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# Locomotory Activity Pattern of Wood Mice as Measured in the Field by Automatic Recording

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Halle S., 1988: Locomotory activity pattern of wood mice as measured in the field by automatic recording. Acta theriol., 33; 22: 305—312 [With 1 Table & 2 Figs]

The locomotory activity of free ranging wood mice *Apodemus sylvaticus* (Linnaeus, 1758) was for the first time registered by means of passage-counters. Although activity prevailed at night during the 4 months of observation, a remarkable amount of daytime activity was found. The latter occurred sporadically and did not follow a continuous time schedule. Further evidence of sporadic diurnal activity could be found in literature, so this behavioural component might be of some importance in the field. Hypothetically, the findings could be explained by the existence of different behavioural types within wood mice populations.

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## 1. INTRODUCTION

The activity of wood mice *Apodemus sylvaticus* (Linnaeus, 1758) has been carefully examined in cages and small enclosures several times (*e.g.* Miller, 1955; Ostermann, 1956; Gurnell, 1975; Lodewijckx *et al.*, 1984). The results seemed to be unequivocal: specimens were strictly nocturnal; a bimodal pattern was to be observed during long nights and a monomodal one during short nights. This view was substantiated by trapping (*e.g.* Brown, 1956; Bäumler, 1975; Larina & Tarasov, 1979) and by radio-istotope tracking (Kikkawa, 1964). Nevertheless, data were not totally satisfying because of the artificial conditions in cages as well as during trapping. Furthermore, radio-isotope tracking in the field was done for one individual and one night only.

The first experiments to study behaviour under natural conditions in detail were made by Wolton (1983), using very light radio collars and a continuously working receiver. With this method, he was able to observe the behaviour of distinct individuals for several days. Although his results supported the general view, there were some hints at a daylight activity component occurring occasionally. Therefore it seems possible, that investigations in the field might bring results which are partly divergent from those in the laboratory.

Surveys on behaviour in natural environments, however, are complicated by inevitable methodical difficulties. Various uncertainties like weather, social conditions and food supply cannot be catered for and an influence on behaviour by the investigation itself can never be totally excluded. Nevertheless, the need of data is obvious, because, when discussing the risk of predation or competition with other species, one has to know what happens in the field. In the case of *A. sylvaticus* this is of particular importance because it is a very common small mammal species in a wide range of biotopes. We tried to employ a method of registering the total above-ground movements of wood mice. It does not concern the behaviour of individuals but of a whole population.

## 2. MATERIAL AND METHODS

In order to measure the distribution of locomotory activity over the 24 hour-cycle, modified passage-counters as described by Lehmann & Sommersberg (1980) were used. Passing through a PVC-tube, small mammals activate a reed-switch by stirring a swing-gate with a magnet attached. The current impulses are registered by an event recorder. This method was developed for voles which mainly move in discernible runways. For *A. sylvaticus*, above-ground activity is not restricted to a runway system, so it was necessary to direct the mice through the passage-counters. This was done by using a chipboard barrier (Fig. 1), covering a length of 14 m, a height of 40 cm and embedded 20 cm in the ground. Every 2 m there was an obtuse angle of about 20°, so the barrier ran zigzag. At the ends further chipboards were placed at right angles so that lateral boundaries were formed. A total of 8 passage-counters were placed at small openings which had been made at each angle and at the ends.

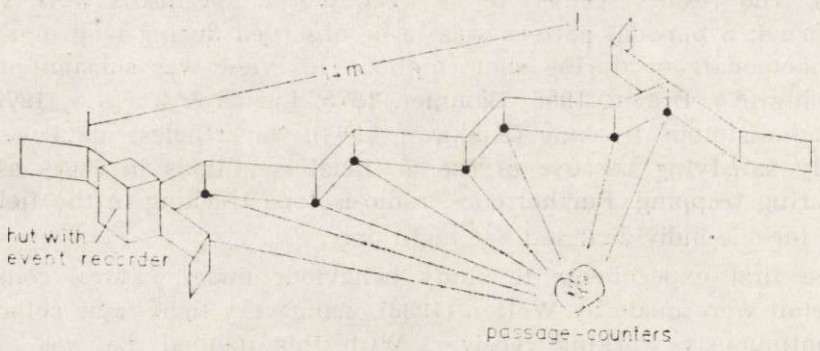


Fig. 1. General view of the barrier which enables the registration of *A. sylvaticus* above-ground movements. Eight electro-mechanically operating passage-counters were placed at small openings at the angles and at the ends of the barrier. Passages were registered by a battery-operated event recorder, which was placed in a hut beside the barrier.

Consequently, such a barrier would lead all species of adequate size through the passage-counters. It was necessary to find a study area where *A. sylvaticus* was the only correctly-sized species. Such a biotope was found in an extended afforestation area of the Rhineland lignite district (50°54'N, 6°24'E). From intensive trapping, it was known that during the first two years after afforestation, the small rodent population in this area, characterized by sparse vegetation cover, was exclusively restricted to *A. sylvaticus* (Halle, 1987).

Activity was registered at one plot for 4 months (August to December 1985). During this time, no trap catches were performed in the surrounding area, as this could have affected the results. Autumn was the most suitable period for the investigation because the density of *A. sylvaticus* reached its maximum during this season (Halle, 1987) and therefore a sufficient amount of passages was guaranteed. For technical reasons, 24-hour activity patterns were evaluated over 7 differing periods of consecutive days. The counts for each hour of the 24-hour day were summarized and then expressed as percentages of all counts during one evaluation period. To separate day and night, the average times of sunset and sunrise were used for each evaluation period.

## 3. RESULTS

A total of 1305 passages were registered. 899 passages (68.9% of the total) occurred between sunset and sunrise, which confirms that *A. sylvaticus* is a mainly nocturnal species. The activity patterns of the 7 evaluation periods are given in Fig. 2. For the nocturnal component, the typical bimodal pattern was revealed with a first, sometimes very pronounced peak just after sunset, and a second maximum some hours before dawn.

The pattern of activity varied, however, to a great degree. During three evaluation periods (14 August — 2 September, 14—23 October and 11—18 November) activity was entirely at night. During the other periods, considerable diurnal activity occurred. Especially during the second and the last period, activity at daytime was nearly of the same dimension as that at night (Table 1). The diurnal component, however, appeared in an irregular manner and could not be described by a continuous pattern. Only in some cases could a more or less pronounced daylight peak be observed in the early afternoon.

The real existence of a diurnal component of above-ground activity in the field was confirmed by two further indices. First, P. Schnitzler (pers. com.) investigated the ecology of avian predators in the same afforestation area and reported 6 visual observations where kestrels (*Falco tinnunculus* Linnaeus, 1758) or buzzards (*Buteo buteo* Linnaeus, 1758) struck wood mice in broad daylight. The prey was clerly identified

by the long tail. Second, we found 13.2% of the prey to be *A. sylvaticus* when analysing the pellets of kestrels and buzzards (Halle, 1987). Both findings verify that, to some extent, wood mice must be present above the ground also in daylight.

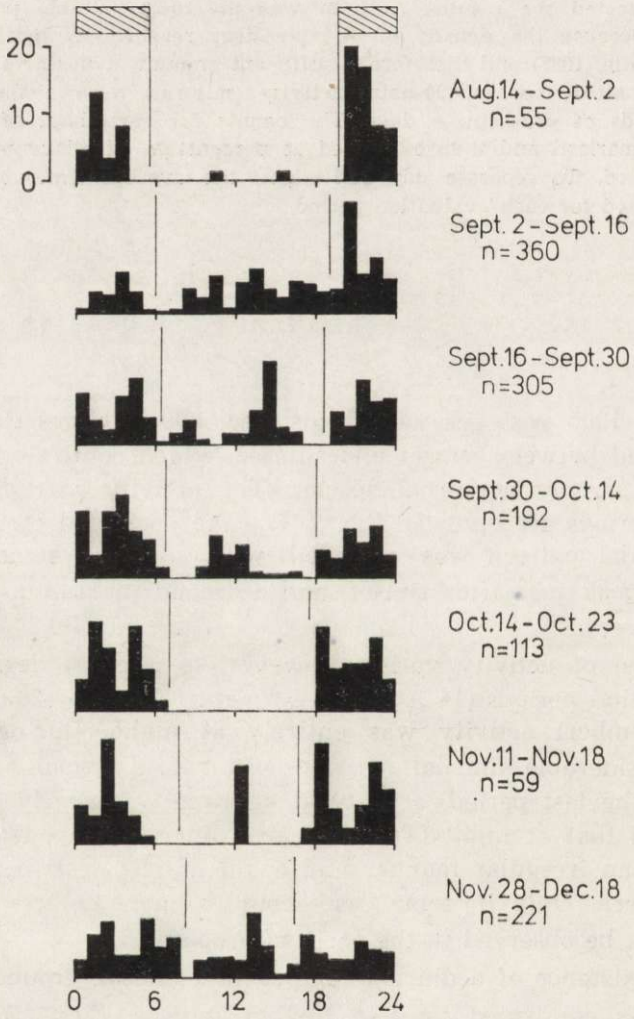


Fig. 2. 24-hour activity patterns of *A. sylvaticus* as measured by passage-counters. $n=100\%$ is the total number of passages during one evaluation period; the passages of one hour are expressed as percentages. Times of sunrise and sunset are marked by vertical lines.

Table 1

Comparison of the amount of diurnal and nocturnal activity. For both phases, single-phase duration and both the relevant percentage amount of activity and the average activity per hour of the phase are given.

| | Evaluation period | | | | | | |
|---|---|---|---|---|---|---|---|
| | Aug. 14 -Sept. 2 | Sept. 2 -Sept. 16 | Sept. 16 -Sept. 30 | Sept. 30 -Oct. 14 | Oct. 14 -Oct. 23 | Nov. 11 -Nov. 18 | Nov. 28 -Dec. 18 |
| | | | Daylight | | | | |
| Duration (hours) | 14 | 13 | 12 | 11 | 11 | 9 | 9 |
| % of passages | 2.8 | 42.9 | 33.2 | 19.1 | 0 | 11.6 | 28.3 |
| Average % of act. per hour | 0.2 | 3.3 | 2.8 | 1.7 | 0 | 1.3 | 3.1 |
| | | | Night | | | | |
| Duration (hours) | 10 | 11 | 12 | 13 | 13 | 15 | 15 |
| % of passages | 97.1 | 56.9 | 66.3 | 80.9 | 99.9 | 88.3 | 71.9 |
| Average % of act. per hour | 9.7 | 5.2 | 5.5 | 6.2 | 7.7 | 5.9 | 4.8 |

## 4. DISCUSSION

The activity of *A. sylvaticus* has mostly been investigated under the aspect of the individual time schedule. Only trap catches relate to the average activity of populations, but this method can analyse the pattern of trappability only. The use of passage-counters represents a new vantage point, because the overall locomotory activity of a population can be studied directly.

By using passage-counters, the locomotion of totally unrestricted specimens was registered and *A. sylvaticus* was the only small mammal in the studied plot. Under these circumstances, a remarkable amount of diurnal activity was observed, which was also indirectly confirmed by the fact that wood mice were a prey of diurnal avian predators. So, at the first view, results seem to be in contradiction to hitherto reported findings: extended daytime activity has never been observed, neither in registration cages nor from trap catches.

However, reading the literature carefully, one could find some very interesting statements. Miller (1955) commented on his results from registration cages as follows: "Daytime activity was more or less sporadic and represented 28.1 per cent of the total" and "The wood mice were consistently more nocturnal than the voles, but in none of the experiments were they strictly nocturnal as they appear to be in the field." He supposed that daytime activity was a phenomenon owed to the artificial laboratory environment. But in our data from free ranging mice, a comparable amount of diurnal activity was obvious (see Table 1).

Furthermore, Brown (1956) stated when summarizing the results of trapping experiments: "Only a few persistent trap visitors among *Apodemus* broke their strictly nocturnal habit, such animals being normally only a small percentage of the total population." Further evidence for at least small amounts of diurnal activity are found in the data of Ostermann (1956), Bäumler (1975), Gurnell (1975) and Larina & Tarasov (1979).

The most essential and perhaps the only relevant results in connection with the activity of *A. sylvaticus* in the field are those gained by radio-tracking. Wolton (1983) was able to follow 14 individuals for at least 7 days during different seasons of the year. The absence of animals from their nests was interpreted as locomotory activity and, therefore, the methodical view was somehow similar to ours. He found that at every season wood mice were nocturnal, however some specimens broke the rule. In mid-winter, one male was active in broad daylight while the others were strictly nocturnal. During the observation period the ground was covered with snow for 4 days in 12, so hunger was supposed to be a possible explanation. In late winter and spring, only sporadic and short excursions from the nests occurred during daytime. Then, for the summer months, extended diurnal activity could be observed in pregnant or lactating females which were obviously foraging. One female in the midst of June described by Wolton (1983) had a daytime activity peak just after noon, as sometimes found in our data as well.

What are the conclusions from these findings? It must be stressed that the primary nocturnal habit of *A. sylvaticus* is not doubted. Nevertheless, it seems that in the field a significant diurnal component of locomotory activity appears. This component does not follow a continuous time schedule and the appearence is sporadic. Diurnal activity is obviously not restricted to situations with difficult food supply (as Wolton (1983) supposed), because our data are derived from autumn, when breeding for the most part was over (Halle, 1987) and a lot of grain was available.

Therefore a different interpretation seems to be reasonable: considerable daytime activity might be caused by distinct individuals with differing time schedules. This hypothesis would explain the observations of Brown (1956) and Wolton (1983) that only some individuals were active during daylight while the others were not. It would also explain why the amount of diurnal activity in our data varied from one evaluation period to another, since individuals with differing time schedules might only be present at the barrier on some occasions. This view is

supported by the high turnover rate during the early stages after afforestation (Halle, 1987). Beyond that, there is some further evidence for the variance of behaviour. Gurnell (1975) found "much interindividual variation" when investigating the behaviour of *A. sylvaticus* in artificial enclosures. Again, testing the amount of activity, Lodewijckx *et al.* (1985) observed large variances, but a very constant reaction of individuals, when they were tested repeatedly. From these findings they also came to the conclusion that several behavioural types might exist within the population.

The results obtained by passage-counters seem to support the hypothesis of behavioural heterogeneity in populations of *A. sylvaticus*. Further investigations in the field are needed to elucidate that problem.

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RYTM AKTYWNOŚCI MYSZY ZAROŚLOWEJ W WARUNKACH NATURALNYCH

Streszczenie

Aktywność lokomotoryczną myszy zaroślowej *Apodemus sylvaticus* (Linnaeus, 1758), badano metodą automatycznej rejestracji przejść w warunkach naturalnych. W ciągu czterech miesięcy obserwacji (sierpień — grudzień) u myszy przeważała aktywność nocna. Stwierdzono także znaczący udział aktywności dziennej, która nie miała ustalonego wzorca, lecz zdarzała się losowo (Tabela 1, Ryc. 2). Być może nocna i dzienna aktywność jest wynikiem współwystępowania w populacji osobników o różnych typach zachowań.