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Overwintering bat colony in Strzaliny (North-Western Poland)

Rafał BERNARD, Adam GŁAZACZOW, Juliusz SAMOLĄG

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Abstract. The bat colony in winter in the underground corridors of a line of fortifications near Strzaliny was investigated in the years 1980-82 and 1988-90. Bats distribution in the corridors, settlement of crevices, change in numbers and rate of return to their winter quarter was studied. In both periods 4 species of bats were found, these are: *Myotis myotis*, *M. daubentoni*, *M. nattereri* and *Plecotus auritus*. The maximum number in the colony was 300 individuals in the years 1980-82 which increased to 657 individuals in the years 1988-90. Now it is a third biggest bat winter quarter in Poland. *Myotis daubentoni* was the dominating species in autumn, during the winter period numbers of all species were similar (there was a lack of distinct domination) and *Myotis myotis* dominated in the early spring. Some of the bats were ringed and a high rate of return to the same winter quarter was recorded, the greatest (67%) was found for *Myotis myotis*.

Key words: bats, overwintering, colony, Poland.

Rafał BERNARD, Department of General Zoology, A. Mickiewicz University, Fredry 10, 61-701 Poznań, Poland.

Adam GŁAZACZOW, Department of Systematic Zoology, A. Mickiewicz University, Fredry 10, 61-701 Poznań, Poland.

Juliusz SAMOLĄG, Poznańska 72, 62-080 Tarnowo Podgórne, Poland.

I. INTRODUCTION

Poland is a country which is unequally explored on chiropterological grounds. So far, all studies have concentrated on its southern and part of its central districts. The bat fauna of Pomerania is one of the least recognized. The data from this province are fragmentary: they were published before and during the IInd World War by the German authors (HEROLD 1934; UTTENDÖRFER 1939; GAFFREY 1944; EISENTRAUT 1960 - data from prewar years). After the war, there was no systematic research on this group of mammals and publications including information about bats from this region were scarce (SKURATOWICZ 1968; RUPRECHT 1971, 1974; HAENSEL 1973). A lot of data come from analysis

of contents of owl pellets (PUCEK, RACZYŃSKI 1983). Undoubtedly, this small amount of information has an effect on the presentation of the ranges of occurrence of some bats in Polish professional literature.

A. GŁAZACZOW studied the system of underground passages near Strzaliny Village in the years 1980-82. In 1988-89 this place was again subject to inspection. The results which were obtained by R. BERNARD and J. SAMOLĄG (BERNARD, SAMOLĄG 1989), inspired them to take up a study in the next winter season 1989/90.

II. DESCRIPTION OF THE STUDY AREA AND METHODS

The under object investigation was part of line of fortifications built by the Germans in 1935-38. It is S-W of Strzaliny Village, 4.5 km from Tuczno (53°11'N, 16°13'E; UTM – WU 89).

It is a complex of structures situated 10-12 m below ground level. It consists of the greater corridor (2.5 m wide, 3 m high and about 100 m long) with five side chambers in the front section (10 - 15 m long) and a smaller corridor (1.2 m wide, 2.2 m high and 350 m long) mostly whitewashed (Fig. 1.). Bats get under the ground through the staircase (Fig. 1, A) and the opening over the bottom of a deep pit (C).

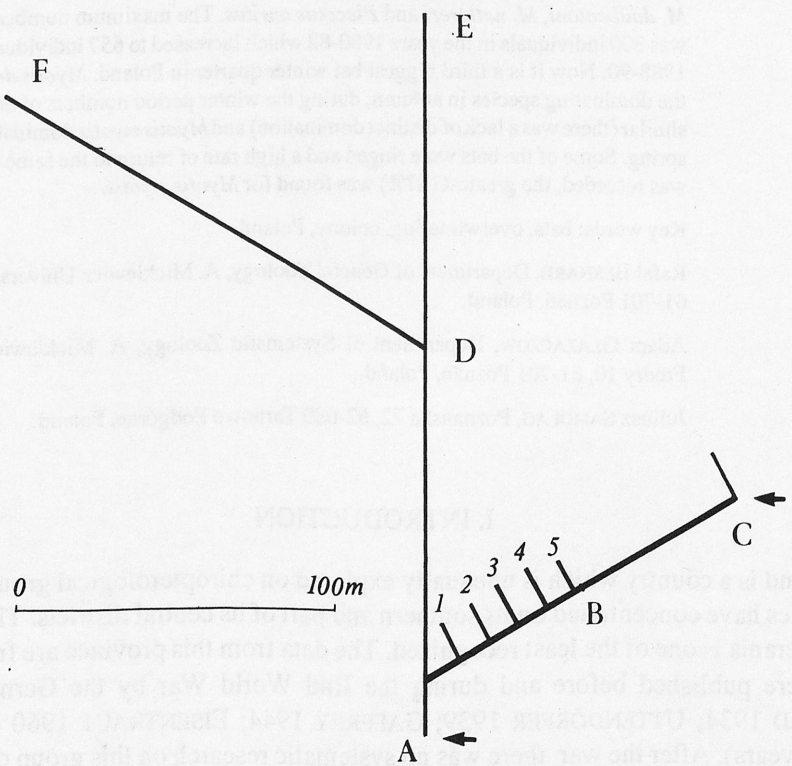

Fig. 1. Scheme of the underground fortification in Strzaliny; AC - greater corridor, AF - smaller corridor, A - staircase, C - pit, 1-5 lateral chambers.

The greater corridor and the chambers have many cracks and crevices while the smaller one has not. A distinguishing feature of the staircase, are many ventilating pipes, mostly destroyed.

The investigations were carried out in two periods. The first period spans the years of 1980-82. A. GŁAZACZOW made 6 inspections at that time (one in season 1979/80, two in 1980/81 and three in 1981/82). The second period of studies took place in 1988-90. R. BERNARD and J. SAMOLĄG made 11 inspections, three random, in the season 1988/89 and eight from the end of August to the end of March in one month intervals in the season 1989/90.

In both periods, during each inspection, all the bats were counted, their distribution in the corridors and settlement of crevices were studied, and previously ringed individuals were identified. Where it was impossible to identify the species, the specimens were pulled out from the crevices and their species status determined. During the second period of the study they were simply treated as unidentified (indet.). During the first period of study 295 individuals of 4 species of bats were ringed.

Some measurements of temperature and relative humidity were made using an ASSMANN psychrometer. Temperatures recorded, ranged from 5.1 - 9.6 °C. Relative humidity ranged from 69-97%. Corridor section AE was characterised by higher temperature and lower relative humidity - 7.8-9.6 °C; 69-80%, while for the section AB these values ranged from 5.1 to 7.80 °C and 80-97%. Only in one place in part AB was water collecting. The index of dominance (D) was used in describing this bat colony.

III. SPECIES COMPOSITION

Both, in the years 1980-82 and 1988-90 only 4 species of bats were found in the tunnels, these are: *Myotis myotis*, *M. daubentoni*, *M. nattereri* and *Plecotus auritus*. The maximum number in the colony was 300 individuals in the first period and 657 individuals in the second period of study.

Myotis myotis (BORKHAUSEN, 1797). The large mouse-eared bat was numerous in tunnels from November and remained in great numbers till April (Tables I, II). It reached maximum number in the second half of February and in the beginning of March (21 Feb. 1989 - 198 specimens). This species hibernated more numerously in the chambers 2 and 3 and in the first 30 m of section BC. The majority of this population were found in the crevices (84% in the first period of the study and 49% in the second). The feature, which distinguished *Myotis myotis* was a great tendency to clustering. Species hibernating in clusters, up to 20 individuals in one cluster, almost always congeneric, constituted up to 82% of this species population.

Myotis nattereri (KUHL, 1819). Natterer's bat appeared in the underground passages as the latest of all species. It occurred in high numbers only from December till the beginning of March (maximum 178 individuals on 21 Feb. 1989), but single specimens were found also in October, November and later in March (Tables I, II). In the years 1980-82 highest numbers were recorded in the middle of the section BC, and later also in

Table I

Occurrence of bats in underground passages in Strzaliny fortification in the years 1980-1982

Species	3.02.80		29.01.81		26.02.81		10.11.81		19.02.82		26.03.82	
	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%
M. myotis	65	36.3	49	20.7	68	27.8	25	22.5	79	26.3	83	62.9
M. nattereri	5	2.8	34	14.3	52	21.3	5	4.6	58	19.4	10	7.9
M. daubentoni	43	24.0	67	28.3	47	19.3	54	48.6	81	27.0	35	26.5
P. auritus	66	36.9	87	36.7	77	31.6	27	24.3	82	27.3	4	3.0
Total	179		237		244		111		300		132	

Table II

Occurrence of bats in underground passages in Strzaliny fortification in the years 1988-1990

Species	30.12.88		4.02.89		21.02.89		26.08.89		7.10.89		7.11.89		9.12.89		6.01.90		7.02.90		4.03.90		31.03.90	
	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%	n	D%
M. myotis	83	23.4	158	27.1	198	30.1	1		1	0.7	86	27.2	117	24.7	141	26.0	162	33.8	172	40.3	62	71.3
M. nattereri	63	17.8	132	22.7	178	27.1	1		3	2.2	12	3.8	64	13.5	93	17.2	106	22.1	96	22.5	–	–
M. daubentoni	76	21.5	125	21.6	143	21.8	–		128	92.1	148	46.8	165	34.8	163	30.1	115	24.0	125	29.3	21	24.1
P. auritus	108	30.5	151	25.9	132	20.1	–		5	3.6	62	19.7	111	23.4	132	24.3	78	16.3	25	5.8	–	–
indet	24	6.8	16	2.7	6	0.9	3		2	1.4	8	2.5	17	3.6	13	2.4	18	3.8	9	2.1	4	4.6
Total	354		582		657		5		139		316		474		542		479		427		87	

the chamber 5. This species, in compliance with literature data was showing the greatest tendency to occupying crevices (LESIŃSKI 1983; CHOLEWA 1987; URBAŃCZYK 1989). The number of individuals hibernating in this shelters was 91% in the first period of the study and 77% in the second and did not show greater deviation in the whole wintering season. *Myotis nattereri* specimens were found singly and in small clusters from 2 to 6 bats, also with the other species.

Myotis daubentoni (KUHL, 1819). Daubenton's bat occurred in tunnels in great numbers as early as the beginning of October and increased in number till December and January. In the following months the number of individuals of this species was showing a tendency to decline (Tables I, II). The highest number of hibernating specimens of *Myotis daubentoni* was recorded in December (9 Dec. 1989 - 165 individuals). This species was fairly regularly distributed in the section AC; also, during some inspections, it was found more numerously in the middle of section DF (this place was characterized by greater relative humudity). In the remaining part of the underground passages it occurred only occasionally. Shelter preferences (e. g. narrow crevices) were not noticeable, but the percentage of individuals hibernating in crevices was increasing during a season from 11 to 48%. Specimens of *Myotis daubentoni* were hibernated individually, seldom in twos, or in sevens at most (they were found in an oblong crevice). They also formed small heterogeneous clusters with *Plecotus auritus* and *Myotis nattereri.*

Plecotus auritus (LINNAEUS, 1758). The long-eared bat was appearing in the tunnels gradually from October and reached peak numbers in January and in the beginning of February (maximum 151 individuals on 4 Feb. 1989). The next gradual drop in number was observed (Tables I, II). It hibernated most numerously in the first part of section BC, and in the years 1980-82 also near the entry C. It was not so numerous in the other part of section AC and in the lateral chambers and was distributed regularly. It was very rare in the remaining parts of the passages. In the first period of investigation more than half the population (63%) were hibernated in crevices, whereas in the second period only 32%. Most specimens of this species occurred separately (85%), only a few were in small clusters (2-4 individuals) often with other species.

IV. DYNAMICS OF POPULATION

In the first period of the study, systematic observations of population dynamics were not planned, but it was one of the main purpose of the study in the second period. Having some data from the years 1980-82 we can compare them with the findings obtained in the late 80's.

In the first period *Myotis daubentoni* was the species which appeared as the earliest in autumn, and in November it reached maximum numbers in its winter quarter. In January and February all species occurred numerously and had a close index of domination. *Plecotus auritus* left the tunnels as the first and *Myotis myotis* stayed the longest in their winter quarters and in March still increased its number.

In the season 1989/90 the study was started at the end of August. There were only a few active bats present at that time. The succeeding inspections revealed seasonal changes in species composition. The beginning of October is a period of complete domination by *Myotis daubentoni* in colonizing assemblage. The value of the domination index reached 92% at that time (Table II). The other species, already there, were represented only by single specimens. DAUBENTON's bat kept the dominating position till the first days of December but its index of domination dropped to 47% in November and 35% in the beginning of December. At the same time the numbers of *Myotis myotis* and *Plecotus auritus* increased gradually (Fig. 2). *Myotis nattereri* started to increase in number as the latest arrival. In November the domination index of this species was only 4% and in December 13.5%. In January and February the numbers of particular species in the colony was close and the differences between the domination index were not significant. At that time, numbers of the colony reached the maximum. From January, the number of *Myotis daubentoni* was decreasing gradually but *Myotis myotis* was continuously increasing in number. As a result, *Myotis myotis* reached dominating status in the beginning of March. This domination was still increasing during this month and by end of it achieved 71% (in spite of a decrease in numbers). The departure from the passages of both *Myotis daubentoni* and *Plecotus auritus*, as well as the rapid withdrawal of *Myotis nattereri* from their winter quarters, was the cause of this growth in domination.

The findings obtained so far confirm the well-known occurrence of autumn domination of *Myotis daubentoni* in the hibernation sites, spring domination of *Myotis myotis*, and the typically winter character of hibernation of *Myotis nattereri* (MUMFORD 1958; KRZANOWSKI 1959; BAGROWSKA-URBAŃCZYK, URBAŃCZYK 1983). Drawing a comparison between both periods of the study, we found that the specific regularity concerning popoulation dynamics in the winter bat colony in Strzaliny did not undergo radical changes. Only the exceptionally warm winter in 1989/90 caused to *Plecotus auritus* and *Myotis nattereri* leave their passages earlier. By the end of March 1990 these species were not present in the colony.

V. THE RESULTS OF BAT RINGING

The bats were ringed only in the first period of investigation (mainly during season 1980/81). The purpose of this study was to test what percentage of bats return to the same winter quarter.

Myotis myotis. In the season 1979/80 only three individuals were ringed. In the years 1981-82 two of them were recaptured. Altogether, in the two first seasons, 64 specimens were ringed (30 ♂♂, 34 ♀♀) of which 43 (22 ♂♂, 21 ♀♀) returned next winter, which gives a 67% rate of return. Out of 112 individuals of this species ringed in the locality of Strzaliny, five were found in the second period of the study: two of them after 8 years, three after 9 years. Since the age of bats at the time of ringing was not known, we can only give the maximum life span after ringing. It was 9 years and 11 days for three individuals (2 ♂♂, 1 ♀) and approaches the maximum age which was found for this species in Poland (HARMATA, personal communication).

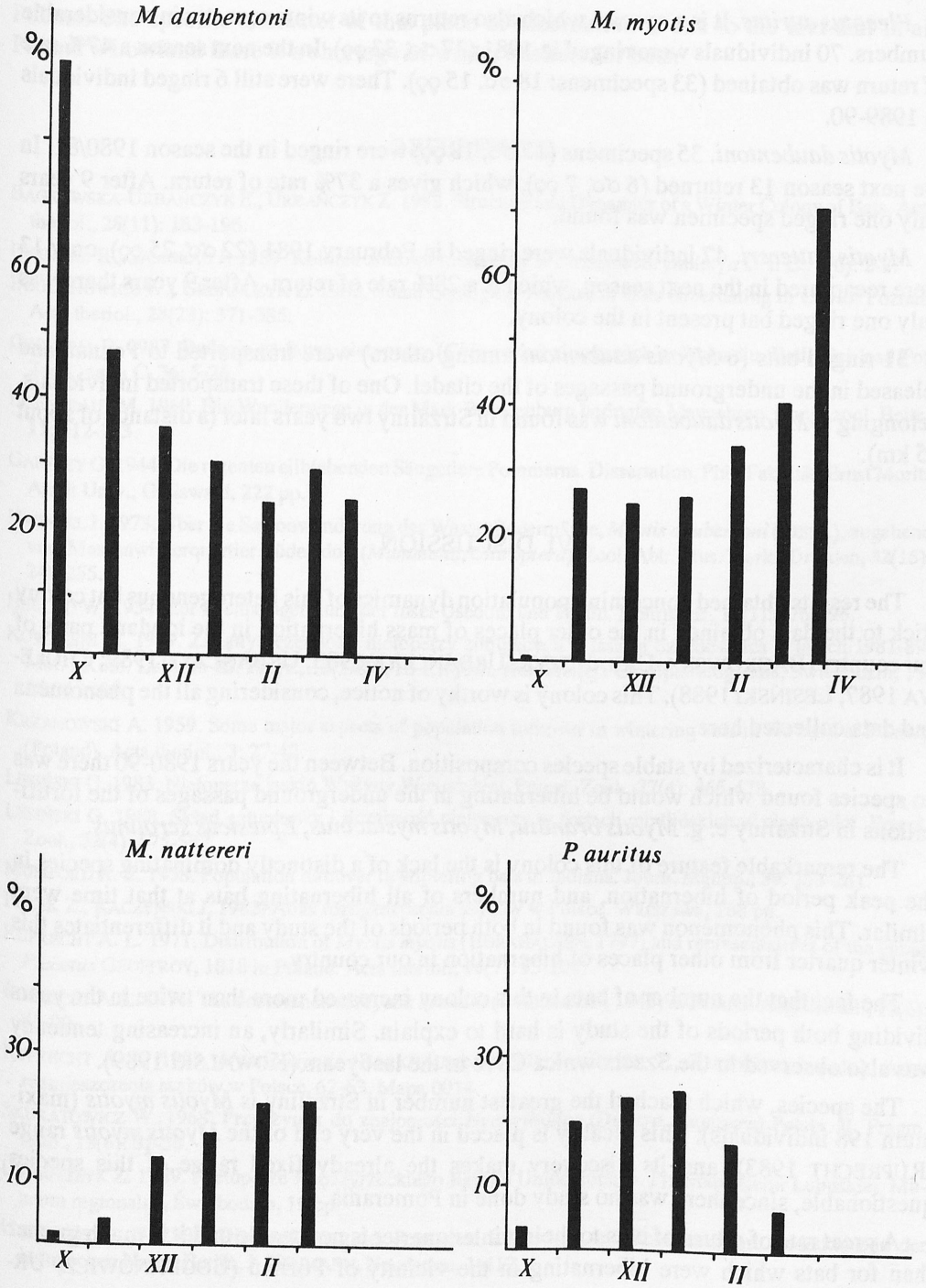

Fig. 2. Percentage of particular species of bats in the winter colony in Strzaliny in the succeeding months in the years 1989-1990.

Plecotus auritus. It is a species which also returns to its winter quarter in considerable numbers. 70 individuals were ringed in 1981 (37 ♂♂, 33 ♀♀). In the next season a 47% rate of return was obtained (33 specimens: 18 ♂♂, 15 ♀♀). There were still 6 ringed individuals in 1989-90.

Myotis daubentoni. 35 specimens (17 ♂♂, 18 ♀♀) were ringed in the season 1980/81. In the next season 13 returned (6 ♂♂, 7 ♀♀), which gives a 37% rate of return. After 9 years only one ringed specimen was found.

Myotis nattereri. 47 individuals were ringed in February 1981 (22 ♂♂, 25 ♀♀), only 13 were recaptured in the next season, which is a 28% rate of return. After 9 years there was only one ringed bat present in the colony.

31 ringed bats (6 *Myotis daubentoni* among others) were transported to Poznań and released in the underground passages of the citadel. One of these transported individuals, belonging to *Myotis daubentoni* was found in Strzaliny two years later (a distance of about 95 km).

VI. DISCUSSION

The results obtained concerning population dynamics of this heterogeneous bat colony stick to the data obtained in the other places of mass hibernation in the lowland parts of our country (BAGROWSKA-URBAŃCZYK, URBAŃCZYK 1983; URBAŃCZYK 1989; CHOLEWA 1987; LESIŃSKI 1988). This colony is worthy of notice, considering all the phenomena and data collected here.

It is characterized by stable species composition. Between the years 1980-90 there was no species found which would be hibernating in the underground passages of the fortifications in Strzaliny e. g. *Myotis brandtii*, *Myotis mystacinus*, *Eptesicus serotinus*.

The remarkable feature of this colony is the lack of a distinctly dominating species in the peak period of hibernation, and numbers of all hibernating bats at that time were similar. This phenomenon was found in both periods of the study and it differentiates this winter quarter from other places of hibernation in our country.

The fact that the number of bats in this colony increased more than twice in the years dividing both periods of the study is hard to explain. Similarly, an increasing tendency was also observed in the Szachownica Cave in the last years (KOWALSKI 1989).

The species, which reached the greatest number in Strzaliny is *Myotis myotis* (maximum 198 individuals). This locality is placed in the very end of the *Myotis myotis* range (RUPRECHT 1983), and its discovery makes the already fixed range of this species questionable, since there was no study done in Pomerania.

A great rate of return of bats to their winter quarter is noticeable and it is much greater than for bats which were hibernating in the vicinity of Poznań (BOGDANOWICZ, URBAŃCZYK 1983).

In recent years a listing of wintering bats was organized by the Polish Academy of Sciences. It revealed that the locality in Strzaliny is the third biggest winter quarter in

Poland. The specific character of this place of hibernation is due to the fact that in all Poland's Lowland there is a shortage of winter shelters for bats.

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