

Current distribution of the Alpine Marmot (*Marmota marmota*) in the Nízke Tatry Mts., Slovakia (Rodentia: Sciuridae)

Súčasnité rozšírenie svišťa vrchovského (*Marmota marmota*) v Nízkyh Tatráh (Rodentia: Sciuridae)

Peter BAČKOR

Department of Biology and Ecology, Faculty of Sciences, Matej Bel University, SK–974 01 Banská Bystrica, Slovakia; backorp@fpv.umb.sk

received on 15 December 2009

Abstract. Altogether 1592 marmot burrows were recorded in the Nízke Tatry Mts. and their altitude was measured using GPS equipment. 21 colonies were found on the northern and 19 colonies on the southern side of the main mountain range. Three burrow systems (colonies) were abandoned, the rest was composed of active colonies. The mean altitude of the burrows was 1759.0 m a. s. l.; that on the northern side being 1727.4 m and that on the southern side 1783.3 m. The minimum altitude of the burrow position was 1594 m a. s. l., the maximum altitude was 1991 m a. s. l. (range 397 m). The highest frequency of burrow occurrence was found between 1700 and 1799 m a. s. l. ($n=782$; 49.54%). The density of colonies per 100 hectares reached 0.25 at the altitudinal level of 1701–1799 m a. s. l. The largest area occupied by one colony was 17.68 ha and the highest number of burrows was 160 in one colony, while the smallest colony had only 5 burrows. The most frequent colony area was ≤ 1 ha (44.7%), although the mean area was 2.68 ha.

Key words. Burrows, altitude, GIS, Western Carpathians.

INTRODUCTION

The Alpine marmot, *Marmota marmota* (Linnaeus, 1758), inhabits high mountains of Central Europe (Alps, Western Carpathians). It was also introduced into the French Pyrenees, Dinaric Alps of Serbia and Montenegro, and Romanian Carpathians (MITCHELL-JONES et al. 1999). Several mountain refuges are strictly protected, but other populations are managed and hunted (e.g. CORTOT et al. 1994, ŽIAK & URBAN 2001). There are two subspecies in Europe: the Alpine marmot, *Marmota m. marmota* (Linnaeus, 1758), occurs in the Alps and Pyrenees, while the Tatra marmot, *Marmota m. latirostris* Kratochvíl, 1961, inhabits the Western Carpathians (KRATOCHVÍL 1961, MITCHELL-JONES et al. 1999).

As a glacial relic, the marmot survived in small refuge habitats in the Carpathians. In Ukraine and Romania, it became extinct in the second half of the 18th century as a result of intensive human pressure (PĂNZARIU 1993, BASHTA & POTISH 2007). Its presence in Slovakia is restricted to several mountain ranges of the Western Carpathians: Západné Tatry, Východné Tatry and Nízke Tatry Mts. Autochthonous populations of the Tatra marmot are present in the Západné Tatry and Východné Tatry Mts. Several authors supposed that marmots were introduced into the whole range of the Nízke Tatry Mts. (e.g. FERIANCOVÁ 1955, FERIANCOVÁ-MASÁROVÁ & HA-

NÁK 1965). In the 19th century, the Alpine marmot was introduced to the eastern part of the Nízke Tatry Mts. near the top of Mt. Kráľova Hoľa, and the successfully established population has been surviving until present time (SOMORA 1954, KRATOCHVÍL 1964). However, JAMNICKÝ (1977, 1999) and URBAN (2002) suggested possible postglacial survival of the population in the Ďumbierske Nízke Tatry Mts., i.e. the western part of the Nízke Tatry range, rather than its spreading from the introduced population in the east. They expected that the marmots were unable to get through the zone of permanent mountain forests in the central parts of the Nízke Tatry Mts. However, a detailed study elucidating the origin of marmot populations in the Nízke Tatry Mts. is still missing.

Recent status of the marmot in the Ďumbierske Nízke Tatry Mts. remains unclear. Although the most recent data on its distribution were published by KARČ (2006), no special study focussed on the current situation has been available. The main aim of the presented paper is to bring new data on spatial distribution and size of colonies of the marmot in the Nízke Tatry Mts. (Western Carpathians).

MATERIAL AND METHODS

The area under study is situated in central Slovakia (interior Western Carpathians) in the geomorphological unit of Ďumbierske Nízke Tatry Mts. (central point – the Chopok peak, 48° 56' 38" N, 19° 36' 32" E). The altitude range is from 1500 to 2043 m a. s. l., the highest peak is Mt. Ďumbier. The core area consists of sub-alpine and alpine habitats; the northern slopes of the main range (exposed rather to NW and NE) are dominated by stone formations and plates, whereas the southern slopes (exposed rather to SE and SW) are

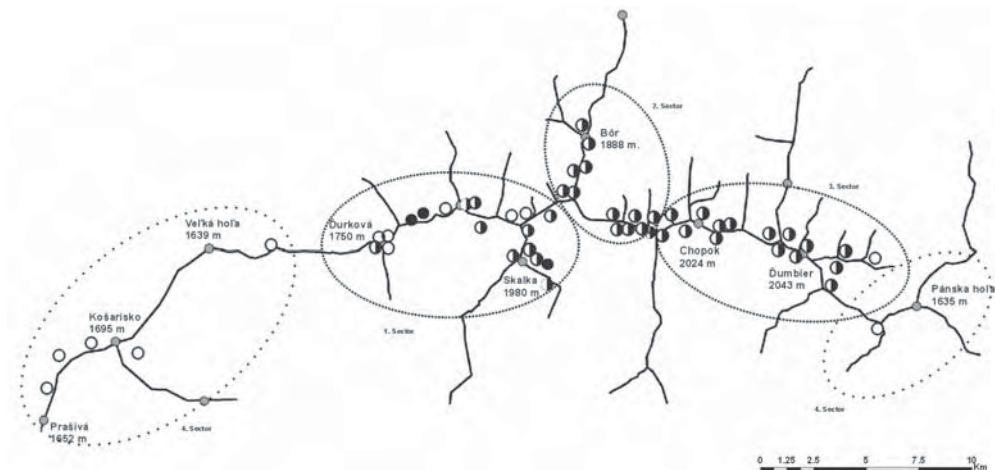


Fig. 1. Marmot distribution in the Nízke Tatry Mts. Legend: empty circles – colonies recorded in 1981 (by KARČ 2006) and found probably abandoned in 2009; half empty circles – existing colonies in 2009; black circles – inactive colonies in 2009.

Obr. 1. Rozšírenie svišťa vrchovského v Nízkyh Tatráh. Vysvetlivky: prázdne bodky – kolónie v roku 1981 (podľa KARČA 2006) a v súčasnosti pravdepodobne zaniknuté; delené bodky – kolónie v roku 2009; čierne bodky – neaktívne kolónie v roku 2009.

Table 1. Statistical data on the altitude of marmot burrows on the northern and southern slopes of the Nízke Tatry Mts., n=počet nôr; SD=šandardná odchýlka

Tab. 1. Štatistické hodnoty nadmorskej výšky nôr na severnej (north) a južnej (south) strane Nízkych Tatier; n=number of burrows; SD=standard deviation

	n	mean	geom. mean	median	min	max	range	SD
north	721	1727.4	1726.4	1715.0	1594.0	1967.0	373.0	60.275
south	871	1783.2	1781.3	1775.0	1620.0	1991.0	371.0	83.579

covered mainly by secondary mountain meadows with a scattered occurrence of stone outcrops. The main vegetation formations are represented as follows: siliceous alpine and boreal grasslands, nardus grasslands on siliceous substrates in mountain area, and siliceous scree of the montane to snow levels (sensu VICENÍKOVÁ & POLÁK 2003). The secondary timber line is made up of *Pinus mugo* and *Sorbus acuparia*. In the habitats inhabited by marmots, *Aquila chrysaetos*, *Canis lupus* and *Vulpes vulpes* appear regularly.

The field data were collected by direct observation from May to October in the period 2006–2009. The area of interest was divided into four sectors delimited by the following peaks: (1) Ďurková–Skalka, (2) Poľna–Dereše, (3) Chopok–Ďumbier, and (4) other colonies in the western and eastern edges of the Nízke Tatry Mts. occurrence area (Fig. 1). Systematic and careful check was the primary method of the burrow census. The position (geographical coordinates) and altitude (metres above sea level) of each found marmot burrow were recorded using GPS technology (Trimble GeoXT). All the obtained data were transformed by post processing using a GIS software (GPS Pathfinder Office 3.00 and Arc Map 9.1). For more details see BALLO & SÝKORA (2005) and BAČKOR et al. (2008). Historical data used for comparison were taken from the review by KARČ (2006). The general area of the marmot habitat was calculated after RODGERS et al. (2007), with 95 percentages of point and fixed mean (the final value is in hectares [ha]). Colony sizes were divided into five categories: ≤ 1 ha; $<1-3>$ ha; $<3-5>$ ha; $<5-10>$ ha; and ≥ 10 ha. For better interpretation of the results, the area under study was divided into two natural parts: the northern and the southern slopes. Descriptive statistical analyses were used for the elementary interpretation of the results.

RESULTS

Spatial and altitudinal distribution

In the area under study, 40 marmot colonies were recorded, 21 colonies on the northern side and 19 colonies on the southern side of the Ďumbierske Nízke Tatry Mts. (Fig. 1), comprises altogether 1592 burrows. The horizontal range of the marmot distribution is 15135 m from the west to the east (Ďurková peak to Štiavnica glacial cirque) and 5120 m from the north to the south (Mošnica glacial cirque to Skalka peak). The available area of the marmot habitat in the Nízke Tatry Mts. was 4447.5 ha. Much more burrows were counted on the southern side than on the northern side (Table 1, Fig. 2). The mean burrow altitude was 1759.0 m a. s. l. The mean altitude was lower on the northern side ($m=1727.40$; ± 60.28 ; $n=721$) than on the southern side ($m=1783.25$; ± 83.58 ; $n=871$). The minimum altitude of the burrow location was 1594 m a. s. l. on the northern side in the glacial cirque below the Poľana peak, while the maximum altitude was 1991 m a. s. l., recorded on the southern slope of the Dereše peak. The altitudinal range was 397 m. The burrows were most frequently found within the altitude span of 1700–1799 m a. s. l. ($n=782$; 49.54%), followed by the spans of 1600–1699 m ($n=356$; 22.95%), 1800–1899 m ($n=353$; 21.70%), >1900 m ($n=96$; 5.53%), and <1600 m ($n=4$; 0.28%). At 1600–1699 m a. s. l., the number of burrows on the northern side was higher than on the southern side. The highest recorded density was 0.25 colonies per 100 hectares in the altitude span of 1701–1800 m a. s. l.

Area of marmot colonies

On the northern side of the Ďumbierske Nízke Tatry Mts., the following active colonies were recorded [number of burrows in the colony; mean altitude of the burrow in the colony in metres a. s. l.], from west to east: Solisko [30; 1777], Mestská hoľa [5; 1728], Chabenec-north [15; 1741], Poľana-Zákľuky saddle [19; 1788], Poľana-north [13; 1612], Zákľuky-west [27; 1787], Bôr-Mošnica [12; 1607], Bôr I [28; 1834], Bôr II [32; 1810], Zákľuky-east [55; 1844], Dereše-north I [48; 1679], Dereše-north II [62; 1702], Dereše-north III [72; 1702], Chopok-north [14; 1721], Chopok-Luková [35; 1711], Konské-north I [18; 1721], Konské-north II [13; 1689], Široká valley [126; 1695], Bystrá valley [69; 1699], Ďumbier-north [17; 1731], and Štiavnica-north [11; 1775]. On the southern side, the following colonies were recorded: Ďurková [32; 1694], Lomnistá-Chabenec saddle [160; 1753], Skalka-Lomníská valley [39; 1848], Skalka-Dve vody [43; 1744], Zadné Kotliská I [13; 1666], Zadné Kotliská II [14; 1709], Predné Kotliská I [29; 1746], Predné Kotliská II [54; 1766], Predné Kotliská-beneath the Krížske saddle [64; 1661], Dereše-south I [59; 1792], Dereše-south II [20; 1876], Dereše-south III [32; 1941], Zadné Dereše [10; 1890], Chopok-south [44; 1876], Konské-south [33; 1769], Krúpova hoľa [92; 1818], Ďumbier-south [28; 1917], Štiavnica-south [56; 1675] and Štiavnica peak [49; 1909]. The area of marmot colonies ranged between 0.06 and 17.68 ha. The cumulative area of all marmot colonies was 108.55 ha (2.4% of the habitat area). The largest colony was situated on the southern side close to the Štiavnica valley with 17.68 ha (105 burrows). However, the colony with the highest number of burrows was found below the eastern Chabenec saddle on the southern side (160 burrows). The smallest colonies were situated on the northern side on the Chabenec peak (15 burrows) and Mestská hoľa (5 burrows), and these colonies were probably

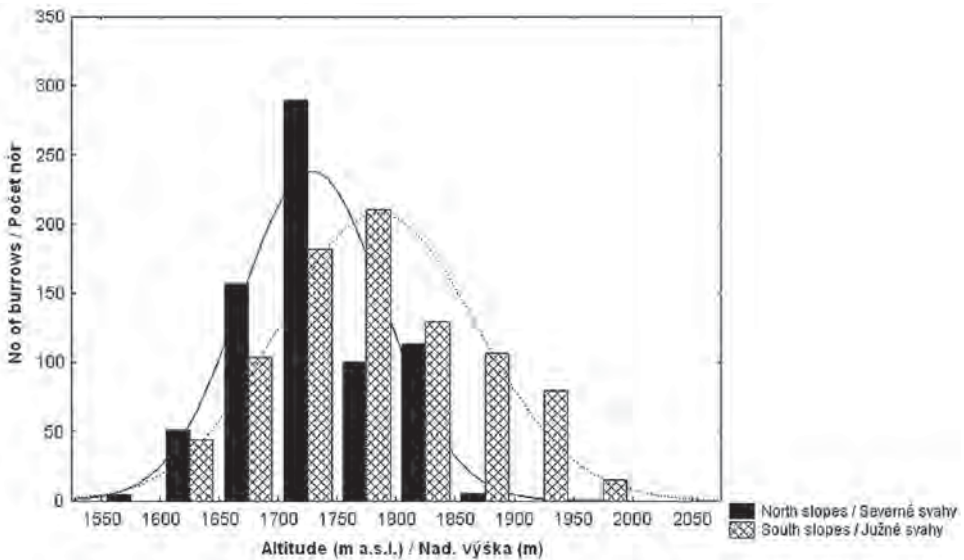


Fig. 2. Altitudinal distribution of marmot burrows in the Nízke Tatry Mts.
Obr. 2. Vertikálne rozšírenie svištých nôr v Nízkyh Tatráh.

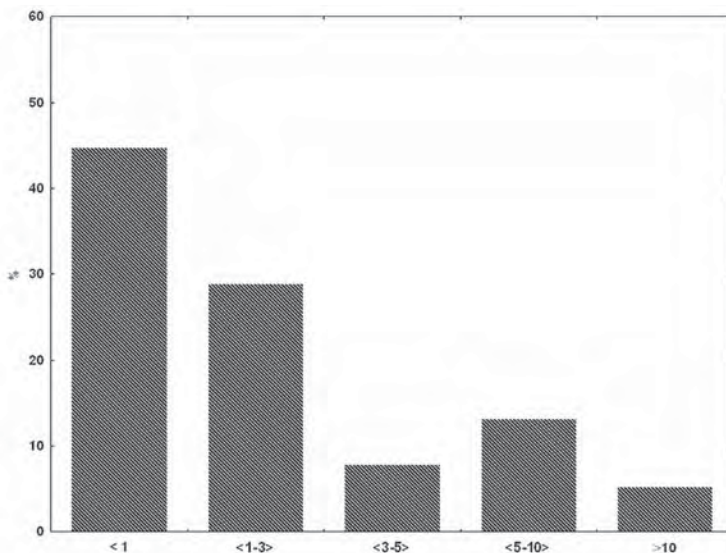


Fig. 3. Distribution of size categories (in ha) of marmot colonies in the Nízke Tatry Mts.
 Obr. 3. Relatívne zastúpenie veľkosti svištích kolónií (v ha) v Nízkyh Tatráh.

inactive. The mean colony size was 2.68 ha, however, this value differed on the two sides of the range; the colonies on the northern slope (mean=1.53 ha) were on average smaller than those on the southern slope (mean=4.49 ha). The dominant colony size category was ≤ 1 ha (44.7% of colonies). In this category, 17 marmot colonies were recorded, mostly on the northern side (15). The second most common category was <1–3> ha (29.0% of colonies), followed by <5–10> ha (13.16%), <3–5> ha (7.89%) and ≥ 10 (5.26%) (Fig. 3).

DISCUSSION

The main area of marmot distribution in the Nízke Tatry Mts. consists of mountain meadows on the southern side and glacial cirques on the northern side. Colonies were recorded more numerous on the northern slope, however, on average with fewer burrows than on the southern slope. A similar pattern of marmot distribution was mentioned by KARČ (2006), who recorded 61 colonies, 42 on the northern side and only 19 on the southern side. The present study describes only 21 active marmot colonies on the northern side, a half of the number counted by KARČ (2006), while on the southern slope the number of reported colonies (19) was identical. I presume three colonies to be inactive (two on the northern side and one on the southern side), since no marks of the marmot presence were observed there. Interestingly, ONDRUŠ (2003) recorded only 25 colonies on both sides of the mountain range.

KARČ (2006) mentioned the horizontal span of marmot distribution in the Nízke Tatry Mts. to be 25500 m from the north to the south and 9200 m from the west to the east. Based on the revised data presented here, the N–S span reduced by 10365 m and the W–E span by 4080 m in the last 28 years. Altogether 13 colonies were probably abandoned (see Fig. 1; Malá Chochuľa-Veľká

Table 2. Comparison of altitudinal distribution of the marmot in the Carpathian Mts.
 Tab. 2. Porovnanie vertikálneho rozšírenia svišťa v Karpatoch

state / mountains štát / pohorie	highest peak najvyšší vrchol	min	max	range rozsah	mean priemer	source zdroj
Slovakia						
Východné Tatry	2655	1560	2330	770	1945	BLAHOUT (1971)
Východné Tatry	2655	1530	2260	730	1915	CHOVANCOVÁ (1987)
Západné Tatry	2248	1496	2131	635	1866	BALLO & SÝKORA (2006)
Nízke Tatry	2043	1580	1855	275	1745	KARČ (2006)
Nízke Tatry	2043	1594	1991	397	1759	this study
Romania						
Rodna	2303	1580	2100	520	1840	PĂNZARIU (1993)

Chochuľa saddle, Veľká Chochuľa I and II, Latiborská hoľa, two colonies below the Ďurková peak, Chabeneč cirque, two colonies in the Krížsky cirque and Ludárova dolina – Matúšovské hole on the northern side; Husárka, Ďurková saddle and Malý Gápel' on the southern side). The differences between the data by KARČ (2006) and the results of this study concerning the number of colonies may have been caused by different counting methods, since KARČ (2006) obtained a part of his information (more than 30%) from secondary sources (hunters, foresters and rangers). The distribution on the northern side of the range is restricted to a glacial cirque, because the foot of the mountains is very steep and living conditions for marmots are rather extreme there (e.g. avalanche channels, blocks of rocks, etc.). Although some burrows were recorded on this steep slope (e.g. the colony below the Poľana-Zákľuky saddle as well as the colony in the glacial cirque Chopok-Luková, Kónské-north), the number of these colonies was small (n=5). On the contrary, similar location was published by BALLO & SÝKORA (2006) from the Západné Tatry Mts. and by CHOVANCOVÁ (1987) from the Východné Tatry Mts. They recorded many colonies (>50) on the extremely steep slopes, but the master burrow lied outside of the avalanche channel. BALLO (2008) recorded altogether 120 colonies (20 of them were inactive) in the Západné Tatry Mts. and CHOVANCOVÁ (1993) 156 active colonies in the Východné Tatry Mts. (including the Belianske Tatry Mts.). Together with 37 active colonies presented in this paper, the total number of marmot colonies in Slovakia is 313. ONDRUŠ (2003) suggested only 179 active colonies in Slovakia. However, survey methods used need to be taken into account, since a precise census of marmot distribution in Slovakia was started only a few years ago.

KARČ (2006) mentioned the altitude span of marmot distribution in the Ďumbierske Nízke Tatry Mts. to be only 275 m. The revised census showed the span of 397 m (a difference of 122 m), see Table 2. On the other hand, KARČ (2006) reported similar altitude for the lowest situated colony. Differences were found in the altitude of the highest situated colony; KARČ (2006) mentioned 1855 m, here I present the value of 1991 m (a difference of 136 m). The latter difference seems to be logical, as a consequence of the method used, since KARČ (2006) estimated the altitude from map contour lines only. Nevertheless, the highest values of altitudinal distribution in Slovakia were found in the Západné Tatry Mts. and Východné Tatry Mts. (CHOVANCOVÁ 1987, BALLO & SÝKORA 2006), the mountains higher than the Nízke Tatry Mts. In the Eastern Carpathians of Romania, a comparable altitude span with those in Slovakia was found; PĂNZARIU (1993) mentioned 520 m in the Rodna Mts.

ONDRUŠ (2003) specified (probably based on BLAHOÚT 1971) the altitude span of the marmot distribution in Slovakia to be 770 m. Generally, it could be stated that the altitude span increases with the height of the mountains. In the Alps and Pyrenees, its value ranges between 750 and 1300 m (MÜLLER 1992, HERRERO et al. 1994). The real altitude span was larger than the altitude span of colonies, because of marmot behavioural (e.g. locomotion). For example, an adult marmot was observed in the Huty saddle, Západné Tatry Mts., 940 m a. s. l. (P. BALLO pers. comm.). Another information is available about the migrations and migration tracks of the marmot across the timber line and the forest zone (see BALLO 2002, BALLO & SÝKORA 2006). Similar unusual cases were described also in the Nízke Tatry Mts. (ONDRUŠ 2003, KARČ pers. comm.).

As indicated above, only the study by BALLO & SÝKORA (2006) gave comparable data on the number of burrows. The authors conducted detailed research of marmot distribution in the Západné Tatry Mts. with a use of similar methods since 2004. They found the largest marmot colony comprising 359 burrows in the Smutná dolina (Roháče area) at the altitude of 1547 m. In the Nízke Tatry Mts., we found the maximum number of burrows in the Lomnístá valley (160). BALLO (2008) found the smallest inactive colony in Liptovská Tomanová, comprising 13 burrows. The smallest inactive colony in the Nízke Tatry Mts. was recorded in Mt. Mestská hoľa, comprising 5 burrows.

To be summarised, the marmot distribution range in the Nízke Tatry Mts. has been reduced, most probably due to natural succession of potential vegetation such as the dwarf pine (*Pinus mugo*), rowanberry (*Sorbus acuparia*) and spruce (*Picea abies*). In the 16th and 17th centuries, the sub-mountain area was deforested by the Walachian colonisers. During the last 28 years, the area of marmot distribution lost more than 1500 hectares. Those marmot colonies which lie close to the margin of the range are abandoned, most probably because the dwarf pine has been spreading into new places (e.g. the Prašivá, Latiborská and Mestská hoľa peak). Illegal hunting, mainly by shepherds and other local people, may be another important cause of marmot decline in the Nízke Tatry Mts. During social crises in nearby regions (Horehronie and Liptov) in the 1920s and 30s, the marmots were killed for fat used as a natural medicine (KARČ & BALLO pers. comm.).

Some results (GIS shapes) of this study could be useful for practical management and protection of this endangered species in the western part of the Nízke Tatry Mts. Patrolling of glacial cirques with marmot colonies in the spring season (late May and June) and their protection from undisciplined ski mountaineers and extreme skiers could help in marmot conservation (39% of all marmot colonies lies in the legal ski mountaineering area). Some tourist trails pass through the areas inhabited by marmot colonies (e.g. in the Široká and Štiavnica valleys) and these trails should be closed and re-routed, respectively. Also cutting of the dwarf pine and responsible management of alpine habitats in the specified areas should help to preserve marmot colonies and to stop the decline of the species range documented by the current data.

SÚHRN

V rokoch 2006–2009 (máj až október) bola uskutočnená revízia rozšírenia svišťa vrchovského (*Marmota marmota*) v Ďumbierskych Nížkych Tatrách. Spolu bolo zaznamenaných 1592 nôr, ktoré predstavujú 40 kolónií (21 kolónií na severnej strane a 19 na južnej strane pohoria). Z tohto počtu boli v roku 2009 tri kolónie pravdepodobne neaktívne. Priemerná nadmorská výška všetkých zameraných nôr bola 1759,0 metrov. Rozsah vertikálneho rozšírenia predstavuje 397 m, najnižšia nora bola zaznamenaná v 1594 m n. m. (glaciálny kar Poľany) a najvyššia nora bola zaznamenaná v 1991 m n. m. (južný svah Derešov). V kolónii nachádzajúcej sa v závere Lomnístej doliny pod východných Chabeneckým sedlom bolo zaznamenaných

najviac nôr (160). Naopak najmenej nôr bolo zistených v kolónii pod Mestskou hoľou (n=5). Najväčšia početnosť nôr sa nachádzala v nadmorských výškach od 1700 do 1799 m. Rozlohou najväčšia kolónia sa nachádza v závere Jánskej doliny a má rozlohu 17,68 ha. Priemerná rozloha všetkých kolónii bola 2,68 ha. Hustota kolónii v nadmorských výškach 1700 až 1799 predstavovala 0,25 kolónie na 100 ha v súčasnom areáli rozšírenia, tj. od Ďurkovej po kótu Štiavnica.

ACKNOWLEDGEMENTS

I would like to thank the Administration of the Nízke Tatry National Park for field and technical support. This study was supported by the Science Grant Agency of the Faculty of Sciences, Matej Bel University, Banská Bystrica, No. 20777-BiE. I also thank reviewer for his useful comments and notes on the manuscript.

REFERENCES

- BÁČKOR P., KLAUČO M. & ONDRUŠ S., 2008: Rozšírenie svišťa vrchovského (*Marmota marmota*, Linnaeus 1758) v Nízkyh Tatrách – časť 1 [Distribution of rock whistler (*Marmota marmota*, Linnaeus 1758) in the Nízke Tatry Mts. – Part 1]. Pp.: 101–109. In: ADAMEC M., URBAN P. & ADAMCOVÁ M. (eds.): *Výskum a ochrana cicavcov na Slovensku VIII. Zborník referátov z konferencie (Zvolen 12.–13. 10. 2007) [Research and Protection of Mammals in Slovakia VIII. Proceedings of a Conference (Zvolen 12–13 October 2007)]*. Štátna ochrana prírody SR, Banská Bystrica, 239 pp (in Slovak, with an abstract in English).
- BALLO M., 2002: Svište v Národnom parku Nízke Tatry [Marmots in the Nízke Tatry National Park]. *Tatry*, **2**: 10–11 (in Slovak).
- BALLO M., 2008: Monitoring kolónii svišťa vrchovského tatranského (*Marmota marmota latirostris*) v Západných Tatrách IV. Úsek (2007) [Monitoring of colonies of *Marmota marmota latirostris* in the West Tatra Mts. – IV. (2007)]. *Naturae Tutela*, **12**: 151–165 (in Slovak, with an abstract in English).
- BALLO P. & SÝKORA J., 2005: Monitoring kolónii svišťa vrchovského tatranského (*Marmota marmota latirostris*) v Západných Tatrách – I. úsek (2004) [Monitoring of colonies of *Marmota marmota latirostris* in the West Tatra Mts.]. *Naturae Tutela*, **9**: 169–190 (in Slovak, with an abstract in English).
- BALLO P. & SÝKORA J., 2006: Monitoring kolónii svišťa vrchovského tatranského (*Marmota marmota latirostris*) v Západných Tatrách, II. úsek (2005) [Monitoring of colonies of *Marmota marmota latirostris* in the Western Tatras Mts.]. *Naturae Tutela*, **10**: 159–187 (in Slovak, with an abstract in English).
- BASHTA A.T. & POTISH L., 2007: *Ssavci Zakarpatskoi oblasti [Mammals of the Transcarpathian Region (Ukraine)]*. Institute of Ecology of the Carpathians, L'viv, 206 pp (in Ukrainian, with a summary in English).
- BLAHOUT M., 1971: Príspevok k bionómii svišťa vrchovského (*Marmota marmota* L.) [Contribution to bionomy of the marmot (*Marmota marmota* L.)]. *Zborník Prác o Tatranskom Národnom Parku*, **13**: 243–285 (in Slovak).
- CHOVANCOVÁ B., 1987: Výsledky inventarizácie svišťa vrchovského tatranského (*Marmota marmota latirostris*, Kratochvíl 1961) na území Tatranského Národného parku v období rokov 1982–1985 [Inventory results of the Tatra marmot (*Marmota marmota latirostris*, Kratochvíl, 1961) on the territory of the Tatra National Park for the period 1982 to 1985]. *Folia Venatoria*, **17**: 137–150 (in Slovak, with summaries in English, Russian and German).
- CHOVANCOVÁ B., 1993: Svište na ústupe [Marmots in defensive]. *Tatry*, **6**: 6–7 (in Slovak).
- CORTOT H., FRANCOU M., JUAN D., TRON L., LE BERRE M. & RAMOUSSE R., 1994: Development of census method of Alpine marmots in the Ecrins National Park. *Journal of Mountain Ecology*, **2**: 32.
- FERIANCOVÁ Z., 1955: Rozšírenie niektorých vzácnych druhov cicavcov na Slovensku [Distribution of some rare species of mammals in Slovakia]. *Práce II. Sekcie Slovenskej Akadémie Vied – Séria Biologická*, **1**(3): 1–24 (in Slovak).

- FERIANCOVÁ-MASÁROVÁ Z. & HANÁK V., 1965: *Stavovce Slovenska IV – Cicavce* [Vertebrates of Slovakia IV – Mammals]. Vydavateľstvo Slovenskej akadémie vied, Bratislava, 336 pp (in Slovak).
- HERRERO J., GARCÍA-GONZÁLES R. & GARCÍA-SERRANO A., 1994: Altitudinal distribution of Alpine marmot (*Marmota marmota*) in the Pyrenees, Spain/France. *Arctic and Alpine Research*, **26**: 238–331.
- JAMNICKÝ J., 1977: Pôvodnosť svišťa vrchovského (*Marmota marmota*) v Nízkyh Tatráh [Originality of the marmot (*Marmota marmota*) in the Nízke Tatry Mts.]. *Folia Venatoria*, **7**: 298–302 (in Slovak, with summaries in English, Russian and German).
- JAMNICKÝ J., 1999: O pôvode nízkotatranských svišťov [On the origin of the marmot in the Nízke Tatry Mts.]. *Poľovníctvo a Rybárstvo*, **51**(9): 20–21 (in Slovak).
- KARČ P., 2006: Príspevok k poznaniu populácie svišťa vrchovského (*Marmota marmota* L.) v západnej časti Národného parku Nízke Tatry (Prašivá – Ďumbier) [A Contribution to knowledge of the Marmot population in the western part of the Low Tatras National Park (Prašivá – Ďumbier)]. *Naturae Tutela*, **10**: 79–93 (in Slovak, with an abstract in English).
- KRATOCHVÍL J., 1961: Svišť horský tatranský, nová subspecies, *Marmota marmota latirostris* ssp. nova [Tatra marmot, the new subspecies, *Marmota marmota latirostris* ssp. nova.]. *Zoologické Listy*, **10**(4): 289–304 (in Czech, with an abstract in English).
- KRATOCHVÍL J., 1964: K aklimatizaci a reaklimatizaci sviště horského u nás [To acclimatisation and re-acclimatisation of the marmot in our country]. *Živa*, **50**(6): 223–224 (in Czech).
- MITCHELL-JONES A. J., AMORI G., BOGDANOWICZ W., KRYŠTUFEK B., REINDERS P. J. H., SPITZENBERGER F., STUBBE M., THISSEN J. B. M., VOHRALÍK V. & ZIMA J., 1999: *The Atlas of European Mammals*. T&AD Poyser, Academic Press, London, 484 pp.
- MÜLLER J. P., 1992: Habitat selection of *Marmota marmota* in the Eastern Alps of Switzerland. Pp.: 233–234. In: BASSANO B., DURIO P., GALLO-ORSI U. & MACCHI E. (eds): *Proceedings of the First International Symposium on Alpine Marmot (Marmota marmota) and on the Genus Marmota*. Dipartimento di Produzioni Animali, Epidemiologia ed Ecologia, Torino, Italy.
- ONDŘUŠ S., 2003: *Program záchrany svišťa vrchovského (Marmota marmota Linnaeus, 1758)* [Programme of Conservation the Marmot (*Marmota marmota* Linnaeus, 1758)]. Unpublished manuscript. ŠOP SR, Správa Národného parku Nízke Tatry, Banská Bystrica, 27 pp (in Slovak).
- PĂNZARIU C., 1993: Marmota (*Marmota marmota* L.) în Muntii Rodnei, după 20 de ani de la colonizare. *Ocotirea Naturii și a Mediului Înconjurător*, **37**(1): 11–18 (in Romanian).
- RODGERS A. R., CARR A. P., BEYER H. L., SMITH L. & KIE J. G., 2007: *Home Range Tools for ArcGIS*. Ontario Ministry of Natural Resources, Centre for Northern Forest Ecosystem Research, Thunder Bay, Ontario, Canada.
- SOMORA J., 1954: Svišť horský (*Arctomys marmota* L.) [Marmot (*Arctomys marmota* L.)]. *Ochrana Přírody*, **9**(2): 36–41 (in Czech).
- URBAN P., 2002: Văčšiu pozornost' svišťovi [More attention to the marmot]. *Chránené Územia Slovenska*, **52**: 14–18 (in Slovak).
- VICENÍKOVÁ A. & POLÁK P. (eds.), 2003: *Európske významné biotopy na Slovensku* [Significant European Habitats in Slovakia]. Štátna ochrana prírody SR, Banská Bystrica, 151 pp (in Slovak).
- ŽIAK D. & URBAN P. 2001: Červený (ekozozologický) zoznam cicavcov (Mammalia) Slovenska [Red (ecososological) list of mammals (Mammalia) of Slovakia]. Pp.: 154–156. In: BALÁŽ D., MARHOLD K. & URBAN P. (eds.): *Červený zoznam rastlín a živočíchov Slovenska*. *Ochrana Prírody*, **20**(Suppl.). Štátna ochrana prírody SR, Banská Bystrica, 160 pp (in Slovak, with an abstract in English).