

## AN IMPRESSIVE AGGREGATION OF BATS HIBERNATING IN THE SOUTHERN CARPATHIANS (ȘURA MARE CAVE – ROMANIA)

Dumitru MURARIU<sup>1</sup>, Vasile DECU<sup>2</sup>, Victor GHEORGHIU<sup>2</sup>, Viorel NISTOR<sup>3</sup>

<sup>1</sup> 'Grigore Antipa' National Museum of Natural History – Bucharest, Kiseleff 1 St., Sectorul 1; e-mail: dmurariu@antipa.ro

<sup>2</sup> Speleological Institute "Emil Racovitza" – Bucharest, Frumoasa 31 St., Sectorul 1; e-mail: victorgheorghiu@hotmail.com

<sup>3</sup> Romanian Federation of Chiropterology – Bucharest, Kiseleff 1 St., Sectorul 1; e-mail: vnistor@yahoo.com

**An impressive aggregation of bats hibernating in the Southern Carpathians (Șura mare Cave – Romania).** The Șura Mare Cave in Romania is one of the largest hibernacula with more than 40,000 individuals. Dominant species are *Pipistrellus pipistrellus*/*P. pygmaeus* with more than 34,000 individuals in mixed colonies. Other 6 bat species are present but less numerous (e.g. *Rhinolophus ferrumequinum*, *Myotis myotis*, *M. blythii*, *Barbastella barbastellus* and *Miniopterus schreibersii*).

**Key words:** Șura Mare Cave, bat hibernation, *Pipistrellus*, monitoring programme

### 1. Introduction

The number of 30 bat species has been reported from Romanian territory. Twenty two are strictly associated with roosts and foraging habitats offered by the Carpathian caves and forests. Caves and tree hollows are used for hibernation as well as for shelters of bat nursery colonies. But some species (e.g. *Rhinolophus ferrumequinum*, *Myotis myotis*) spend the winter time in caves and leave them in summer.

Data about bat distribution and their biology on the Romanian territory has been collected from the second half of the 20<sup>th</sup> century: DUMITRESCU *et al.* (1962-1963); DUMITRESCU *et al.* (1963, 1967); ORGHIDAN *et al.* (1984) etc.

Among the caves mentioned as very important roosts for bats we can find Șura Mare. This karstic object was the subject of studies by GHERMAN (1934), MITROFAN *et al.* (1985), PONTA (1989), MARIN (2000), NAGY *et al.* (2003), BLEAHU *et al.* (2003).

Within this paper we report an estimation of number of bats found in different colonies from Șura Mare Cave, conducted during the monitoring programme in Romania, in the years 2002 and 2003. The impressive aggregation refers to the unusual large number of

individuals of *Pipistrellus pipistrellus* found during winter.

## 2. Materials and Methods

The Şura Mare Cave is situated about 1 km in the north-east direction from the last houses in Ohaba Ponor village, locality Pui, Hunedoara County, Southern Romanian Carpathians (Fig. 1). Located on the southern slope of Large Fruntea (Fruntea Mare) Hill in southern part of the Sebes Mountain at 460 m a.s.l. (UTM FR 64; 23°5'43" E and 45°34'15" N). After MITROFAN *et al.* (1985) the Şura Mare Cave has been since the lower Pleistocene in the plate of the tectonic limestone overlapped on the Sebes crystalline mountains. Level difference from the edge of contact of crystalline with limestone rocks to the surface of water (basin) is 500 m Streiului Valley (waters spring from the Şura Mare entrance). Within this zone a strong process of water erosion is observed, resulting in an intensive process of karstification, numerous dolines and caves (ORGHIDAN *et al.* 1984). Total length of the Şura Mare cave is 11,123 m, and it is +425 m high (PONTA 1989).



Fig. 1. Geographic location of Şura Mare cave (●).

Şura Mare is a warm cave with a great thermal reserve, very wet, and with a drought produced by the underground river.

**Foraging habitats:** Outside the cave, in about 50 m distance from the entrance there are shrubs and rare grass on the stony slopes of Ohaba Ponor gorges. Flying out, bats have a free way above the Ponor River – the main route for bats commuting to adjacent

foraging areas. The nearest village is Ohaba Ponor, in a distance of about 1 km. Habitats within the radius of 0.5 km from the entrance of the cave: broad-leaf forest or mixed forest 60%, arable land/horticultural 5%, pasture and meadows 30%, free land/horticultural 5%, inhabited land/village 1%, stony zones 3%, surface waters 1%, the forested and fragmented area 20%.

The cave was visited and investigated four times: on the 13<sup>th</sup> of August 2002, the 1<sup>st</sup> of December 2002, the 5<sup>th</sup> of March 2003, and on the 19<sup>th</sup> of June 2003.

### 3. Results

#### 3.1. Microclimate

The range of temperatures (during visit time) was: 1.7 – 26°C outside; 1.7 – 26°C at the entrance; 2.1-13.6°C temperature of the air inside cave; 6.4-10.5°C close to the walls (deep down the cave); 6.6-8.1°C at roosts of the colonies; 6.2-7.2°C temperature of water inside the cave (Tab. 1).

Table 1. Measurements of temperature in different locations of Şura Mare Cave (in °C).

Date	Hour	Outside	Entrance	Location	Air	Walls	Water
13 Aug. 2002	9.30	21	19.8	Main gallery, +100 m from the entrance	13.6		
1 Dec. 2002	13.30	1.7	1.7	Id. (+340 m)	6.6*	8.1	7.2
5 March 2003	9.30	3.7	3.7	Id. (+690 m) Id. (+340 m)	8.1* 2.1		6.2
19 June 2003	15.30	26.5	26.0	Id. (+450-750m) Id. (+140 m)	6.6* 12.7	6.4 10.5	

Note: \* indicates temperature taken close to bat colonies (in the air and near the walls)

#### 3.2. Bats

The total number of bats registered in winter in the Şura Mare Cave was about 40,000 (Tab. 2). Observations were made in the main hall at 850 m distance from the entrance (Fig. 2). Large hibernating bat aggregations consist of *Pipistrellus sp.* GHEORGHIU *et al.* (2002) have reported the existence of the species *Pipistrellus pygmaeus* (Tab. 3) for the Romanian fauna on the basis of bat detector recordings. While hibernating in cervices or high in large aggregations, these animals are not distinguishable by morphological features. Moreover, another species from *Pipistrellus* genus is present in Romania in very low numbers, and it should be taken into account to be careful in identifying species (NAGY & SZANTO 2003).

*Miniopterus schreibersii*, *Nyctalus noctula*, *Barbastella barbastellus*, *Myotis myotis* / *M. blythii*, *Rhinolophus ferrumequinum* and isolated individuals or small groups of *Pipistrellus pipistrellus* were found in summer time.

**Threats of bat colonies:** The Şura Mare Cave is not easily accessible; therefore the human impact is very low. Only speleologists are entering this cave during October – April

period and if they use lights with acetylene they can affect bat colonies.

Table 2. Number of individuals for each observed species in Şura Mare cave in the period June 2002 – March 2003.

Species	Winter		Summer	
	1.12.2002	5.03.2003	19.06.2002	13.06.2002
<i>Pipistrellus</i> sp.	34000	34000	20	20
<i>Rhinolophus ferrumequinum</i>	600	150		
<i>Nyctalus noctula</i>	30			
<i>Barbastella barbastellus</i>	5			
<i>Miniopterus schreibersii</i>	3500	3000		
<i>Myotis</i> sp.	2000			
<i>Myotis myotis</i> / <i>M. blythii</i>	170	70		
Total	40305	37220	20	20

Note: Within the summer period there are no nursery colonies inside the cave. Using a mist-net we collected only two specimens from different species. Close to the entrance we found a small aggregation of *Pipistrellus* sp. occupying not accessible crevice.

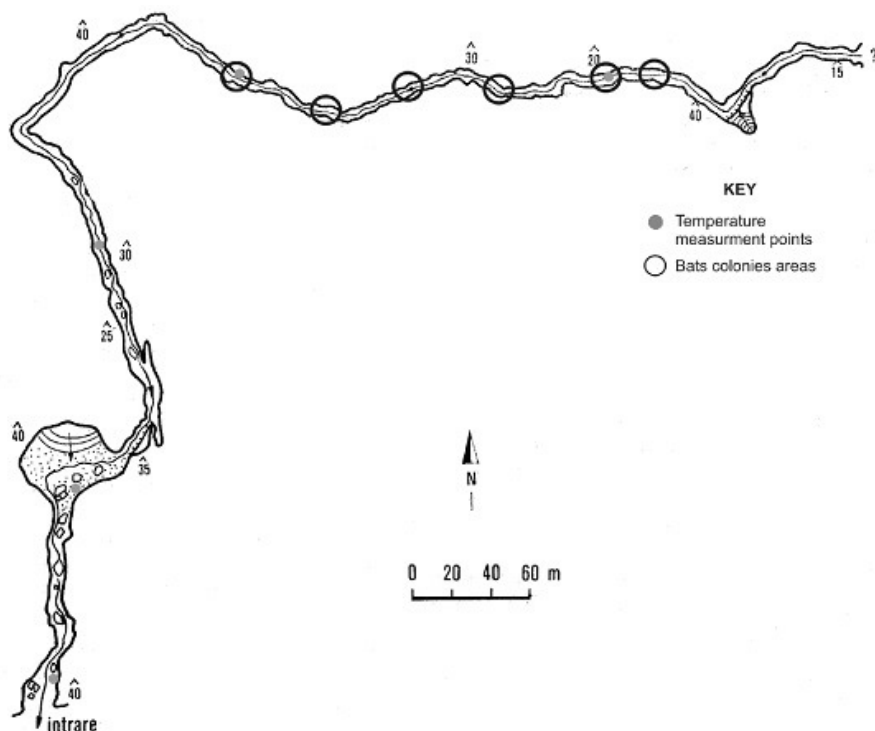


Fig. 2. The sector with bat colonies situated along the first 850 m from the entrance in Şura Mare cave.

### 3.3. Bats in cave in winter (hibernation period)

Table 3. Locations and number of bat species and temperature in the Şura Mare cave.

Date	Part of the cave	Species	Number of ind.	Distribution	Temp. (°C)
1.12.2002	main gallery about 340 m from the entrance	<i>Pip sp.</i>	approx. 4500	colony in 3 large crevices at 3-5 m height	6.6 (air) 8.1 (wall) 7.2 (water)
	Idem	<i>Nnoc</i>	20-30	colony in crevice	6.6 (air) 8.2 (wall)
	Idem	<i>Bbar</i>	4-5	colony	6.6 (air) 8.2 (wall)
	approx. 390 m	<i>Pip sp.</i>	approx. 6500 ind.	colony parietal; at the height of 7m	6.6 (air) 8.1 (wall)
	approx. 450 m	<i>Pip sp.</i>	approx. 8000-9000	colony parietal; at the height of 35-40 m	Idem
	approx. 520 m	<i>Pip sp.</i>	approx. 6000	colony parietal; at h. 20m	Idem
	approx. 550 m	<i>Msch</i>	approx. 3000-3500	colony parietal; at the height of 25m	Idem
	approx. 670 m	<i>Pip sp.</i>	approx. 8000	colony parietal + vault; at the height of 40 m	Idem
	Idem	<i>Myotis sp.</i> (medium size)	approx. 2000	colony parietal; at the height of 20 m	Idem
	approx. 690 m	<i>Rfer</i>	approx. 500-600	spread	Idem
	along all way	<i>Mmyo/Mbly</i>	approx. 150-170	isolated	Idem
5.03.2003	main gallery, about 450 m from the entrance	<i>Pip sp.</i>	approx. 23000	colony vault; at the height of 40 m	6.6 (air); 6.4 (wall) 6.2 (water)
	approx. 530 m	<i>Msch</i>	approx. 3000	colony parietal; at the height of 30 m	Idem
	approx. 580 m	<i>Pip sp.</i>	approx. 7000	colony parietal; at the height of 25 m	Idem
	approx. 680 m	<i>Pip sp.</i>	approx. 4000	colony parietal; at the height of 30 m	Idem
	approx. 690 m	<i>Rfer</i>	approx. 150	colony spread, parietal; at the height of 15 m	Idem
	along the gallery, 350 – 750 m from entrance	<i>Mmyo/Mbly</i>	approx. 70 individuals	isolated	Idem

#### Notes:

The number of *Pipistrellus sp.*, and *Miniopterus* is probably higher. Our estimation was limited by the walls' sinuosities, crevices and the height of corridors/chambers, and by the fact that we performed our observations only within 850 m from the entrance.

Temperature in the cave determined movement of bats. We found colonies at various levels and points of investigated gallery area. The colony of medium size *Myotis sp.*

was not found for the second time and the group of *Barbastella* and *Nyctalus* changed their location. This is why we consider to continue monitoring as very necessary, especially during the hibernating time.

#### 4. Discussion

The Şura Mare Cave is one of the greatest hibernating roost reported from Romania with impressive colony size of more than 40,000 individuals. The dominant species, about 34,000 individuals, is *Pipistrellus* sp. Thus the Şura Mare cave is comparable with Huda lui Păpără Cave with a total estimated number of 60,000 individuals of hibernating bats (Prof. Ion COROIU from the „Babeş-Bolyai” University – Cluj, in verbis, in 2003 and NAGY & SZANTO 2003).

Other species: *Rhinolophus ferrumequinum* (maximum 600 hibernating individuals); *Myotis myotis* / *Myotis blythii* – isolated individuals (not more than 170 individuals) dispersed along investigated gallery. A colony of *Myotis* sp. (approximately 2,000 individuals estimated in December 2002) was not found again at the end of hibernation period. We suppose that unusual length of winter with very low temperatures was the factor which could cause change of the locations of colonies observed in December. The winter persisted up to the end of April 2003. It refers to *Rhinolophus ferrumequinum*, *Miniopterus schreibersii* and *Pipistrellus* sp.

*Nyctalus noctula* were directly observed only in the number of 30 individuals, but taking into account very large number of crevices and hidden places in the ceiling, their number must have been much larger. We observed movements of these bats, and collected dead specimens or skeletons from the floor and cliffs. That is why we estimate number of *Nyctalus noctula* as more than 1000 individuals in this cave.

*Barbastella barbastellus* was also directly observed in a low number – 5 individuals only. Other individuals could be hidden in the holes of the cave walls, in places inaccessible for direct observations.

*Miniopterus schreibersii* was the second species (after *Pipistrellus*) forming large colony (numbering about 3,500 individuals in December).

*Rhinolophus ferrumequinum*, *Myotis myotis*, *M. blythii*, *Barbastella barbastellus* and *Miniopterus schreibersii* are the priority species with special status of protection according to the European Community's legislation. This is the reason why we started documentation for Şura Mare Cave – to be declare as protected area.

Hibernating bat colonies change their place in the cave according to variation of the temperature: in December most colonies were observed close to the entrance and in March they moved deeper.

The results are not exhaustive because bats occupy hidden places and because out of the total of 11,123 m length of the cave only 850 m was surveyed, with clear visible bat colonies.

#### Acknowledgements

This survey was developed in the LIFE00NAT/RO/7187 with the financial contribution of the European Community. The authors address their grateful thanks to speleologist John Smaranda and

Tudor Marin – the president of the Association „Focul viu” (Life fire). Special thanks to the speleologists Mihai Baci and Ludovic Mark from GESS for their valuable information as well as for the map. They, together with Dorel Cojocaru offered a helpful assistance in the field trips too. For botanical information thanks are extended to Dr. Gavrilă Negrean. Authors are obliged to the anonymous referees who offered pertinent suggestions and improved the manuscript.

## Literature

- BLEAHU M., DECU V., NEGREA ST., PLESA C., POVARA I., VIEMANN I., 1976. Pesteri din Romania. Editura stiintifica si enciclopedica, Bucuresti: 289-291.
- GHERMAN I., 1934. Contributii la cunoasterea regiunii carstice de la NE de Pui. *Revista Muzeului de Geologie, Universitatea Cluj*, **5**, 1: 119-133.
- DUMITRESCU M., TANASACHI J., ORGHIDAN T., 1962-1963. Raspandirea chiropterelor in R.P. Romana. *Lucrarile Institutului de Speologie „Emil Racovitza”*, **1-2**: 509-576.
- DUMITRESCU M., ORGHIDAN T., 1963. Contributions à la connaissance de la biologie de *Pipistrellus pipistrellus* Schreber. *Annales de Spéologie*, **18**, 4: 511-517.
- DUMITRESCU M., ORGHIDAN T., PUSCARIU V., TANASACHI J., GEORGESCU M., AVRAM ST., 1967. Contributii la studiul pesterilor din regiunea Hunedoara. *Lucrarile Institutului de Spéologie „Emil Racovitza”*, **6**: 9-88.
- GHEORGHIU V., MURARIU D., 2002. *Pipistrellus kuhlii* Kuhl, 1819 and *P. pygmaeus* Leach, 1825 (Chiroptera, Vespertilionidae) recently reported in the Romanian vertebrate fauna. *Travaux du Muséum National d'Histoire Naturelle „Grigore Antipa”*, **44**: 443-454.
- MARIN T., 2000. 130 de ore de bivouac pentru cea mai spectaculoasa explorare a anului 1999 – Şura Mare. *Spéomond, Revue de la Fédération Roumaine de Spéologie*, **5**: 11-15.
- MITROFAN H., PONTA G., 1985. Preliminary note on the karstic system of Şura Mare (Sebes Mountains). *Theoretical and Applied Karstology, Institute of Speleology „Emil Racovitza”*, **2**: 79-86.
- NAGY Z., SZANTÓ L., 2003. The occurrence of hibernating *Pipistrellus pipistrellus* (Schreber, 1774) in caves of the Carpathian Basin. *Acta Chiropterologica*, **5**, (1): 155-160.
- ORGIDAN T., NEGREA ST., RACOVITA GH., LASCU C., 1984. Pesteri din Romania. Editura sport-turism, Bucuresti: 316-320.
- PONTA G., 1989. Pestera Şura Mare (M-tii Sebes). *Buletin Speologic*, **12**: 74-89.