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Some ecological aspects and threats for population of *Barbastella barbastellus* hibernating in Poznań (Poland)

Quelques données sur l'écologie et les menaces d'une population de *Barbastella barbastellus* hivernant à Poznań (Pologne)

Einige ökologische Aspekte und Gefahren der in Poznań (Polen) überwinternden *Barbastella barbastellus*-Population

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Abstract

Poznań is the biggest city of Wielkopolska region in Poland. In the past many military structures were built there (e.g. citadel, 18 forts and dozens of bunkers). These artificial shelters are very important for overwintering bats because in Wielkopolska Lowland no natural caves exist. In Poznań every winter (during the last few years) about 2000 hibernating bats, among them more than 300 Barbastelles, were found.

In one of the forts (Fort I), where in winter 1996/97 more than 150 Barbastelles hibernated, some ecological studies (inter alia temperature preferences, arousal frequency) were made. In Fort I we distinguished three zones which differed (each other) in air temperatures. Nearly all Barbastelles overwintered in two colder zones (average temperatures during „deep winter", i.e. from December to February, were -0.2°C in Zone I and 0.7°C in Zone II). In Zone III (average temp. 1.0°C) only a few hibernating individuals were found. The average period of uninterrupted hibernation (controls every 2 days were made) was about 5.6 days (6 days during „deep winter").

Some winter shelters are protected in different degree against people's penetration. Unfortunately, from time to time some shelters were devastated and bats which overwintered inside were killed. In 1996 the Polish Society for Nature Protection „Salamandra" started with the project of protection of bats and their winter shelters. The main aims of this project are to put iron bars in the entrances of shelters, to cut down trees which could destroy walls of shelters, to educate society why and how to protect bats.

Résumé

Poznań est la plus grande ville de la région de Wielkopolska en Pologne. Dans le passé, de nombreuses installations militaires furent construites (des citadelles, 18 forts et des douzaines de bunkers). Ces abris artificiels s'avèrent très importants pour l'hivernage des chauves-souris, parce qu'il n'y a pas de cavités naturelles dans la plaine de Wielkopolska. Durant ces derniers hivers, environ 2000 chauves-souris en hibernation ont été découvertes à Poznań, parmi elles, 300 Barbastelles.

Dans le Fort 1, ou plus de 150 Barbastelles hivernaient pendant l'hiver 1996/97, une étude sur les préférences de températures et sur les fréquences de réveils a été réalisée. Dans ce fort, nous avons distingué trois zones qui diffèrent par leur température de l'air. Presque toutes les Barbastelles hivernaient dans les deux zones les plus froides, ou les températures moyennes en plein hiver (décembre-février) étaient de -0,2°C dans la Zone I et 0,7°C dans la Zone II. Dans la Zone III (température moyenne 1,0°C), seuls quelques individus hivernants ont été trouvés. La durée moyenne d'une hibernation ininterrompue (contrôles effectués tous les jours) était environ de 5.6 jours (environ 6 jours en plein hiver).

Les sites d'hivernage sont protégés à des degrés différents contre les infractions humaines. Malheureusement, de temps en temps, certains sites sont dévastés et les chauves-souris hivernant à l'intérieur tuées. En 1996, la Société polonaise pour la Protection de la Nature „Salamandre" a lancé un projet de protection des chauves-souris et de leurs sites d'hivernage. Ce projet a pour principaux buts de fermer les entrées des gîtes avec des barres métalliques, de couper les arbres qui pourraient détruire les murs des sites et d'expliquer aux gens pourquoi et comment protéger les chauves-souris.

Zusammenfassung

Poznań ist die größte Stadt der Wielkopolska-Region in Polen. In der Vergangenheit wurden dort zahlreiche militärische Stützpunkte eingerichtet (z.B. die Zitadelle, 18 Forts und mehrere Dutzend Bunker). Diese künstlichen Quartiere sind für überwinternde Fledermäuse von großer Bedeutung, da im Wielkopolska Tiefland keine natürlichen Höhlen

existieren. In jedem Winter (während der vergangenen Jahre) wurden in Poznań ca. 2000 überwinternde Fledermäuse, unter denen sich mehr als 300 Mopsfledermäuse befanden, gefunden.

In einem der Forts (Fort I), wo im Winter 1996/97 mehr als 150 Mopsfledermäuse ihren Winterschlaf hielten, wurden einige ökologische Studien zu Temperaturansprüchen und Störfrequenzen durchgeführt. Im Fort I gibt es drei verschiedene Zonen, in denen unterschiedliche Lufttemperaturen herrschen. Annähernd alle Mopsfledermäuse überwinterten in den beiden kälteren Zonen. Die Durchschnittstemperatur im „tiefen Winter", also von Dezember bis Februar, lag in Zone I bei -0,2°C und in Zone II bei 0,7°C. In der Zone III, wo die Durchschnittstemperatur bei 1,0°C lag, wurden nur einige winterschlafende Exemplare gefunden. Der durchschnittliche Zeitraum, in dem die Tiere ununterbrochen schliefen (Kontrollen wurden jeden zweiten Tag durchgeführt), betrug ca. 5,6 Tage (ca. 6 Tage im „tiefen Winter").

Etliche Winterquartiere sind in unterschiedlichem Maß vor menschlichem Eindringen gesichert. Leider wurden von Zeit zu Zeit einige Quartiere verwüstet und die dort überwinternden Fledermäuse getötet. 1996 begann ein Projekt der Polnischen Naturschutzgesellschaft „Salamandra" zum Schutz der Fledermäuse und ihrer Winterquartiere. Die Hauptziele dieses Projektes sind das Vergittern der Quartiereingänge mit Eisenstangen, das Fällen von Bäumen, welche die Quartierwände zerstören könnten, sowie Öffentlichkeitsarbeit zum Fledermausschutz.

Introduction

Wielkopolska is one of the regions of Poland. It is a lowland where no natural caves exist. Poznań is the biggest city of Wielkopolska region. Many military structures were built in Poznan in the past, among other things citadel, 18 forts and dozens of bunkers (POLAK 1988). Many rooms in these fortifications serve nowadays as hibernacula for bats. Several dozen years ago, when Poznań was much smaller than today, many of these fortifications were outside the city. Nowadays most of them border on houses (Fig. 1).

Historical data on the bat fauna of Poznań date from 1911 (SCHULZ 1911). Up to the present many studies on distribution and ecology of bats were carried out (e.g. BOMBICKI 1960, NOWOSAD 1974, BOGDANOWICZ 1983, BOGDANOWICZ & URBANCZYK 1983, CHOLEWA 1987, BERNARD & JURCZYSZYN 1994, JURCZYSZYN & BAJACZYK 1996).

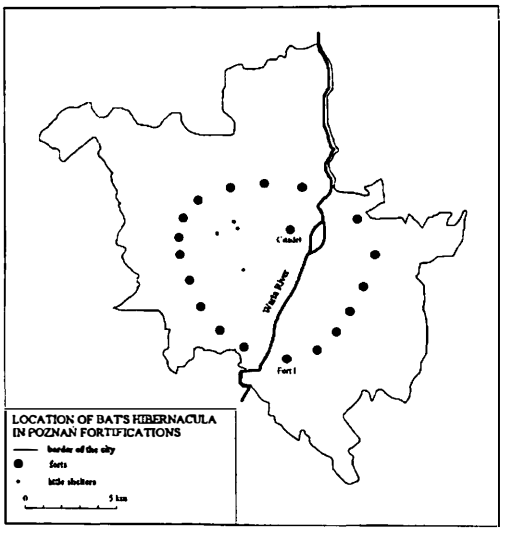

Fig. 1. Distribution of hibernacula within the city limits of Poznań

Graph. 1. Distribution des hibernacula an de dans de l'agglomération de Poznań

Abb. 1. Verteilung von Hibernacula innerhalb der Stadtgrenzen von Poznań

The purpose of this study was to ascertain some ecological aspects (temperature preferences, arousal frequency) of Barbastelles hibernating in a city. We also describe threats for population of Barbastelle in Poznań and protective works which were undertaken there during the last years.

Methods

The data concerning distribution and some ecological aspects of Barbastelles in all known hibernacula in Poznań were collected during annual winter bat censuses which were carried out in the first part of February 1994-1997.

In the Fort I we studied the microclimatic preferences and arousal frequency of hibernating Barbastelles. Studies have been carried out during winter season 1996/97. They started in November and terminated in March. Frequency of displacements was a measure of arousal frequency. Hibernaculum was visited every second day. During every control notations were made on location and postural position of every visible Barbastelle. In the investigations small

paper pieces with written numbers were used for identification purposes. These markings were fixed to the fur of Barbastelles. In Fort I the air temperature and relative humidity was measured. A mercury thermometer with accuracy 0.1 °C and an Assmann psychrometer were used for measurements.

Results and discussion

Nine species of bats were found during bat censuses in Poznań, namely *Myotis myotis*, *Myotis nattereri*, *Myotis dasycneme*, *Myotis daubentonii*, *Myotis mystacinus/brandtii*, *Eptesicus serotinus*, *Plecotus auritus*, *Plecotus austriacus* & *Barbastella barbastellus*. The number of bats observed during the censuses ranged from 1301 to 1816 (Fig. 2). The most numerous winter colony of bats was found in the Fort I. About half of the bats which were found in Poznań overwintered in rooms of this fort. Number of Barbastelles found in Poznań ranged from 230 to 421 individuals (Fig. 2). One third to two thirds of them hibernated in the Fort I. In every one of other hibernacula we found much less individuals of Barbastelles (mostly a few individuals in the whole fortification, very seldom more than 20).

In the Fort I Barbastelles overwintered mainly in clusters (2 or more bats), in other hibernacula most of them hibernated solitarily (Table 1). We have full data only from the years 1995 and 1997. Basing on the above results we can state that in the hibernaculum (Fort I) with more than one hundred Barbastelles, bats of this species showed tendency to form clusters. These were mainly clusters which consisted of Barbastelles. In other relatively large fortifications in which only several or a dozen or so Barbastelles overwintered, they dispersed in rooms of forts and were found mostly solitarily. Many authors wrote about tendency of Barbastelles to form clusters (e. g. Hoehl 1960, Woloszyn 1962, Ryba 1975, Haitlinger 1976, Bagrowska 1978, Urbanczyk 1992).

We distinguished in the Fort I three zones with hibernating Barbastelles which differed from each other in air temperatures (significantly I and III, II and III; but not I and II) (Table 2). Nearly all Barbastelles hibernated in zones I (48.9%) and II (50.9%).

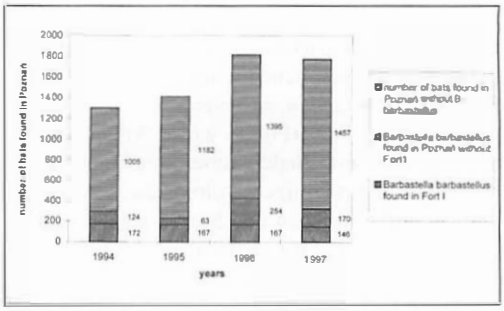

Fig. 2. Number of bats in Poznań fortifications with specification of *Barbastella. Barbastellus*

Graph. 2. Nombre de chauves-souris et de Barbastelles dans les fortifications de Poznań

Abb. 2. Anzahl der Fledermäuse in der Fortifikation Poznań, mit Spezifizierung Mopsfledermäuse

Year (February)	*Barbastella barbastellus*			
	in Fort I		in other shelters in Poznan	
	in clusters	solitarily	in clusters	solitarily
1995	81 %	19 %	7 %	93 %
1997	81 %	19 %	29 %	71 %

Table 1. Percentages of *Barbastella barbastellus* which hibernated in clusters and solitarily in Fort I and in other hibernacula in Poznań

Tableau 1. Pourcentages de Barbastelles hivernant en essaim et isolément dans le Fort I et dans les autres hibernacula de Poznań

Tab. 1. Prozentuale Verteilung von in Clustern bzw. einzeln überwinternden *Barbastella barbastellus* im Fort I sowie in anderen Winterquartieren von Poznań

The temperature range in which we found hibernating Barbastelles in the Fort I was -7 °C to +7°C. But preferred temperature was 0 °C to +3 °C. This result agrees with the ones of Bogdanowicz (1983), Bogdanowicz & Urbanczyk (1983) and Cholewa (1987) who made their studies in Poznań in the late seventies and early eighties.

In Fort I Barbastelles were found in places where the humidity ranged from 70% to 95%. Bogdanowicz and Urbanczyk (1983) found Barbastelles in the range 75% to 90%. Cholewa (1987) in the range 80 - 90%.

The mean duration of hibernation bouts during the whole study period was 5.6 days. The mean duration of uninterrupted hibernation periods during so called „deep winter" (from December

Zone	Temperature (°C)					
	November - March			December - February		
	min.	max.	$\bar{x}$	min.	max.	$\bar{x}$
I	-7.0	7.0	0.9	-7.0	4.0	-0.2
II	-6.0	6.0	1.6	-6.0	5.0	0.7
III	-5.0	5.0	2.0	-5.0	5.0	1.0

Table 2. Temperature in the three different zones in Fort I

Tableau 2. Température dans les trois zones differentes du Fort I

Tab. 2. Temperaturen der drei unterschiedlichen Zonen im Fort I

to February) was about 6 days. The mean duration of hibernation bouts in zone I was 5.5 days (in deep winter 5.7) and in zone II 5.7 days (in deep winter 6.2). The difference between zones was not statistically significant neither in the whole study period ($t = -0.62$; $p = 0.53$) nor in the deep winter ($t = -1.18$; $p = 0.24$). DAAN (1973) found that in some *Myotis* species, having similar body mass to Barbastelle, the mean duration of torpor bouts were much longer than in *Barbastella barbastellus* and they lasted 20-23 days in *Myotis mystacinus*, 14-16 days in *Myotis daubentonii*. The average length of uninterrupted hibernation of *Rhinolophus hipposideros* (HARMATA 1987) was also about three times longer (17.8 days) than in Barbastelle.

Protection

The fundamental threat for Barbastelles hibernating in Poznań is man and his activity. Bat's hibernacula are devastated or even destroyed by adventurers. People can cause many awakenings of bats from hibernation, sometimes they even kill the animals. We noticed, during our studies on different species of bats hibernating in Poznań, that Barbastelle is more sensitive to any disturbances (touching, boisterousness, strong light) than *M. daubentonii, M. nattereri* or *M. myotis*.

Commercial using of forts can be a danger to overwintering bats (e.g. making of reconstruction, shutting up openings, using fork lift trucks, using open fire inside the rooms). In some cases, however, when only a part of a fort is commercially used, bats are well situated because they are protected against vandals, adventurers, etc.

Roots of trees which grow above the fortifications burst the walls, thus destroy the hibernacula. Taking into consideration the above-mentioned threats, practical protective actions started. In 1996 the Polish Society for Nature Protection „Salamandra" has started a complex project of bat protection. The project includes three types of activities: technical infrastructure, legal protection and education.

By the end of 1997 a hundred and two (102) gratings of different size were installed in 10 forts. In all these forts the information boards with description of our protective activities were provided. Inside rooms of the four forts cavity bricks were placed in order to increase the number of small shelters for bats. Large number of small holes is profitable for Barbastelle which in Poznań overwinter mostly in places providing complete shelter (BOGDANOWICZ & URBANCZYK 1983, CHOLEWA 1987).

In five forts dense cover of trees and shrubs were cut down.

Six of the forts have been given the status of ecological zones (5 of them owing to efforts of „Salamandra") and three other ones should be given soon this status.

One of forts is rented from the municipality for educational purposes (for arranging the educational centre). The educational campaign in schools, press, radio and TV broadcasts is still running.

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