

Syntopic occurrence of the Garden Dormouse (*Eliomys quercinus*) and the Edible Dormouse (*Glis glis*) in a montane climax spruce forest (Rodentia: Gliridae)

Syntopický výskyt plcha zahradního (*Eliomys quercinus*) a plcha velkého (*Glis glis*) v klimaxové horské smrčtině (Rodentia: Gliridae)

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Abstract. Here we provide an unequivocal evidence of syntopic occurrence of the garden dormouse (*Eliomys quercinus*) and the edible dormouse (*Glis glis*) in a talus habitat in the montane climax spruce forest (*Piceion abietis: Calamagrostio villosae-Piceetum*) in the Bohemian Forest (Czech Republic). Whereas the garden dormouse has been regularly recorded within spruce stands throughout Central Europe, presence of the edible dormouse in the coniferous woodland is unusual and therefore discussed. At the locality both dormouse species shared not only the same macrohabitat, but also the same vertical niche and, moreover, utilized identical trophic resources. Their diet consisted of ripe bilberries (*Vaccinium myrtillus*) and arthropods (especially spiders). Finally, factors enabling the syntopic occurrence of the garden and edible dormice are discussed.

Key words. *Eliomys quercinus*, *Glis glis*, *Picea abies*, *Piceion abietis*, *Calamagrostio villosae-Piceetum*, Bohemian Forest, Šumava, Bayerischer Wald, scree, talus, syntopy, sympatric, competition, diet.

During the nights 10–11 and 11–12 August 2008 we conducted live-trapping on a scree slope oriented to the southwest at Mt. Jezerní hora (1160–1170 m a. s. l.; 49° 09' 37" N, 13° 11' 27" E; mapping square 6845) nearby the village of Špičák in the Bohemian Forest (toponymy sensu JENÍK 2002), Czech Republic (see Fig. 1). By a regular grid of wooden traps and Sherman traps we covered both the upper two thirds of the talus and a little rocky forested ridge above it (the total trapping effort was 124 trap-nights). The sparse vegetation overgrowing the stones was classified within the alliance *Asplenion septentrionalis*, whereas the scree itself was surrounded by a mature climax spruce forest of the alliance *Piceion abietis*, association *Calamagrostio villosae-Piceetum* (see NEUHÄUSLOVÁ & ELTSOVA 2003 for details).

As a whole, four garden dormice (*Eliomys quercinus*), two edible dormice (*Glis glis*) and a stoat (*Mustela erminea*) were caught at the site. The edible dormice and two individuals of the garden dormouse were present there for both nights (we retrapped them), while two garden dormice were trapped only once and the stoat was captured the second night (see Fig. 2). All animals were processed in the standard mammalogical way and subsequently released at the place of trapping. In addition, fresh faeces were collected from all live-traps, which provided a dormouse, and later were analysed in a laboratory (see NOWAKOWSKI & GODLEWSKA 2006).



Fig. 1. The habitat shared by the garden dormouse, the edible dormouse and the stoat in the Bohemian Forest. Obr. 1. Společný biotop plcha zahradního, plcha velkého a hranostaje na Šumavě (foto V. MIKEŠ).

Every individual was sampled only once, at the time of the first trapping. The analysis showed that, besides the bait, both dormouse species were feeding on bilberries (*Vaccinium myrtillus*) and arthropods (A. BERNARDOVÁ & Š. VODKA pers. comm.). Bilberry seeds and remains of spiders were recorded in the faeces of three garden dormice (75%), besides that one insect larva was taken as well. The arthropod diet of the edible dormouse consisted exclusively of spiders.

The garden dormouse is a regular inhabitant of the above described habitat in the Bohemian Forest (MÜLLER-STIESS 1996, MIKEŠ & SEDLÁČEK 2008) and, moreover, also a characteristic species of the montane spruce (*Picea abies*) stands throughout Central Europe (BITZ 1990). In the Bohemian Forest the stoat lives commonly in field balks, wood margins, bushes, near human settlements, avoiding practically only vast complexes of spruce monocultures (ANDĚRA & ČERVENÝ 1994). Hence, our record is rather unusual, nevertheless the species has been already observed in a montane spruce forest at Mt. Černá hora at 1300 m a. s. l. in the same area (ANDĚRA & HANZAL 1996). Analogous to its discovery at Mt. Jezerní hora in 2007 (see MIKEŠ & BUFKA 2008), the edible dormouse was again trapped in a talus habitat within the coniferous woodland, which suggests its regular presence there. Although the new locality lies only ca. 900 m from the original site of occurrence, it represents an elevation record of the species not only for the Bohemian Forest (see MÜLLER-STIESS 1996, MIKEŠ & BUFKA 2008), but also for the Czech Rep. (see ANDĚRA & BENES 2001, ANDĚRA & HORÁČEK 2005). Since the principal habitat

of the edible dormouse is deciduous and mixed woodland, where mast seeders (especially beech, *Fagus* and/or oak, *Quercus*) are present (KRYŠTUFEK 2010), our field experience from Mt. Jezerní hora merits a brief discussion. The scree is located deep inside extensive spruce stands, which however are disrupted with several logged areas. Besides a few rowans (*Sorbus aucuparia*) overgrowing directly the rocks, the nearest group of scattered broadleaved trees (beeches) grows some 300 m apart. Despite the general belief in the entire absence of the edible dormouse from pure coniferous forests (SCHOPPE 1986, ANDĚRA & BENEŠ 2001, BÜCHNER 2009), we were able to find several similar records in the literature. Thus, GOETHE (1955) observed edible dormice among the sandstone boulders within a young (ten to twenty years old) spruce growth on a steep slope



Fig. 2. A schematic illustration of syntopic occurrence of the garden dormouse, the edible dormouse and the stoat at the talus slope in the Bohemian Forest. Legend: hatching – open scree; triangles – garden dormouse; squares – edible dormouse; circle – stoat; arrows indicate movement of a given individual between the consecutive nights.

Obr. 2. Schématické znázornění syntopického výskytu plcha zahradního, plcha velkého a hranostaje na kamenném moři na Šumavě. Legenda: šrafování – kamenné moře; trojúhelníky – plch zahradní; čtverce – plch velký; kruh – hranostaj; šipky znázorňují přesun daného jedince mezi oběma odchyťovými nocemi.

in the Teutoburg Forest. Nevertheless, the same author afterwards adds information on mixed woodland with a great proportion of broadleaved trees on the opposite side of a local brook (how far?). Moreover, an edible dormouse was present in a cottage nearby a rocky ridge surrounded by a ten-year-old natural rejuvenation of the spruce at 930 m a. s. l. in the Harz Mts. (GROSS 1985). Finally, the edible dormice are also known to damage young spruce plantations by bark stripping both in Veneto (FRANCO 1990) and Croatia (GLAVAŠ et al. 1999). In the latter area the damage usually occurs in spring (GLAVAŠ et al. 1999) and is directly connected to dispersal of an overcrowded population of the species (see GRUBEŠIĆ et al. 2004). In contrast, the edible dormice seem to inhabit spruce plantations in the Venetian Prealps year round (FRANCO 1990). Since the edible dormouse is predominantly herbivorous (e.g. ROSSOLIMO et al. 2001), the main reason for its preference for deciduous woodland is primarily the availability of food, which however is generally scarce in coniferous stands (SCHOPPE 1986). FRANCO (1990) analyzed 55 stomachs of edible dormice collected in the Venetian spruce plantations in the period July–October. The principal components of the dormice diet were the fruits of honeysuckle (*Lonicera* spp.), aphids and the larvae of the spruce web-spinning sawfly (*Cephalcia arvensis*). From the spruce itself solely the needles and bark were rarely taken. It is noteworthy the remains of spruce cones have not been found in the stomachs and also the captive edible dormice refused them even when facing starvation (FRANCO 1990). However, this is in contradiction with the observations from Crete (SIEWERT 1949), Tuscany (SANTINI 1978) and Calabria (RIMA et al. 2007), where the edible dormice regularly feed on pine (*Pinus* spp.) cones. Apparently there is some difference between a pine and spruce cone from the dormouse point of view. Although at our study site, the distance of the talus from the closest group of beeches still falls within the night radius of the species (see e.g. JURCZYŠZYN 2006), the results of FRANCO (1990) suggest that the occurrence of edible dormice in the spruce forests at Mt. Jezerní hora does not necessarily need to be only temporary (see MIKEŠ & BUFKA 2008).

The above mentioned results evidence presence of both the garden dormice and the edible dormice in the same macrohabitat (= the scree slope) at the same time, which must be interpreted as a syntopic occurrence (sensu RIVAS 1964). In one case we caught the two glirids in one trap during the consecutive nights: the first trapping session provided an edible dormouse, the second night a garden dormouse entered the trap (see Fig. 2). However, since the two species usually do not occur together (see KÖNIG 1969, SCHOPPE 1986, BITZ 1990, MÜLLER-STIESS 1996), the record will be discussed thereafter. Whereas the edible dormouse is a broadleaved wood specialist (e.g. KRYŠTUFEK 2010), the garden dormouse is a euryoecious species (see the review of inhabited biotopes in STORCH 1978), for which the tree species composition and the presence of a forest at all is only of secondary importance (KRATOCHVÍL 1967, STORCH 1978). Despite the proved ability of the garden dormouse to live in a beech and/or oak dominated woodland (see JURÍK 1962, MEIER 1980, SCHOPPE 1986, TVRTKOVIĆ et al. 1995, VATERLAUS-SCHLEGEL 1997), the species is usually absent from the places occupied by the edible dormouse in the zone of their sympatry (KÖNIG 1969, SCHOPPE 1986, BITZ 1990, MÜLLER-STIESS 1996). Moreover, there is an apparent vertical habitat partitioning of the two dormouse species in Central Europe, with the garden dormouse inhabiting the high altitude coniferous stands and the latter being present in the lower deciduous woodland belt (see BITZ 1990, MÜLLER-STIESS 1996, VATERLAUS-SCHLEGEL 2001). KÖNIG (1969) and SCHOPPE (1986) proposed that the edible dormouse displaces the more adaptable garden dormouse from deciduous forests to the less suitable montane coniferous woods. Nevertheless, such habitat segregation of both species could also be connected with the possible garden dormouse preference for colder and wetter sites (see ANDÈRA 1986, BITZ

1990). Herein, it is convenient to note that there are several facts, which stand in contradiction with possible competition between the two species. To begin with, the garden dormouse and the edible dormouse usually occupy different vertical niches: the first is known as a widely ground dwelling rodent, the latter spends the majority of its active life in the tree canopy (e.g. MÜLLER-STIESS 1996). Moreover, as a rule the garden dormouse seeks for a shelter on the ground, whereas the edible dormice normally inhabit tree cavities (e.g. ROSSOLIMO et al. 2001). Finally, since the foraging strategy of either species is usually different (STORCH 1978), we cannot expect the trophic competition even on the same locality (see HOLIŠOVÁ 1968).

Analysing the available literature, we were able to find several other records of the garden and edible dormice living in a close proximity. Four dormouse species shared the same macro-habitat in deciduous woodland on a limestone rocky substrate in the Slovak Karst (KRATOCHVÍL 1967, HOLIŠOVÁ 1968). Besides the above mentioned species, the hazel dormouse (*Muscardinus avellanarius*) and the forest dormouse (*Dryomys nitedula*) were also present. Further, the edible dormouse and the garden dormouse were found in adjacent nestboxes in the forests of Bavaria (FALTIN 1988) and Switzerland (VATERLAUS-SCHLEGEL 2001). HRUBÁ (1995, 1997) did not find any differences between the garden and edible dormouse places of occurrence located within the sandstone rocks of the České Švýcarsko [Bohemian Switzerland] National Park. The rocks were overgrown by relic pine (*Pinus sylvestris*) stands and were surrounded by mixed woodland, which consisted of beeches, spruces, pines (*Pinus* spp.) and birches (*Betula* spp.). Nevertheless, from the data presented by HRUBÁ (1995, 1997) it is not clear whether the two species were living there in true syntopy. Her note: “both species successfully reproduced at one site, but in different years” indicates rather an allotopic occurrence. Finally, the use of baited hair tubes suggested syntopic appearance of the garden and edible dormice at four localities in the Lower Engadin (TESTER & MÜLLER 2000). However, as the tubes were checked first after three to seven days of exposition, the “syntopy” could also be caused by the shift in home ranges of individual dormice between the consecutive nights.

The factors enabling common occurrence of the garden and the edible dormouse were summarized by BITZ (1990). Those are namely: (i) presence of diversified mixed deciduous-coniferous forests, where the tree species composition changes on a small scale, (ii) presence of a transition zone between the colder higher altitudes and warmer lower elevations and/or the ecotone between treeless landscape and broadleaved woods, (iii) long-term human exploitation of forests in former times, (iv) low population density of both species and (v) abundance of hollows, crevices and similar structures within a diverse landscape.

It is noteworthy that at least the first three points are not valid for our observation. The forests at the study site are quite uniform, consist of a single dominant tree species and entirely fall within the cold montane climate. Although the talus constitutes a treeless habitat, the surrounding woodland is purely coniferous. Finally, since the area of Mt. Jezerní hora lies completely within the last zone of the Bohemian Forest to be settled (see BENEŠ 1996), we believe that the local climax spruce stands were only marginally affected by man in the past. On the other hand, a low population density of the two dormouse species could perhaps be expected at Mt. Jezerní hora and, at the same time, the scree itself surely provides plenty of hollows and crevices. The importance of a sufficient number of shelters, which would allow the garden dormouse to avoid its counterpart, has been already emphasized by KÖNIG (1969). Similarly, as GROSS (1985) mentions, the garden dormice resident in a cottage in the Harz Mts. disappeared immediately after a specimen of the edible dormouse had moved in. Moreover, they did not reoccupy the cottage until the edible dormouse left for hibernation (GROSS 1985).

Surprisingly, at Mt. Jezerní hora both the garden and edible dormice utilized identical food. However, as only one edible dormouse faecal sample provided some information, we cannot exclude the spider being accidentally taken when feeding on bilberries (see also MIKEŠ & BUŤKA 2008). OBŘTEL & HOLIŠOVÁ (1977) state that the dietary competition between two species can take place only when the supply of the exploited resource(s) is not sufficient to satisfy the foraging requirements of either of them. Since ripe bilberries were overabundant within the ecotone between the talus and the forest, the food competition among individual dormice cannot be expected. Last but not least, as we did not use the live-traps equipped with timers, we cannot rule out the temporal segregation of niches of both glirids during their nocturnal activity (see BRUSEO & BARRY 1995).

In conclusion, we believe that the garden dormouse absence from the deciduous woodland occupied by edible dormice could be directly connected with the lack of shelters. Since the edible dormouse heavily depends on the presence of tree cavities (see SCHOPPE 1986), it is possible to imagine that in forests with a scarcity of ground refuges the garden dormouse will seek for a shelter in a canopy too. As far as the tree hollows are scarce, the dormice can compete for them. Nevertheless, the competition for shelters no doubt could be reduced by providing of nestboxes and/or by the presence of a rocky substrate with abundant crevices, which in consequence can allow syntopic occurrence of both dormouse species.

SOUHRN

V článku je prezentován syntopický výskyt plcha zahradního (*Eliomys quercinus*), plcha velkého (*Glis glis*) a hranostaje (*Mustela erminea*) na kamenném moři obklopeném přirozenou horskou třtinovou smrčínou svazu *Piceion abietis*, asociace *Calamagrostio villosae-Piceetum* na Jezerní hoře (CHKO Šumava). Otevřené kamenné moře se nalézá v nadmořské výšce 1160-1170 m a je pokryté pouze sporou vegetací silikátových skal a drolní (svaz *Asplenion septentrionalis*). V případě plcha velkého se jedná o jeho nejvyšší známou lokalitu v rámci celého Česka. Zatímco plch zahradní je charakteristickým druhem jehličnatých lesů v celé střední Evropě, výskyt plcha velkého v takovémto biotopu je přinejmenším neobvyklý. Nicméně, srovnáním s dostupnými literárními údaji jsme došli k závěru, že by plch velký možná mohl být schopen rozsáhlé smrkové porosty na Jezerní hoře osidlovat i dlouhodobě. Na základě analýzy trusu bylo zjištěno, že se jak plši zahradní, tak plši velcí živili obdobnou potravou: rostlinná složka byla tvořena zralými borůvkami (*Vaccinium myrtillus*), ve složce živočišné převládali pavouci. Na závěr krátkého sdělení jsou diskutovány faktory umožňující syntopický výskyt obou druhů plchů.

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