BEHAVIOR OF MOUND-BUILDING MOUSE, *MUS SPICILEGUS* DURING AUTUMN-WINTER PERIOD IN CAPTIVITY

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ABSTRACT

*Mus spicilegus* is an outdoor species from southern-eastern Europe, adapted to agroecosystems. In the beginning of autumn, to spend the winter, mound-building mice build complex mounds. These mounds are built using accumulation of seeds covered with earth. This behavior is unique among mice species. However, there is evidence that at higher temperatures and a larger availability of food in winter, mice can optimize this particular behavior in direction to simpler constructions or even not build them at all. To clarify if mice display building activity under laboratory conditions we studied behavior of *M. spicilegus* in 5 intraspecific cage groups during autumn-winter period. The observations were carried out in 100 x 100 cm glass cages provided with earth and sawdust as bedding and straw and hay as nesting material. The groups were formed by 3-4 mice captured from a wild population in northern Bulgaria in early September of 2008, where mounds were already built. Mice were grouped according to the mound they belong to. The results showed that mound-building mice display high level of building activity, especially in the first month of their time in the laboratory. In majority of groups mice built domed nests made from straw and hay, where they lived together. Seeds in the cages were covered with earth, as far as that was possible. However, mice in some groups made burrows of simple design. Based on these findings it could be assumed that building behavior of *M. spicilegus* is genetically determined, but as microtine rodents *M. spicilegus* can be quite flexible in employing behavior to suit the local environment.

**Keywords:** building behavior, intraspecific cage groups, *Mus spicilegus*, nest design, time budget

Introduction

The mound-building mouse (*Mus spicilegus* Petényi 1882) is an outdoor species from south-eastern Europe, adapted to agroecosystems. In the beginning of autumn, mound-building mice build complex mounds (2, 9, 10, 15). In order to spend the winter, these mounds built represent an accumulation of seeds covered with earth. The mounds serve as food reservoirs during the winter period, especially for the young, immature individuals born in the autumn (13). According to (2), mound building appears to be kin based, and the evolution of mound building and communal nesting in this species would then be partly due to kin selection. In spring, mound-building mice about 6 months old leave the mound and begin to reproduce (3, 6, 10, 13, 15, 17).

Although *M. spicilegus* is unique with its ability to construct complex earthen mounds, data suggests that under higher temperatures and a larger availability of food in winter mice can optimize this behavior by building simpler constructions or even not build them at all. For instance an interesting field observation has been registered in Greece where a pair built its nest in the middle of a discarded, 2m long, plastic piece of irrigation tube (7). This deviation from the mound-building ethology raised questions about building activity of *M. spicilegus* and factors that affect it. In order to clarify whether mice display building activity under laboratory conditions, we studied behavior of *M. spicilegus* in 5 intraspecific cage groups during autumn-winter period. We hypothesised that the behavior of *M. spicilegus* individuals and their building activity reflect their life-history traits.

Materials and methods

The mound-building mice were collected from a wild population of *M. spicilegus* in the region of Northern Bulgaria (43°21'N, 24°15'E). Mice were caught in an agricultural area at the beginning of September of 2008 using...
live-traps. During the period, mounds in this agroecosystem were built. The live-traps were distributed around each mound in order to capture kin-related or familiar mice.

A total of 17 mice were captured. Behavior of mice captured was tested in 5 intraspecific cage groups – 2 male and 4 mixed. Each group consisted of 3-4 individuals. Mixed groups consisted of 2-3 males and 1 female. Mice in each group belonged to the same mound. The group composition was based on the demographic structure of the population in early autumn period of 2008 – males dominated over the females nearly 2:1. All mice in the groups were juveniles. The age of each animal was determined on the base of its body mass and reproductive status (juveniles, ≤ 10 g).

The experiments were carried out in 100 x 100 cm glass cages. Each cage contained earth and sawdust as bedding, as well as nesting material – straw and hay. The animals captured were kept in the laboratory at a temperature of 15°C ± 2°C, humidity (approximately 60%) and natural daylight. They were fed on a mixed seed diet supplemented with apples and provided with water.

The study on behavior of *M. spicilegus* in intraspecific cage groups was conducted by regular observations for half an hour 2-3 times a day till the end of February 2009. In addition during September and November mice in 3 groups were observed and recorded using 24 h video surveillance in order to determine time budgeting behavior during the autumn-winter period. Relative time spent on each behavioral category was calculated and analyzed. The significance of differences between behavioral patterns, demonstrated by mice in September and November were estimated by one sample χ² test at p < 0.05.

The behavioral events demonstrated by *M. spicilegus* in the experimental groups are as follow: 1. Individual behavior: locomotion (activities such as walking, running, or jumping), self-grooming, digging (the animals perform digging movements with hind legs), building (the animals move pieces of straw with their muzzles and gather them in a given spot in the cage, resting (movements are absent while the animals are in the nests or they stop moving for a short time), eating and drinking; 2. Social behavior: agonistic behavior – offensive behavior (threat, attack, fight, chase, offensive-upright and sideways postures), defensive behavior (defensive-upright posture, jumping apart, pushing forepaws against opponent, running away, crouching, submissive posture), and amicable behavior (approaching, following, nose-nose, nose-anal, nose-body, passing above, pushing under, grooming, clambering on, standing side by side). Pattern of behaviour and terms used for each pattern were borrowed from studies on rodents by (1, 5, 12, 15, 16). The investigation conformed to international requirements for ethical attitude towards animals (4).

**Results and Discussion**

High levels of loco-exploratory activity were observed after the initial introduction of mice to the cages. During the dark period, since the species is essentially nocturnal, mice were active and showed high levels of building and digging activity. This was evident especially in the first weeks of mound forming (Fig. 1). The animals moved pieces of straw with their muzzles and gathered them in a given spot in the cage. (Fig. 2). During the day mice mostly slept (Fig. 3). *M. spicilegus* individuals displayed significantly more building and digging activity in September in comparison to November (χ² = 54.2, p < 0.001 for building activity, χ² = 20.1, p < 0.001 for digging activity (Fig. 1). The general described pattern is similar to other rodent species (8, 18).

Many studies conducted in laboratory and semi-natural conditions demonstrate that male as well as female *M. spicilegus* are aggressive towards unfamiliar individuals (11, 12), but tolerant to familiar individuals (12). In the present study, conflicts were registered only in one group during the first week of their forming. In the rest of the groups mainly amicable behaviors were observed. Therefore, social interactions of *M. spicilegus* individuals seem to reflect these life-history traits.

Results demonstrated that mice in some of the groups built domed nests made from straw and hay with length 13–26 cm, width 11–16 cm and height 4–12 cm, where they live together during the entire autumn-winter period. They looked like small piles (Fig. 4). The nests were built up by mice until the end of September and the beginning of October, a period that is consisted with observations done in the wild (13, 15, 17). Seeds in the cages were covered with earth, as far as that was possible. However, mice in other groups made burrows of simple design. Based on these findings it could be assumed that building behaviour of *M. spicilegus* is genetically determined, but as microtine rodents *M. spicilegus* can be quite flexible in employing behavior to suit the local environment. Such flexibility can account for the fact why some mice did not build any nest at all.
Fig. 1. Building activity of mound-building mice in September and November of 2008.

Fig. 2. Pieces of straw gathered by mice in a given spot in the cage.

Fig. 3. Resting periods displayed by mound-building mice in September and November of 2008.

Fig. 4. A domed nest made from straw and hay.
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REFERENCES