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## ȘURA MARE CAVE (ROMANIA), THE MOST IMPORTANT KNOWN HIBERNATING ROOST FOR *PIPISTRELLUS PYGMAEUS* LEACH, 1825 (CHIROPTERA: VESPERTILIONIDAE)

DUMITRU MURARIU, VICTOR GHEORGHIU

**Abstract.** The Sura Mare cave from Romania is one of the largest roost for hibernating colonies of bats with more than 40,000 individuals. *Pipistrellus pipistrellus* and *P. pygmaeus* are prevalent species with more than 34,000 individuals in mixed colonies. Other 6 bat species are less represented (e.g. *Rhinolophus ferrumequinum* only 500 individuals) but *Miniopterus schreibersii*'s colony counts 3,500 individuals. From the total of 8 identified bat species, 5 are a priority according to the European Union legislation: *Rhinolophus ferrumequinum*, *Myotis myotis*, *M. oxygnathus*, *Barbastella barbastellus* and *Miniopterus schreibersii*.

**Résumé.** On a investigué, du point de vue chiroptérologique, seulement les premiers 850 m, en partant de l'entrée principale, de la Grotte Șura Mare, longue de 11.123 m. Les auteurs font une analogie avec la grotte Huda lui Paparã, car elles se ressemblent par l'hauteur et la largeur du portal, mais aussi parce qu'elles abritent plus de 76.000 chauve-souris (cf. Coroiu et coll., 2006), avec la mention que cette dernière a été investiguée sur toute sa longueur. Dans la Grotte Șura Mare, *Pipistrellus pipistrellus* est l'espèce dominante (avec environ 30.600 individus), tandis que *P. pygmaeus* a été estimé à environ 3.400 individus. La seconde espèce de cet abri (avec 3.500 individus) a été *Miniopterus schreibersii*, qui a connu un déclin drastique de sa population au cours des dernières 50 années et mérite l'inclusion dans le programme national de monitoring. D'autres espèces prioritaires (conformément à la législation européenne) sont: *Rhinolopus ferrumequinum*, *Myotis myotis*, *M. oxygnathus*, *Barbastella barbastellus*. Pour cette raison, les auteurs proposent que la Grotte Șura Mare soit déclarée aire protégée.

**Key words:** bat hibernation colony, important roost in Europe, *Pipistrellus pygmaeus*.

### INTRODUCTION

*Geographic localization and genesis:* The Șura Mare cave is situated at about 1 km North-East from the last houses in Ohaba Ponor village, locality Pui, Hunedoara County. It is disposed on the southern slope of Fruntea Mare Hill in southern part of the Sebeș Mountains, at 460 m a.s.l. The U.T.M code is FR 64 and geographic coordinates are: 23°5'43"E and 45°34'15"N. This cave was mentioned by Bleahu et al. (1976).

After Mitrofan et al. (1985), the Șura Mare Cave is in the plate of the Tithonic limestone overlapped on the Sebeș crystalline mountains since the lower Pleistocen. The difference of level between the edge of contact of crystalline with limestone from the collecting basin of surface waters is Strei Valley at a level difference of 500 m (waters spring at the entrance of Șura Mare cave). In the area there is a strong process of water erosion, especially in the places and existing diaclases from limestone deposits. The result was an intense process of karstification, resulting numerous sinkholes and many active caves (Orghidan et al., 1984).

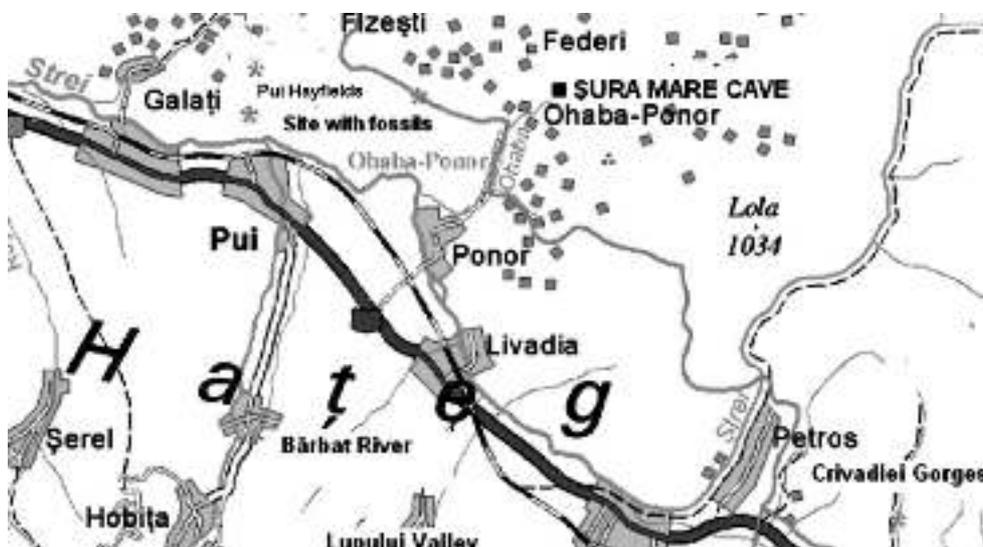


Fig. 1 - Geographic location of Şura Mare Cave (black square) in Grădiştea de Munte – Ciclovina Natural Park.

*Short history:*

First investigations in the cave were made in 1929 by two local people (Schalder and Toma Enciu). After Ponta (1989) these people entered 600 m in the cave. Starting with 1931, the geologist I. Gherman entered with a boat and investigated 700 m from the entrance and published a detailed description of the cave (Gherman, 1934; Ponta, 1989, with a correction of the first descriptions). An attempt of Orghidan and Codreanu (1950) was interrupted by large blocks of stones collapsed from the cave's ceiling. Starting with 1954, Dumitrescu, Orghidan and Tanasachi explored and mapped the first km of the cave (Orghidan et al., 1984). That programme was initiated by the Romanian Geological Institute in order to identify the deposits of guano.

Investigations continued with observations on bat colonies (Dumitrescu et al., 1962 – 1963; Dumitrescu et al., 1963). In 1964, Orghidan, Botoşăneanu and Dumitrescu investigated over 2 km of the cave length. They coloured (with fluorescein) the main points of the drainage from cave in the underground river and established main sources and the reservoir. These results were published by Dumitrescu et al. (1967). One Romanian and two Romanian-English expeditions were organized in 1967 – 1969, visiting 4.5 km up to one not passing siphon/chimney very close to Large Falls. During the next 30 years, some amateur speleologists established a total length of 11,123 m, with 425 m positive difference of level.

*Summary description:*

Şura Mare is a large and active cave with a main gallery of 30 m high and 2 – 3 m wide and an irregular ceiling. The entrance is very large (37/13 m), oriented towards South. The main gallery is oriented to North-East and is interrupted by several large halls, the terminal one being the largest. The first hall, situated at 120 m from the entrance, is of 45/35 m and 30 m high. The underground river receives

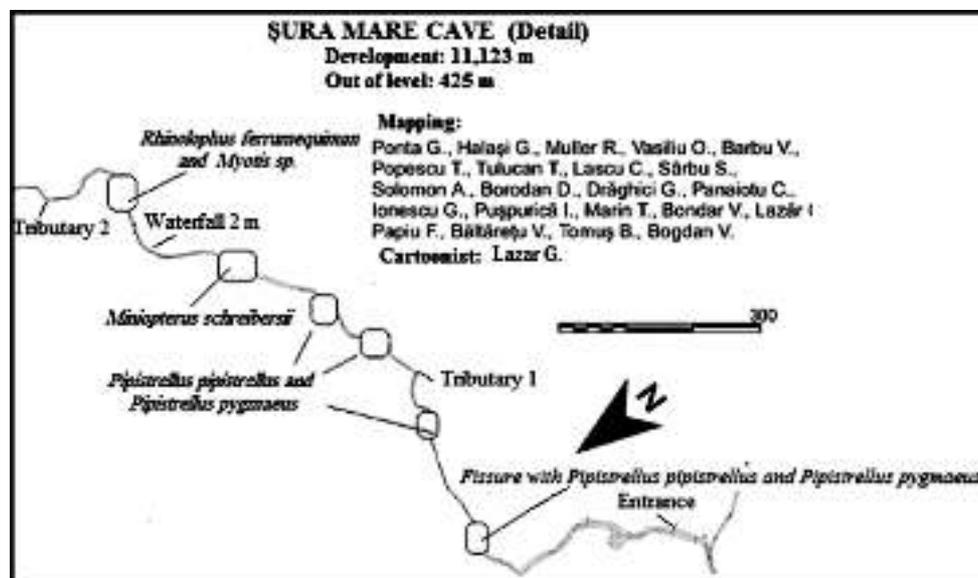


Fig. 2 - The sector with chiropteran colonies situated in the first 850 m from the entrance in Șura Mare Cave, total length being of 11,123 m.

seven tributaries originating in the Ponor Valley's waters which disappear at the Blind lane of Ponor. The first tributary rises from Dosul Lăcșorului pit and the second, from Ponor Leorda Cave (Ponta, 1989). The third tributary forms a gallery with two floors continued with Mendip Hall where there are the largest and nicest calcites and basins from Romania. Marin (2000) reported a new exploration of the cave.

#### *Climate:*

Șura Mare is a warm cave with a great thermal reserve, very wet and has a fan produced by the underground river. Temperature (during the visit period) was 1.7-26°C outside; 1.7-26°C at the entrance; 2.1-13.6°C in the air; 6.2-7.2°C in water; 6.4-10.5°C close to walls (very deep).

#### *METHODS*

The authors investigated Șura Mare Cave at: 13 August 2002, 1 December 2002, 5 March 2003, 19 June 2003.

#### *Estimation of the bat number.*

The following two methods were used:

- the division of the bats which form compact colonies, into three categories: 1 - large sized bats (e.g. *Myotis myotis/oxygnathus*); 2 - medium sized bats (e.g. *Miniopterus schreibersii*); 3 - small sized bats (*Pipistrellus pipistrellus/P. pygmaeus*). For each of the three categories, we deduced the following: 1. The number of the large sized bats which are included in a 20/20 sq cm is of 30-32 individuals; it results that the number of the individuals present in a 1 sq m colony is of about 750-800 individuals; 2. The number of the medium sized bats included in a

15/15 sq cm is of about 45-48 individuals; it results that the approximate number of individuals present in a 1 sq m colony is of about 2000-2100 individuals; 3. The number of the small sized bats included in a 10/10 sq cm is of about 30-34 individuals; it results that the number of individuals present in 1 sq m colony is of about 3000-3400 individuals. After the estimation of the colony surface and the species identification which belong to the respective population, we made the estimation of the number of individuals. This method was also used for the estimation of the bat populations uniformly spread (*Rhinolophus ferrumequinum*) and after we counted the bats from a square, we extrapolated the results to the entire occupied surface.

#### RESULTS AND DISCUSSIONS

*Bats localization:* Observations were made in the Main Hall at 1400 m distance from the entrance. The large hibernating bat colonies included *Pipistrellus pipistrellus* and *P. pygmaeus* (as dominant species), *Miniopterus schreibersii*, *Nyctalus noctula*, *Barbastella barbastellus*, *Myotis myotis/oxynathus*, *Rhinolophus ferrumequinum*. Among the isolated individuals or small groups of *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus*, basing on bat detector registrations, it was reported the existence of the species *P. pygmaeus* in the Romanian fauna (Gheorghiu & Murariu, 2002). In table 1, the observations on the numerical distribution of the chiropteran population, in site, on 01.12.2002, are minutely presented. Table 2 includes morphometrical data resulted from some bat species (*Pipistrellus pipistrellus*, *P. pygmaeus*, *Nyctalus noctula*, *Barbastella barbastellus* and *Rhinolophus ferrumequinum*) on the same date, captured in the crevices (Fig. 3). The synthesis of the obtained information, on 05.03.2003, is included in table 3, because it was considered that the details are not significantly different from those resulted on 01.12.2002.

Table 1

Observation sheet in the hibernating period

Observers' name: Victor Gheorghiu, Viorel Nistor				
Date of observation: 1.12.2002; Starting hour of observation: 11.30				
Number of persons who attended observations: 6; Duration of observation: 9 hours				
Outside air temperature: 1.7 C				
Weather in the previous night: clouded sky, light snowing				
Relative humidity in the cave: very high; active and permanent				
Not visible changes comparing with the last visit				
Localization (see the map)	Genus, species	Number of individuals	Distribution	Temp. (°C)
Main gallery about 340 m from the entrance	<i>Pipistrellus pipistrellus/ P. pygmaeus</i> - in 3 large crevices at 3-5 m high	approximately 4500	colony	Air t.: 6.6 Wall t.: 8.1 Water t.: 7.2
approximately 340 m	<i>Nyctalus noctula</i> - crevice	20-30	colony	Air t.: 6.6 Wall t.: 8.2

Table 1 (continued)

Localization (see the map)	Genus, species	Number of individuals	Distribution	Temp. ( C)
approximately 340 m	<i>Barbastella barbastellus</i>	4-5	colony	Ibidem
approximately 390 m	<i>Pipistrellus pipistrellus</i> and <i>P. pygmaeus</i> - parietal; 7 m high	approximately 6500	colony	Air t.: 8.1
approximately 450 m	<i>Pipistrellus pipistrellus</i> / <i>P. pygmaeus</i> - parietal; 35-40 m high	approximately 8000-9000	colony	Ibidem
approximately 520 m	<i>Pipistrellus pipistrellus</i> and <i>P. pygmaeus</i> parietal; 20 m high	approximately 6000	colony	Ibidem
approximately 550 m	<i>Miniopterus schreibersii</i> - parietal; 25 m h.	approximately 3000-3500	colony	Ibidem
approximately 670 m	<i>Pipistrellus pipistrellus</i> / <i>P. pygmaeus</i> parietal + vault; 40 m high	approximately 8000	colony	Ibidem
approximately 670 m	<i>Myotis</i> sp. (medium size); parietal; 20 m high	approximately 2000	colony	Ibidem
approximately 690 m	<i>Rhinolophus ferrumequinum</i>	approximately 500-600	spread	Ibidem
along all way	<i>Myotis myotis</i> / <i>oxygnathus</i>	approximately 150-170	isolated	Ibidem

Note: Doubtlessly, the number of *Pipistrellus* groups, possibly *Miniopterus*, are more numerous because of the wall's sinuosities, crevices and the height where the bat colonies are hidden. In addition, our observations were made at only 850 m away from the entrance, and, as it was mentioned, the total length of the cave is 11,123 m.

Table 2

Sheet of bats evidence of collected bats.

Observer's name: Victor Gheorghiu
Date of observation: 1 Dec. 2002; Hour of starting observation: 13.30. Hour of the end of observation: 14.10
Number of experienced persons who collected: 1
Method of collecting: snap net
Motivation of bat collecting: identification, measurements, weighting
Bat collecting was made inside the cave with a 30 cm diameter hand net (area = 0.09 m <sup>2</sup> ) or directly by hand, from the walls.

Table 2 (continued)

Hour of first capture: 13.30; Hour of last capture:14.05					
Total number of collected bats: 12; Number of species collected: 5					
No injuries to bats in the identification time					
Details on collected bats					
Hour	Species	Sex	Age	Length of the forearm (mm)	Weight (g)
13:30	<i>Nyctalus noctula</i>	♀	adult	54.83	30.7
	<i>Rhinolophus ferrumequinum</i>	♂	adult	59.01	22.8
	<i>Myotis myotis</i>	♀	adult	59.36	25.7
	<i>Pipistrellus pygmaeus</i>	♂	adult	30.43	5.1
	<i>Pipistrellus pygmaeus</i>	♂	adult	30.01	5.0
	<i>Pipistrellus pygmaeus</i>	♂	adult	30.79	5.2
	<i>Pipistrellus pygmaeus</i>	♀	adult	31.24	5.4
	<i>Pipistrellus pipistrellus</i>	♂	adult	31.82	5.1
	<i>Pipistrellus pipistrellus</i>	♂	adult	31.31	5.5
	<i>Pipistrellus pipistrellus</i>	♀	adult	31.75	5.6
	<i>Pipistrellus pipistrellus</i>	♀	adult	32.09	5.9
	<i>Pipistrellus pipistrellus</i>	♂	adult	32.28	5.3
	<i>Barbastella barbastellus</i>	♂	adult	38.67	9.9
	14:45	<i>Barbastella barbastellus</i>	♀	adult	42.07

From this location, placed at about 4 m high, sufficient specimens could be collected to which we made a correct identification and could establish the density ratio of these two species.

Table 3

Bat species observed in hibernating winter 2002 – 2003.

ȘURA MARE CAVE	BIOLOGICAL CYCLE - Hibernation	
	DATE OF OBSERVATIONS	
	1 December 2002	5 March 2003
Genus and species		
<i>Rhinolophus ferrumequinum</i>	600	150
<i>Pipistrellus pipistrellus</i> / <i>Pipistrellus pygmaeus</i>	34000	34000
<i>Nyctalus noctula</i>	30	
<i>Barbastella barbastellus</i>	5	
<i>Miniopterus schreibersii</i>	3500	3000
<i>Myotis</i> sp.	2000	
<i>Myotis myotis/oxygnathus</i>	170	70
TOTAL INDIVID.	40305	37220

After Murariu et al. (2007), the Șura Mare cave is one of the greatest hibernating roosts from Romania with an impressive colony of more than 40,000 individuals, the dominant species (about 34,000 individuals) being *Pipistrellus pipistrellus*/*P. pygmaeus*. Thus, the Șura Mare cave is comparable with Huda lui Păpără from the Western Carpathians. In the last one, the maximum number of recorded individuals was of 76,330 (03.03.2005), belonging to six species

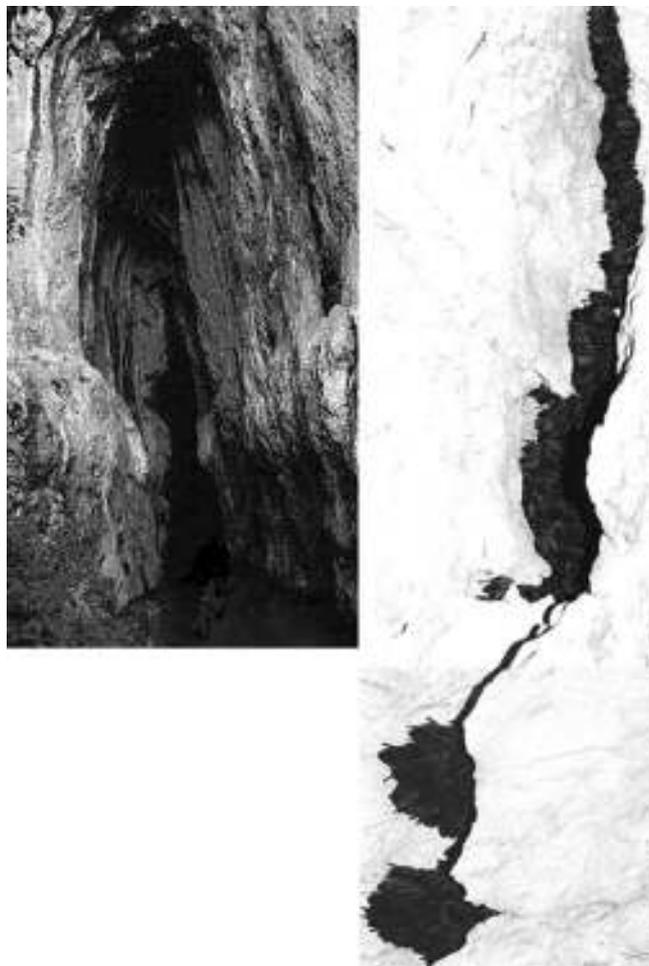


Fig. 3 - Left: The main entrance of Sura Mare Cave, 37 m high and 13 m wide; Right: The crevices of 3-3.5 m long and roosts of a hibernating bat colony with thousands of *Pipistrellus pipistrellus* and *P. pygmaeus*.

(*Miniopterus schreibersii*, *Pipistrellus pipistrellus*, *Myotis myotis/oxynathus*, *Rhinolophus euryale*, *R. ferrumequinum*) out of which 90% belong to the species *Miniopterus schreibersii* and *Pipistrellus pipistrellus* (Coroiu, Viehmann & David, 2006). Also, from the morphological point of view there are numerous resemblances between Şura Mare cave and Huda lui Papară cave: huge portals at the entrances, very high ceilings; both caves are active so that there is a constant temperature inside, of over 6°C; they are caves with an extremely difficult route which can be covered only with special equipment; thus the bats are not disturbed during the hibernation. Up to now, *Pipistrellus pygmaeus* was not reported from Huda lui Papară cave.

We consider that the diminishing of the present population of *Pipistrellus* (ca. 34,000 individuals) from the Şura Mare cave, in comparison with the 100,000 individuals reported by Prof. Margareta Dumitrescu in the '60s, is not due to a direct

threat on bats. The present information on the lower number of bats is according to the general tendency of numerical decreasing of all chiropteran species populations of Europe, because of the pesticide pollution from the '70s.

In occurrence with typical species, *Pipistrellus pygmaeus* was identified, too. The number of individuals of this last species is only 1/10 comparing with *P. pipistrellus*. The ratio 1/10 between these two species was estimated after collecting, identification and counting of bat individuals hidden in a 3 – 3.5 m length crevice in the cave's wall. Under these circumstances the number of *Pipistrellus pygmaeus* individuals is minimum of 3,400, making this roost to be considered one of the most important roosts of Europe for the hibernation of this species and the second of Romania, considering its size, after Huda lui Păpară cave for mixed colonies (6 bat species) in hibernation.

Other species: *Rhinolophus ferrumequinum* (maximum 600 hibernating individuals); *Myotis myotis/oxynathus* – isolated individuals are not more than 170 individuals spread up to the all length of the investigated gallery. An unitary colony of *Myotis* sp. (approximately 2,000 individuals estimated in December 2002) was not found again at the end of hibernating period. We suppose the factors which determined the change of locations of colonies observed in December were the unusual length of winter with very low temperatures. The winter lasted until the end of April 2003. This applies to *Rhinolophus ferrumequinum*, *Miniopterus schreibersii*, *Pipistrellus pipistrellus* and *P. pygmaeus*.

Only 30 individual of *Nyctalus noctula* were directly observed. But considering the very large number of crevices and hidden places in the ceiling the number of Noctule is much larger. These places were not accessible, but we noticed movement around them, and dead specimens or skeletons were collected from the floor and cliffs. That is why we estimate this species with more than 1,000 individuals in this cave.

*Barbastella barbastellus* was also present in a low number (only 5 individuals) directly observed. The additional individuals could have been hidden in the halls of the cave's walls, inaccessible places for direct observations.

The results are not exhaustive because on one side some hidden spaces with bats might exist, on the other one, from the total of 11,123 m length of the cave only 850 m were surveyed, with only clearly visible bat colonies .

#### Conclusions

*Pipistrellus pipistrellus* is the dominant species in Șura Mare cave and *P. pygmaeus* approx. 1/10 (3,400) from the total number of individuals of these two species.

*Miniopterus schreibersii* was the second species (after *Pipistrellus*) with large colonies (counting about 3,500 individuals in December 2002). In the summer time, there were no nursery colonies. Trying to collect by net, only two specimens of *Pipistrellus pipistrellus* were found.

Species *Rhinolophus ferrumequinum*, *Myotis myotis*, *M. oxynathus*, *Barbastella barbastellus* and *Miniopterus schreibersii* are prior species with special status of protection according to the European Community's legislation. This is the reason why documentation for Șura Mare cave started in order to be declared a protected area.

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

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#### PEȘTERA ȘURA MARE (ROMÂNIA), CEL MAI IMPORTANT ADĂPOST CUNOSCUT PENTRU HIBERNAREA SPECIEI *PIPISTRELLUS PYGMAEUS* LEACH, 1825 (CHIROPTERA: VESPERTILIONIDAE)

#### REZUMAT

Din totalul lungimii Peșterii Șura Mare (11.123 m) au fost investigați, din punct de vedere chiropterologic, doar primii 850 m, de la intrarea principală. Autorii fac analogii cu peștera Huda lui Păpară, deoarece sunt asemănări în privința înălțimii și lățimii portalului, dar și în privința adăpostirii pentru hibernare a peste 76.000 lilieci (cf. Coroiu și colab., 2006), cu mențiunea că această din urmă peșteră a fost investigată în totalitatea ei.

În Peștera Șura Mare, *Pipistrellus pipistrellus* este specia dominantă (cu aproximativ 30.600 indivizi), iar *P. pygmaeus* a fost estimat la aproximativ 3.400 indivizi.

A doua specie din acest adăpost (cu 3.500 indivizi) a fost *Miniopterus schreibersii* care a cunoscut un declin drastic al populației în ultimii 50 de ani și trebuie să fie inclusă în programul național de monitorizare.

Alte specii prioritare (cf. legislației europene) sunt *Rhinolophus ferrumequinum*, *Myotis myotis*, *M. oxygnathus*, *Barbastella barbastellus*. Din acest motiv, autorii propun ca Peștera Șura Mare să fie declarată arie protejată.

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