Contributions to the knowledge of the bats' fauna in the Rodna Mountains National Park

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Abstract

During the period 2004-2017, 20 species of bats were identified in the Rodna Mountains National Park through direct observations from the cave visits and the use of monitoring using mixed bat detectors (heterodines with frequency division and expansion time) and chicropterological nets placed in forest and aquatic habitats. Of the 20 species of bats in the Rodna Mountains, one is included in the category of vulnerable species (VU), 3 species in the moderate threat category (NT). The inventory of bats species has increased from 14 to 20 species through research carried out with the support of the Rodna Mountains National Park Administration, but the number of species in the Rodna massif may increase in future studies.

Keywords: lilieci, peşteri, protejat, inventar

Introduction

The bats study was carried out during the period 2004-2017 in Rodna Mountains National Park, the second national park in the country, with an area of 47.202 ha. The importance of this protected area is due both to the geology and geomorphology of the mountains and to the presence of many species of fauna and flora, endemites and glacial relics.

The Rodna Mountains, which show the highest altitudes in the Eastern Carpathians (Pietrosu Peak – 2.303 m, Inău Peak 2.279 m, Inăuţ Peak 2.222 m), are located in the northern part of Romania. Being included in the Nordic group, also known as the Carpathians of Maramureş and Bucovina, these mountains dominate the landscape, with the highest level differences in the Maramureş Depression, located to the north.

From an administrative point of view, the park extends in the counties of Maramureş and Bistriţa-Năsăud. The Rodna Mountains National Park does not include the entire chain of the Rodna Mountains but only a part of them. From the West to the East, along a main ridge of about 55 km (from Şetref to the Rotunda), and from North to South, on a 25 km length, from Prislop Pass to Valea Vinului - Bistriţa-Năsăud county. From the administrative point of view,

the park area is spread over the districts of Bistriţa-Năsăud (80%) and Maramureş (20%), being surrounded by 17 neighboring communes (fig.1).

On the territory of Romania there are 32 species of bats, thus representing one of the most diverse bats fauna in Europe. The caves in our mountains shelter some of the largest colonies of bats on the continent, with two colonies that can cross the threshold of 100.000 individuals. Building bridges can shelter thousands of colonies, and in old forests they hunt bats that prefer these unique habitats (Gheorghiu et al., 1999, Valenciuc, 2002).

By their special biology, bats play multiple roles in ecosystems, keeping control of the size of the populations of atropes feeding them, and by flying over long distances, they help maintain flora diversity by spreading seeds, pollination. At the same time, bats are species that are indicative of ecosystem health, suffering rapid changes in the population as a result of changes in food abundance and sensitivity to changes occurring in feeding habitats or in shelters (Csaba&Farkas, 2010).

Fig. 1 Research area - Rodna Mountains National Park

The fauna of bats in the Rodna Mountains National Park is poorly known, with rising quotes about the presence of species in these ecosystems.

Materials and methods

The study consists of observations made over 13 years in the Rodna Mountains National Park area. The methods used consisted in direct observations and the identification of species in the massive caves (Cobăşel, Baia lui Schneider, Laptelui, Speranţei, Grota Zânelor, Arcaşilor lui Ştefan cel Mare etc., Goran, 1982), capturing with the help of chiropterological nets acquired through the project "Conservati*ve management measures of the biodiversity in the Rodna Mountains National Park* "implemented through POS Mediu Program, gathered in various forest and aquatic habitats (mountain valleys, streams, lakes, ponds, trout).

Another method used was ultrasound-based identification using 5 combined ultrasound detectors (heterodine, frequency division and time extension, eg. Peterson D-1000X Bat Detector). Some of the bioacoustic observations were made on during field trips on the forest roads of the Rodna Mountains National Park, with ultrasound detectors with mobile-time expansion.

The transects at a steady speed of about 24 km/h. The detector records a sequence of 0,3 s every 4 s of the sequence at approximately 24 m. After each sequence the recorded sound was extended ten times to decrease its frequency to a value that can be perceived by the human ear . Extended sound was recorded on a minidisc. Each transect has about 30 km, 90 minutes of extended records. Simultaneously with ultrasound, every 15 m was recorded with GPS, geographic coordinates, altitude and distance to the starting point of each registered individual. The results were processed with GIS software, quantitative geological and ecological parameters (IKA, AR, density, frequency etc.) were calculated. The specialized software used for sonogram analysis was BatSound, BatScan and Species Keys (Pocora & Pocora, 2012, Russ, 2012).

Data on the chiroptera fauna in the Rodna Mountains area and its surroundings were published by: Frivaldszky (1875), Szilagyi (1876), L. Méhely (1910), J. Paszlavszky (1918), I. Călinescu (1931), D. Margareta, D. Jana, O. Traian (1963), G. Ardelean (1993), D. Murariu, N. Răduleţ (1997), D. Ştefănescu (1998), Chiş V. and Manole M. C.&A. Cosma A. (2012).

Other materials used were: GPS units, mechanical and electronic measuring equipment, measuring cloth bags, wire and leather gloves, electronic scales and Pesola.

Results and discussions

Between 2004 and 2017, 20 species of bats were identified in the Rodna Mountains National Park and its surroundings (Table 1). Species identification was performed with the help of bat determiners (Csaba Jere, Farkas Szodoray-Parady, 2010) and ultrasound analysis (Pocora & Pocora, 2012, Russ, 2012).

Table 1. List of species of bats identified in the Rodna Mountains National Park and the habitats of presence

No.	Species	Summer habitat	Winter habitat		
			Forests	Caves	Atticks
1	*Rhinolophus ferrumequinum* (Greater horseshoe bat)	Forests, caves, mines, atticks		x	
2	*Rhinolophus hipposideros* (Lesser horseshoe bat)	Forests, caves, mines, atticks		x	
3	*Barbastella barbastellus* (Western Barbastelle)	Tree trunks, forests, caves		x	
4	*Myotis bechsteini* (*Bechstein's Myotis*)	Tree trunks, forests	x	x	
5	*Myotis blythi* (Lesser mouse-eared bat)	Forests, caves, mines, atticks	x	x	x
6	*Myotis myotis* (Greater mouse-eared bat)	Forests, caves, mines, atticks	x	x	x
7	*Myotis daubentonii* (Daubenton's bat)	Tree trunks, near the water, atticks		x	
8	*Myotis mystacinus* (Whiskered bat)	Forests		x	x
9	*Myotis dasycneme* (Pond bat)	Near the water, forests		x	

No.	Species	Summer habitat	Winter habitat		
			Forests	Caves	Atticks
10	*Myotis nattereri* (Natterer's bat)	Forests, under the tree bark		x	
11	*Myotis emarginatus* (Geoffroy's bat)	Forests		x	
12	*Pipistrelus pipistrelus* (Common pipistrelle)	Atticks, forests		x	
13	*Eptesicus serotinus* (Serotine bat)	Atticks, houses		x	x
14	*Eptesicus nilsonii* (Northern bat)	Atticks, buildings		x	
15	*Vespertilio murinus* (Parti-coloured bat)	Buildings, under the tree bark, forests	x	x	
16	*Nyctalus noctula* (Common noctule bat)	Forests, under the bark tree	x		x
17	*Nyctalus leisleri* (Lesser noctule bat)	Forests, under the bark tree	x		
18	*Nyctalus lasiopterus* (Giant noctule bat)	Forests, under the bark tree	x		
19	*Plecotus austriacus* (Big-eared bat)	Atticks, forests		x	x
20	*Plecotus auritus* (Brown long-eared bat)	Forests, under the bark tree		x	

The basic measurement used for all bat species is the forearm length (LA), supplemented for certain species with finger length 5 (D5) and finger 3 (D3). Additional measurements are: thumb length (D1), tibia length (Tib), foot length (LP). In some species, ear or tragus measurements are also required (ear length - long, ear width - latU, tragus length - lungTr, tragus width - latTr).

Most species of bats in the Rodna Mountains National Park hibernate in caves, respectively 85% of the inventory species, 35% of the species identified hibernate in forest habitats, in scrub or under tree bark.

The areas investigated based on the ultrasounds were: Valea Vinului (BN), Valea Gagiului (BN), Valea Bistriţei Aurii (SV), Valea Anieşului (BN), Valea Cobăşelului (BN), Valea Rebra (BN), Valea Parva (BN), Valea Strâmba (BN), Valea Pietroasa (MM), Valea Repedea (MM), The Izvoru lui Dragoş (MM), Valea Izei (MM) Valea Nichitaş (BN), Valea Someşului Mare (BN).

Habitats investigated with regard to the presence of bats and the identification of the species of chitropheres are presented in Table 2. Among the most common species in the Rodna Mountains are *Myotis myotis* and *Eptesicus serotinus*.

Some valleys with a large diversity of ecosystems include many species of bats, for example the Anieş Valley inhabits about 70% of the species present in the massif. The explanation is that the Anieş Valley is the largest basin in the Rodna Mountains and contains the widest variety of ecosystems, including decommissioned mines and field constructions. Also, the Valea Vinului sees over 55% of the bats species present in the Rodna Mountains, because besides the diversity of ecosystems (mixed forests and conifers, limestone rocks, valleys), there are also a large number of decommissioned mining galleries (over 30) which is shelter for many species of bats.

Table 2. Habitats investigated for the presence of bats in the Rodna Mountains National Park

No.	Species	Investigated habitats														
		Valea Vinului	Valea Anieşului	Valea Izei	Valea Gagiului	Valea Bistriţei Aurii	Valea Cormaia	Valea Cobăşel	Valea Rebra	Valea Parva	Valea Strâmba	Valea Bila	Valea Lala	Valea Peitroasa	Valea Repedea	Valea Someşului Mare
1	*Rhinolophus ferrumequinum*	x	x				x									
2	*Rhinolophus hipposideros*	x	x							x						x
3	*Barbastella barbastellus*	x						x								
4	*Myotis bechsteini*		x													x
5	*Myotis blythi*						x	x								
6	*Myotis myotis*	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7	*Myotis daubentonii*	x	x		x											
8	*Myotis mystacinus*	x				x				x						
9	*Myotis dasycneme*	x	x													
10	*Myotis nattereri*		x													
11	*Myotis emarginatus*		x													
12	*Pipistrelus pipistrelus*		x				x				x			x		
13	*Eptesicus serotinus*	x	x	x		x	x	x		x	x		x		x	x

No.	Species	Investigated habitats														
		Valea Vinului	Valea Anieşului	Valea Izei	Valea Gagiului	Valea Bistriţei Aurii	Valea Cormaia	Valea Cobăşel	Valea Rebra	Valea Parva	Valea Strâmba	Valea Bila	Valea Lala	Valea Peitroasa	Valea Repedea	Valea Someşului Mare
14	*Eptesicus nilsonii*		x				x									
15	*Vespertilio murinus*													x		
16	*Nyctalus noctula*	x	x			x				x					x	
17	*Nyctalus leisleri*				x											
18	*Nyctalus lasiopterus*	x														
19	*Plecotus austriacus*		x		x		x				x			x		x
20	*Plecotus auritus*	x	x		x			x				x			x	x

Regarding the status of protection of the species of bats in the Rodna Mountains, most of them appear on various protective lists (Table 3).

Table 3. Species of bats in the Rodna Mountains National Park, respectively international and national legislation regarding their protection. Roman numerals refer to the number of annexes in the respective legislation, the symbol "+" denotes the presence of the respective species in that normative act. According to IUCN: NT = near threatened, LC - low concern, DD - insufficient data (deficient data), VU - vulnerable.

No.	Species	Law 13/1993	Law 13/1998	Law 90/2000	Law 49/2011	OM 566/2014	Red List IUCN
1	*Rhinolophus ferrumequinum*	II	II	+	II, IV	+	LC
2	*Rhinolophus hipposideros*	II	II	+	II, IV	+	LC
3	*Myotis daubentonii*	II	II	+	IV	–	LC
4	*Myotis dasycneme*	II	II	+	II, IV	–	NT
5	*Myotis mystacinus*	II	II	+	IV	–	LC
6	*Myotis nattereri*	II	II	+	IV	–	LC
7	*Myotis emarginatus*	II	II	+	II, IV	–	LC
8	*Myotis bechsteinii*	II	II	+	II, IV	+	NT
9	*Myotis myotis*	II	II	+	II, IV	+	LC
10	*Myotis oxygnathus/blythi*	II	II	+	II, IV	+	LC
11	*Nyctalus noctula*	II	II	+	IV	–	LC
12	*Nyctalus lasiopterus*	II	II	+	IV	–	VU
13	*Nyctalus leisleri*	II	II	+	IV	–	LC
14	*Eptesicus serotinus*	II	II	+	IV	–	LC

No.	Species	Law 13/1993	Law 13/1998	Law 90/2000	Law 49/2011	OM 566/2014	Red List IUCN
15	*Eptesicus nilssonii*	II	II	+	IV	–	LC
16	*Vespertilio murinus*	II	II	+	IV	–	LC
17	*Pipistrellus pipistrellus*	II	II	+	IV	–	LC
18	*Plecotus auritus*	II	II	+	IV	–	LC
19	*Plecotus austriacus*	II	II	+	IV	–	LC
20	*Barbastella barbastellus*	II	II	+	II, IV	+	NT

The 20 species of bats from Rodna Mountains National Park are protected by a series of laws. This protection or legislation applies whether colonies or specimens are inside or outside the protected area. This legislation specifically refers to:

- Law no. 13 of 1993, by which Romania adheres to the Convention on the Conservation of Wildlife and Natural Habitats in Europe (the Berne Convention): Romania, as a signatory party, undertakes to take the necessary measures to protect the wildlife and biotopes characteristic of animal species and plants mentioned in the annexes to the law. All species of bats in our country are listed in Annexes II and III as species strictly protected or protected.
- Law no. 13 of 1998 for the accession of Romania to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention): As a signatory to this Convention, Romania has an obligation to act in favor of migratory species and to ensure the favorable conservation status of these species . The species of bats in Romania, as well as in the rest of the continent, being migratory animals with unsatisfactory conservation status, fall under the scope of this law and are included in Annex II.
- Law no. 90 of 2000 for the accession of Romania to the Agreement on the Conservation of Bats in Europe (EUROBATS Agreement). Among other things, the signatory parties have the following basic obligations regarding the shelters and habitats used by bats, including the respect of additional resolutions adopted by the signatory parties as follows: Article III (1). Each Party shall prohibit the capture, possession or deliberate killing of bats, except as permitted by its competent authority; Article III (2). Each Party will identify those sites within its jurisdiction, which are important for conservation status, including the shelter and protection of bats. Considering, as the case may be, economic and social considerations, each party will protect these sites from destruction or disturbance. In addition, each Party shall endeavor to identify and protect from the destruction or disturbance of important feeding areas for bats; Article III (3). When deciding which habitats are to be protected for general conservation purposes, each Party will give due importance to habitats that are important for bats; Article III (4). Each Party will take appropriate action to promote the conservation of bats and promote public awareness of the importance of bat conservation; Article III (6). Each Party shall take such additional measures as it deems necessary to protect the bat populations that it identifies as being at risk, and shall report on the measures taken, in accordance with Art. 6; Article IV (1). Each Party shall adopt and implement legal and administrative measures as may be necessary to ensure the effectiveness of this Agreement; Article IV

(2). The provisions of this Agreement shall in no way affect the right of the Parties to adopt stricter conservation measures for bats.

- In addition to the EUROBATS agreement and Law 90/2000, resolutions were developed and accepted in the meetings of the signatory states, specifying aspects regarding the way of protection of bat species, namely: Resolutions 4.3/2003 and 7.6/2014, regarding guidelines on the protection and management of underground habitats identified as important for bats; Resolution 4.6/2003 and 5.5/2006 on capture and research of bats; Resolution 6.5/2010 on guidelines on bats' research ethics and methods applied to fieldwork.
- Law no. 49 of 2011 for the approval of Government Emergency Ordinance no. 57/2007 on the regime of protected natural areas, conservation of natural habitats, wild flora and fauna, for the purpose of applying the Council of Europe Directives 92/43/EEC and 79/409/EEC in the national legislation. Annex III to the Ordinance mentions the species for which conservation is required and special areas of conservation and special avifauna protection areas are required.
- Ministerial Order no. 656/2014 approving the Regional Action Plan for the management of the species of bats *Rhinolophus ferrumequinum, Rhinolophus hipposideros, Myotis myotis, Myotis oxygnathus, Myotis bechsteinii, Barbastella barbastellus, Miniopterus schreibersii.*
- In addition to the legislative aspects, the protection of bats in Romania must take into account the existence of the IUCN Red List, developed for each species, with the analysis of the threat factors, respectively resulting in the categorization of the species in a threat category and indicating the trend of the populations.

Conclusions

Between 2004 and 2017, 20 species of bats were identified in the Rodna Mountains National Park through direct observations from the cave visits and the use of monitoring using mixed bat detectors (heterodines with frequency division and expansion time) and chicropterological tabs located in forest and aquatic habitats.

From 20 species of bats in the Rodna Mountains, one is included in the category of vulnerable species (VU - *Nyctalus lasiopterus*), 3 species in the moderate threat category (NT), 7 species of communitarian interest (*Rhinolophus ferrumequinum, Rhinolophus hipposideros, Barbastella barbastellus, Myotis bechsteini, Myotis blythi, Myotis dasycneme, Myotis myotis*).

The inventory of bats species has increased from 14 to 20 species through research carried out with the support of the Rodna Mountains National Park Administration, but the number of species in the Rodna massif can increase in future studies.

At the same time, a great diversity of species of bats in the Rodna Mountains proves a high level of biodiversity, knowing that bats are good indicators of biodiversity, demonstrating the diversity of species.

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