

## Behavioural repertoire of *Glis glis* (Rodentia: Gliridae)

Behaviorální repertoír plcha velkého (*Glis glis*) (Rodentia: Gliridae)

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**Abstract.** The behavioural repertoire of the edible dormouse (*Glis glis*) was investigated in the laboratory using night vision cameras. Analysis was carried out for 106 h 44 min of video records of behaviour. The main forms of behaviour during the active period were comfort, exploratory, feeding, scent marking, defensive and social actions. They were interrupted by sitting still or feeding. Occurrences of biased activity were revealed, in which elements of a concrete behaviour do not have a functional meaning (e.g. grooming). Typical examples of some forms of behaviour are illustrated. In social behaviour, the most common types of encounters characteristic for rodents were presented. From the total number (419) of registered encounters the most frequent were agonistic ones (46.3%), represented by aggressive attacks, avoidances, chasings, bites and fights. Identification encounters (41.1%) were less frequent and of two types: nasal and naso-lateral. Friendly encounters were observed (12.6%) much less often: mainly sitting in contact and allogrooming. This distribution illustrates the territoriality and mainly solitary way of life in this species. The systematization of the characteristic behavioural elements can serve as a methodological basis for experimental ethological studies, including pairings, assessment of the level of stress and the study of behavioural differentiation of closely related species.

**Key words.** *Glis glis*, edible dormouse, behaviour, encounters, video recording.

## INTRODUCTION

Behaviour of animals is the most labile way to maintain intrapopulation homeostasis. The behaviour of rodents in the family Gliridae, differs from other rodents because of peculiarities of their physiology connected with hibernation and contributes to the study of the complex of adaptations of these arboreal nocturnal rodents in ecosystems. The edible dormouse (*Glis glis*) is the largest species of dormouse. It has a status ranging from being a rare protected species to a pest in different parts of its range (CARPANETO & CRISTALDI 1994, JUŠKAITIS 2018). Accordingly, the study of its behaviour is necessary for the development of a population management strategy under different conditions. Descriptions of different types of behaviour of these dormice and their formation in ontogeny is given in the monographs by KOENIG (1960), VON VIETINGHOFF-RIESCH (1960), AJRAPET'ĀNC (1983) and LOZAN et al. (1991). Despite the fact that dormice are considered nonsocial animals (MARIN & PILASTRO 1994), they have some obvious features of social behaviour (MORRIS & MORRIS 2017). STEPANOVA (2012) began the study of elements of

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social behaviour in the Zhiguli Mountains (Russia). The purpose of this work was to describe elements of different types of behaviour of the dormouse according to the modern classification (SOKOLOV et al. 1996, ROŽNOV 2011), which facilitates conducting experimental ethological work with objective quantitative indicators.

## MATERIAL AND METHODS

The behavioural repertoire of the edible dormouse was investigated in the laboratory using night vision cameras without the presence of an observer. An analysis of 106 h 44 min of video records of behaviour was performed. The records were created in 2011 during the active season of dormice (June–August). This was a year of reproduction failure. Observations were conducted in a cage with a volume of 3.4 m<sup>3</sup> for one night after captures in nature and then the animals were released where they had been trapped. Simultaneously there were from two to five individuals of different age and sex in the enclosure depending on daily trapping results. These animals were not kept together before recording. The observations were made by two cameras installed in the cage. One of them covered the entire enclosure, the other was installed on the feeder. The study was conducted by the method of continuous data recording (MARTIN & BATESON 1993). Times of observations per night were different and depended on the volume of data, recorded on the hard disc.

When analyzing the different types of behaviour, the classification by SOKOLOV et al. (1996) was used. All contacts between individuals for the period of video recording were registered separately. The total number of contacts of different types was counted. Although the total number of animals involved is unknown, the overall period of recording allowed the evaluation of the ratio of contacts of different types.

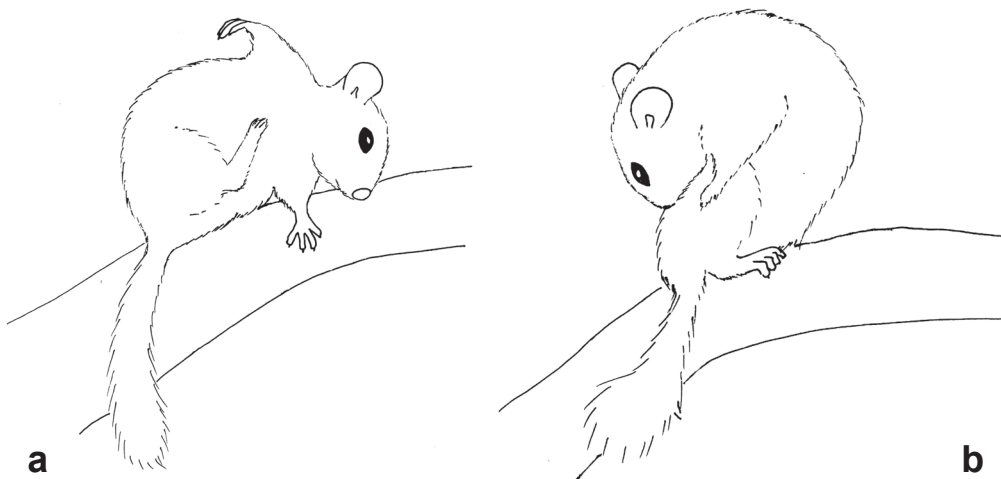


Fig. 1. Examples of comfort behaviour of the edible dormouse: a – cleaning by hind foot, b – cleaning by teeth.

Obr. 1. Příklady komfortního chování plcha velkého: a – čištění zadní tlapkou, b – čištění zuby.



Fig. 2. Typical posture of the edible dormouse in feeding behaviour.

Obr. 2. Typický postoj plcha velkého při potravním chování.

## RESULTS AND DISCUSSION

The main forms of behaviour during the active period were comfort, exploratory, feeding, scent marking, defensive and social behaviours. They were interrupted by sitting still or other forms of activity.

**Comfort behaviour** encompassed a large part of the time budget of the animals and was the most common form of behaviour. The elements of comfort behaviour were scratching, licking, washing, yawning and stretching. Usually, complex cleanings were recorded, including scratching and licking. Cleaning schemes could be very diverse and did not have fixed patterns, as they do for example in aquatic mammals (MAHOTKINA & RUTOVSKAÂ 2013). Sequences such as



Fig. 3. Example of rubbing with cheekbones – an element of marking behaviour in the edible dormouse.

Obr. 3. Příklad drhnutí lícními kostmi – prvek značkovacího chování plcha velkého.



Fig. 4. Grooming at sexual behaviour in the edible dormouse.  
Obr. 4. Péče (grooming) při pohlavním chování plcha velkého.

side-tail-paws, side-head-paws, head-abdomen-sides, abdomen-side-head, back-side-tail-head etc. were observed (Fig. 1a, b). Cleaning was done, mainly by teeth and forepaws, less often by hind feet. Most often comfort behaviour was observed after sleeping and after eating. This suggests that comfort behaviour is of great importance for the nocturnal dormice, perhaps to protect them from predators, since it reduces the probability of their detection by smell.

**Nutritional behaviour**, as in all animals, was represented by the search for and eating of food. During feeding the animal usually held the food in its front paws. The characteristic posture of the animal during feeding is shown in Fig. 2.

**Exploratory behaviour** included runs, looking around and oriented-sniffing. It was observed in different situations: when searching for food, developing a new territory and also in cases of danger.

**Marking behaviour** was represented by the following elements: urination, defecation and rubbing with cheekbones (Fig. 3). Fecal and urinary marks were located at certain fixed points used for rubbing and urinary and fecal marks. Often the elements of scent marking and comfort behaviour followed one another. Scent marking not only denotes an individual's territory, but also gives information about its sex, age and reproductive status (ROŽNOV & ROŽNOV 2003, SUROV et al. 2004).

**Sexual behaviour** was recorded only once. It included elements such as mountings and grooming (Fig. 4).

In cases of danger or stress, the animals showed **defensive behaviour** – a freezing posture, which could last more than 10 minutes.

Instances of **biased activity** were represented by grooming and a freezing posture, most often after conflicts between individuals.

In **social behaviour**, the most common types of encounters characteristic for rodents were presented. The most frequent negative interactions were agonistic encounters which increased

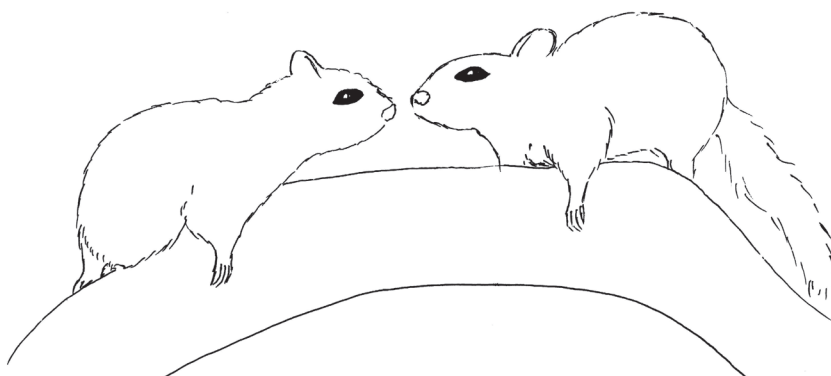


Fig. 5. Example of naso-nasal encounter in the edible dormouse.  
 Obr. 5. Příklad kontaktu čenich-čenich u plcha velkého.

the distance between contacting animals. They were represented by aggressive attacks, chasing, bites and fights or avoidances. It was noted that the more individuals that were in the aviary simultaneously, the more often manifestations of aggression were recorded. Two types of



Fig. 6. Example of naso-lateral encounter in the edible dormouse.  
 Obr. 6. Příklad kontaktu čenich-bok u plcha velkého.

neutral identification encounters were presented: nasal-nasal (Fig. 5), most frequent in rodents (SOKOLOV et al. 1996), and nasal-lateral (Fig. 6), typical and most frequent in the edible dormouse. Benevolent interactions were represented mostly by sitting in contact and allogrooming.

From the total number of registered encounters ( $n=419$ ), agonistic ones (46.3%) were the most frequent. Neutral identification encounters were detected less often (41.1%) and benevolent interactions were much less frequent (12.6%). The ratio of aggressive and benevolent encounters (3.7:1) illustrates territoriality and a mainly solitary way of life for this species.

The possibilities for comparing the behavioural repertoire of the dormouse with closely related species are limited. MADIKIZA (2017) studied sociality of the African woodland dormouse (*Graphiurus murinus*) both in a laboratory and in the field. The woodland dormouse has a smaller repertoire of elements of social behaviour. Similar studies have not been conducted in other species of dormice. Members of the Gliridae are distant systematically and ecologically, from representatives of other families of rodents. In comparison with non-social species of mouse-like rodents and hamsters, social behaviour includes a smaller set of elements (PAYNE & SWANSON 1970, OSIPOVA & SOKTIN 2008).

The systematization of the characteristic behavioural elements of the species can serve as a methodological basis for various ethological studies, including pairings, assessment of the level of stress and the study of behavioural differentiation of closely related species. Social behaviour is of greatest interest for research, because it assists studying the relationships of animals in nature and the structure of populations. For example, the above classification helped to reveal a maximal number of female aggressive encounters during pregnancy and a sharp decrease after resorption of embryos (VEKHNIK 2010, STEPANOVA 2012). Females were much more aggressive than males. For males, avoidance of encounters was more characteristic. There were also opposite changes in the level of aggressiveness of males and females. Aggressive behaviour declined in females towards the end of the active season, but it reached its peak in males after the period of functional activity of their reproductive system. A logical continuation of this work will be a comparative study of edible dormouse behaviour in reproductively successful years and years of reproductive failure, as well as possible relationships between the behaviour of females and mass resorption of embryos in the population.

## SOUHRN

Behaviorální repertoár plcha velkého (*Glis glis*) byl zkoumán laboratorně s použitím kamer pro noční vidění, přičemž výsledně byl analysován videozáznam chování o více než 106 hodinách. Hlavními zjištěnými formami chování během období aktivity bylo komfortní, průzkumné, potravní, značkovací, obranné a sociální chování, přerušované klidným sezením anebo krmením. Zaznamenány byly i odchýlené aktivity, u kterých prvky konkrétního chování neměly funkční význam, např. péče o srst (typické příklady některých forem chování jsou ilustrovány). V sociálním chování byly zaznamenány nejčastější typy kontaktního chování, známé u hlodavců. Z celkového počtu zaznamenaných kontaktů (419) byly nejčastěji přítomny agonistické kontakty (46,3 %), představované agresivními výpady, honičkami, kousáním a bojem. Rozpoznávací kontakty byly méně časté (41,1 %) a dvou typů: nasální (čenich-čenich) a naso-laterální (čenich-bok). Přátelské kontakty byly pozorovány mnohem méně často (12,6 %): představovaly zejména společný odpočinek a společnou péči o srst. Toto rozložení dokumentuje teritorialitu a především samotářský způsob života u tohoto druhu. Systematisace charakteristických behaviorálních prvků může sloužit jako metodický základ pro experimentální ethologické studie, včetně párování, hodnocení úrovně stresu a studia behaviorálního vymezování blízkce příbuzných druhů.

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