

Wintering of the Barbastelle, *Barbastella barbastellus*, in fortifications of the Masurian Lake District (Poland)

Hibernation de la Barbastelle, *Barbastella barbastellus*, dans les fortifications en Mazurie (Pologne)

Überwinterung der Mopsfledermaus, *Barbastella barbastellus*, in Befestigungsanlagen der Masurischen Seenplatte (Polen)

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Abstract

The paper describes changes in the number of Barbastelles wintering in two big hibernation sites, located in Gierloz and Mamerki in the N-E of Poland. Both sites – groups of concrete bunkers dating from the Second World War – were visited once a month during two consecutive winter seasons – 1996/97 and 1997/98. Wintering bat communities were strongly dominated by Barbastelles in Gierloz (83.92%) as well as in Mamerki (95.05%) (Tab. 1). In spite of outside temperature changes during winter and differences in weather conditions between the two study seasons, the number of wintering Barbastelles was fairly stable in Gierloz (Fig. 2), while in Mamerki it changed dramatically from year to year and, during one season, also from survey to survey (Fig. 1). A pronounced increase of the number of wintering Barbastelles after a cold spell in December 1996 can be explained either by the fact that the hibernaculum in Mamerki is a kind of refuge where bats can come if severe frost drives them away from other shelters, or that during milder spells it is possible for bats to stay within the hibernaculum in places that we can not penetrate.

Résumé

La contribution décrit les variations dans la quantité de la *Barbastella barbastellus* dans deux grandes colonies d'hivernage qui se trouvent à Gierloz et Mamerki. Les deux localités – abris antiaériens de la deuxième guerre mondiale – avaient été visité une fois par mois au cours de deux hivers consécutifs – 1996/97 et 1997/98. Colonies d'hivernage de Barbastelles avaient dominé à Gierloz (83,92%) tout comme à Mamerki (95,92%) (Tab. 1). Malgré les changements de température à l'extérieur en hiver et les différentes conditions météorologiques entre les deux saisons d'étude, le nombre de Barbastelles hivernant était plus ou moins stable à Gierloz (Fig. 2), tandis qu'à Mamerki il changea de

façon dramatique d'année en année et, pour une saison, d'une observation à l'autre (Fig. 1). Une forte augmentation du nombre de Barbastelles hivernant après une période froide en Décembre 1996 se laisse expliquer par le fait que l'hibernaculum à Mamerki représente un refuge, où les chauves-souris peuvent se retirer pour échapper aux fortes gelées, ou en cas de froid moins sévère, elles peuvent hiverner en lieux qui nous sont inaccessibles.

Zusammenfassung

Der Beitrag beschreibt die Schwankungen in der Anzahl von überwinternden *Barbastella barbastellus* in zwei großen Überwinterungsorten, die in Gierloz und Mamerki gelegen sind. Beide Orte – Bunkergruppen vom Zweiten Weltkrieg – wurden einmal im Monat in zwei aufeinanderfolgenden Wintern (1996/97 und 1997/98) besucht. Überwinterungsgesellschaften wurden in Gierloz genauso stark von *Barbastella barbastellus* dominiert wie in Mamerki. Trotz der schwankenden Außentemperaturen und unterschiedlichen Witterungsbedingungen während der beiden Studienwinter war die Zahl der überwinternden *Barbastella barbastellus* in Gierloz stabil, während sie in Mamerki dramatisch von einem Jahr zum andern, zwischen den Jahreszeiten und sogar von Zählung zu Zählung schwankte. Die beschriebene Zunahme in der Anzahl von überwinternden *Barbastella barbastellus* nach einer Kälteperiode im Dezember 1996 kann einmal durch den Fakt erklärt werden, daß das Hibernaculum in Mamerki eine Art Rückzugsgebiet darstellt, wohin die Fledermäuse kommen können, wenn kalter Frost sie aus anderen Zufluchtsorten verdrängt. Oder aber dadurch, daß es für die Fledermäuse möglich ist, während den milderen Perioden im Hibernaculum an Orten zu verbleiben, die wir nicht betreten können.

Introduction

The Barbastelle, *Barbastella barbastellus*, is ge-

nerally believed to be adapted to hibernation in relatively low temperatures and to prefer cooler winter shelters than other species of bats (KOWALSKI 1953, HARMÁTA 1973, BOGDANOWICZ & URBANCZYK 1983, LESINSKI 1986). In Poland typical hibernacula of the species are forts, bunkers, big brick vaults (FUSZARA et al. this volume). The Masurian Lake District was for a long time considered to be located north of the northern border of *Barbastelles*' range (RUPRECHT 1983), but the research started there in 1991 showed that there is a relatively numerous population hibernating in bunkers (KASPRZYK & FUSZARA 1992, FUSZARA & KASPRZYK 1994). The aim of this project was to study changes in numbers of *Barbastelles* hibernating in bunkers of the Masurian Lake District. We hoped that our results would help to evaluate the importance of these shelters for hibernation of *Barbastelles* in the region.

Species	Mamerki [%]	Gierloz [%]
<i>M. nattereri</i>	0.75	2.68
<i>M. mystacinus/brandtii</i> *	0.04	–
<i>M. daubentonii</i>	0.93	2.68
<i>E. nilssonii</i>	0.67	10.10
<i>E. serotinus</i>	0.04	–
<i>P. auritus</i>	2.52	0.62
<i>B. barbastellus</i>	95.05	83.92
n=100%	2262	485

* The bat was identified as *M. mystacinus* or *M. brandtii*.

*La chauve-souris était identifiée comme *M. mystacinus* ou *M. brandtii*.

*Fledermaus wurde als *M. mystacinus* oder *M. brandtii* (identifiziert.)

Table 1. Composition of bat communities wintering in studied hibernation sites. As the dominance seemed stable in time, percentages for all species were calculated on the basis of total numbers from all eight surveys.

Tableau 1. Composition des communautés de chauves-souris dans les gîtes d'hivernage. Pendant que la dominance sur le temps restait apparemment stable, les pourcentages de toutes les espèces furent calculés à la base des résultats des huit recensements.

Tab. 1. Zusammensetzung der Fledermausgesellschaften in zwei kontrollierten Winterquartieren. So wie die Dominanz über die Zeit hinweg anscheinend stabil blieb, wurden die prozentualen Anteile für alle Arten auf der Basis der Ergebnisse von acht Zählungen errechnet.

Study area and methods

The Masurian Lake District is situated in the north-eastern part of Poland. This is the coldest lowland area in the country, with the snow cover lasting from 90 to over 110 days. Mean temperature of January is between -4.5 and -5°C . The number of days with temperature dropping below 0°C is over 130 (KONDRACKI 1981).

Our paper summarises results of surveys conducted in two big hibernation sites known in the area – groups of bunkers in Mamerki (UTMEF 40) and Gierloz (UTM EE 29) – during two winter seasons: 1996/97 and 1997/98.

All hibernacula were visited once a month from December till March, i.e. four times each winter season. Bats were counted and identified without handling. We didn't measure the ambient temperature. Instead, we used local mean temperatures for ten-day periods from the nearby meteorological station in Ketrzyn, situated about 10 km from the bunkers in Gierloz and about 20 km from the bunkers in Mamerki (Bulletin of the Hydro-Meteorological Institute).

The Mamerki hibernation site is a group of 22 Second World War concrete bunkers of the former German ground forces headquarter „Mauerswald”, scattered in the forest surrounding Mamry Lake. Most of them are 2 or 5-room structures situated on ground level, a few have also small underground tunnels or tanks. Usually there are two entrances and a narrow corridor connecting all the rooms. Heavy metal doors, once closing the entrances, have been generally removed. Places where bats can hide are clogged ventilation pipes and crevices under pieces of plaster or board on the walls (but we've also found bats hanging just on walls or ceilings).

The hibernacula in Gierloz are located in the former German armed forces headquarter „Wolfschanze”. Among the remains of destroyed bunkers 5 underground structures (cellars and water-tanks) remain almost intact. Crevices between concrete ceiling units in some of them seem to be bats' favourite shelters there.

Results

In the bunkers of Mamerki the *Barbastelle* strongly dominated over the rest of wintering bat community: *Myotis nattereri*, *M. mystacinus*/

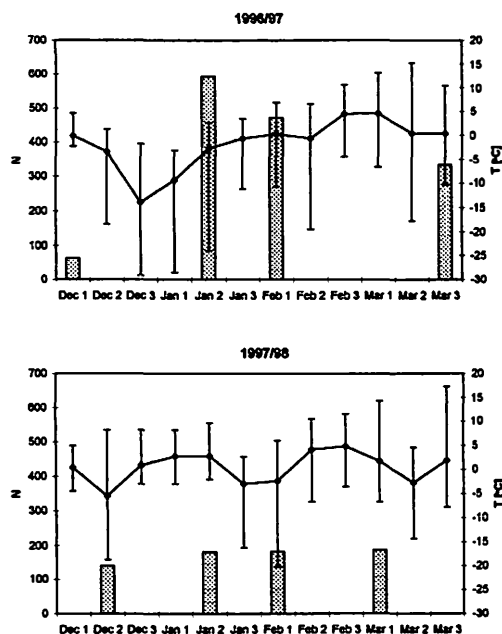


Fig. 1. Numbers of wintering Barbastelles (dotted bars) recorded in Mamerki hibernation site with mean, maximum and minimum temperatures for ten-day periods (according to the Bulletin of the Hydro-Meteorological Institute).

Graph. 1. Quantités de Barbastelles hivernantes (barres pointillées), enregistrées à Mamerki avec les températures moyennes, maxima et minima pour des périodes de dix jours (selon l'Institut Hydro-Météorologique).

Abb. 1. Anzahl der überwinternden Mopsfledermäuse (Balken mit Punkten) verzeichnet im Winterquartier Mamerki mit Mittel-, Höchst- und Tiefsttemperaturen für 10-Tagesperioden (nach dem Bulletin des Hydro-Meteorological Institute).

brandtii, *M. daubentonii*, *Eptesicus nilssonii*, *E. serotinus*, and *Plecotus auritus* (Table 1).

The highest number of bats in Mamerki was recorded in January 1997, when 607 bats were counted, including 593 Barbastelles (Fig. 1). A shelter housing the majority of bats wintering in Mamerki is a complex of two bunkers connected by an underground tunnel. In January 1997 577 Barbastelles hibernated there, together with 8 bats of other species. In other bunkers of the Mamerki group usually only a few bats were found.

Wintering bat community in the shelter of Gierloz (77 individuals) was recorded in January 1998. 57 out of the 64 Barbastelles counted during that survey wintered in one concrete cellar.

In other shelters of the Gierloz group except one, the number of hibernating bats never exceeded 10 individuals.

Temperatures in the two winter seasons of our study were quite different (Fig. 1, Fig. 2). The season of 1996/97 was cold; in the third decade of December 1996 mean temperature dropped as low as -13.9°C and the lowest temperature of the winter was recorded as -29.1°C (Bulletin of the Hydro-Meteorological Institute). The season of 1997/98 was relatively warm, mean temperatures for ten-day periods never dropped below -5.5°C , and the lowest temperature reported from the area was -20.2°C (Bulletin of the Hydro-Meteorological Institute).

Changes in the number of Barbastelles wintering in Gierloz were surprisingly similar in both study seasons (Fig. 2). At the beginning of the hibernation period – in December – the number was already high, and it did not decrease remarkably before March.

In the shelters of Mamerki changes of the number of Barbastelles were quite different in the two study periods (Fig. 1). In December 1996 the number was relatively low, but it increased almost tenfold by January to decrease during the following months. In December 1997 almost twice as many Barbastelles wintered in Mamerki as a year ago, but by January the number increased only by approximately 30% and remained quite stable for the rest of the winter.

Another difference between the two study seasons was the number of shelters occupied by wintering Barbastelles. During the colder winter of 1996/97 Barbastelles were found only in 11 shelters of Gierloz and Mamerki together, while a year later they wintered in 23 shelters.

Only 5 shelters (3 in Mamerki and 2 in Gierloz) were found used by wintering Barbastelles during all the 8 surveys conducted. On the other hand, out of the total number of 27 shelters visited regularly during our study (all of them known from previous research to be bat hibernacula, unpublished own data) only 3 were never used by Barbastelles.

Changes in numbers of wintering Barbastelles were analysed for each of the study seasons and each of the two shelter groups (Mamerki and Gierloz) separately. The results do not seem to

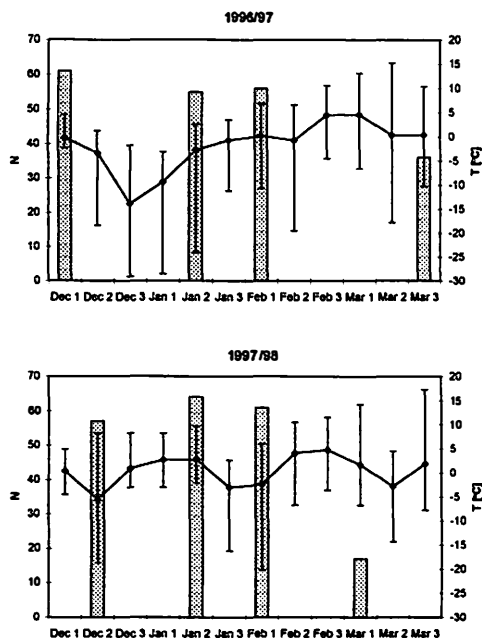


Fig. 2. Numbers of wintering Barbastelles (dotted bars) recorded in Gierloz hibernation site with mean, maximum and minimum temperatures for ten-day periods (according to the Bulletin of the Hydro-Meteorological Institute).

Graph. 1. Quantités de Barbastelles hivernantes (barres pointillées), enregistrées au gîte d'hibernation de Gierloz avec les températures moyennes, maxima et minima pour des périodes de dix jours (selon l'Institut Hydro-Météorologique).

Abb. 2. Anzahl der überwinternden Mopsfledermäuse (Balken mit Punkten) verzeichnet im Winterquartier Gierloz mit Mittel-, Höchst- und Tiefsttemperaturen für 10-Tagesperioden (nach dem Bulletin des Hydro-Meteorological Institute)

support the hypothesis that bats move within the group of shelters from one bunker to another during the hibernation period.

Discussion

Mass wintering of Barbastelles in the bunker of Gierloz and Mamerki and their strong domination there are not surprising – similar phenomena are reported from bunkers located in different parts of Poland (FUSZARA et al. this volume). However, the third important bat hibernaculum known from the Masurian Lake District, the Boyen fortress in Gizycko, shows completely different structure of wintering bat community. Among 6 bat species found there

(*Myotis nattereri*, *M. daubentonii*, *Eptesicus serotinus*, *E. nilssonii*, *Plecotus auritus*, *Barbastella barbastellus*) the most numerous was Natterer's bat (64%), and the Barbastelle constituted only 9% of the total number of individuals (FUSZARA & KASPRZYK 1994). One of the possible reasons for such difference is that the fortress, originating from XIXth century, is built of bricks and most of its structures are covered with a deep layer of soil. Thus, shelters available for bats there are probably too warm for Barbastelles. Another reason could be that the fortress is frequently penetrated by people, as it is situated close to the center of a small town.

The January peak in the number of wintering Barbastelles so pronounced in Mamerki in 1997 is not a unique feature of the site. In the largest Barbastelle hibernaculum in Poland, the „Nietoperek” Bat Reserve, the highest numbers were also recorded in January (URBANCZYK 1991). It thus may seem surprising that in the forts surrounding the Modlin fortress, located much closer to the studied site than „Nietoperek”, the peak was recorded in November (LESINSKI 1986, FUSZARA et al. 1996). However, it should be remembered that the highest numbers of Barbastelles are reported from different hibernacula at different time of the hibernation period – also in December (RYBAR 1975), February (KRZANOWSKI 1959, JOZA & KARES 1986) and even March (CHOLEWA 1987).

The hibernacula in Mamerki and Gierloz probably play different roles for the local Barbastelle population. The Gierloz site seems to be a shelter where a group of individuals spends the whole hibernation seasons. The outside temperature does not affect their number significantly. Mamerki seems to play a much more important role. Besides the obvious fact that much more Barbastelle winter here, it should be stressed that there are great differences in the number of bats between the years and considerable fluctuations within the winter season. Both phenomena could be explained by a hypothesis that the Mamerki is a kind of a „last chance” shelter where bats can come from other hibernacula during extremely cold spells.

As we didn't mark the bats, we haven't got unmistakable data considering the switching

of shelters. We hoped, however, to be able to draw some conclusions from the changes of numbers of bats in shelters, especially in Mamerki, where one structure serves as a mass hibernaculum, while in others generally only a few individuals are found. We expect the Barbastelle to use the smaller shelters more frequently at the beginning and at the end of the hibernation period, and disappear from there in the coldest periods of winter to gather in the main hibernaculum. Our data, however, does not support this expectation. The increase in the number of Barbastelles in the main hibernaculum seems thus to be caused by bats coming from outside the site – another fact supporting the „last shelter chance” hypothesis. Probably the late arriving Barbastelles come from shelters of different type. In the climate of the Masurian Lake District wintering in hollow trees or under bark throughout the winter would be probably impossible for bats, but it is not unlikely that they use such shelters during warmer parts of the season. Actually, it seems quite possible in the light of the data collected in Białowieża (RUPRECHT 1976), where winters are not less severe than in our study area (KONDRACKI 1981).

On the other hand, we can not reject an alternative hypothesis, belying the idea of a „last chance shelter”. It is possible that the main hibernaculum in Mamerki abounds with hiding places for bats we can’t penetrate (e.g. ventilation shafts, deep crevices in external layers of concrete, etc.) and that bats simply move from such places to cluster in the deepest (and hence better isolated) tunnels of the shelter during the coldest spells, thus giving us the impression of an increase in number.

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