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Chromosomal forms of the mole rat *Microspalax* from Greece and Turkey

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Abstract

The karyotype of several populations from different regions of Greece and Turkey was analysed. On the basis of the analysis, the existence of five different karyotypes is recorded: *Microspalax leucodon makedonicus* with 2n = 52 and NF = 86, *M. l. epiroticus* 2n = 56 and NF = 84, *M l. hellenicus* 2n = 58 and NF = 88, *M. l. turcicus* 2n = 56 and NF = 78 and the newly described karyotype from the western part of Asia Minor and from the island of Lesbos (probably *M. nehringi anatolicus*) with 2n = 38 and NF = 74.

It is interesting to note that the karyotype of the population Polychnitos from the Aegean island of Lesbos is identical to the karyotype of the populations Havran and Selçuk from the western part of Asia Minor.

Although there are great differences in respect of the number of chromosomes between the Asian and Aegean populations *M. nehringi anatolicus* on the one hand, and the population *M. leucodon turcicus* on the other, it can be assumed on the basis of the NF value and the number of subacrocentric chromosomes that these two karyotypes are phylogenetically closely linked.

Introduction

Karyotype studies of the populations of the complex species *Microspalax leucodon* (Nordmann, 1840) from south-eastern Europe reveal obvious chromosome polymorphism. Several different karyotypes from this region have been described until now. Their diploid chromosome number vary from 46 to 58, while their NF ranges from 76 to 98 (Savić and Soldatović 1979a; Peshev 1980).

The first karyological analyses of mole rat populations in Greece were made by Savić and Soldatović (1978, 1979a) and Savić (1981). They recorded two new karyotypes: *M. l. epiroticus* (the population of Lefkothea) and *M. l. hellenicus* (the population of Hag. Spyridon).

Karyotype studies of the mole rat in Turkey were initiated by Soldatović and Savić (1978) and Savić and Soldatović (1979a, b). They described the karyotype *M. l. turcicus* in two populations in Balkan Turkey (the Çorlu and Karaevli populations). Another karyotype was discovered in Turkey in two populations in western Asia Minor (the Havran ans Selçuk populations), most probably belonging to the species *M. nehringi* (*M. n. anatolicus* Méhely, 1909). Since the karyotype of these latter two populations was only analysed in the female however, the sex chromosomes could not be determined.

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The analysis of the karyotype of mole rat populations on the island of Lesbos (the Polychnitos population), whose results are shown here, represents a contribution to knowledge of the karyotype of the mole rat populations on this Aegean island for the purpose of explaining problems of taxonomy and speciation of representatives of the genus *Microspalax* on the Balkan peninsula and in neighbouring regions. The study also includes a comparative survey of all the karyotypes found in Greece and Turkey.

Results and discussion

Savić and Soldatović (1978, 1979a) and Savić (1981) described two karyotypes from Greek territory: *M. l. epiroticus* (the Lefkothea population) with 2n = 56 and NF = 84 and *M. l. hellenicus* (the Hag. Spyridon population) with 2n = 58 and NF = 88 (Fig. 1). Both karyotypes have a great number of acrocentric autosomes – 14 pairs, six pairs each of subacrocentric and one pair each of metacentric autosomes. The only difference between these two karyotypes lies in the number of submetacentric autosomes – *M. l. epiroticus* has six and *M. l. hellenicus* seven. Since the sex chromosomes of both these forms are identical, it may be concluded that their karyotype is extremely similar.

Savić and Soldatović (1979b) analysed two populations in the Balkan part of Turkey (Çorlu and Karaevli) which belong to the subspecies *M. l. turcicus* and have an identical karyotype – 2n = 56 and NF = 78. In the western part of Asia Minor, there was an analysis made of the karyotype of two populations (Havran and Selçuk) which probably belong to a quite different species – *M. nehringi* (according to Mursaloglu 1978 – *M. leucodon*, to Méhely 1909 and Ondrias 1966 – *M. l. anatolicus* and to Lyapunova et al. 1974 – *M. nehringi*) and they were found to have an identical karyotype = 2n–38 and NF = 74. Compared with all the karyotypes of the mole rat described, the form *M. l. turcicus* has by

Fig. 1. Survey of the localities of the populations analysed karyologically from Greece and Turkey. 1 = Çorlu, 2 = Karaevli, 3 = Arnissa, 4 = Havran, 5 = Lefkothea (and Eleousai), 6 = Polychnitos (Island of Lesbos), 7 = Hag. Spyridon, 8 = Selçuk

far the greatest number of acrocentric autosomes – 17 pairs. It has two pairs of metacentric chromosomes, five pairs of submetacentric and only three pairs of subacrocentric autosomes, which is at the same time one of the lowest values for subacrocentric autosomes among all the other karyotypes of the mole rat in Europe.

Of the studies of the karyotypes of mole rat populations in the Balkan peninsula and Asia Minor, studies of populations from the Aegean islands are of particular significance as they can offer appropriate information on mutual phylogenetic relations.

On this occasion, the results of the analysis of the karyotype of one population of the Aegean islands are given for the first time. The analysis was made on the Polychnitos population from the island of Lesbos (Fig. 1), using two males and one female. Chromosome preparations were obtained by the direct method from the bone marrow (Hsu and Kellog 1960).

This karyotype is characterized by a diploid number of chromosomes 2n = 38 and NF = 74 (Fig. 2). According to the morphology and position of the centromere, the chromosomes can be divided into four groups. The first contains six pairs of metacentric autosomes of greater and medium length, as well as two pairs of the smallest autosomes in the karyotype. The group of submetacentric chromosomes has eight pairs of mainly larger autosomes, only the last pair of which is considerably smaller. In the third – the group of subacrocentric chromosomes, there are three pairs of autosomes, of which the first two pairs are the longest chromosomes in the karyotype. It es interesting to point out that in the fourth group, the group of acrocentric chromosomes, there is only one pair of autosomes – which are very small. The X chromosome is larger and subacrocentric, while the Y chromosome is acrocentric, very small and corresponding in size to a pair of acrocentric autosomes.

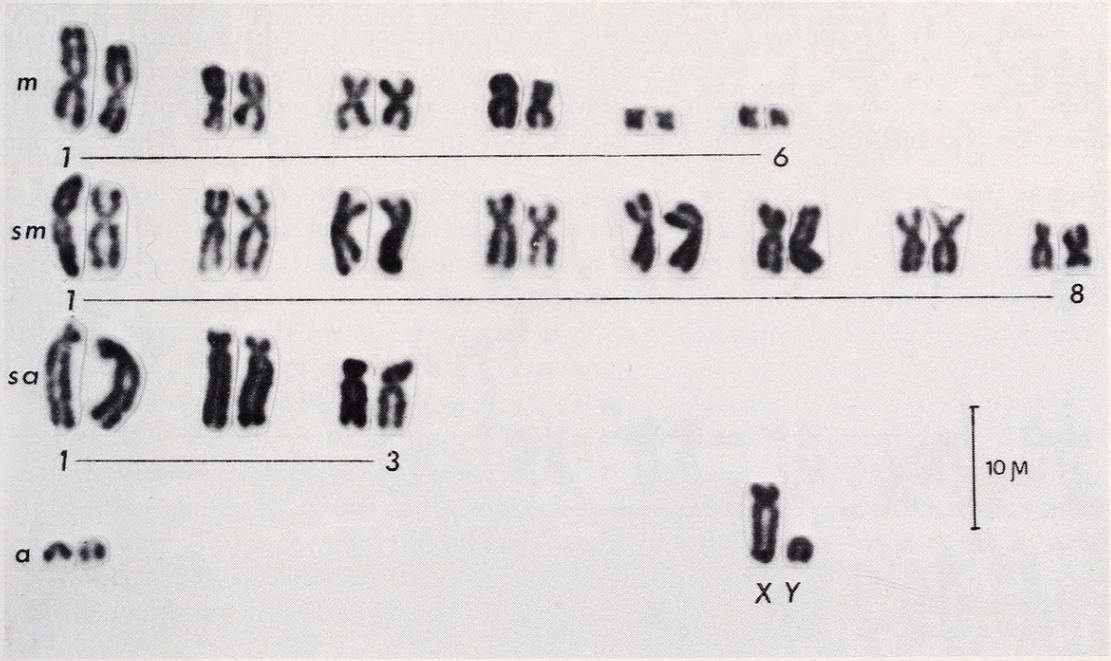

Fig. 2. Karyogram of the population Polychnitos from the island of Lesbos-male (probably *Microspalax nehringi anatolicus)*

According to the morphology of the chromosomes of the population Polychnitos from the island of Lesbos, it can easily be perceived that this karyotype could be identical to the karyotype of the populations Havran ans Selçuk from the western part of Asia Minor (Savić and Soldatović 1979b). It could therefore be assumed that the sex chromosomes

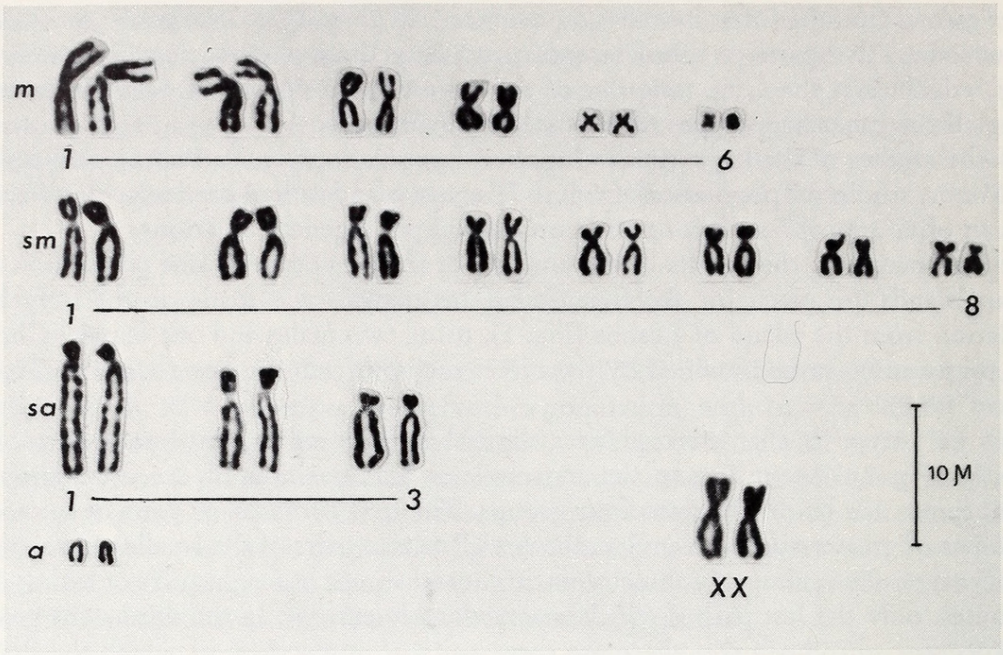

Fig. 3. Karyogram of the population Havran from the western part of Asia Minor-female (probably *Microspalax nehringi anatolicus)*

of the two poulations from Asia Minor are also the same as in the population Polychnitos (Fig. 3).

The karyotype of the population Arnissa (two males and two females) was analysed in northern Greece. The diploid number of chromosomes in this population is 52 and NF = 86 (Fig. 4). According to the position of the centromere, we distinguish four groups of chromosomes. There are two pairs of autosomes in the group of metacentric chromosomes. There are seven pairs each of submetacentric and subacrocentric autosomes. The subacrocentric autosomes are the longest chromosomes in the karyotype. There are nine

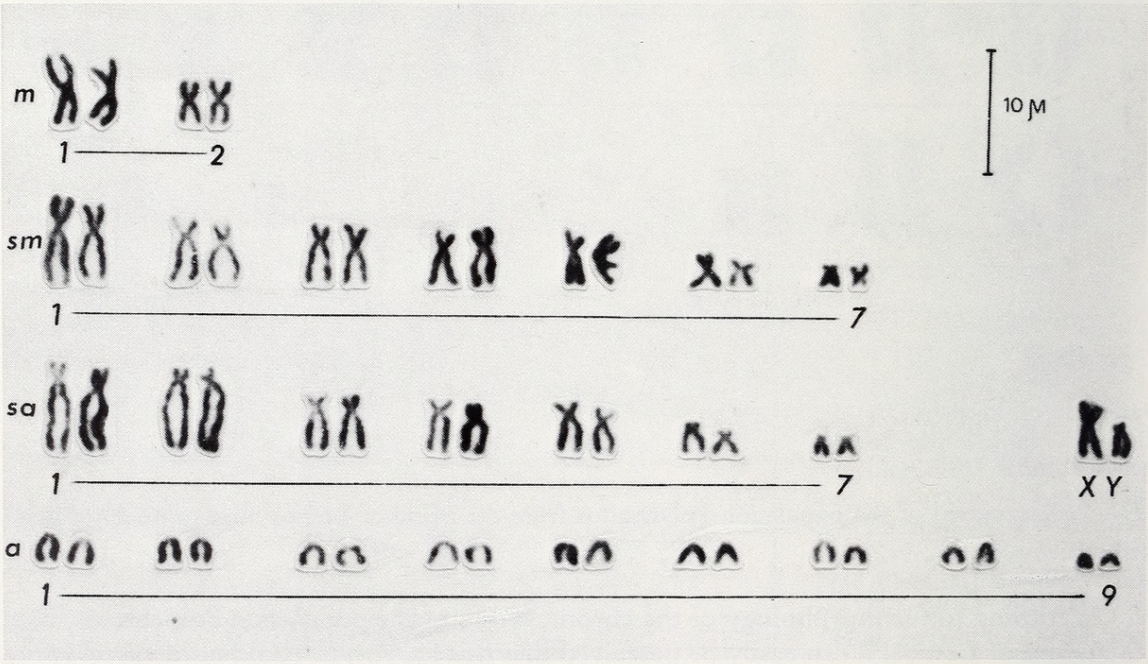

Fig. 4. Karyogram of the population Arnissa from northern Greece-male *(Microspalax leucodon makedonicus)*

pairs of autosomes in the group of acrocentric chromosomes. These chromosomes are the smallest in the karyotype. The X chromosome is of medium size and submetacentric while the Y chromosome is small and acrocentric. The mole rat populations of western Macedonia in Yugoslavia have a similar karyotype.

The table gives a comparative survey of all populations analysed to date of the genus *Microspalax* from Greece and Turkey. On the basis of comparative analysis of karyotypes, it can be concluded that there is great chromosome polymorphism in this region which is manifested in the differences in respect of the number and morphology of the chromosomes. The diploid number of chromosomes of the majority of the populations is over 50

Comparative survey of the morphology of the karyotypes from Greece and Turkey

Karyotypic form	Autosomes				Sex chromosomes		2n	NF
	m	sm	sa	a	X	Y		
M. nehringi	6	8	3	1	sa	a	38	74
M. l. makedonicus	2	7	7	9	sm	a	52	86
M. l. turcicus	2	5	3	17	sm	a	56	78
M. l. epiroticus	1	6	6	14	sm	a	56	84
M. l. hellenicus	1	7	6	14	sm	a	58	88

m = metacentric, sm = submetacentric, sa = subacrocentric, a = acrocentric

(52–58), which is within the borders of the corresponding values with other populations of the Balkan peninsula and other regions of their range (Savić and Soldatović 1979a; Peshev 1980). However, the extremely small number of chromosomes in the population of the island of Lesbos and two populations (Havran and Selçuk) from Asia Minor is particularly striking. This number also deviates greatly in comparison with the lowest number of chromosomes registered until now in representatives of the genus *Microspalax* (population Kozarevets 2n = 46, Peshev 1980; *M. l. hungaricus* 2n = 48, Savić and Soldatović 1977). Apart from this, it is also significant to stress the fact that the karyotype of the populations from the island of Lesbos as well as from two localities in Asia Minor contains only one pair of acrocentric autosomes. In all the karyotypes of mole rats on the Balkan peninsula described, the number of acrocentric chromosomes was considerably greater and varied from 6 in the subspecies *M. l. serbicus* (Savić and Soldatović 1974) to 17 in *M. l. turcicus* (Soldatović and Savić 1978). Such a karyotype, which differs extremely from all karyotypes of *Microspalax* representatives known to-day, has introduced a degree of confusion into our knowledge of the cytogenetics of the mole rat. Nevertheless, if the NF is analysed, its relative closeness to the karyotype of the subspecies *M. l. turcicus* is to be seen. This fact leads us to believe that there is a close mutual phylogenetic link between these two karyotypes, whereby one could have sprung from the other mainly by means of Robertson's fusion or fission, by the transformation of chromosomes in groups of meta- and submetacentric or acrocentric autosomes. Analysis of the phylogenetic links between the other karyotypes is mainly in line with the earlier conclusions of Savić and Soldatović (1979a, b).

Zusammenfassung

Chromosomenformen von Blindmäusen (Microspalax) aus Griechenland und der Türkei

Neu beschrieben werden die Karyogramme je einer Population von *Microspalax* aus Nordgriechenland und von der Insel Lesbos. Aus Griechenland und der Türkei sind damit insgesamt fünf Karyotyp-Formen bekannt: 2n = 52, NF = 86 (*Microspalax leucodon makedonicus*); 2n = 56, NF = 84 (*M. l. epiroticus*); 2n = 58, NF = 88 (*M. l. hellenicus*); 2n = 56, NF = 78 (*M. l. turcicus*); 2n = 38, NF = 78 (wahrscheinlich *M. nehringi anatolicus*). Der Karyotyp von Lesbos stimmt mit dem aus West-Kleinasien (Havran und Selçuk) überein.

Obwohl sich die Chromosomenzahlen zwischen europäischen und kleinasiatischen *Microspalax* stark unterscheiden, dürften die Karyotyp-Formen namentlich von *anatolicus* und *turcicus* verwandt sein. NF-Werte und Zahlen subakrozentrischer Chromosomen lassen nämlich vermuten, daß die Unterschiede durch Robertsonsche Fusionen bzw. Fissionen zustande gekommen sind.

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A note on the vocal behaviour of the Giant panda, *Ailuropoda melanoleuca* (David, 1869)

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Abstract

The vocal repertoire of adult giant pandas as observed in the pair living at the National Zoo, Washington, D.C., was studied with the help of sound spectrographic analysis. Vocal activity in the ♂ and the ♀ is nearly exclusively restricted to pro-oestrus and oestrus period of the ♀. The vocal repertoire of the species consists of several vocal forms, the ♀ exhibiting more vocal types than the ♂. Most of the vocalizations form a graded system with at least one other form in the repertoire, one

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