

## *New Data on the Tetrapod Fauna of Lyulin Mts., Bulgaria*

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**Abstract.** Lyulin Mountain is located near the capital city of Sofia, but its fauna is relatively poorly studied. It offers a wide variety of habitats, which suggests the possible presence of many species of vertebrates. Older preliminary studies show that some of them are species of national and European importance. Our survey was conducted in 2021, between April and September. Transects were walked for direct visual or vocal observations of amphibians, reptiles, birds, mammals, or traces of their presence. A total of 12 species of amphibians and reptiles were observed during the current study. The most common species were the green lizard (*Lacerta viridis*), the fire salamander (*Salamandra salamandra*) and the yellow-bellied toad (*Bombina variegata*). 46 species of birds were registered, with the Eurasian blackcap (*Sylvia atricapilla*), Common chaffinch (*Fringilla coelebs*) and Common blackbird (*Turdus merula*) being the most common. 11 species of wild mammals were documented, including the endangered in Bulgaria pine marten (*Martes martes*). The most common and widely distributed mammals were the roe deer (*Capreolus capreolus*) and the red fox (*Vulpes vulpes*). The results of our study demonstrate that Lyulin Mts. hosts a large diversity of vertebrates and needs to be studied in more detail to aid their effective management and conservation.

**Key words:** diversity, amphibians, reptiles, birds, mammals.

### **Introduction**

Assessing the biodiversity is invariably the first step towards the successful management and conservation of any area of interest. Lyulin Mountain is located near the capital city of Sofia and the much larger protected area Nature Park "Vitosha". Perhaps this is the reason Lyulin is relatively poorly studied in comparison. However, it offers a wide variety of habitats, which suggests the presence of many species of vertebrates. Preliminary studies show that some of them are species of national and European importance (Petrov, 2016).

Lyulin Mountain is not a protected area, which means that various human activities are allowed: tourism, logging, hunting etc. Furthermore, the mountain is bordering numerous human settlements and urbanised areas, which additionally increases anthropogenic disturbance. All of these factors contribute towards the uncertain status of the vulnerable or endangered species that might inhabit it. Thus, the aim of the current study is to assess the vertebrate biodiversity (Tetrapoda) and its conservation status in Lyulin, aiming its effective management and conservation.

## Material and Methods

### Study area

Lyulin Mountain is in the Southwestern part of Bulgaria, easily accessible, near numerous settlements. The highest peak – Dupevitsa (1256 m) is in the eastern part. The western part is a ridge that rises like an arc to the north (Raylovsko gradishte peak, 1199 m). The rivers that spring from Lyulin Mts. are short and shallow. They dry up at the maximum summer temperatures. Lyulinska River is the largest river in the mountain. Lyulin Mts. has limited water resources based on only 600 mm annual precipitation. Therefore, the mountain is characterised as relatively waterless. The snow cover lasts from 60 to 80 days, and usually it is one to 1.5 meters thick. Steep slopes and low forest cover turn deep ravines and small rivers into destructive torrents (Georgiev, 1985).

The climate is temperate continental. The average annual air temperature for the period 1956-2007 is 9.8°C, the coldest month is January (-1.3°C) and the warmest is July (20°C). Typical for the region is the wind Fyon - strong and stormy south pulsating wind, accompanied by a sharp rise in air temperature and lower humidity (Bondev, 1982).

Nowadays, the woody and shrubby vegetation is of natural origin – mostly coppice. Coniferous trees comprise about 6% of the forest area, and they are artificial plantations. Predominantly the woodlands are aggregation of oak (*Quercus* sp.) trees. Beech (*Fagus sylvatica*) forests are located in the highest parts of the mountain. There are also bushes, represented by hazel (*Corylus avellana*), dogwood (*Cornus* sp.), hawthorn (*Crataegus monogyna*). Black elderberry (*Sambucus nigra*) and dog rose (*Rosa canina*) are widespread. These shrublands do not occupy large areas but are an integral part of the mountains' landscape ([bgjourney.com](http://bgjourney.com), 2022).

### Methods

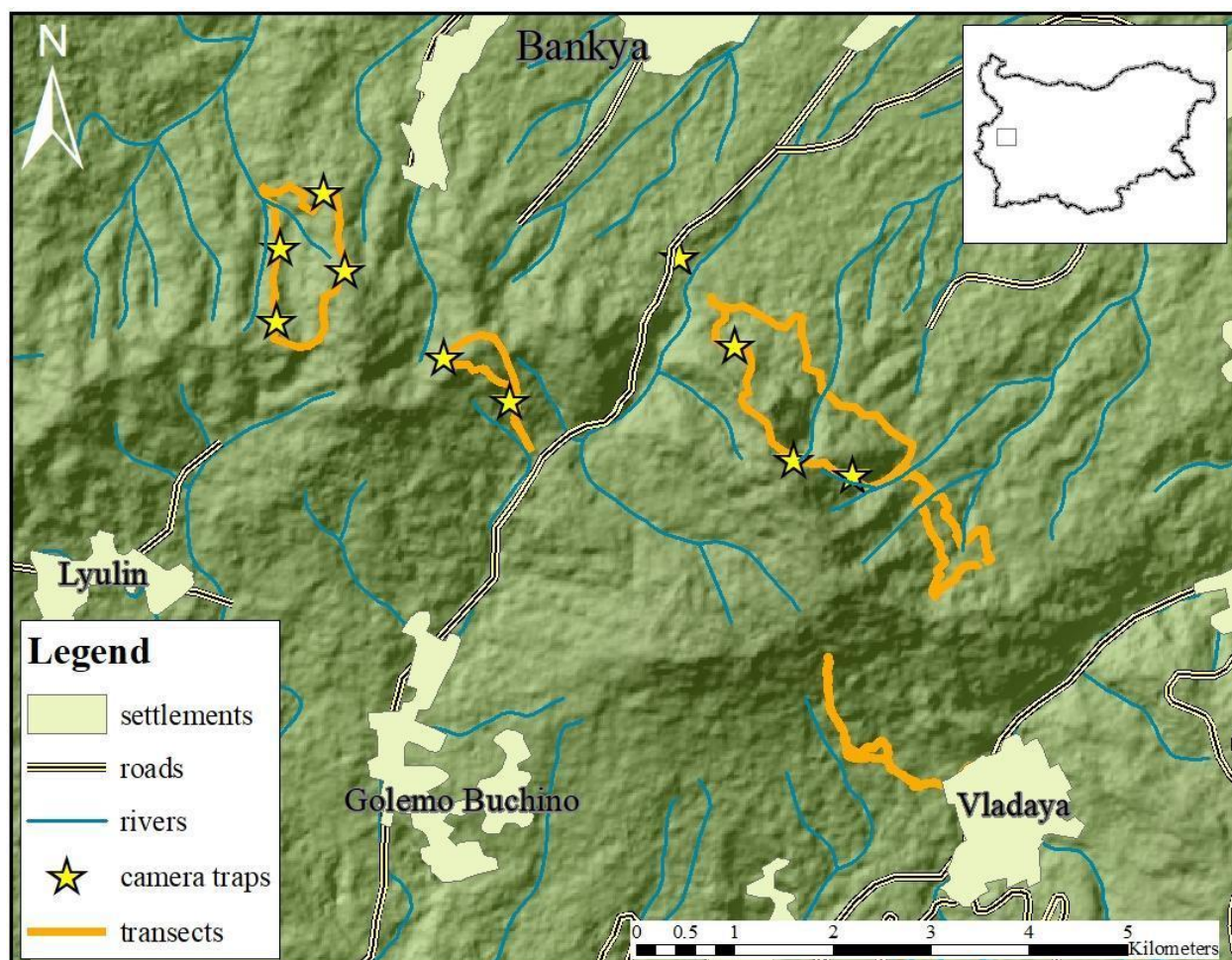
Field observations in Lyulin mountain were conducted from 2014. In 2021, between April and September, we conducted a study

using camera traps for mammals and periodically (on average twice a month) walked transects for direct visual or vocal observations of amphibians, reptiles, and birds. 10 camera traps were placed on animal paths in three areas of the mountain (Fig. 1). They were set up to take 3 consecutive photos and a 10-second video (5 seconds apart) upon triggering. Additionally, five pre-set (via GIS tools) line transects (overall approx. 15 km) were surveyed in the same areas (Fig. 1) in order to record directly (through observation or capture) species or through traces of their presence (tracks, excrements, markings, etc.). The transect method was applied to register amphibians, reptiles, birds and mammals inhabiting the Lyulin Mountains. The transects were visited periodically (at least once every 30 days, during the active period for amphibians and reptiles, and throughout the whole study period for birds and mammals). All observed or captured amphibians and reptiles were identified to species level (Tsankov et al., 2014) and GPS coordinates of the sites were recorded. During the survey of the transects, all observed mammals or traces of their activity (tracks, excrements, markings, feeding sites, etc.) were also documented.

### Results

12 species of amphibians (n = 6, from four families) and reptiles (n = 6, from four families) were observed during the study duration (Table 1). All of these species are under the protection of the Biodiversity Law in Bulgaria or are included in the Appendix II (or III) of the Bern Convention. The most common species were the green lizard *Lacerta viridis*, the fire salamander *Salamandra salamandra* and the yellow-bellied toad *Bombina variegata*, and the rarest was the European copper skink *Ablepharus kitaibelii*.

Forty six species of birds from nine orders were also registered, with the Eurasian blackcap (*Sylvia atricapilla*), Common chaffinch (*Fringilla coelebs*) and common blackbird (*Turdus merula*) being the most common. The observed species are presented in Table 2.



**Fig. 1.** Map of the study area with camera trap locations and transects.

Thirteen species of mammals (11 wild and 2 domesticated) were documented, including the endangered in Bulgaria pine marten (*Martes martes*) (Table 3). The most

common and widely distributed mammals were the roe deer (*Capreolus capreolus*) and the red fox (*Vulpes vulpes*), which were registered on all camera traps and transects.

**Table 1.** List of the observed amphibians and reptiles, number of locations in which the species were observed and legal and conservation status. *Legend:* II, III, IV, V – the species is listed in Appendix № 2, 3, 4 and/or 5 respectively; BBA – Bulgarian Biodiversity Act (State Gazzette, 09.08.2002); RDB – Red Data Book of the Republic of Bulgaria, (part 2, 2015) – EN – endangered species, VU – vulnerable species; HD – Habitats Directive (Directive 92/43/EEC); BC – Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

Family/species	Latin name	No. locations	of	Legal and conservation status			
				BBA	RDB	HD	BC
<b>Bufonidae</b>							
Common toad	<i>Bufo bufo</i> L.	2		III			III

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<b>Ranidae</b>						
Marsh frog	<i>Pelophylax ridibundus</i> Pallas	3	IV		V	III
Agile frog	<i>Rana dalmatina</i> Fitzinger	6	II		IV	II
<b>Bombinatoridae</b>						
Yellow-bellied toad	<i>Bombina variegata</i> L.	12	II, III		II, IV	II
<b>Salamandridae</b>						
Fire salamander	<i>Salamandra salamandra</i> L.	21	III			III
Smooth newt	<i>Lissotriton vulgaris</i> L.	1	III			III
<b>Anguidae</b>						
Slow worm	<i>Anguis fragilis</i> L.	3	III			III
<b>Scincidae</b>						
European copper skink	<i>Ablepharus kitaibelii</i> Bibron & Bory	1	III		IV	II
<b>Lacertidae</b>						
European green lizard	<i>Lacerta viridis</i> Laurenti	26			IV	II
Common wall lizard	<i>Podarcis muralis</i> Laurenti	3			IV	II
<b>Colubridae</b>						
Grass snake	<i>Natrix natrix</i> L.	2				III
Aesculapian snake	<i>Zamenis longissimus</i> Laurenti	2	III	EN	IV	II

**Table 2.** List of the observed birds and number of locations in which the species were observed during the study and legal and conservation status. *Legend:* II, III, IV, V - the species is listed in Appendix № 2, 3, 4 and/or 5 respectively; BBA - Bulgarian Biodiversity Act (State Gazette, 09.08.2002); HGPA - I - Hunting And Game Preservation Act (State Gazette, 26.09.2000) - Appendix № 1; RDB - Red Data Book of the Republic of Bulgaria, (part 2, 2015) - EN - endangered species, VU - vulnerable species; BC - Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention); CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Order/ species	Latin name	No. of locations	Legal and conservation status				
			BBA	HGPA - I	RDB	BC	CITES
<b>Accipitriformes</b>							
Common buzzard	<i>Buteo buteo</i>	6	III			II	II
European honey buzzard	<i>Pernis apivorus</i>	1	II, III		LC	II	II
<b>Falconiformes</b>							
Common kestrel	<i>Falco tinnunculus</i>	4	III			II	II
Eurasian hobby	<i>Falco subbuteo</i>	1	III		VU	II	II
<b>Piciformes</b>							
Great spotted woodpecker	<i>Dendrocopos major</i>	5	III			II	
Black woodpecker	<i>Dryocopus martius</i>	2	II, III		VU	II	
European green woodpecker	<i>Picus viridis</i>	3	III			II	
<b>Gruiformes</b>							
Corncrake	<i>Crex crex</i>	1	II, III		VU	II	
<b>Cuculiformes</b>							

Common cuckoo	<i>Cuculus canorus</i>	3	III		III
<b>Columbiformes</b>					
Common wood pigeon	<i>Columba palumbus</i>	5	IV, VI	+	
Eurasian collared dove	<i>Streptopelia decaocto</i>	1	IV	+	III
<b>Coraciiformes</b>					
European bee-eater	<i>Merops apiaster</i>		II		II
<b>Apodiformes</b>					
Common swift	<i>Apus apus</i>	1	III		II
<b>Passeriformes</b>					
European skylark	<i>Alauda arvensis</i>	1	III		III
Barn swallow	<i>Hirundo rustica</i>	1	III		II
Common house martin	<i>Delichon urbica</i>	6	III		II
Red-rumped swallow	<i>Hirundo daurica</i>	3	III		II
White wagtail	<i>Motacilla alba</i>	1	III		II
African stonechat	<i>Saxicola torquatus</i>	1	III		II
Common nightingale	<i>Luscinia megarhynchos</i>	1	III		II
Song thrush	<i>Turdus philomelos</i>	4	III		III
Mistle thrush	<i>Turdus viscivorus</i>	4	III		III
Common blackbird	<i>Turdus merula</i>	10	III		III
Common chiffchaff	<i>Phylloscopus collybita</i>	9	III		II
Semicollared flycatcher	<i>Ficedula semitorquata</i>	5	II, III		VU II
Blackcap	<i>Sylvia atricapilla</i>	10	III		II
European robin	<i>Erithacus rubecula</i>	5	III		II
Common whitethroat	<i>Sylvia communis</i>	4	III		II
Great tit	<i>Parus major</i>	6	III		II
Coal tit	<i>Parus ater</i>	1	III		II
Sombre tit	<i>Parus lugubris</i>	1	III		II
Marsh tit	<i>Parus palustris</i>	1	III		II
Eurasian wren	<i>Troglodytes troglodytes</i>	5	III		II
Red-backed shrike	<i>Lanius collurio</i>	4	II, III		II
Black redstart	<i>Phoenicurus ochruros</i>	1	III		II
European goldfinch	<i>Carduelis carduelis</i>	2	III		II
European greenfinch	<i>Carduelis chloris</i>	5	III		II
Common chaffinch	<i>Fringilla coelebs</i>	12	III		III
Brambling	<i>Fringilla montifringilla</i>	1	III		III
Eurasian nuthatch	<i>Sitta europaea</i>	5	III		II
Hawfinch	<i>Coccothraustes coccothraustes</i>	4	III		II
Eurasian bullfinch	<i>Pyrrhula pyrrhula</i>	2	III		III
Common starling	<i>Sturnus vulgaris</i>	3	IV	+	
Yellowhammer	<i>Emberiza citrinella</i>	5	III		II
Corn bunting	<i>Miliaria calandra</i>	1	III		III
Eurasian jay	<i>Garrulus glandarius</i>	3			III
Common raven	<i>Corvus corax</i>	1	III		III

**Table 3.** List of the observed mammals, number of locations in which the species were observed and legal and conservation status. *Legend:* II, III, IV, V – the species is listed in Appendix №, 2, 3, 4 and/or 5 respectively; BBA – Bulgarian Biodiversity Act (State Gazette, 09.08.2002); HGPA - I – Hunting And Game Preservation Act (State Gazette, 26.09.2000) - Appendix № 1; RDB - Red Data Book of the Republic of Bulgaria, (part 2, 2015) - EN – endangered species, VU – vulnerable species; HD – Habitats Directive (Directive 92/43/EEC); BC – Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention); CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Family/ species	Latin name	No. of locations	Legal and conservation status					
			BBA	HGPA - I	RDB	HD	BC	CITES
<b>Canidae</b>								
Red fox	<i>Vulpes vulpes</i> L.	7		+				
Golden jackal	<i>Canis aureus</i> L.	1		+				
Domestic dog	<i>Canis familiaris</i> L.	1						
<b>Felidae</b>								
European wildcat	<i>Felis silvestris</i> Schr.	2	III		EN	IV	II	II
Domestic cat	<i>Felis catus</i> L.	4						
<b>Suidae</b>								
Wild boar	<i>Sus scrofa</i> L.	5		+				
<b>Cervidae</b>								
Roe deer	<i>Capreolus capreolus</i> L.	9		+				III
<b>Leporidae</b>								
European hare	<i>Lepus europeus</i> Pallas	2		+				III
<b>Mustelidae</b>								
European badger	<i>Meles meles</i> L.	5		+				III
Stone marten	<i>Martes foina</i> Erxl.	1		+				III
Pine marten	<i>Martes martes</i> L.	1	III		EN	V		III
Unidentified marten	<i>Martes</i> sp.	5						
<b>Sciuridae</b>								
Red squirrel	<i>Sciurus vulgaris</i> L.	2		+				III
<b>Erinaceidae</b>								
Northern white-breasted hedgehog	<i>Erinaceus roumanicus</i> Barrett-Hamilton	1	III					

## Discussion

### *Amphibians and reptiles*

From a herpetological point of view, Lyulin Mountain is largely understudied. For the identified species, information on population size, distribution, etc. is scarce, which indicates the need for continuous, more detailed studies of the mountain and its surroundings. This study can serve as a

basis for such research. In a previous study of the herpetofauna of Lyulin Mountain (Petrov, 2016) the European copper skink (*Ablepharus kitaibelii*) and the slow worm (*Anguis fragilis*) were not observed. Therefore, these two species are newly registered for the mountain in the current study. Meanwhile, during our research, three previously observed species were not

found – the Buresch's crested newt (*Triturus ivanbureschi*), sand lizard (*Lacerta agilis*) and smooth snake (*Coronella austriaca*). Thus, the total number of registered amphibians and reptiles from the two studies is 15.

Tsankov et al. (2014), published a detailed identification guide of the amphibians and reptiles in Vitosha Nature Park, part of the Vitosha Mountain. The species composition of this field guide includes all the species from our study. This is so, apart from the topographic features and similar climatic conditions, and also because of the good connectivity between the two mountains, regardless of the presence of the motorway between them (Naumov et al., 2020)

Although Lyulin Mts. has a limited territory, 39% of the amphibians and 23% of the reptiles inhabiting Bulgaria are found in the mountain.

#### Birds

Among the observed birds, the most common species were typical of forest habitats - the blackcap (*Sylvia atricapilla*), the common finch (*Fringilla coelebs*) and the blackbird (*Turdus merula*). Other forest species, such as Eurasian wren (*Troglodytes troglodytes*) and European robin (*Erithacus rubecula*), were also well represented. The majority of the observed species are under protection from the Bulgarian biodiversity act.

Of the species with unfavourable conservation status, it is important to note the presence of at least 3 territorial pairs of semi-collared flycatchers (*Ficedula semitorquata*). According to the Atlas of breeding birds in Bulgaria, the species was previously reported in the period 1958-1959 (Iankov, 2007). During the present research, one of the pairs was found in an atypical habitat in a sparse birch (*Betula alba*) plantation, situated on a dry southwestern slope, while the others were in dense forests of beech (*Fagus*) and hornbeam (*Fraxinus*), listed as typical habitats by Iankov (2007). It is likely that additional researches in Lyulin

Mountain will reveal more pairs, given the favourable conditions we found in the present study. The species is listed as “vulnerable” in Bulgaria (Golemanski, 2011). In the relatively small but representative wet meadows, a mating song of the corncrake (*Crex crex*) was documented. The species is sensitive to the destruction of its habitats thus categorised as “vulnerable” in Bulgaria (Golemanski, 2011). It was reported for many locations in the vicinity of city of Sofia in the previous decades (Nankinov, 1982), but many of the suitable meadows in the area were turned in urbanised zones, which probably caused the retreat of the species to the surviving favourable habitats in the neighbouring territories such as Lyulin mountain. The meadows in the researched area are also home to species such as the red-backed Shrike (*Lanius collurio*) and the corn bunting (*Miliaria calandra*), and given the findings of amphibians and reptiles in these meadows, special attention should be paid to the conservation of these valuable areas. During the study, another rare observation was made for the country - a male brambling (*Fringilla montifringilla*) in mating plumage in late spring (May). Such observations are very few in the published literature for Bulgaria, as the species has a northern nesting distribution and usually should have left the country much earlier. According to Nankinov (1982) the species could be observed very rarely until mid May, with the latest observation on 13.05.1976 from Rila mountain, which is 5 days earlier than our present one.

The presence of well-preserved forests aged 100 or more years and the large quantities of deadwood are a prerequisite for a good variety of woodpeckers. During the study, Black (*Dryocopus martius*) - listed as “vulnerable” in the Red data book of Bulgaria (Golemanski, 2011), European green (*Picus viridis*) and Great spotted woodpecker (*Dendrocopos major*) were found, as well as numerous hollows and traces of their

activity on all walked transects. The hollows that are not used by the woodpeckers provide an opportunity for nesting of many other species, including the semi-collared flycatchers, a species of conservation importance.

Future research of the avifauna is recommended, since no data related to the area was published in the recent decades. Detailed research was found only in unpublished sources (Master's thesis from 1954-1967 and 1989). Compared to the species listed in them, in the current study we observed one additional species, not reported for the mountain so far – the common swift (*Apus apus*).

*Mammals*

Despite its relatively small territory, Lyulin hosts a large percentage of the

middle and large mammals inhabiting Bulgaria (Popov & Sedefchev, 2003) (Table 4). Mammals with diverse legal and conservation status have been registered (Table 3). 73% (n=8) of the observed wild mammals are game species, while only 2.7% (n=3) are protected and 1.8% (n=2) are listed in the Bulgarian Red Data book as endangered. 64% (n=7) are species of European importance, listed in the Bern Convention, including 1 species which is also listed in CITES. The careful management and conservation of the protected and endangered species of national and European importance in the mountain, most of which fall into hunting areas, is of particular importance.

**Table 4.** Percentage of species documented for Lyulin Mts. in the current study, relative to the known biodiversity for Bulgaria by family.

Suidae	Leporidae	Erinaceidae	Canidae	Felidae	Sciuridae	Mustelidae	Cervidae
100%	100%	100%	50%	50%	50%	38%	33%

For the first time in the present study, the presence of pine marten was detected. The nearest other known records are found in PP “Vitosha”, located at a 10 km straight-line distance. The two locations are separated by two major roads, which most likely indicates that they are not connected. Another interesting observation was that of a wildcat (*Felis silvestris*), which is also a protected species. Stray cats were also found in the same area. It is known that this is a prerequisite for the emergence of hybridization and deterioration of the genetic status of the wildcat. The problem has not yet been studied in sufficient detail in Bulgaria, and due to the increased anthropogenic impact, it is probably very pronounced on the territory of Lyulin Mountain. The presence of stray dogs was also documented, which is an important factor in disturbing wildlife. A brown bear *Ursus arctos* L. footprint was documented

in 2016 during preliminary studies (Petrov, pers. comm.). However, we did not detect its presence during the current research. One of the camera traps was placed on the wildlife overpass on the Lyulin Motorway near the village of Malo Buchino. The presence of red fox, roe deer, European badger, European hare and an unidentified species from the *Martes* genus (most likely a stone marten) was established, indicating that the passage at least partially fulfils its intended functions.

**Conclusions**

Even with the strong anthropogenic influence due to the proximity of many human settlements, the old forests of the mountain give home to many vertebrates. The results of our study demonstrate that Lyulin mountain hosts a large diversity of vertebrates and needs to be studied in more detail, aiding its effective management and conservation.



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