

## **Species composition and conservation of small mammals (Mammalia: Erinaceomorpha, Soricomorpha, Lagomorpha, Rodentia) in Vrachanska Planina Mountains**

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**Abstract.** A review on the composition of the small mammals in Vrachanska Planina Mts. was completed using published and author's data. A total of 27 species occur within the territory. All of the species found are typical for the region. The species with the highest conservation status, the European ground squirrel *Spermophilus citellus*, disappeared from the region in the early 1950s. In the last years activities on its recovery were carried out. We analyze the threats for the small mammals and propose conservation activities to improve their conservation status.

**Key words:** Micromammalia, threats, conservation, checklist, *Spermophilus citellus*, Bulgaria.

### **Introduction**

The Vrachanska Planina Mts. is situated between the Fore-Balkan and the main Balkan ridge. Within its territory there are several protected areas with different designation – Natural Park (NP) Vrachanski Balkan, Nature Reserve Vrachanski Karst, 4 protected sites and 5 natural monuments (mainly caves). Vrachanska Planina Mountain partially overlaps with Special Protection Area (SPA) “Vrachanski Balkan” BG0002053, which is included in EU Directive 79/409 (Birds) and the Special Area of Conservation (SAC) “Vrachanski Balkan” BG0000166 of Directive 92/43 (Habitats).

The information about small mammals in the region of Vrachanska Planina Mts., NW Bulgaria, is scarce or outdated. Data can be found in faunistic (Markov 1968) or taxonomic (Peshev 1969, Belcheva et al. 1987, Belcheva & Kolevska 1992) publications. Data is also found in publications about the diet of owls (Simeonov 1968, Baumgart et al. 1973,

Simeonov 1981) and birds of prey (Stoyanov & Boev 2009).

During the last decade, projects were conducted on mapping the distribution of rare mammal species and the implementation of management plans of the protected areas within the study site. Data on species composition and distribution of small mammals in Vrachanski Balkan NP was published by Atanasov et al. (2001) and Zidarova (2007). Data for the small mammals from the adjacent SPA BG0002005 "Ponor" was presented by Koshev (2014).

Here, we summarize the latest available data about small mammals in Vrachanska Planina Mts. and its surroundings. This paper is based on literature data and personal observations and is aimed on analyzes of the threats for the small mammals.

### **Materials and Methods**

To collect data about small mammals in the field we used two methods – the transect method and data from the diet of owls and birds of prey. Using the transect method (Lovari & Rolando 2004) we found accidentally killed animals and species with diurnal activity that could be observed directly or could be determined through the traces they left behind.

In the summer of 2015 we conducted field surveys and searched for potential nesting or resting places of owls. Pellets were collected only from a Little owl (*Athene noctua*) from Stoyanovo village.

In 2013 under the project "Implementation of activities for the planning and management of NP "Vrachanski Balkan" within the Operational Programme" Environment 2007-2013" provide for reintroduction of the European ground squirrel (*Spermophilus citellus*) in the area of NP "Vrachanski Balkan".

### **Results and Discussion**

A total 27 species of small mammals were identified in Vrachanska Planina Mts. (Table 1). Their conservation status is as follows:

- Biodiversity Act, Appendix 2, Appendix 3: 4 species;
- Red Data Book (2011), VU: 1 species;
- Bern convention, Appendix 2: 1 species, Appendix 3: 12 species;
- IUCN, VU: 1, LC: 25, DD: 1 species;
- Directive 92/43, Appendix 2 and 3: 1 species, Appendix 4: 2 species.

### **Erinaceomorpha**

#### **Erinaceidae**

The Eastern hedgehog (*Erinaceus roumanicus* Barrett-Hamilton, 1900) is a common species within the study region. Markov (1968) reported this species as quite common in the vicinity of Vratsa town. It has been found in the diet of the Eagle owl nearby Gara Cherepish (Baumgart et al. 1973).

**Table 1.** Conservation status of small mammals were identified in Vrachanska Planina Mts..

No	Latin name	Biodiversity Act 2002	Directive 92/43	Bern Convention	IUCN	RDB	Presence
<b>ERINACEOMORPHA</b>							
<b>Erinaceidae</b>							
1	<i>Erinaceus roumanicus</i> Barrett-Hamilton, 1900	3			LC		FC
<b>SORICOMORPHA</b>							
<b>Soricidae</b>							
2	<i>Sorex araneus</i> Linnaeus, 1758			3	LC		FC
3	<i>Sorex minutus</i> Linnaeus, 1766			3	LC		FC
4	<i>Neomys anomalus</i> Cabrera, 1907			3	LC		FC
5	<i>Neomys fodiens</i> Pennant, 1771			3	LC		P/U
6	<i>Crocidura leucodon</i> Hermann, 1780			3	LC		FC, C
7	<i>Crocidura suaveolens</i> Pallas, 1811			3	LC		FC, C
<b>Talpidae</b>							
8	<i>Talpa europaea</i> Linnaeus, 1758				LC		FC, C
<b>LAGOMORPHA</b>							
<b>Leporidae</b>							
9	<i>Lepus europaeus</i> Linnaeus, 1758			3	LC		FC, C
<b>RODENTIA</b>							
<b>Sciuridae</b>							
10	<i>Sciurus vulgaris</i> Linnaeus, 1758			3	LC		FC, C
11	<i>Spermophilus citellus</i> Linnaeus, 1766	2	2, 3	2	VU	VU	FC, C
<b>Gliridae</b>							
12	<i>Glis glis</i> Linnaeus, 1766			3	LC		FC, C

13	<i>Muscardinus avellanarius</i> Linnaeus, 1758	2, 3	4	3	LC	FC, C
14	<i>Dryomys nitedula</i> Pallas, 1778	2	4	3	LC	FC, C
<b>Muridae</b>						
15	<i>Micromys minutus</i> Pallas, 1771				LC	P/U
16	<i>Apodemus agrarius</i> Pallas, 1771				LC	FC, C
17	<i>Apodemus flavicollis</i> Melchior, 1834				LC	FC, C
18	<i>Apodemus sylvaticus</i> Linnaeus, 1758				LC	FC, C
19	<i>Rattus norvegicus</i> Berkenhout, 1769				LC	FC, C
20	<i>Rattus rattus</i> Linnaeus, 1758				LC	FC, C
21	<i>Mus musculus</i> Linnaeus, 1758				LC	FC, C
<b>Arvicolidae</b>						
22	<i>Clethrionomys glareolus</i> Shreber, 1780				LC	FC, C
23	<i>Arvicola terrestris</i> Linnaeus, 1758				LC	FC, C
24	<i>Microtus</i> ex. gr. <i>arvalis</i>				LC	FC, C
25	<i>Microtus subterraneus</i> de Selys-Longchamps, 1836				LC	FC, C
26	<i>Chionomys nivalis</i> Martins, 1842			3	LC	FC, C
<b>Spalacidae</b>						
27	<i>Spalax leucodon</i> Nordmann, 1840				DD	FC, C

**Legend:**

**Biodiversity Act 2002** – Biodiversity Protection Act (State Gazette, No.77 from 9 August 2002), Appendix 2 and Appendix 3 – protected species on the territory of Bulgaria.

**Directive 92/43/EU** – Recommendation No.43 on the conservation of threatened mammals in Europe (1995) and its Amendment (1996) adopted by the Standing Committee of Council of Europe; Annex II – species whose conservation requires the designation of special areas of conservation, Annex IV – species of community interest in need of strict protection;

**Bern Convention** – Convention on the conservation of European wildlife and natural habitats, adopted by the Council of Europe in 1998; Appendix II – strictly protected fauna species, Appendix III – protected species;

**IUCN** – The 2013 IUCN Red List of Threatened Species (IUCN 2013); **Categories:** (VU) – Vulnerable; (LC) – Least Concern; (DD) – Data Deficient

**RDB** (Red Data Book of Bulgaria, Vol. 2 Animals, GOLEMANSKY 2011) **Categories:** (VU) – Vulnerable; (NT) – NearThreatened; (LC) – Least Concern

**Presence** – found with certainty (FC) constant (C)/temporary (T)/accidental (A); probable (P)/unproven (U) (there are favorable conditions, but the species was not found in studies). Data found with certainty are based on literature review or this study.

## Soricomorpha

### Talpidae

The European mole (*Talpa europea* Linnaeus, 1758) inhabits various habitats – mainly wet grasslands – meadows, pastures, but also gardens and forest edges. It is most active in the summer and autumn (Markov, 1968). We found molehills from this species in the regions of Zgorigrad village, Ledenika cave, Parshevitsa hut, Lokvata, Milanovo village, Okolchitsa peak. It has been found in the vicinity of Parshevitsa hut, Uchitelski koloni, Milanovo and Ochin villages (Atanasov *et al.* 2001, Zidarova 2007).

### Soricidae

The shrews are represented by 6 species (7 species total in Bulgaria). The Common (*Sorex araneus* Linnaeus, 1758) and Pygmy shrews (*S. minutus* Linnaeus, 1766) are typical inhabitants of mountains. Markov (1968) reported the Common shrew for Vratsa region. We presume, on the basis of the existing habitats, the presence of the Pygmy shrew as well.

The presence of the two water shrews (*Neomys*) – the Eurasian water shrew (*N. fodiens* Pennant, 1771) and Miller's water shrew (*N. anomalus* Cabrera, 1907), are likely. Markov (1968) reported both species from the western part of the Balkan mountain. The Eurasian water shrew prefers clear mountain streams and small rivers; while the Miller's water shrew is not so closely tied to water and can live in wet meadows, away from water.

In the lower part of the mountain were found the Bicolored shrew (*Crocidura leucodon* Hermann, 1780) and the Lesser white-toothed shrew (*Cr. suaveolens* Pallas, 1811) (Markov 1968). They inhabit open areas such as abandoned land, hedges, meadows, shrubs, and forests edges. The Bicolored shrew has been found in the diet of the Little owl from Gara Lakatnik (Simeonov 1968). Belcheva & Kolevska (1992) reported the karyotype of this shrew (2n=28) from Lakatnik village.

## Lagomorpha

### Leporidae

The European hare (*Lepus europaeus* Linnaeus, 1758) is a common species within NP "Vrachanski Balkan" (Zidarova 2007). We found hare traces in the regions of Parshevitsa hut, locality of Lokvata, Dolno Ozirovo village, Stoyanovo village, Zorigrad village. It has been found in the diet of the Eagle owl (Baumgart *et al.* 1973) and the Egyptian vulture (Stoyanov & Boev 2009).

## Rodentia

### Sciuridae

The two species of the family were represented – the Red squirrel (*Sciurus vulgaris* Linnaeus, 1758) and the European ground squirrel (*Spermophilus citellus* Linnaeus, 1766). The Red squirrel inhabits beech forests, as well as walnut gardens (Markov 1968). It has been found in the diet of the Eagle owl (Baumgart *et al.* 1973).

The European ground squirrel has been widely distributed in the past in Bulgaria – from lowlands to open habitats in high mountain up to 2000 m a.s.l. (Koshev 2008). Markov (1968) reported the species as common in the western Balkan mountain. Preliminary evidence of *S. citellus* at the end of the 1950s there by shepherds-Karakachans area around hut Parshevitsa (G. Stoyanov, unpublished data). Atanasov *et al.* (2001) found only single

specimens in NP “Vrachanski balkan”, but after that neither Zidarova (2007) nor the study before reintroduction, confirmed this information.

The project “Implementation of activities for the planning and management of NP “Vrachanski Balkan” within the Operational Programme” Environment 2007-2013” provided means for the reintroduction of *S. citellus*. The project started with the preparation of a plan for reintroduction, using the recent literature sources (Hapl *et al.* 2006, Gedeon *et al.* 2011, Matějů *et al.* 2010, 2012).

Measures were undertaken to improve its habitat and status, specifically through reintroduction of the species. During the project were carried studies and analyses of the environmental conditions and abiotic factors of potential reintroduction sites (e.g. soil types, vegetation, land cover type, intensity of grazing, predators, lack of threatening factors). Colonies from the Danube plain were explored to provide individuals for the reintroduction. The surveys showed that only one colony near Kobilyak village had sufficiently high density to be a donor of individuals. During the study were identified target habitats in the NP in which to place *S. citellus*. Each of the selected sites had to meet all the basic requirements for conditions of habitats, including being previously inhabited by ground squirrels. The survey conducted before the reintroduction did not reveal ground squirrels in the Natural Park.

The location chosen for reintroduction (south of Parshevitsa hut) was prepared in advance by erecting an electric fence and organizing grazing by horses. Special adaptation cages for *S. citellus* were placed, under continuous observation by experts. Artificial holes in which to put individuals were made with a motorized drill. Reintroduction was carried out in the spring and early summer of 2013 and 2014. Prior to release, captured individuals of *S. citellus* from the donor colony were measured; their sex and age were determined and individuals were tagged with transponders. Individuals in poor health, unsuitable conditions or age (too young or old) were not used for the reintroduction. Thus, 91 individuals were selected to be released in NP “Vrachanski Balkan”. The number of individuals was further limited by the density of the colony-donor and the extremely unfavourable weather conditions during the adaptation period for animals (Koshev, Arangelov - unpubl. data).

During both years of reintroduction were observed extreme weather values for rainfall (exceeding the respective month’s average) and low temperatures during the active period of *S. citellus*. In addition, there was an accumulation of predators (personally unpublished data - G. Stoyanov). The synergistic effect of these negative factors are likely adversely affect the released individuals.

*S. citellus* successfully survived the first stage of the reintroduction – the establishment and survival of individuals to the new territory in the early days and into hibernation.

## **Gliridae**

Two of the four species of dormice in Bulgaria, are widespread in the country – the Edible Dormouse (*Glis glis* Linnaeus, 1766) and the Forest Dormouse (*Dryomys nitedula* Pallas, 1778). They can be found from the sea level up to high altitudes in the mountains (Peshev *et al.* 2004). Markov (1968) reported the Edible Dormouse from the vicinity (from a walnut garden) of Vratsa town. Remains from this species were found in bat’s boxes from Bilichin preslap, also from Sokolskata cave above Lyutadzhik village, Goliamata cave nearby Zgorigrad village, and Ochindol village (Zidarova 2007). It has been found in the

diet of the Eagle owl (Baumgart *et al.* 1973). Atanasov *et al.* (2001) reported the Forest dormouse in the forest of the NP “Vrachanski Balkan”, without specifying an exact location.

The presence of the third dormouse species – the Hazel dormouse (*Muscardinus avellanarius* Linnaeus, 1758) is likely. Markov (1968) reported this species from the Western part of the Balkan mountain.

### **Muridae**

The Wood mice (*Apodemus*) are one of the most numerous and widespread rodents in Europe and Bulgaria, occurring in various habitats. The Yellow-necked mouse (*Apodemus flavicollis* Melchior, 1834) inhabits the forests in the Western Balkan Mountain (Markov 1968). The lower part of the mountain are inhabited by the Wood mouse (*Apodemus sylvaticus* Linnaeus, 1758), preferring more open habitats than *A. flavicollis* – arable lands, gardens, forest edges (Markov 1968, Atanasov *et al.* 2001).

The Striped field mouse (*Apodemus agrarius* Pallas, 1771) is a mesophyll species, related to wet habitats, but in northern Bulgaria it is one of the dominant species in alfalfa fields, occurring mainly in the lower elevation areas of the country. It has been found nearby Ledenika cave (Zidarova 2007) and Cherepish village (Belcheva *et al.* 1987).

The Harvest mouse (*Micromys minutus* Pallas, 1771), also prefers wet habitats, and is likely to be present in Vrachanska Planina Mts.. In the Balkan Mountain this species distribution goes up to 1200 m a.s.l. (Peshev *et al.* 2004).

In human settlements live some synanthropic species such as the House mouse (*Mus musculus* Linnaeus, 1758), the Brown (*Rattus norvegicus* Berkenhout, 1769) and Black rats (*R. rattus* Linnaeus, 1758). The Brown rat has been one of the predominant species in the diet of an Eagle owl nearby Gara Cherepish (Baumgart *et al.* 1973).

### **Arvicolidae**

The Bank vole (*Clethrionomys glareolus* Shreber, 1780) is a typical inhabitant of our mountains. This is a dominant species in the beech forest in the Balkan Mountain (Markov *et al.* 1978, Atanasov *et al.* 2001)

In Bulgaria, the *Microtus* genus is represented by two twin species – *Microtus* (s.str.) *arvalis* (Pallas, 1778) and *Microtus* (s.str.) *levis* (Miller, 1908) (*M. rossieameridionalis* Ognev, 1924) (Peshev *et al.* 2004). Their identification is practically impossible solely based on conventional characteristics (e.g. fur color, body and skull size) (Peshev *et al.* 2004), so in this work we use the name *M. ex gr. arvalis* for the grey vole. It inhabits open habitats in the natural park – meadows and pastures (Atanasov *et al.* 2001). It was found in the diet of a Little owl from Stoyanovo village, in the diet of Long-eared owl from Skaklia cave (Atanasov *et al.* 2001), also in the diet of the Eurasian Scops owl (Simeonov 1981) and the Egyptian vulture (Stoyanov & Boev 2009).

The European pine vole (*Microtus subterraneus* Selys-Longchamps, 1836) inhabits various deciduous and coniferous forests in our mountain, but it is a rare species in the lower elevations (Peshev *et al.* 2004). Its presence was not confirmed, but it is one of the dominant species in the small mammal community of the beech forest of the Balkan Mountain (Markov *et al.* 1978).

The Water vole (*Arvicola terrestris* Linnaeus, 1758) inhabits river and stream banks. It was found in pellets of a Little owl from Stoyanovo village, and also in the diet of an Eagle owl nearby Gara Cherepich (Baumgart *et al.* 1973).

The Snow vole (*Chionomys nivalis* Martins, 1842) is a typical rock-dwelling species,



which inhabits Bulgarian mountains, mainly in their higher part. This species was found nearby Lakatnik and Cherepish; these locations being among the lowest observations in Bulgaria. There, the species population was in low numbers (Peshev 1969). Recently, this vole was reported from the vicinity of Madzharovo town (Eastern Rhodopes) at an elevation 150–200 m a.s.l. (Nedyalkov 2012).

It has been found in the pellets of a Long-eared owl (*Asio otus*) from “Skaklia cave” (Atanasov *et al.* 2001). A dead specimen of the species was found in the rocky massive above Dolno Ozirovo village (G. Stoyanov, unpubl. record).

### **Spalacidae**

The Lesser Mole rat (*Spalax leucodon* Nordmann, 1840) inhabits open habitats, e.g. meadows and pastures (Atanasov *et al.* 2001). The species is well distributed in the region of Ponor Mountain (Koshev 2014).

### **Threats for small mammals**

Amongst the threats for the populations of small mammals in Vrachanska Planina Mts. we have identified:

- Investment proposals those are likely to damage the habitats of small mammals. All forms of construction (e.g. for ski runs, wind- and solar power parks, hydropower plants, infrastructure objects, power lines) can directly destroy the habitats of small mammals and/or lead to deterioration of the environment.

- Poaching (mostly associated with illegal hunting and illegal logging of wood) can lead to direct destruction of forest habitats and may influence negatively mammal populations, especially through excessive hunting of hare. Currently, within the park territory is situated hunting reserve “Ledenika”, where control and prevention of illegal hunting are exercised.

- Incorrect pasture management is a possible threat. Grazing is an essential factor for the proper management of open habitats, changing the direction of the succession processes; however, grazing in forest habitats needs constant monitoring (Koshev 2014).

- Unregulated garbage disposal, which is most often seen near tourist sites and the most visited tourist routes.

- Non-reclaimed tailings and mining areas. Although the mines in the area of the park are not operational anymore, most of the tailings ponds have not yet been reclaimed and pose a potential risk during high levels of rainfall and subsequent flooding.

- Fires caused by human activity. Lighting fires in unsecured locations poses a risk of forest fires and loss of habitats. The Directorate of the Natural park has developing a system for monitoring and early warning of fires, which greatly reduces this risk.

- Unregulated (intensive) traffic of motor vehicles, including SUVs, snowmobiles, motorcycles, ATVs, etc. outside the roads of the national road network, the municipal roads and the specially designated for this purpose forest roads.

- Climate changes has negative impact on hibernating mammals (e.g. *D. nitedula*, *M. avellanarius*, *G. glis* and *S. citellus*) (Inouye *et al.* 2000).

### **Conservation activities**

To promote the long-term preservation of small mammals in the Vrachanska Planina Mts., we propose the following:

All investment proposals related to the building of new road infrastructure,

construction, forest management projects, etc., should be mandatorily assessed for environmental impact and for the compatibility with the goals of the Management plan of NP "Vrachanski Balkan" and Natura 2000 Network of Protected Areas and co-ordinated with scientific institutes and universities.

Enforcement of rights-of-way and limit on the intensive traffic of vehicles and mechanized equipment on pastures, meadows and grassy fields and other locations off the designated roads.

Prohibition of plowing and planting of meadows and pastures and turning them into arable land and permanent crops and changing their permanent use.

Development of environmentally friendly forms of agriculture and livestock breeding.

Stimulating free pasture breeding and mowing, to favor the maintenance and conservation of natural grasslands and meadows.

Preservation of old-growth forests, which maintain the rich diversity of small mammals of conservation importance.

Limiting the transformation of meadows and grasslands into arable lands.

Limiting the construction of forest roads and enforcing the speed limits on the roads.

Provision of dry passageways for small mammals, guiding paths and noise barriers, during the construction of new roads or renovation of old ones.

Continued scientific research in order to establish the species composition of the small mammals and the population characteristics of the species of conservation importance completely.

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### References

- Atanasov, N., Pandourski, I., Pandourska, R. & Guéorguiev, R. (2001) Contemporary investigations on the fauna of the Natural Park „Vratchanski Balkan“. – In: *Natural potential and stable development of the mountainous regions. Balkan scientific – practical conference*. Symposium. Vratsa (Alpiko – BG print), 82-97. (In Bulgarian, English summary).
- Balaz, I., Jancova, A. & Ambros, M. (2008) Restitution of the European Ground Squirrel (*Spermophilus citellus*) in Slovakia. *Lynx*, n. s., 39: 235–240.
- Baumgart, W., Simeonov, S. D., Zimmermann, M., Bonsche, H., Baumgart, P. & Kohnast, G. (1973) An Horsten des Uhus (*Bubo bubo*) in Bulgarien. I. Der Uhu im Iskerdurchbruch (Westbalkan). *Zoologische Abhandlungen aus dem staatlichen Museum für Tierkunde in Dresden*, 32: 203-247.
- Belcheva, R. & Kolevska, N. (1992). Cytogenetical study of some Soricidae (Insectivora, Mammalia). *Annuaire de L'Universite de Sofia "Kliment Ohridski" Faculte de Biologie, Zoologie*, 80 (1): 144-156.

- Belcheva, R., Topashka-Ancheva M., Peshev D. & Gerasimov S. (1987) Kariologichni izsledvania na nyakoi vidove grizachi ot Bulgaria (Kariological studies on some rodent species in Bulgaria). – in: *Savremenni postizhenia na balgarskata zoologia BAN (Contemporary achievements on Bulgarian zoology, BAS)*, 376-379. (in Bulgarian)
- Budajova, J. (1995) Experiences with repatriation of the European souslik in the Košická basin]. Pp.: 103–107. In: URBAN P. (ed.): *Mammal Research and Conservation in Slovakia II*. Štátna ochrana prírody SR, Banská Bystrica, 112 pp (in Slovak, English summary).
- Gedeon, C. I., Váczi, O., Koósz, B. & Altbäcker, V. (2011) Morning release into artificial burrows with retention caps facilitates success of European ground squirrel (*Spermophilus citellus*) translocations. *European Journal of Wildlife Research*, 57 (5): 1101-1105.
- Golemansky, V. (ed.) 2011. *Red Data Book of the Republic of Bulgaria*. Vol. 2 Animals. Digital edition. Sofia (IBER – BAS & MOEW).
- Hapl, E., Ambros, M., Olekšák, M. & Adamec, M. (2006) Suslik (*Spermophilus citellus*) reintroduction in Slovakia. Guidelines. State Nature Conservancy of the Slovak Republic, Banská Bystrica, 28 pp.
- Inouye, D. W., Barr, B., Armitage, K. & Inouye, B. (2000) Climate change is affecting altitudinal migrants and hibernating species. *Proceedings of the National Academy of Sciences of the USA*, 97 (4): 1630-1633.
- Koshev, Y. (2008) Distribution and status of European ground squirrel (*Spermophilus citellus*) in Bulgaria. *Lynx (Praha)*, n.s., 39 (2): 251-261.
- Koshev, Y. (2012) Ecological and ethological characterization of European ground squirrels (*Spermophilus citellus* L.) in model colonies in Bulgaria. PhD thesis, Institute of Biodiversity and Ecosystem Research, BAS, 30pp.
- Koshev, Y. & Kocheva, M. (2007) Environmental factors and distribution of European ground squirrel (*Spermophilus citellus*) in Bulgaria. *Journal Ecology & Safety. International Scientific Publications*, 1: 276-287.
- Koshev, Y. (2014) Small Mammals (Mammalia: Erinaceomorpha, Soricomorpha, Rodentia and Lagomorpha) in Ponor Special Protection Area (Natura 2000), Western Bulgaria: Species Diversity, Distribution and Conservation . *Acta Zoologica Bulgarica*, Suppl. 5: 107-115.
- Lovari, S. & Rolando, A. (2004) *Guida allo studio degli animali in natura*. Bollati Boringhieri, Torino (Italy), 240 pp.
- Markov, G. (1968) Insektenfressende Säuge- und Nagetiere in Westlichen “Stara-Planina” Gebirge. *Izvestia na Zoologicheskia Institut s Muzei (Bulletin of the Zoological Institute with Muzeum)*, 28: 96-118. (In Bulgarian., German summary).
- Markov, G., Christov, L. & Petrov, E. (1978) Izsledvane na populatsiyata na kafyavata gorska polevka (*Clethrionomys glareolus* Schreb.) v bukova ekosistema na Stara planina (An investigation on the population of *Clethrionomys glareolus* Schreb. in a Beech ecosystem in the Balkan mountain). *Ecology*, Sofia, 4: 45-54. (In Bulgarian, English summary).
- Matějů, J., Štěpánka, Ř., Michal, A., Borys, K., Ervín, H. & Matějů K. (2010) Reintroductions of the European Ground Squirrel (*Spermophilus citellus*) in Central Europe (Rodentia: Sciuridae). *Lynx*, n.s. 41: 175-191.
- Matějů, J., Řičanová, Š., Poláková, S., Ambros, M., Kala, B., Matějů, K. & Kratochvíl, L.

- (2012) Method of releasing and number of animals are determinants for the success of European ground squirrel (*Spermophilus citellus*) reintroductions. *European Journal of Wildlife Research*, 58 (2): 473-482.
- Nedyalkov, N. (2013) New records of some rear rodents from South-east Bulgaria. *ZooNotes*, 39: 1-4.
- Peshev, Ts. (1969) Distribution and taxonomy of *Microtus nivalis* Martins (Mammalia) in Bulgaria. *Izvestia na Zoologicheskia Institut s Muzei (Bulletin of the Zoological Institute with Muzeum)*, 30: 197-219.
- Peshev, T., Peshev, D. & Popov, V. (2004) *The Fauna of Bulgaria. Vol. 27. Mammalia*. Sofia (Editio Academica „Marin Drinov). 632 pp. (in Bulgarian, English summary).
- Simeonov, S. (1968) Iviaterialien uber die nahrung des Dteinkauzes (*Athene noctua* SCOPOLI) in Bulgarien. *Fragmenta Balkanika, Musei Macedonici scientiarum naturalium, Skopje*, 6, 17 (152): 157-165.
- Simeonov, S. (1981) Prouchvane na gnezdovata biologia i hraniyelnia spektar na chuhala (*Otus scops* (L.)) v Bulgaria (Study on the breeding biology and diet of Eurasian scops owl (*Otus scops* (L.)) in Bulgaria). *Ecology*, Sofia, 9: 51-57. (in Bulgarian)
- Stoyanov, G. & Boev, Z. (2009) Dei Nahrung des Schmutzgeiers *Neophron percnopterus* in Norwest-Bulgarien. *Ornithologische Mitteiluneen*, 61 (10): 333-335.
- Zidarova, S. (2007) Klas Bozainitsi (Mammalia: Insectivora, Rodentia, Lagomorpha, Artiodactyla, Carnivora). – In: *Plan za upravlenie na Priroden park “Vrachanski Balkan”*. (Management Plan of Nature Park “Vrachanski Balkan”) (Agrolesproject Ltd.). 185- 190. (in Bulgarian).

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## **Видов състав и консервационен статус на дребните бозайници (Mammalia: Erinaceomorpha, Soricomorpha, Lagomorpha, Rodentia) на Врачанска планина**

НЕДКО НЕДЯЛКОВ, ЙОРДАН КОШЕВ

**(Резюме)**

Обобщени са данните за дребните бозайници на Врачанска планина използвайки литературни и авторски данни. Установени са 27 вида всички са типични за този район на България. Европейският лалугер *Spermophilus citellus*, вид с висок консервационен статус, в миналото широко разпространен, вероятно изчезва през 50-те години на XX век. През последните няколко години се провеждат дейности по неговото възстановяване. Анализират се заплахите за дребните бозайници и се предлагат мерки за тяхното смекчаване.