

Shelter preference of the Barbastelle, *Barbastella barbastellus* (Schreber, 1774), hibernating in Poland

Die bevorzugten Winterquartiere der Mopsfledermaus, *Barbastella barbastellus* (Schreber, 1774), in Polen

Les gîtes préférés de la Barbastelle, *Barbastella barbastellus* (Schreber, 1774), pour l'hivernage en Pologne

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Abstract

This paper summarises data from 719 bat hibernacula surveyed in Poland since 1980. Data from 580 shelters were collected by the authors, and the rest was taken from the literature.

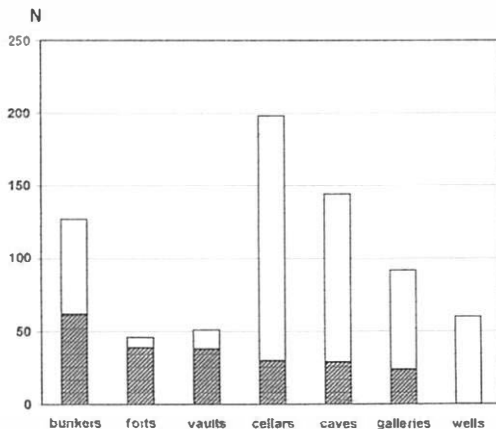


Fig. 1. Number of shelters occupied [striped bars] and not occupied [empty bars] by Barbastelles in each shelter type.

Based on own data and the following papers: BERNARD (1994), BERNARD (1995), BERNARD et al. (1990), BERNARD et al. (1995a), BERNARD et al. (1995b), GAWLAK (1996), GODAWA (1994), GÓLSKI (1992), HARMATA (1994), JARZEMBOWSKI & OSTRACI (1994), JARZEMBOWSKI & PRZESMYCKA (1996), KEPEL (1995), MLECZYK et al. (1994), PASZKIEWICZ et al. (1995), POSTAWA et al. (1994), PRZESMYCKA et al. (1996), URBANCIK & GÓLSKI (1994), WOLOSZYN et al. (1994), WOLOSZYN et al. (1996).

Abb. 1. Anzahl der besetzten Winterquartiere (gestreifte Balken) und der nicht besetzten (leere Balken) mit Mopsfledermäusen, bezogen auf jeden Quartiertyp.

Graph. 1. Nombre de gîtes occupés (barres hachurées) et inoccupés (barres vides) par les Barbastelles dans chaque type de gîte.

The basic information for each hibernaculum was the highest number of Barbastelles recorded in a single survey. 7 categories of winter shelters were distinguished: bunkers, forts, big brick vaults, cellars, caves, abandoned mining galleries and wells. The „Nietoperk” Bat Reserve was considered a separate category.

Barbastelles wintered in 31% of bat hibernacula. The species was present in 85% of forts, 75% of big brick vaults, almost 50% of bunkers, and it has not been found in wells (Fig. 1).

In bunkers Barbastelles formed 85% of the total number of bats, in forts over 60% and in other types of shelters except for wells 40% (Fig. 2). In twelve shelters the number of wintering Barbastelles at least once exceeded 100. The highest number was recorded in „Nietoperk” (Table 1). In 11% of shelters the number of Barbastelles was between 20 and 99. In over 50% of cellars, over 40% of caves and almost 40% of bunkers only single individuals were found (Fig. 3).

In Poland the most important winter shelters for Barbastelles are those of military origin – forts (housing 24% of hibernating Barbastelles), bunkers (18%), the „Nietoperk” system (24%) and big brick vaults (22%) (Table 2).

Zusammenfassung

Diese Arbeit faßt die Daten von 719 geprüften Fledermausüberwinterungen seit 1980 in Polen zusammen. Die Daten von 580 Winterquartieren wurden von den Autoren gesammelt, die übrigen der Literatur entnommen.

Als Hauptinformation für jede Überwinterung wird die höchste Anzahl an Mopsfledermäusen aufgezeichnet, in einer einzelnen Schätzung. Es werden 7 Kategorien an Winterquartieren unterschieden: Bunker, Forts, große Backsteingewölbe, Keller, Höhlen, verlassene Bergwerkstollen und Brunnen-

schächte. Das „Nietoperek“-Fledermausschutzgebiet wurde als getrennte Kategorie berücksichtigt.

Mopsfledermäuse überwintern in 31 % der Fledermaus-Winterquartiere. Die Art war in 85 % der Forts, in 75 % der großen Backsteingewölbe, beinahe in 50 % der Bunker anzutreffen, nur in Brunnenschächten war sie nicht zu finden (Abb. 1).

In Bunkern setzt sich die Gesamtzahl der Fledermäuse zu 85 % aus Mopsfledermäusen zusammen, in Forts zu über 60 % und in anderen Arten von Quartieren ausgenommen Brunnenschächte zu 40 % (Fig. 2). In zwölf Winterquartieren überstieg die Zahl der überwinternden Mopsfledermäuse die Einhundertergrenze. Die höchste Zahl wurde in „Nietoperek“ erreicht (Tab. 1). In 11 % der Quartiere lag die Zahl an Mopsfledermäusen zwischen 20 und 99 Ex. In über 50 % der Keller, mehr als 40 % der Höhlen und in beinahe 40 % der Bunker wurden nur einzelne Individuen gefunden (Abb. 3).

In Polen sind die meisten der wichtigen Winterschlafplätze für Mopsfledermäuse militärischen Ursprungs – Forts (Unterkünfte für 24 % der überwinternden Mopsfledermäuse), Bunker (18 %), „Nietoperek“-System (24 %) und große Backsteingewölbe (22 %) (Tab. 2).

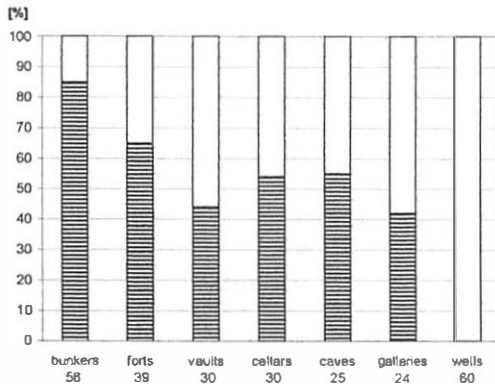


Fig. 2. Percentage of Barbastelles in bat communities hibernating in different shelter types (number of objects is given below).

Based on own data and the following papers: BERNARD (1995), BERNARD *et al.* (1990), BERNARD *et al.* (1995a), BERNARD *et al.* (1995b), GAWLAK (1996), GODAWA (1994), GÓLSKI (1992), KEPEL (1995), MŁECZEK *et al.* (1994), POSTAWA *et al.* (1994), WOŁOSZYN (1994).

Abb. 2. Anteil der Mopsfledermäuse an überwinternden Fledermausgemeinschaften in verschiedenen Quartiertypen (Anzahl der Objekte ist unten angegeben).

Graph. 2. Proportion de Barbastelles dans les communautés de chauves-souris hibernant dans différents types de gîtes (le nombre d'objets est donné en-dessous).

Site	Type of shelter	Maximum number of Barbastelles	Year	Source
„Nietoperek“	Large system of fortifications	Over 1300	1992	Lesiński <i>et al.</i>
Mameki 10/II	Bunker	577	1997	Fuszara, Fuszara, Wojciechowski (this volume)
Strubiny I	Fort	363	1996	Own data
Oswiec II	Fort	304	1993	Lesiński (1994)
Stachownica	Cave	275	1994	Hejduk, Radzicki (1996)
Świecie	Vault	245	1992	Gólski (1992)
Konewka	Fort	228	1994	Own data
Cieszaków	Vault	224	1997	Own data
Poznań – Fort I	Vault	172	1994	Bernard <i>et al.</i> (1995)
Salis Sogbio	Vault	160	1994	Godawa (1994)
Stolec	Gallery	127	1997	Own data
Poznań – Fort III	Vault	106	1996	Own data

Table 1. The most important Barbastelle hibernacula in Poland.

Tabelle 1. Die wichtigsten Mopsfledermaus-winterquartiere in Polen.

Tableau 1. Les principaux gîtes d'hivernage de la Barbastelle en Pologne.

Type of shelter	Number of shelters taken into account	Number of Barbastelles	Percentage of the total number of Barbastelles
Bunkers	58	1012	18%
Forts	39	1307	24%
Vaults	30	1190	22%
Cellars	30	68	1%
Caves	25	406	7%
Galleries	24	240	4%
„Nietoperek“ Bat Reserve	1	over 1300 *	24%
TOTAL	207	5523	100%

*Lesiński *et al.* (this volume)

Table 2. Percentages of the total number (i.e. sum of maximum numbers noted) of Barbastelles wintering in different types of shelter.

Tabelle 2. Anteil an der Gesamtzahl (d.h. an der Summe der bekannten Höchstzahl) überwinternder Mopsfledermäuse in verschiedenen Arten von Winterquartieren.

Tableau 2. Proportion du nombre total (somme des maxima connus) des Barbastelles dans différents types de gîtes.

Resumé

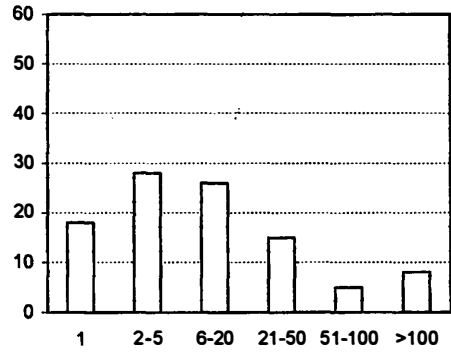
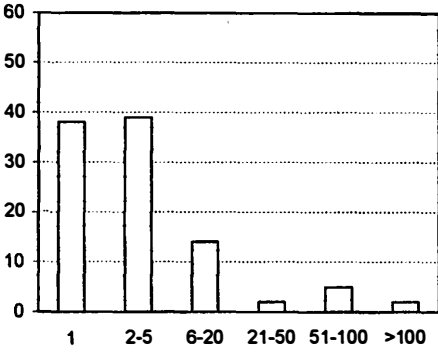
Cet article rassemble 719 données d'hivernage de chauves-souris depuis 1980 en Pologne. Les auteurs ont collecté des informations concernant 580 gîtes d'hivernage et le reste a été tiré de la littérature.

Le nombre maximal de Barbastelles a été noté en

[%]

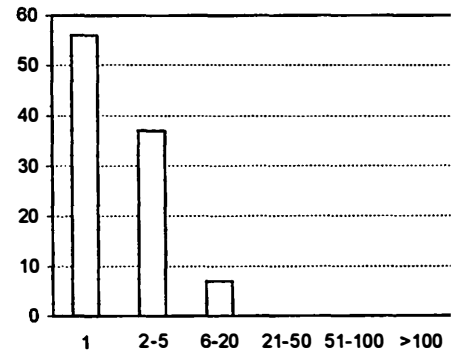
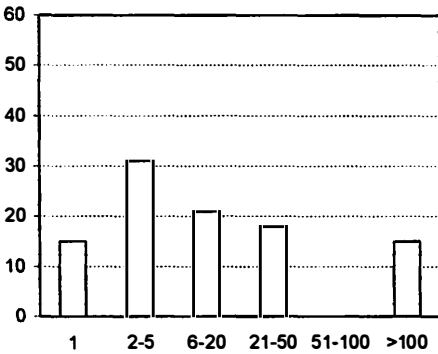
Bunkers

Forts



Vaults

Cellars



Caves

Galleries

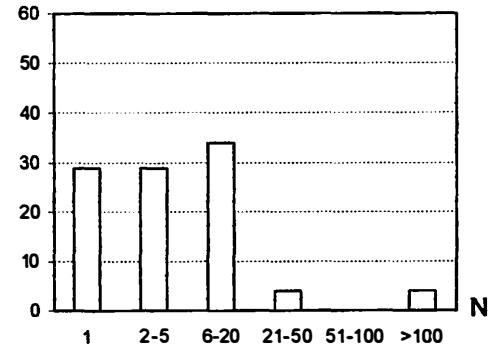
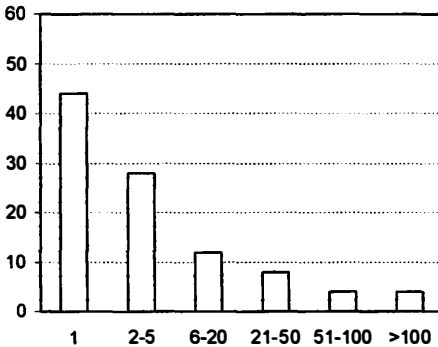


Fig. 3. Percentage of shelters housing different numbers of hibernating Barbastelles in each shelter type. Based on own data and the following papers: BERNARD (1995), BERNARD et al. (1990), BERNARD et al. (1995a), GAWLAK (1996), GODAWA (1994), GÓLSKI (1992), JARZEMBOWSKI & OSTRACH (1994), JARZEMBOWSKI & PRZESMYCKA (1996), KEPEL (1995), MLECZEK et al. (1994), POSTAWA et al. (1994), WOŁOSZYN et al. (1996). N - number of Barbastelles

Abb. 3. Anteil an überwinternden Mopsfledermäusen in jedem Quartiertyp, gestaffelt nach Häufigkeitsklassen.

Graph. 3. Rapport entre le nombre de gîtes et l'effectif des Barbastelles dans chaque type de gîte.

une seule estimation pour chaque site. On a distingué 7 catégories de gîtes: les bunkers, les forts, les grandes voûtes en briques, les caves, les grottes, les galeries de mines abandonnées et les murs. Le site de „Nietoperek” a été considéré dans une catégorie à part. Les Barbastelles hivernent dans 31% des sites. On pouvait rencontrer des chauves-souris dans le 85% des forts, le 75% des grandes voûtes en briques et dans près de 50% des bunkers, mais on n'en trouvait pas dans les murs (Graph. 1).

Dans les bunkers, le nombre total de chauves-souris était constitué de 85% de Barbastelles; il était de 60% dans les forts et dans les autres types de gîtes et jusqu'à 40% dans les murs (Graph. 2). Dans douze gîtes d'hivernage le nombre de Barbastelles dépassait les cent individus. Le plus grand nombre a été atteint à „Nietoperek” (Tab. 1). Le nombre de Barbastelles se situait entre 20 et 99 dans le 11% des gîtes d'hivernage. Seuls des individus isolés ont été trouvés dans plus de 50% des caves, dans plus de 40% des grottes et dans près de 40% des bunkers (Graph. 3).

En Pologne, la plupart des sites importants d'hivernage des Barbastelles ont des origines militaires: les forts abritent 24% des Barbastelles hivernant, les bunkers 18%, le complexe de „Nietoperek” 24% et les grandes voûtes en briques 22% (Tab. 2).

Introduction

The Barbastelle *Barbastella barbastellus* (Schreber, 1774) is known to choose for hibernation relatively cold shelters, where the temperature only slightly exceeds 0 °C. It has been encountered in places with strong airflow or freezing (KOWALSKI 1953, HARMATA 1973, BOGDANOWICZ & URBANCZYK 1983, LESINSKI 1986).

The aim of this study was to determine types of shelters preferred by hibernating Barbastelles in Poland. For the first time such analysis is based on data from the whole country, including most of the bat hibernacula in Poland.

Papers describing wintering of the Barbastelle mention first of all caves, abandoned mines and other underground tunnels. This is because of the high percentage of the species in bat communities wintering in such shelters (BAUEROVÁ et al. 1987, GAISLER, HANÁK & HORÁČEK 1981), and also because the most numerous winter aggregations of the Barbastelles are reported from such shelters (UHRIN 1995, PALÁŠTHY, OLEJÁR 1963, RUMLER 1985). However, the summary of data on bat hibernation in Central and

North-eastern Poland suggested, that in our country the situation may be different (FUSZARA et al. 1996)

Materials and methods

In this paper we use data from 719 bat hibernacula located all over Poland. Of that number 580 shelters were surveyed by us, and the remaining 139 were accurately enough described in the literature. We do not include numerous objects (mainly bunkers and cellars) where bats were not found, even if conditions seemed to be suitable and the site was located next to an occupied hibernaculum.

The basic information for each hibernaculum was the highest number of Barbastelles recorded in a single survey. Observations dating from before 1980 were excluded, and most of the data included in this study were collected after 1990. We distinguished 7 categories of winter shelters used by bats (on figures we use the names printed in bold letters):

1. **Bunkers** (127 objects) – small, concrete structures with a few chambers, sometimes located below the ground surface.
2. **Forts** (46 objects) – big, concrete fortifications with a system of chambers and corridors, mostly below the ground surface.
3. **Big brick vaults** (51 objects) – big, mainly underground structures, similar to the previous category (in fact, brick forts were included here).
4. **Cellars** (198 objects) – small underground brick (sometimes also concrete) objects with one or a few chambers, situated under inhabited houses or separately.
5. **Caves** (144 objects) – natural and artificial caves of different size, as well as limestone caverns made as parts of old fortifications.
6. **Abandoned mining galleries** (92 objects) – small old mines consisting of one or few corridors, total length from few to few hundred metres.
7. **Wells** (60 objects) – objects made of concrete or brick, from 5 to 30 m deep, about 80 cm across.

The largest winter shelter in our country, the „Nietoperek” Bat Reserve, was considered a separate category, as the structure (a huge system of approximately 30 km of concrete corridors

situated 30-50 m under ground level) did not conform to the adopted classification of winter shelters.

Results

Barbastelles wintered in 223 of the 719 (31%) bat hibernacula taken into consideration. The species was present in 85% of forts, 75% of big brick vaults and almost 50% of bunkers (and even so the latter category was the most numerous). Barbastelles have not been found in any of 60 wells occupied by wintering bats, and they were present in only 15% of cellars (Fig. 1).

In all types of shelters studied except for wells, Barbastelles composed over 40% of the winter bat community (Fig. 2). In forts they accounted for over 60% of the total number of bats, and in bunkers even for 85%. In the „Nietoperek” Bat Reserve Barbastelles usually constitute only 4% of the bat community (URBANCZYK & GOLSKI 1994) but, as „Nietoperek” often houses over 20 thousand bats (URBANCZYK 1994), the number is still impressive. In twelve of the shelters studied the number of wintering Barbastelles at least once exceeded 100. The highest number was recorded in „Nietoperek”, others are 5 big brick vaults, 3 forts, 1 bunker, 1 cave and 1 abandoned gallery (Table 1).

In 11% of shelters housing wintering Barbastelles the number of individuals was between 20 and 99. Such numbers were most frequently encountered in forts (8 objects) and big brick vaults (6 objects) (Fig. 3).

In over 50% of cellars, over 40% of caves and almost 40% of bunkers housing Barbastelles only single individuals were found. Such shelters accounted for 30% of the total number of Barbastelles' hibernacula, as did shelters housing from 2 to 5 individuals.

If – despite of the fact that the maximum numbers of hibernating Barbastelles in different sites were recorded in different years – we sum up these numbers in each of the shelters' categories, the results show that 24% of Barbastelles described in this study hibernated in forts, another 24% in underground tunnels of „Nietoperek”, 22% in big brick vaults and 18% in bunkers (Table 2).

Discussion

Barbastella barbastellus is usually described as hibernating in underground shelters, such as cellars, caves, mines and tunnels (STEBBINGS & GRIFFITH 1986, RYDELL & BOGDANOWICZ 1997). This is widely confirmed by data from different countries. In the study conducted in Thuringia the species was encountered in 107 shelters. 57% of hibernating Barbastelles were found in caves and mines, and 41% in cellars (HEDDERGOTT 1994). In Austria 72% of Barbastelles hibernate in caves and mine galleries (SPITZENBERGER 1993).

In Poland the percentage of caves (20%) and mine galleries (26%) housing wintering Barbastelles seems to be relatively low, especially when compared with data from the adjacent territory of the former Czechoslovakia. In the Moravian Karst Barbastelles hibernated in 65% of surveyed shelters, i.e. 39 caves and 1 mine gallery (BAUEROVÁ et al. 1987). Another study, conducted mostly in galleries and caves, showed the presence of Barbastelles in 80% of localities (GAISLER, HANÁK & HORÁČEK 1981)

In Poland the most important winter shelters for Barbastelles seem to be those of military origin – forts, bunkers, the „Nietoperek” system and also big brick vaults. The importance of bunkers and forts for the species had been suggested earlier, in a paper describing wintering of bats in over 100 shelters in Central and North-eastern Poland (FUSZARA et al. 1996). Barbastelle was also found to be a dominating species in bunkers of Masurian Lake District, where it accounted for 60% of the community (FUSZARA & KASPRZYK 1994). Dominance of the Barbastelle in military objects was also noted in other countries. In the former Czechoslovakia in forts of Hlucin region (REHÁK 1992) and in fortress of Bouda (RYBÁR 1975) the Barbastelle composed 50% and 75% of the winter bat community, respectively, and it was also the most abundant species in the fortress of Hanicka (SKLENÁR 1981). Similarly, in Lithuania and the Kaliningrad Province 68% of bats hibernating in fortifications were Barbastelles (MASING & BUSA 1983).

Shelters of military origin are undoubtedly the most important Barbastelle hibernacula in

Poland. There are, however, two necessary remarks. First, the basis for all calculations in this study were maximum numbers of Barbastelles recorded for each shelter. This was the only possible approach since there was no uniform way of surveys. Thus, the percentage of Barbastelles in hibernacula may be overestimated, especially in those shelters, where – like in cellars – often only single bats are found, and then a single Barbastelle constitutes a 100%, even if it occurred once during few years of observations. Second, our paper describes only the Barbastelle preferences as to underground shelters. Data collected in Białowieża (NE Poland) by RUPRECHT (1976) suggest that the species may also use other types of hibernacula, e.g. lofts and hollow trees.

The biggest currently known Barbastelle hibernaculum is an unused railway tunnel in Slovakia, where 6800-7800 individuals hibernated in 1993 (UHRIN 1995). Other mass hibernacula include a mine in Bavaria, where up to 3000 Barbastelles were noted prior to 1970 (KRAUS, after RICHARZ 1989), and a mine in Libanka at Dubník (Slovakia), once housing nearly 2000 individuals (PALÁSTHY & OLEJÁR 1963). Unfortunately neither of them houses such large winter colonies nowadays. The numbers in Bavaria dropped to 300-400 by 1988/89 (KRAUS, after RICHARZ 1989), and in Libanka in 1987 only 550 individuals were found (DANKO, MIHÓK 1988). Thus, the „Nietoperek” Bat Reserve seems to be now the second most important Barbastelle winter shelter in Europe.

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