

A new species of mole rat, *Nannospalax munzuri* sp. n., and karyotype of *Nannospalax tuncelicus* (Coşkun, 1996) (Rodentia: Spalacidae) in eastern Anatolia

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Abstract. Two different forms of *Nannospalax* have been found in the central part of eastern Anatolia. The one has a karyotype of $2n = 54$, $NF = 74$, and $NFa = 70$, and was found in the Bingöl, Elazığ and Tunceli provinces. Their karyotypes consist of 9 of pairs metacentric and submetacentric autosomes and of 17 pairs of acrocentric autosomes. The X chromosomes are large-sized submetacentrics and Y chromosomes are small acrocentrics. This form corresponds to the description of *Nannospalax tuncelicus* (Coşkun, 1996). The second form is morphologically and karyologically clearly distinct. The parietals are trapezoid (not square-shaped as in *N. tuncelicus*), palatal foramina are large and situated in a deep groove (not minute and situated in a shallow groove as in *N. tuncelicus*), and the upper molars have only one root (not three as in *N. tuncelicus*). The karyotype of this form is $2n = 58$, $NF = 68$, $NFa = 64$, and the autosomal set has 4 pairs of biarmed and 24 pairs of acrocentric chromosomes. The X chromosomes are small biarmed and Y chromosomes are small acrocentrics. This form is described as a new species, *Nannospalax munzuri* sp.n.

Kurzfassung. Im mittleren Teil von Ostanatolien wurden zwei Formen des Bildmolls der Gattung *Nannospalax* festgestellt: Die eine hat einen Karyotyp von $2n = 54$, $NF = 74$ und $NFa = 70$, und wurde in den Provinzen Bingöl, Elazığ und Tunceli gefunden. Ihr Karyotyp umfasst 9 Paare metazentrischer und submetazentrischer Autosomen sowie 17 Paare von acrozentrischen Autosomen. Die X-Chromosomen sind groß und submetazentrisch, die Y-Chromosomen klein und acrozentrisch. Diese Form stimmt gut mit der Beschreibung von *Nannospalax tuncelicus* (Coşkun, 1996) überein. Die zweite Form unterscheidet sich in morphologischer und karyologischer Hinsicht deutlich: Die Parietalen sind trapezförmig (nicht quadratisch wie bei *N. tuncelicus*), die Gaumenspalten sind groß und liegen in einer tiefen Furche (nicht klein und in einer flachen Mulde wie bei *N. tuncelicus*) und die oberen Molaren haben nur eine Wurzel (nicht drei wie bei *N. tuncelicus*). Der Karyotyp dieser Form ist $2n = 58$, $NF = 68$, $NFa = 64$, und das autosomale Set besteht aus 4 Paaren von zweiarmigen und 24 Paaren von acrozentrischen Chromosomen. Die X-Chromosomen sind klein und zweiarmig, die Y-Chromosomen klein und acrozentrisch. Diese Form wird als *Nannospalax munzuri* sp.n. als neue Art beschrieben.

Key words. Rodentia, Spalacidae, *Nannospalax tuncelicus*, *Nannospalax munzuri* sp.n., morphology, karyotype, Turkey

Introduction

The phylogeny and systematics of the subterranean mole rats Spalacidae have been largely intractable since the establishment of the family. This is true from the family down to the specific level, and no consensus is yet in sight. The systematics of the Spalacidae at the

generic and specific levels need urgent revision (SAVIC & NEVO 1990, NEVO et al. 1995).

To date, about 50 chromosomal forms of *Spalax* have been reported (SAVIC & SOLDATOVIC 1984, SAVIC & NEVO 1990, NEVO et al. 1994, IVANITSKAYA et al. 1997). NEVO et al. (1995) pointed out that each chromosomal form must be assigned a separate good biological species, and according to this concept, about 20 species can be expected in Turkey. According to GROMOV & BARANOVA (1981) the name of the genus *Microspalax* Nehring, 1898, is preoccupied by *Microspalax* Megnin & Trouessart, 1884, (Acarina) and should be replaced by the name *Nannospalax* Palmer, 1903. They recognized two genera: *Nannospalax* and *Spalax* with altogether eight living species: *Nannospalax ehrenbergi*, *N. nehringi*, *N. leucodon*, and *Spalax giganteus*, *S. arenarius*, *S. microphthalmus*, *S. polonicus* and *S. graecus*. According to NEVO et al. (1995) both taxa of mole rats are present in Turkey. The ancestral *Spalax leucodon* is present in most of Turkey whereas the descendant *Spalax ehrenbergi* is restricted to southeast Anatolia.

Nannospalax nehringi was first described by SATUNIN (1898), based on specimens collected from the Ararat region (Kars-Gaziler-Kaskoparan). This species is distributed in Caucasia and Anatolia (ELLERMAN & MORRISON-SCOTT 1951, TOPACHEVSKII 1969, CORBET & HILL 1991). MEHELY (1909) pointed out that two forms of mole rats live in Anatolia, which differ on subspecies level: *Spalax monticola nehringi* and *S. m. armeniacus*. Also TOPACHEVSKII (1969) accepts that two subspecies are living in Turkey: *Microspalax nehringi nehringi* from East Anatolia and *M. n. cilicicus* from central and western Anatolia. FELTEN et al. (1973) called all Turkish mole rats *Nannospalax nehringi*, and MURSALOĞLU (1979) *Spalax leucodon*. SAVIC & NEVO (1990) and NEVO et al. (1994, 1995) attributed Anatolian mole rats to a superspecies *Spalax leucodon*.

The first study of the karyology of *Nannospalax nehringi* was carried out by MATTHEY (1959) who recorded the diploid chromosome number as $2n = 48$, for material from the Caucasus. NEVO et al. (1994, 1995) reported two chromosomal forms from east Anatolia with $2n = 50$ from Erzurum and Sarıkamış, and with $2n = 54$ from Bingöl. SÖZEN et al. (2000) found mole rats with $2n = 50$ in the provinces of Kars (Susuz), Erzurum and Ardahan, and COŞKUN (2003) mole rats with $2n = 48$ in the Van and Ağrı provinces of eastern Anatolia.

According to TOPACHEVSKII (1969) mole rats from middle east Anatolia can be attributed to *Microspalax n. nehringi*; and according to KIVANÇ (1988) to *Spalax leucodon nehringi*. However, COŞKUN (1996) could find there a new subspecies which he described as *Spalax nehringi tuncelicus*, based on the morphological characters of specimens collected from the Gömemiş area in Tunceli province. However, the distribution area and karyology are not known yet, and the aim of this study was to collect more data on distribution and to determine the karyotype. In the course of this study, I found two different karyotypes, so that the other will be described here as a new species.

Material and method

The study was conducted in central part of eastern Anatolia which is characterised by high mountains. Twenty-three living specimens (10 ♂, 13 ♀) were collected from nine localities (Fig. 1). Nineteen specimens (8 ♂, 11 ♀) revealed to belong to *Nannospalax tuncelicus* (Coşkun, 1996) from Elazığ, Bingöl and Tunceli populations, and four (2 ♂, 2 ♀) to a new species from Tunceli-Ovacık. Trapping mole rats involves the opening of a burrow system and catching the animal with a hoe when it comes to plug the opening. Age determination was based on molar

crest patterns. Mitotic chromosomes were obtained from bone marrow and preparations were made by means of the general air-drying technique (LEE & ELDER 1980). The data obtained from the specimens were compared with the results of previously published accounts.

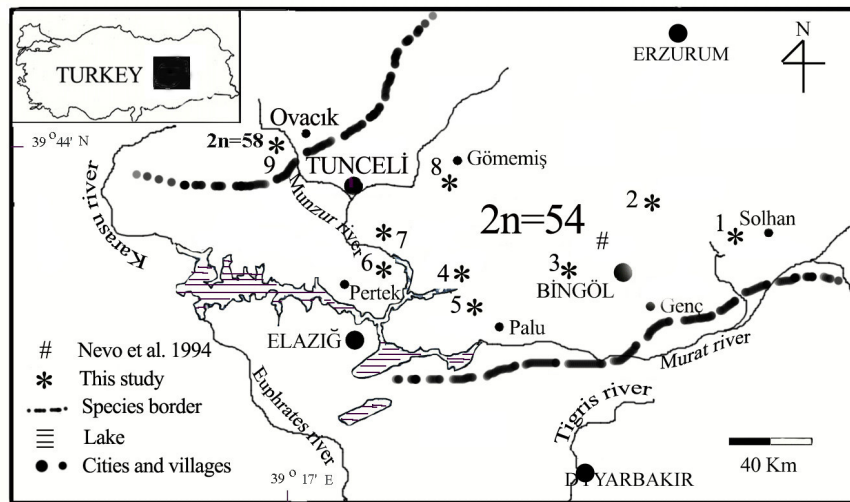


Fig. 1. Sampling localities (sample sizes are given in parentheses) of *Nannospalax tuncelicus*: 1. Bingöl prov.: Solhan-Altındağ, Şerefmeydanı village, 24 km west of Solhan (3); 2. Bingöl prov.: Kuruca village, 17 km west of Bingöl (1); 3. Bingöl prov.: road from Bingöl to Karlıova, 5 km after Bingöl (2); 4. Elazığ prov.: Kovancılar-Taşören village (4); 5. Elazığ prov.: 2 km northwest of Palu (2); 6. Elazığ prov.: Pertek-Yeniköy (2); 7. Tunceli prov.: Nişantaşı village (3); 8. Tunceli prov.: Kocakoç-Gömemiş village (2) (type locality). *Nannospalax munzuri* sp. n.: 9. Tunceli prov.: Ovacık-Sarısun village (4).

The new species was compared with the holotype, four paratypes and two metatypes of *Nannospalax tuncelicus* (Coşkun, 1996), and the topotype of *N. nehringi* (Satunin, 1898). Specimens are deposited at the Biology Department, Science and Art Faculty, University of Dicle-Diyarbakir.

Results

Nannospalax tuncelicus (Coşkun, 1996)

Spalax nehringi tuncelicus Coşkun (1996), Säugetierkundliche Mitteilungen 37 (3): 103-109.

The first karyological analysis of mole rats of this region were made by NEVO et al. (1994) from specimens from 10 km south of Bingöl and called as a superspecies *Spalax leucodon*. According to this study the diploid chromosome number is $2n = 54$, but the knowledge concerning chromosomal arm number and sex chromosomes is missing.

The karyotypes of 19 specimens from Bingöl, Elazığ and Tunceli have a diploid chromosome number of $2n = 54$; a fundamental chromosome arm number of $NF = 74$; and an autosomal arm number of $NFa = 70$. Their karyotypes consist of 9 pairs of meta/submetacentrics, and 17 pairs of acrocentric autosomes. The X chromosomes are medium-sized submetacentric whereas Y chromosomes are small acrocentrics (Fig. 2 A-B). Geographical distribution of *Nannospalax tuncelicus* is shown in Fig. 1.

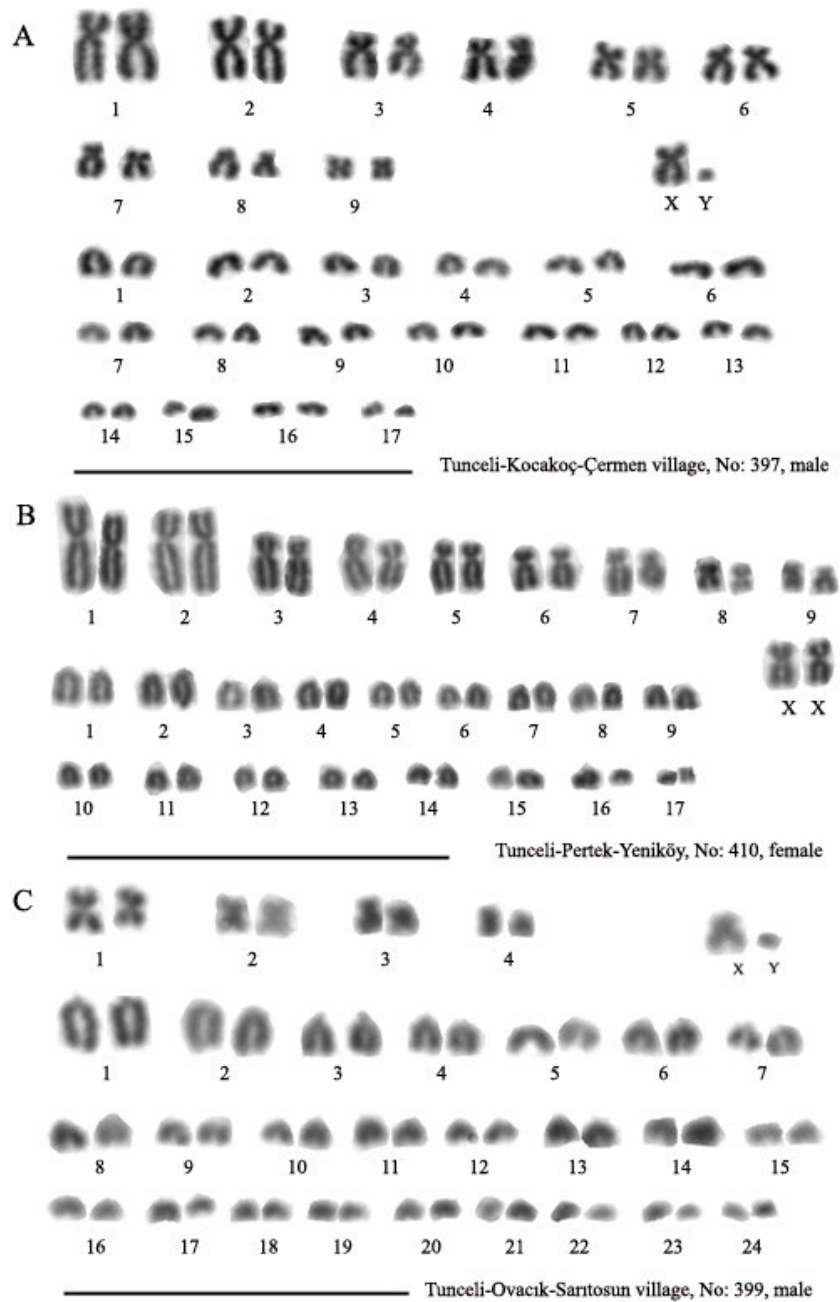


Fig. 2. A and B- Karyotypes of *Nannospalax tuncelicus* from Kocakoç-Cermen village, 6 km south of type locality, and C- karyotype of *Nannospalax munzuri* sp. n. (Ovacık-Saritosun village).

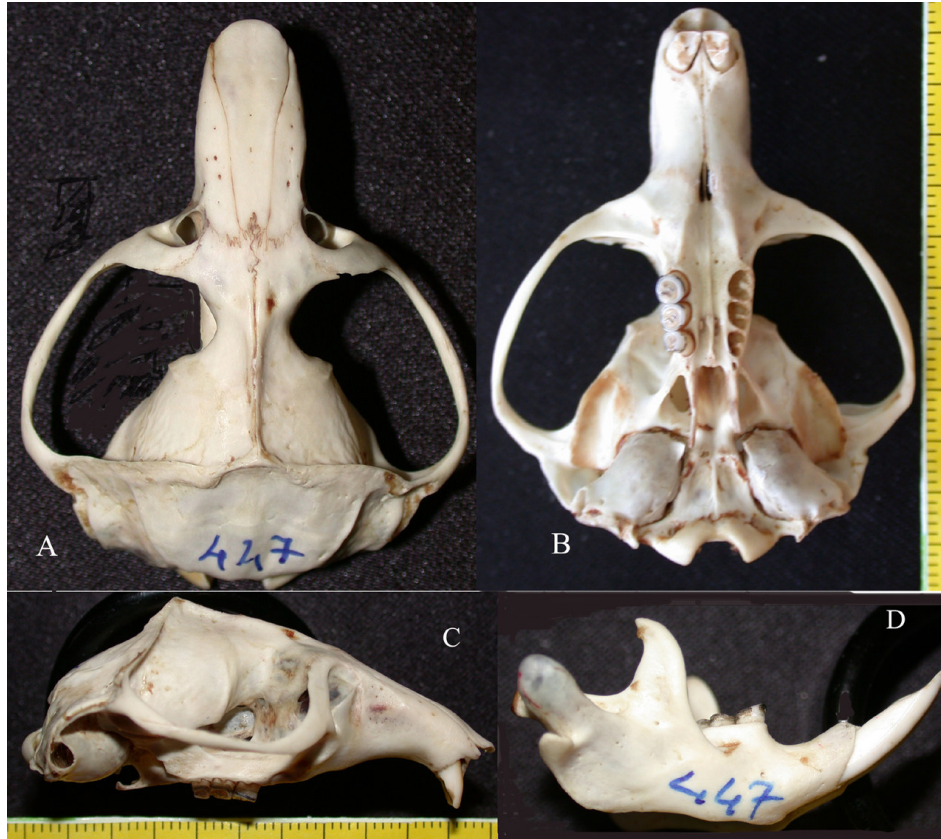


Fig. 3. Skull of *Nannospalax munzuri* sp. n., A - dorsal, B - ventral, C - lateral views, D - mandible.

***Nannospalax munzuri* sp. n.**

Holotype. Adult ♀, coll. number 447; collected from Saritosun village, 5 km southeast Ovacık, Tunceli prov. (39°44'N, 39°17'E, Fig. 1), altitude ca. 1500 m., 22.8.2002, leg. Y. COŞKUN. The skin and skulls of holotype and paratypes will be deposited in the Department of Biology, Science and Art Faculty, University of Dicle, Diyarbakır-Turkey.

Paratype. Three specimens, two males and one female, from the type locality.

Diagnosis. The form of the parietals is trapezoid. Palatal foramina large and situated in deep grooves. Upper molars have one root. Diploid chromosome number is $2n = 58$; chromosomal arm number $NF = 66$, and autosomal arm number $NFa = 62$.

Description. Medium-sized spalacid. Body and skull measurements are given in Tab. 1. All specimens examined have supracondyloid foramen above both sides of the occipital condyles. The lambdoid and sagittal ridges are well developed in mature individuals. The

nasal bones do not have longitudinal slit-like depression in the region of the sutures between them. (Fig. 3).

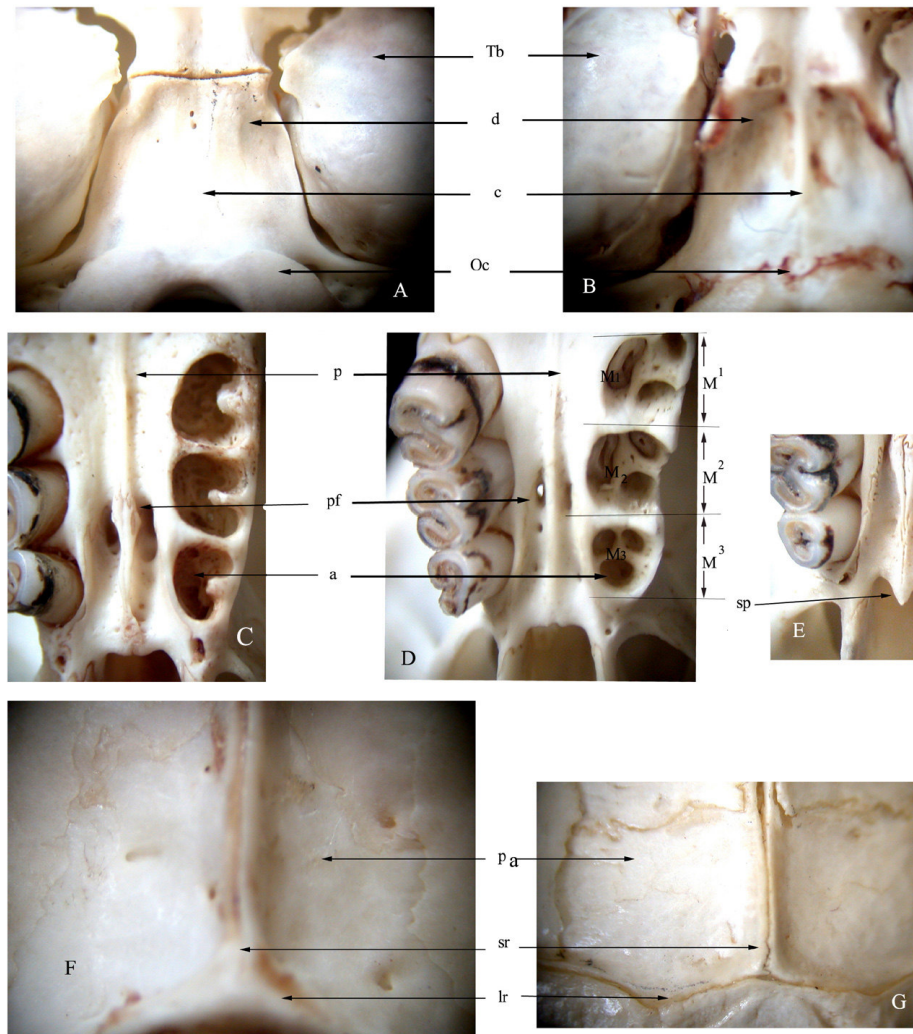


Fig. 4. Comparative skull morphology of the species. A, E - *Nannospalax nehringi*; B, C, F - *Nannospalax munzuri* sp. n. (holotype); D, G - *Nannospalax tuncelicus* (holotype). a: alveoli, c: tuberculum pharyngeum, d: depression, lr: lambdoid ridge, M^{123} : upper molars, oc: occipital. p: palate, pa: parietale, pf: palatal foramen, sp: styloid process, sr: sagittal ridge, Tb: Tympanic bullae.

The foramen postpalatines are large, situated in a deep groove, and placed in front of the line passing between M^2 - M^3 (Fig. 4C). The palate extends beyond the line connecting the rear edges of the alveoli of the last upper molars, and do not have styloid process (Fig. 4C).

Tuberculum pharyngeum is well-developed (Fig. 4B). The parietals are trapezoid and longer than wide (Fig. 4F).

Tab. 1. Body and selected cranial measurements (in mm) of *Nannospalax munzuri* sp. n. (SD: standard deviation) from Ovacık-Saritosun (Tunceli prov.), Turkey.

	Holotype	Paratypes				
	447	399	403	435	mean	SD
	♀	♂	♀	♂		
Head+ body length	208	238	198	150	198.50	36.5
Hind foot length	29	29	25	24	26.75	2.6
Weight (gr)	267	281	170	122	210.00	76.6
Condylonasal length	52.7	52.9	44.8	42.3	48.18	5.4
Zygomatic breadth	40.3	38.2	30.5	30.0	34.75	5.3
Greatest skull height	22.8	21.0	19.6	17.9	20.33	2.1
Interorbital breadth	6.4	7.4	7.2	8.1	7.28	0.7
Nasal length	20.8	21.4	18.0	16.6	19.20	2.3
Incisive foramen length	3.4	3.0	2.6	2.9	2.98	0.3
Upper incisive width/ Antero-posterior cross section (%)	89.6	80.0	83.3	90.4	85.83	5.1
Upper molar length	6.9	7.1	6.2	6.5	6.68	0.4
Upper diastema length	19.7	18.6	15.0	14.0	16.83	2.8
Lower incisive width/ Antero-posterior cross section	75.0	90.0	88.8	83.3	84.28	6.8
Lower molars length	7.4	7.2	6.8	7.2	7.15	0.3
Coronoid process height	17.5	18.0	14.9	13.6	16.00	2.1
Mandible length	30.7	30.1	26.8	23.2	27.70	3.5

The anterior surface of the upper incisors are light yellow and smooth, without longitudinal ridges. Relation of width and antero-posterior cross section of the upper and lower incisors are 80.0–85.83–90.4 for the upper, and 75.0–84.28–90.0 for the lower teeth.

The sella externa is placed below the sella interna on the mandible in all samples. The alveolar process of the lower jaw is higher than the condyloid process. In mature specimens, M^3 has one enamel island on chewing surface (Fig. 5). $M^{1,2,3}$ and $M_{2,3}$ have welded one root in all specimens, while M_1 has two roots (Fig. 4C). The base of baculum wider than the tip and slightly curved dorsoventrally in the median part, whereas it is curved close to the distal in Malatya population ($2n = 60$) (Fig. 6A). There is a groove on the proximal (Fig. 6C).

Karyology. The karyotypes of four specimens from the Tunceli-Ovacık-Saritosun village have a diploid chromosome number of $2n = 58$; the fundamental chromosome arms number is $NF = 68$; and the autosomal arm number is $NFa = 64$. Their karyotypes consist of 4 pairs of meta/submetacentrics, and 24 pairs of acrocentric autosomes. The X chromosomes are medium-sized submetacentric whereas Y chromosomes are small acrocentrics (Fig. 2C).

Derivatio nominis. This species is named after the Munzur Mountains.

Distribution. Santosun near Ovacık in Tunceli prov. of Turkey. Only known from the type locality (Fig. 1).

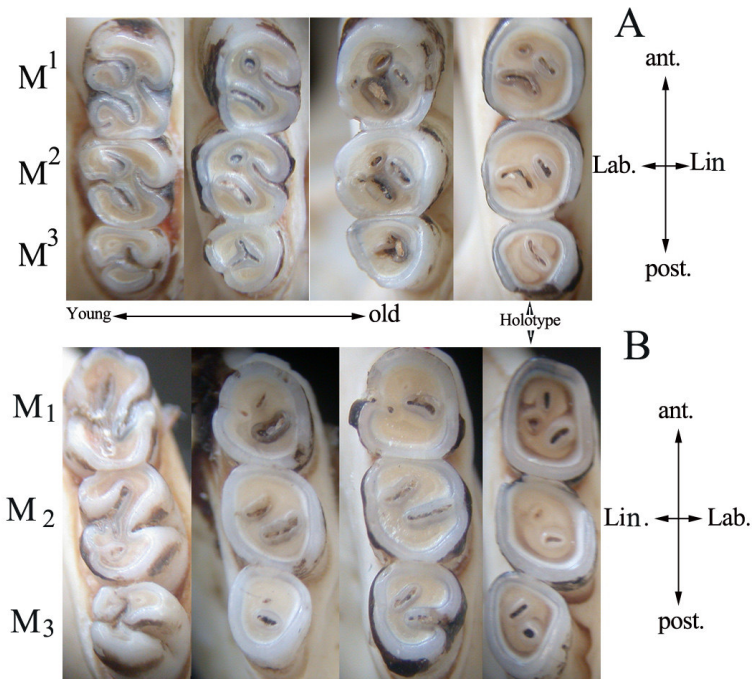


Fig. 5. Upper (A) and lower (B) molars of *Nannospalax munzuri* sp. n., ant. = anterior; Lab. = labial, Lin. = lingual, post. = posterior side.

Comparison. *Nannospalax munzuri* differs from *N. tuncelicus* by the parietals form which is trapezoid (square in *N. tuncelicus*) (Fig. 4F-G); palatal foramina are large and situated in a deep groove (minute and situated in a shallow groove in *N. tuncelicus*); Upper molars have one root (three roots in *N. tuncelicus*) (Fig. 4C-D); and the diploid chromosome number is $2n = 58$, $NF = 66$, and $NFa = 62$, compared to $2n = 54$, $NF = 74$ and $NFa = 70$ in *N. tuncelicus* (Fig. 2A-C).

N. munzuri also differs from the nominal species, *Nannospalax nehringi* by the lack of styloid process (present in *N. nehringi*) (Fig. 4C-E), well-developed tuberculum pharyngeum (totally absent or weakly developed in *N. nehringi*) (Fig. 4A-B), and a diploid chromosome number of $2n = 58$, $NF = 66$, and $NFa = 62$ ($2n = 48$, $NF = 68$ and $NFa = 64$ in *N. nehringi*) (Fig. 2A-C).

Discussion

According to GROMOV & BARANOVA (1981), Spalacidae consists of two genera, *Nannospalax* and *Spalax*, and Turkish spalacids belong to genus *Nannospalax*. Following this, I used the genus name *Nannospalax* in this paper. According to TOPACHEVSKII (1969) *Microspalax nehringi* has three rooted upper molars, the nasal bones have a sharply defined longitudinal slit-like depression in the region of the suture between them (Fig. 3A); and gives the ratio of upper and lower molars width to antero-posterior cross section. As these characters are not found in the east Anatolian populations, they do not belong to *nehringi*.

On the basis of a comparative analysis of karyotypes, it can be concluded that two different chromosomal forms of *Nannospalax* live in middle eastern Anatolia. They can be distinguished by differences in the number and morphology of their chromosomes. Comparative morphological and karyological findings show that the population living in Bingöl, Elazığ and Tunceli is not a subspecies, as described by COŞKUN (1996), but a good species. For this reason, *Spalax nehringi tuncelicus* was given species rank, as *Nannospalax tuncelicus*. As a result, two different species, *Nannospalax munzuri* sp. n. (Tunceli-Ovacık population) and *Nannospalax tuncelicus*, are living in this region.

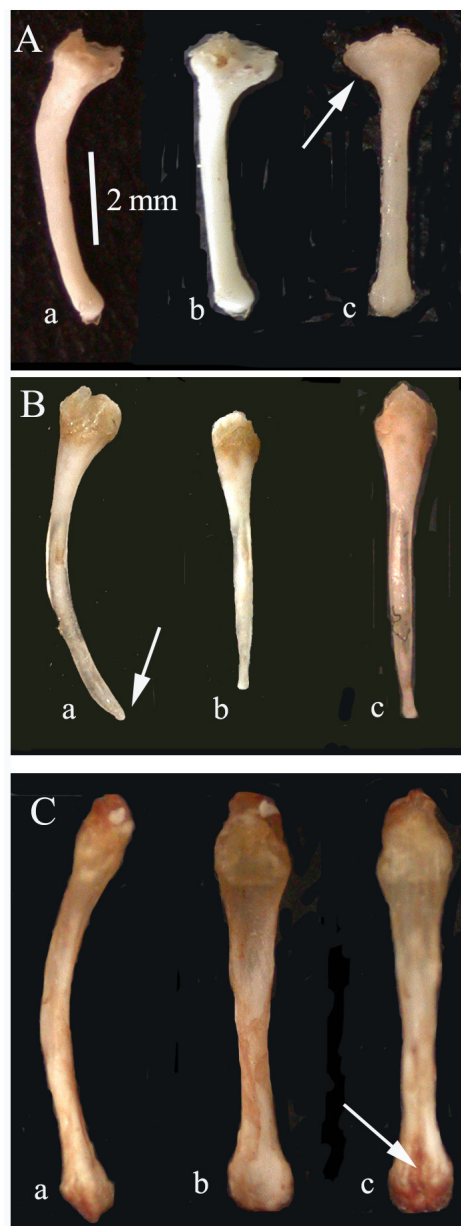


Fig. 6. Comparative baculum morphology of the species. A - Malatya population ($2n = 60$), B - *Nannospalax nehringi*, C - *Nannospalax munzuri* sp. n., a-lateral, b-ventral, c- dorsal views. Arrows indicate differences.

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