The Occurrence of Hibernating Pipistrellus pipistrellus (Schreber, 1774) in Caves of the Carpathian Basin

Authors: Nagy, Zoltán L., and Szántó, László

Source: Acta Chiropterologica, 5(1) : 155-160

Published By: Museum and Institute of Zoology, Polish Academy of Sciences

URL: https://doi.org/10.3161/001.005.0115

The BioOne Digital Library (https://bioone.org/) provides worldwide distribution for more than 580 journals and eBooks from BioOne's community of over 150 nonprofit societies, research institutions, and university presses in the biological, ecological, and environmental sciences. The BioOne Digital Library encompasses the flagship aggregation BioOne Complete (https://bioone.org/subscribe), the BioOne Complete Archive (https://bioone.org/archive), and the BioOne eBooks program offerings ESA eBook Collection (https://bioone.org/esa-ebooks) and CSIRO Publishing BioSelect Collection (https://bioone.org/csiro-ebooks).

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use

The occurrence of hibernating *Pipistrellus pipistrellus* (Schreber, 1774) in caves of The Carpathian Basin

ZOLTÁN L. NAGY and LÁSZLÓ SZÁNTÓ

Transylvanian Museum Association, 3400 Cluj, Op.1 Cp.191, Romania; E-mail of ZLN: bigze@personal.ro

Key words: Carpathian Basin, distribution, *Pipistrellus pipistrellus*, Romania, underground hibernacula

INTRODUCTION

The pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774) is one of the most widespread and abundant bat species in Europe (Mitchell-Jones *et al.*, 1999). Some studies have even inferred recent population increases or expansions in some Central and Western European countries (Arlettaz *et al.*, 2000). *Pipistrellus pipistrellus* forms large nursery colonies in summer, sometimes up to several hundred females, typically located in houses, tree holes or bat boxes (Gerell and Lundberg, 1985). In winter both sexes congregate, forming large hibernating colonies. They have been reported from tree holes (Kepka, 1976), underground cavities (Haensel, 1992; Lustrat and Julien, 1993; Kretzschmar and Heinz, 1995), church and house attics (Racey, 1973; Gjerde, 1994), and caves (Dumitrescu and Orghidan, 1963; Uhrin, 1995).

Dumitrescu and Orghidan (1963) reported the first large hibernating colony in Sura Mare cave (Sebes Mountains, Southern Carpathians), Romania, numbering up to 60,000 individuals. Individuals and sporadic colonies were also found in Liliecilor and Meziad caves (Dumitrescu *et al*., 1963). One group of *P. pipistrellus* was located hibernating in deep and dry crevices in the Drienovec cave in former Czechoslovakia (Gaisler and Hanák, 1962; see also Matis, 2000). Uhrin (1995) reviewed the winter distribution of *P. pipistrellus* in underground shelters in the Slovak Republic, remarking on the presence in three caves in South Slovakia, one of which contained ca. 10,000 individuals. In addition, 2,100 *P. pipistrellus* were found hibernating together with a large number of *Barbastella barbastellus* in mine gallery in the Muranska Plain Protected Landscape Area. In France 800–900 *P. pipistrellus* were reported during the winter of 1990 in a 600 metre tunnel near Paris (Lustrat and Julien, 1993) and in South West Germany about 1,000 *P. pipistrellus* were also discovered in a mine (Kretzschmar and Heinz, 1995).

Other records in European countries during the winter months show a sporadic occurrence of *P. pipistrellus* in underground shelters, including caves in Spain (Alcalde and Escala, 1999), Austria (Bernd, 1994), Hungary (Paulovics *et al*., 1996), Poland (Krzanowski, 1959; Bagrowska-Urbańczyk and Urbańczyk, 1983), Ukraine (Krochko, 1964), Bulgaria (Pandruska and Beshkov, 1998) and Switzerland (Aellen, 1965).

In view of the fact that the Sura Mare cave was reported to contain the largest number of hibernating *P. pipistrellus* throughout the range of this species, it was of interest to repeat and extend the original survey of Dumitrescu *et al*. (1963) 40 years later.

MATERIAL AND METHODS

From 1999–2002 we mapped the location and size of winter and summer colonies of *P. pipistrellus* in 50 caves in the Western and Southern Carpathians, and Dobrogea, Romania. In addition, potential roosts, i.e., those displaying adequate habitat parameters but not known to harbour *P. pipistrellus*, were also

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use

investigated. We censused *P. pipistrellus* in hibernacula visually, sometimes with the help of binoculars. Inside caves we used bat detectors (Pettersson D200). The biopsy punch technique was used to sample wing tissue of 24 pipistrelles from Huda lui Papara cave according to Worthington Wilmer and Barratt (1996). Mitochondrial DNA analysis carried out at The University of Aberdeen indicated that all the sampled individuals were *P. pipistrellus*. Juveniles were distinguished from adults by the lack of ossification in the plates in the joints of finger bones (Anthony, 1988). Microclimatic measurements (temperature and humidity, using Checktemp 1, Hygrocheck, Hanna Instruments) were taken as near as possible to hibernating individuals. The winter sampling of sites was carried out each season between 20 December and 1 March. In order to estimate colony size, we counted bats in compact clusters in 10 cm^2 areas ($n = 7$, range = 29–35 bats/10 cm^2, $\bar{x}$ = 31.57 bats/10 cm^2). The area occupied by bats was estimated or measured where possible. Lone individuals were counted separately. In addition to *P. pipistrellus*, we counted the number of individuals of other species sharing the roost. Other species within the genus *Pipistrellus* are rare in Romania. *Pipistrellus kuhlii* was recorded only by bat detector in 2000 (H. Limpens, pers. comm.), and *P. nathusii* were described in three localities within the country (Dumitrescu *et al.*, 1963; Barbu, 1968; Dobrosi and Gulyás, 1997). *Pipistrellus pygmaeus* was observed since 2000 in the western part of Romania, in the Cris River valley, and in the Danube Delta (H. Limpens, pers. comm.). The probability of the occurrence of any other *Pipistrellus* species in large winter aggregations, where individual identification was not possible, is therefore low.

The six studied caves housing *P. pipistrellus* were located in the Southern and Western Carpathian Mountains in Romania at an altitude of 62–567 m a.s.l., in limestone areas rich in underground formations. Those containing the largest number of bats have large entrances (16 m high by 10 m wide to 37 m high by 8–12 m wide), corridors up to 25 m high, large chambers, and a maximum length of 4,750 m. All caves, with the exception of the Grota Haiducilor and Magura cave, had a constant water flow in winter.

Results

Individuals of *P. pipistrellus* were observed in six caves during winter, frequently together with other species (Table 1). In Sura Mare cave (Southern Carpathians), they were hanging free from the roof and inside large crevices on corridor walls, 300–350 m from the entrance, forming compact clusters and aggregations. A large number of smaller groups were also located deep in crevices where they could not be counted. The total number of pipistrelles in this cave was estimated to be about 32,000–34,000. In contrast only 33, individuals of the second most common species *B. barbastellus* were found. In the two other caves, Grota Haiducilor and Gura Ponicoavei, which are also located in the Southern Carpathians, pipistrelles were hidden in crevices, with no distinct clusters at the roof or walls. In Groata Haiducilor, only eight individuals were counted, and an exact estimate was not possible. In Gura Ponicoavei the presence of about 1,000 *P. pipistrellus* was confirmed in 17 crevices.

In the Western Carpathians, the Huda lui Papara cave housed the second major aggregation of *P. pipistrellus* in Romania. In the winter of 2001, 16,000–17,000 *P. pipistrellus* were estimated to hibernate there. These bats were seen in the same locations during three consecutive years. They formed free hanging groups on the roof and walls, and were also present in wide horizontal and vertical fissures. In a few cases, they formed clusters together with *Nyctalus noctula*. The percentage of males to females in one randomly chosen group was 41.7 : 58.3 ($n = 24$). Solitarily hibernating pipistrelles were quite rare. The site, estimated to contain up to 55,000 individuals of 10 species (Table 1) probably constitutes the largest bat hibernaculum in Europe.

The Meziad cave contained large aggregations of *Rhinolophus ferrumequinum* together with small numbers of *P. pipistrellus* and some other species (Table 1). In February 2000, more than 200 pipistrelles were found in fissures of an artificial wall near the entrance. In January 2001, even larger number of pipistrelles were present in the same place. A few individuals were also

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use

TABLE 1. Name and location of the caves, containing hibernating *Pipistrellus pipistrellus*. Temperature and humidity recorded under colonies of pipistrelles

Cave name	Geographic coordinates	Date of census	No. of pipistrelles	Location of pipistrelles	Temperature (°C) and humidity (%)	Other species
Meziad	46°45'N, 22°28'E	2000.02.15 2001.01.22 2002.01.19	> 250	crevices free hanging	-1.2–3.7 81.1	*Rhinolophus ferrumequinum, R. hipposideros, R. euryale, Miniopterus schreibersii, Myotis myotis, M. blythii, Nyctalus noctula, Barbastella barbastellus*
Magura	46°31'N, 22°32'E	2002.01.20	200	free hanging	0.6 83.2	*R. ferrumequinum, R. hipposideros, B. barbastellus, Plecotus auritus*
Huda lui Papara	46°23'N, 23°17'E	2000.02.20 2001.01.20 2001.02.03 2002.01.22	16,000–17,000	crevices free hanging	-0.5–4.7 82–96	*R. ferrumequinum, R. hipposideros, M. myotis, M. blythii, M. daubentonii, B. barbastellus, Vespertilio murinus, M. schreibersii, Nyctalus noctula*
Gura Ponicoavei	44°34'N, 22°14'E	2000.02.03	≤ 1,000	crevices	6.7 82.4	*R. ferrumequinum, R. hipposideros, R. euryale, P. auritus, M. daubentonii*
Grota Haiducilor	44°52'N, 22°24'E	2000.02.03	8	crevices	6.8 87.3	*R. ferrumequinum, M. daubentonii*
Sura Mare	45°32'N, 23°08'E	2000.02.06	32,000–34,000	crevices free hanging	4.8 95	*B. barbastellus*

recorded in the summer of 2000. In the Magura cave, after several years of winter monitoring, about 200 pipistrelles were discovered in January 2002. The bats formed a compact cluster in one niche of the roof, near to the entrance.

DISCUSSION

Pipistrellus pipistrellus was formerly considered to be primarily a house and tree-cavity dwelling bat, which occasionally occurred in caves during winter, primarily in Eastern Europe (Schober and Grimmberger, 1997). For a long time, the only available data regarding significant underground hibernacula in Europe for *P. pipistrellus* were those in the Sura Mare cave (Dumitrescu and Orghidan, 1963). Data from this locality have been incorrectly cited many times, with respect to the geographic position of the cave and the number of bats hibernating there. Schober and Grimmberger (1997) erroneously reported that 100,000 individuals constituted the aggregation, while Stebbings (1988) placed the hibernaculum in Dobrogea, where *Pipistrellus* spp. had not been reported previously in underground shelters.

The largest clusters of *P. pipistrellus* in underground hibernacula of Europe are found in the Carpathian Basin, in the mountains of Slovakia and Romania (Dumitrescu and Orghidan, 1963; Uhrin, 1995; this paper). Much smaller aggregations (< 10 individuals) of hibernating *P. pipistrellus* occur in caves in other European countries. There are some records of these bats present in the same caves during summer, but it appears that in such instances, the caves are being used as temporary resting places during migration.

The temperature of a church hibernaculum used by *P. pipistrellus* in England recorded throughout the hibernation period ranged from -5° to 12°C (Racey, 1974).

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use

It thus seems that these bats can occur in varying types of habitats, including caves (albeit not in England). The median temperature recorded in our study (4.2°C; range: -1.2–6.7°C) was close to the median (3.4°C) described by Racey (1974), but circumscribed within a narrower range of values, which may be the result of the relatively stable microclimatic environment within caves. In all caves occupied by bats, there was a high level of relative humidity, nearing saturation (81.1–96%). Climatic factors do not seem to affect the beginning of hibernation in bats, but they do affect its duration. Grimmberger (1979) noted that if the average daily temperature is under 0°C, the activity of bats is very reduced within hibernacula.

The distribution of *P. pipistrellus* in caves does not seem to be affected by elevation (range: 62–567 m in Romania), and individual *P. pipistrellus* have been observed at altitudes of up to 2,000 m (Schober and Grimmberger, 1997). These bats do not appear to display any marked preference relative to cave topography or structural complexity, and are found near the entrance in the diffuse light zone, as well as deep within the caves. It was observed, however, that they hibernate in the same region within the cave for many consecutive years.

There is an extensive record of subfossils of *P. pipistrellus* in cave deposits in the Carpathian Basin area, documented especially well for Southern Poland (e.g., Kowalski, 1967; Nadachowski, 1976; Madeyska, 1981; Alexandrowicz *et al.*, 1985; Nadachowski *et al.*, 1989; Ochman and Wołoszyn, 2000). In Romania, subfossil remains of this species were found in the Huda lui Papara and Meresti caves in the Persani Mountains in Southern Carpathians (L. Barti, pers. comm.). All these findings strongly suggest that cave dwelling is not a recent occurrence in this region.

The decline in population sizes evident in the colony at Sura Mare cave seems to be the result of human perturbation. As in the rest of Europe, cave dwelling bats have shown dramatic declines in the last decades (Stebbings, 1988). This phenomenon may be a consequence of the increasing popularity of cave tourism. Similar, but more drastic, is the case of the Manastirea Bistrita cave, which 40 years ago held aggregations of more than 10,000 individuals of a few species, including small aggregations of *P. pipistrellus* (Dumitrescu *et al.*, 1963). At present, all these aggregations are extinct, and the cave is used daily as a place of cultic or religious worship. In the case of the other caves used by pipistrelles, it is not possible to document declines, due to the lack of earlier data.

These recent records of large aggregations of pipistrelles within the Carpathians suggest that this area is particularly important for these bats during hibernation. The diversity of bats in the underground sites of the Carpathian Basin also reveals the importance of the area for other cave dwelling bat species. At present caves in Romania are not protected as important bat roosts. The lack of legal and practical conservation measures makes the long-term existence of these unique places particularly vulnerable. Developing an action plan for the conservation of the cave dwelling bat species at a national and international level is clearly a high priority.

Acknowledgements

We thank Luis Ruedas for the critical and helpful comments on the manuscript and for the assistance on English. We also thank Peter Lina, Lena Godlewsky and Katharina Ochman for providing references, and for our colleagues: Krecsák László, Dóczy Anna, Szodoray-Parádi Farkas, and Paulovics Péter for their support in the fieldwork, and Professor Paul A. Racey and Mrs. Freda Marshall of the University of Aberdeen for carrying out DNA analysis.

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use

Literature Cited

Aellen, V. 1965. Les chauves-souris cavernicoles de la Suisse. Speology, 1: 270–278.

Alcalde, J. T., and M. C. Escala. 1999. Hibernation of bats in Navarre (Northern Spain). Myotis, 37: 89–98.

Alexandrowicz, S. W., A. Nadachowski, J. Rydlewski, P. Valde-Nowak, and B. W. Wołoszyn. 1985. Subfossil fauna from a Cave in Sobczański Gully (Pieniny Mts., Poland). Folia Quaternaria, 56: 59–70.

Anthony, E. L. P. 1988. Age determination in bats. Pp. 47–58, *in* Ecological and behavioural methods for the study of bats (T. H. Kunz, ed.). Smithsonian Institution Press, Washington, D.C., 544 pp.

Arlettaz, R., S. Godat, and H. Meyer. 2000. Competition for food by expanding pipistrelle bat population (*Pipistrellus pipistrellus*) might contribute decline of lesser horseshoe bats (*Rhinolophus hipposideros*). Biological Conservation, 93: 55–60.

Bagrowska-Urbańczyk, E., and Z. Urbańczyk. 1983. Structure and dynamics of a winter colony of bats. Acta Theriologica, 28: 183–197.

Barbu, P. 1968. A *Pipistrellus nathusii* Keys. et Blas. 1839 summer colony in the lighthouse of Sf. Gheorghe — Dobrudja. Ocrotirea naturii, 2: 211–215. [in Romanian with English summary].

Bernd, F. 1994. *Pipistrellus pipistrellus* (Schreber, 1774) — Winterschlafgemeinschaften der Zwergfledermaus in Hohlen des Rothelsteinstockes bei Mixnitz, Steiermark (Mammalia, Chiroptera). Mitteilungen des Naturwissenschaftlichen Vereins für Steiermark, 124: 241–242.

Dobrosi, D., and J. Gulyás. 1997. Cave dwelling bats in Bihar-Mountain. Pp. 34–36, *in* Proceedings of the 1st Conference on the Bat Conservation in Hungary (V. Molnár, Z. Molnár, and D. Dobrosi, eds.). Hungarian Bat Research Society, Budapest, 69 pp. [in Hungarian with English summary].

Dumitrescu, M., and T. Orghidan. 1963. Contribution à la connaissance de la biologie de *Pipistrellus pipistrellus* Schreber. Annales de Speologie, 18: 511–517.

Dumitrescu, M., J. Tanasachi, and T. Orghidan. 1963. Distribution of bats in Romania. Lucrările Institutului Speolologie 'Emil Racovită', 1–2: 509–575. [in Romanian with Russian summary].

Gaisler, J., and V. Hanák. 1962. Bats of the Drienovec Cave and their research. Krasový sborník (Praha), 3: 15–25. [in Czech with English summary].

Gerell, R., and K. Lundberg. 1985. Social organization in the bat *Pipistrellus pipistrellus.* Behavioral Ecology and Sociobiology, 16: 177–184.

Gjerde, L. 1994. Hibernacula destroyed: 3000 bats killed in Rogaland County. Fennoscandian Bats, 2: 2–3.

Grimmberger, E. 1979. Untersuchungen über den Einfluß klimatischer Faktoren auf das Verhalten der Zwergfledermaus, *Pipistrellus pipistrellus* (Schreber, 1774), im Winterquartier und während der sogenannten Invasionen. Nyctalus, 2: 145–157.

Haensel, J. 1992. Weitere Mitteilungen zum saisonbedingten Quartierwechsel der Zwergfledermaus (*Pipistrellus pipistrellus*). Nyctalus, 4: 274–280.

Kepka, O. 1976. Eine Winterschlafgemeinschaft der Zwergfledermaus, *Pipistrellus pipistrellus* Schreb. und des Großen Abendseglers, *Nyctalus noctula* Schreb. in Graz (Mamm. Chiroptera). Faunistische Nachrichten aus der Steiermark (XXI). Mitteilungen des Naturwissenschaftlichen Vereins für Steiermark, 106: 221–222.

Kowalski, K. 1967. Fauna plejstocenu Polski. Pp. 72–82, *in* Czwartorzęd Polski (R. Galon and J. Dylik, eds.). PWN, Warszawa, 527 pp.

Kretzschmar, F., and B. Heintz. 1995. Social behaviour and hibernation of a large population of *Pipistrellus pipistrellus* (Schreber, 1774) (Chiroptera: Vespertilionidae) and some other bat species in the mining-system of a limestone quarry near Heidelberg (South West Germany). Myotis, 32–33: 221–229.

Krochko, Yu. I. 1964. Some data on bats' hibernation. Pp. 195–201, *in* Okhoronyaimo pryrodu (I. I. Grunyanskiy, C. D. Ivanov, and V. I. Komendor, eds.). Karpaty, Uzhgorod, 222 pp. [in Ukrainian].

Krzanowski, A. 1959. Some major aspects of population turnover in wintering bats in the cave at Puławy (Poland). Acta Theriologica, 3: 27–42.

Lustrat, P., and J. F. Julian. 1993. Un important gîte d'hibernation de chauves-souris à Paris (France). Mammalia, 57: 447–448.

Madeyska, T. 1981. Środowisko człowieka w środkowym i górnym paleolicie na ziemiach polskich w świetle badań geologicznych. Studia Geologica Polonica, 69: 1–125.

Matis, Š. 2000. The current knowledge of bats of Drienovská jaskyňa cave (Slovak Karst, SE-Slovakia). Vespertilio, 4: 117–126. [in Slovakian with English summary].

Mitchell-Jones, A. J, G. Amori, W. Bogdanowicz, B. Kryštufek, P. J. H. Reijnders, F. Spitzenberger, M. Stubbe, J. B. M. Thissen, V. Vohralík, and J. Zima. 1999. The atlas of

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use

European mammals. T & AD Poyser, London, 484 pp.

NADACHOWSKI, A. 1976. Fauna kopalna w osadach Jaskini Mamutowej w Wierzchowiu koło Krakowa. Folia Quaternaria, 48: 17–36.

NADACHOWSKI, A., T. MADEYSKA, E. ROOK, B. RZEBIK-KOWALSKA, E. STWORZEWICZ, Z. SZYNDLAR, T. TOMEK, M. WOLSAN, and B. W. WOŁOSZYN. 1989. Holocene snail and vertebrate fauna from Nad Mosurem Starym Duża Cave (Grodzisko near Cracow): palaeoclimatic and palaeoenvironmental reconstructions. Acta Zoologica Cracoviensia, 32: 495–520.

OCHMAN, K., and B. W. WOŁOSZYN. 2000. Analysis of the Holocene bat fauna (Chiroptera) from Pod Sokolą Górą Cave. Studia Chiropterologica, 1: 57–72.

PANDRUSKA, R. S., and V. A. BESHKOV. 1998. Species diversity of bats in underground roosts of the Western Stara Planina Mts. (Bulgaria). Vespertilio, 3: 81–91.

PAULOVICS, P., I. DOMBI, and E. C. FEHER. 1996. Results of winter census in Bakony Mountains. Hungarian Bat Research News, 2: 10–15. [in Hungarian with English summary].

RACEY, P. A. 1973. The time of onset of hibernation in pipistrelle bats, *Pipistrellus pipistrellus.* Journal of Zoology (London), 171: 465–467.

RACEY, P. A. 1974. The temperature of a pipistrelle hibernaculum. Journal of Zoology (London), 173: 260–262.

SCHOBER, W., and E. GRIMMBERGER. 1998. Die Fledermäuse Europas, kennen — bestimmen — schützen. Franckh-Kosmos Verlags-GmbH., Stuttgart, 266 pp.

STEBBINGS, R. E. 1988. The conservation of European bats. Christopher Helm, London, 245 pp.

UHRIN, M. 1995. The finding of a mass winter colony of *Barbastella barbastellus* and *Pipistrellus pipistrellus* (Chiroptera, Vespertilionidae) in Slovakia. Myotis, 32–33: 131–133.

WORTHINGTON WILMER J., and E. BARRATT. 1996. A non-lethal method of tissue sampling for genetic studies of chiropterans. Bat Research News, 37(1): 1–3.

Received 11 November 2001, accepted 30 December 2002

Downloaded From: https://staging.bioone.org/journals/Acta-Chiropterologica on 23 Mar 2025
Terms of Use: https://staging.bioone.org/terms-of-use