – forest edge.

($n = 183$) travelled by adult females from one nestbox to another was 72 ± 3 m. The furthest travels of adult females (up to 200–250 m) were registered in autumn after the breeding season (Fig. 2).

Mean home range size for males ($n = 46$) was 1.0 ± 0.05 ha, ie throughout their active season they were most frequently captured in 3–6 (from 1 to 6) adjacent nestboxes (Fig. 1). Home ranges of adult males were greater than those of females

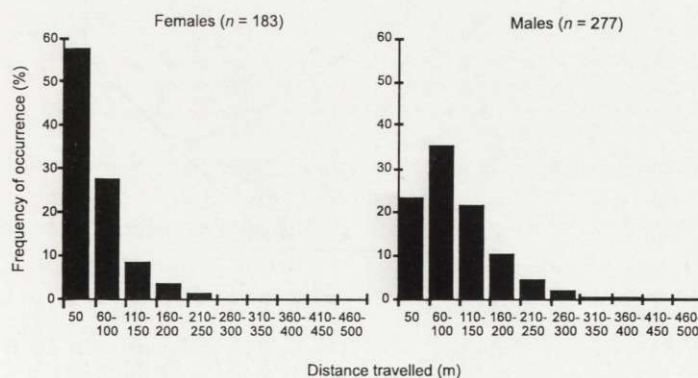


Fig. 2. Distances travelled by marked adult *Muscardinus avellanarius* between nestboxes.

(Student's t -test: $t = 4.2$, $p < 0.001$). Mean distance travelled by males between nestboxes ($n = 277$) made 112 ± 4 m. This was also greater than that travelled by females ($t = 8.0$, $p < 0.001$). There were cases when males travelled 200–300 m from one nestbox to another, the maximum distance registered being 500 m (Figs 1 and 2). Such great distances travelled by adult males it is mainly due to two main reasons: (1) in the mating season (most frequently in May and occasionally in July) males went beyond the limits of their normal home ranges and later returned, (2) in spring young males which survived the first winter were looking for vacant areas.

Home ranges of males and females also differed in their location with respect to other ranges. As shown in Fig. 1, home ranges of females seldom overlapped, whereas home ranges of separate males often partially overlapped, ie two or three males could be captured in the same nestbox but at different times. Home ranges of males, as a rule partially overlapped those of females, and a home range of one male could overlap the home ranges of two females. Such a spatial structure of dormouse populations in the breeding season, with larger home ranges of more

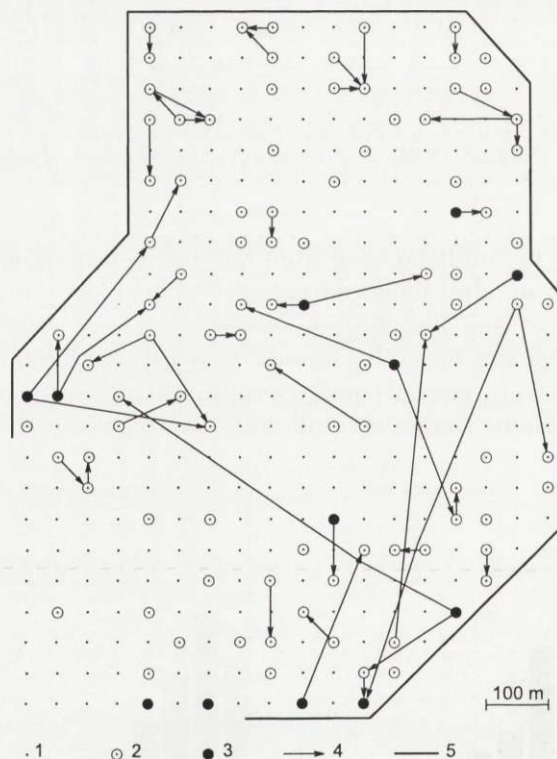


Fig. 3. The results of the capture of marked young *Muscardinus avellanarius* in site B (July–October 1985). 1 – nestboxes, 2 – capture of young dormice, 3 – marking of the brood, 4 – dispersal and movements, 5 – forest edge.

mobile males partially overlapping the smaller home ranges of more sedentary females, could create favourable conditions for reproduction.

Territoriality of adult males and females in spring may be illustrated by the following data. In April–June a single dormouse in a nestbox was found 1001 times, a male and a female – 78 times, two or three dormice of the same sex – only nine times. The latter cases were registered in late April to early May, ie soon after hibernation, prior to the breeding season.

In July, dormouse populations began to include the young that had been born in the same year and were already independent. Marking of the young in their birth places showed that dispersal is a necessary stage in their life. Only solitary individuals remained in their birth places, whereas the great majority were found at a certain distance away (Fig. 3). This distance depends upon when the young were born (Fig. 4). The young of earlier litters travelled further ($t = 7.75, p < 0.001$). Maximum distances travelled from the birth place by young born in May–July were 800–1200 m, mean distance ($n = 65$) being 363 ± 28 m. In contrast, maximum distances travelled from the birth place by the young that were born in August–September were 400–600 m, mean distance ($n = 109$) being 127 ± 12 m. It should

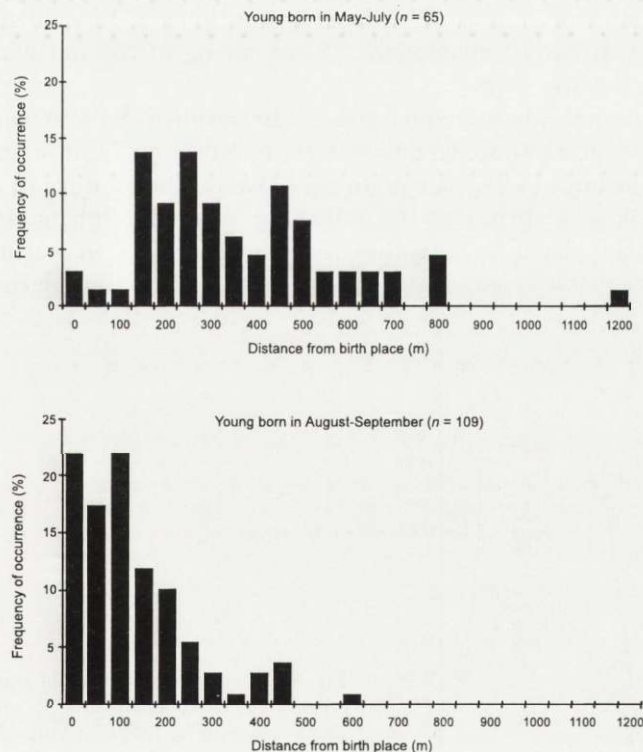


Fig. 4. Distance from birth place to recapture site moved by young *Muscardinus avellanarius* born in two different periods.

be noted that in both cases the mean distance travelled by these juvenile males and that travelled by juvenile females was nearly the same.

The maximum straight line distance that was travelled by a marked dormouse from one nestbox to another was 1200 m. This was in site B, travelled by a male born in June, marked in its birth place in July and recaptured a month later already independent. One more male, that was marked in its birth place outside site A in September and recaptured in the same place in mid-October, was recaptured again in June of the following year. It was then 1200 m away from its birth place, and had become resident in site A.

While analysing the results of marking young dormice, attention should be paid to the fact that, contrary to the animals marked in their birth places, the young marked already as independent animals, were most frequently recaptured in the same or adjacent nestbox (Fig. 3). We may assume that these dormice had already become sedentary. Dispersal of the young is likely to last about a month. Consequently, the young born in June became sedentary in August–September, and those born in August became sedentary in September–October.

However, some young dormice were observed travelling in spring of the next year as indicated by the following data. From the material obtained we selected 130 dormice which were captured at least three times: (1) in autumn of the first year of their life, already independent, (2) in spring of the following year, (3) in autumn of the following year.

In all three life periods indicated above 110 dormice (84.6%) were captured in the same or adjacent nestbox, or no more than 100 m away, ie within their home ranges. For six dormice (4.6%) the distance between the capture in autumn of the first year and that in spring of the following was 150–200 m. It is not clear, however, when the dormice travelled these distances – in autumn or spring. Fourteen dormice (10.8%) caught in spring were in the same place as in autumn

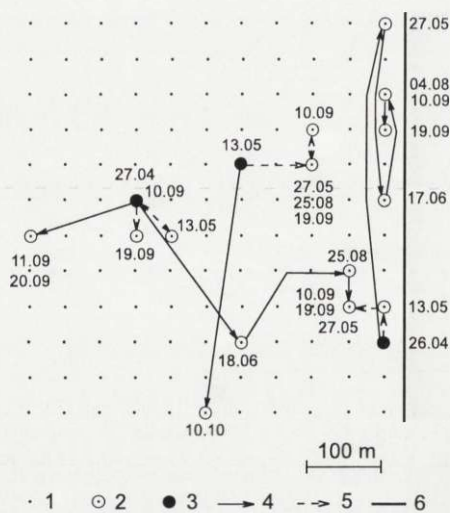


Fig. 5. The movements of young and old *Muscardinus avellanarius* males captured in spring in the same nestboxes (site A, 1986). Capture dates are specified near the capture sites. 1 – nestboxes, 2 – capture of males, 3 – capture of 2 or 3 males in spring, 4 – movements of young males, 5 – movements of old males, 6 – forest edge.

of the previous year, but later they travelled 150–350 m. Thus, we may conclude that about 90% of all the young that survived the first winter became sedentary in autumn of the first year of their life.

Wandering juveniles sometimes appeared in the home ranges of adult dormice and in autumn they might be frequently found in the same nestbox together (163 cases). The most frequent pairs were: an adult male and a young female ($n = 61$) or an adult female and a young male ($n = 48$). Nestboxes either with pairs of adult and young dormice of the same sex ($n = 27$) or with adult dormouse and two or three independent juveniles ($n = 27$) were less frequent. This suggests that in autumn there was no hostility between adults and independent juveniles, especially of different sex.

The young spent the winter in their established home ranges which overlapped those of adults. Approximately 70% of all dormice marked in autumn died during hibernation or at least were never recaptured after winter (Juškaitis 1994). The areas occupied in autumn, may be extended in spring or partially changed for new places.

Some of the young hibernated in the home ranges of adults, perhaps together with them. As a result, early in spring nine nestboxes were found with two or three dormice of the same sex but different age (in seven cases these were males). Three such cases were registered in 1986 in site A (Fig. 5). In all three cases old males remained in their home ranges. Whereas the young were forced to look for vacant areas and in May–June they were registered travelling 300–500 m. This is presumably the main reason for spring dispersal of young dormice.

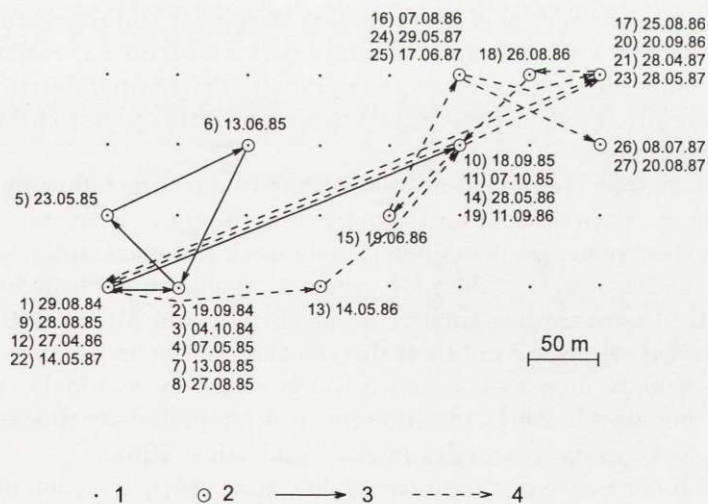


Fig. 6. The movements and home range shifts of the adult male No. 33 of *Muscardinus avellanarius* (site A, 1984–1987). Capture dates are specified near the capture sites. 1 – nestboxes, 2 – capture of the male, 3 – movements in the first and second year of the life, 4 – movements in the third and fourth year of the life.

Range shifts were also noted in some adult dormice. This phenomenon was more characteristic of males than females. A new home range may partially overlap the old one or adjoin it, it may also be distant from the earlier home range. The most vivid example is presented in Fig. 6. The movements of a male recorded over four years illustrate not only range shifts but also other issues considered in this paper.

A male born in June 1984 was first captured apparently already in an established range area. In 1985 it was living in the same area but in the autumn of the same year it moved to a new territory about 200 m away and was living there for the following two years. But in spring, both of 1986 and 1987, ie during the mating period, the male was captured in its old range area which was usually left in late May. The home range of this male as registered in 1987 did not entirely correspond with that in 1986.

Discussion

Some data are already available on home ranges of dormice (Wachtendorf 1951, Likhachev 1967, Schulze 1987, Bright and Morris 1991, 1992). They indicate that male home ranges are larger than those of females, and the home range of one male usually partially overlaps those of one or several females (Likhachev 1967, Bright and Morris 1991).

A precise range size for dormice has so far been considered only in a small number of works. In the Alps, for example, the nests of one animal were distributed over about 0.7 ha area (from 0.3 to 0.9 ha; Wachtendorf 1951). With the help of radiotracking in two localities of Great Britain (Somerset and Hereford) male home ranges were found to occupy approximately 0.45 and 0.68 ha, respectively, and female home ranges 0.19 and 0.22 ha, respectively (Bright and Morris 1991, 1992). Our defined dormice home ranges in Lithuania are little greater (1.0 ha for males and 0.8 ha for females).

These data, however, cannot be directly compared for the following reasons: (1) different methods of investigation (radiotracking is more accurate), (2) the time during which the range size is defined (in our work this parameter is established for the entire active season of dormice, whereas in shorter periods (and for radiotracking studies) dormice use smaller areas (Bright and Morris 1991, 1992), (3) abundance of food resources and their distribution in the environment (when food resources were more dispersed dormice would range more widely (Wachtendorf 1951, Bright and Morris 1991), (4) different population density (in cases of higher population density range is smaller in size (Likhachev 1967).

Despite of the presence of more recent home range size estimation methods used in radiotelemetry-based investigations (Samuel and Fuller 1994), we decided to employ that old one proposed by Manville (1949). We suppose that nestboxes with dormice nests were not situated on the border of the home range: area in all sides of the nestbox was used by animals. Under this supposition, size of the home range

of dormice was better evaluated by Manvilles (1949) method and not by most commonly used the minimum convex polygon method. In our case the last one leads to underestimated, and in some cases even zero-sized, home range size.

Our results showing partial male and female home ranges overlapping corroborate those obtained in the Moscow region (Likhachev 1967) and in Great Britain (Bright and Morris 1991, 1992). Concerning overlapping of home ranges between dormice of the same sex, there are some differences. In Lithuania female home ranges hardly ever overlap, whereas partial male range overlaps were occasionally registered, ie the same nestbox was found to hold two or three males during different checkings. Likhachev (1967) also maintains that female home ranges never overlap and indicates that one cannot speak about strict isolation of male ranges. Investigations in Great Britain showed that home ranges of female dormice overlapped more frequently and to a greater extent than those of males which seldom overlapped at all, especially in the breeding season (Bright and Morris 1991). It is not clear what the reasons are for such differences (different methods of investigation, diverse structure or density of populations).

In Lithuania were registered cases of range shifts in separate years, presumably due to low population density and the occurrence of vacant areas in the dormice populations studied (Juškaitis 1990). In the literature could be found only investigations of seasonal range shifts which were related to seasonal changes in food resources (Bright and Morris 1991, 1992).

Several authors (Pielowski and Wasilewski 1960, Likhachev 1967, Gaisler *et al.* 1977, Catzeflis 1984, Schulze 1973, 1987, Bright and Morris 1991, 1992) obtained results based on different ways of marking dormice and determining the distances they travelled. Maximum distances travelled by dormice were recorded in South Harze, where one marked male travelled 3300 m, five males – 1500–1800 m, and one female – 1400 m (Schulze 1987). Likhachev (1967) indicated that young born in early summer sometimes travelled 1 km or more. Other authors (Gaisler *et al.* 1977, Catzeflis 1984, Bright and Morris 1991, 1992) found considerably lower maximum distances. Most likely they registered merely the distances travelled by adult dormice. In Lithuania the maximum distance travelled (1200 m) was registered twice. The size of study sites did not allow us to register greater possible distances. Both in Lithuania and in other places (Likhachev 1967, Schulze 1973, 1987, Bright and Morris 1991, 1992) males are more mobile than females and travel greater distances.

With the exception of Likhachev (1967) other authors mentioned above did not consider the movements and range establishment of the young. Likhachev (1967) without presenting actual numbers, remarked that young born in early summer travel great distances but, not those of born in the second half of summer. This coincides with the present data obtained in Lithuania.

The data on the time when the young become sedentary differ slightly. In Lithuania about 90% of the young that survive the first winter had become sedentary in autumn of the first year of their life, the remainder in spring of the

following year. According to Likhachev (1967), in the Moscow region the majority of young females settle in their permanent home ranges also in autumn of the first year. A few of them were found travelling up to 300–500 m at the beginning of summer. Whereas young males become sedentary later than females, ie in spring of the second year of their life, and the majority in mid-summer or as late as in autumn. Such differences may be due to different population density, as it is difficult to find a vacant area where population density is high.

Future investigations should be carried out alongside research into population density. It would help to elucidate how ranging and movements of dormice depend upon population density. A complex of methods, including radiotracking, would help to elucidate many of these questions.

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