BATS (CHIROPTERA) FROM DOBROGEAN KARSTIC SHELTERS

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Abstract. Frequent karstic structures in Dobrogea should be safety shelters for bat fauna. In spite of national and international regulations to protect Chiroptera, today, caves, mining tunnels, any crevices in limestone as well as tree hollows and garrets are checked by curious people and bat colonies or isolated individuals are disturbed. We noticed that caves with bat colonies of thousands of individuals in mid of 20th century, in first decade of the 21st century decreased to only several hundred or less. Because of bat's biological role in control of pest insects and as important bioindicators of the environmental quality, these mammals must be protected. Collating literature with personal data there are 25 bat species in all Dobrogea. Out of 22 bat species reported by us, 12 are endangered, 5 – vulnerable and 5 species are at risk with slowly decreasing numerical populations and therefore are protected by national and international regulations.

Key words: karst shelters, bat colonies, risk of populations, regulations.

1. INTRODUCTION

Although the Dobrogean Mountains from South-East of Romania (Fig. 1) were generated by the Paleozoic Hercynian orogeny, the caves in the area are in the sedimentary layers of Mesozoic and Neozoic age. Referring to the Dobrogean karst and its features (NITZU, 2001), similarly to karst formations on the entire planet, they have resulted under the action of acidic water on the mother-rock (limestone or dolomite), starting with thin cracks, which in time are becoming wider and deeper. As much as the water drainage speed is increasing, the rock erosion is increasing too. In addition to the most common carbonic acid, sulfuric acid is also an important factor in karstic erosion. When the karstification is on the surface lapies – a limestone pavement result. When karstification is underground, caves are formed.

Fig. 1. Localization of Dobrogea (orange color) – South-East of Romania (from: https://ro.wikipedia.org/wiki/Dobrogea).

With particular conditions (darkness, high degree of relative humidity – RH, relative constant temperature), caves are suitable refuges for many beings. Most of them originated from the surface and in time they adapted to the underground life. Two large parts of the Romanian Dobrogea are considered by geographers: Mountains of North Dobrogea and Southern Dobrogean Tableland. In both of them there are important microbiological, plant and animal communities. Biospeleologists consider three main categories of beings from caves: 1 – troglobionts – spend their entire life cycle within a cave and wouldn't be able to survive outside a cave; 2 – troglophilics – with a part of their life in caves, but with need to complete their cycle of life outside or to the surface (e.g., grasshoppers, centipedes, pseudoscorpions etc.); 3 – trogloxenes – visitors of caves only in one part of their cycle of life and the need to exit for another part of life (e.g., some reptile, bats etc.). Some reports on bat fauna from Romania date since the 19th century, but at the beginning of the 20th century a new era in bat research was opened by MATSCHIE (1901) and MÉHELY (1911). In the second half of the 20th century, scientists from "Emil Racoviţă" Institute of Speleology (from the Faculties of Biology – University of Bucharest, University of Iassy and of Cluj, "Grigore Antipa" National Museum of Natural History) studied bats all over the country. Dobrogea was investigated by DUMITRESCU *et al.* (1958), DUMITRESCU (1960), DUMITRESCU *et al*. (1962–1963), DUMITRESCU *et al.* (1965), BARBU (1960), VALENCIUC (2002). Those teams extended the research areas and reported bat species from almost all important karst structures from the south-east part of Romania. To the end of the 20th and in the 21st century new scientists reported important contributions to the bat fauna from Dobrogea: RĂDUEŢ (1994; 1996), NAGY *et al*. (2005), NAGY and POSTAWA (2010), DRAGU and BORISSOV (2011), IFRIM and POCORA (2007), POCORA and

POCORA (2011), MURARIU *et al*. (2016), MURARIU and GEACU (1998), MĂNTOIU *et al*. (2020) etc. However, mentioning above about three main categories of beings from caves, the bats are between trogloxenes. For some species, the nursery colonies and hibernation are safe in caves. But even those bats which are mostly domicolous or dwell in tree hollows are occasionally visitors of caves. Therefore, in this article (as the title is suggesting), we will refer to relations with karstic formations in Dobrogea, of all identified bat species.

2. MATERIAL AND METHODS

Because bats roost in hidden shelters and forage in diferent habitats (forests, cultivated areas, above ponds, around street lights etc.) the most common methods were observations, visits in caves, mining tunnels, tower of churches, garrets, cellars, checking tree hollows and mist-netting, mainly for ringing and immediately releasing marked individuals. After 2000 non-invasive methods to study bats appeared: listening and registration of chiroptera's ultrasounds with different devices such as Bat detectors with heterodyne (Pettersson D-940 and 980), Westec and Anabat (of two types), Ultra Sound Advice S-25 etc. Information on Dobrogean bats were gathered between 2007 and 2012.

3. RESULTS

Order **Chiroptera** Blumenbach, 1779 is represented in Dobrogea by 23 species. Data of POCORA and POCORA (2011), MĂNTOIU *et al*. (2020) and results of this article are about three species of Rhinolophidae Bell, 1836, and 19 species of Vespertilionidae Gray, 1821, and one species of Miniopteridae Dobson, 1875. According to MURARIU *et al.* (2016), in the Romanian fauna there are five rhinolophid species, but in the reported area they were registered only three of them: *Rhinolophus ferrumequinum, R. hipposideros* and *R. mehelyi*.

Fig. 2. Greater Horseshoe Bat (*Rhinolophus ferrumequinum*).

Fig. 3. Lesser Horshoe Bat (*R. hipposideros*).

Rhinolophus ferrumequinum (Schreber, 1774) – Greater Horseshoe (Fig. 2) was mostly observed and registered in the northern part of Dobrogea. It has a silky fur, of gray-brownish or smoky-greyish colour on the back and grey-whitish to yellowish-white ventrally. The upper saddle process is short and rounded or blunt. The lower process is somewhat smaller and when seen in profile it tapers to a point. From above, this lower process appears wide and rounded or blunt. The saddle edges are concave. For hibernating period it roosts in caves, in mining galleries and in any karstic crevices. For summer time, individuals leave the underground refuges and usually the nursery colonies are in house garrets, towers and in downstairs. The species is listed in Annexes II and III of Bern Convention (1997); Annexes II and IV – the EC Habitats Directive – Council Directive 92/43/EEC (1992) on the Conservation of natural habitats and of wild fauna and flora; Bat Agreement, London 1991 (EUROBATS since 1994); European Convention of Endangered Mammals, Strasbourg (1997). Low concern according to IUCN Red List. **N** = Law 90/10 May 2000 – Conservation of the Romanian bat species populations. Annexes No. 3 and 4A – Emergency Governmental Ordinance No. 57/29 June 2007. Vulnerable species, according to Red Book of Vertebrates from Romania/2005.

Rhinolophus hipposideros (Bechstein, 1800) – Lesser Horshoe Bat (Fig. 3) was observed and registered from entire Dobrogea. Individuals have tiny body with maximum length of 8 cm. They shelter in karstic areas, where the temperature is higher. When refuges are in localities, these bats prefer the attic of buildings. For winter, they choose warm places or at least shelters where the temperature does not decrease bellow 5ºC–6ºC. The Lesser Horseshoe Bat hibernates between September and April. Eating insects, the species' populations are important in control of pest insects for forests, orchards, gardens. Unfortunately, its populations are continuously decreasing and therefore the species is in Appendixes II and III of Bern Convention, Annexes II and IV of EC Habitat Directive. According to Romanian legislation, the species is protected by Romanian Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as a vulnerable species.

Fig. 4. Mehely's Horseshoe Bat (*Rhinolophus mehelyi*).

Fig. 5. Northern Bat (*Eptesicus nilssonii*).

Rhinolophus mehelyi Matschie, 190 – Mehely's Horseshoe Bat (Fig. 4) – was observed only in the southern part of Dobrogea. It has a medium size and the total length is not beyond 9 cm. Being a trogloxenic bat, it has shelters in caves and in underground tunnels, usually near the running waters. The foraging habitats are close to the place of shelters. Therefore, we can say it is a very sensitive species to the anthropic pressure and pesticide pollution and must be protected. It is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Eptesicus nilssonii (Keyserling et Blasius, 1839) Northern Bat (Fig. 5) was reported only from the southern part of Dobrogea. Individuals are of a medium size bats, with a total length of 85–113 mm. They prefer open areas with shrubs and isolated leafy trees. Nursery colonies and hibernation shelters can be in caves, in stone crevices, in attics and garrets with temperature of 2°C–6°C. Foraging areas should be as natural as possible, because the species is a sensitive bioindicator, suffering in case of poor environmental quality. Any kind of pollution can determine it to leave the area for a more natural habitat. The main food consists of insects. Populations of this bat are numerically decreasing. Therefore, it is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Fig. 6. Serotine Bat (*Eptesicus serotinus*).

Fig. 7. Bechstein's Bat (*Myotis bechsteinii*).

Eptesicus serotinus (Schreber, 1774) – Serotine Bat (Fig. 6) – has a large distribution all over Dobrogea. It is of a larger size than the previous species, the total length being up to 14 cm. It is an example of how a primary silvicolous species adapted to be domicolous and occasionally it enters in the caves in the southern Dobrogea. It was observed in gardens, in parks, along the roads, but also in skirts.

It is seriously involved in biological control of pest insects. Frequently disturbed in nursery colonies its populations decreased drastically. It is protected, being in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as a vulnerable species.

Myotis bechsteinii (Kuhl, 1817) – Bechstein's Bat (Fig. 7) – lives mostly in the southern Dobrogea. It has a rufous muzzle. Ears and wing membrane are of gray-brownish colour. Body length is below 10 cm. It is a silvicolous species, but it was seen in gardens, orchards and in parks in localities, mostly as flying solitary individuals. In shelters, it mixes with other bat species, but only in groups of a couple of individuals and not in clusters. The foraging flights catch mostly moths, mosquitos, beetles, but they were also observed picking up araneids, opilionids, chilopoda from solid supports or even from the soil. Thus, the species is important to control populations of different pest invertebrates. The lack of roosts and disturbance of shelters in attics and home-annexes as well as the pressure of domestic cats on nursery colonies determine continuous numerical decrease of its populations. Bechstein's Bat is protected, being in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Fig. 8. Lesser Mouse-eared Bat (*Myotis blythii*).

Fig. 9. Daubenton's Bat (*Myotis daubentonii*).

Myotis blythii (Tomes, 1857) – Lesser Mouse-eared Bat (Fig. 8) – can be observed in the southern Dobrogean karstic shelters. It has fur with gray-whitish color of hairs at their base. It is frequent in karst formations or in warmer areas with pastures around and in localities, looking for warm attics and church towers with permanent positive temperature. Its prey is hunted in flight, but occasionally was seen picking up some invertebrates from the soil and from tree branches. Wild and domestic carnivores and prey birds are its most important predators. As the

nursery colonies were highly in localities the species become endangered. Therefore, the Lesser Mouse-eared Bat is protected, being in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as mentioned above, an endangered species.

Myotis daubentonii (Kuhl, 1819) – Daubenton's Bat (Fig. 9) – from the southern Dobrogea is a small vespertilionid with the total length below 10 cm. The back fur is of brown-grayish color and the belly is gray-silvery. Ears and wing membrane are gray-brownish. Forest, parks, gardens close to a running water are its most preferred habitats. For hibernation it shelters in tree hollows, in caves, in underground tunnels, in cellars and in old buildings with fissured walls. Foraging area are water surfaces and it flies at only 10–20 cm above, hunting mosquitos, trichopterans, occasionally young fish. All the prey is consumed in flight. Prey birds hunt these bats, waiting at the entrance of tree hollows. Because of deforestation and missing old trees as well as because of anthropic pressure the populations of Daubenton's Bat are in decline. Therefore, it is protected, included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania is protetcted by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Fig. 10. Geoffroy's Bat (*Myotis emarginatus*).

Fig. 11. Greater mouse-eared Bat (*M. myotis*).

Myotis emarginatus (Geoffroy Saint-Hilaire, 1806) – Geoffroy's Bat (Fig. 10) – is distributed all over Dobrogea in very small colonies or even isolated individuals. It is a small size species, with broad wings and an arm membrane attached at the base of toe no. I. The fur with long and wooly hairs is red-brownish on the back side of the body and yellow-brownish underneath. Small colonies of *M. emarginatus* were found in karstic shelters and in underground tunnels all over Dobrogea. Being a thermophilic species, in more northern latitude it was reported in houses and annexes in different localities (e.g., in Poland). If in summer time temperature in shelters could be above 30^{o}C, in wintertime shouldn't be less than 5^{o}C. Foraging

flights are in open areas, but above the water surface too as for previous species. Because of anthropic pressure, populations of this species are decreasing. It is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Myotis myotis (Borkhausen, 1797) – Greater mouse-eared Bat (Fig. 11) – is distributed mostly in the southern part of Dobrogea. It is the largest species of the genus, with a total length of individuals up to 15 cm. The back fur is of gray-brown-reddish color and ventrally is gray-whitish. Wings are wide. As a thermophilic species, the Greater mouse-eared Bat looks for shelters both in localities and in caves, if available in the area. It lives in large colonies. Nursery colonies are less in underground shelters and more in attics, church towers, and cellars. Foraging flights are in orchards, parks in villages and towns and above cultivated areas. With its large size, it consumes many pest insects and should be protected. It is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Fig. 12. Whiskered Bat (*Myotis mystacinus*).

Fig. 13. Natterer's Bat (*Myotis nattereri*).

Myotis mystacinus (Kuhl, 1817) – Whiskered Bat (Fig. 12) – was registered mostly in karstic refuges in the southern part of Dobrogea but it was also observed in orchards, gardens and in parks of localities. For summer time this species seems to be more domicolous than a forest bat. Inside the genus, this species has the smallest individuals. Their total length is below 8 cm. The fur of the backside is dark-brown to blackish and beneath has gray hues. Nursery colonies are usually in buildings in localities, while for hibernation they look for different underground shelters. Its natural enemies are snakes, prey birds and carnivore mammals. Anthropic pressure, disturbances of refuges and foraging habitat pollution are the

main reasons why its populations are in drastic decline. Therefore, it is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Myotis nattereri (Kuhl, 1817) – Natterer's Bat (Fig. 13) – is represented by small and isolated populations in the southern part of Dobrogea. The total body length of individuals is below 10 cm. The tragus is long, narrow (three times less than its length). Dorsally the fur is light-grayish and on the belly is gray-whitish. The color of wing membrane and ears is light gray-brownish. The preferred habitats are forests, but it was observed in parks, orchards, gardens in localities. Nursery colonies are mostly placed in buildings – in cracks of walls, cellars, and attics. The hibernation colonies are in underground shelters. Foraging flights are in parks, along skirts and in everglades. The Natterer's Bat is also active in the day time, picking up chilopods, araneids, and beetles. Because of nursery and hibernating colonies are disturbed, the populations are in decline and the species is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrate from Romania it is evaluated as an endangered species.

Fig. 14. Noctule Bat (*Nyctalus noctula*).

Fig. 15. Kuhl's Pipistrelle (*Pipistrellus kuhlii*).

Nyctalus noctula (Schreber, 1774) – Noctule Bat (Fig. 14) – was observed all over Dobrogea, both latitudinally and longitudinally. It is of large size, with the total length of individuals up to 15 cm. Its ears are broad with rounded tips and the tragus is of mushroom shape. The wings are long and narrow. The back fur is of rufous sheen color and beneath is light-brownish. As an arboreal bat, mostly it shelters in tree hollows as well as in deep stones crevices and in wall cracks. Some individuals roost in bird boxes. With fast (50 km/h) and straight flight, the Noctule Bat explores foraging habitats at about 6 km around the shelter. The species is important in controlling insect populations. Wild deforestation and lack of old trees with tree hollows as shelters determined the numerical decline of populations of

this bat. Not having increasing or stable populations, the species is included in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. Statute of conservation in Romania: Least Concern.

Pipistrellus kuhlii (Kuhl, 1817) – Kuhl's Pipistrelle (Fig. 15) – can be found all over Dobrogea. With a total length up to 8 cm individuals of this species have triangular ears and tragus is rounded. The back fur is medium brown to yellowish-brown while the belly is gray-whitish. The karst formations with caves and crevices in limestones are preferred, but it was also observed in localities, sheltering in cellars. Nursery and hibernating colonies are only with a couple of individuals and in many instances solitary bats were observed. Its presence in the north Dobrogean Tableland is beneficial to agriculture and to people because the trophic base consists of Diptera, Trichoptera, Lepidoptera, Hemiptera, Coleoptera etc. Because of frequently disturbances in nursery and in hibernating colonies the populations of this bat are in decline. Therefore, it is in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. Statute of conservation in Romania: Least Concern.

Fig. 16. Nathusius' Pipistrelle (*P. nathusii*).

Fig. 17. Common Pipistrelle (*P. pipistrellus*).

Pipistrellus nathusii (Keyserling et Blasius, 1839) – Nathusius' Pipistrelle (Fig. 16) – with a distribution all over Dobrogea, has short triangular ears and their external edges have 4–5 horizontal creases. The back fur is rufous in summer time and darker-brownish after molting, in August. The belly is yellow-brownish. Wing membranes are blackish-brown. It is a silvicolous bat, but occasionally it was seen in localities. Cracks in walls, tree hollows and caves are also shelters both for nursery and hibernating colonies. Foraging habitats are along skirts and roads, but they also catch insects flying above the water surface. Snakes and prey birds are

the natural enemies. Lack of safety shelters and pollution of foraging habitats determined a drastic decline of this bat populations. It is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrates from Romania it is evaluated as an endangered species. Statute of conservation in Romania: Least Concern.

Pipistrellus pipistrellus (Schreber, 1774) – Common Pipistrelle (Fig. 17) – was observed and identified mostly in the southern Dobrogea, but for sure it is also in the northern part. In the second half of January 2011, I saw one flying individual (probably disturbed from hibernation), crossing Danube toward Tulcea. It is known as the smallest European bat species (as Soprano Pipistrelle is). Individuals have the total length below 8 cm. It has short and triangular ears with an outside lobe under the horizontal creases. The back fur is of brown-blackish color and lighter ventrally. Observed along skirts, this bat shelters both in forest, but also in localities (church tower, garrets, sheds) and therefore it is considered a domicolous species. Nursery colonies can be in tree hollows, but also in houses, beneath pictures or in cracks of walls. Hibernation places are everywhere the temperature is positive in winter time. With a fast and agile flight, the Common Pipistrelle hunts small and soft insects. This species is part of pest insect control and therefore it is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. Statute of conservation in Romania: Least Concern.

Fig. 18. Soprano Pipistrelle Bat (*Pipistrellus pygmaeus*).

Pipistrellus pygmaeus (Leach, 1825) – Soprano Pipistrelle Bat (Fig. 18) – is larger distributed all over Romania, but up to now it was observed only in karst formation from the southern part of Dobrogea. In fact, this is the smallest species of the genus, relatively recently reported in the Romanian fauna. The total body length is below 7 cm. The ears and muzzle are shorter than in Common Pipistrelle.

The back fur is brown-greenish and beneath is gray-yellowish. As a riparian bat, it occurs in everglades and in limestone area. The preferred shelters are in caves and in any underground refuges, but it can also enter cellars and other annexes of houses. Foraging flights are in gardens, parks, above the water surface and around the street lights. It is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. Statute of conservation in Romania: Least Concern.

Fig. 19. Savi's Pipistrelle (*Hypsugo savii*).

Fig. 20. Gray-long-eared Bat (*Plecotus austriacus*).

Hypsugo savii (Bonaparte, 1837) – Savi's Pipistrelle (Fig. 19) – was observed all over Dobrogea. Individuals have a medium size with a total length less than 10 cm. Up to now the species was reported only in Dobrogea. Ears are large and rounded. The back fur color is variable between pale-yellow-brown and grayish-white. The belly is yellow-whitish. Ears and muzzle are blackish. Wing membrane are dark-brown. Caves and limestone crevices are shelters both for nursery and for hibernating colonies. In localities it shelters in walls' fissures, under roofs, and in cellars. Foraging flights are along skirts and roads, above pastures and wetlands as well as around the street lamps. This bat species is part of pest insect control. It is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrates from Romania it is a vulnerable species.

Plecotus austriacus (Fisher, 1829) – Gray-long-eared Bat (Fig. 20) – roosts in all kind of karstic structures from the southern Dobrogea. The total body length of individuals is up to 11 cm. The back fur color is mostly grayish. The underside is light-grayish. The muzzle and upper lip are dark-grayish. Around the eyes there is a stripe like a mask. Wing membrane and ears are of gray color. The preferred habitats are cultivated landscapes. In some areas it is considered to be a domicolous species (being found in cellars), but winter shelters are in caves and in underground

tunnels. With fast flight it hunts mostly moths and from the soil it harvests spiders, caterpillars, centipedes etc. Thus, this bat plays and important role in pest insect control. It is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrates from Romania it is an endangered species.

Fig. 21. Parti-coloured Bat (*Vespertilio murinus*).

Fig. 22. Schreiber's Bent-winged Bat (*Miniopterus schreibersii*).

Vespertilio murinus Linnaeus, 1758 – Parti-colored Bat (Fig. 21) – is mostly a domicolous bat species, but was also reported in high buildings, some scientists considering these refuges as a substitute of karstic shelters. The total length of individuals is below 9 cm. Ears of oval shape, sometimes hidden in fur. A short tragus widens above. Hairs are blackish-brown at their basis and silvery-whitish at their tips. Ventrally the fur is of gray-whitish color. Wing membranes are narrow, of brownish color as ears and muzzle are. The preferred shelters are caves, but when these miss, the Parti-colored Bats use any crack of building walls in rural and urban localities. In stone fissures and in cracks of walls are also nursery and hibernating colonies, sometimes mixed with different species of the *Pipistrellus* and *Myotis* genera. Foraging flights are fast and high (at about 20 m) all over the night, with short breaks. Neuroptera, Coleoptera, Diptera, and Lepidoptera are the most common component of food. In this way, the species contributes to the pest insect control. It is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrates from Romania it is an endangered species.

Miniopterus schreibersii (Kuhl, 18919) – Schreiber's Bent-winged Bat (Fig. 22) – is present in caves in the southern Dobrogea, with populations of

200–300 individuals, especially in nursery colonies. The total length of individuals is up to 12 cm. Muzzle, ears and head are short and wide. The fur on the head has short, dense and erected hairs. The back color of the fur is gray-brownish, partly with mauve tinge and beneath the fur is lighter-gray. The muzzle, ears and wing membranes are of gray-brownish color. Wings are long and narrow. Main shelters for large colonies (hundreds of individuals) are in caves and in any karst formations, preferable with overlapped system of galleries and close to the running water. Occasionally it was observed in localities, sheltering in attics and garrets in small colonies – a couple of individuals. With a fast flight (app. 55 km/h) at about 20 m high, the Schreiber's Bent-winged Bat has foraging flights up to 10 km far from shelters. An important factor in controlling the pest insect populations with impact in agriculture, forests, orchards and gardens on one hand and on the other hand as a sensitive species with its populations in decline, it is listed in the Annexes II and III of Bern Convention, in Annexes II and IV of EC Habitat Directive. In Romania it is protected by Law 90/10 May 2000 and it is included in Annexes No. 3 and No. 4A of Emergency Governmental Ordinance No. 57/29 June 2007. In the Red Book of Vertebrates from Romania it is a vulnerable species.

4. DISCUSSIONS

To these 21 bat species, different scientists reported some additional, such as *Myotis aurascens* and *Myotis oxygnathus* (controversial species) from Gura Dobrogei Cave (Constanța County), identified by POCORA and POCORA (2011). The same authors reported 13 bat species from four Dobogean caves, but in the Table 7, with values (in %) and class of ecological indices based on observations and capture of bats in karst of Dobrogea, the species *M. emarginatus* misses. At page 122, before **Protection** part, the authors observe a summer colony with 6 individuals of this species in Hagieni casemate. In summer in the same place usually there is a nursery colony with 250–300 individuals of *Miniopterus schreibersii*. POCORA and POCORA (2011) mention that *M. schreibersii* "...was the most abundant with 68%" and reported also nursery colonies of *Myotis daubentonii*, "and probably" *M. emarginatus*; probably because not definitely identified, this is why in Table 7 the last species misses. The authors reported three bat species (*Miniopterus schreibersii, Plecotus auritus* and *Rhinolophus hipposideros*) hibernating in Hagieni casemate. Inventorying nine bat species only from Gura Dobrogei (Bat Cave) POCORA and POCORA (op. cit.) underlined that in previous studies (1958–2010) of this cave and "La Adam Cave" 18 species were reported – today all of them being confirmed if we refer to bats from all Dobrogean caves. Certainly, at least for some bat species (*Rhinolophus mehelyi, Myotis myotis, M. oxygnathus, Hypsugo savii, Miniopterus schreibersii* etc.) it was a drastic decline in their populations. Therefore, there are national and international regulations for their conservation: avoid uncontrolled visits of cave all over the year – in nursery colonies, in hibernating periods, in torpidity etc. MĂNTOIU *et al*.

(2020) reported a four-year study of bat fatality rates at a wind park (20 wind turbine) on the Black Sea coast area. In Table 3 the authors mentioned 11 bat species from Dobrogea. Two collected carcasses were not identified up to species level of genera *Myotis* and *Pipistrellus*. The authors were focused on bat fatality because the wind parks in eastern Europe. They estimated that all carcasses observed along four years "...exhibited symptoms of barotrauma". Being an important route for migration of wildlife – between bats being well documented for *Nyctalus noctula* as well as for *Pipistrellus pipistrellus* and *P. nathusii* – the western coast of the Black Sea being surnamed Via Pontica, the wind turbine "may kill large number of bats in this region...".

In synthesis we present Table 1 with comparative reported species by POCORA and POCORA (2011), MĂNTOIU *et al*. (2020) and MURARIU (2020).

Table 1

Comparative data on bat species reported in the second decade of the 21st century in Dobrogea

No.	Species	Pocora & Pocora (2011)	Măntoiu *et al.* (2020)	Present work
1	*Rhinolophus ferrumequinum*	+	-	+
2	*Rhinolophus hipposideros*	+	-	+
3	*Rhinolophus mehelyi*	+	-	+
4	*Eptesicus nilssonii*	+	-	+
5	*Eptesicus serotinus*	+	+	+
6	*Myotis* aurascens*	+	+	-
7	*Myotis bechsteinii*	+	-	+
8	*Myotis blythii*	+	-	+
9	*Myotis daubentonii*	+	-	+
10	*Myotis emarginatus*	+	-	+
11	*Myotis myotis*	-	-	+
12	*Myotis mystacinus*	-	-	+
13	*Myotis nattereri*	-	-	+
14	*Myotis oxygnathus*	+	-	-
15	*Nyctalus leisleri*	-	+	-
16	*Nyctalus noctula*	+	+	+
17	*Pipistrellus* kuhlii*	+	+	+
18	*Pipistrellus nathusii*	+	+	+
19	*Pipistrellus pipistrellus*	+	+	+
20	*Pipistrellus pygmaeus*	+	+	+
21	*Hypsugo savii*	+	+	+
22	*Plecotus austriacus*	+	-	+
23	*Plelcotus auritus*	+	-	-
24	*Vespertilio murinus*	+	+	+
25	*Miniopterus schreibersii*	+	-	+

* Măntoiu *et al*. (2020) – unidentified one species for *Myotis* and one of *Pipistrellus* genera.

To the 21 bat species reported by us (Tab. 1), *Myotis aurascens, M. oxygnathus, Nyctalus leisleri* and *Plecotus auritus*, identified in four caves from Dobrogea by

POCORA and POCORA (2011) and in the Babadag Wind Park (Măntoiu *et al*., 2020) should be added. Thus, the total number of bat species in Dobrogea should be 25. We should mention that in a team of scientists from "Grigore Antipa" National Museum of Natural History and from "Emil Racoviță" Institute of Speleology, MURARIU (unpublished) identified in 2010 one live individual of *M. aurascens* in the chimney at the end of a mining gallery, on the left side in our way to Canaraua Fetii Cave.

5. CONCLUSIONS

1 – Dobrogea is reach in karst structures and in spite of the drastic decline of populations of some bat species, this fauna is still rich and conservation measures are necessary.

2 – The northern (mountainous) and the southern (tableland) Dobrogea have optimum shelters and foraging habitats for 25 bat species.

3 – All Dobrogean bat fauna is endangered by phonic and chemical pollution, by the extension of infrastructure which determines the fragmentation and destruction of habitats, by the uncontroled visits of shelters and by the disturbance of bat colonies and by the parks of wind turbines.

4 – One rhinolophid (*Rhinolophus mehelyi*), three vespertilionids (*Myotis myotis*, *M. oxygnathus*, *Hypsugo savii*) and one miniopterid (*Miniopterus schreibersii*) of Dobrogean bat fauna are extremely endangered, their populations are numerically decreasing from past colonies with thousands of individuals to several hundred or only isolated specimens.

5 – Between our 22 identified bat species in Dobrogea, 12 have a statute of endangered, 5 of vulnerable and 5 with larger distribution, but with slowly decreasing of populations. Therefore, they are protected by national and international regulations.

6 – In spite of the National Park in Dobrogea and several protected areas as well the Danube Delta Biosphere Reserve, the anthropic pressure is higher and higher on all bat species and on all biodiversity. Therefore, at least existing national regulations must be respected to protect bats, as useful mammals in pest insects' control and as important bioindicators of the environment quality.

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