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THE STRUCTURE AND DYNAMICS OF A RHINOLOPHID BAT COMMUNITY OF LATIUM (CENTRAL ITALY) (CHIROPTERA)

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ABSTRACT - The present paper summarizes the results of 3 years of observation made at six month intervals for six months at a time (18 field surveys) in a man-made cave in Northern Latium (Central Italy) from April 1992 to April 1995. Its aim is to analyze the main structural and dynamic features of a bat community which hibernates at the shelter. *Rhinolophus ferrumequinum* and especially *Rhinolophus euryale* are the most abundant species. Population dynamics of both species as well as that of *Rhinolophus hipposideros* show higher levels of abundance between December and February of each semester. In mid-winter, large and sometimes mixed aggregations of *Rhinolophus ferrumequinum* and *Rhinolophus euryale* in deep hypothermia occur. A small number of *Rhinolophus hipposideros*, mainly adult males, was observed. The paper compares the structure of this community to the structure of another community of the same district which has been previously analyzed. in which Vespertilionidae, especially *Miniopterus schreibersi*, are much more abundant. Despite the difference in species composition, body size was found to be a significant and common feature (as highlighted by forearm length), of the dominant species in both communities, *Rhinolophus euryale* and *Miniopterus schreibersi* respectively.

Key words: community ecology, Chiroptera, Rhinolophidae, Central Italy.

INTRODUCTION

There haven't been many studies on bat communities in Italy. A lot more have been carried out in other European and Northamerican countries. Nevertheless, bats are a critically important component of most ecosystems (Wilson, 1989). Furthermore. communities of predators require suitable management and conservation strategies, which means that studies on the structure and population dynamics of bats are of vital importance.

Over the last ten years, ecological investigations were carried out on temperate cave bat communities in northern Latium (*), Central Italy, by the Società Romana di Scienze Naturali (Crucitti et al., 1992). A cave bat community in which *Rhinolophus euryale* is the most abundant taxon has been recently discovered in the region that was studied. A comparison between structurally different communities was possible in spite of the recent decline of the Mediterranean horseshoe bat populations (Brosset et al., 1988; Crucitti et al., 1993; Stebbings and Griffith. 1986). A three-year field study, based on monthly sampling, was carried out in the Tolfetano-Cerite-Manziate district. The aim of this study is to investigate the structure and dynamics of a Rhinolophid bat community and to compare it with the structure and dynamics of another bat community from the same area (Crucitti et al., 1992).

(*) Ricerche dclla SRSN, progetto "I Chirotteri del Lazio: caratterizzazione ccotipologica delle comunità troglofile". 20° contriluto allo studio hioecologico delle chirotterofaune laziali.

MATERIALS AND METHODS

The territory between Allumiere and Tolfa, near the western border of the Tolfetano district, northwestern Latium, is characterized by a marked orography moulded by the recent geological evolution (Fazzini et al., 1972).

The area has a mediterranean temperate climate, without a marked period of dryness (mesomediterranean medium thermotype, upper subhumid / lower humid ombrotype, xerotheric region, mesomediterranean subregion. Its average monthly temperature is <10°C for 3-4 months within an average yearly temperature of between 13.7 and 15.2 °C. Annual rainfall is between 822 and 1110 mm (Blasi, 1994). Spring and autumn rainfalls are another distinctive feature of the climate (Contoli et al., 1980).

The cave is located 74 kms NW of Rome, near the village of Allumiere in a substratum of slightly marly limestone rock. The site, at low altitude, is covered by beech wood with chestnut, oak and maple trees being also present in fewer numbers. Undergrowth consist of ferns, holly, juniper and butcher's broom (Spada, 1977).

Study site: La Cavaccia, in the beech forest of Monte Urbano near the football ground of Allumiere (Fig. 1). Topographical data: F142 II NE Tolfa of the Istituto Geografico Militare 1:25000, 580 m a.s.l. This artificial cave, used to be an aluminium mine until a few decades ago and is known as "Cava di S. Barbara".

The cave consists of a succession of terraces and short tunnels, which are only a few meters tall, with the exception of a chamber in which the vault has collapsed. In the deeper chambers the vault is supported by concrete pillars. At a lower level, there are some narrow tunnels which start. Some are hundreds of meter long and water has infiltrated. The difference in level between the entrance and the deeper chambers is 20 meters. The distance between the entrance and the lower site, along a trail of steps, is 96 meters,

The cave was visited monthly, between 18th and 25th of each month, from November to April of 1992/1993, 1993/1994, and 1994/1995. During each of the 18 visits, measurements of temperature and humidity were made in 7 sites, 6 of which inside the cave, between the entrance (I) and the deeper site (S5), and one outside near the entrance (E). An Assman psychrometer with a electrical motor and thermometers 1/5°C was used.

Single individuals, small or large clusters of the greater horseshoe bat *Rhinolophus ferrumequinum* (Schreber) and the Mediterranean horseshoe bat *Rhinolophus euryale* Blasius were discovered on the ceiling (2-4 meter high), while the Lesser horseshoe bats *Rhinolophus hipposideros* (Bechstein) were found on the walls. Whenever possible, bats were simply counted when observed. Alternatively, the number of hibernating bats of large and dense, pure or mixed (*Rh. ferrumequinum* and *Rh. euryale*) clusters, was estimated by photographic techniques. A 35 mm reflex camera with a zoom lens, electronic flash and 50-100 ISO fine grain slide film, was used.

To obtain quantitative data (the number of bats for each species), the pictures were processed as follows:

- slide projection and enlargment on a A4 sheet;
- drawing of each individual bat (silouette);
- counting of the total amount of silouettes per picture (Crucitti et al., 1990a) (Fig. 2).

The diagnosis of bat species was based on morphological features, head and body size and ear morphology, as described by Lanza (1959). Owing to the considerable height of mixed roosts of Greater and Mediterranean Horseshoe bats on the ceiling, accurate estimates of the number of each species was quite difficult. In spite of this difficulty, the total amount of bats was always stated. Sex and age were determined to provide further information on the social structure of the Lesser horseshoe bat.

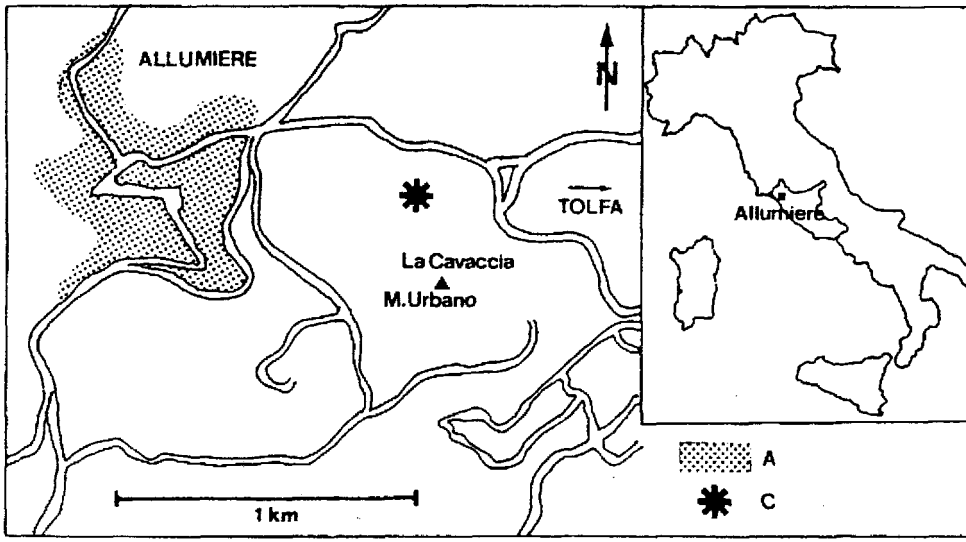


Figure 1 - The location of the study site **(A:** the town of Allumiere; C: the cave).

RESULTS

In spite of the marked fluctuation of E and I temperatures, the widest thermic range in the inner sites of the cave, within one season, was 2.8 °C. In S3 and S4 sites, in which the greatest bat clusters occur, ranges of 2.2 "C (1992/1993), 1.4 "C (1993/1994), and 1.6 °C (1994/1995), were measured. The highest value, 12.2 °C, was measured during November 1992; the lowest, 10.0 °C, during January 1995 and February 1993 and 1994 (Fig. 3). In the deepest sites, humidity was found to be between 95 and 100%.

During November, small and mixed clusters of Greater and Mediterranean horseshoe bats were found. During the cold season, especially January and February, pure clusters were commonly observed. Packed clusters of *Rhinolophus euryale* were found, while in the aggregations of *Rhinolophus ferrumequinum*, individuals were less concentrated.

Other species were sporadically observed during 8 visits: 1 *Miniopterus schreibersi* (Natterer) and 1-6 *Myotis myotis* (Borkhausen) / *Myotis blythi* (Tomes).

There are 5-6 species in the community which are unequally distributed according to their individual number and biomass. The contribution of *Rhinolophus hipposideros*, *Miniopterus schreibersi*, and *Myotis myotis / Myotis blythi* is insignificant. At the end of November, a few hundred bats were present; during the 199211993 semester half of the bats were Greater and half were Mediterranean horseshoe bats. The increase in the next two months is chiefly due to the increase of the Mediterranean horseshoe bat population. The highest number of hibernating bats was observed at the end of January. In this period, 99.0% (1993), 71.5% (1994), and 86.0% (1995) of the "large" Rhinolophid bats *(Rhinolophus ferrumequinum* and *Rhinolophus euryale*) were *Rhinolophus euryale*. At the end of February, despite the marked decrease, the amount of hibernating bats was 2-4 times higher than November. During March-April, the decrease was more sudden in 1993 and less so in 1994, 1995.

Figure 2 - **A** cluster of 1055 *Rhinolophus euryale* from a picture taken at the shelter on 21.II.1993

Rhinolophus ferrumequinum

During the 1992/1993 semester, the highest number of bats (182) was found at the end of November. At the end of the next month, a marked decline was noticed (74.2%). At the end of April only 8 individuals were counted. The population dynamics of the 1993/1994 and 1994/1995 semester followed (contrary to the comtnon trend) a high abundance level in January and February and a low level during the preceding and following months. **At** the end of March the number of bats was quite different for each of the years: 3 (1993). 111 (1994), and 39 (199.5). At the end of April, only few individuals were found. The Greater horseshoe bat was found in all the 18 visits to the cave (Fig. 4).

Rhinolophus euryale

At the end of November, a different number of individuals was found; 141 (1992), 171 (1993), and only 5 (1994). The highest number of individuals was observed between December and February (January 1995: 1274). The species completely disappeared between March and April 1993 and 1994. The decline was less sharp between March and April 199.5. The Mediterranean horseshoe bat was found in 16 out of the 18 visits (Fig. 4).

Rhinolophus hipposideros

The highest number of individuals (18) was counted at the end of December 1992. Until then, the highest number of individuals observed during a single visit to a cave of Latium, was 15 (Crucitti et al., 1990b). This species reached a maximum between December and February. At the end of April it completely disappeared. The Lesser Horseshoe bat was observed in 17 out of the 18 visits (Fig. 5). A biased sex ratio in favour of males was observed. Adult males were the most frequently collected, which is in agreement with Brosset (1974), Crucitti (1985), arid Crucitti and Chiné (1994) (Table 1).

The data is summarized are Tables 2 and 3.

DISCUSSION

The highest number of bats was regularly censused between the end of December and

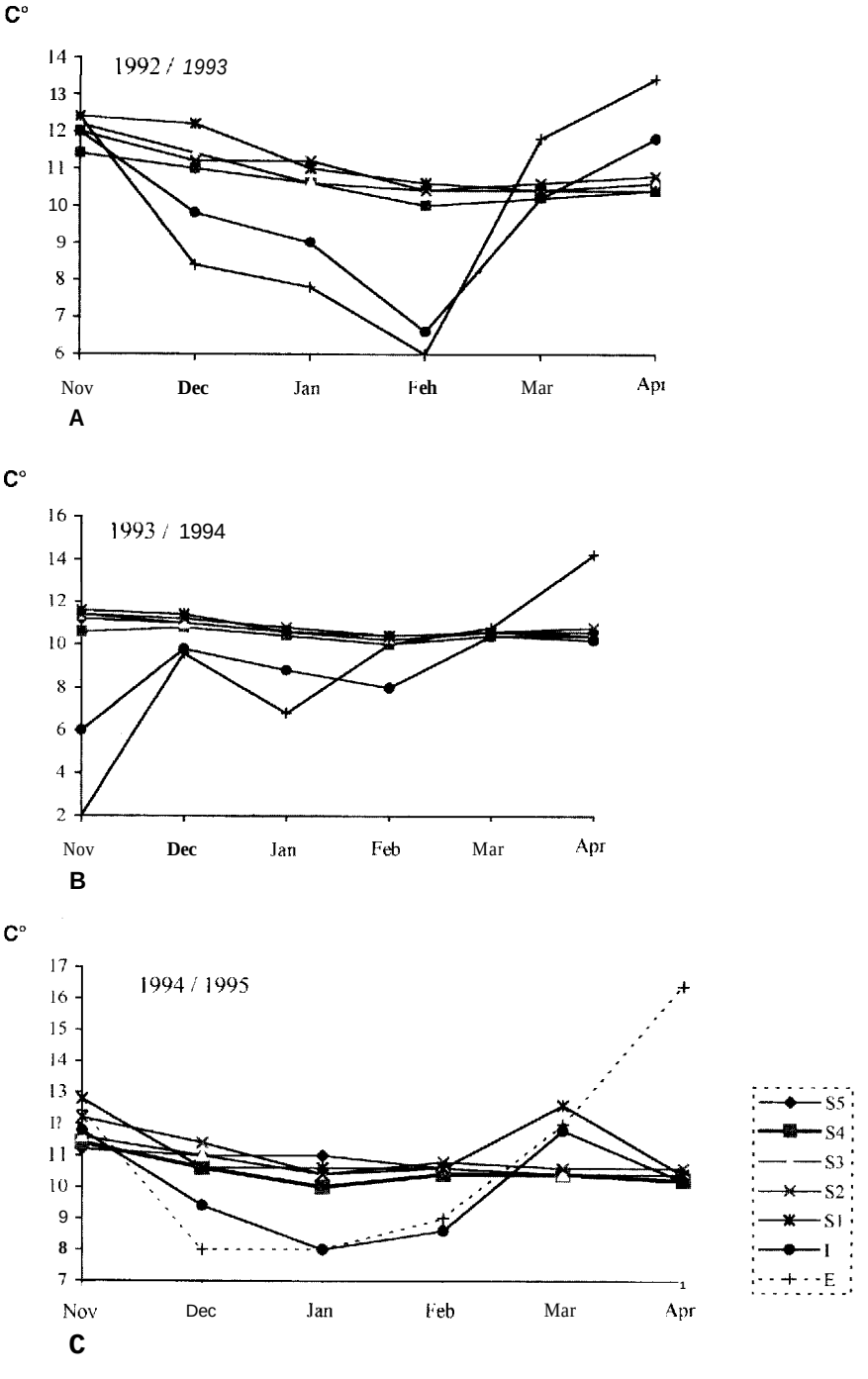


Figure 3 - Air temperature in the cave, from the entrance (I) to the inner site **(SS).** through the intermediate sites S2, S3. S4. Part **A** : semester Nov.-Apr. 1992/93; part B: semester Nov.-Apr. 1993/94; part C : semester Nov.-Apr. 1994/95.

Table 1 - Sex, age classes and structure of the aggregations of *Rhinolophus hipposideros*. MM = adult males; Mm = subadult males; FF = adult females; Ff = subadult females.

DATE	MM	MM	FF	FF	UNDETERMINED SEX	STRUCTURE	N
21.II.1993	13	0	2	0	2	13MM+2FF	17
19.XII.1993	9	0	3	2	0	9MM+3FF+2Ff	14
23.1.1994	11	0	1	0	0	11MM+1FF	12
20.11.1994	9	0	1	0	0	9MM+1FF	10
20.III.1994	2	0	1	1	1	2MM+1FF+1Ff	5
24.IV.1994	3	0	0	0	0	3MM	3
20.XI.1994	2	0	1	1	0	2MM+1FF+1Ff	4
18.XII.1994	4	1	1	0	0	4MM+1Mm+1FF	6
22.1.1995	4	3	0	2	1	4MM+3Mm+2Ff	10
19.II.1995	3	1	0	1	0	3MM+1Mm+1Ff	5
19.III.1995	1	0	0	1	0	1MM+1Ff	2

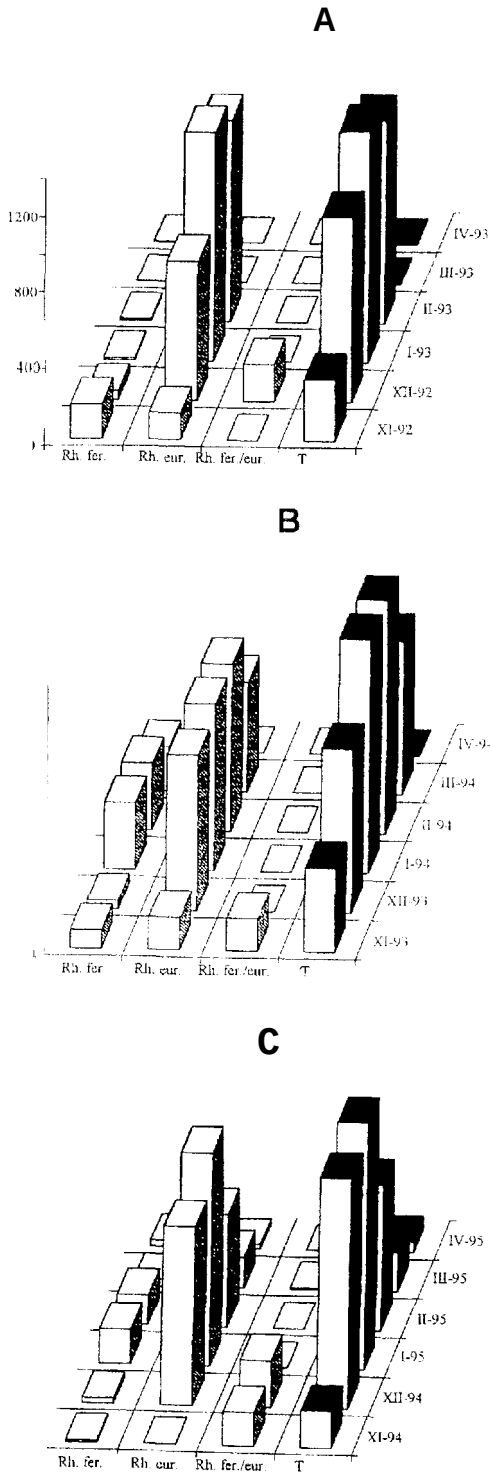
Table 2 - Species abundance: the highest number of individual bats (Ni) counted in a single visit (Date) to the cave.

SPECIES	NI	DATE
Rhinolophus ferrumequinum	348	23.1.1994
Rhinolophus euryale	1274	22.I.1995
Rhinolophus hipposideros	18	20.XII.1992
Myotis myotis/Myotis blythi	6	20.XII.1992
Miniopterus schreibersi	1	22.X1.1992

Table 3 - A comparison between two cave bat communities of the Tolfetano - Cerite - Manziate district (Latium, Central Italy): S = species richness; Nt = the highest number of counted bats, considered as the sum of the highest number of bats for each species counted in a single visit to a cave.

CAVES	THE MOST ABUNDANT SPECIES	S	NT
Allumiere (this work)	*Rhinolophus euryale*	5	1647
Blera (Crucitti et **al.,** 1992)	*Miniopterus schreibersi*	8	2763

the end of February of each year. Large clusters chose humid, dark and inner chambers which were characterized by low temperatures. The chamber's stable microclimatic conditions allow bats to hibernate in deep hypothermia, especially in mid-winter. The number of hibernating bats at the cave were of comparable proportions during each of the same winter months of the three different semesters which seems to suggest that disturbance due to observers during their visits to the cave is minimal. However, a considerable detrimental effect could be caused by a prolonged period of observation and by uncontrolled ringing (Brosset et al., 1988). The community



shows, as a whole, a predominance, both in abundance and biomass, of Rhinolophidae, especially *Rhinolophus euryale*. The serious decline of the Mediterranean horseshoe bat populations suggests that conservation measures arc necessary. In fact total protection of all cave roosts in the Tolfetano district is urgently required to help block the dispersion of cave bat populations at the end of the hibernating period (Saint Girons et al., 1969).

Seasonal dynamics are quite homogeneous. Fluctuations of *Rhinolophus ferrumequinum* were found to be quite uneven from year to year. Marked variations were observed in a large population of the Greater horseshoe bat which hibernated in a cave of north-castern France even during the same winter (Brosset and Poillet, 1985). However, the period of complete fasting lasts from late December to late February in the populations of Western France too (Saint Girons ct al., 1969).

The general trend of population dynamics reflects the pattern of *Rh. euryale* fluctuations expecially during winter months. The Mediterranean horseshoe bat is already abundant at the end of November and reaches a maximum at the end of February. At the end of April, the species had completely vanished.

Rh. hipposideros shows the same pattern too, which is different to the few individuals, generally adult males, of the Lesser horseshoe bat which commonly hibernate in the caves of Latium (Crucitti et al., 1993). Up to now, two different cave bat communities have been discovered at two different

Figure 4 - Seasonal dynamics of *Rhinolophus ferrumequinum* (Rh. Ser.) and *Rhinolophus euryale* (Rh. eur.) at the shelter. Rh. fer./eur.: individuals of "large" Rhinolophid bats. T: amount of bats of the two species in each month. Part A: semester Nov.-Apr. 1992/93; part **B:** semester Nov.-Apr. 1993/94; part C: semester Nov.-Apr. 1994/95.

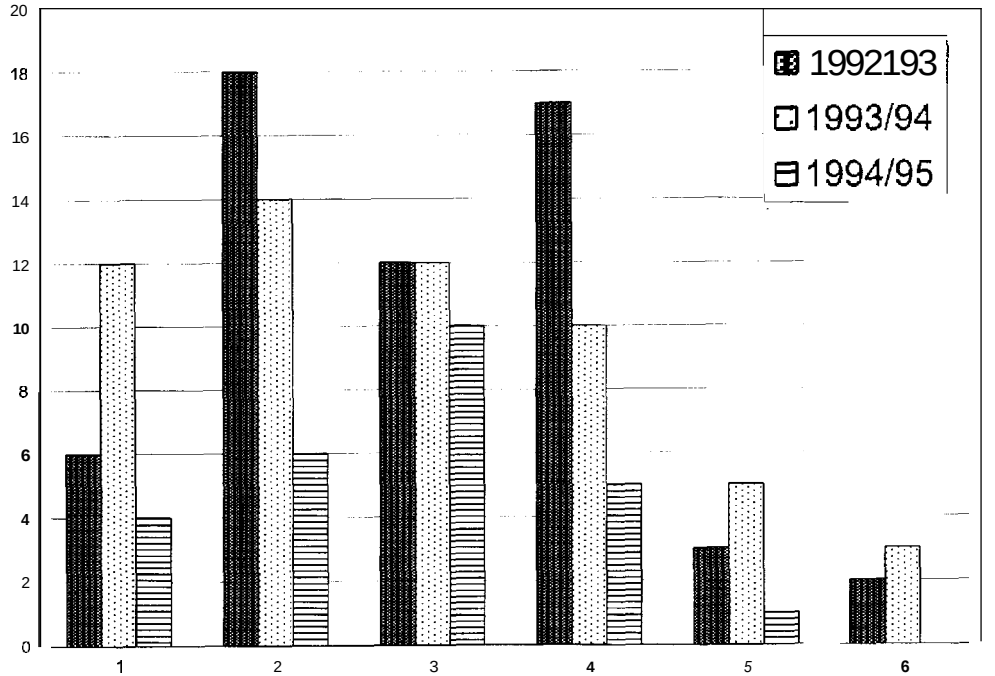


Figure 5 - Seasonal dynamics of *Rhinolophus hipposideros* at the shelter during the semesters November - April 1992/1993 (black), 1993/1994 (grey), 1994/1995 (white)

winter quarters of the Tolfetano district, Latium (Central Italy):

a) a community of 8 bat species. 5 of which are Vespertilionidae: *Miniopterus schreibersi* was the most abundant species (Crucitti et al., 1992; cf. Hanzal and Prucha, 1988 for a temperate cave bat community of central Europe);

b) the community under consideration with 5-6 species, 3 of which are Rhinolophidae: *Rh. euryale* was the most abundant species.

Nevertheless, the similar body size of the dominant species is a common and interesting feature which should be stressed. For example the forearm length was found to be in *Rh. euryale*, 45.3 - 4Y.0 mm (Allumiere; number of measured individuals: 35) and in *Mi. schreibersi*, 42.4 - 46.6 mm (Blera; number of measured individuals: 247).

Evidence suggests that the guild structure of these insectivorous nocturnal predators is quite similar in both communities.

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