



## Contributions to the karyology and taxonomy of *Spalax leucodon nehringi* Satunin, 1898 and *Spalax leucodon* *armeniacus* Mehely, 1909 (Mammalia: Rodentia) in Turkey

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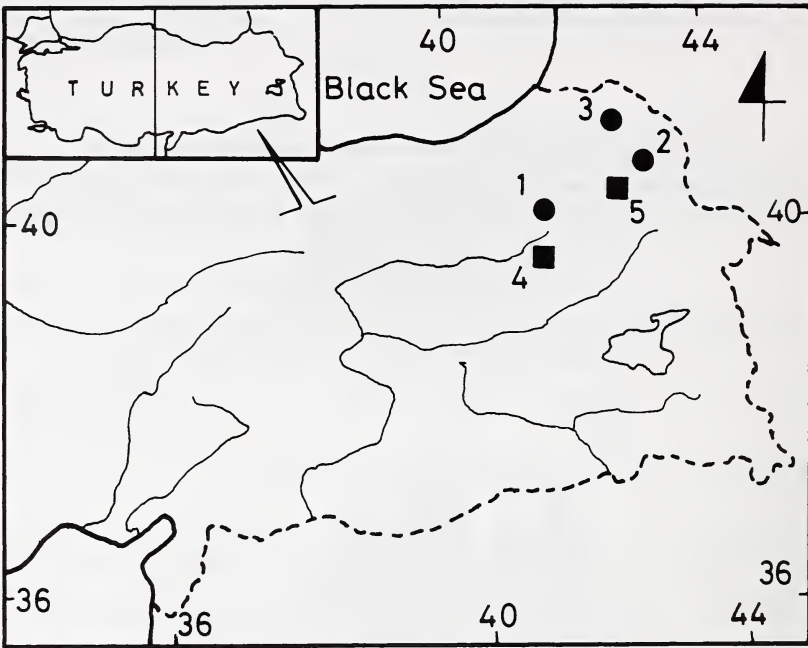
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The subterranean mole rats belonging to the family Spalacidae are widely distributed in southeastern Europe, Asia Minor, Caucasus, Transcaucasus, Ukraine, Armenia, Syria, Palestine, Iraq, Israel, Jordan, and northeastern Africa (OGNEV 1947; ONDRIAS 1966; LAY and NADLER 1972; CORBET 1978; SAVIC and NEVO 1990; NEVO 1991; HARRISON and BATES 1991). To date, about 50 chromosomal forms of *Spalax* have been reported in the literature from these areas.

According to the most recent morphological studies there are two species (*S. leucodon* (Nordmann, 1840) and *S. ehrenbergi* Nehring, 1898) and nine subspecies (*S. l. nehringi* Satunin, 1898; *S. l. armeniacus* Mehely, 1909; *S. l. cilicicus* Mehely, 1909; *S. l. anatolicus* Mehely, 1909; *S. l. turcicus* Mehely, 1909; *S. l. tuncelicus* Coşkun, 1996; *S. l. nevoi* Coşkun, 1996; *S. e. intermedius* Nehring, 1898, and *S. e. kirgisorum* Nehring, 1898) of blind mole rats in Turkey (KIVANÇ 1988; COŞKUN 1996 a, b). However, the results from karyological studies revealed ten karyological forms ( $2n = 36, 38, 40, 50, 52, 54, 56, 58, 60,$  and  $62$ ) of *S. leucodon* and four karyological forms ( $2n = 52, 54, 56,$  and  $58$ ) of *S. ehrenbergi* in Turkey, and the number of chromosome arms (NF) for *S. leucodon* and *S. ehrenbergi* varied from 70 to 84 and from 72 to 90, respectively (SOLDATOVIC and SAVIC 1978; SAVIC and SOLDATOVIC 1979; YÜKSEL 1984; GÜLKAÇ and YÜKSEL 1989; YÜKSEL and GÜLKAÇ 1992, 1995; NEVO et al. 1994, 1995; IVANITSKAYA et al. 1997; SÖZEN and KIVANÇ 1998 a, b; SÖZEN et al. 1999) (Tab. 2). NEVO et al. (1994, 1995) stated that each of the chromosomal forms is a separate biological species. They also examined the populations by using Nei's genetic distance between populations obtained by allozyme electrophoresis and claimed that some populations having identical diploid chromosome numbers are different biological species, presumably representing about 20 such species in Turkey. Later, SÖZEN and KIVANÇ (1998 a, b) and SÖZEN et al. (1999) added 7 karyotypes. These results have increased the total number of alleged biological species of *Spalax* in Turkey to about 30.

The karyotypes of 5 specimens from a site 10 km W of Ardahan, 3 specimens from a site 3 km S of Susuz (Kars), and 3 specimens from a site 20 km E of Erzurum belonging to *Spalax leucodon* were analysed in the present study (Fig. 1, Tab. 1). Chromosome preparations from bone marrow were made in accordance with FORD and HAMERTON (1956), and about 30 metaphase cells from each animal were examined. The karyotype preparations and animals examined were deposited in the Department of Biology, Faculty of Science, University of Ankara.

It was determined that specimens have  $2n = 50$  and  $NF = 72$  in all populations examined. The X chromosome is a large-sized metacentric, and the Y chromosome is a small



**Fig. 1.** Geographic distribution of 3 sampling localities (●), and recorded localities (■) by NEVO et al. (1994,1995) in Turkey: 1: 20 km E of Erzurum, 2: 3 km S of Susuz, 3: 10 km W of Ardahan, 4: 80 km S of Erzurum, 5: 14 km W of Sarikamiş.

**Table 1.** The location and the number of animals examined

<i>Spalax leucodon nehringi</i> Satunin, 1898			
Locality	Male	Female	Total
Erzurum 20 km E	2	1	3
<i>Spalax leucodon armeniacus</i> Mehely, 1909			
Susuz 3 km S	2	1	3
Ardahan 10 km E	2	3	5

acrocentric. The autosomal set has 6 pairs of meta-submetacentrics, 4 pairs of subtelocentrics, and 14 pairs of acrocentrics. The same karyotypes were found by NEVO et al. (1994,1995) in specimens from a site 80 km S of Erzurum and 14 km W of Sarikamiş (Fig. 1, Tab. 2).

KIVANÇ (1988) classified the specimens from Ardahan and Susuz as *S. I. armeniacus* and from Erzurum as *S. I. nehringi*. Nevertheless, we determined the karyotype of these populations as belonging to the same karyotypes. This result shows that, as indicated by SAVIC and NEVO (1990), NEVO (1991), NEVO et al. (1994, 1995), the results of morphological studies at the subspecies level require a modern revision based on chromosome and molecular-genetic data, in addition to their morphology, physiology, and behaviour.

**Table 2.** Chromosomal records of *Spalax leucodon* (Nordmann, 1840) and *Spalax ehrenbergi* Nehring, 1898 from Turkey

\* m: metacentric, sm: submetacentric, st: subtelocentric, a: acrocentric

<i>Spalax leucodon</i> (Nordmann 1840)						
Locality	2n	NF	NFa	X	Y	Reference
Bayındır	36	70	–	–	–	SÖZEN et al. (1999)
Balıkesir and İzmir	38	74	70	st	a	NEVO et al. (1994, 1995)
Havran and Selçuk	38	74	70	st*	a	SAVIC and SOLDATOVIC (1979)
Beyşehir	40	72	68	sm	–	NEVO et al. (1994, 1995)
Aydın, Erzurum	50	–	–	–	–	NEVO et al. (1994, 1995)
Sarıcamış	50	72	68	sm	–	NEVO et al. (1994, 1995)
Sebil	52	72	68	sm	a	SÖZEN and KIVANÇ (1998 a)
Bolu and Bingöl	54	–	–	–	–	NEVO et al. (1994, 1995)
Yozgat	54	74	70	sm	st	YÜKSEL and GÜLKAÇ (1995)
Gülek	56	72	68	m	a	SÖZEN and KIVANÇ (1998 a)
Çorlu and Karaevli	56	78	74	sm*	a*	SOLDATOVIC and SAVIC (1978)
Madenköy	58	72	68	sm	a	SÖZEN and KIVANÇ (1998 b)
Denizli, Pınarbaşı	60	–	–	–	–	NEVO et al. (1994, 1995)
Akşehir	60	76	72	sm	st	SÖZEN et al. (1999)
Malatya	60	78	74	sm	a	IVANITSKAYA et al. (1997)
Malatya	60	78	74	sm	a	NEVO et al. (1994, 1995)
Malatya	60	80	76	sm	st	YÜKSEL (1984)
Malatya and Yazihan	60	80	76	sm	st	GÜLKAÇ and YÜKSEL (1989)
Kırşehir, Nevşehir and Kayseri	60	80	76	sm	st	YÜKSEL and GÜLKAÇ (1995)
Arguvan	60	82	78	sm	–	GÜLKAÇ and YÜKSEL (1989)
Ankara	60	82	78	sm	st	SÖZEN et al. (1999)
Afyon	60	82	78	sm	st	SÖZEN et al. (1999)
Burdur	60	84	80	sm	st	SÖZEN et al. (1999)
Kütahya, Afyon, Konya, Sivas, Ankara, Kayseri, Havza, Şuşheri	62	–	–	–	–	NEVO et al. (1994, 1995)
Erzurum 20 km E	50	72	68	sm	a	This study
Susuz 3 km S	50	72	68	sm	a	This study
Kars 10 km W	50	72	68	sm	a	This study
<i>Spalax ehrenbergi</i> Nehring, 1998						
Locality	2n	NF	NFa	X	Y	Reference
Kilis	52	74	70	sm	a	SÖZEN et al. (1999)
Birecik, Siverek, Diyarbakır, Elazığ	52	76	72	sm	–	IVANITSKAYA et al. (1997)
Diyarbakır, Urfa	52	76	72	–	–	NEVO et al. (1994, 1995)
Elazığ	52	76	72	sm	st	YÜKSEL (1984)
Adıyaman, Hilvan	52	76	72	m*	st	YÜKSEL and GÜLKAÇ (1992)
Urfa	52	80	76	sm	–	IVANITSKAYA et al. (1997)
Suruç	54	76	72	m	st	YÜKSEL and GÜLKAÇ (1992)
Tarsus	56	72	68	–	–	NEVO et al. (1994, 1995)
Tarsus	56	72	68	m	–	IVANITSKAYA et al. (1997)
Gaziantep	56	82	78	sm	–	IVANITSKAYA et al. (1997)
Gaziantep	56	90	86	m	st	YÜKSEL and GÜLKAÇ (1992)
Gaziantep	58	82	78	–	–	NEVO et al. (1994, 1995)

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