Mammalia (2007): 86–88 © 2007 by Walter de Gruyter • Berlin • New York. DOI 10.1515/MAMM.2007.007

Short Note

Roosting behaviour of the greater noctule *Nyctalus lasiopterus* Schreber, 1780 (Chiroptera, Vespertilionidae) in Hungary as revealed by radio-tracking

Péter Estók[1,*], Péter Gombkötő[2] and Tamás Cserkész[3]

[1] Department of Hydrobiology, University of Debrecen, 4032 Debrecen, Egyetem tér 1, Hungary, e-mail: batfauna@gmail.com
[2] Bükk National Park Directorate, 3301 Eger, Sánc út 6, Hungary
[3] Department of Animal Systematics and Ecology, Eötvös Loránd University, 1117 Budapest, Pázmány P. sétány 1/C, Hungary

*Corresponding author

Keywords: Chiroptera; Europe; radio tracking; roosting behaviour.

Introduction

Nyctalus lasiopterus is one of the rarest bat species in Europe and there is little information on the roosting requirements and habitat preference of this species. In recent times two papers have been published regarding carnivory of small birds by the species (Dondini and Vergari 2000, Ibáñez et al. 2001). In these articles some notes are also presented on the roosts of the species and Ibáñez et al. (2004) give a summary on the knowledge of the ecology of *N. lasiopterus*, including data on roosting behaviour.

N. lasiopterus is known as a typical tree-dwelling bat, roosting in trees all year round. It has been found in the cavities of very different trees, including both deciduous and coniferous species (Ibáñez et al. 2004). Dondini and Vergari (2000) reported the species from bat boxes fitted on beech trees (*Fagus sylvatica*) in Tuscany, Italy. Ibáñez et al. (2001, 2004) found 11 tree roosts of *N. lasiopterus* in a park in Sevilla, eight of which were in *Platanus* spp. and three in *Sophora japonica*. They also described a maternity colony of 80 specimens roosting under the dried leaves of three palm trees (*Washingtonia filirifera*) in Jerez de la Frontera, Southern Spain. Beck and Gebhard (2000) reported on an unusual occurrence of the species: a female specimen was found in the cellar of a castle in Aargau Kanton, Switzerland. Another subterranean occurrence was discovered by Tvrtković and Baltić (1996), where the remains of 16 *N. lasiopterus* were found in a cave on the island of Mljet, Croatia.

N. lasiopterus is known from nine locations in Hungary (Vásárhelyi 1964, Topál 1959, 1976, Dobrosi 1993, Gombkötő et al. 1996, Czájlik and Harmos 1997, Cserkész 1998, Matis et al. 2003), but no roosts have been reported. However, one partly destroyed corpse of *N. lasiopterus* was found in an attic in Hungary (Topál 1976), but this might have been captured and transported post-mortem to the building by *Tyto alba*.

One of the Hungarian localities of *N. lasiopterus* is a significant place of occurrence, which gives the opportunity to observe the species regularly. In 2004, a radio telemetry programme was initiated with the main aim of finding the roosts of *N. lasiopterus* and ensuring their conservation. This paper reports the first results concerning the roosting behaviour of the species.

Materials and Methods

The study area is situated in the vicinity of the highest point of Hungary (Kékes peak, 1014 m a.s.l.) at an altitude ranging from 670 to 850 m a.s.l. Drinking specimens of *N. lasiopterus* were mist-netted near a small pond surrounded by different plant associations (*Aegopodio-Alnetum* and *Melitti-Fagetum*). The neighbouring Kékes Észak Forest Reserve with its old beech trees gives a valuable example of *Aconito-Fagetum* association (the core area is 54.8 ha in extent).

Three females of *N. lasiopterus* were fitted with Holohil BD-2N radio transmitters on 26 July 2004. Eight individuals were fitted with Holohil LB-2N transmitters in 2005, five females and one male on 13 July 2005, one male on 14 July 2005 and one male on 16 July 2005. The nipple of each female showed signs of lactation. The transmitters were glued onto the back of the bats after shortening the hair with scissors on an area of ca. 0.5 cm^2 between the scapulae. All of the animals were in good condition, and the transmitters (0.43 g and 0.37 g) were far below the 5% load limit (Aldridge and Brigham 1988). Two receivers (Wildlife Materials TRX1000S) equipped with three- and five-element Yagi antennas were used to capture the transmitter signals.

Continuous tracking of the flying animals at night was not possible with only two receivers. Tracking of the tagged bats to find their roosts was conducted during the day. The trees of explored roosts were marked with paint on the trunk. The tree locations were fixed using global positioning system equipment and four parameters were measured: the circumference of the trunk at breast height (150 cm), the height of the roost entrance above the ground, the exposure of the roost entrance from the North, and the size of the roost entrance.

A hollow was considered to be occupied when a tagged bat was located there during the day and

Table 1 Main characteristics of the trees and hollows occupied by radio-tracked *Nyctalus lasiopterus*.

Tree code	Tree circumference at breast height (cm)	Height of roost entrance (cm)	Exposure (° from N)	Roost entrance	
				Type	Size (cm)
N1	106	1350	140	Decayed	–
N2	212	725	206	Decayed	–
N3	192	825	264	Circular	8
N4	200	1550	280	Decayed vertical	15×5
N5	143	1075	270	Decayed vertical	–
N6	142	610	294	Decayed vertical	17×4
L1	124	770	258	Decayed vertical	10×5
L2	161	1340	240	Decayed vertical	70×5
L3	107	780	84	Woodpecker hole	–

–: Measurements were not taken due to the position and/or visibility of the entrance.

emerged after sunset (the signal failed). A transmitter was considered to have fallen when the signal was received continuously from the tree after emergence time and during the following nights or if the detached transmitter was found.

Results and discussion

In 2004, six roosting trees were located (N1, N2, N3, N4, N5, N6, Table 1). Transmitters remained on females 249, 169 and 188 for at least 3, 7 and 8 days, respectively (Table 2). Females 249 and 169 were located from only one tree over 3 days before the disappearance of the signal from their radio tags. Female 188 used five different roosts on five consecutive days, which is very dynamic roosting behaviour. This female occupied the same roost together with female 249 on three consecutive days. On 27 July 2004, *N. lasiopterus* did not emerge due to the cool, rainy weather. After emergence time, several *N. leisleri* swarmed around the hollow and some of them entered the roost, which provided additional data on collective roosting of *N. leisleri* and *N. lasiopterus* (cf Ibáñez et al. 2004). On 31 July 2004, 38 bats emerged from roost N3 between 20:12 and 20:35 h, first *N. leisleri* and then *N. lasiopterus*; the exact species ratio of the emerging bats was not determined because of poor visibility.

In 2005, unfortunately five of the eight transmitters fitted came off on the first day and one bat was not located after fitting the transmitter. However, three new roosts were located (L1, L2 and L3, Table 1). Five females occupied the same tree roost (L2), four of them on the night of attachment. On 14 July 2005, 31 bats emerged from this roost (L2) between 20:31 and 21:10 h. Two males were relocated once each in the two other roosts (L1 and L3). Further investigations were impossible because of early detachment of the transmitters. This time, much more ectoparasites were visible on the bats than in 2004. It is possible that increased scratching caused the early discarding of the transmitters.

A total of nine roosting trees (Table 1) were occupied by tagged bats. These were exclusively beech trees (*Fagus sylvatica*). Of the nine roosts of *N. lasiopterus*, six were located in the Kékes Észak Forest Reserve, where the oldest beech trees are 200 years old. Three roosts were situated in the vicinity of the reserve, a forest that is 150 years old. The distance between the two further roost trees was not more than 1400 m.

The circumference of roosting trees (measured at breast height) varied from 106 to 216 cm (154.1± 39.8 cm, mean±SD). The height of the roost entrances varied between 6.1 and 15.5 m (10.03±3.36 m) and they were exposed mainly to the south-west. The openings of the hollows were very variable in size (Table 1), while the extent of the cavities in the trunks is not known.

The average height (10.03 m) of the roost entrances is considerable. It is possible that the species prefers high roost locations for easier emergence. There were other old trees of different species in the forest areas located, but the roosts identified were all situated in beech trees. The structure of beech trees (few side branches, uncluttered trunk) may be preferred by the species because of easier flight for these large bats, which have reduced manoeuvrability. *N. lasiopterus* probably also likes the structure of the decayed cavities of beech trees. These hypotheses should be tested in the future.

The availability of old trees with hollows and the natural composition of the forest are certainly important factors for the species. Frequent roost-changing by one observed female indicates that the species needs not only suitable hollows, but also a network of hollows, which are used in rotation, similar to many forest-dwelling bat species (Kunz and Lumsden 2003). Conservation of the roosting trees situated in the forest reserve and in its protected

Table 2 Occupation of trees by the three females radio-tracked in 2004.

Animal code	Sex	Codes of the trees occupied on days of the research period								
		27 July	28 July	29 July	30 July	31 July	1 Aug	2 Aug	3 Aug	4 Aug
249	♀	N1	N1	N1	?	?	?	?	?	?
188	♀	N1	N1	N1	N1	N2	N4	N5	N6	N6 (fallen)
169	♀	?	?	?	?	N3	N3	N3	?	?

Fallen: transmitter fell off the bat.

vicinity is guaranteed. Trees in other old beech forests that are possibly suitable for *N. lasiopterus* are threatened by logging, which has increased in recent years due to a switch from fossil fuels to wood as the energy source for power stations. It is important to locate other forest areas where *N. lasiopterus* colonies may be roosting, for which radio-tracking represents an effective method.

Acknowledgements

We thank James Benett for language correction and Julia Deák for French translation.

References

Aldridge, H.D.J.N. and R.M. Brigham. 1988. Load carrying and maneuverability in an insectivorous bat: a test of the 5% "rule" of radio-telemetry. *J. Mammalogy* 69: 379–382.

Beck, A. and J. Gebhard. 2000. Riesenabendsegler (*Nyctalus lasiopterus*) im Schloss Hallwyl, Kanton Aargau, gefunden. Pro Chiroptera 1: 1–3.

Cserkész, T. 1998. Presence of bats in owl pellets collected in Northern Hungary. Denevérkutatás [Hungarian Bat Research News] 3: 36–39.

Czájlik, P. and K. Harmos. 1997. Data on the occurrence of bat species in the Kékes Észak forest reserve. Fol. Hist. Nat. Mus. Matraensis 22: 345–348.

Dobrosi, D. 1993. Contribution to the knowledge of the bat-fauna of the Bükk mountains. Fol. Hist. Nat. Mus. Matraensis 18: 191–197.

Dondini, G. and S. Vergari. 2000. Carnivory in the greater noctule bat (*Nyctalus lasiopterus*) in Italy. J. Zool. Lond. 251: 233–236.

Gombkötő, P., Z. Bihari and P. Estók. 1996. New records of greater noctule (*Nyctalus lasiopterus*) and parti-coloured bat (*Vespertilio murinus*) in North Hungary. Denevérkutatás [Hungarian Bat Research News] 2: 38–39.

Ibáñez, C., J. Juste, J.L. Garcia-Mudarra and P.T. Agirre-Mendi. 2001. Bat predation on nocturnally migrating birds. Proc. Natl. Acad. Sci. USA 98: 9965–10022.

Ibáñez, C., A. Guillen and W. Bogdanowicz. 2004. *Nyctalus lasiopterus* (Schreber, 1780) Riesenabendsegler. In: (Krapp, F., ed.) Handbuch der Säugetiere Europas. Vol. 4/II. AULA-Verlag, Wiesbaden, Germany. pp. 695–716.

Kunz, T.H. and L.F. Lumsden. 2003. Ecology of cavity and foliage roosting bats. In: (T.H. Kunz and M.B. Fenton, eds.) Bat ecology. The University of Chicago Press, Chicago. pp. 3–89.

Matis, Š., S. Boldogh and P. Pjenčák. 2003. Records of *Nyctalus lasiopterus* in the Gömör-Torna Karst (Slovakia, Hungary). Vespertilio 7: 135–138.

Topál, Gy. 1959. Two rare bat species in the fauna of the Carpathian Basin. Vertebr. Hung. 1: 89–103.

Topál, Gy. 1976. New records of *Vespertilio murinus* (Linnaeus) and of *Nyctalus lasiopterus* (Schreber) in Hungary. Vertebr. Hung. 17: 9–14.

Tvrtković, N. and M. Baltić. 1996. Giant noctule (*Nyctalus lasiopterus* Schreber, 1780), first refinding in Croatia (Mljet Island) after 69 years. Nat. Croat. 5: 89–93.

Vásárhelyi, I. 1964. The vertebrate fauna of Borsod-Abaúj-Zemplén County. Manuscript.