

OBSERVATIONS ON THE BAT FAUNA (MAMMALIA: CHIROPTERA) OF ROȘIA MONTANĂ (ROMANIA)

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Abstract. The observation and identification of some bat species of the families Rhinolophidae and Vespertilionidae from Roșia Montană led to the completion of the list of the bat fauna, known from this locality, to a number of 12 species. This fact proves a certain state of the ecosystem complex from Roșia Montană, knowing that the bats are good indicators of the biodiversity state of an area. The bat species identified by the authors and added to the species list for Roșia Montană are: *Rhinolophus hipposideros*, *Myotis brandtii* and *Pipistrellus* (= *Hypsugo*) *savii*. *Rhinolophus hipposideros* is included in the Annex II of the Directive of Habitats, and it is a key species in the National Programme for Bat Monitoring.

Résumé. Les galeries des mines (destinées à l'exploitation ou à l'exploration géologique) des Monts Metaliferi (département Alba) peuvent offrir un bon refuge pour l'hibernation de quelques espèces de chauve-souris. Dans ce travail il s'agit de l'identification dans une galerie d'exploration géologique de l'espèce *Rhinolophus hipposideros*, qui n'a pas été mentionnée dans les précédentes investigations de la zone. En plus de cette espèce, qui est incluse dans l'Annexe II de la Directive des Habitats, quatre exemplaires de vespertilionides, appartenant aux espèces *Myotis myotis* (2 ex.), *M. brandtii* et *Pipistrellus* (= *Hypsugo*) *savii* ont été recueillis à la fin du mois de novembre 2010, étant trouvés morts dans le grenier de l'église gréco-catholique de Roșia Montană. Les deux dernières espèces sont signalées pour la première fois de la zone investiguée, ce qui fait monter la liste des chauve-souris, qui sont un bon indicateur pour la richesse de la biodiversité, à 12 espèces.

Key words: bat species, underground roosts, foraging habitats, Roșia Montană.

INTRODUCTION

Characteristics of the surveyed area

Locality Roșia Montană is in Transylvania, in the south-east side of the Apuseni Mountains of Romania, in Metaliferi Mountains (Fig. 1). These mountains are limited to south by the Mureș River (section between Alba Iulia and Căpruța), to north by the rivers Arieș and Abrud, to west by the Căpruța - Slatina de Mureș – Gurahonț corridor and to east by the Ampoi River Valley. From the administrative point of view, locality Roșia Montană belongs to

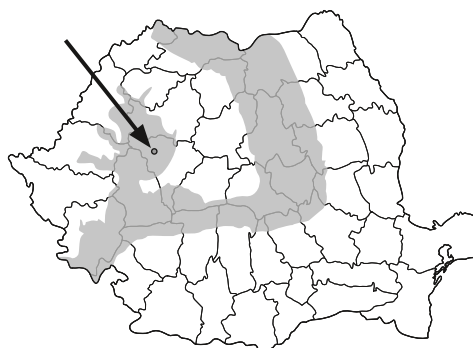


Fig. 1 - Geographic position (arrow) of Roșia Montană locality.

Alba county. Being a part of the “gold square” of the Western Carpathians, Roşia Montană is known for its gold-silver deposits, since antiquity. Gold exploitation from Roşia developed almost continuously since the 3rd – 1st centuries B.C., according to some French-Romanian archaeological studies (Cauuet et al., 2003). The geological context, of a remarkable diversity, determines not only the underground richness but also the landscape diversity. Therefore, the landscape is made by the diversity of the geological formations, existing an interpenetration of the volcanic formations with the sedimentary ones.

Volcanic formations are represented by Neogene volcanic and sub-volcanic bodies of dacite and andesite, represented by massifs of over 1000 m altitude, as Cărnic (with spectacular formations, as Piatra Corbului), Cetate, Orlea. Sedimentary formations created a soft relief, of hills and gentle slopes. The landscape of Roşia Montană surroundings has also an important anthropic element, because the method of gold ore extraction and processing in this area required an administration of waters, its hydrography being not so generous. Between 1752 and 1779, during the Habsburg Empire period, large hydrotechnical work for water accumulations, named by local people “tăuri” were made. So, Tăul Mare, Orlea, Corna, Țarina and Găuri appeared, which can be observed even now. The landscape resulted after geological processes, climate and anthropic activity has a special patrimonial value, especially from the point of view of the European Convention of Landscape, adopted in Florence in 2000 and ratified by Romania in 2002, by the Law 451.

Diversity of the ecosystems

A very diverse landscape means a mosaic of ecosystems, according to the “Landscape Ecology”, with specific structure and functions resulted from the spatial and functional interactions between different included ecosystems (see Turner, 1989). A large diversity of the ecosystems on a spatial scale, not very large (the present study focuses on a surface of 25 km²), presumes a large diversity of the ecological niches and, as a result, of the species of flora and fauna. The present study brings some new information on the diversity of the bat fauna and proposes a preliminary ecological interpretation of it.

If the mosaic of habitats present in Roşia Montană offers a diversity of foraging places for bat species, the presence of some anthropic elements can offer shelter or hibernating places. Therefore, some mine galleries (of exploitation of geological explorations) from the massifs from Roşia Montană locality represent a chance for the trogophilous fauna, for finding resting places during the day and for hibernation, and some older buildings of the locality are used by the chiropteran fauna as shelters for nursing colonies.

Usually, some bat species (*Nyctalus noctula*, *Vespertilio murinus*) are considered house or anthropophilous because they use the settling and their annexes for sheltering; others are considered forest species (*Myotis daubentonii*, *Eptesicus serotinus*), because they shelter mainly in tree hollows, but also in

the empty spaces left after branches break or under the bark; the species which prefer the caves (*Rhinolophus ferumequinum*, *R. hipposideros*, *R. mehelyi*, *Myotis myotis*, *M. brandtii*, *Plecotus auritus*, *Pipistrellus pipistrellus*), mine galleries, those of geological exploration, rock crevices are named cave species. Out of these three categories, most of the species roost in caves of anthropogenic galleries for hibernation, from where they spread in spring to other shelters, usually smaller and warmer, for forming breeding shelters. Also, there are cases with optimum temperatures for raising young in summer, through which thermal waters pass or spring; thermal waters offer them a high temperature all along the year. In most of the cases, the caves are left for the spreading of the hibernation colonies, the decreasing of the competition for food within a limited area and for being much closer to the feeding habitats, as diversified as possible. There are numerous papers on the distribution of bat species: Dumitrescu et al. (1962 - 1963), Valenciuc (1982), Decu et al. (2003), Borda (2001, 2002), Coroiu & Szántó (1996), Coroiu et al. (2007), Coroiu & David (2008), Reiter (2004), Ifrim & Valenciuc (2006) and others, referring to all bat species of the Romanian fauna or to punctual reports for a certain species from a certain roost.

By the present paper, we report the presence of some bat species in a gallery of geological exploration from Cârnic Massif (from the area of Roșia Montană locality) and in the loft of the Greek-Catholic Church from Roșia Montană.

MATERIAL AND METHOD

Between 27th and 29th of November 2010, one of the authors (Dorin Alexandru Pop) visited Roșia Montană and its surroundings – Cetate, Cârnic and Jig-Văidoaia massifs. During this trip, he investigated a gallery of geological exploration from Cârnic Massif, between the natural monument Piatra Despicață and Cârnicel Peak (Fig. 2). Then, outer temperature of the gallery was under 0°C, and a snow layer of about 15 cm. Investigated gallery was in the area 34 N, with the coordinates UTM 654863.573406485 and 5095992.170619755 and geographical coordinates 46°17'47"N and 23°07'40"E. For finding the last coordinates we used GPS Microsport Evidence 2010, and for temperature measuring we used a thermometer with alcohol.

In the gallery, two specimens of *Rhinolophus hipposideros*, in a latency state, were found and photographed. Also, other galleries of the Cârnic Massif were inspected, without going deeper. Guano was observed on the ceiling, without representing important accumulations, this thing showing their accidental use or that they were a passage to the hibernation places or nursery colonies.

On 28th of November 2010, the loft of the Greek-Catholic Church of the Roșia Montană locality was inspected in order to verify the presence of a nursery and/or hibernation colony. Location was chosen after the information got from a member of ARA Association, by which a project for the restoration of some buildings of the

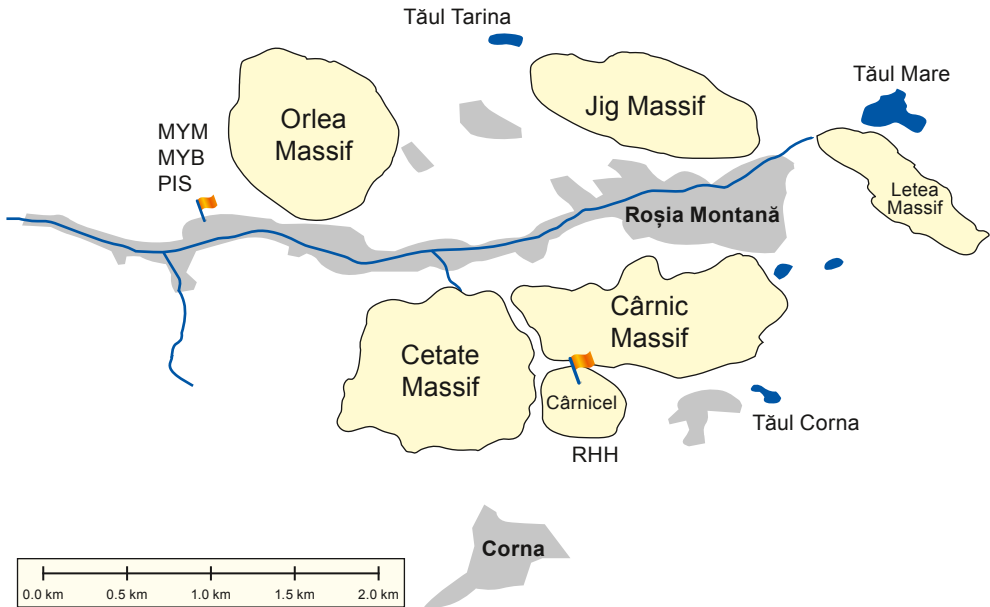


Fig. 2 - Localization of the identified bat species from Roșia Montană. (27-28.11.2010)

locality was carried out. Traces of a nursery colony were identified (guano in large quantities and bat bodies) and the bodies of four specimens were collected: two of *Myotis myotis*; one of *M. brandtii*; one of *Pipistrellus (=Hypsugo) savii*. The species identification was made in laboratory, using the binocular. The skull and dentition of the four bodies were preserved (at least partially), the last one being very important among the identification criteria. Dental formula of each individual was correlated with the forearm length.

RESULTS AND DISCUSSIONS

The choice for bat roosts is influenced by the environment conditions from the studied areas. Transylvania includes the Western Carpathians, with altitudes below 1900 m, as the Metaliferi Mountains where there is the Cârnic Massif. Caves, cracks of the rocks and mine galleries can offer good shelter for the cave bats. Optimum conditions refer to the lack of the air currents, which generates temperature and relative humidity fluctuations.

Family Rhinolophidae

Therefore, in the studied area, such conditions were found in a gallery of geological exploration, where *Rhinolophus hipposideros* was identified. The gallery is placed at 990 m altitude, in an area of birch and pine young culture, on the south-eastern slope of the Cârnic Massif, between Pietra Despicață and Cârnicel Peak. The entrance is directed towards Corna Valley – a mosaic of forest habitats,

balks, rocks (especially in the upper side, on the south-eastern slope of the Cărnic Massif), secondary lawns, greenlands, meadows, gardens and Corna tarn. In winter, the temperature does not fall below 10°C - 9°C in that gallery, and the wet walls maintain a relative humidity of 50 – 55%. After the single gallery entrance (Fig. 3) there is a decending “T”-shaped section of about 2 m, from where two asymmetrical ramifications start of about 3 m in the left ramus and of 5 – 6 m in the right one. The height of the left ramus gallery, where the two specimens of Lesser horseshoe bats were found, is of about 1.5 m. Location of the gallery entrance, chosen by *Rhinolophus hipposideros* for hibernation, in a young plantation of pine and birch can be correlated with the species preference of hunting in the bushes and young wood (Bontandina et al., 2002; Motte & Libois, 2002; Spitzenberger & Hutson, 2008). When the gallery was visited, only two individuals of *Rhinolophus hipposideros* (Fig. 4) were observed – species which was not reported from Roșia Montană, up to now.



Fig. 3 - In the geological exploration gallery close to Cărnicele Peak (Photo: D. A. Pop).



Fig. 4 - One of the *R. hipposideros* (Photo: D. A. Pop).

Information on the chiropteran fauna of Roșia Montană area base on two studies: „Studiu de condiții inițiale privind biodiversitatea” [“Study of initial conditions on biodiversity”] for achieving the Impact Evaluation on the Environment of the project of gold exploitation, requested by Roșia Montană Gold Corporation S.A. and carried on within the period May – August 2003 by Stantec Consulting Corporation, and the study „Specii de lilieci și statutul lor de protecție la Roșia Montană” [“Bat species and their protection status in Rosia Montană”], carried on within the period 9-11 September 2003 by the Association for Bat Protection of Romania (Nagy, 2003). Both groups of researchers visited the mining galleries and different habitats from Roșia Montană and identified the same 9 bat species.

According to these two studies, 7 of the 9 identified species shelter for hibernation in caves, mining galleries and tunnels. Two of the 7 species (*Myotis myotis* and *M. oxygnathus*) are included in the Annex II of the Directive of the Habitats (H.D. 92/43EEC). In the same annex, all 5 Rhinolophidae species of the Romanian fauna are included. Therefore, to the bat species listed in the Annex II of the ECHD, previously reported for Roşia Montană, a third species is added - *R. hipposideros*, by this study. These three species are also included in the Annex no. 3 of the Emergency Decree no 57/20th of June 2007 of national legislation on the regime of the protected areas, of conservation of natural habitats, of wild flora and fauna. The species included in the Annex 3 need the designation of the special conservation areas, if they meet the requirements on the population livestock and their representativeness for their national distribution range. In the Annex no 4 of the same document, all bat species of Romania which need strict protection are listed.

R. hipposideros is considered a thermophilic stenothermal species (Crucitti & Cavalletti, 2002), but the presence of some roosts with favourable microclimatic conditions (with a temperature varying between 2 - 13°C) allowed it the distribution in latitude, up to the southern Poland (Wegiel & Wegiel, 1996; Wołoszyn, 1976, 2001). On the other hand, in Poland it is considered a rare species, because of the complex pollution forms as well as because of the habitat fragmentations and damages (Stebbing et al., 1988) – the reason why it vanished from Holland, Belgium and north-western Boemia along the last 50 years (Jacobs et al., 1957).

In Romania, it is a widespread species, but without forming colonies of hundreds of individuals. Also in Romania, it is considered species in decline (Eurobats Report of Impl. of Agreem. in Ro. 2008). The leaving of the hibernation roosts (caves, tunnels, mine galleries, rock cracks) and the installation in church steeples, in attics and event under the house eaves from rural localities is due to the sex separation, on the one hand, females creating maternal colonies, and males grouping separately on the other hand, both types of colonies increasing their proximity to and for a better use of the foraging habitats, partially avoiding the competition for food with the permanent cave species. As regards this species, it is not about migrations, because the seasonal travels of the individuals from a type of shelter to another are made on distances of only 3 - 5 km.

It has to be mentioned that not all exploitation galleries or those of geological exploration from Roşia Montană are proper for sheltering bats, because many of them are connected to a large gallery net, coal pits and faces, situated in several levels and with several access possibilities, this aspect creating some air currents not favourable to hibernation. But fissures or pockets might be present where the necessary conditions for roosting of some species exist. In this respect, an indication is represented by guano on the floor of some galleries from Cârnic Massif. Therefore, we recommend to carry on these studies in order to identify new hibernation locations or summer roosts of the bat species from Roşia Montană.

Family Vespertilionidae

As it was mentioned before, from the attic of the Greek-Catholic Church of Roșia Montană locality the bodies of four individuals of three different species were collected: *Myotis myotis* (two individuals), *M. brandtii* – one individual, and *Pipistrellus* (= *Hypsugo*) *savii* – one individual (Fig. 5). If *Myotis myotis* was identified also by the two referential studies for Roșia Montană, *M. brandtii* and *Pipistrellus* (= *Hypsugo*) *savii* are new species, not reported till now for this location from Romania.



Fig. 5 - Mummified bats from Roșia Montană locality: left – *Myotis myotis*; middle – *M. brandtii*; right – *Pipistrellus* (= *Hypsugo*) *savii*.

Although the conservation state of the four bodies is not good, we could examine the dental formula and could measure (without an important error), the forearm length. Therefore, for the two individuals of *M. myotis*, the dental formula was: $I = 2/3$; $C = 1/1$; $Pm = 3/3$; $M = 3/3 \times 2 = 38$. The length of the forearms was of 54, and respectively 55 mm.

As regards *M. brandtii*, the dental formula was: $I = 2/3$; $C = 1/1$; $Pm = 3/3$; $M = 3/3 \times 2 = 38$, and the forearm length = 51 mm.

Finally, for *Pipistrellus* (= *Hypsugo*) *savii*, dental formula was: $I = 2/3$; $C = 1/1$; $Pm = 2/2$; $M = 3/3 \times 2 = 34$, and the forearm length = 38 mm.

It has to be remarked the advanced degree of wear, excepting one of the two specimens of *M. myotis* (Fig. 6 - left). The wear state of dentition, on the one hand, makes us to consider that all specimens were adult, and on the other one, allows the supposition according to which the death of those bats happened when they reached their maximum longevity. Some incisors and premolars remained acicular or were blunt till the neck (Fig. 6 – middle and right).

If for *M. myotis* it is known that in the northern part of the range it is an anthropophilous species, in summer preferring the artificial shelters (Hutson et al., 2008), and in the southern part of its range, it is a cave species, in the Romanian territory it prefers the underground roosts, both for hibernation and for nursery



Fig. 6 - Dentition to: *Myotis myotis* (left); *M. brandtii* (middle); *Pipistrellus (=Hypsugo) savii* (right).

colonies. But sometimes, in summer, it can stay in the building attics, as the specimens of the present study. As regards *M. brandtii*, it is known its preference for the artificial shelters, nesting in the spaces between the root boarding and sheet or between laths and tiles – inaccessible dark places. As foraging habitats, it prefers the mixed forests or the deciduous ones, with pools near them, and as hibernation roosts, it prefers the caves, basements and mine galleries (Boye (2004); Boye et al. (1999); Ifrim & Valenciu (2006); Nagy et al. (2005)). So that, nursery roosts are left in autumn, when mixed colonies gather again for mating, and then withdraw in caves or galleries for hibernation. At the same time, the species is known as an occasionally migratory one (Hutterer et al., 2005 in Hutson et al., 2008), seasonal trips being of 200 – 250 km sometimes. That is why, we have to take into account the habit of the individuals of changing the hibernation places every year, when estimating the populations of *M. brandtii*; the results of the observations made during the same period, for 2 - 3 years, may be closer to the real tendencies of the populations of this species.

Pipistrellus (=Hypsugo) savii was reported in Romania only from 2 localities: the cave from Canaraua Fetii, from Dobrogea (Murariu, 2005; Murariu et al., 2009) and that from Baziaș, in Banat (Barti, 2005). At present, it has a population estimated at less than 100 specimens for Romania (Murariu, 2005). For hunting, it prefers the forest belts, lawns and wetlands, but sometimes the areas of public lighting in rural localities; it hibernates in rock crevices, buildings, and rarely under the old tree bark or in underground habitats (Hutson et al., 2008).

If we have to compare the number of the bat species in Roșia Montană, which reaches now 12, with the number of the bat species of the entire region of Moldavia, which reaches 19 (Ifrim & Valenciu, 2006), or of Romania, which reaches 34 (Murariu, unpubl.), or of Europe, which reaches 45 species (Nagy et al., 2005), a very high diversity of bat species results for a relatively small surface (the surface of the Roșia Montană commune is of 4161 ha). Further on, we present a synoptic table of the bat species from Roșia Montană, with their conservation status in international conventions, European and national legislation and their priority in the Programme of the Monitoring National Strategy of chiropteran fauna.

Table 1

Bat species of Roșia Montană, their national conservation priority and their conservation status.

No.	Species	National priority	Conserv. statute*	Bern Conv.	Bonn Conv.	ECHD	OUG 57/2007
1	<i>Rhinolophus hipposideros</i> **	H	Vu	AII	AII	AII, AIV	3A, 4A
2	<i>Myotis myotis</i> **	M	En	AII	AII	AII, AIV	3A, 4A
3	<i>Myotis oxygnathus</i>	M	En	AII	AII	AII, AIV	3A, 4A
4	<i>Myotis nattereri</i>	M	En	AII	AII	AIV	4A
5	<i>Myotis daubentonii</i>	L	Cr En	AII	AII	AIV	4A
6	<i>Myotis brandtii</i>	L	En	AII	AII	AIV	4A
7	<i>Eptesicus serotinus</i>	L	Vu	AII	AII	AIV	4A
8	<i>Plecotus austriacus</i>	L	En	AII	AII	AIV	4A
9	<i>Plecotus auritus</i>	L	Vu	AII	AII	AIV	4A
10	<i>Nyctalus noctula</i>	L	-	AII	AII	AIV	4A
11	<i>Pipistrellus pipistrellus</i>	L	-	-	AII	AIV	4A
12	<i>Pipistrellus savii</i>	L	Vu	AII	AII	AIV	4A

National priority (H = high; M = medium; L = low)

* = According to the Red Book of Romanian Vertebrate.

** = Key species for the National Bat Monitoring Programme.

Vu: vulnerable species; En: endangered species; Cr En: critically endangered species.

As it is known, dimensions, form and space/fragments diversity of a landscape influence the abundance patterns of the species (Turner, 1989). Therefore, if on a reduce surface (from the landscape ecology point of view, at a small scale) we have more then a third of the bat species present in the Romanian fauna, that means that the landscape is very diverse and offers some proper habitats.

At the same time, a large diversity of the bat species may prove us a high biodiversity, knowing that the bats are good biodiversity indicators, demonstrating the species diversity and richness in a certain area (Jones et al., 2009). Also, due to their position within the trophic chain, to their diverse food and their sensibility to pollution and habitat changing, bats are considered ecological indicators (they can offer a perspective on the ecological processes) and of environment (they can be used as indicators for a series of impact factors on environment (cf. Jones et al., 2009). Basing on these observations we postulate the presence of a rich trophic network within the area of Roșia Montană commune.

Conclusions

General context of the country and of the continent is that of population numerical diminishing of most of the bat species, in the same tendency joining the bat fauna of the Apuseni Mountains. National monitoring programmes of the Transylvanian bat species released a situation of these species, pointing out their faunal and protective importance.

When visiting Roșia Montană locality and its surrounding, another three bat species were reported (*Rhinolophus hipposideros*, *Myotis brandti* and *Pipistrellus savii*), their local list reaching now 12 bat species. This large diversity of bat species may indicate a high diversity of the habitats, a relative good state of their conservation (excepting lotic ecosystems, knowing the heavy metal pollution of the tributaries of Roșia stream), and a large diversity of the floral and faunal species, this thing requiring the inclusion of this area in a coherent programme of biodiversity conservation.

OBSERVAȚII ASUPRA FAUNEI DE LILIECI (MAMMALIA: CHIROPTERA) DE LA ROȘIA MONTANĂ (ROMÂNIA)

REZUMAT

Galeriile miniere (de exploatare sau de explorare geologică) din Munții Metaliferi (județul Alba) pot fi un bun refugiu pentru hibernare, cel puțin pentru unele specii de lilieci. În acest articol este vorba despre identificarea într-o galerie de explorare geologică a liliacului mic cu nas potcoavă - *Rhinolophus hipposideros*, neraportat cu ocazia investigațiilor anterioare efectuate în zonă. Pe lângă această specie, care figurează în Anexa II a Directivei Habitare, au mai fost colectate la sfârșitul lunii noiembrie 2010, cadavrele a patru exemplare de vespertilionide, aparținând următoarelor specii: *Myotis myotis* (2 ex.), *M. brandtii* și *Pipistrellus (=Hypsugo) savii*, din podul bisericii greco-catolice din Roșia Montană. Ultimele două specii sunt la prima semnalare din zona cercetată. Pe baza acestor rezultate privind fauna de lilieci reiese faptul că biodiversitatea locală este bogată și încă într-o stare bună de conservare, de unde nevoia continuării documentării științifice și în privința altor specii de interes comunitar, în vederea propunerii de includere a ecosistemelor de la Roșia Montană într-un program coerent de conservare a biodiversității.

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