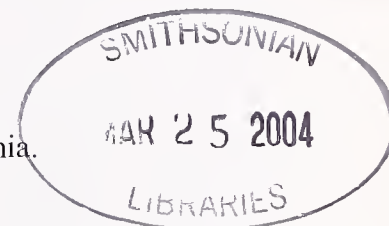


Annotated Checklist of the Mammals of the Republic of Macedonia

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Abstract. Eighty-two mammals in 51 genera, 18 families and 6 orders occur in the Republic of Macedonia. Eight species were introduced, either deliberately or accidentally by humans, and the red deer, *Cervus elaphus*, has been reintroduced. The number of recent human induced extinctions is low, and includes, besides the red deer, also the golden jackal, *Canis aureus*.

Any domesticated mammal has established permanent feral populations. Among the 25 taxa originally named and described from the Republic of Macedonia, three are currently considered to be valid species: *Talpa stankovici*, *Microtus felteni*, and *Mus macedonicus*. All new names, proposed for Macedonian mammals are listed and type localities are shown on a map. Distribution of 20 species is spot mapped.

Key words. Mammalia, status, biogeography, distribution, bibliography

INTRODUCTION

1.1. General

The Republic of Macedonia, one of the top European hot spots of biodiversity (GASTON & RHIAN 1994), has attracted considerable attention of naturalists in this century. Consequently, compared with the general level of knowledge in the Balkans, its mammal fauna is fairly well known. The results, however, have been published in numerous, very different languages and are widely scattered in many periodical or occasional publications, at least some of which are not easily accessible. Thus, the aim of this checklist is to provide the reader with an up-to-date summary of the current state of knowledge concerning Macedonian mammals. Although all available published information known to the authors has been considered, the report is also based on the authors' first hand experience with the mammals of the Republic of Macedonia.

1.2. Geography

The Republic of Macedonia is located in the central part of the Balkan Peninsula (Fig. 1). It has existed within its present borders since 1945 as one of the federal units of the Socialist Federal Republic of Yugoslavia; in 1991 the Republic of Macedonia declared its independence. Until 1912, this area was a part of the Ottoman Empire, then was included as Southern Serbia within the Kingdom of Serbia (until 1918), and then within the Kingdom of Yugoslavia (until 1941). The area under study should not be confused with the province of Macedonia in northern Greece.

Republic of Macedonia consists of three main natural units (Fig. 1): the mountainous eastern and western

regions and the lowlands. The first two are delimited by the River Vardar. Western Macedonia is a part of the Šara-Pindus mountain massifs (highest peak 2748 m), while Eastern Macedonia contains portions of the Rhodope mountains (highest peak 2252 m). The bedrock is mostly sediments of the Lower Palaeozoic, as well as metamorphic rocks with occasional limestones. The Macedonian lowlands stretch primarily along the River Vardar, albeit there is also an extensive lowland (Pelagonija) in Western Macedonia.

Summers are hot and winters generally cold. The average temperature of the warmest month in the lowlands is 26.0°C (Demir Kapija), and of the coldest, -0.1°C (Skopje). The climate is dry with annual precipitation up to about 600 mm in the lowlands. Temperatures rapidly drop with increasing altitude; the average temperature of the warmest month on Mt. Pelister (at an altitude of 1220 m) is 18.9°C and of the coldest month, -1.9°C. Mt. Pelister receives annual precipitation of 1060 mm; however, precipitation is lower in the majority of remaining mountains. Mediterranean climatic influences penetrate along the River Vardar as far north as Skopje, but the effects generally remain to the south of Demir Kapija.

The indigenous vegetation of the lower altitudes is forests of *Quercus pubescens*, *Q. cerris* and *Carpinus orientalis*. The dry areas of south-eastern Macedonia are overgrown with degraded remnants of *Q. coccifera* shrublands. At higher altitudes forests are mainly of *Q. petraea* and *Fagus moesiacus*. For more comprehensive information about vegetation see JOVANOVIĆ et al. (1986).

Lower areas are subject to intensive cultivation, the forests being preserved only in the mountains. Nevertheless, montane forests are also frequently overex-



Fig. 1. The three main natural regions of the Republic of Macedonia. I – Western Macedonia, II – Eastern Macedonia, III – low Macedonia. See text for explanation.

plotted, and cleared pastureland above the tree line is usually overgrazed by extensive sheep flocks. Impacts from human activities are more obvious in Eastern Macedonia (25–50% of area under cultivation) than in Western Macedonia (10–15% of area being cultivated). The human population of the Republic of Macedonia (area 25,713 km²) is 2,034,000 (1991), which gives an average density of 79 persons per km² (45 per km² in 1948).

1.3. History of Mammal Research

The first known mammal research in the territory of the present Republic of Macedonia was undertaken by a German zoologist, F. DOFLEIN, during World War I (DOFLEIN 1921). In the post-war period, extensive studies of Macedonian fauna were initiated by S. KARAMAN from the Natural History Museum in Skopje (established in 1926). KARAMAN was a zoologist of broad scientific interest. Mammal papers (KARAMAN 1929, 1931, 1937) are only a minor part of his exten-

sive bibliography. The most detailed research on Macedonian mammals was, however, performed by the Russians, V. E. MARTINO and his wife E. V. MARTINO. During the period between the First and Second World Wars, this couple organised field expeditions to different parts of region which, at that time, had not been explored by any researcher of mammals: Mt. Pelister (1929), Mt. Bistra (1933), Mt. Korab (1935), Mts. Jakupica and Karađica (1937), and Mt. Kožuv (1938).

In addition, the MARTINOS also studied specimens collected either by themselves or by their collaborators from Ohrid, Gevgelija, Kočani, Prilep, Mt. Šar planina, Skopje, Kumanovo, and Mariovo. Of the 25 new names proposed so far for Macedonian mammals, 14 were published by the MARTINOS. Among numerous other papers (see list of references) they also provided the first list of the mammals from this region, then known as Southern Serbia (MARTINO, V. 1939a); the 75 specific and subspecific names indicate the presence of 61 different species, as they are understood today. Shortly before World War II, B. M. PETROV began his lifelong study of the mammals of the region by his independent collection of insectivores, bats, and rodents in the Vardar valley (PETROV 1939a, b, 1940).

After 1945, Macedonian mammals attracted the attention of researchers from Skopje (A. ĐIMOVSKI, L. STOJANOVSKI), Belgrade (B. M. PETROV, A. RUŽIĆ-PETROV, Đ. MIRIĆ, M. TODOROVIĆ, I. R. SAVIĆ, M. TODOROVIĆ, Z. DUNĐERSKI, S. ŽIVKOVIĆ, D. RIMS), Zagreb (B. ĐULIĆ, Z. VIDINIĆ), and Germany (F. FELTEN, F. MALEC, G. STORCH, H. HACKETHAL, G. PETERS). A Catalogue of the mammals of the Socialist Federal Republic of Yugoslavia, compiled by B. ĐULIĆ and Đ. MIRIĆ (1967), is still the most recent checklist available for Macedonian mammals; 70 species, as understood today, are listed (introductions were not considered). Although nomenclature and taxonomy are out of date in several cases, the Catalogue is still a valuable source for references published by the mid-1960s.

Further information concerning the history of mammal research in the Republic of Macedonia may be found in the papers of ĐULIĆ (1987), PETROV (1992), and ZIMMERMANN (1962).

2. Material and Methods

This checklist is based on published information (see list of references); however, we also consulted specimens in the collections of the Slovenian Museum of Natural History, Ljubljana; Macedonian Natural History Museum, Skopje; Natural History Museum, London (MARTINO's collection); Naturhistorisches Museum Wien, Vienna; Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main; and Zoologische Staatssammlung München, Munich (DOFLEIN's specimens).

Listed are all species of mammals known to occur in the territory of the Republic of Macedonia in the wild, no matter whether they are indigenous or introduced by man. We also endeavoured to provide the most recent information regarding their status. Taxonomy and nomenclature follow WILSON & REEDER (1993) and MITCHELL-JONES et al. (1999). For common names (in Macedonian) see MITCHELL-JONES et al. (1999).

Annotations are intended to provide concise information on the actual status, both taxonomic and distributional, of a particular species in the Republic of Macedonia. Wherever we confronted a lack of published primary sources, we substituted other relevant data, if available.

Taxonomic content includes information on conventional diagnostic characters, morphology and morphometrics, karyotype, and genetic makeup. Described subspecies were considered in spite of the fact that very few have been subjected to comprehensive comparative studies and critical re-evaluations. Listed are all taxa described from the territory of the Republic of Macedonia. **Type localities** of all mammalian taxa (species, subspecies or lower rank) are mapped on Fig. 2. Because many place names were subjected to changes during this century, it is not unusual to encounter geographic names in Turkish, Serbian, Albanian and Macedonian. In this paper, valid Macedonian names are given; see also KRYŠTUFEK et al. (1992).

The section on **Distribution** provides the reader with published sources containing distributional map(s). In cases where we had at our disposal significant additions to maps already published, or where there was a total lack of information, we have provided amended maps. Whenever possible, dot maps with place names and sources are given. Any other relevant information for a particular species is given as **Other information**.

2. CHECKLIST

Eighty-two mammals in 51 genera, 18 families and 6 orders occur in the Republic of Macedonia (Table 1); however, the continuous presence of several introduced species is doubtful (e.g., the rabbit, *Oryctolagus cuniculus*). Eight species were introduced, either deliberately or accidentally by humans, and the red deer, *Cervus elaphus*, has been reintroduced. The number of recent human induced extinctions is low, and includes, besides the red deer, also the golden jackal, *Canis aureus*.

Any domesticated mammal has established permanent feral populations. Among the 25 taxa originally named and des-

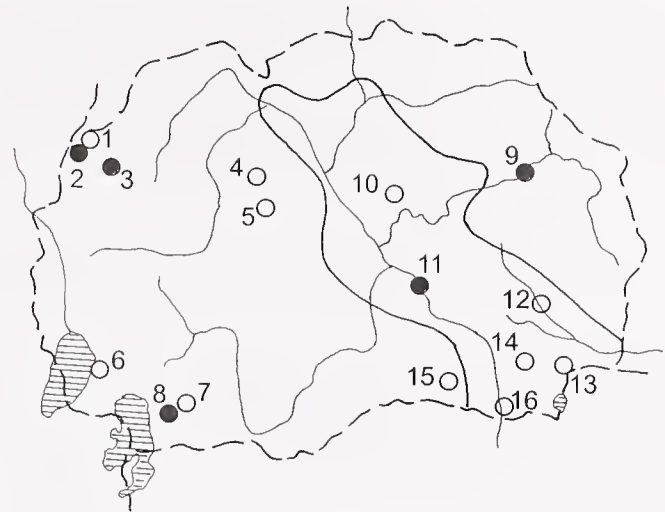


Fig. 2. Type localities of mammals which were described and named on specimens originating from the territory of the Republic of Macedonia. Taxonomic names (in parentheses) are given as they appear in original descriptions; valid name follows after equation mark for all those taxa which were named under different generic or specific names. Closed circles indicate type localities with more than one taxon described from.

1 – Mt. Korab: Velika Korabska vrata, 1,900 m (*Dolomys grebenščikovi korabensis* = *Dinaromys bogdanovi*); 2 – Mt. Korab: Čos-Alija, 1,500 m (*Arvicola terrestris korabensis*); Mt. Korab: Štirovica, 1,300 m (*Pitymys mustersi* = *Microtus subterraneus*); Mt. Korab: Guri Velpnis, 1,700 m (*Sylvaenus sylvaticus stankovici* = *Apodemus flavicollis*); 3 – Mt. Bistra: Senečki suvati, 2,000 m (*Dolomys grebenščikovi* = *Dinaromys bogdanovi*); Mt. Bistra: Senečki suvati (*Dryomys nitedula ravijojla*); Mt. Bistra: Trnica, 900 m (*Mus hortulanus caudatus* = *Mus domesticus*); 4 – Mt. Karađica: above Patiška, 2,000 m (*Citellus citellus karamani* = *Spermophilus citellus*); 5 – Mt. Jakupica (*Spalax /Mesospalax/ macedonicus* = *Nannospalax macedonicus*); 6 – Ohrid (*Neomys milleri josti* = *Neomys anomalus*); 7 – Mt. Pelister: Magarevo, 1,000 m (*Talpa romana stankovici* = *Talpa stankovici*); 8 – Mt. Pelister at 1,800 m (*Talpa caeca beaucournei*); Mt. Pelister (*Clethrionomys glareolus makedonicus*); Mt. Pelister: Trnovo, 1,200 m (*Pitymys savii felteni* = *Microtus felteni*); 9 – Kočani (*Erinaceus roumanicus roumanicus* morpha drozdovskii = *Erinaceus concolor*), (*Sylvaenus sylvaticus sylvaticus* morpha *dichruroides* = *Apodemus sylvaticus*); 10 – Ovče Pole, 300 m (*Spalax /Mesospalax/ ovchepolensis* = *Nannospalax leucodon*); 11 – Pepe-lište near Krivolak (*Talpa europaea velessiensis*), (*Sumeromys guentheri martinoi* = *Microtus guentheri*); Trifunoviæevo brdo near Pepe-lište, 400 m (*Rhinolophus ferrum-equinum martinoi* = *Rhinolophus ferrumequinum*); 12 – Dabilja near Strumica, 240 m (*Spalax /Mesospalax/ strumiciensis* = *Nannospalax leucodon*); 13 – Banja Bansko, 265 m (*Apodemus agrarius kalmanni*); 14 – Valandovo (*Mus hortulanus macedonicus* = *Mus macedonicus*); 15 – Mt. Kožuv: Asan-Česma (*Sorex araneus petrovi*); 16 – Gevgelija (*Citellus citellus gradojevici* = *Spermophilus citellus*).

Table 1

Taxonomic breakdown of the mammals of the Republic of Macedonia, by order (numbers of taxa).

Order	Families	Genera	Species	Introduced species	Taxa described from Macedonia
Insectivora	3	6	11		6
Chiroptera	3	10	24		1
Lagomorpha	1	2	2	1	
Rodentia	4	17	26	5	18
Carnivora	4	10	13		
Artiodactyla	3	6	6	2	
Total	18	51	82	8	25

cribed from the republic of Macedonia, three are currently considered to be valid species: Balkan mole, *Talpa stankovici*, Balkan pine vole, *Microtus felteni*, and Balkan short-tailed mouse, *Mus macedonicus*. Although the first two have very small ranges in the western Balkans, any of them is strictly endemic to the Republic of Macedonia.

Order: INSECTIVORA

Distributional data are summarised by PETROV (1992). BRELIH & PETROV (1978) provide data on ectoparasites (Siphonaptera).

Family: Erinaceidae Fischer von Waldheim, 1817
Subfamily: Erinaceinae Fischer von Waldheim, 1817

Genus: *Erinaceus* Linnaeus, 1758

Eastern hedgehog *Erinaceus concolor* Martino, 1838

Taxonomy.

Erinaceus roumanicus roumanicus morpha *drozdovskii* Martino & Martino, 1933

Type locality: Kočani, Republic of Macedonia.

Erinaceus roumanicus drozdovskii V. Martino, 1939 (MARTINO, V., 1939a)

The subspecific position of *drozdovskii* was accepted by the majority of subsequent authorities (e.g. HOLZ & NIETHAMMER 1990); GIAGIA-ATHANASOPOULOU & MARKAKIS (1996) synonymise *drozdovskii* with *E. c. bolkayi* V. Martino, 1930.

Distribution. Widespread and common throughout the Republic of Macedonia. For spot distribution map see PETROV (1992).

Family: Soricidae Fischer von Waldheim, 1817

Subfamily: Soricinae Fischer von Waldheim, 1817

Genus: *Sorex* Linnaeus, 1758

Pygmy shrew *Sorex minutus* Linnaeus, 1766

Taxonomy. PETROV (1939b) considered Macedonian pygmy shrews as con-specific with *S. m. volmurchinii* Ognev, 1921; as understood today, *volmurchinii* is an independent species of the Caucasus and northern Asia Minor (HUTTERER 1993). The karyotype of pygmy shrews from Mt. Pelister ($2n = 42$, $NF = 56$) is identical to the one in *S. minutus* (PETROV et al. 1983; ZIMA et al. 1997).

Distribution. All the records are from mountain regions of Western Macedonia (KRYŠTUFEK & PETKOVSKI 1990a; PETROV 1992); no doubt, the species occurs also in the mountains of Eastern Macedonia.

Common shrew *Sorex araneus* Linnaeus, 1758

Taxonomy

Sorex araneus petrovi V. Martino, 1939 (MARTINO, V. 1939a)

Type locality: Asan-Česma, Mt. Kožuv, Republic of Macedonia.

Due to the lack of correspondence between phenetic and chromosomal variation in the common shrew, subspecies seem to be poor predictors of phyletic groups. The Mt. Pelister population displays a unique karyotype within the common shrew (MACHOLÁN et al. 1994): $2n_a = 28$; Y_1 is small

metacentric. This chromosomal form is known as the "Pelister race (Pe)" with the type locality at Mt. Pelister (ZIMA et al. 1996). Genetic properties are described in the papers by MACHOLÁN et al. (1994) and ZIMA et al. (1994), but the evolutionary relationship to other common shrew samples is not clear. Phenetic variation is poorly documented (e.g. MARTINO 1939a, FELTEN & STORCH 1965).

Distribution. All the records are from the mountainous regions of Western Macedonia (Fig. 3), the lowest being from the banks of Lake Prespa at 1,000 m above sea level (KRYŠTUFEK & VOHRALÍK 1992). Its presence is still not confirmed for the mountains of Eastern Macedonia in spite of intensive field work conducted there.

Genus: *Neomys* Kaup, 1829

For distinguishing characters of the two species see KRYŠTUFEK & PETKOVSKI (1989). Phenetic relationships between Macedonian water shrews and those from the Balkans and Asia Minor have been evaluated by KRYŠTUFEK & GRIFITHS (2000).

Water shrew *Neomys fodiens* (Pennant, 1771)

Taxonomy. MARTINO (1939a) ascribed Macedonian water shrews to the nominal race, which was also followed by ĐULIĆ & MIRIĆ (1967). For biometric data, see KRYŠTUFEK & PETKOVSKI (1989) and SPITZENBERGER (1990b). Karyotype was described by ZIMA et al. (1997) on the basis of specimens from Mt. Pelister: $2n = 52$. Species identity of Macedonian water shrews was confirmed by an approximate 379 base pair sequence of 12S rRNA fragments (KRYŠTUFEK et al. 2000).

Distribution. Widespread in the mountains of Eastern and Western Macedonia (Fig. 4).

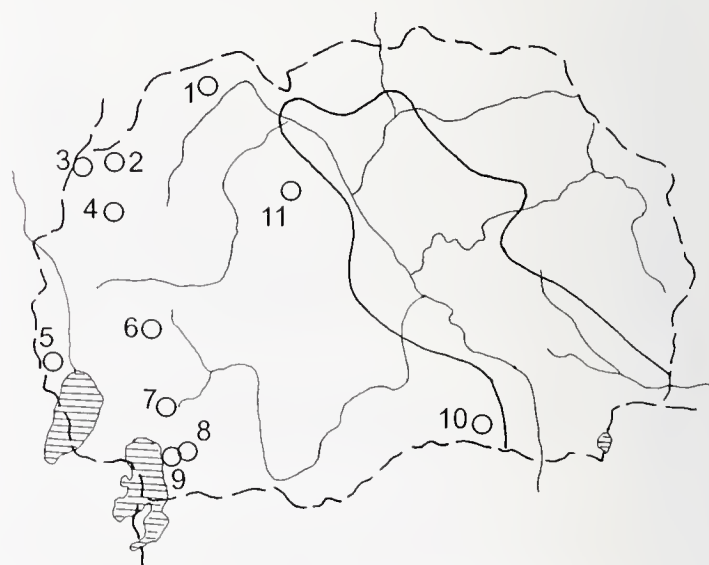


Fig. 3. Localities of the Common shrew *Sorex araneus* in the Republic of Macedonia.

1 – Mt. Šar planina: Popova Šapka; Jelak and Lešnica; 2 – Dolno Lukovo; 3 – Mt. Korab: Strezimirovo; Čosalije; 4 – Mt. Bistra: above Mavrovi Anovi; 5 – Mt. Jablanica: Gorna Belica; 6 – Mt. Karaorman: above Crven Kamen; 7 – Mt. Pelister: Kopanki; Begova Česma; 8 – Mt. Pelister: Golemo Ezero; 9 – Asamati, Kurbinovo; 10 – Mt. Kožuv: Asan Česma; 11 – Mt. Jakupica: Kitka. Based on PETROV (1992), STOJANOVSKI (1996) and new unpublished records.

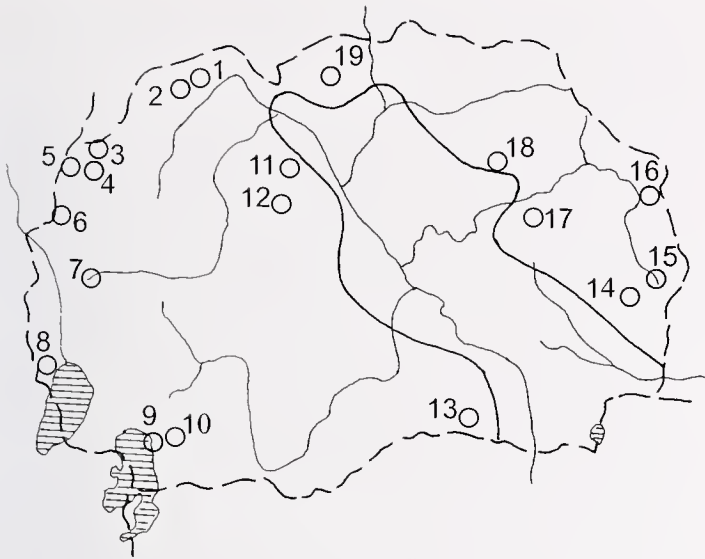


Fig. 4. Localities of the Water shrew *Neomys fodiens* in the Republic of Macedonia.

1 – Mt. Šar planina: Popova Šapka; Lešnica; 2 – Mt. Šar planina: spring of the River Ulevička reka; 3 – Gorno Lukovo Pole; 4 – Dolno Lukovo Pole; 5 – Mt. Korab: Čosalije; 6 – Bituše; 7 – Mt. Stogovo: Ajdar Česma; 8 – Mt. Jablanica: Gorna Belica; 9 – Asamati, Kurbinovo; 10 – Mt. Pelister: Kopaniki; Begova Česma; 11 – Mt. Jakupica: Kitka; 12 – Mt. Jakupica: Aldinci; 13 – Mt. Kožuv: Asan Česma; 14 – Mt. Džami Tepe, Suvi Lak; 15 – Ratevska Reka; 16 – Delčevo, 4 km east of Zvegor; 17 – Zrnovci; 18 – Mt. Osogovo: Ponikva; 19 – Mt. Skopska Crna Gora: Monastery Matejče. Based on KRYŠTUFEK & PETKOVSKI (1990), PETROV (1992), STOJANOVSKI (1996) and new unpublished records.

Miller's water shrew *Neomys anomalus* Cabrera, 1907

Taxonomy

Neomys milleri josti Martino & Martino, 1940 (MARTINO, & MARTINO 1940a).

Type locality: Ohrid, Republic of Macedonia.

MARTINO (1939a) reported two subspecies of *N. anomalus* from the Republic of Macedonia: *N. a. josti* and *N. a. milleri* Mottaz, 1940. SPITZENBERGER (1990a) synonymised *josti* with the nominal subspecies. For biometric data, see MARTINO & MARTINO (1940a), MALEC & STORCH (1963), FELTEN & STORCH (1965), TVRTKOVIĆ et al. (1980), KRYŠTUFEK & PETKOVSKI (1989), and SPITZENBERGER (1990a)

Distribution. Widespread, but restricted to lower altitudes than *N. fodiens* (KRYŠTUFEK & PETKOVSKI 1989; PETROV 1992). The specimen reported by PETROV (1969) for the Šar planina Mts. (at 1,700 m above sea level) seems to be the result of a misidentified *N. fodiens*.

Subfamily: Crocidurinae Milne-Edwards, 1872

Genus: *Suncus* Ehrenberg, 1832

Pygmy white-toothed shrew *Suncus etruscus* (Savi, 1822)

Distribution. Two records are available (Fig. 5); a report for Belčišta needs confirmation.

Genus *Crocidura* Wagler, 1832

Lesser white-toothed shrew *Crocidura suaveolens* (Pallas, 1811)

Taxonomy. MARTINO (1939a) ascribed lesser white-toothed shrews from the Republic of Macedonia to the nominal subspecies, while FELTEN & STORCH (1965) considered them as subspecies *debeauxi* Dal Piaz, 1925. The larger size of Macedonian shrews no doubt follows the general cline representing a negative Bergman's response in Europe (VLASÁK & NIETHAMMER 1990; TOŠKAN 1999). There are also local differences in the Republic of Macedonia, with larger shrews in the lowlands (KRYŠTUFEK, unpublished). For biometric data see FELTEN & STORCH (1965) and VESMANIS (1976). Karyotype was described by RIMSA et al. (1978) based upon five specimens from Lake Dojran: $2n = 40$, $NF = 50$.

Distribution. Fairly widespread but restricted mainly to lowlands (i.e., along the Vardar and its tributaries in Eastern Macedonia; around the Lakes of Prespa and Ohrid). The highest record from the Šar planina Mts. (2,000 m above sea level) is an anomaly. See PETROV (1992) for a spot map.

Bicoloured white-toothed shrew *Crocidura leucodon* (Hermann, 1780)

Taxonomy. MARTINO (1939a) considers the Macedonian bicoloured white-toothed shrew to represent the nominal subspecies; they are actually smaller than central European populations and thus closer to subspecies *narentae* Bolkay, 1925 (KRYŠTUFEK 1997a). The karyotype of specimens from Lake Dojran and Prilep is $2n = 28$, $NF = 56$ (RIMSA et al. 1978).

Distribution. Evidently widespread but uncommon. See PETROV (1992) for spot map.

Family: Talpidae Fischer von Waldheim, 1817

Subfamily: Talpinae Fischer von Waldheim, 1817

Genus: *Talpa* Linnaeus, 1758

For a taxonomic key see PETROV (1971); eye conditions in three Macedonian species were illustrated by PETROV

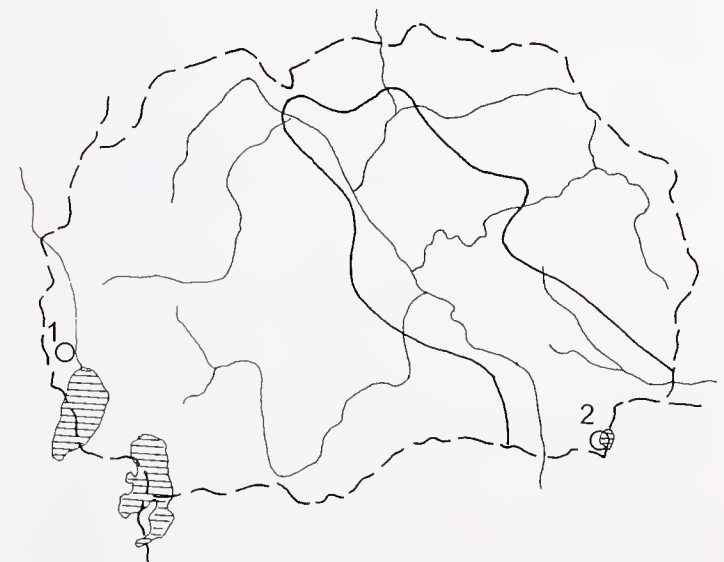


Fig. 5. Localities of the Pygmy white-toothed shrew *Suncus etruscus* in the Republic of Macedonia.

1 – Belčišta (files of the Macedonian Museum of Nat. Hist.); 2 – Lake Dojran: Mrdaja (STOJANOVSKI 1998a).

(1974). TODORVIĆ (1970) compared crania of *T. stankovici* and *T. europaea*; KRYŠTUFEK (1994) compared *T. stankovici* and *T. caeca*.

Common mole *Talpa europaea* Linnaeus, 1758

Taxonomy

Talpa europaea velessiensis Petrov, 1940 (PETROV 1940).

Type locality: Pepelište near Krivolak, Republic of Macedonia.

In the absence of agreement regarding the subspecific division of the northern mole, subspecies *velessiensis* is considered differently, based upon the authority; DOĞRAMACI (1989) ascribes to *velessiensis* moles from European Turkey, while STEIN (1963) synonymised it with the nominal race. Distribution in the Republic of Macedonia of moles with *velessiensis* properties is discussed by PETROV (1992). PETROV (1971) provides morphometric data. Karyotype was studied on specimens from the Tetovo area (TODORVIĆ et al. 1972): $2n = 34$, $NF = 68$, $NFa = 64$.

Distribution. Restricted to Eastern Macedonia, where it is widespread and common. A spot map is provided by PETROV (1992). The only records to the west of the Vardar valley are from Mt. Šar planina and Mt. Kožuv.

Additional information. TODORVIĆ (1955) gives data on moulting.

Blind mole *Talpa caeca* Savi, 1822

Taxonomy

Talpa caeca beaucourmi Grulich, 1971 (GRULICH (1971)).

Type locality: Mt. Pelister, Republic of Macedonia, at 1,800 m above sea level.

Balkan blind moles, including Macedonian ones, differ from the Alpine *T. caeca* in the fundamental number of chromosome arms: $NF = 70$ in the Alps, $NF = 68$ in the Balkans (see NIETHAMMER 1990 for a review). KRYŠTUFEK (1994) synonymised subspecies *T. c. beaucourmi* with subspecies *T. c. hercegovinensis* Bolkay, 1925. Karyotype ($2n = 36$, $NFa = 64$) is reported for specimens from Mt. Jakupica (TODORVIĆ et al. 1972). A detailed morphological description of the population from Mt. Pelister has been provided by GRULICH (1971a); PETROV (1971) published biometric data from some other localities in the Republic of Macedonia; see KRYŠTUFEK (1994) for statistics on biometric data of subspecies *hercegovinensis*, including Macedonian material. Variability of the pelvis is described by GRULICH (1971b) and KRYŠTUFEK (1994).

Distribution. Mountainous regions of Western Macedonia (to the west of the Vardar River). See PETROV (1992) for a spot map.

Additional information. GRULICH (1970) describes habitat requirements.

Balkan mole *Talpa stankovici* Martino & Martino, 1931

Taxonomy

Talpa romana stankovici Martino & Martino, 1931 (MARTINO & MARTINO 1931).

Type locality: village Magarevo, Mt. Pelister, Republic of Macedonia, altitude 1,000 m.

Note: An error occurred in the original description of the type locality; Magarevo is not a mountain, but rather a village on Mt. Pelister.

Morphometric (CORTI & LOY 1987) as well as electrophoretic data (FILIPPUCCI et al. 1987) support the status of *stankovici* as an independent species; PETROV (1992) continues to consider it conspecific with *romana* THOMAS, 1902. Subspecies were reviewed by KRYŠTUFEK (1994), who listed the nominal race for the entirety of the Republic of Macedonia. Biometric data and their variability were provided by PETROV (1971) and KRYŠTUFEK (1987, 1994). Variability of the pelvis is described by GRULICH (1971b), PETROV (1971) and KRYŠTUFEK (1994). Karyotype ($2n = 34$, $NF = 66$, $NFa = 62$) is reported from the Šar planina Mts., Mt. Jakupica, Mt. Bistra, and Mt. Pelister (TODORVIĆ et al. 1972; ZIMA et al. 1997).

Distribution. Western Macedonia, i.e., to the west of the Vardar River. A spot map is provided by PETROV (1992). In contrast to *T. caeca*, with which it is broadly sympatric, *T. stankovici* is also common in the lowlands; the vertical range is from 580 to 2,200 m above sea level.

Additional information. See PETROV (1992) for biological observations.

Order: CHIROPTERA

A faunal review with spot maps and biological observations is provided by KRYŠTUFEK et al. (1992), as updated by KRYŠTUFEK et al. (1998).

Family: Rhinolophidae Gray, 1825

Genus: *Rhinolophus* Lacépède, 1799

Greater horseshoe bat *Rhinolophus ferrumequinum* (Schreber, 1774)

Taxonomy

Rhinolophus ferrum-equinum martinoi Petrov, 1940 (PETROV 1940).

Type locality: Trifunovićevo brdo (č Orl-Bajir) near Pepelište, Republic of Macedonia, altitude 400 m.

Subspecies *R. f. martinoi* was studied in detail by FELTEN et al. (1977); KRYŠTUFEK (1993a) synonymised it with the nominal subspecies. For descriptive statistics of morphometric data see FELTEN et al. (1977).

Distribution. Widespread troglophilous bat. For a spot map see KRYŠTUFEK et al. (1992).

Lesser horseshoe bat *Rhinolophus hipposideros* (Bechstein, 1800)

Taxonomy. ĐULIĆ & MIRIĆ (1967) described two subspecies for the Republic of Macedonia: the nominal and *R. h. minimus* Heuglin, 1861. FELTEN et al. (1977) restricted the latter to Africa and the island of Crete only. Measurements of a single individual were provided by HACKETHAL & PETERS (1987).

Distribution. Scattered throughout the Republic of Macedonia, but the lesser horseshoe bat is less common than its greater counterpart. See KRYŠTUFEK et al. (1992) for a spot map.

Additional information. HACKETHAL & PETERS (1987) and STOJANOVSKI (1994) give some biological notes.

Mediterranean horseshoe bat *Rhinolophus euryale* Blasius, 1853

Taxonomy. ĐULIĆ & MIRIĆ (1967) report the nominal subspecies.

Distribution. All records (seven in total) are from caves in the valley of the Vardar River and from Western Macedonia (KRYŠTUFEK et al. 1992).

Additional information. See HACKETHAL & PETERS (1987) for biological observations.

Mehely's horseshoe bat *Rhinolophus mehelyi* Matschie, 1901

Taxonomy. For a comparison between this species and *R. euryale* see KRYŠTUFEK et al. (1992).

Distribution. Known from two caverns: Belica and Rabrovo (KRYŠTUFEK et al. 1992).

Blasius' horseshoe bat *Rhinolophus blasii* Peters, 1866

Taxonomy. ĐULIĆ & MIKUŠKA (1966) provide biometric data.

Distribution. Known from three caves only: Mečkina dupka, Leskoec and Demir Kapija (KRYŠTUFEK et al. 1992).

Additional information. For biological observations on the colony from Demir Kapija see ĐULIĆ & MIKUŠKA (1966).

Family: Vespertilionidae Gray, 1821

Subfamily: Vespertilioninae Gray, 1821

Genus: *Myotis* Kaup, 1829

Whiskered bat *Myotis mystacinus* (Kuhl, 1819)

Taxonomy. MARTINO (1939a) described "*Myotis (mystacinus) brandti*" for Kočani, Eastern Macedonia, which was followed by ĐULIĆ & MIRIĆ (1967). BENDA (1999) demonstrates that MARTINO's specimens do not belong to *M. brandti* (Eversmann, 1845), but resemble closely *M. mystacinus popovi* Strelkov, 1983. All recently examined "whiskered bats" from the Republic of Macedonia are also *M. mystacinus* (KRYŠTUFEK et al. 1998).

Distribution. Widespread bat (KRYŠTUFEK et al. 1992).

Geoffroy's bat *Myotis emarginatus* (Geoffroy, 1806)

Distribution. Demir Kapija, where a nursing colony was found, is the only record of Geoffroy's bat in the Republic of Macedonia (KRYŠTUFEK et al. 1992).

Natterer's bat *Myotis nattereri* (Kuhl, 1818)

Distribution. This species was recently recorded on Mt. Šar planina (KRYŠTUFEK et al. 1998).

Greater mouse-eared bat *Myotis myotis* (Brokhausen, 1797)

Taxonomy. ĐULIĆ & MIRIĆ (1967) list for the Republic of Macedonia the nominal subspecies. For a comparison between this species and *M. blythi* see HACKETHAL & PETERS (1987) and KRYŠTUFEK et al. (1992). HACKETHAL & PETERS (1987) also give biometric data.

Distribution. Widespread cave dweller. See KRYŠTUFEK et al. (1992) for a spot map.

Additional information. Biological notes are given by ĐULIĆ & MIKUŠKA (1966) and HACKETHAL & PETERS (1987).

Lesser mouse-eared bat *Myotis blythi* (Tomes, 1857)

Taxonomy. ĐULIĆ & MIRIĆ (1967) use the name *oxygnathus* Monticelli, 1885.

Distribution. Widespread but probably less common than the previous species with which it co-occurs in caves (KRYŠTUFEK et al. 1992).

Daubenton's bat *Myotis daubentoni* (Kuhl, 1819)

Distribution. Recorded only from Lake Ohrid (BOGDANOWICZ 1990).

Long-fingered bat *Myotis capaccinii* (Bonaparte, 1837)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian long-fingered bats to the nominal subspecies.

Distribution. Three localities are known in southern Macedonia: Golem Grad on the Lake Prespa, Rabrovo, and Demir Kapija (KRYŠTUFEK et al. 1992).

Genus: *Vespertilio* Linnaeus, 1758

Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian parti-coloured bats to the nominal subspecies.

Distribution. This species was reported only once in Skopje (KARAMAN 1931).

Genus: *Eptesicus* Rafinesque, 1820

Serotine *Eptesicus serotinus* (Schreber, 1774)

Taxonomy. MARTINO (1939a), and later, ĐULIĆ & MIRIĆ (1967), tentatively ascribe Macedonian serotine to the nominal subspecies.

Distribution. In addition to the four locations provided by KRYŠTUFEK et al. (1992), we collected an additional male near the Monastery Sc. Jovan Bigorski. Serotine seems to be widespread, but uncommon in the Republic of Macedonia.

Genus: *Nyctalus* Bowdich, 1825

Leisler's bat *Nyctalus leisleri* (Kuhl, 1818)

Distribution. Recorded only once near Valandovo (KRYŠTUFEK et al. 1992).

Noctule *Nyctalus noctula* (Schreber, 1774)

Taxonomy. ĐULIĆ & MIRIĆ (1967) ascribe Macedonian noctules to the nominal subspecies.

Distribution. The few known localities from the valley of the Vardar river are summarised by KRYŠTUFEK et al. (1992). We collected additional specimens near Ponikve on Mt. Osogovske planine.

Additional information. HACKETHAL & PETERS (1987) provide biological observations.

Genus: *Pipistrellus* Kaup, 1829

Common pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774)

Taxonomy. MARTINO (1939a), and later, ĐULIĆ & MIRIĆ (1967), ascribe Macedonian common pipistrelles to the nominal subspecies.

Distribution. Scattered localities suggest this bat to be widespread (KRYŠTUFEK et al. 1992).

Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling & Blasius, 1839)

Taxonomy. ĐULIĆ & MIKUŠKA (1966) provide biometrical data.

Distribution. Locations are known from the Vardar valley and from Eastern Macedonia (KRYŠTUFEK et al. 1992, 1998).

Additional information. For biological notes see ĐULIĆ & MIKUŠKA (1966).

Kuhl's pipistrelle *Pipistrellus kuhli* (Kuhli, 1819)

Taxonomy. HACKETHAL & PETERS (1987) provide biometrical data.

Distribution. Records are mainly from the Vardar valley (KRYŠTUFEK et al. 1992), but the species was also recorded recently from Eastern and Western Macedonia (KRYŠTUFEK et al. 1998).

Additional information. For notes on biology see HACKETHAL & PETERS (1987).

Savi's pipistrelle *Pipistrellus savii* (Bonaparte, 1837)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian Savi's pipistrelles to the nominal subspecies.

Distribution. Probably widespread (KRYŠTUFEK et al. 1992, 1998).

Genus: *Barbastella* Gray, 1821

Barbastelle *Barbastella barbastellus* (Schreber, 1774)

Distribution. Known only from two localities (Fig. 6).



Fig. 6. Localities of the Barbastelle *Barbastella barbastellus* in the Republic of Macedonia.

1 – Demir Kapija (ĐULIĆ & MIKUŠKA 1966); 2 – 3.5 km north-east of Kriva Palanka (STOJANOVSKI 1998b).

Genus: *Plecotus* Geoffroy, 1818

Grey long-eared bat *Plecotus austriacus* (Fischer, 1829)

Taxonomy. ĐULIĆ (1980) ascribe Macedonian material to the nominal subspecies. Biometrical data are found in ĐULIĆ & MIKUŠKA (1966) and HACKETHAL & PETERS (1987).

Distribution. Three localities are known, all from the lowlands along the River Vardar: Štip, Skopje, and Demir Kapija (KRYŠTUFEK et al. 1992).

Additional information. HACKETHAL & PETERS (1987) give biological observations.

Subgenus: *Miniopterinae* Dobson, 1875

Genus: *Miniopterus* Bonaparte, 1837

Schreiber's bat *Miniopterus schreibersi* (Kuhl, 1819)

Taxonomy. MARTINO (1939a) ascribes Macedonian Schreiber's bats to subspecies *inexpectatus* Heinrich, 1936, which is listed by CORBET (1978) in the synonymy of the nominal race. Descriptive statistics of biometrical data, according to sex, given by HACKETHAL & PETERS (1987).

Distribution. This cavernicolous bat is widespread in the Vardar valley and in Western Macedonia (KRYŠTUFEK et al. 1992).

Additional information. ĐULIĆ & MIKUŠKA (1966) and HACKETHAL & PETERS (1987) give some biological observations.

Family: Molossidae Gervais, 1856

Genus: *Tadarida* Rafinesque, 1814

European free-tailed bat *Tadarida teuiotis* (Rafinesque, 1814)

Taxonomy. ĐULIĆ & MIRIĆ (1967) ascribe Macedonian bats to the nominal subspecies. ĐULIĆ & MIKUŠKA (1966) give measurements of a male specimen and provide its photograph.

Distribution. Recorded in three places in the valley of the Vardar river: Demir Kapija, Markova Kula near Veles, and Skopje (KRYŠTUFEK et al. 1992, 1998).

Order: LAGOMORPHA

Family: Leporidae Fischer, 1817

Genus: *Lepus* Linnaeus, 1758

Brown hare *Lepus europaeus* Pallas, 1778

Taxonomy. MARTINO (1935b) noted the small size of hares from the Republic of Macedonia. ĐULIĆ & MIRIĆ (1967) list for the region two subspecies: *transylvanicus* Matschie, 1901, and *macedonicus* Martino & Paspalev, 1953. The validity of these two taxa is doubtful; there is no evidence of the existence of two distinct morphotypes in the Republic of Macedonia. DONČEV & TRPKOV (1971a) provide external measurements for a pooled sample from different Macedonian localities.

Distribution. Probably widespread but not many distributional records are available.

Additional information. For notes on game biology see DONČEV & TRPKOV (1971b).

Genus: *Oryctolagus* Lilljeborg, 1874

Rabbit *Oryctolagus cuniculus* (Linnaeus, 1758)

Distribution. Feral rabbit occurred on the islet of Golem grad (Lake Prespa) in the 1980s; there is no evidence of its recent occurrence in the Republic of Macedonia.

Order: RODENTIA

PETROV (1992) provides spot distribution maps.

Family: Sciuridae Hemprich, 1820

Subfamily: Sciurinae Hemprich, 1820

Genus: *Sciurus* Linnaeus, 1758

Red squirrel *Sciurus vulgaris* Linnaeus, 1758

Taxonomy. MARTINO (1939a) ascribed Macedonian red squirrels to subspecies *lilaeus* MILLER, 1907, which was followed by subsequent authors (ĐULIĆ & MIRIĆ 1967; FELTEN & STORCH 1965). For colour variation and biometric data see MARTINO (1934a) and FELTEN & STORCH (1965).

Distribution. Common in wooded parts of the entirety of the Republic of Macedonia. For a spot map see PETROV (1992).

Genus: *Spermophilus* Cuvier, 1825

European souslik *Spermophilus citellus* (Linnaeus, 1766)

Taxonomy. *Citellus citellus gradojevici* Martino & Martino, 1929 (MARTINO & MARTINO 1929).

Type locality: Gevgelija, Republic of Macedonia.

Note: see KRYŠTUFEK (1993b) for comments on the type locality as it appeared in the original description.

Citellus citellus karamani Martino & Martino, 1940 (MARTINO & MARTINO (1940b).

Type locality: above Patiška, Mt. Karadžica, Republic of Macedonia, altitude 2,000 m.

For a detailed comparison of the two subspecies see KRYŠTUFEK (1993b). KRYŠTUFEK (1996) evaluated the validity of the recognised subspecies, including both Macedonian taxa; subspecies *karamani* is phenetically most unique among European sousliks. Data are available on the variability of different segments of the phenon: colour (KRYŠTUFEK 1996), skull (KRYŠTUFEK 1993b, 1996), non-metric cranial traits (KRYŠTUFEK 1990a), baculum (KRYŠTUFEK & HRABE 1996), and pelvis (KRYŠTUFEK 1998). Karyotype ($2n = 40$, $NF = 80$) is reported for both Macedonian subspecies (SAVIĆ et al. 1971, SOLDATOVIĆ et al. 1984).

Distribution. Known from two areas: subspecies *karamani* is restricted to high pastures on Mt. Jakupica; subspecies *gradojevici* populates lowlands in the Vardar valley south of Demir Kapija. For details see KRYŠTUFEK (1993b).

Additional information. Information on biology is summarised by KRYŠTUFEK (1993b). Population decline has been documented by RUŽIĆ (1977).

Family: Muridae Illiger, 1815

Subfamily: Arvicolinae Gray, 1821

Genus *Clethrionomys* Tilesius, 1850

Bank vole *Clethrionomys glareolus* (Schreber, 1780)

Taxonomy. *Clethrionomys glareolus makedonicus* Felten & Storch, 1965 (FELTEN & STORCH 1965).

Type locality: Mt. Pelister, Republic of Macedonia.

Morphometric data are provided by FELTEN & STORCH (1965). The karyotype of specimens from Mt. Šar planina is described by VUJOŠEVIĆ & BLAGOJEVIĆ (1997), those from Mt. Pelister (i.e., the topotypes of subspecies *makedonicus*) by ZIMA et al. (1997): $2n = 56$, $NF = 58$, $NFa = 56$. The Y chromosome is metacentric.

Distribution. Wooded regions of Eastern and Western Macedonia (KRYŠTUFEK & PETKOVSKI 1990a; PETROV 1992). See Fig. 7 for details.

Genus: *Ondatra* Link, 1795

Muskrat *Ondatra zibethicus* (Linnaeus, 1766)

Distribution. Recorded along the Rivers Vardar and Bregalnica and around Lake Prespa (PETROV 1992).

Genus: *Dinaromys* KRETZOL, 1955

Balkan snow vole *Dinaromys bogdanovi* (Martino & Martino, 1922)

Taxonomy. *Dolomys grebenscikovi* Martino, 1934 (MARTINO 1934a).

Type locality: Senečki suvati, Mt. Bistra, altitude 2,000 m.

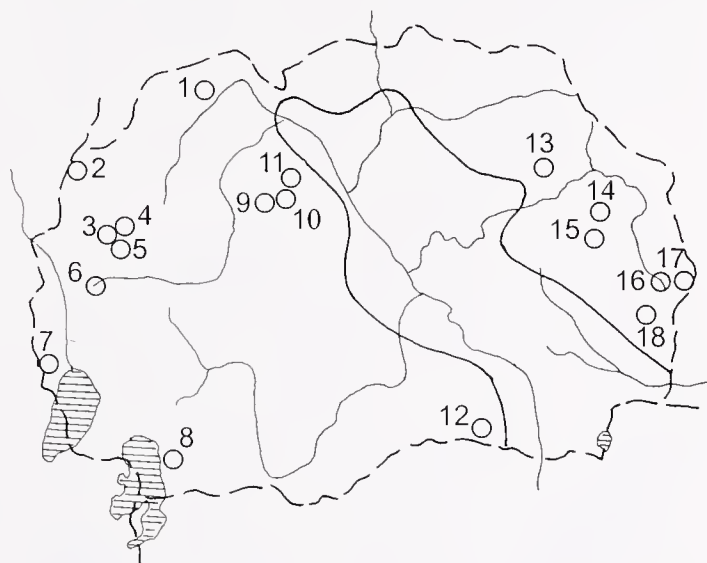


Fig. 7. Localities of the Bank vole *Clethrionomys glareolus* in the Republic of Macedonia.

1 – Mt. Šar planina: Jelak, 1700 m; Popova Šapka, 1750–1800 m; 2 – Mt. Korab: Strezimirovo; Čosalije; 3 – Mt. Bistra: Senečki Suvati; 4 – Mavrovo, Leunovo; 5 – Mt. Bistra, Carevec, 1580 m; 6 – Mt. Stogovo, Ajdar Česma; 7 – Mt. Jablanica, Gorna Belica; 8 – Mt. Pelister: Trnovo, 1200 m; Kopanki, 1600–1700 m; Begova Češma, 1430 m; 9 – Mt. Solunska Glava: Gorno Begovo, 1980 m; 10 – Mt. Karađica: above Patiška; 11 – Mt. Jakupica: Kitka; 12 – Mt. Kožuv: Asan Česma, 1330 m; Dve Uši, 1700 m; 13 – Mt. Osogovo: Ponikva; 14 – Mt. Šavka: Golak, 1200 m; 15 – Budinarci, 800 m; 16 – Berovo, 900 m; 17 – Ratevska reka, 1100 m; 18 – Mt. Ogražden, Suvi Lakim 1300 m. Based on KRYŠTUFEK & PETKOVSKI (1990), PETROV (1992), and new unpublished records.

Dolomys grebenscikovi korabensis Martino & Martino, 1937 (MARTINO & MARTINO 1937).

Type locality: Velika Korabska vrata, Mt. Korab, Yugoslavia, altitude 1,900 m.

TODOROVIĆ (1956) recognised Macedonian MARTINO's voles as a separate group (*grebenscikovi*), which is further supported by allozyme evidence (GILL et al. 1987). For dental variability see TODOROVIĆ (1956); for biometric data see PETROV & TODOROVIĆ (1982); for allelic frequencies of twenty eight proteins see GILL et al. (1987). Karyotype is described from Mt. Šar planina and Mt. Bistra (SAVIĆ et al. 1969; ZIMA et al. 1997): $2n = 54$, $NF = 58$.

Distribution. Restricted to the mountains of Western Macedonia above 1,500 m (Fig. 8).

Additional information. Biological information summarised by PETROV & TODOROVIĆ (1982); this rodent is strictly associated with eroded limestone bedrock, where it seeks shelter in crevices. For ectoparasites (Siphonaptera) see BRELIH (1986).

Genus: *Arvicola* Lacépede, 1799

Water vole *Arvicola terrestris* (Linnaeus, 1758)

Taxonomy. *Arvicola terrestris korabensis* Martino & Martino, 1937 (MARTINO & MARTINO 1937).

Type locality: Čos-Alija, Mt. Korab, Republic of Macedonia, altitude 1,500 m.

Taxonomy. Two additional subspecific names were in use for Macedonian water voles besides *korabensis*: *illyricus*

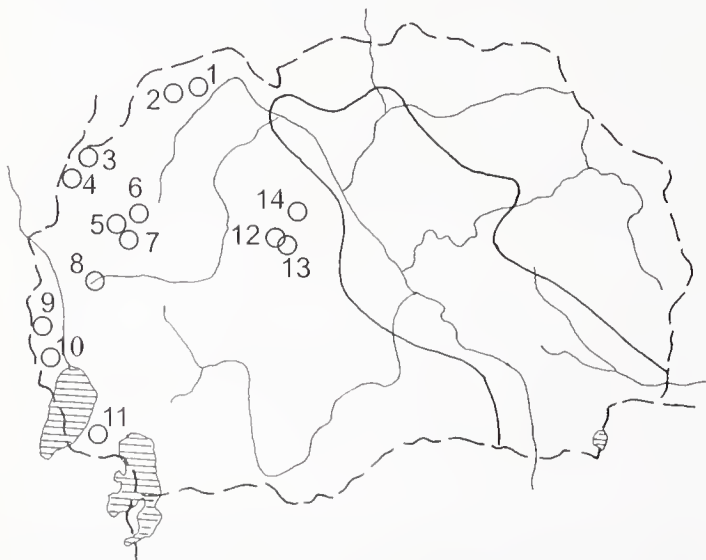


Fig. 8. Localities of the Balkan snow vole *Dinaromys bogdanovi* in the Republic of Macedonia.

1 - Mt. Šar planina: Piribeg, 1700 m; Jelak, 1900 m; 2 - Mt. Šar planina: Ceripašina, 2000 m; 3 - Mt. Korab: Golema Korabska vrata, 1900 m; 4 - Mt. Korab: Kobilino pole, Crna Čuka, 2200 m; 5 - Mt. Bistra: Senečki suvati, 1800-1900 m; Trebiški Čuk, 2000 m; 6 - Mt. Bistra: above Mavrovo, 1700 - 1750 m; 7 - Mt. Bistra, Brzovec; 8 - Mt. Stogovo, Ajdar Česma; 9 - Mt. Jablanica, Podgoriško Ezero; 10 - Mt. Jablanica, above Gorna Belica, 1600 m; 11 - Mt. Galičica, pass, 1600 m; 12 - Mt. Jakupica: Šiljegovica; 13 - Mt. Jakupica: Gorno Begovo; 14 - Mt. Karađica: above Patiška. Based on PETROV (1992) and new unpublished records.

(Barrett-Hamilton, 1899) and *italicus* Savi, 1839 (MARTINO 1939a; MALEC & STORCH 1963). All Macedonian water voles belong to a large aquatic type. For its morphometrics see FELTEN & STORCH (1965).

Distribution. Widespread but restricted to river banks and marshes (KRYŠTUFEK & PETKOVSKI 1990a; PETROV 1992).

Additional information. DUNDJERSKI (1988) documents a population outbreak in the rice fields of Eastern Macedonia.

Genus: *Microtus* Schrank, 1798

Common vole *Microtus arvalis* (Pallas, 1779)

Taxonomy. Information on this species as published before 1975 relates mainly to *M. rossiaemeridionalis* (see below). Karyotype is reported for specimens from Mt. Šar planina, Mt. Bistra and Mt. Maleš (ŽIVKOVIĆ et al. 1975b; PETROV & GAREVSKI 1983; ZIMA et al. 1997): $2n = 46$, $NF = 86$, $NFa = 82$.

Distribution. Karyotyped specimens, which provide the only reliable method of identification, are known from three mountains in north-western and Eastern Macedonia (see above).

Sibling vole *Microtus rossiaemeridionalis* Ognev, 1924

Taxonomy. PETROV (1992) ascribed the Macedonian population to subspecies *M. r. epiroticus* ONDRIAS, 1966. Karyotype is reported from numerous locations throughout the republic of Macedonia (ŽIVKOVIĆ et al. 1975b): $2n = 54$, $NF = 56$; for G-banded karyotype see RADOSAVLJEVIĆ et al. (1990). GILL et al. (1987) report allele frequencies at 28 protein loci. For biometric data see PETROV & RUŽIĆ (1982), for baculum see RUŽIĆ et al. (1975).

Distribution. Widespread in the Republic of Macedonia but restricted to lowlands. See PETROV (1992) for a spot map.

Additional information. For biological data see PETROV & RUŽIĆ (1982) and PETROV (1992).

Guenther's vole *Microtus guentheri* (Danford and Alston, 1880)

Taxonomy. *Sumeromys guentheri martinoidi* PETROV, 1939 (PETROV 1939a).

Type locality: Pepelište near Krivolak, Republic of Macedonia.

Microtus guentheri macedonicus Kretzoi, 1964 (KRETZOI, M. (1964).

Note: *M. g. macedonicus* is a new name for *Sumerionys guentheri martinoidi*, which is preoccupied by *Pitymys nyi-rensis martinoidi* Ehik, 1935.

For a discussion on the validity of *M. g. macedonicus* see ONDRIAS (1966), NIETHAMMER (1982), and PETROV (1992). Cranial dimensions were published by PETROV (1939a); karyotype ($2n = 54$, $NF = 54$) was studied in specimens from Veles (ŽIVKOVIĆ & PETROV 1975).

Distribution. The range is fragmented. One portion is in the lowlands along the Vardar river (north of Pepelište). The other is in the hilly area to the east of Bitola (Fig. 9).

Additional information. See PETROV (1992) for notes on biology.

Common pine vole *Microtus subterraneus* (de Selys-Longchamps, 1836)

Taxonomy. *Pitymys mustersi* Martino & Martino, 1937 (MARTINO & MARTINO 1937).

Type locality: Štirovica, Mt. Korab, Republic of Macedonia, altitude 1,300 m.

The report of *Microtus majori* THOMAS, 1906 for Mt. Pelister (STORCH 1982) actually pertains to *M. subterraneus* (KRYŠTUFEK et al. 1994). Karyotype is described in specimens from Mt. Šar planina, Mt. Pelister and Mt. Kajmakčalan (PETROV & ŽIVKOVIĆ 1971a,b; ŽIVKOVIĆ et al. 1975b; KRYŠTUFEK et al. 1994): $2n = 52$, $NF = 60$; the Mt. Pelister population is characterised by a large Y chromosome (KRYŠTUFEK et al. 1994). For allele frequencies of the Mt. Pelister population see KRYŠTUFEK et al. (1994). For biometric data see FELTEN & STORCH (1965), MALEC & STORCH (1963), and STORCH (1982).

Distribution. According to PETROV (1992) the range covers the mountains along the borders with Albania, Greece and Bulgaria; Common pine vole also occurs in central Macedonia (Mt. Jakupica; unpublished data).

Balkan pine vole *Microtus felteni* (Malec & Storch, 1963)

Taxonomy. *Pitymys savii felteni* Malec & Storch, 1963 (MALEC & STORCH 1963).

Type locality: Trnovo, Mt. Pelister, Republic of Macedonia, altitude 1,200 m.

See PETROV et al. (1976) for a detailed description, biometric data, and the karyotype ($2n = 54$, $NF = 56$, $NFa = 54$). GILL et al. (1987) report 28 protein loci. This vole was first described as a subspecies of *M. savii* (de Selys-Longchamps, 1838) and later raised to the specific level based upon chromosomal evidence (PETROV & ŽIVKOVIĆ 1979); PETROV (1992) again considers it within the scope of *M. savii*.

Distribution. Western Macedonia. The range is restricted and the species was reported from very few other places, all of which are in the vicinity of the Republic of Macedonia (Fig. 10).



Fig. 10. Localities of the Balkan pine vole *Microtus felteni*. Federal Republic of Yugoslavia: 1 – Mt. Kopaonik, Suvo Rudište, 2000 m (specimen No. 1937.3.22.53 in the Natural History Museum London); 2 – Buzluk, 350 m (PETROV & ŽIVKOVIĆ 1979); 3 – Mt. Šar planina, Brezovica, 900 m (PETROV 1992). Macedonia: 4 – Mt. Jakupica, Kitka, 1400 m (STOJANOVSKI 1997); 5 – Mt. Babuna, 1100 m (PETROV & ŽIVKOVIĆ 1971c); Derven Pass, 1092 m (specimen No. 21,503 in Naturhistorisches Museum Wien); 6 – Mt. Pelister: Trnovo, 1400 m (MALEC & STORCH 1963); Begova Česma (PETROV & ŽIVKOVIĆ 1979). Greece: 7 – Mt. Voras, Kalivia (VOHRALÍK & SOFIANIDOU 1987); 8 – Mt. Vernon, near Antartikon, 1400 m (NIETHAMMER 1986); 9 – Pindus Mts.: Katara Pass, 1700 m (NIETHAMMER 1986); 10 – Pindus Mts.: Petrouli, 1100 m (NIETHAMMER 1986). Albania: 11 – Mali i-Cikës Mts.: Llogora, 1050 m (Andira 1991).



Fig. 9. Localities of the Guenther's vole *Microtus guentheri* in the Republic of Macedonia.

1 – Kumanovo; 2 – 4 km east of Veles; 3 – Orizari; 4 – Karatmanovo; Lozovo; 5 – Dorfulija; Saramazalino; 6 – Kadrifakovo; 7 – Bogoslovec; 8 – 7 km north of Gradsko; 9 – Krivolak, Pepelište; 10 – between Stobi and Negotino, 150 m; 11 – Radoviš, 350–450 m; 12 – Kremenica, 13 – Germijan; 14 – Skočivir, 800 m. Based on PETROV (1992) and new unpublished records.

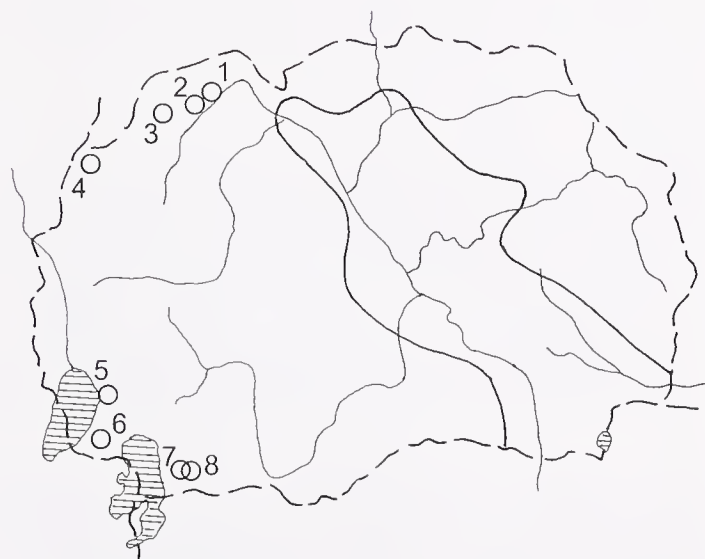


Fig. 11. Localities of the Snow vole *Chionomys nivalis* in the Republic of Macedonia.

1 – Mt. Šar planina: Jelak, 1900 m; 2 – Mt. Šar planina: Ceripašina, 2000 m, 2600 m; 3 – Mt. Šar planina: Titov vrv, 2750 m; 4 – Gorno Lukovo; 5 – Ohrid, 700 m; 6 – Mt. Galičica, Pass, 1600 m; 7 – Mt. Pelister: Golemo Ezero, 2250 m; 8 – Mt. Pelister: Kopanki, 1700 m; Virovi, 1750 m; Jorgov Kamen; Rotinska reka near Begova Česma. Based on PETROV (1992) and new unpublished records.

Genus: *Chionomys* MILLER, 1908

Snow vole *Chionomys nivalis* (Martins, 1842)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian Snow voles to subspecies *C. n. malyi* Bolkay, 1925. External, skull and dental morphology were described by KRYŠTUFEK (1990b), who found the subspecies taxon inadequate to describe the complex geographic variability in the Balkans. Karyotype is reported for specimens from Mt. Šar planina (TODOROVIĆ et al. 1971), Mt. Pelister and Mt. Galičica (ZIMA et al. 1997): $2n = 54$, $NF = 56$, $NFa = 52$. According to allozyme variation of 34 gene loci, populations from Mt. Pelister and Mt. Galičica belong to the eastern group of populations (FILIPPUCCI et al. 1991).

Distribution. Mountains of Western Macedonia (Fig. 11).

Additional information. For ectoparasites (Siphonaptera) see BRELIH (1986).

Subfamily: Murinae Illiger, 1815

Genus: *Apodemus* Kaup, 1829

Striped field mouse *Apodemus agrarius* (Pallas, 1771)

Taxonomy. *Apodemus agrarius kahmanni* Malec & Storch, 1963 (MALEC & STORCH 1963).

Type locality: Banja BANSKO, Republic of Macedonia, altitude 265 m.

The subspecies *A. a. kahmanni* is easily recognised by its large size and dark colour (KRYŠTUFEK 1985a) which, however, most likely results from non-genetic environmental factors (HILLE & MEINIG 1996). See HILLE & MEINIG (1996) for descriptive statistics of biometric data and SOLDATOVIĆ et al. (1971) for karyotype ($2n = 48$, $NF = 56$; specimens from Lake Dojran).

Distribution. High density population around Lake Dojran; scattered records along the Vardar valley. Exceptional observation on Mt. Šar planina at 1,700 m (PETROV 1992).

Rock mouse *Apodemus mystacinus* (Danford & Alston, 1877)

Taxonomy. Republic of Macedonia is populated by the subspecies *A. m. epimelas* (Nehring, 1902) (e.g., ĐULIĆ & MIRIĆ 1967), which might be specifically distinct from *A. m. mystacinus* (STORCH 1999). See MIRIĆ (1964) for biometrical data and ZIMA et al. (1997) for a karyotype of a single male from Mt. Galičica ($2n = 48$, $NF = 50$, $NFa = 48$).

Distribution. Widespread in the Republic of Macedonia (up to 1600 m above sea level) but restricted to rocky environments. See PETROV (1992) for a spot map.

Yellow-necked mouse *Apodemus flavicollis* (Melchior, 1834)

Taxonomy. *Sylvaemus sylvaticus stankovici* Martino & Martino, 1937 (MARTINO & MARTINO (1937).

Type locality: Guri Velpnis, Mt. Korab, Republic of Macedonia, altitude 1,700 m.

ĐULIĆ & MIRIĆ (1967) report two subspecies: the nominal one and subspecies *A. f. braueri* Martino & Martino, 1926. The latter subspecies, however, is hardly discernible. Subspecies *S. s. stankovici*, which was synonymised with *A. f. flavicollis* by KRYŠTUFEK & STOJANOVSKI (1996), is smaller

than other yellow-necked mice from the Republic of Macedonia. Recently, PETROV (1993/94) considered *S. s. stankovici* to be an independent species and mapped its range. This opinion, based entirely on vague morphometric characters, seems tentative. The diagnostics provided certainly do not hold in this area. For morphometric data see MALEC & STORCH (1963), FELTEN & STORCH (1965) and KRYŠTUFEK & STOJANOVSKI (1996). Karyotype is described from Mt. Šar planina, Mt. Pelister, and Mt. Galičica ($2n = 48$, $NF = 48$, $NFa = 46$); additional (B) chromosomes occur in Macedonian populations (SOLDATOVIĆ et al. 1972; ZIMA et al. 1997). Separation of *A. f. flavicollis* and *S. sylvaticus* by skull characteristics (relative foramina incisiva length) was discussed by TVRKOVIĆ (1979) and KRYŠTUFEK & STOJANOVSKI (1996). Recently, BLAGOJEVIĆ & VUJOŠEVIĆ (2000) demonstrate that B chromosomes affect morphometric characters in *A. flavicollis* and consequently questioned taxonomic value of the foramen incisivum length. Anyhow, they did not show that this variation actually affects morphological separation between *A. flavicollis* and *S. sylvaticus*.

Distribution. Widespread and common mammal throughout the Republic of Macedonia. See PETROV (1992) and KRYŠTUFEK & STOJANOVSKI (1996) for a spot map.

Wood mouse *Apodemus sylvaticus* (Linnaeus, 1758)

Taxonomy. *Sylvaemus sylvaticus sylvaticus* morpha *dichruroides* Martino, 1933 (MARTINO 1933a).

Type locality: Kočani, Republic of Macedonia.

Sylvaemus sylvaticus dichruroides Martino 1939 (MARTINO 1939a).

ĐULIĆ & MIRIĆ (1967) list three subspecies for the Republic of Macedonia in addition to *S. s. stankovici* (see under *A. flavicollis*): *S. s. dichrurus* (Rafinesque, 1814), *S. s. hessei* (Martino & Martino, 1933), and *S. s. dichruroides* (Martino & Martino, 1933); there is no firm evidence for so many distinct races. For skull measurements see MALEC & STORCH (1963) and FELTEN & STORCH (1965). Karyotype is



Fig. 12. Localities of the Harvest mouse *Micromys minutus* in the Republic of Macedonia.

1 - Mt. Šar planina: Popova Šapka, 1750 m; 2 - Katlanovsko pole, 222 m; 3 - Kočansko pole: Kočani; Krupište; Šiflik; 4 - Vinica; 5 - vicinity of Ohrid (specimen in the Provincial museum in Struga). Based on KRYŠTUFEK & KOVAČIĆ (1984) and PETROV (1992).

described in two specimens from Mt. Bistra (ZIMA et al. 1997): $2n = 48$, $NF = 48$, $NFa = 46$.

Distribution. Widespread, but much less common than the previous species. See PETROV (1992) and KRYŠTUFEK & STOJANOVSKI (1996) for a dot map.

Genus: *Micromys* Dehne, 1841

Harvest mouse *Micromys minutus* (Pallas, 1771)

Taxonomy. VIDINIĆ (1963) ascribed Macedonian specimens to subspecies *M. m. braueri* Martino, 1930.

Distribution. Possibly widespread in lowlands, but few localities are known (Fig. 12).

Genus: *Rattus* Fischer, 1803

Black rat *Rattus rattus* (Linnaeus, 1758)

Taxonomy. ĐULIĆ & MIRIĆ (1967) consider different colour morphs as distinct subspecies. They reported two to occur in the Republic of Macedonia: *R. r. rattus* and *R. r. alexandrinus*.

Distribution. Widespread, but the exact distribution is unknown. The species seems to be strictly commensal. See PETROV (1992) for a spot map.

Brown rat *Rattus norvegicus* (Berkenhout, 1769)

Taxonomy. MARTINO (1939a) lists for the Republic of Macedonia the nominal subspecies.

Distribution. Presumably widespread, but very few records are available (PETROV 1992). Possibly also occurs outdoors.

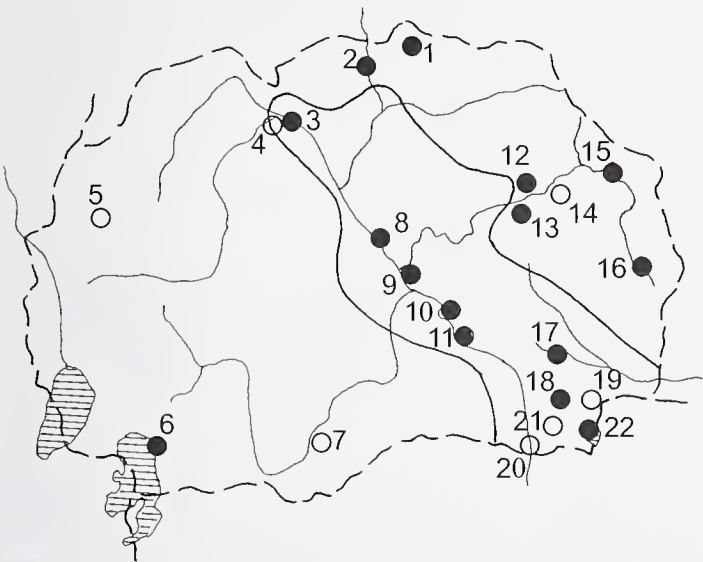


Fig. 13. Localities of the Western house mouse *Mus domestica* in the Republic of Macedonia.

1 – Arbanaško, 940 m; 2 – Kumanovo, Orizari; 3 – Skopje; 4 – Mt. Vodno, 600 m; 5 – Trnica, 900 m; 6 – Asamati, 860 m; 7 – Budimirci; 8 – Veles; 9 – Ulanci; 10 – Krivolak, Pepelište; 11 – Negotino; 12 – Kočani, 320 m; 13 – Zrnovci; 14 – Vinica, Pribačevo; 15 – Delčevo, Trabotivište; 16 – Berovo; 17 – Strumica, Dabilja; 18 – Valandovo; 19 – Banja BANSKO; 20 – Gevgelija; 21 – Bogdanci; 22 – Nov Dojran. Closed circled indicate records, verified by B.K.; all other localities are from PETROV (1992).

Genus: *Mus* Linnaeus, 1758

Western house mouse *Mus domestica* Schwarz & Schwarz, 1943

Taxonomy. *Mus hortulanus caudatus* Martino, 1934 (MARTINO 1934).

Type locality: Trnica, Mt. Bistra, Republic of Macedonia, altitude 900 m.

This species has been reported for the area under a plethora of different names: *M. musculus musculus* Linnaeus, 1758, *M. musculus domesticus* Ruddy, 1772, *M. musculus brevirostris* Waterhouse, 1837, *M. musculus caudatus* Martino, 1934, *M. musculus azoricus* Schinz, 1845 and *M. hortulanus caudata* Martino, 1934 (see MARTINO 1939a; PETROV 1940; MALEC & STORCH 1963; ĐULIĆ & MIRIĆ 1967). ELLERMAN & MORRISON-SCOTT (1966) allocated *M. h. caudatus* to *M. musculus domesticus*; it is not evident whether this step is supported by an examination of type specimens. It is also not clear what MARTINO categorised under the name *M. hortulanus hortulanus*, which he listed for the region (“to the north of Skopje”), in addition to *M. h. hispanicus* (i.e., *M. h. macedonicus*) and *M. h. caudatus* (i.e., *M. m. domesticus*). For biometric data see PETROV & RUŽIĆ (1985). ĐULIĆ et al. (1980) report Robertsonian populations ($2n = 36$, $NF = 40$) from Katlanovo and Strumica.

Distribution. Widespread, but closely associated with human activity (Fig. 13).

Balkan short-tailed mouse *Mus macedonicus* PETROV & RUŽIĆ, 1983

Taxonomy. *Mus hortulanus macedonicus* Petrov & Ružić, 1983 (PETROV & RUŽIĆ 1983).

Type locality: Valandovo, Republic of Macedonia.

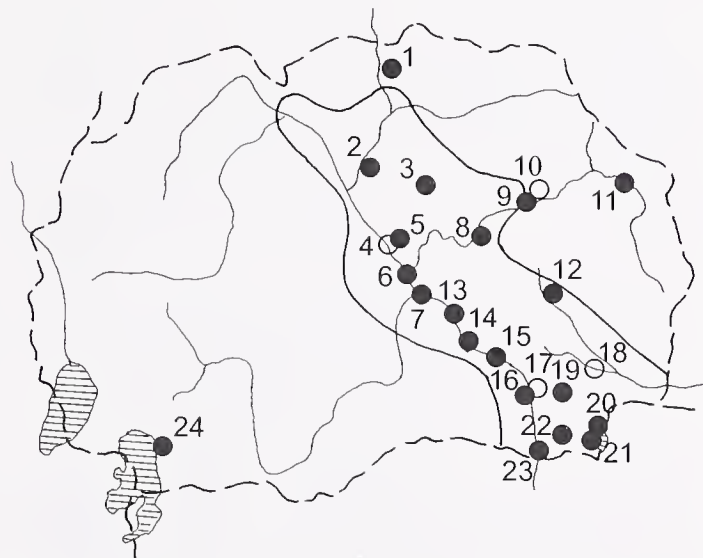


Fig. 14. Localities of the Balkan short-tailed mouse *Mus macedonicus* in the Republic of Macedonia.

1 – Kumanovo, Romanovci; 2 – Katlanovo, 224 m; 3 – Sv. Nikole, 300 m; 4 – Veles; 5 – 5 km est of Veles; 6 – 7 km north of Stobi; 7 – Stobi, 150 m; 8 – Bogoslovec; 9 – Češinovo; 10 – Kočani, 320 m; 11 – Delčevo, Trabotivište; 12 – Radoviš; 13 – Krivolak, Pepelište; 14 – Negotino; 15 – Demir Kapija; 16 – Miletkovo; 17 – Udovo, 100 m; 18 – Strumica, 224 m; 19 – Valandovo, 100 m; Anska Reka; 20 – Lake Dojra, A?ikot; 21 – Nov Dojran; 22 – Bogdanci; 23 – Gevgelija, 47 m; 24 – Asamati, 860 m. Closed circles indicate records, verified by B.K.; all other localities are from PETROV (1992).

This mouse was reported from the Republic of Macedonia under the names *M. musculus spicilegus* Petény, 1882 and *M. hortulanus hispanicus* MILLER, 1909 (MARTINO 1939a; PETROV 1940; MALEC & STORCH 1963; ĐULIĆ & MIRIĆ 1967). For biometric data see MALEC & STORCH (1963) and PETROV & RUŽIĆ (1985). KRYŠTUFEK & MACHOLÁN (1998) compared it with other conspecific populations and with closely related *Mus spicilegus* Petenyi 1882.

Distribution. An outdoor species, common in the lowlands along the Vardar and in Eastern Macedonia; an isolated population is also in Western Macedonia near Lake Prespa (Fig. 14).

Subfamily: Spalacinae Gray, 1821

Genus: *Nannospalax* Palmer, 1903

Lesser mole-rat *Nannospalax leucodou* (Nordmann, 1840)

Taxonomy. *Spalax (Mesospalax) macedonicus* Savić & Soldatović, 1975 (SAVIĆ & SOLDATOVIĆ 1975).

Type locality: Western Macedonia; restricted to Mt. Jakupica (SAVIĆ 1982).

Spalax (Mesospalax) strumiciensis Savić & Soldatović, 1975 (SAVIĆ & SOLDATOVIĆ 1975).

Type locality: Dabilja, near Strumica, Republic of Macedonia, altitude 240 m.

Spalax (Mesospalax) ovchepolensis Savić & Soldatović, 1975 (SAVIĆ & SOLDATOVIĆ 1975).

Type locality: Ovče Pole, Republic of Macedonia, altitude 300 m.

Note: 1975 seems to be the correct year of publication and not 1974 as stated by SAVIĆ (1982).

As already mentioned (KRYŠTUFEK 1997b) "the state of taxonomic uncertainty amongst Balkan mole rats is further increased by the introduction of plethora of new names which barely meet the most basic requirements of the International Code of Zoological Nomenclature." Names, proposed by SAVIĆ & SOLDATOVIĆ (1975) from the Republic of Macedonia are not an exception. Although at least some chromosomal forms most likely present distinct allopatric species, evidence available does not permit any definitive taxonomic conclusions. Four chromosomal forms occur in the territory of the Republic of Macedonia (species or subspecies sensu SAVIĆ & SOLDATOVIĆ 1984) (Fig. 15):

1. form *serbicus* ($2n = 54$, $NF = 98$, $NFa = 94$); localities: Katlanovo, Veles (SAVIĆ & SOLDATOVIĆ 1984).

2. form *macedonicus* ($2n = 52$, $NF = 86$, $NFa = 82$); localities: Mt. Jakupica, Pelagonija (between Bitola and Kukurčani), Ohrid, Mt. Pelister (Magarevo and Golemo Ezero), Mt. Bistra (SAVIĆ & SOLDATOVIĆ 1984; ZIMA et al. 1997).

3. form *ovchepolensis* ($2n = 54$, $NF = 94$, $NFa = 90$); occurs on Ovče Pole field, between Sveti Nikole and Probištip (SAVIĆ & SOLDATOVIĆ 1984).

4. form *strumiciensis* ($2n = 54$, $NF = 88$, $NFa = 84$); Strumičko Pole field, at 250 m above sea level (SAVIĆ & SOLDATOVIĆ 1984).

Some morphometric data are provided by SAVIĆ (1982). We found no stable cranial or dental characters permitting differentiation among taxa in museum material.

Distribution. Widespread over the Republic of Macedonia, from the lowlands to alpine pastures. See PETROV (1992) for a dot map.

Additional information. For biological data see SAVIĆ (1982); for Siphonaptera see SAVIĆ & Ryba (1977).

Family: Gliridae THOMAS, 1897

Subfamily: Glirinae THOMAS, 1897

Genus: *Glis* Brisson, 1762

Fat dormouse *Glis glis* (Linnaeus, 1766)

Taxonomy. MARTINO (1939a) lists for the Republic of Macedonia subspecies *G. g. minutus* (MARTINO, 1930), which was followed by ĐULIĆ & MIRIĆ (1967). ONDRIAS (1966) tentatively indicates *G. g. minutus* for northern and *G. g. pindicus* (ONDRIAS, 1966) for southern Republic of Macedonia; this must be in error since he assigns specimens from Mt. Kožuv, southern Republic of Macedonia, to *G. g. minutus*. In our opinion, *G. g. pindicus* is merely a junior synonym of *G. g. minutus*.

Distribution. Common in wooded regions of the Republic of Macedonia (Fig. 16).

Genus: *Muscardinus* Kaup, 1829

Common dormouse *Muscardinus avellanarius* (Linnaeus, 1758)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian Common dormice to the nominal subspecies. Specimens from the Republic of Macedonia we examined are larger than those from Central Europe.

Distribution. All the records are from Western Macedonia and the vicinity of Skopje. PETROV (1992) indicated the presence of common dormouse in Eastern Macedonia, as well; this might be in error however, since no such record is evident in his list of localities.

Subfamily: Leithiinae Lydekker, 1896

Genus: *Dryomys* THOMAS, 1906

Forest dormouse *Dryomys nitedula* (Pallas, 1779)

Taxonomy. *Dryomys nitedula ravijojla* Paspaleff, Martino & Pecheff, 1952 (PASPALLEFF et al. 1952).

Type locality: Senečki suvati, Mt. Bistra, Republic of Macedonia.

For morphometrics see KRYŠTUFEK (1985b) and FILIPPUCI et al. (1995). Allele frequencies of 40 loci are described by FILIPPUCI et al. (1995); the karyotype of a single specimen from Mt. Pelister is reported by ZIMA et al. (1997): $2n = 48$, $NF = 96$, $NFa = 92$.

Distribution. Widespread in Western Macedonia and in the Vardar valley, with a single record available from Eastern Macedonia. Recently we collected specimen in Trbotivište, near the Bulgarian border.

Additional information. For habitat requirements and biological data see KRYŠTUFEK (1985b) and KRYŠTUFEK & VOHRALÍK (1994).

Family: Myocastoridae Ameghino, 1904

Genus: *Myocastor* Kerr, 1792

Coypu *Myocastor coypus* (Molina, 1792)

Distribution. PURGER & KRYŠTUFEK (1991) list three localities from the valleys of the Vardar and Bregalnica and another one from the banks of Lake Prespa.

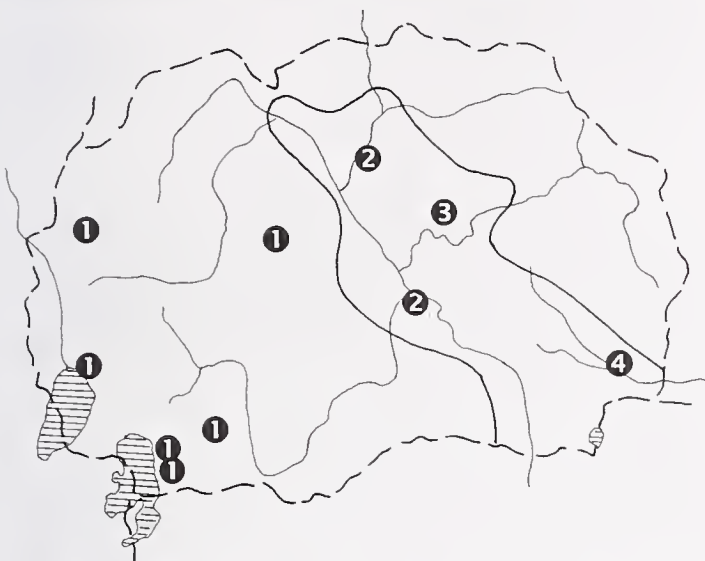


Fig. 15. Distribution of the four chromosomal forms of the Lesser mole-rat *Nannospalax leucodon* in the Republic of Macedonia (based on SAVIĆ & SOLDATOVIĆ 1984). 1 – *macedonicus*, 2 – *serbicus*, 3 – *ovchepolensis*, 4 – *strumiciensis*. Mole-rats populate the entire country.



Fig. 16. Localities of the Fat dormouse *Glis glis* in the Republic of Macedonia.

1 – Mt. Skopska Crna Gora; 2 – Monastery Blagoveštenije, 860 m; 3 – Sonje; 4 – Mt. Kitka; 5 – Mt. Šar planina: Dolna Lešnica; Lešnica, 1480 m; 6 – Mt. Korab: River Štirovica; 7 – Rostuše, 750 m; 8 – Mt. Bistra: Senečki Suvati, 1800–1900 m; Senečki Livadi, 800 m; 9 – Mt. Bistra: above Mavrovo, 1750–1900 m; 10 – Kičevo; Bigor Dolenci, 620 m; 11 – Makedonski Brod, Grešnica; 12 – Selci; 13 – Vevčani; 14 – Velmej, Jaorec, 800 m; 15 – Elen Vrv, 1150 m; 16 – Asamati, Monastery Sv. Bogorodica, 1000 m; 17 – Mt. Kožuv: Dve Uši, 1700 m; Kiči-Kaj, 1600 m; Mala Rupa, 1700 m; 18 – Demir Kapija; 19 – Mt. Osogovo, Ponikva. Based on Kranjčev (1987), KRYŠTUFEK & PETKOVSKI (1990), PETROV (1992), STOJANOVSKI (1996), and new unpublished records.

Order: CARNIVORA

Family: Canidae Fischer, 1817

Genus: *Canis* Linnaeus, 1758

Golden jackal *Canis aureus* Linnaeus, 1758

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe south Macedonian golden jackals to subspecies *C. a. moreoticus* Geoffroy, 1835. Dimensions are provided by ATTANASOV (1955) and KRYŠTUFEK & PETKOVSKI (1990b).

Distribution. The jackal was exterminated in the Republic of Macedonia, probably at the beginning of 1960s (see KRYŠTUFEK & PETKOVSKI 1990b for a review). Since then, it was recorded only twice: Želino near Skopje in March 1989 (KRYŠTUFEK & PETKOVSKI 1990b) and Nikuljane near Kumanovo in December 1996 (unpublished record based on skull specimen). These records probably result from a recent range expansion from Bulgaria (KRYŠTUFEK et al. 1997).

Wolf *Canis lupus* Linnaeus, 1758

Taxonomy. The validity of subspecies *kunjak* Bolkay, 1925, to which Macedonian wolves were ascribed by ĐULIĆ & MIRIĆ (1967), is questionable. For cranial dimensions see MARTINO (1933b) and KRYŠTUFEK (1995).

Distribution. Widespread and common (Fig. 17); 11,604 wolves were killed between 1947 and 1987, and the annual kill between 1980 and 1987 varied from 101 to 164 (DONČEV 1996).

Genus: *Vulpes* Frisch, 1775

Red fox *Vulpes vulpes* (Linnaeus, 1758)

Taxonomy. See MARTINO (1936a) for comments on cranial characters of Macedonian foxes. ĐULIĆ & MIRIĆ (1967) ascribe Macedonian foxes to two subspecies: larger *V. v. crucigera* (Bechstein, 1789) and smaller *V. v. meridionalis* Fitzinger, 1860. MIRIĆ (1979) distinguished between the two on the basis of the condylobasal length: 135 to 145 mm in *V. v. crucigera* and 126 to 137 in *V. v. meridionalis*.

Distribution. Widespread and common throughout the country. No map is available.



Fig. 17. Localities in the Republic of Macedonia where Wolf *Canis lupus* was killed between 1980–1987. Based on DONČEV (1996).

Family: Ursidae Fischer, 1817

Subfamily: Ursinae Fischer, 1817

Genus: *Ursus* Linnaeus, 1758

Brown bear *Ursus arctos* Linnaeus, 1758

Taxonomy. On the basis of their small size, MARTINO (1936b, 1939a) ascribed Macedonian brown bears to subspecies *U. a. meridionalis* Middendorff, 1851. Since ELLERMAN & MORRISON-SCOTT (1964) synonymised *U. a. meridionalis* with *U. a. syriacus* Hemprich and Ehrenberg, 1828, the latter name was subsequently applied to Macedonian bears by ĐULIĆ & MIRIĆ (1967). Such application is highly tentative. MARTINO (1936b) published measurements of a single specimen.

Distribution. Mountains of Western Macedonia; the population is in decline.

Family: Mustelidae Fischer, 1817

Subfamily: Mustelinae Fischer, 1817

Genus: *Mustela* Linnaeus, 1758

Weasel *Mustela nivalis* Linnaeus, 1766

Taxonomy. MARTINO (1939a) used for Macedonian weasels the subspecific name *M. n. boccamela* Bechstein, 1800, which was followed by ĐULIĆ & MIRIĆ (1967).

Distribution. Very few records are available, but it is presumably widespread (Fig. 18).

Western polecat *Mustela putorius* Linnaeus, 1758

Taxonomy. MARTINO (1937) ascribed specimens from Eastern Macedonia to subspecies *M. p. aureolus* (Barrett-Hamilton, 1904), which is diagnosed by colour alone (MILLER 1912). The few skins we examined did not differ from other polecats of the Balkan peninsula and adjacent areas of central Europe.



Fig. 18. Localities of the Weasel *Mustela nivalis* in the Republic of Macedonia.

1 – Kumanovo, Orizari; 2 – Skopje; 3 – Katlanovo; 4 – Vrapčište near Gostivar; 5 – Orovnik at Lake Ohrid; 6 – Mt. Pelister, Begova Česma; 7 – 3 km west of Veles; 8 – Kočani; 9 – Maleš and Pijanec; 10 – Berovo; 11 – Valandovo; 12 – Nov Dojran. Based on KRYŠTUFEK & PETKOVSKI (1990), PETROV & (GAREVSKI 1983) and unpublished data.

Distribution. Widespread, but rare throughout the country (Fig. 19).

Genus: *Vormela* Blasius, 1884

Marbled polecat *Vormela peregusua* (Gueldenstaedt, 1770)

Taxonomy. MARTINO (1939a) ascribes Macedonian marbled polecats to the nominal subspecies, which was followed by ĐULIĆ & MIRIĆ (1967).

Distribution. Only few locations are known from the Vardar valley and from Eastern Macedonia (MIRIĆ et al. 1983). The species is evidently rare and little known.

Genus: *Martes* Pinel, 1792

Pine marten *Martes martes* (Linnaeus, 1758)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian pine martens to the nominal subspecies.

Distribution. A few records are available from wooded, mountainous areas (Fig. 20).

Beech marten *Martes foina* (Erxleben, 1777)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian beech martens to the nominal subspecies.

Distribution. Presumably widespread and common (Fig. 21).

Subfamily: Melinae Bonaparte, 1838

Genus: *Meles* Boddacrt, 1785

Badger *Meles meles* (Linnaeus, 1758)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian badgers to the nominal subspecies.

Distribution. Widespread and common (KRYŠTUFEK & PETKOVSKI 1990a).

Additional information. For conservation and management see GRIFFITHS & THOMAS (1997).



Fig. 19. Localities of the Western polecat *Mustela putorius* in the Republic of Macedonia.

1 – R'žaničko ezero; 2 – Skopje; 3 – Glumovo; 4 – Gostivar; 5 – Mavrovi Anovi; 6 – Sateska; 7 – Kališta; Radažda; 8 – Kočani; 9 – Kočansko polje; Šiflik; Orizari; 10 – Maleš and Pijanec Mts. Based on KRYŠTUFEK & PETKOVSKI (1990), PETROV & (GAREVSKI 1983) and unpublished data.

Subfamily: Lutrinae Bonaparte, 1838

Genus: *Lutra* Brünnich, 1771

Otter *Lutra lutra* (Linnaeus, 1758)

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian otters to the nominal subspecies.

Distribution. In their distributional review for former Yugoslavia, LILES & JENKINS (1984) provide no otter records for the Republic of Macedonia. Known records are plotted on Fig. 22.

Family: Felidae Fischer, 1817

Subfamily: Felinae Fischer, 1817

Genus: *Felis* Linnaeus, 1758

Wildcat *Felis silvestris* Schreber, 1777

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian wildcats to the nominal subspecies.

Distribution. Range not know, but might be widespread (Fig. 23).



Fig. 20. Localities of the Pine marten *Martes martes* in the Republic of Macedonia.

1 – Mavrovo; 2 – Bituša; 3 – Mt. Bistra; 4 – Paligrad near Skopje; 5 – Mt. Osogovo; 6 – Maleševo and Pijanec Mts. Based on KRYŠTUFEK & PETKOVSKI (1990), PETROV & (GAREVSKI 1983) and unpublished data.



Fig. 22. Localities of the Otter *Lutra lutra* in the Republic of Macedonia. Year is in parentheses.

1 – Novo selo (1949); 2 – area of Skopje (1949, 1951, 1973); Skopje (around 1960); 3 – Izvor near Kičevo (1995); 4 – River Tresanička reka (1997); 5 – Kališta near Struga (1995); 6 – Kočansko Pole field (1995); 7 – Mt. Osogovo: Ponikva (1996). From various unpublished sources.

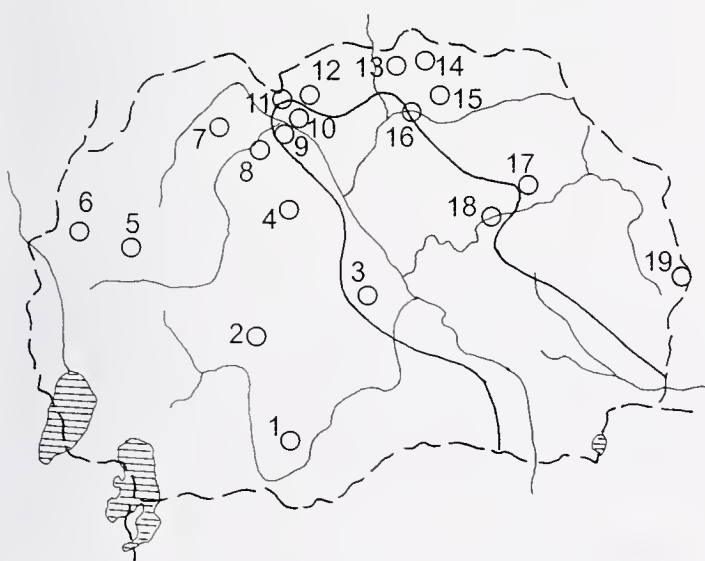


Fig. 21. Localities of the Stone marten *Martes foina* in the Republic of Macedonia.

1 – Iveni, Krapa; 2 – Pletvar; 3 – Jabolčište; 4 – Mt. Kitka; 5 – Mt. Bistra; 6 – Bituše; 7 – Grupčin; 8 – Matka near Skopje; 9 – Zelenikovo near Skopje; 10 – between Creševo and Bulčani; 11 – Volkovo; 12 – Skopska Crna Gora; 13 – Kana-revo; 14 – Suševo; 15 – Oblavsko; 16 – Klečozi; 17 – Mt. Osogovo: Ponikva; 18 – Kočani; 19 – Maleševo and Pijanec. Based on KRYŠTUFEK & PETKOVSKI (1990), PETROV & (GAREVSKI 1983) and unpublished data.

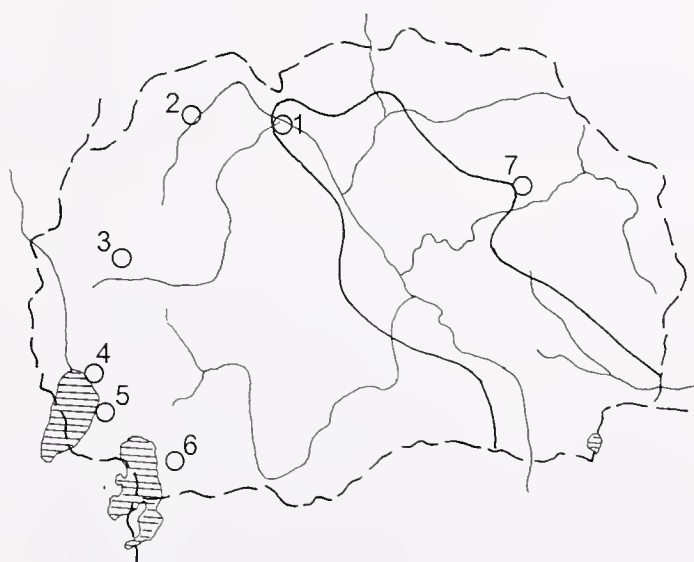


Fig. 23. Localities of the Wild cat *Felis silvestris* in the Republic of Macedonia.

1 – Vučji dol near Skopje; 2 – Žepino near Tetovo; 3 – Mt. Bistra; 4 – Livadište near Struga; 5 – Šapkar near Ohrid; 6 – Mt. Pelister: Gavran; foothills of Mt. Pelister; 7 – Mt. Osogovo: Ponikva. From various unpublished sources.

Genus: *Lynx* Kerr, 1792

Lynx *Lynx lynx* (Linnaeus, 1758)

Taxonomy. MIRIĆ (1978) ascribed Macedonian specimens to subspecies *L. l. martinoi* Mirić, 1978.

Distribution. Survives in the mountains of Western Macedonia; for details see MIRIĆ (1981). We found its tracks on Mt. Korab (1997); in 1990 hunters also reported it to be still common in Mt. Pelister.

Order: ARTIODACTYLA

Family: Suidae Gray, 1821

Genus: *Sus* Linnaeus, 1758

Wild boar *Sus scrofa* Linnaeus, 1758

Taxonomy. MARTINO (1939a) and ĐULIĆ & MIRIĆ (1967) report for the Republic of Macedonia subspecies *S. s. reiseri* Bolkay, 1925, the validity of which was already questioned by BELIĆ (1938).

Distribution. Widespread and common; no detailed map available.

Family: Cervidae Goldfuss, 1820

Subfamily: Cervinae Goldfuss, 1820

Genus: *Cervus* Linnaeus, 1758

Red deer *Cervus elaphus* Linnaeus, 1758

Taxonomy. ĐULIĆ & MIRIĆ (1967) tentatively ascribe Macedonian red deer to subspecies *C. e. maral* Gray, 1850.

Distribution. The autochthonous red deer was exterminated, probably in 1940s. Limited historical information is provided by DOFLEIN (1921) and MARTINO (1939b). Reintroductions from different stocks (Slovenia, Slavonia, Vojvodina) resulted predominantly in fenced populations around Mavrovo, on Mt. Pelister, and on Mt. Osogovo.

Genus: *Dama* Frisch, 1775

Fallow deer *Dama dama* (Linnaeus, 1758)

Distribution. Introduced from the Brijuni Islands (Croatia) and from Bulgaria. Mainly in fences at Mavrovo and on Mt. Osogovo.

Subfamily: Odocoileinae Pocock, 1923

Genus: *Capreolus* Gray, 1821

Roe deer *Capreolus capreolus* (Linnaeus, 1758)

Taxonomy. MARTINO (1939a) considers roe deer from Mt. Šar planina to fit the newly described form *C. c. balemii* Martino, 1932. ĐULIĆ & MIRIĆ (1967) tentatively report for the Republic of Macedonia subspecies *C. c. grandis* Bolkay, 1925, which is accepted as a valid subspecies by VON LEHMANN & SÄGESSER (1986).

Distribution. Wooded, mountainous areas of Eastern and Western Macedonia, but possibly also in the lowlands; no map available.

Family: Bovidae Gray, 1821

Subfamily: Caprinae Gray, 1821

Genus: *Ovis* Linnaeus, 1758

Mouflon *Ovis orientalis* Gmelin, 1774

Taxonomy. Introduced animals belong to subspecies *O. o. musimon* (Pallas, 1811).

Distribution. Fenced at Mavrovo and on Mt. Osogovo.

Genus: *Rupicapra* de Blainville, 1816

Alpine chamois *Rupicapra rupicapra* (Linnaeus, 1758)

Taxonomy. ĐULIĆ & MIRIĆ (1967) ascribe Macedonian alpine chamois to two subspecies: *R. r. balcanica* Bolkay, 1925, and *R. r. olympica* Koler, 1929. The latter is usually synonymised with *R. r. balcanica*. Phenetic characteristics of Macedonian chamois are discussed by MARTINO (1934b, 1935b). Horns, which are believed to be more strongly hooked and shorter than in the alpine subspecies (e.g. MIRIĆ 1970), seem to be highly variable (own observations).

Distribution. Mountains of Western Macedonia (KRYŠTUFEK et al. 1997).

Unlikely records

Jerboa *Allactaga* sp.

MARTINO (1939a) cites a personal communication by N. ŽEMČUŽNIKOV who said to have observed a Jerboa between Udovo and Valandovo. MARTINO had visited the same area "in the previous year" (MARTINO 1939a) and found among numerous holes, mainly of sousliks, also burrows which might be used by jerboas. Due to a shortage of time, no collection attempt was made. We found no evidence that V. MARTINO ever observed jerboas in what is now Republic of Macedonia himself, nor did he use the generic name *Allactaga* as is claimed by PETROV (1992). MATVEJEV (1961) was the first to report ŽEMČUŽNIKOV's observation under the generic name *Allactaga*. PETROV's (1992) search for the jerboa in different parts of the Republic of Macedonia resulted in nothing but another unverified night sighting near Pepe-lište. Considering the actual range of the jerboas (CORBET 1978), the probability of catching any specimens in the Balkans is close to zero.

Steppe polecat *Mustela eversmanni* Lesson, 1827

MILENKOVIĆ (1990) reports a skull of *M. eversmanni* from Valandovo, which is far outside the known distribution of the steppe polecat (compare MITCHELL-JONES et al. 1999). The determination was based mainly on the shape of the postorbital constriction. Taking into consideration the variability of polecats from Turkish Thrace, this character is likely to result in the misidentification of *putorius* as *eversmanni* in the southern Balkans (KURTONUR et al. 1994).

Possible Additions

The occurrence of up to eight unrecorded species of mammals varies from possible to probable in the territory of the Republic of Macedonia. Major additions are likely for bats, in spite of the fact that country is already known to be populated by 24 out of the approximate 30 European bats. Insectivores and rodents have been studied most thoroughly, which make new records less likely. Nonetheless, we have listed several small mammals which are known from locations near Macedonian borders.

Alpine shrew *Sorex alpinus* Schinz, 1837

The alpine shrew reaches the southern border of its known range within the Balkans in the mountains between Montenegro and Kosovo (PETROV 1992). The nearest records are from Mt. Žljeb (KRYŠTUFEK 1983) and Mt. Hajla (MIRIĆ 1987), i.e., approximately 100 km to the north-west of Mt. Šar planina, which abounds with habitats suitable for this species.

Brandt's bat *Myotis brandti* (Eversmann, 1845)

The only records in the southern Balkans are from two caves in the Smoljan district, southern Bulgaria (HORÁČEK et al. 1974). Specimens were collected in the mountains, at altitudes of 1240 and 1350 m above sea level, respectively. Our collecting in the mountains of the Republic of Macedonia produced only *M. mystacinus* (KRYŠTUFEK et al. 1998).

Bechstein's bat *Myotis bechsteini* (Kuhl, 1817)

Scattered records of Bechstein's bat are available from Serbia (PETROVIĆ et al. 1987), Greece (VON HELVERSEN & WEID 1990), Bulgaria (HORÁČEK et al. 1974), and Albania (UHRIN et al. 1996). This makes its presence in the Republic of Macedonia very likely.

Northern bat *Eptesicus nilssoni* (Keyserling & Blasius, 1839)

There are very few reliable records of the northern bat in the Balkans. The reliability of two localities in Croatia was questioned by ČERVENY & KRYŠTUFEK (1991). HANÁK & HORÁČEK (1986) report a single record from Bulgaria (Mt. Rila), which gives optimism that the northern bat might also be found in the mountains of the Republic of Macedonia.

Greater noctule *Nyctalus lasiopterus* (Schreber, 1780)

Records exist in the former Federal Socialist Republic of Yugoslavia (see e.g., a review of Croatian data by TVRTKOVIĆ & BALTIĆ 1996). Data provided by VON HELVERSEN & WEID (1990) for Greece and by HANÁK & JOSIFOV (1959) for Bulgaria give reason to expect this migratory bat also in the Republic of Macedonia.

Brown long-eared bat *Plecotus auritus* (Linnaeus, 1758)

KARAMAN'S (1929) report of this bat for Štip actually refers to its sibling, *P. austriacus* (KRYŠTUFEK et al. 1992). There are several records, however, in the vicinity of the Republic of Macedonia: from Greece (VON HELVERSEN & WEID 1990) and from Bulgaria (HORÁČEK et al. 1974), where it occurs in wooded mountains. Its presence in the Republic of Macedonia is thus highly probable.

Thomas' vole *Microtus thouasi* Barrett-Hamilton, 1903

ONDRIAS (1966) reported Thomas' vole from Edessa, i.e., only about 30 km south of the Macedonian border. VOHRALÍK & SOFIANIDOU (1987) provide no further records from this area of Greece.

Eastern house mouse *Mus musculus* Linnaeus, 1758

The southern border of *M. musculus* in the Federal Republic of Yugoslavia is not well established and its presence in nor-

thern Macedonia cannot be ruled out (compare PETROV 1992). So far, we have collected in southern Serbia (Vladičin Han; Preševo) only *M. domesticus*.

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