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Kazimierz KOWALSKI

Microtus nivalis (MARTINS, 1842) (*Rodentia*) w Karpatach
Microtus nivalis (MARTINS, 1842) (*Rodentia*) в Карпатах
Microtus nivalis (MARTINS, 1842) (*Rodentia*) in the Carpathians

[With 5 textfigures]

HISTORY OF THE PROBLEM

In 1897 MOJSISOVICS VON MOJSVAR mentions a specimen of snow vole which he saw in the Museum of Lwów. This specimen was presumably collected in the environs of Stanisławów. The author expresses his surprise because of this place of finding and states that the snow vole had not hitherto been reported from the Carpathians.

In 1908 G. S. MILLER described a new species of vole, viz. *Microtus ulpius* MILLER from 18 specimens found at Hatszeg in Transylvania by DANFORD. MILLER places this new species in his subgenus *Chionomys* MILLER and shows its close relation to *Microtus nivalis* (MARTINS).

In 1932, L. SAGAN found numerous specimens of the snow vole in Czarnohora (Eastern Carpathians). One of the specimens was sent to H. POLE, who published a note on it (1932). He stated that it is *Chionomys nivalis* (MARTINS), but that for the time being it was not possible to define to what subspecies it belonged. A year later J. FUDAKOWSKI wrote in detail on the voles of Czarnohora considering them as belonging to the species *Chionomys ulpius* MILLER. He mentioned as well that this species may be also found in the Tatras. LUBICZ-NIEZABITOWSKI (1933, 1934) also wrote on *Microtus ulpius* MILLER in the Czarnohora and published a drawing of its teeth from a specimen collected by L. SAGAN.

In 1934 L. SAGAN gave further data on *Chionomys ulpius* MILLER from the Czarnohora. He also mentioned that he had found in the Tatras

voles related to those of the Eastern Carpathians, but differing somewhat in the structure of the teeth and in colour. He did not describe these specimens in detail.

In 1933, H. SCHAEFER found some subfossil material of small mammals in the Murańska Cave in the Tatra Mountains. In 1935 he published the results and stated the presence in the material of a new form of vole which hen named *Microtus* (*nivalis*?) *mirhanreini* SCHAEFER. He writes: „Der systematische Wert der Form ist noch unbestimmt; der Name ist zunächst nur ein Gebrauchsterminus". While his paper was in press SCHAEFER received from E. BETHENFALVY one complete specimen of *Microtus mirhanreini* SCHAEFER, but he did not describe it in detail.

J. EHIK obtained in 1942 two specimens of voles from the Rodna Mountains in the Eeastern Carpathians. On this basis he established a new species which he named *Microtus radnensis* EHIK. In this new species he also includes the voles from the Czarnohora, one specimen of which, collected by SAGAN, was in his possesion.

In 1949 J. HANZAK and B. ROSICKY collected in the Tatra Mountains a numerous series of voles belonging to the form *Microtus mirhanreini* SCHAEFER, and were able therefore to describe this rodent in more detail than SCHAEFER. According to SCHAEFER's suggestions, these authors deny the independence of the subgenus *Chionomys* MILLER and consider *Microtus mirhanreini* SCHAEFER as a separate species, intermediate between *Microtus nivalis* (MARTINS) and *Microtus oeconomus* (PALLAS). Simultaneously with the paper of the Czechoslovak authors, there was published that of EHIK based on the material sent him by them. Here the author is of different opinion regarding the systematic position of the high-mountain Carpathian voles. He thinks that they all belong to the species *Microtus nivalis* (MARTINS) as three subspecies and are not closely related to *Microtus oeconomus* (PALLAS). S. I. OGNEV is of similar opinion as to the independence of *M. nivalis* (MARTINS) and *M. oeconomus* (PALLAS), he, however, includes all Eastern Carpathian voles in *Microtus* (*Chionomys*) *nivalis ulpius* MILLER. In the work of B. S. VINOGRADOV and I. M. GROMOV (1952) we also find a note that *M. nivalis ulpius* MILLER occurs in the USRR in the Eastern Carpathians. In 1954 there was published K. A. TATARINOV's work on the Eastern Carpathians snow vole. The author gives measurements of several specimens of this rodent and data on its biology. He states that only *Microtus nivalis ulpius* MILLER occurs in the whole region of the Carpathians. Finally in 1956 KRATOCHVIL published a paper with a characteristic of morphology of *Microtus nivalis mirhanreini* SCHAEFER population in Tatra Mountains in which some details of its biology are given.

Recent monographs of rodents give various opinions regarding the taxonomy of the Carpathian snow voles. J. R. ELLERMAN (1941) mentions from the Carpathians only *Microtus ulpius* MILLER. E. MOHR (1950) includes the snow voles of the Eastern Carpathians and Tatra

Mountains in *Chionomys nivalis ulpius* MILLER. J. R. ELLERMAN and T. C. S. MORRISON-SCOTT (1951) mention *Microtus nivalis ulpius* MILLER and *M. nivalis radnensis* EHIK. As it is clear from this review of the literature, we find a great divergence of opinion on the taxonomy of the Carpathian snow voles, even in the most recent works. Some authors consider them as only one form (MOHR, 1950; TATARINOV, 1954), some recognize two separate forms (ELLERMAN and MORRISON-SCOTT, 1951), and others three forms (HANZAK and ROSICKY, 1949; EHIK, 1949). Some scientists place all Carpathian forms in the species *Microtus nivalis* MARTINS as subspecies (EHIK, 1949), others consider them as species, and *Microtus mirhanreini* SCHAEFER is supposed to be an intermediate form between *M. nivalis* (MARTINS) and *M. oeconomus* (PALLAS), reducing thus to nothing the independence of the subgenus *Chionomys* MILLER.

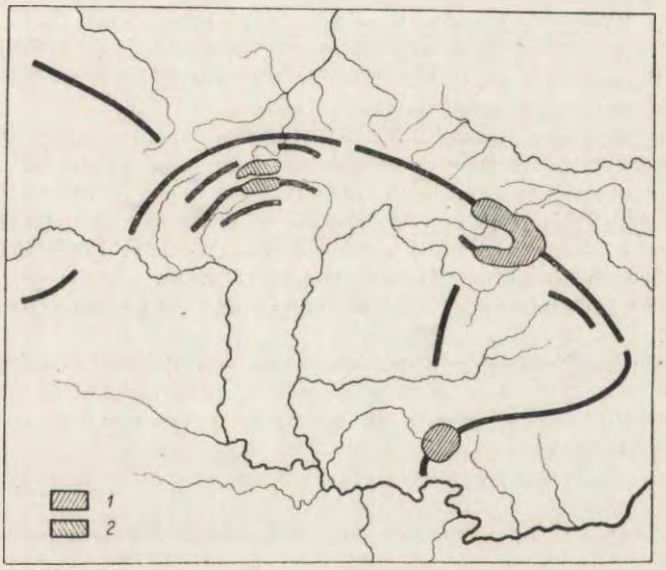

Fig. 1. Distribution of *Microtus nivalis* (MARTINS) in the Carpathians. 1. *M. nivalis ulpius* MILLER, 2. *M. nivalis mirhanreini* SCHAEFER.

The aim of my research was to clear up the systematic position of the Carpathian voles of the group *Microtus nivalis* (MARTINS). I based my investigations on the recent literature as well as on a relatively abundant material of voles from the Eastern Carpathians and the Tatras in the collection of the Cracow Branch of the Zoological Institute of the Polish Academy of Sciences.

Microtus nivalis ulpius MILLER, 1908

Microtus ulpius MILLER, 1908, 100—101.
Microtus ulpius MILLER, MILLER, 1912, 723.
Chionomys nivalis MARTINS, POHLE, 1932.
Microtus (*Chionomys*) *ulpius* MILLER, LUBICZ-NIEZABITOWSKI, 1933, 68—69, fig. 15.
Chionomys ulpius MILLER, FUDAKOWSKI, 1933.
Microtus (*Chionomys*) *ulpius* MILLER, LUBICZ-NIEZABITOWSKI, 1934, 192.
Chionomys ulpius MILLER, SAGAN, 1934.
Chionomys ulpius MILLER, SAGAN, 1939.
Microtus ulpius MILLER, ELLERMAN, 1941, 606.
Microtus (*Chionomys*) *nivalis* MARTINS, EHIK, 1941, 11.
Microtus (*Chionomys*) *nivalis ulpius* MILLER, WINOGRADOW and ARGYROPULO, 1941, 213.
Microtus (*Chionomys*) *ulpius* MILLER, EHIK, 1942, 18—23, fig. 5.
Microtus (*Chionomys*) *radnensis* EHIK, 1942, 18—25, fig. 1—4, tab. 1; holotype: ♀ ad from the shores of Lake Mosolygo (1900 m. alt.) in the Rodna Mts., collected by Z. KASZAB in 1941; in the possession of the Budapest National Museum, no. 4176/2.
Microtus radnensis EHIK, EHIK, 1949 [in the paper he states that he considers the form as a subspecies of *Microtus nivalis* (MARTINS)].
Microtus ulpius MILLER, EHIK, 1949 [in the paper he states that he considers this form as a subspecies of *Microtus nivalis* (MARTINS)].
Microtus (*Chionomys*) *nivalis ulpius* MILLER, OGNEV, 1950, 451—452.
Chionomys nivalis ulpius MILLER, MOHR, 1950, 18.
Microtus nivalis ulpius MILLER, ELLERMAN and MORRISON-SCOTT, 1951, 693.
Microtus nivalis radnensis EHIK, ELLERMAN and MORRISON-SCOTT, 1951, 694.
Microtus (*Chionomys*) *nivalis ulpius* MILLER, VINOGRADOV and GROMOV, 1952, 260.
Microtus (*Chionomys*) *nivalis ulpius* MILLER, TATARINOV, 1954.

Holotype: ♀ ad. (skull and skin) collected at Hatszeg in the Transylvanian Alps, Rumania, at 2000 feet, by C. G. DANFORD, in the possession of the British Museum, no. 3, 2, 2, 48.

Figures: NIEZABITOWSKI-LUBICZ, 1933, fig. 15 (teeth); SAGAN, 1934, fig. 56 (photograph in toto); EHIK, 1942, figs. 1—4, tab. 1 (drawing and photograph of the teeth of type and cotypes of *Microtus radnensis* EHIK), fig. 5 (drawing of teeth of topotype of *Microtus ulpius* MILLER according to T. OLDFIELD's drawing from a specimen in the British Museum); TATARINOV, 1954, fig. 1 (photograph in toto).

Geographical distribution: Transylvanian Alps (known only from the vicinity of Hatszeg; according to EHIK, 1942, it was probably not found in this locality but in the mountains surrounding it), Rodna Mountains, Marmaros Mountains, and Czarnohora.

Material examined: 20 skins and 25 skulls from the Czarnohora and the Marmaros Mountains in the collection of the Zoological Institute of the Polish Academy of Sciences and 6 skins and 6 skulls from the Transylvanian Alps from the collection of the British Museum.

Diagnosis according to MILLER, 1908: „Similar to *Microtus nivalis* but colour darker and tail usually brown above (often distinctly bicolor throughout); posterior border of palate with median ridge sharply defined; its width less than that of deep lateral pit; anterior loop of first molar as in *M. nivalis aquitanicus*". Miller writes further: „This species is well differentiated from *Microtus nivalis* by the peculiar form of the palate and by the dark colour of the upperparts. Among the thirteen skins examined all show traces of brown on the upper surface of the tail, while in seven (including the type) the tail is distinctly bicolor throughout".

The morphology of this species, on the basis of the material which I brought together appears as follows.

Summer coat of adult specimens brown-grey on the dorsal side; along the middle of the back a little darker; sides clearer and gradually greying downwards. Ventral side grey, slightly suffused with brown. The transition of the colour of the back into that of the ventral side gradual. Colour similar to that of the specimens of *Microtus nivalis nivalis* (MARTINS) from the Alps which I had for comparison. Tail distinctly bicoloured, dark above, clear-grey below. Young specimens differing distinctly in colour from the adults; they are smoke-grey with indistinct, slight brown suffusion on the dorsal side; whiskers very long, reaching 4 or even 5 cm, some of them fair, others dark brown.

Shape of palate similar to that of *Microtus nivalis nivalis* (MARTINS) but squama carinae medianae rather high, distinctly separated at the sides from the fossae laterales. Fossae laterales deep. Fossa interpterygoidea wide, its anterior edge of a rather variable outline, sometimes even and semicircular, sometimes with a slightly backwards protruding blunt projection of the squama carinae medianae. Width of the squama carinae medianae smaller than that of the fossae laterales.

Table

Microtus nivalis

no.	label of the Zool. Inst. in Kraków	locality	altitude in m.	date
1	394	Czarnohora Mts., Breskuł	1450	29 VII 1934
2	395	Czarnohora Mts., Pop Ivan	1900	12 VIII 1935
3	396	Czarnohora Mts.	—	4 VIII 1934
4	399	Czarnohora Mts., Zaroślak	1500	29 VI 1934
5	401	Marmaros Mts., Micheilecul	1600	7 VIII 1935
6	407	Czarnohora Mts., Kocioł Breskulski	1320	22 VI 1934
7	408	Czarnohora Mts., Kocioł Koźmieski	1650	23 VII 1935
8	409	Czarnohora Mts., Kocioł Breskulski	1350	28 VIII 1935
9	410	Czarnohora Mts., Kocioł Mały	—	15 VIII 1935
10	412	Marmaros Mts.	1600	7 VIII 1935
11	(5)	Czarnohora Mts., Breskuł	1450	—
12	(6)	Czarnohora Mts., Kocioł Breskulski	1450	17 VII 1934
13	(7)	Czarnohora Mts., Breskuł	1750	19 VII 1935
14	398	Czarnohora Mts., Kocioł Breskulski	1650	10 VII 1934
15	413	Czarnohora Mts., Kocioł Breskulski	1340	10 VII 1934
16	(1)	Czarnohora Mts., Breskuł	1450	28 VII 1934
17	(2)	Czarnohora Mts., Smotrycz	1700	—
18	(3)	Czarnohora Mts., Kocioł Breskulski	1450	10 VII 1934
19	(8)	Czarnohora Mts., Kocioł Mały	—	15 VIII 1935
20	397	Czarnohora Mts., Kocioł Pożyżewski	1500	14 VII 1934
21	400	Czarnohora Mts.	1600	22 VII 1935
22	402	Czarnohora Mts., Breskuł	1450	27 VI 1934
23	403	Marmaros Mts., Micheilecul	1600	7 VIII 1935
24	404	Czarnohora Mts., Pożyżewska	1300	9 VIII 1935
25	405	Czarnohora Mts., Breskuł	1450	27 VI 1934
26	406	Czarnohora Mts., Kocioł Breskulski	1340	10 VII 1934
27	411	Czarnohora Mts., Breskuł	1450	29 VII 1934
28	(4)	Czarnohora Mts., Kocioł Wielki	—	17 VIII 1935

I

ulpius MILLER, 1908

collected by	sex and age	head and body	tail	hind foot	ear	condylobasal length	zygomatic breadth	interorbital constriction	nasal	diastema	maxillary tooth-row	mandibular tooth-row
L. SAGAN	♀ ad.	121	72	21	16,5	29,3	16,6	4,5	8,8	9,7	6,8	6,9
L. SAGAN	♀ ad.	121	68	21	17	29,8	17,1	4,5	8,7	9,8	6,8	7,0
L. SAGAN	♂ ad.	113	62	20	15	28,2	16,2	4,4	7,8	8,8	6,5	6,5
L. SAGAN	♀ ad.	130	66	20	17	31,4	18,0	4,6	9,0	10,3	7,2	7,3
L. SAGAN	♀ ad.	130	65	20	17	30,6	18,0	4,5	8,6	10,0	7,1	6,8
L. SAGAN	♀ ad.	135	66	20	17	31,2	17,8	4,5	8,3	10,1	7,0	7,0
L. SAGAN	♀ ad.	121	64	21	17	30,0	17,7	4,4	8,4	9,5	—	—
L. SAGAN	♀ ad.	130	62	21	18,5	30,5	17,8	4,4	8,4	10,0	7,0	7,0
L. SAGAN	♀ ad.	127	67	21	18	30,7	17,8	4,4	8,8	9,8	7,1	7,0
L. SAGAN	♀ ad.	133	64	21	17	29,9	17,7	4,4	8,0	9,7	6,9	6,9
L. SAGAN	ad.	—	—	—	—	30,3	17,3	4,4	8,5	9,8	7,0	7,0
L. SAGAN	ad.	125	68	21	18	29,9	17,0	4,4	8,4	10,0	7,0	7,0
L. SAGAN	♀ ad.	120	63	20	17,5	30,0	16,9	4,5	8,4	9,6	6,5	6,7
L. SAGAN	♀subad.	105	57	19,5	16,5	26,9	15,9	4,3	7,5	9,0	6,4	6,5
L. SAGAN	♀subad.	110	58	21	16	—	—	—	—	—	—	—
L. SAGAN	♀subad.	108	61	20	17	27,7	16,5	4,5	7,8	8,9	6,5	6,5
L. SAGAN	♂subad.	107	56	20	15	26,7	16,5	4,5	7,2	8,4	6,6	6,7
L. SAGAN	♀subad.	110	58	21	16	27,8	16,4	4,5	8,0	8,6	6,8	6,7
L. SAGAN	♀subad.	105	59	20	16	26,5	16,0	4,5	8,3	8,1	6,4	6,3
L. SAGAN	♀ juv.	95	46	20	15	25,9	14,8	4,4	7,1	8,2	6,4	6,3
L. SAGAN	♀ juv.	96	48	20	15	24,5	14,6	4,5	7,1	8,2	6,3	6,2
L. SAGAN	♂ juv.	94	47	20	15,5	25,4	14,2	4,5	7,1	ca 8,9	6,3	6,2
L. SAGAN	♂ juv.	100	56	21	16	25,8	14,9	4,4	7,6	8,1	6,4	6,4
J. FUDAKOWSKI	♂ juv.	97	45	20	13	—	—	—	—	—	—	—
L. SAGAN	♂ juv.	94	47	20	15,5	—	—	—	—	—	—	—
L. SAGAN	♂ juv.	106	61	19	15	26,8	15,5	4,5	7,4	8,4	6,3	6,2
L. SAGAN	♀ juv.	95	58	20	16	25,9	16,3	4,5	7,7	8,3	6,5	6,3
L. SAGAN	♂ juv.	105	59	19	17	26,6	17,7	4,5	7,8	8,4	6,6	6,7

Molar teeth of similar shape as in *Microtus nivalis nivalis* (MARTINS). First loop of first lower molar wide, variability of its shape small. Among the specimens which I have examined one shows a distinctly different structure of the second upper molar; its median enamel triangle is deeply incised from the inside. Several other specimens show in this place an indistinct depression in the enamel. Among the three specimens studied by EHIK one had a distinct incision

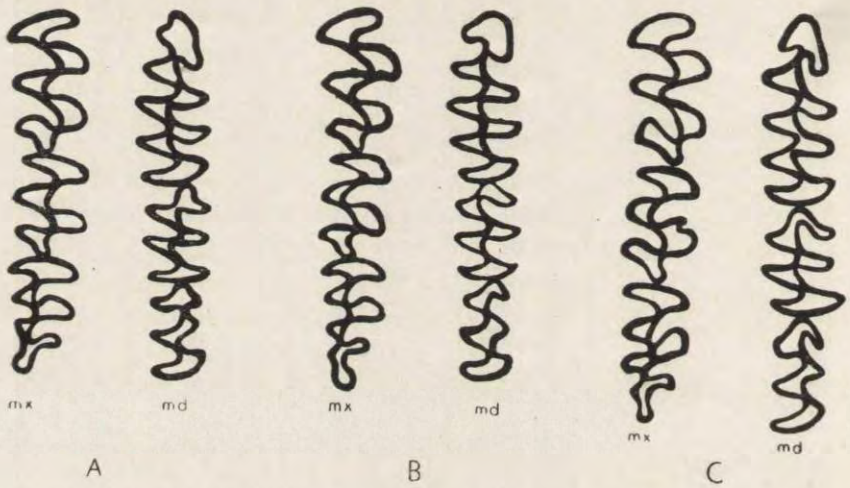

Fig. 2. Molar teeth of three specimens of *M. nivalis ulpius* MILLER from the Czarnohora. In specimen C a dental anomaly in the form of enamel incision in m^2 is seen. mx — maxillar teeth, md — mandibular teeth.

of the enamel, in the second this feature was rather distinctly marked in one jaw, the third did not show this feature. The majority of specimens which I have examined showed no trace of any incision on the inside of the median triangle of the second upper molar tooth.

The measurements of the type are as follows. Head and body — 131 mm., tail — 58 mm., hind foot — 20 mm., ear — 17 mm., condylobasal length of skull 30,4 mm., zygomatic breadth — 18,0 mm., interorbital constriction — 4,4 mm., nasal length — 8,0 mm., diastema — 9,2 mm., length of the maxillary tooth-row — 7,2 mm., length of the mandibular tooth-row — 7,0 mm.

The measurements of the adult specimens which I have examined are as follows. Head and body — 120—135 mm. (mean 125,5 mm.), tail — 62—72 mm. (mean 65,6 mm.), hind foot — 20—21 mm. (mean 20,6), ear — 16,5—18,5 mm. (mean 17,1 mm.), condylobasal length — 28,2—31,4 mm. (mean 30,1 mm.), zygomatic breadth —16,1—18,0 mm. (mean 17,4 mm.), interorbital constriction — 4,4—4,6 mm. (mean 4,5 mm.), nasal lenght — 7,8—8,8 mm. (mean 8,4 mm.), diastema — 8,8—10,3 mm. (mean 9,8 mm.), length of the maxillary toot-row — 6,5—7,3 mm. (mean 6,9 mm.), length of the mandibular tooth-row — 6,5—7,3 mm. (mean 6,9 mm.). The ratio of the mean length of the tail to the mean length of the body is 52:100. The tail is thus a little longer than the half of the body. My material was not weighed. The weight of adult specimens, according to TATARINOV (1954), varies from 41 to 68 g., the mean value being 51,2 g.

Biology: The snow vole occurs in the Eastern Carpathians in the alpine meadows and *Pinus mughus* SCOP. zone. It was generally collected in the valleys covered with scattered stones, with rich vegetation growing among them. The snow vole inhabits the regions at an altitude of 1300—1900 m. SAGAN mentions the finding of a *Microtus nivalis ulpius* MILLER in the alimentary canal of a viper at 1220 m. In the forest zone, however, the voles were not collected.

Microtus nivalis ulpius MILLER has probably two breeding periods in the year. According to TATARINOV (1954) SOKUR found four embryos 19 mm. long in a female on May 25. Young and half-grown specimens collected in July and August are from the spring brood. In the summer months both pregnant and nursing females are met with. The latest observation is dated August 28, when SAGAN found four embryos in a female. The number of embryos found in pregnant females varies from two to four.

Eastern Carpathian voles live in burrows among stones. Burrows dug in the turf are rarely met with. Near the entrances of the burrows remains of food are found; these indicate that the voles feed on *Vaccinium myrtillus L.*, *Gentiana asclepiadea* L., *Cystopteris fragilis* (L.) BERNH., *Homogyne alpina* (L.) CASS. and *Aira* L. sp. In the winter the voles dig burrows beneath the snow cover, very close to the surface of the soil.

Microtus nivalis mirhanreini SCHAEFER, 1935

Microtus (*nivalis*?) *mirhanreini* SCHAEFER, 1935, 560–561, fig. 12.
Microtus mirhanreini SCHAEFER, EHIK, 1941, 11.
Microtus mirhanreini SCHAEFER, HANZAK and ROSICKY, 1949.
Microtus mirhanreini SCHAEFER, EHIK, 1949 [in his text he states that he considers this form as a subspecies of *M. nivalis* (MARTINS)].
Microtus mirhanreini SCHAEFER, ROSICKY and KRATOCHVIL, 1955.
Microtus (*Chionomys*) *nivalis mirhanreini* SCHAEFER, KRATOCHVIL, 1956.

Type: SCHAEFER (1935) does not say which of the 100 subfossil mandibles is to be considered as the type. HANZAK and ROSICKY give as a typical specimen „in toto" a male from the Mięguszowiecka Valley in the Tatras (1900 m. alt.), collected by HANZAK on Nov. 1, 1948. This specimen is in the collection of the Národní Museum in Praha.

Figures: SCHAEFER, 1935, fig. 12 b–h (drawings of the enamel pattern of m_1); HANZAK and ROSICKY, 1949, figs. 2, 3 (photograph of 6 specimens in toto), fig. 4 (drawings of the enamel pattern of m_1 in 13 specimens), fig. 5 (drawing of the skull); EHIK, 1949, fig. 1 (photograph of the mandibular teeth); KRATOCHVIL, 1956, figs. 4–9 (drawings of the enamel pattern of m^1, m^2 and m^3), figs. 16–17 (2 specimens in toto).

Geographical distribution: Tatra and Lower Tatra Mountains, above the border of the forest zone.

Material examined: 51 skins, 43 skulls, 3 specimens in alcohol from the Tatra in the collection of the Cracow Branch of the Zoological Institute of the Polish Academy of Sciences.

The diagnosis according to SCHAEFER is as follows. „Vertreter der *ratticeps-nivalis*-Gruppe. Beiden an Grösse gleich und mit beiden durch lange Übergangsketten im typischen Merkmal des m_1 verbunden. Kennzeichen des Extrems: m_1 besitzt ausser aboraler Schleife 6 Dreiecke, aussen und innen je 3, von denen nur das vordere Paar unter sich geöffnet ist. Hierauf folgt eine abgetrennte Kappe, die etwas kleiner als bei *nivalis* ist". To this diagnosis, based only on the fossil material, HANZAK and ROSICKY add further features: „On the whole it resembles in colouring the alpine fieldmice of the Alps, but is as a whole darker, dark gray with brown elements. Summer coat on the dorsal side nearly dark brown, far darker than the summer coat of *M. nivalis*. The winter coat is lighter, gray, the hair denser and longer (15–18 mm.) with whitish elements. The colouring of the ventral side is almost white

without seasonal changes. In this feature it differs considerably from *M. nivalis*. Tail: upper side grayish brown, whitish below. One of our specimens in its winter coat has an almost unicolored whitish tail, which we attribute to ist considerable age. The difference between the light and dark hair is much more marked in the summer coat. All the measurements of the skull appear smaller in comparison with the other representatives of the group *nivalis*. But it was not possible to find essential differences in the details of its configuration".

The morphology of this species, on the basis of the material which I have examined, is as follows. Summer coat of adults grey on the dorsal side with slight light yellowish suffusion. It differs distinctly from *Microtus nivalis ulpius* MILLER and *M. nivalis nivalis* (MARTINS), being more grey and without the dark brown shades occuring in those subspecies. Ventral part grey without any brown suffusion. Transition of the colour of the back into that of the ventral side gradual. Tail bicoloured; darker brownish above, silvery gray below. Young specimens smoke-grey, almost without brown shades. Whiskers very long, reaching 5 cm, some fair, others dark brown.

Shape of palate similar to that of *Microtus nivalis ulpius* MILLER. It shows considerable variability. The squama carinae medianae high, distinctly separated at the sides from the deep fossae laterales. Fossa interpterygoidea wide, arched anteriorly.

Molar teeth. The characteristic feature of this subspecies is the great variability of the structure of the enamel loop of the first lower molar. In more or less half of the specimens in addition to the terminal loops in this tooth there occur six triangles and the front pair is connected by a wide transition. In the remaining specimens the sixth loop is more or less atrophied while the second triangle may be separated from the anterior terminal loop by a constriction (as in *M. nivalis nivalis* (MARTINS) or connected with it by a wide transition (as in *M. oeconomus* (PALLAS)). The latter type of m_1 structure is the least frequent. The variability of m_1 concerns not only individual specimens but also the mandibular rami in the same individual. As a rule the loops of the first molar tooth are different on the left and right sides, and, sometimes,

Table

Microtus nivalis

no.	label of the Zool. Inst. in Kraków	locality	altitude in m.	date	collected by
1	341	Tatra Mts., Żółta Turnia	1700	28 IX 1954	S. Sagan
2	345	Tatra Mts., Liliowe	1800	1 IX 1954	S. Sagan
3	346	Tatra Mts., Beskid	1800	1 IX 1954	S. Sagan
4	348	Tatra Mts., Żółta Turnia	1700	1 IX 1954	S. Sagan
5	350	Tatra Mts., Liliowe	1800	12 IX 1954	S. Sagan
6	352	Tatra Mts., Liliowe	1800	23 VII 1954	S. Sagan
7	354	Tatra Mts., Hala Gąsienicowa	1500	25 VII 1954	K. Kowalski
8	355	Tatra Mts., near Zadni Staw Gąsienicowy	1900	6 VIII 1954	K. Kowalski
9	357	Tatra Mts. near Staw Litworowy	1650	9 VIII 1954	K. Kowalski
10	360	Tatra Mts., Raptawicka Turnia	1200	19 VIII 1954	K. Kowalski
11	361	Tatra Mts., Raptawicka Turnia	1200	20 VIII 1954	K. Kowalski
12	362	Tatra Mts., Hala Gąsienicowa	1550	31 VIII 1954	K. Kowalski
13	364	Tatra Mts., Żółta Turnia	1500	1 IX 1954	K. Kowalski
14	365	Tatra Mts., Żółta Turnia	1500	1 IX 1954	K. Kowalski
15	366	Tatra Mts., Żółta Turnia	1500	1 IX 1954	K. Kowalski
16	368	Tatra Mts., Granaty	2000	1 IX 1054	K. Kowalski
17	371	Tatra Mts., near Zawrat	2050	7 IX 1954	K. Kowalski
18	372	Tatra Mts., near Zawrat	2050	7 IX 1954	K. Kowalski
19	390	Tatra Mts., near Morskie Oko	1400	22 VIII 1934	L. Sagan
20	392	Tatra Mts., Żółta Turnia	1600	6 VII 1954	S. Sagan
21	(9)	Tatra Mts., near Morskie Oko	1400	17 VIII 1934	L. Sagan
22	337	Tatra Mts., Uhrocie Kasprowe	1700	12 VIII 1954	S. Sagan
23	338	Tatra Mts., Uhrocie Kasprowe	1700	12 VIII 1954	S. Sagan
24	340	Tatra Mts., Żółta Turnia	1700	27 VIII 1954	S. Sagan
25	342	Tatra Mts., Żółta Turnia	1700	28 VIII 1954	S. Sagan
26	344	Tatra Mts., Żółta Turnia	1800	1 IX 1954	S. Sagan

II

mirhanreini SCHAEFER, 1935

sex and age	head an body	tail	hind foot	ear	condylobasal length	zygomatic breadth	interorbital constriction	nasal	diastema	maxillary tooth-row	mandibular tooth-row	weight in g.
♀ ad.	123	55	21	15	—	—	—	6,9	—	—	6,6	45
♂ ad.	120	60	21	18	28,2	16,2	4,6	7,5	9,3	6,2	6,3	43
♀ ad.	116	56	21	16	—	—	4,4	7,0	8,7	6,4	6,6	39
♂ ad.	134	61	21,5	18	—	—	4,5	8,3	9,8	6,4	6,5	50
♀ ad.	133	62	19	17	—	17,0	—	8,2	—	6,5	6,7	—
♀ ad.	128,5	56,5	25	17	—	—	—	—	—	—	—	—
♂ ad.	122	54	21	16	30,1	17,1	4,4	8,9	9,8	6,4	6,6	—
♂ ad.	116	60	20	16	—	16,2	—	—	—	6,5	6,4	48
♂ ad.	140	61	20	18	30,9	17,3	4,3	8,2	10,0	7,0	7,1	60
♀ ad.	124	64	22	19	—	—	4,4	—	—	6,7	7,1	—
♀ ad.	119	52	18	16	—	—	4,5	—	—	5,9	6,1	—
♀ ad.	109	55	20	16	27,8	16,0	4,4	7,6	8,4	6,3	6,4	42,5
♀ ad.	122	60	19	16	—	—	—	7,8	—	6,9	6,8	49,5
♀ ad.	116	54	20	16	—	—	—	7,8	—	6,8	6,5	51,5
♀ ad.	106	51	20,5	16	—	—	—	7,5	—	6,5	6,8	40
♀ ad.	112	57	19,5	15,5	—	—	—	7,6	8,6	6,1	6,1	38
♂ ad.	119	56	20	16,5	—	—	—	7,5	9,4	6,7	6,6	38,5
♀ ad.	112	67	19	17	—	—	—	—	—	—	6,4	40,5
♀ ad	118	64,5	20	16	—	—	—	—	—	—	—	—
♂ ad.	129	56	20	18	27,6	—	4,5	7,5	8,7	6,4	—	—
—	—	—	—	—	—	—	4,1	8,0	9,0	6,4	6,5	—
♀ subad.	116	60	20	16	—	—	—	—	—	—	—	—
♀ subad.	107	60	20	16	—	—	—	—	—	—	—	—
♀ subad.	107	53	21	14	—	15,4	4,4	—	—	6,4	6,4	35
♀ subad.	112	52	19,5	15	27,8	16,5	ca 4,5	7,1	9,1	6,6	6,7	—
♀ subad.	114	51	20	16	26,4	15,3	4,3	7,0	8,2	6,1	6,2	38

Continuation of

no.	label of the Zool. Inst. in Kraków	locality	altitude in m.	date	collected by
27	351	Tatra Mts., Uhrocie Kasprowe	1800	12 IX 1954	S. Sagan
28	358	Tatra Mts., near Staw Litworowy	1650	9 VIII 1954	K. Kowalski
29	369	Tatra Mts., Żółta Turnia	1500	3 IX 1954	K. Kowalski
30	370	Tatra Mts., Żółta Turnia	1500	3 IX 1954	K. Kowalski
31	383	Tatra Mts., Uhrocie Kasprow	1800	24 IX 1953	S. Sagan
32	384	Tatra Mts., near Czarny Staw Gąsienicowy	1650	17 VIII 1934	L. Sagan
33	385	Tatra Mts., Hala Gąsienicowa	1620	17 VIII 1934	L. Sagan
34	387	Tatra Mts., near Morskie Oko	1400	23 VIII 1934	L. Sagan
35	388	Tatra Mts., near Morskie Oko	1400	17 VIII 1934	L. Sagan
36	389	Tatra Mts., near Morskie Oko	1400	23 VIII 1934	L. Sagan
37	391	Tatra Mts., near Morskie Oko	1400	17 VIII 1934	L. Sagan
38	(10)	Tatra Mts., near Morskie Oko	1400	23 VIII 1934	L. Sagan
39	334	Tatra Mts., Uhrocie Kasprowe	1800	7 VIII 1954	S. Sagan
40	335	Tatra Mts., Uhrocie Kasprowe	1800	7 VIII 1954	S. Sagan
41	336	Tatra Mts., Uhrocie Kasprowe	1800	7 VIII 1954	S. Sagan
42	343	Tatra Mts., Żółta Turnia	1700	28 VIII 1954	S. Sagan
43	347	Tatra Mts., Beskid	1800	1 IX 1954	S. Sagan
44	349	Tatra Mts., Żółta Turnia	1700	12 IX 1954	S. Sagan
45	353	Tatra Mts., Hala Gąsienicowa	1450	23 VII 1954	K. Kowalski
46	356	Tatra Mts., near Zadni Staw Gąsienicowy	1900	6 VIII 1954	K. Kowalski
47	359	Tatra Mts., near Staw Litworowy	1650	9 VIII 1954	K. Kowalski
48	363	Tatra Mts., Hala Gąsienicowa	1550	31 VIII 1954	K. Kowalski
49	367	Tatra Mts., Żółta Turnia	1500	1 IX 1954	K. Kowalski
50	373	Tatra Mts., Żółta Turnia	1600	5 VII 1954	S. Sagan
51	380	Tatra Mts., Uhrocie Kasprowe	1750	7 XI 1953	S. Sagan
52	386	Tatra Mts., near Morskie Oko	1400	26 VIII 1934	L. Sagan
53	393	Tatra Mts., Liliowe	1700	26 VII 1954	S. Sagan

table II

sex and age	head an body	tail	hind foot	ear	condylobasal length	zygomatic breadth	interorbital constriction	nasal	diastema	maxillary tooth-row	mandibular tooth-row	weight in g.
♂ subad.	121	54	19	15	—	—	4,4	7,5	8,6	6,0	6,3	—
♂ subad.	113	44	20	15	25,8	14,9	4,5	7,3	8,1	5,9	5,9	31,5
♀ subad.	117	48	20	15	—	—	4,3	—	8,1	6,1	6,3	33,5
♀ subad.	107	47	20	16	—	ca 15,7	4,5	—	—	6,4	6,4	31,5
♀ subad.	109	66	21	19	27,7	16,7	4,3	7,6	8,6	6,1	6,0	—
♂ subad.	104 5	59	19	16,5	25,7	15,2	4,3	7,4	8,1	5,9	6,1	—
♂ subad.	103	58	19	16,5	27,7	—	4,1	7,5	8,8	6,3	6,2	—
♀ subad.	99	48	18	14,5	26,1	14,8	4,5	7,2	8,3	6,3	6,2	—
♀ subad.	103	53	18	16	27,3	16,1	4,4	7,8	8,8	6,1	6,2	—
♀ subad.	100	47	20	16	25,6	14,4	4,5	—	7,8	5,9	6,2	—
♀ subad.	101	52,5	19,5	16	—	—	—	—	—	—	—	—
♀ subad.	109	66	20	16	27,3	16,1	4,3	7,4	8,8	6,2	6,5	—
♀ juv.	107	48	20	16	—	—	—	—	—	—	—	—
♂ juv.	120	55	20	15	± 25,2	14,5	± 4,3	6,9	—	5,9	6,1	—
♀ juv.	107	50	20	15	—	—	—	—	—	—	—	—
♀ juv.	98	43	20	13,5	—	ca 14,0	4,4	—	—	5,9	5,7	—
♂ juv.	104	47	20	16,5	25,7	—	—	—	8,5	6,0	6,1	30
♀ juv.	110	50	19	13	—	—	4,4	7,5	8,1	6,2	6,3	—
♂ juv.	89	34	19	18	—	—	4,5	7,2	7,0	5,8	5,8	—
♂ juv.	94	41	18	13	24,1	13,6	4,6	6,8	7,6	5,7	5,7	18,5
♂ juv.	99	42	17	15	—	—	4,5	6,8	7,7	5,9	6,4	27
♂ juv.	93	46	20	15	—	—	—	ca 6,9	—	5,9	6,0	26,7
♂ juv.	94	38	19	14	—	—	—	6,8	—	—	5,9	21
♀ juv.	104,5	46,5	19	15	—	—	—	—	—	—	—	—
♀ juv.	124	46	22	19(?)	—	—	—	—	—	—	—	—
♂ juv.	91	44	18	14	23,7	13,7	4,2	6,3	7,8	5,7	6,0	—
♀ juv.	107,5	44,5	20	15	—	—	—	—	—	—	—	—

there is on one side a structure typical of *M. nivalis nivalis* (MARTINS) while on the other of *M. nivalis mirhanreini* SCHAEFER.

The remaining molar teeth do not show such extensive variability. In m^2 there is usually no trace of an incision on the second internal loop. Only in one of the specimens examined [fig. 3] we see on this loop, in the right as well as in the left row of teeth, very distinct and deep incisions, as in several specimens of *M. nivalis ulpius* MILLER.

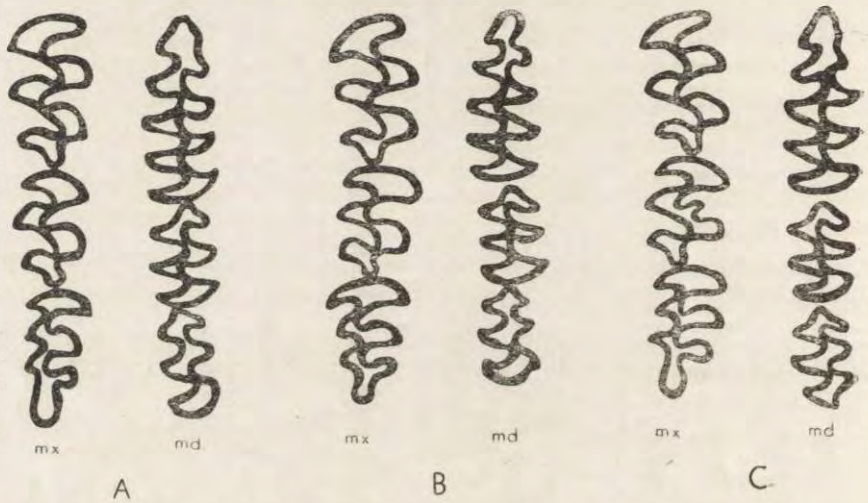

Fig. 3. Molar teeth of three specimens of *M. nivalis mirhanreini* SCHAEFER from the Tatras. In specimen C a dental anomaly in the form of enamel incision in m^2 is seen. mx — maxillar teeth, md — mandibular teeth.

The measurements of the type represented by the subfossil mandible are not known. The specimen chosen by HANZAK and ROSICKY as typical „in toto" has the following measurements: Head and body — 130 mm., tail — 55 mm., hind foot — 23 mm., condylobasal lenght — 28,6 mm., zygomatic breadth — 16,8 mm., interorbital constriction — 4,7 mm., the length of the maxillary and mandibular rows of teeth each — 5,3 mm.

The measurements of the adult apecimens which I have examined are as follows. Head and body — 106—140 mm. (mean 120,8 mm.), tail — 51—67 mm. (mean 58,2 mm.), hind

foot — 18—22 mm. (mean 20,3 mm.), ear — 15,5—19 mm. (mean 16,7 mm.), condylobasal length — 27,6—30,9 mm. (mean 28,9 mm.), zygomatic breadth — 16—17,3 mm. (mean 16,6 mm.), interorbital constriction — 4,3—4,6 mm. (mean 4,4 mm.), diastema — 8,4—10 mm. (mean 9,2 mm.), length of maxillary

Fig. 4. Variability of enamel pattern of the first lower molar in *M. nivalis mirhanreini* SCHAEFER from the Tatras.

tooth-row — 5,9—7,0 mm. (mean 6,5 mm.), length of mandibular tooth-row — 6,1—7,1 mm. (mean 6,6 mm.). The ratio of the mean length of the tail to that of the body is 48:100, the tail is thus a little shorter than half the body length. The weight of the adult specimens varies from 38 to 60 g.; the mean value is 45,0 g.

Biology: The Tatra snow vole is found in the subalpine and alpine zone of the Tatras and Lower Tatras. In the Tatras I have never found it in the dense forest zone, althought in not forested places such as steeps rocks and alpine meadows it occurs at much lower altitudes. The lowest places where it was collected are situated at an altitude of 1200 m. Above this, the snow vole reaches the highest Tatra summits. The highest position where I have observed it lies at 2250 m. ROSICKY and KRATOCHVIL (1955) write that voles were observed on the highest peak of the Tatras, the Gerlach (2663 m).

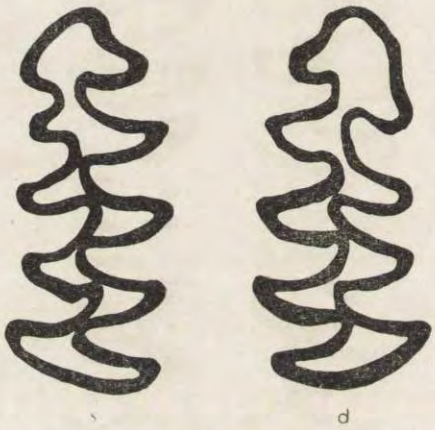

Fig. 5. Asymetry of enamel pattern of the first lower molar in *M. nivalis mirhanreini* SCHAEFER from the Tatras. s — m_1 of left mandibular ramus, d — of right one in the same specimen.

The Tatra snow vole is most numerous in the zone of *Pinus mughus* SCOP. Above this, it usually appears in the rich alpine valleys regions. According to HANZAK and ROSICKY's supposition, which are not, however, based on any immediate proof, the voles migrate in winter from the higher regions to the zone of *Pinus mughus* SCOP.

The Tatra snow vole is active mainly in the night, when it is most often caught in traps. It may, however, also be observed on the surface of the ground during day-time.

Observations hitherto made do not allow to establish the number of breeding periods. In July and August I observed,

besides adults, numerous young and half-grown specimens. I did not collect pregnant females at that time, but the adult males had very well developed testicles. The Tatra snow voles generally hide in crevices and burrows between stones and roots of *Pinus mughus* SCOP. I have not found burrows dug by them. Twigs of *Vaccinium myrtillus* L. are often drawn into the entries to their hideouts. This is presumably the main food of the vole in the zone of *Pinus mughus* SCOP. In the stomachs of specimens cought I have always found a well ground pulp of vegetable tissues.

GENERAL REMARKS

In the Carpathians there appear to occur two distinctly different forms of the snow vole, *Microtus nivalis ulpius* MILLER and *Microtus nivalis mirhanrtini* SCHAEFER. They differ from each other by the colour, which in the Tatra form is of a greyer shade and completely lacks the brown shades on the ventral side, while the Eastern Carpathian form is distinctly brown with a slight brown suffusion on the ventral side. The Tatra forms is characterized also by the unusual variability of m_1, which in at least half of the specimens shows the presence of at least traces of the sixth enamel triangle between the two terminal lopps. Finally the Tatra snow vole is smaller than the Eastern Carpathian. Althout the limits of variability overlap, the means of all total measurements of specimens as well as of the skulls, are higher in the series of voles from the Czarnohora. All these facts justify completely the distinction of the Eastern Carpathian and Tatra voles as two separate subspecies.

Beside *M. nivalis ulpius* MILLER and *M. nivalis mirhanreini* SCHAEFER one more form of snow vole from the Carpathians, viz. *M. radnensis* EHIK has been described. The main diagnostic feature of this form was supposed to be the presence of an incision on the inner enamel loop of m^2. Among the three specimens upon which EHIK based the description of *M. radnensis* EHIK one showe this feature distinctly, in the second it was less distinct and visible only on one side and in the third it was completely absent. As the examination of a larger series of specimens showed, the incision of the inner

enamel loop of m^2 is a rather rare anomaly in some individuals and is not a feature shown by the whole population investigated. This anomaly was found also in one specimen of *M. nivalis mirhanreini* SCHAEFER. This feature therefore cannot serve to distinguish *M. radnensis* EHIK from *M. nivalis ulpius* MILLER. The remaining differences between these two forms which EHIK points out arise from his erroneous interpretation of MILLER's diagnosis. EHIK had no specimens of *M. nivalis ulpius* MILLER but only the description at his disposal. In his diagnosis MILLER (1908) writes „posterior border of palate with median ridge sharply defined". As is clear from EHIK's text, he understands „sharply defined" as „spitzwinkelig vorspringend" and because of this misunderstanding he thinks the palate in the two forms to be of different structure.

A comparison of the series of specimens from the Marmaros Mountains and the Czarnohora with the 6 specimens from the Transylvanian Alps forming a part of the series upon which MILLER based his description of the species *Microtus ulpius* MILL., lent by the British Museum, showed that they belong to the same subspecies. The colour and dentition do not differ in the specimens from the two regions, and the structure of the palate, rather variable individually, varies within almost the same limits. We see therefore that there are no reasons to distinguish a third subspecies of the Carpathian snow voles. The Northern and Southern parts of the Eastern Carpathians are inhabited by the same subspecies, viz. *Microtus nivalis ulpius* MILLER, 1908.

As mentioned, the structure of m_1 is very variable in *Microtus nivalis mirhanreini* SCHAEFER, and some specimens have the shape of the enamel loop quite similar to that in *Microtus oeconomus* (PALLAS). This similarity argues by no means in favour of the relationship of these forms since all other features show distinctly that these specimens belong to the species *Microtus nivalis* (MARTINS). This points however, to the necessity of great caution in describing new forms — as often happens in paleontology — on the basis of one tooth or even on the basis of the whole dentition. In connection with this an outstanding dental anomaly should be pointed out

in one specimen of *Microtus nivalis mirhanreini* SCHAEFER [fig. 4] which shows a very deep incision in the enamel of the inner loop of m^2.

Both Carpathian forms of the snow vole present common features distinguishing them from specimens from the Alps. First of all the structure of the palate is the same in both, and differs from the typical form of this species. The bicoloured tail and its small length distinguishes both Carpathian forms from the Alpine ones.

Nevertheless I think that the Carpathian forms should not be considered as a separate species. These differences are not greater than those in the subspecies of the snow vole described from the Pyrenean, the Appenines and the Caucasus. Therefore I treat both Carpathian forms as two subspecies of *Microtus nivalis* (MARTINS).

The Eastern Carpathian snow voles are more similar to the Alpine ones than the specimens from the Tatras. For example the colour of *M. nivalis ulpius* MILLER is similar to that of *M. nivalis nivalis* (MARTINS) and the colour of *M. nivalis mirhanreini* SCHAEFER is distinctly different. The structure of m_1 in the Eastern Carpathian specimens does not present any major differences in comparison with the Alpine ones, but the same tooth in the Tatra specimens, being very variable, is usually of quite a different structure. Finally the length of the tail in the Alpine forms amounts to about 53 per cent of the body length (according to the measurements given by MILLER, 1912), in those from the Czarnohora to 52 per cent and in those from the Tatras to 48 per cent. These facts show that *M. nivalis ulpius* MILLER is more nearly related to the snow voles from the Alps than *M. nivalis mirhanreini* SCHAEFER. It may therefore be presumed that the colonization of the Carpathians by the voles came from the South East. We see a similar phenomenon in many plant and animal forms, e. g. rhododendrons occuring in the Alps and the Eastern Carpathians and not appearing in the Tatras. The fact that snow voles are absent in the Sudetes is also in accordance with this.

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STRESZCZENIE

W strefie alpejskiej i subalpejskiej Karpat występują dwa podgatunki polnika śnieżnego: *Microtus nivalis ulpius* MILLER, 1908, w Karpatach Wschodnich i *Microtus nivalis mirhanreini* SCHAEFER, 1935, w Tatrach i Niżnich Tatrach. Opisany przez EHIKA (1942) *Microtus radnensis* EHIK jest synonimem *Microtus nivalis ulpius* MILLER. Oba podgatunki znane były dotąd z niewielkich serii okazów. Zbadanie większych serii pozwoliło dokładniej uchwycić zakres ich zmienności i wykazać ich wyraźne różnice. Oba podgatunki mają jednak szereg cech wspólnych, wyróżniających je od *M. nivalis nivalis* (MARTINS) z Alp. Podgatunek wschodnio-karpacki jest bardziej zbliżony do alpejskiego niż podgatunek tatrzański, co wskazuje na zasiedlenie Karpat przez te polniki od południowego wschodu. Niezwykła zmienność budowy m_1 u podgatunku *M. nivalis mirhanreini* SCHAEFER przy jednoczesnej stałości takich cech jak ubarwienie, budowa podniebienia i inne, wskazuje na konieczność dużej ostrożności przy opieraniu opisów nowych form *Microtinae* jedynie na podstawie kształtu pętli szkliwa zębów trzonowych.

РЕЗЮМЕ

В альпийской и субальпийской зоне Карпат встречаются два подвида *Microtus nivalis* (MARTINS): *Microtus nivalis ulpius* MILLER, 1908, в восточных Карпатах и *Microtus nivalis mirhanreini* SCHAEFER, 1935, в Татрах и Нижних Татрах. Опи-

санный Эйком (1942) *Microtus radnensis* Enik является синонимом *Microtus nivalis ulpius* Miller. Оба подвида известны были до сих пор лишь в небольших сериях экземпляров. Исследование больших серий позволило точно установить пределы их изменчивости и выяснить их существенные отличительные черты. Оба подвида обладают рядом общих признаков, отличающих их от *M. nivalis nivalis* (Martins) из Альп. Восточно-карпатский подвид приближается более к альпийскому, чем подвид из Татр. Это доказывает, что эти полевки проникли в Карпаты с юго-востока. Необыкновенная изменчивость строения m_1 у подвида *M. nivalis mirhanreini* Schaefer, при одновременном постоянстве таких признаков, как окраска, строение неба и другие, указывает на необходимость большой осторожности при описывании новых форм *Microtinae* только на основании строения петлей эмали коренных зубов.

Redaktor pracy — prof. dr A. Dehnel

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