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Adam NADACHOWSKI

On the taxonomic status of *Chionomys* MILLER, 1908 *(Rodentia: Mammalia)* from Southern Anatolia (Turkey)

[With 4 text-figs]

Pozycja taksonomiczna *Chionomys* MILLER, 1908 *(Rodentia: Mammalia)* z południowej Anatolii (Turcja)

Abstract. Comparative studies of dental features do not confirm the presence of *Chionomys gud* in Southern Anatolia. Specimens previously included to the mentioned taxon belong to *Ch. nivalis spitzenbergerae* spp. nov., which is characterized by a peculiar dental pattern.

I. INTRODUCTION

Genus *Chionomys* MILLER, 1908 comprises three species: *Ch. nivalis* (MARTINS, 1842), *Ch. gud* (SATUNIN, 1909) and *Ch. roberti* (THOMAS, 1908) inhabiting mountain regions of Europe, Asia Minor and some parts of Asia including Caucasus Mts., Transcaucasia and Kopet Dag in the East, and Lebanon and Anti-Lebanon Mts. in the South (CORBET 1978, KRAPP 1982).

In Anatolia, *Ch. nivalis* probably occurs at higher altitudes in most of mountain. In the southern part of this territory, it was recorded in different parts of Taurus Mountains (SPITZENBERGER 1971, 1972). Another species, *Ch. gud* is known from extreme NE part of Turkey, where it occurs sympatrically with *Ch. nivalis* (STEINER 1972) while SPITZENBERGER (1971) reported it from Middle Taurus Mts. in Southern Anatolia. Both mentioned populations do not differ in most of external features, while their dental pattern is distinctly different. Recently, also in Southwestern Anatolia near Antalya. Late Pleistocene remains identified as *Ch. gud* were discovered which closely correspond to the Middle Taurus population (STORCH 1988).

The primary aim of this study has been to describe the differences in dental patterns of particular populations and to revise the taxonomic position of *Chionomys* from Southern Anatolia.

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II. MATERIAL AND METHODS

In the analysis of dentition, the nomenclature and measurements of VAN DER MEULEN (1973) were used. On first lower molar (M_1) the length of the tooth (L) and distances B_1 and W_2 were taken (Fig. 1 a, Table I). The two latter dimensions were employed to calculate the ratio B_1/W_2, which expresses the degree of separation of the anterior cap from T5. The low value of this coefficient (approximately 1—15) is characteristic for nivaloid variants. In the morphological structure typical for *Ch. gud*, the value of the ratio occupies an intermediate position (approximately 16—30) while higher values are characteristic for ratticepoid variants, typical for *Microtus oeconomus*. On the third upper molar (M^3), the following measurements were taken: length of the tooth (L), lenght of posterioconid complex (P) and distance W_2 always taken in the same part of a tooth independently of its length (Fig. 1, b, c, d). The ratio P/L (expressed in %) shows the relative length of the posteroconid complex which is distinctly different in *Ch. nivalis* and *Ch. gud*. Both right and left teeth of specimens were measured because of high frequency of fluctuating asymmetry occurring in the dentition of the *Chionomys* group. The materials examined are listed in Appendix.

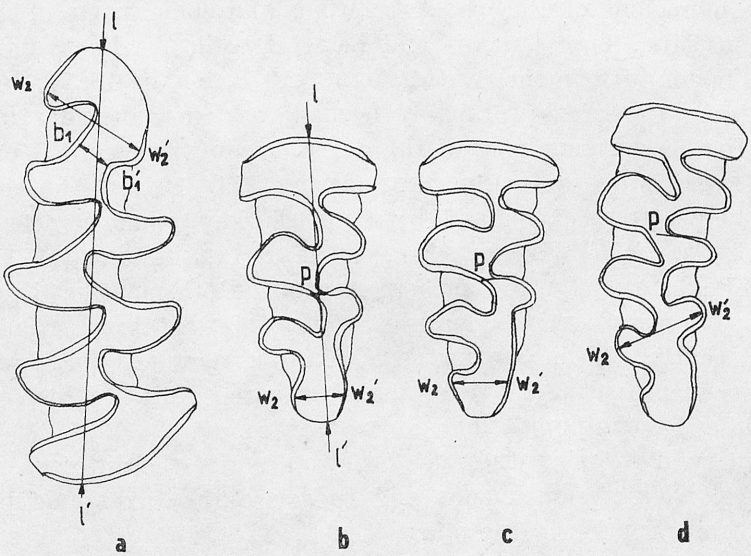

Fig. 1. Measurement methods of M_1 and M^3. a: M_1 — length L = 1—1'; $B_1 = b_1—b_1'$; $W_2 = w_2—w_2'$, b, c and d: M^3 — length L = 1—1'; length of posterioconid complex P = l'—p; $W_2 = w_2—w_2'$

Table I

Measurements (L) and ratio data (B_1/W_2) of M_1 samples in some populations of *Chionomys nivalis* and *Chionomys gud*. N — number of specimens; OR — observed range of variation; M — mean value; SD — standard deviation; SE — standard error; CV — coefficient of variation. 1 — *Ch. n. spitzenbergerae* ssp. nov. from Maden Köy and Zanapa; 2 — *Ch. n. spizenbergerae* ssp. nov. from Karain B; 3 — *Ch. n.* ssp. from Arslanköy; 4 — *Ch. n. cedrorum* from Ciğlikara; 5 — *Ch. n. hermonis* from Lebanon and Anti-Lebanon Mts.; 6 — *Ch. n. pontius* from Yalnizçam; 7 — *Ch. n. loginovi* from Caucasus Mts.; 8 — *Ch. n. lebrunii* from Massif Central; 9 — *Ch. g. nenjukovi* from western part of Caucasus Mts.; 10 — *Ch. g. gud* from central part of Caucasus Mts.; 11 — *Ch. g. lghesicus* from Daghestan; 12 — *Ch. g. lasistanius* from Yalnizçam and Rize Dăg

No	Population	N	L					B_1/W_2				
			OR	M	SD	SE	CV	OR	M	SD	SE	CV
1	*Ch. nivalis spitzenbergerae* (rec.)	14	2.78—3.07	2.90	0.10	0.03	3.6	5.3—43.7	24.0	12.5	3.3	51.9
2	*Ch. nivalis spitzenbergerae* (foss.)	22	2.34—3.06	2.74	0.18	0.04	6.4	10.0—46.9	33.2	8.8	1.9	26.5
3	*Ch. nivalis* ssp.	6	2.78—2.90	2.84	0.04	0.02	1.3	4.6—13.2	7.8	3.0	1.2	38.1
4	*Ch. nivalis cedrorum*	8	2.68—2.75	2.71	0.03	0.01	1.1	18.9—26.3	22.0	2.2	0.8	10.0
5	*Ch. nivalis hermonis*	75	2.60—3.32	2.99	0.14	0.02	4.7	1.1—14.3	6.8	3.5	0.4	51.3
6	*Ch. nivalis pontius*	4	2.89—3.13	3.00	0.11	0.05	3.7	3.6—8.9	7.2	2.1	1.0	29.3
7	*Ch. nivalis loginovi*	46	2.36—2.78	2.61	0.12	0.02	4.7	2.6—25.7	9.5	4.8	0.7	50.8
8	*Ch. nivalis lebrunii*	49	2.70—3.26	2.93	0.14	0.02	4.8	5.1—41.9	20.4	8.9	1.3	43.9
9	*Ch. gud nenjukovi*	64	2.68—2.24	3.00	0.14	0.02	4.6	9.3—41.9	22.4	7.1	0.9	31.4
10	*Ch. gud gud*	62	2.46—3.16	2.74	0.15	0.02	5.7	6.8—42.4	22.1	6.4	0.8	29.2
11	*Ch. gud lghesicus*	12	2.44—2.84	2.61	0.13	0.04	4.9	12.5—32.5	22.0	5.9	1.7	26.8
12	*Ch. gud lasistanius*	6	2.76—3.07	2.89	0.12	0.05	4.1	22.8—30.1	25.9	2.1	0.8	8.3

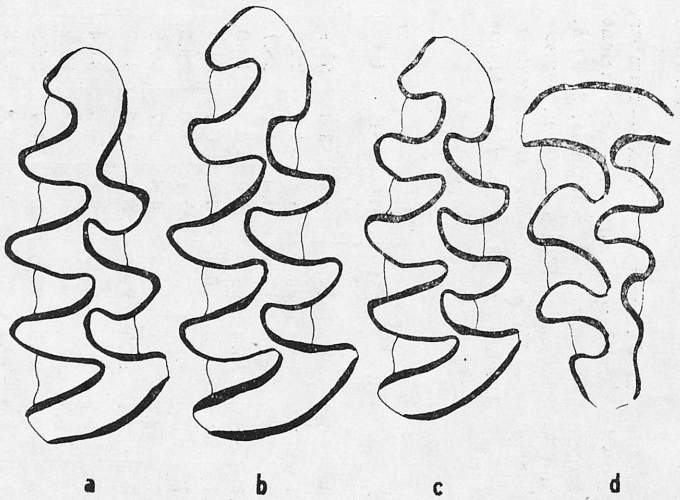

Fig. 2. *Chionomys nivalis spitzenbergerae* ssp. nov., morphological variation of M_1 (a, b, c) and M^3 (d). a — specimen NHMW 13290, b — NHMW 13271 (holotype), c — ISEZ 5264, d — NHMW 13271 (holotype)

III. SYSTEMATICS

Chionomys nivalis spitzenbergerae ssp. nov.
Figs 2—4

1971 *Microtus gud*: F. SPITZENBERGER, Zur Systematic und Tiergeographie..., 372—373, Tab. 2, 3, Abb. 1—3.

1988 *Microtus* (*Chionomys*) *gud*: G. STORCH, Eine jungpleistozäne/altholozäne..., 80, Abb. 3 (3—9)

Holotype: adult male, NHMW 13271

Type locality: south of Maden Köy, Vil. Niğde, Middle Taurus Mts., Turkey.

Name derivation: named for F. SPITZENBERGER, Naturhistorisches Museum Wien.

Paratypes: 2 males and 1 female. NHMW 13290—13292.

Referred material: adult male, ISEZ 5264; adult female, ISEZ 5267: both from Bolkar Dağlari, above Zanapa, Middle Taurus Mts, Turkey, 19.07.1977, leg. K. KOWALSKI et al.; Late Pleistocene material (23 M_1 and 11 M^3) from Karain B, near Antalya, Turkey (STORCH 1988).

Measurements: ISEZ 5264 and 5267, respectively: total length: 175, 178; tail length: 67, 63; length of hind foot: 18, 19; height of ear: 14, 17; condylobasal length: 28.3, 0; brain-case length: 17.9, 0; length of nasals: 0, 7.4; diastema length: 9.0, 9.2; maxillary tooth-row length: 6.3, 6.7; mandibular tooth-row length: 6.2, 6.4; brain-case breadth: 13.0, 0; interorbital construction: 4.6, 4.3; rostrum breadth: 4.5, 5.0; brain-case height between bullae: 8.0, 0. For measurement of NHMW collection see SPITZENBERGER (1971).

Diagnosis: First lower molar (M_1) very simple with broadly confluent T5 and T6. BSA4 incipient or not developed at all. LRA5 rather small or even absent. Values of B_1/W_2 ratio in most of specimens are higher than 20. Generally, morphology of M_1 is more primitive than in other subspecies of *Ch. nivalis* and *Ch. gud* from Caucasus and Transcaucasia. Third upper molar (M^3) more complicated in comparison with other subspecies of *Ch. nivalis*, with distinctly marked LSA5, comparable in this respect to *Microtus oeconomus*. Skull relatively massive, tail distinctly longer in comparison with most of other subspecies of *Ch. nivalis*.

IV. DISCUSSION

ANGERMANN (1974, 1984), comparing the morphological structure of dentition in voles from *Chionomys* group (*Ch. nivalis*, *Ch. gud*, *Ch. roberti*) and that in *Microtus oeconomus*, came to the conclusion that they are highly polymorphous. In each of the mentioned species it is possible to find in M_1 morphotypes "*oeconomus*", "*gud*" and "*nivalis*". Especially *M. oeconomus* (ANGERMANN 1984) and *Ch. nivalis* (NADACHOWSKI in press) are very variable in this respect. Particular subspecies and even populations are characterized by their own spectrum and frequency of morphotypes. These differences are sometimes very distinct in *Ch. nivalis* because of its disjunctive character of distribution. Studies of structure of anteroconid complex of M_1, especially the manner of confluence of T5 and T6, commonly used as a criterion of distinguishing *Ch. gud* from *Ch. nivalis* show that it is not adequate for a positive separation of both species (NADACHOWSKI in press, Fig. 3). Although most of subspecies of *Ch. nivalis* (including *Ch. n. hermonis* and *Ch. n. loginovi*) distinctly differ in structure of M_1 from *Ch. gud*, there are also some primitive populations in Europe (e. g. *Ch. n. lebrunii*) and in Anatolia (*Ch. n. cedrorum*) whose M_1 is generally similar to *Ch. gud*. On the other hand, the M_1 of Maden Köy population and of fossil material from Karain B show some special features corresponding to the dental structure of *M. oeconomus*. This is also indicated by the fact that some specimens go beyond the variation normally observed in the *Chionomys* group (Fig. 3, Table I). The ratticepoid variants (= "*oeconomus*" sensu ANGERMANN 1974), are completely absent in most populations of *Ch. nivalis* with the exception of West-Europaean subspecies: *Ch. n. lebrunii* (frequency of the morphotype 18%), *Ch. n. leucurus* (18%), *Ch. n. abulensis* (6%) and *Ch. n. aquitanius* (2%) (NADACHOWSKI in press), while its frequency in the Middle Taurus population reaches about 42%. The frequency distribution of the M_1 morphotypes in *Ch. n. spitzenbergerae* ssp. nov. is as follows:

	„*oeconomus*"	„*gud*"	„*nivalis*"	N
Maden Köy and Zanapa	42%	33%	25%	12
Karain B	26%	70%	4%	23

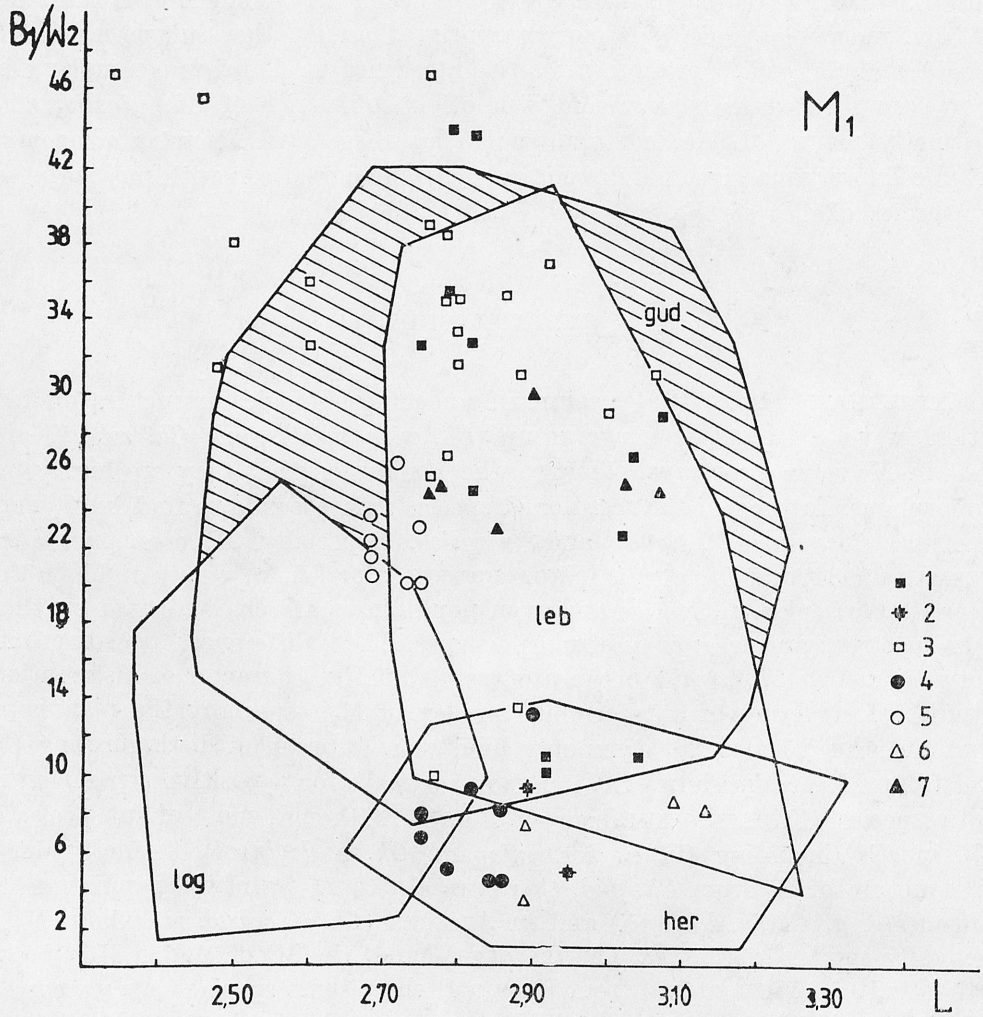

Fig. 3. Relation between L and B_1/W_2 index in M_1 of some subspecies of *Chionomys*. This figure shows that the most used criterion of distinguishing of *Ch. nivalis* from *Ch. gud* on the basis of M_1 is not adequate for separating the two species. 1 — *Ch. nivalis spitzenbergerae* ssp. nov. from Maden Köy (Turkey) described by SPITZENBERGER (1971) as belonging to *Ch. gud*; 2 — *Chionomys* from Maden Köy described by SPITZENBERGER (1971) as *Ch. nivalis*; 3 — *Ch. nivalis spitzenbergerae* ssp. nov. from Karain B (Turkey) included by STORCH (1988) to *Ch. gud*; 4 — *Ch. nivalis* ssp. from Arslanköy (Turkey); 5 — *Ch. nivalis cedrorum* from Ciğlikara (Turkey); 6 — *Ch. nivalis pontius* from Yalnizçam (Turkey); 7 — *Ch. gud lasistanius* from Yalnizçam and Rize Dăg (Turkey); gud — *Ch. gud* (including subspecies *gud*, *nenjukovi* and *lghesicus* from Caucasus Mts. and Daghestan, USSR, N = 138; her — *Ch. nivalis hermonis* from Lebanon and Anti-Lebanon Mts. (Israel, Syria, Lebanon), N = 75; leb — *Ch. nivalis lebrunii* from Massif Central, France, N = 49; log — *Ch. nivalis ioginovi* from Caucasus Mts., USSR, N = 46

Analysis of M^3 shows that this tooth corresponds morphologically rather to *Ch. nivalis* although it occupies the intermediate position between *Ch. nivalis* and *Ch. gud* (Fig. 4, Table II). Cluster analysis of morphology of M^3 undertaken for different subspecies of *Ch. nivalis*, *M. oeconomus* and the population from Middle Taurus Mts., clearly confirms the similarity of the latter sample to *M. oeconomus* (NADACHOWSKI in press). However, the typical M^3 pattern of *Ch. n. spitzenbergerae* ssp. nov. (Fig. 2d) occurs sporadically in most of the European populations of *Ch. nivalis* (with frequency below 1%). It is very probable that typical, simple nivaloid variants of M^3 are also present in *Ch. n. spitzenbergerae* ssp. nov. In the population from Karain B, for example, four specimens show such a pattern.

This unexpected combination of very primitive M_1 and relatively complicated M^3 for *Chionomys nivalis* constitutes the basis for the description of a new taxon on the subspecific level. Thus, comparative studies of dentition do not confirm the presence of *Ch. gud* in Southern Anatolia. External characteristics of population under discussion also show some special features. Skull is relatively massive, while tail is long and comparable in this respect with *Ch. gud* (SPITZENBERGER 1971). It is very probable that this new taxon,

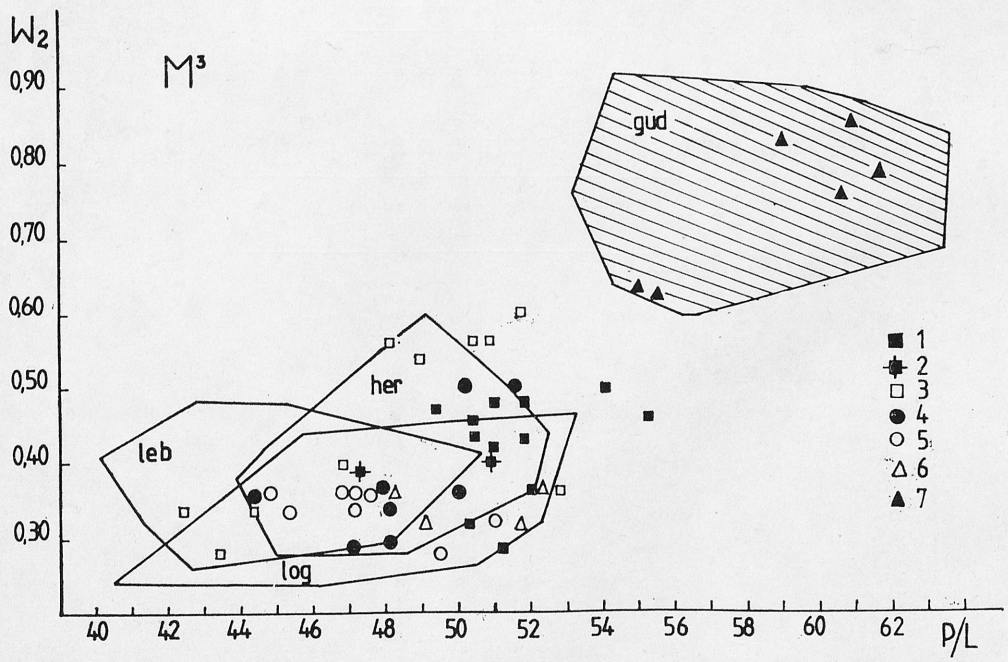

Fig. 4. Relation between P/L index and W_2 in M^3 of some populations of *Chionomys*. This figure shows that criteria used are adequate in distinguishing *Ch. nivalis* from *Ch. gud*. Specimens from Southern Anatolia previously described under the name *Ch. gud* (from Maden Köy and Karain B) belong to *Ch. nivalis*. For further explanations see Fig. 3

Table II

Measurements (W_2) and ratio data (P/L) of M^3 samples in some populations of *Chionomys nivalis* and *Chionomys gud*. For explanation see Table I

No	Population	N	P/L					W_2				
			OR	M	SD	SE	CV	OR	M	SD	SE	CV
1	*Ch. nivalis spitzenbergerae* (rec.)	14	47.3—55.3	51.2	1.8	0.5	3.6	0.28—0.60	0.42	0.06	0.02	14.3
2	*Ch. nivalis spitzenbergerae* (foss.)	11	42.3—52.7	48.0	3.3	1.0	6.9	0.28—0.60	0.46	0.12	0.04	25.5
3	*Ch. nivalis* ssp.	8	44.5—51.6	48.4	2.0	0.7	4.9	0.29—0.50	0.37	0.08	0.03	20.6
4	*Ch. nivalis cedrorum*	8	44.7—51.0	47.6	2.0	0.7	4.2	0.28—0.36	0.34	0.03	0.01	7.8
5	*Ch. nivalis hermonis*	74	43.9—52.5	47.9	2.0	0.2	4.3	0.28—0.60	0.39	0.06	0.01	16.8
6	*Ch. nivalis pontius*	4	48.1—52.3	50.3	1.8	0.9	3.6	0.32—0.36	0.34	0.02	0.01	5.9
7	*Ch. nivalis loginovi*	46	40.5—53.3	48.2	2.6	0.4	5.5	0.24—0.46	0.32	0.05	0.01	15.9
8	*Ch. nivalis lebrunii*	52	41.3—50.7	45.1	2.1	0.3	4.8	0.26—0.48	0.37	0.05	0.01	14.4
9	*Ch. gud nenjukovi*	56	53.2—63.6	58.2	2.4	0.3	4.2	0.62—0.92	0.75	0.07	0.01	8.7
10	*Ch. gud gud*	59	54.2—61.7	57.7	1.6	0.2	2.9	0.62—0.80	0.71	0.04	0.01	6.3
11	*Ch. gud lghesicus*	12	56.2—60.3	58.4	1.2	0.3	2.1	0.60—0.76	0.67	0.04	0.01	6.6
12	*Ch. gud lasistanius*	6	55.1—61.5	58.8	2.6	1.1	4.4	0.61—0.86	0.75	0.09	0.04	12.7

which certainly represents a "mixture" of features of both species, should be separated at the specific level; this requires, however, further studies of additional material at the biochemical level.

Institute of Systematics and Evolution of Animals
Polish Academy of Sciences
31-016 Kraków Sławkowska 17
Poland

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STRESZCZENIE

Studia porównawcze budowy morfologicznej M_1 i M^3 przedstawicieli *Chionomys* z Południowej Anatolii i terenów sąsiednich wykazały, że populacja z Maden Köy (Środkowy Taurus) opisana przez SPITZENBERGER (1971) jako

Chionomys gud, należy do *Chionomys nivalis*. Wyraźnie odmienna budowa uzębienia stała się podstawą do opisania nowego podgatunku *Ch. nivalis spitzenbergerae* ssp. nov. Kopalne materiały z późnego plejstocenu z Karain B koło Antalya należą również do tego podgatunku.

Redaktor pracy: mgr Z. Bocheński

APPENDIX

Collections

1. British Museum (Natural History), London — BMNH
2. Museum National d'Histoire Naturelle, Paris — MNHN
3. Laboratoire de la Faune Sauvage, Jouy-en-Josas — LFS
4. Museum d'Histoire Naturelle, Toulon — MHNT
5. Forschungsinstitut Senckenberg, Frankfurt am Main — FIS
6. Institute of Systematic and Experimental Zoology, Polish Academy of Sciences, Cracow — ISEZ (now: Institute of Systematics and Evolution of Animals)
7. Zoological Museum of Lomonosov State University, Moscow — ZMUM
8. Zoological Institute of Academy of Sciences of the USSR, Leningrad — ZIAS
9. Naturhistorisches Museum Wien — NHMW
10. Zoological Museum of Tel-Aviv University, Tel-Aviv — ZMTU
11. Ussishkin House, Regional and History Museum, Dan, Israel — UH

Specimens examined

1. *Ch. nivalis spitzenbergerae* ssp. nov. (recent) — NHMW 13271, 13290—92; ISEZ 5264, 5267.

2. *Ch. nivalis spitzenbergerae* ssp. nov. (fossil) — FIS 86334, 86337—38, 86347—48, 86356—58, 86360, 86375—77, 86379, 86388, 86394—96, 86421, 86442—47, 86449—52, 86610—11, 86618—19, 86630.

3. *Ch. nivalis* ssp. (Arslanköy) — NHMW 13219—20, 13243, 13248, 13259: (Maden Köy) — NHMW 13289.

4. *Ch. nivalis cedrorum* (Spitzenberger, 1973) — FIS 36482—83, 36485—86; NHMW 20477.

5. *Ch. nivalis hermonis* (Miller, 1908) — BMNH 61423—24, 71821—31; ZMTU 3768, 3904, 4085, 4209, 4547—48, 4550—51, 4628, 5120, 5449, 5460—61, 5497, 6869; UH 149—50, 159, 161, 163, 174, 179, 181.

6. *Ch. nivalis pontius* (Miller, 1908) — NHMW 18533, 19881.

7. *Ch. nivalis loginovi* (Ognev, 1950) — ZMUM 20663, 20702, 20722—23, 20725, 35124, 78388, 101419—21, 101424, 101487—89, 101495—98, 101500, 115084—85; ZIAS 31531, 31537, 31540, 31542, 3154ɔ.

8. *Ch. nivalis lebrunii* (Crespon, 1844) — BMNH 8810101—102; MNHN 227, 336, 337, 341, 274, 2009, 2014, 2017, 3867—70; LFS 1618, 719—20, 1743, 2211, 2768—72; NHMW 29980—81.

9. *Ch. gud gud* (Satunin, 1909) — BMNH 3612627; ZMUM 5398, 6895, 6900, 6902, 7963, 15550, 15554—55, 15558, 15561, 15568, 15577, 15583, 17796, 17803, 17810, 58130, 65161, 65168, 107455, 107632; ZIAS 28694—95, 32713—14, 32718—19, 32721—22, 65162, 65177.

10. *Ch. gud nenjukovi* (Formosov, 1931) — BMNH 3612629; ZMUM 7933, 7936, 7943, 7958, 9645, 115068, 17806, 20668, 21670, 21674, 20677, 20682, 21697—98, 20704—05, 20738, 20748, 20749—50, 20754, 20786, 35111, 78566, 78956—57, 78969, 101440, 101499, 101506, 101512, 136068; ZIAS 31544.

11. *Ch. gud lghesicus* (Shidlovsky, 1919) — ZMUM 17816, 136297, 136303—05; ZIAS 69767.

12. *Ch. gud lasistanius* (Neuhäuser, 1936) — BMNH 75598; NHMW 18574, 19879—80.