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Road bridges as a roosts for Noctules (*Nyctalus noctula*) and other bat species in Slovakia (Chiroptera: Vespertilionidae)

Cestné mosty ako úkryty pre raniaka hrdzavého (*Nyctalus noctula*) a iné druhy netopierov na Slovensku (Chiroptera: Vespertilionidae)

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Abstract. Here we want to present new findings of *Nyctalus noctula*, *Myotis myotis and Myotis daubentonii* roosts in bridges in Slovakia. Annual observations from one bridge in Nitra showed high use of this habitat type. Also incidental findings from five other localities are presented. In Nitra 1533 records of *N. noctula* were obtained during 28 surveys. Noctules used the bridge drainpipes and other crevices all year round except the summer months. The highest number was recorded in November (164 individuals) when groups of up to 60 individuals were present. In autumn mating aggregations accumulated (3–9 individuals). The bridge was also used by solitary *M. myotis* males (64 records). In autumn mating groups of 2–3 *M. myotis* were also present. Big aggregations of *N. noctula* (maximum 457 individuals) were also found in a bridge in Ružomberok. In addition, two other localities with bridge roosts of *M. daubentonii* were found.

Key words. Habitat use, roads, shelter, hibernation, mating, Chiroptera

INTRODUCTION

Humans always alter their environment in more intensive and in various ways. Natural habitats are disappearing and new structures are built. These activities have negative to devastating impact on local plant and animal communities. Road construction is one of the most frequent activities of man, and it is developing most rapidly in the most developed countries of the world – North America and West Europe. Roads and transport disturb ecological processes, lead to degradation, loss and isolation of wildlife habitat and cause landscape fragmentation (Limpens et al. 2005, Seiler & Helldin 2006, Lesiński 2007). They also have other important negative impacts after construction – increased mortality in animals, including bats (Lesiński 2007, Bartonička et. al. 2008). Road construction due to economic growth is very intensive in Slovakia and the impact of this activity is rising.

Many structures related to road construction – such as bridges – as well as posing negative impacts can also provide new roosts for bats (cf. Limpens et al. 2005, Seiler & Helldin 2006). In Northern America there were 24 species found in bridges and also huge colonies with several hundred thousand individuals (Keeley & Keeley 2004). Such colonies are not common and research showed that less than one percent of bridges in USA offer suitable conditions for bats

(Keeley & Tuttle 1999). Records of bats in bridges are increasing in Europe. This could be due to the increased interest of researchers. Hibernation aggregation of 10 000 noctule bats, *Nyctalus noctula* (Schreber, 1774) is known from a road bridge in Germany (Harrje 1994, Gloza et al. 2001) and maternity colonies of the greater mouse-eared bats, *Myotis myotis* (Borkhausen, 1797) in hollow chambers in bridges (Zahn 1999, Walther 2002). The noctule is a species that uses a wide spectrum of anthropogenic roosts (c.f. Bihari 2004, Boye & Dietz 2004, Gebhard & Bogdanowicz 2004, Ceľuch et. al. 2006). It is found very often in housing estates with prefabricated buildings in Slovakia, but there are no records from bridges. The only record of bats in bridge comes from authors Matis & Pasztor (1995). They observed an aggregation of 10–15 pipistrelles, *Pipistrellus pipistrellus* (Schreber, 1774) in summer in the Košická kotlina basin. Bats were roosting in drainage tubes and crevices between concrete girders. In the winter of 2002 the hollow chamber in the 700 m long viaduct on the road R1 (southern part of the Zvolen city) was surveyed, but no signs of bats were seen (P. Kaňuch & M. Veľký, ad verb.).

Here we want to present new findings of noctule bat, greater mouse-eared bat and Daubenton's bat, *Myotis daubentonii* (Kuhl, 1817) roosts in bridges in Slovakia and annual use of bridges.

MATERIAL AND METHODS

The paper presents year-round observation from one locality in Nitra city and individual occasional records from five other localities. The bridge over the river Nitra on the motorway R1 junction (48° 19' 16" N, 18° 02' 59" E, 145 m a. s. l. DFS 7674, Nitrianska pahorkatina Hills) was monitored from November 2007 to December 2008. After the first incidental finding of bats a further six bridges in the city of Nitra were surveyed. Two other positive findings have been documented, based on information from local people (children from the village) – the **bridge in the Branč** village on the Malá Nitra brook (48° 12' 46" N, 18° 09' 06" E, 130 m a. s. l., DFS 7774, Nitrianska pahorkatina Hills) and **bridge in the city of Ružomberok** (49° 04' 41" N, 19° 18' 55" E, 475 m a. s. l., DFS 6981, Liptovská kotlina Basin, M. Baláž in verb.). Occasionally three other localities were checked: a **bridge in Hrboltová** village (49° 05' 51" N, 19° 15' 14" E, 465 m a. s. l., DFS 6881, Veľká Fatra Mts.), a **bridge in Ľubochňa** village (49° 07' 23" N, 19° 10' 13" E, 440 m a. s. l., DFS 6881, Veľká Fatra Mts.) and a **bridge in Kalná nad Hronom** village (48° 12' 09" N, 18° 31' 23" E, 155 m a. s. l., DFS 7777, Hronská pahorkatina Hills).

The bridge in Nitra city, with the most data, is 200 m long of which only 65m were surveyed (the rest was inaccessible because of the river). Its height rises gradually from 2.5 m to 6 m. Twenty-five vertical iron drainage pipes were surveyed in the bridge construction. They were 25 cm long and with a diameter of 6 cm (Plate 1). Pipes are half the length embedded in the structure of the bridge and the upper part is finished at the bottom with polystyrene filling. On some of them polystyrene was impaired and there is a hollow with maximum dimensions of 10×8×8 cm. The original function of the tubes is probably to drain the rainwater out of the bridge. Six larger pipes with a diameter of 13 cm were surveyed. They are located in the vertical shafts in the bridge, with dimensions of about 25×20×80 cm and transfer water from the top of the bridge. Quite a wide spectrum of roosts was created by transverse crevices 3–5 cm wide, 14 m long with space around a cylindrical console covered by gum cover. Bridge was visually

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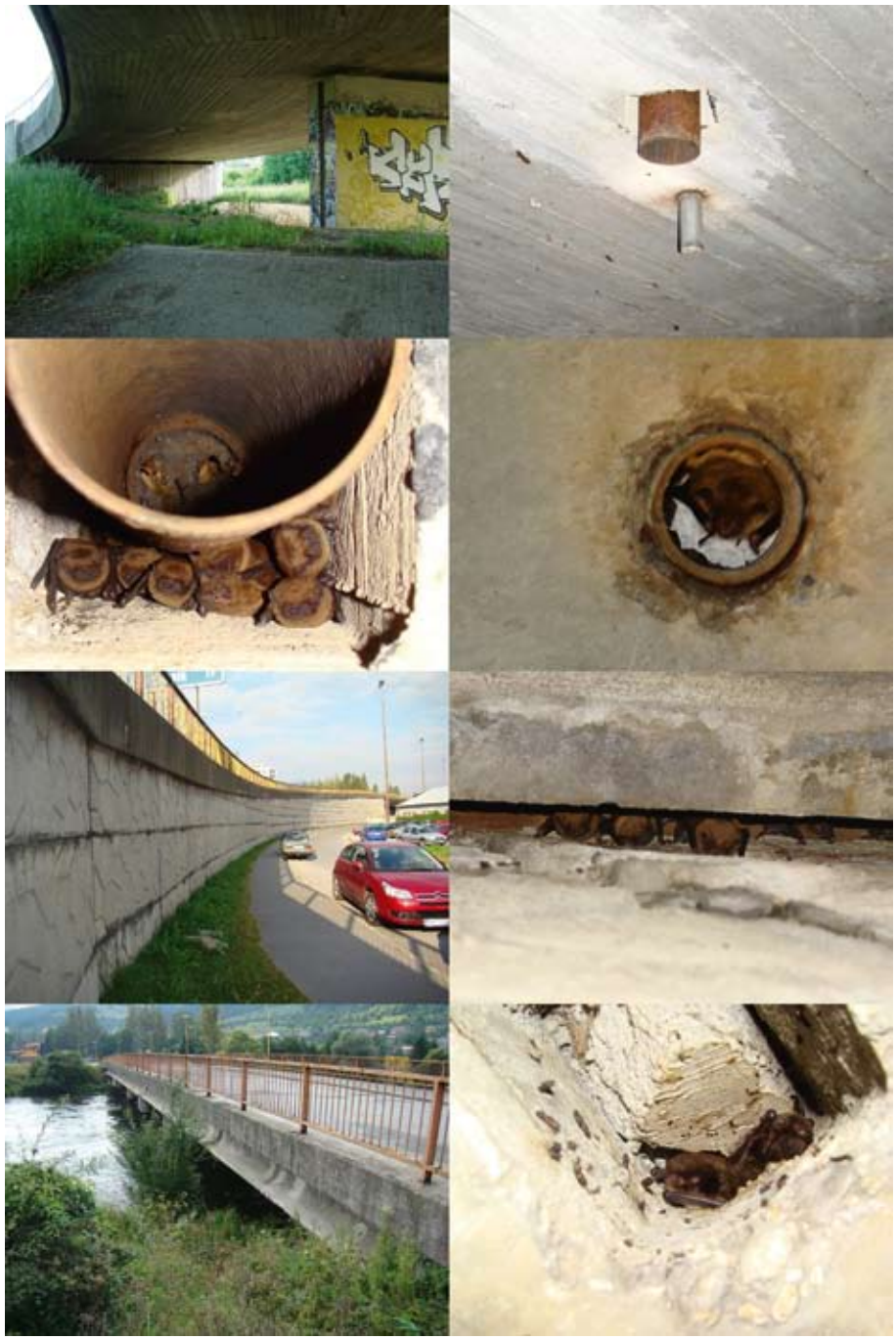
Plate 1 (from upper left side). Bridge in Nitra; two most frequent roost types in Nitra bridge; noctules around drainage pipe in Nitra; mouse-eared bat in Nitra; bridge in Ružomberok; noctules behind concrete facing on the bridge in Ružomberok; bridge in the Hrboltová vilage; Daubenton's bats in drainage shaft in Hrboltová.

Tabuľa 1 (zhora zľava). Most v Nitre; dva najčastejšie typy úkrytov v Nitre; raniaky okolo rúry v Nitre; netopier veľký v Nitre; nadjazd v Ružomberku; raniaky za obložením nadjazdu v Ružomberku; most do Hrboltovej; netopiere vodné v odvodňovacej šachte v Hrboltovej.



monitored 28 times from November 2007 to December 2008 during the day, including during the winter. Other localities were mostly checked once.

Bats were mist-netted under the bridge in Nitra city on 14 May 2008 and also by the bridge in Ružomberok city on 25 June 2008 to find the sex ratio of the bats.

RESULTS AND DISCUSSION

Bridge in the Nitra city

Of all the surveys of the bridges, only two were negative and a total of 1533 registrations of the noctule bats were recorded (Fig. 1). During the winter of 2006/2007, the number reduced from 90 individuals (1 November 2007) to 30 individuals (30 January 2008). An aggregation of around 30 noctule bats hibernated there. The winter was very mild, temperatures were mostly higher than freezing point and the minimum temperature reached only –13 °C in February. At the beginning of spring the number of individuals rose to quite a stable number of 60–70

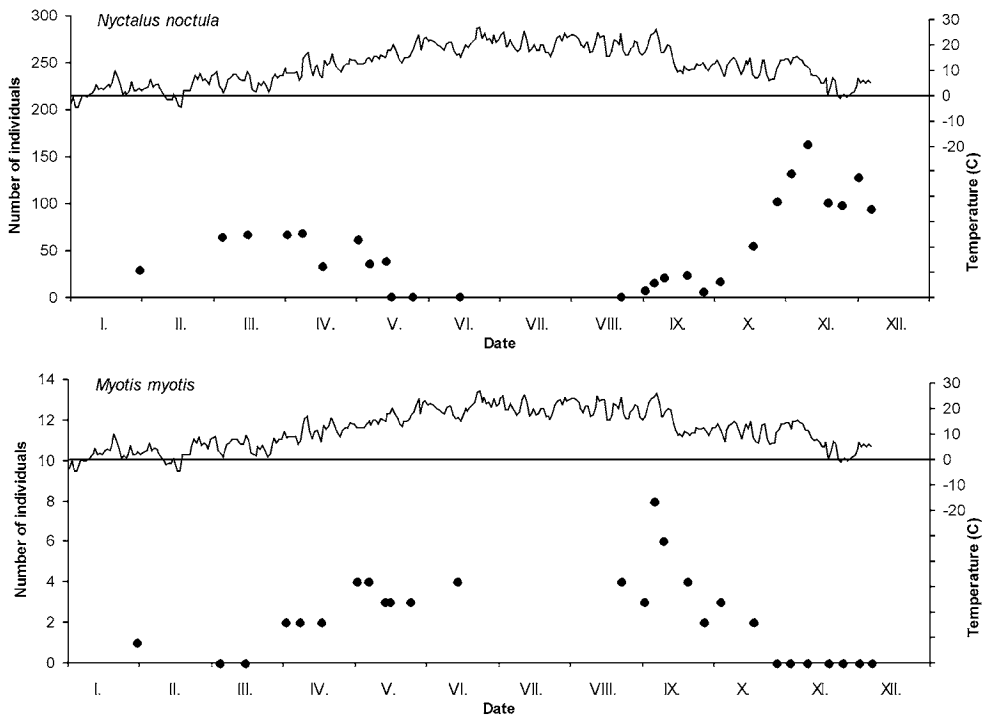


Fig. 1. Year round changes in number of noctule bats and greater mouse-eared bats in 36 observed roosts in the bridge in the Nitra city (dots) and average day temperatures in 2008 (line).
Obr. 1. Zmeny celkovej početnosti raniakov hrdzavých a netopierov veľkých v 36 sledovaných úkrytoch v moste v Nitre (body, Number of individuals) a prehľad priemernej dennej teploty v roku 2008 (čiara, Temperature).

individuals, which remained there until mid-May. Than the number steeply decreased to 39 individuals (14 May 2008) and later to zero (25 May 2008). In the summer some monitoring was missed but based on zero bats present on May 25 and only one individual on June 16, it is presumable that the bridge was used very sporadically. Mist-netting of 20 individuals on May 14 showed occurrence of females (40%) and males (60%). Only a few individuals were caught emerging from the bridge, most of them were only flying around the roosts under the bridge. Both sexes occurred there, while females leave Slovakia at the end of May (unpublished observations). In the mating season (September and October) only 16–24 individuals were present and more aggregations were, based on behaviour, mating harems. The number was quite low in comparison to tree hollows and roosts in housing estates, where high numbers of noctule bats occur in autumn (Ševčík & Ceľuch 2006) and mating in harems of around 5–10 individuals takes place (McCracken & Wilkinson 2000, Gebhard & Bogdanowicz 2004). It is probably because of the low access and small inner space in the smaller pipes for noctule bats. All the more spacious places were occupied by noctule bats (2 vertical shafts and 1 crevice) or greater mouse-eared bats (3 shafts) in the autumn. Shafts around bigger pipes were occupied all season long by one species only – probably males, protecting their roost against other males and other species. Harems disappeared after significant temperature decrease in mid-September (from 20° C to 10° C average daily temperature). Males ceased territorial behaviour and in some days hibernating aggregations in all shafts start to build (Fig. 1). By the end of October the number of individuals rose to 164 (11 November 2008). In November after more freezing nights the two biggest aggregations partly disintegrated and the number of individuals decreased. These roosts are probably not very climatically stable and will freeze through, which is why noctule bats do not hibernate there in high numbers.

The aggregations of noctule bats frequently reconfigured; the groups increased and decreased in number. The roosts around bigger pipes were used most often (70% of registrations) and big aggregations up to 60 individuals in one group assembled there.

The monitored roosts were less occupied at the end of May, in June (0–3%) and in January (3%). The highest number of occupied roosts was in October (31%), followed by November. Roosts were used year-round. Numbers were lowest in the summer because of the absence of females.

The same roosts were also used by greater mouse-eared bats (64 registrations), but only by 0–8 individuals (Fig. 1). It is interesting that this species was found for the first time in Nitra city after the dispersal of reproduction maternity colonies (cf. Ligač 1986, Ševčík & Ceľuch 2006). One individual was found in January, followed by negative monitoring results. In April the number increased to 4 individuals. These were probably solitary males, confirmed by mist-netting on 14 May, when two males were caught (one very old with very worn teeth). The number of males was stable in summer, because the last monitoring results in May and June were similar to the monitoring results in August. The highest number was recorded on 5 September (8 individuals), then the number and since from the end of October the monitoring results were negative.

Mouse-eared bats similarly occupied shafts (50% registrations) and narrow pipes. All mating groups were found in shafts. Individuals hung individually (91% registrations) except September where pairs (7% registrations) and once three individuals were found. These were probably mating individuals. Similar use of bridges – as a mating roost and roost for solitary males – was found in two bridges in Germany (Heck & Barz 2000). In studied localities in four cases mouse-eared bats were found in the same roost with noctule bats (2–15 noctules), but hanging separately.

Six other bridges in Nitra city were surveyed on 9 March 2008, but all were negative. Most of them did not provide similar roosting possibilities.

Other localities

A similar bridge was identified and surveyed in the Ružomberok city. After the first record on 6 June seven repeat monitoring visits were made in 2008. An aggregation of 70 noctule bats divided into several groups were present in the summer (records on 6 and 25 June). Bats occupied a 140 m long space behind the bridge cover (Plate 1). The crevices were 0–10 cm wide and about 50 cm deep. Predominantly the sections with 5 cm crevices were used by noctule bats at a height of 3–8 m. Mist-netting was done on 25 May to ascertain the sex ratio in the aggregations, because such large groups are not usual in Slovakia in summer. Typically only smaller groups of males occur in this time (Kaňuch & Ceľuch 2004, Ceľuch et al. 2006). All of 15 mist-netted bats were males. At the beginning of the autumn season 50–100 noctules were present and based on voices, were very active also during daylight hours, probably associated with mating (3 and 11 September). After a significant drop in temperature the number of individuals rose (14 October – 160 ex., 30 October – 457 ex.) and by the last monitoring on 30 November 409 hibernating and also four dead noctule bats were recorded.

Four kilometres from Ružomberok city another bridge to Hrboltová village was surveyed on 9 September 2008. There was visible bat guano on the side of the bridge under drainage shafts. Under 36 of the 56 shafts fresh or old guano was found. Eight shafts with fresh guano were surveyed using rope technique. Four of them were negative, solitary Daubenton's bats were found in three of them and one pair was found in one shaft. Probably these shafts were used as mating sites in autumn.

The construction of the bridge in the Ľubochňa village was moulded and there were no potential crevices or hollows.

Daubenton's bats were found based on information from local children under a small bridge (8 m) in Branč village. Six individuals were found on 27 May 2008 in a 2.5 cm wide and 15 cm deep vertical crevice between bridge beams. Bats were disturbed by children the day before, so possibly there had been more of them. It could have been a small maternity group.

The last observation is from Kalná nad Hronom village on 15 June 2008. One resting individual bat (identified only as *Myotis* sp.) was observed during night hours on the bottom of the bridge beams. After few minutes and light disturbance it disappeared. Probably it was only temporal roost (cf. Adam & Hayes 2000), or place to consume bigger prey.

There are many bridges in Slovakia and some of them provide potential roosts for bats and birds (cf. Ševčík et al. 2008). They probably offer appropriate microclimate, safety from predators (Ferrara & Leberg 2005) and human disturbance. An interesting idea for road construction comes from Arnett & Hayes (1999), who suggest building bat roosts (or hanging bat boxes) in bridges or leaving suitable crevices. There are more ideas to study in the future – concentrating more on the seasonal dynamics of habitat use, species composition, bridge construction types used by bats and microclimatic conditions under (or in) bridges.

SÚHRN

V práci prezentujeme nové nálezy raniaka hrdzavého, netopiera veľkého a netopiera vodného v cestných mostoch na Slovensku. Celoročné pozorovania z mostnej konštrukcie v Nitre ukázali časté využívanie

tohto habitatu. Prezentované sú aj náhodné nálezy z piatich ďalších lokalít Slovenska. V Nitre bolo počas 28 kontrol získaných 1533 registrácií raniaka hrdzavého. Netopiere využívali priestory okolo odvodňovacích trubiek počas celého roka okrem leta. Najvyšší počet bol zistený v novembri (164 jedincov) formovaný agregáciami do 60 jedincov. Jeseň bola sprevádzaná vytváraním párіacich zoskupení – háremov (3–9 jedincov). Most bol využívaný aj solitérnymi samcami netopiera veľkého, kde počas jesene utvárali rovnako párіace háremy v počte 2–3 jedince. Nájdená bola aj veľká agregácia raniakov hrdzavých v moste Ružomberku (maximum 457 jedincov) a ďalšie dve lokality s výskytom netopiera vodného v mostoch v Branči a Hrboltovej.

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