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# BREEDING AND BIOLOGICAL DATA FOR THE COMMON DORMOUSE (MUSCARDINUS AVELLANARIUS) IN EASTERN SAXONY (GERMANY)

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A mark-recapture study was undertaken in Upper Lusatia (Eastern Saxony, Germany) in 1996 and 1997, where data on breeding, daily torpor and parasites of common dormice (*Muscardinus avellanarius*) could be gathered by nest box checking and live trapping. Juveniles were born from June to October, so the breeding period lasted for nearly the whole active season of the dormice. Mean litter size was 4.2 among new-born juveniles and 3.6 among 4 to 6 week old nestlings. Single cases of females with a second litter in the same year were recorded, as well females reproducing before their first hibernation. Daily torpor occurred throughout the whole active season. Two species of fleas and one tick were found on common dormice and five flea species were found in nests.

Key words: *Muscardinus avellanarius*, breeding, daily torpor, ectoparasites, *Siphonaptera*

## INTRODUCTION

The Common Dormouse is a rare species in Germany, occurs at low densities, is long-lived and could be considered as a k-strategist among small mammals (BRIGHT & MORRIS 1996). However, although there are few wild mammals where litters and their development can so easily be observed (using nest boxes) as in common dormice, the breeding of this protected species is far from being fully elucidated over its whole distribution area (JUŠKAITIS 1997*a*). One aim of the present study was to obtain data on breeding from Upper Lusatia (Eastern Saxony, Germany) to compare with data presented by JUŠKAITIS (1997*a*) and other authors. Common dormice show a special behaviour: optional daily torpor at comparatively high temperatures (EISENTRAUT 1956). The present study provides some data on the occurrence of daily torpor in a study area in Central Europe. Parasites can be an important feature in the ecology of a species (BEGON *et al*. 1996), and the fleas and ticks found on common dormice in Upper Lusatia are also recorded here.

## METHODS

Data on the breeding of common dormice were gathered by a mark-recapture study in 1996 and 1997 in a hilly landscape in Upper Lusatia. Typical habitats for common dormice in the study area are forests dominated by European bird cherry (*Padus avium*) and ash (*Fraxinus excelsior*); birch-oak woods (*Quercus petraea* and *Betula pendula*) with well developed under storey of mountain ash (*Sorbus aucuparia*), hazel (*Corylus avellana*), blackberry (*Rubus fruticosus*) and raspberry (*R. idaeus*) and well developed species-rich forest edges. Two small and isolated woods were chosen as study sites, one was an area of old coppicing and the other formed the edge of surrounding larger forests.

The climate in the study area shows a yearly temperature range of 18.5 to 19 °C (average temperature 7.5 to 8 °C), with annual rainfall of about 700 mm (SCHMIDT 1994).

Since dormice willingly occupy nest boxes and about 90% of the population can be found there (MORRIS *et al*. 1990, JUŠKAITIS 1997*b*) a total of 220 specially designed wooden nest boxes were put up in January 1996 with their entrance hole facing a tree trunk. They were positioned at a height of 1.5 to 2 m above ground in three grid systems (covering the small woods and the coppicing area) and in rows along the edges of the large forests with distances between the nest boxes of approximately 30 m. Additionally, live trapping with 50 wooden live traps (20 cm long × 6 cm wide × 8 cm high) made by DeuFa (Neuburg/Inn Germany) was conducted. Traps were set in trees or shrubs overnight, between 1 and 2.5 m above the ground (BRIGHT & MORRIS 1989).

Nest boxes (216 in 1996 and 202 in 1997) were inspected at two-weekly intervals from March 20th to November 14th 1996 and March 26th to December 1st 1997. Live trapping was conducted during the summer of both years. Results from 1,350 trap nights in 1996 and 305 trap nights in 1997 could be analysed.

Upon capture, dormice were sexed, weighed, checked for reproductive status, their location was noted and if possible the age was estimated. For age estimation from July onwards animals below 15 g body mass were considered as juveniles and animals after their first hibernation were considered as adults. Birth dates were estimated according to the development of external features (SCHULZE 1970). Animals were marked individually by ear tattoos and identified if recaptured. Fleas (Siphonaptera) were directly picked from 8 dormice and one tick (Ixodidae) from one dormouse. In November 1996, 54 dormouse nests were removed from the nest boxes for gathering and identifying fleas.

During the study period 204 individuals were found or trapped and marked individually in 368 captures.

## RESULTS

Juveniles were born in the study area from June to October, so the breeding of common dormice occupies nearly the whole active season. The first litters were found during both years in the first week of June. The earliest birth was on June 2nd (1997) and the latest birth date was October 21st (1997). Figure 1 shows the dynamics of births during the seasons. If a litter was not obviously new-born, the birth date was estimated.

The litter size ranged from 2 to 6 new born individuals. The distribution of litter size was different between the two years. More and larger litters were registered in 1997 compared to 1996 (Table 1). Postnatal mortality could be recorded in some

**Table 1.** Size of litters of *Muscardinus avellanarius* in different ages in 1996 and 1997

| Litters with | year | litter size | | | | | average litter size | |
|---|---|---|---|---|---|---|---|---|
| | | 2 | 3 | 4 | 5 | 6 | | |
| Fresh born juveniles | 1996 | 1 | 1 | 6 | 0 | 0 | 3.6 | 4.2 |
| | 1997 | 0 | 0 | 7 | 2 | 2 | 4.5 | |
| Nearly independent juveniles | 1996 | 0 | 3 | 2 | 0 | 0 | 3.4 | 3.6 |
| | 1997 | 1 | 3 | 5 | 2 | 0 | 3.7 | |

**Table 2.** Reproduction indices of *Muscardinus avellanarius* in two years

| Year | Number of adult females | Number of reproducing females | Number of females with two litters | Number of females reproducing before first hibernation |
|---|---|---|---|---|
| 1996 | 19 | 11 | 1 | 1 |
| 1997 | 30 | 17 | 4 | 1 |

cases but differences in the litter size between new-born and nearly independent juveniles could not be shown ($Chi^2$-test n. s.) because sample size was too small.

Only a proportion of the females known to be present in the study area were found with reproductive signs, 58% of all marked adult females in 1996 and 57% in the following year. The reproduction indices are shown in Table 2.

A second litter could be recognized in 18 % of all reproducing adult females. For one female both birth dates could be exactly determined. The time between the two litters was 41 days.

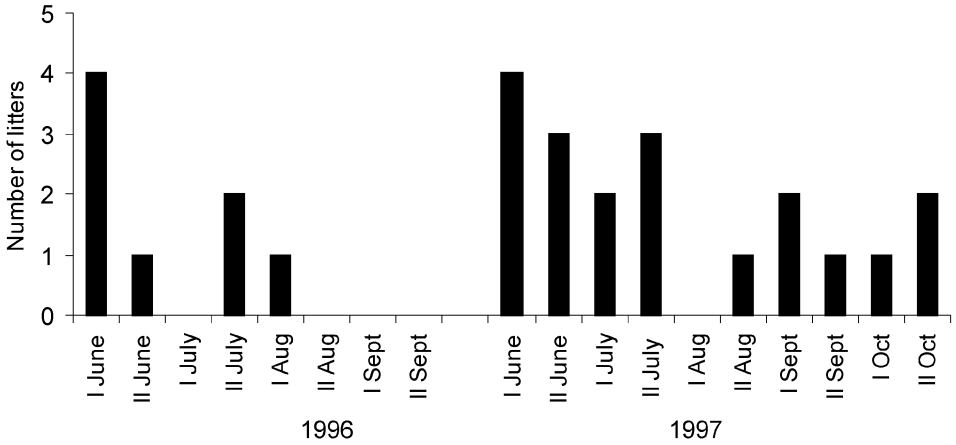


**Fig. 1.** Number of litters of *Muscardinus avellanarius* per half of month during the years 1996 and 1997

**Table 3.** Frequency of *Muscardinus avellanarius* in torpor and percentage all animals found in nest boxes

| Sex | | frequency | % of all those found in nest boxes |
|---|---|---|---|
| Female | juvenile | 1 | 0.006 |
| | adult | 6 | 0.06 |
| Male | juvenile | 0 | – |
| | adult | 16 | 29.1 |

In both years a single case of a marked female breeding in the same year as it was born was also recorded. One marked juvenile female had swollen nipples in 1996. The female in 1997 was born around the 28th of July in a second litter. She gave birth to 4 juveniles on October 14th.

By checking nest boxes 17 individuals were found in torpor for a total of 23 times, classified according to age and sex in Table 3.

While adult females were found only exceptionally in torpor, nearly one third of the males were lethargic. The difference is significant ($Chi^2$-test, $p = 0.03$). Lactating females were never found in torpor. The difference between the age groups is more distinct than the difference between adult females and males ($Chi^2$-test, $p < 0.001$). Juvenile dormice were found a total of 169 times in nest boxes, but only one was in torpor.

A relationship between the body mass of a dormouse and tendency towards lowering the body temperature was found, although there were individuals in tor-

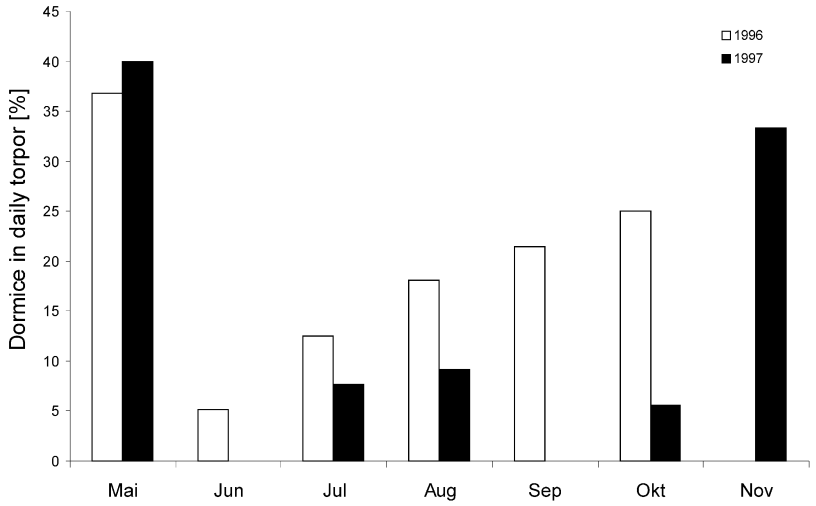


**Fig. 2.** Percentage of adult *Muscardinus avellanarius* found in daily torpor during the active season

por with lighter body mass than the monthly average body mass as well as heavier animals. Daily torpor could be observed during the whole active season, but the majority of lethargic dormice were found in May. The percentage decreased during summer and increased again in the autumn (Fig. 2).

Dormice in torpor were found in spring particularly after nights with minimum temperatures of about 0 °C.

Altogether 27 fleas were collected from 8 individual dormice, between 1 and 13 fleas per host animal. Two species were recorded: *Monopsyllus sciurorum* and *Megabothris turbidus.*

Fifty four dormouse nests were removed from nest boxes, 43 of which contained a total of 1,113 fleas, belonging to 5 species as shown in Table 4.

One nymph of the wood tick *Ixodes ricinus* was collected from one dormouse.

## DISCUSSION

The data on breeding are similar to those recorded for Lithuania (JUŠKAITIS 1997*a*) and Switzerland (CATZEFLIS 1984) where the breeding period (from mating until independence of the juveniles) was also reported to continue for nearly the whole active season. As expected, the majority of litters were found in June. Juveniles born in early summer will have the best chance to accumulate fat reserves for hibernation. The very late litters in 1997 were probably a response to the warm and dry weather in autumn that year. They show the wide variation of breeding time that is possible, but the probability that these late born individuals will survive the winter is rather low (JUŠKAITIS 1999*a*), since a dormouse should weigh at least 15 g before hibernation (BRIGHT & MORRIS 1996).

The average litter size of 3.6 in litters 4 to 6 weeks old is the same as in Hessen (BANGURA 1988) and similar to the size (3.8 respectively 3.7) recorded in the Harz mountains (SCHULZE 1970) and the Alps (KAHMANN & FRISCH 1950). JUŠKAITIS (1997*a*) obtained yearly variation in litter size (between 3.4 and 4.4) in

**Table 4.** Species and numbers of Siphonaptera from 43 nests of *Muscardinus avellanarius*

| Species | Number |
|---|---|
| *Monopsyllus sciurorum* | 550 |
| *Ceratophyllus gallinae* | 403 |
| *Megabothris turbidus* | 113 |
| *Ctenophthalmus agyrtes* | 46 |
| *Ctenophthalmus solutus* | 1 |

Lithuania. In comparison to these data, the present study was much too brief and the study site too small to see differences between the years. The same problem arises with the comparison of size between first and second litters of one female in the same year because only 5 second litters were found. While these five litters were the same size as the first five, in Lithuania the second litter of a female was larger than the first (JUŠKAITIS 1997*a*). In contrast, MÜLLER-STIESS (pers. comm.) found first litters to be larger than the second.

Even though not all of the marked females were found during the whole season it can be stated that only a proportion of the females reproduce. There seem to be different reasons for this phenomenon, like duration of torpor and variable food supply (BRIGHT & MORRIS 1996), also densities and age structure of the population (JUŠKAITIS 1997*a*, 1999*b*).

Two litters per female in one year are regular reproductive behaviour of common dormice in Upper Lusatia. If we consider the very different recapture rates of adult females (from 0 recaptures to 17 in two years) the proportion (18%) of the females found with a second litter is probably underestimated in this study. Previously, ZIMMERMANN (1921) had pointed out that the common dormouse has two litters per year, whereas SCHULZE (1973) in Harz and BANGURA (1988) in Hessen found second litters only in exceptional cases and in the Alps no second litter of a female in the same season was recorded (KAHMANN & FRISCH 1950, WACHTENDORF 1951). In Lithuania the mean proportion of females with a second litter was 38%, where the proportion of females with a second litter (as well as the proportion of reproducing females) depends on the spring population density (JUŠKAITIS 1997*a*).

SCHULZE (1970) thought that females might reproduce before their first hibernation, but he could not record a marked individual doing so. In Switzerland, CATZEFLIS (1984) described single cases of dormice breeding in the same year as they were born. In Upper Lusatia it appears that these cases are occasional events, but the proportion of females breeding before their first hibernation is probably higher than is verifiable. The problem is the difficulty of estimating the age of an unmarked individual in the autumn, since the adult dormice also have grey colour in their fur in Lusatia. Age estimation from body mass of a dormouse is rather unreliable in the autumn since there have been several marked juveniles with weights of more than 20g already by September. JUŠKAITIS (1997*a*) regularly found females with litters in their first year and showed that population density is again the regulating factor, although the importance of feeding factor cannot be ignored.

Hibernation is an adaptation to overcome food shortage for dormice during winter. For the start of hibernation the crucial temperature for common dormice is comparatively high at about 16 °C (EISENTRAUT 1956). Even during summer the

temperature often falls below this crucial value in central and northern Europe. Dormice can optionally spend these days in a 'light hibernation' (EISENTRAUT 1956). BANGURA (1988) showed a correlation between dormice in torpor and the ambient temperature but BRIGHT and MORRIS (1996) pointed out that food availability is another factor. This may explain why dormice in torpor were found at the present study site in July and August 1997, but none in September when there was abundant food available. It seems that endogenous factors are also important. Lactating females have to care for their offspring and probably cannot enter torpor, and for juveniles it also seems important to be active the whole time to find food.

STRIESE (1989) surveyed fleas and their hosts in Upper Lusatia, but found only one flea on the common dormouse, *Megabothris turbidus.* In the present study, beside this species, the squirrel flea (*Monopsyllus sciurorum)* was found as a parasite directly on dormice. Furthermore it might be supposed that *Ctenophthalmus agyrtes* is a third species living on common dormice in the study area since it was found in nests and has already been described as a parasite of dormice (MOHR 1954, ROSICKY 1957, STRIESE, unpubl. data). The other two species of fleas found in dormice nests point to other users of the nest boxes. *Ceratophyllus gallinae* is the most common flea found on birds living in tree holes and *Ctenophthalmus solutus* prefers small mammals like wood mice (*Apodemus sylvaticus*) or yellow necked mice (*A. flavicollis*), both of which sometimes use dormouse nest boxes.

The single record of the tick *Ixodes ricinus* on a dormouse could be an exceptional one.

Investigations on prevalence of parasites on common dormice are still lacking but it could be shown for the study area that dormice are not free of parasites. In contrast, BRIGHT and MORRIS (1996) found dormice in England were normally remarkably free of flees, mites and ticks. The only life-threatening parasite found there was the nematode *Rhabditis orbitalis* inhabiting the surface of the eye. In addition to the fleas, the louse *Schizopthirus pleurophaeus* has also been described from the common dormouse (MOHR 1954).

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