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Karyological characteristics, morphological peculiarities, and a new distribution locality for *Talpa davidiana* (Mammalia: Soricomorpha) in Turkey

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Abstract: *Talpa davidiana* is the least known species of the genus *Talpa*, and the karyotype of this species is still unknown. Its distribution records are also very scattered. The karyological, cranial, and pelvic characteristics of 2 samples from Kızıladağ in Adana Province were analyzed for the first time. It was determined that *T. davidiana* has $2n = 34$, $NF = 66$, and $NFa = 62$. The X chromosome was large and metacentric and the Y chromosome was dot-like acrocentric. The 2 samples are different from each other, and from previous *T. davidiana* records, in terms of their lower incisor and premolar numbers. Unique among the *T. davidiana* samples examined to date, 1 of the samples studied here had 2 premolars on the lower jaw half instead of 3. In contrast to the literature, 1 sample has a europeoidal pelvis, and the other has an intermediate form. *T. davidiana* has been recorded from 6 localities from the area between Hakkari and Gaziantep provinces in Turkey. The Kızıladağ high plateau of Adana was a new distribution locality and the most western for *T. davidiana*. The nearest known locality is Meydanakbes village, and it is almost 160 km away, as the bird flies, from Kızıladağ high plateau. The new distribution record from Kızıladağ high plateau implies that the mountain range between Tatvan and Adana may include some undiscovered samples.

Key words: *Talpa davidiana*, karyotype, distribution, dentition, pelvis

Introduction

Moles of the genus *Talpa* are represented by 4 species in Turkey: *Talpa europaea*, *T. levantis*, *T. caucasica*, and *T. davidiana* (Kryštufek and Vohralik, 2009). The karyotypes of the first 3 species were published previously; however, the karyotype of Père David's mole, *T. davidiana*, has been unknown since its identification from Meydanakbes on the Syrian border of Turkey (Kryštufek et al., 2001; Kryštufek and Vohralik, 2001; Gornung et al., 2008).

Talpa davidiana was first described by Milne-Edwards (1884) based on one specimen from

Meydanakbes, on the border between Syria and Turkey, under the name *Scaptochirus davidianus*. In 1965, Lay described a new mole from northwestern Iran as *Talpa streeti* (Lay, 1965). Spitzenberger (in Felten et al., 1973) stated that *Scaptochirus davidianus* is a member of the genus *Talpa* and should be regarded as a different species or given the oldest name, *Talpa streeti*. Later, Dođramacı (1989a) reported *T. streeti* from Hakkari in Eastern Turkey. Recently, Kryštufek et al. (2001) reevaluated specimens from Iran, Hakkari, Tatvan, and the type specimen from Meydanakbes and accepted all of them as *Talpa davidiana*. Kryštufek and Vohralik

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(2001, 2009) also stated that the above-mentioned localities belong to *T. davidiana*. Populations in Meydanakbes, Hakkari, and Bitlis are far apart from each other. Further localities in Iran (Kryštufek et al., 2001) are putatively isolated from the localities in Turkey. In addition to the known records, Benda and Obuch (2009) recently reported the first record of the genus *Talpa* based on *Tyto alba* pellets from Al Lathiqiyeh Province in western Syria and stated that for biogeographic reasons a right humerus in a pellet may belong to a Père David's mole.

T. davidiana is well defined by its robust rostrum, a feature best expressed by breadth across the canines among moles of the Western Palaearctic region. According to the dental formula, there are some differences among samples of *T. davidiana* from Hakkari, Meydanakbes, and Tatvan (Kryštufek et al., 2001). Hakkari specimens have 4.1.4.3–3.1.4.3 = 44, while Tatvan specimens have 3.1.3.3–2.1.3.3 = 38 and the Meydanakbes specimen (type) has 3.1.3.3–2/3.1.3.3 = 39 (as I.C.P.M-i.c.p.m) (Kryštufek et al., 2001).

The aim of this study was to provide the karyological characteristics of *T. davidiana* for the first time, hereby completing the karyological data on *Talpa* species in Turkey, and report a new distribution record from Turkey. In addition, we contribute to the

taxonomic data on Père David's mole in Turkey by presenting some cranial and pelvic measurements and differences in the lower incisors and premolars in 2 *T. davidiana* samples.

Materials and methods

The 2 mole specimens (1 male and 1 female) were collected from the Kızıldağ high plateau [(37°24'52.81"N, 35°2'13.12"E, 1575 m above sea level (a.s.l.)) in Adana Province on 24 June 2009 (Figure 1). Karyotypes were prepared from bone marrow according to Ford and Hamerton (1956). Skulls and skeletal parts were cleaned using 5% ammonia solution at 75–80 °C (Doğramacı, 1989b).

Weight and 3 linear measurements from the body were taken. In addition, 7 linear measurements from each skull (Table 1) and each pelvis (Table 2) were taken using a vernier caliper, accurate to the nearest 0.1 mm, and an ocular micrometer attached to a Nikon SMZ 1000 stereomicroscope. Abbreviations of these measurements are as follows: H&B: head and body length, TL: tail length, HL: hind foot length, W: weight, CbL: condylobasal length, MxT: maxillar tooth row, BcB: braincase breadth, BcH: braincase height, RoC: breadth of rostrum over canines, RoM: breadth of rostrum over molars, and LM: length of mandible. For pelvic measurements, the abbreviations

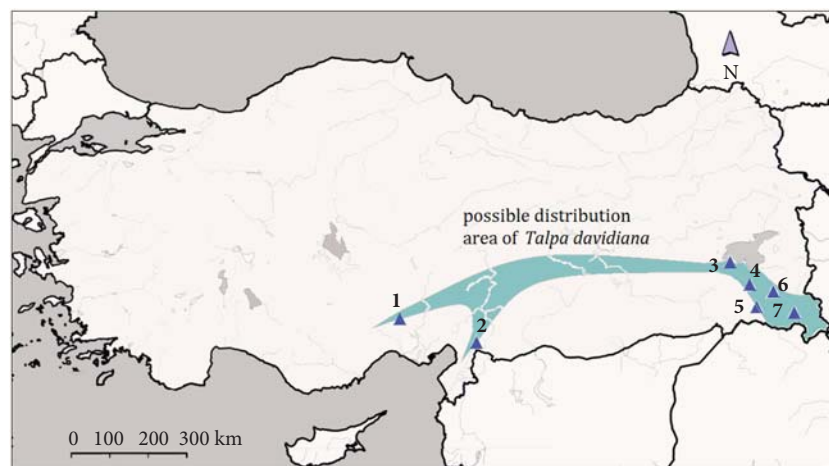


Figure 1. Distribution records of *T. davidiana*. 1: Kızıldağ high plateau; 2: Meydanakbes (type locality); 3: Tatvan; 4: Mergan zoma; 5: Hakkari mezralar; 6: Otluca; 7: Hakkari, Yüksekova. Localities 5, 6, and 7 from Doğramacı (1989a); 3 and 4 from Kryštufek et al. (2001). Turquoise area shows possible distribution and connection among distribution localities of *T. davidiana* in Turkey.

Karyological characteristics, morphological peculiarities, and a new distribution locality for *Talpa davidiana* (Mammalia: Soricomorpha) in Turkey

Table 1. External and cranial measurements of *T. davidiana* from Turkey. ID: 5647 and 5648, current study; OMU166, OMU232, FMNH96424, FMNH96421, FMNH82136, OMU167, OMU231, and MNHN1883-469, Kryštufek et al. (2001); FMNH96424, type *T. street*; and MNHN1883-469, type *S. davidianus*.

ID	Locality	Sex	H&B	TL	HL	W	CbL	MxT	BcB	BcH	RoC	RoM	LM
5647	Kızıldağ	♂	115	30	17	42	29.5	12.4	15	8.6	4.4	8.95	19.7
5648	Kızıldağ	♀	115	30	17	43	30.04	11.1	15.2	8.75	4.54	9.52	20.1
Doğramacı (1989b, n = 10)	Hakkari	♂/♀	134	30	20	78	31.4	14.6				10.2	21.6
OMU166	Hakkari	♂			21	76	32.4	12.5	16.3	8.80	5.6	10.7	21.6
OMU232	Hakkari	♀	134	30	20	79	32.9	13	16	9.50	5.2	9.8	22.2
FMNH96424	Iran	♂					32.6	12.6	16.4	9.50	4.9	9.6	22.2
FMNH96421	Iran	♂					32	12.8	16.7	8.80	5	10.1	21.4
FMNH82136	Tatvan	♀	128	18	18		29.9	11.3		8.60	4.5	8.9	19.7
OMU167	Tatvan	♀					29.2	10.8	15.3	9	4.8	9.7	19.9
OMU231	Hakkari	♂	130	29	20	80	32.1	12.3	16.6	9.40	5.3	9.9	21.5
MNHN1883-469	Meydanakbes	♂	120	20			28.3	10.6	14	8	4.4	8.1	

Table 2. Pelvis measurements of *T. davidiana*.

Province	ID	Sex	PL	PB	IL	IB	IscB	IscL	OL
Adana	5647	♂	21.87	7	10.46	7.15	9.14	-	5.85
Adana	5648	♀	22.89	6.99	10.68	7.29	9.84	6.1	5.98
Hakkari	Doğramacı (1989b) (n = 10, mean values)	♂/♀	24.1	6.9	12.50	8.6	11.90	8.6	7.5

are: ID: sample identity, PL: pelvis length, PB: pelvis breadth, IL: ileum length, IB: ileum breadth, IscL: ischium length, IscB: ischium breadth, and OL: obturator length. Abbreviations for dentition are: I: upper incisor, C: upper canine, P: upper premolar, M: upper molar, i: lower incisor, c: lower canine, p: lower premolar, and m: lower molar.

Karyotype preparations and the examined vouchers are deposited at the Department of Biology, Faculty of Arts and Sciences, Bülent Ecevit University in Zonguldak.

Results and discussion

Karyotype

Both specimens had a karyotype of $2n = 34$, $NF = 66$, and $NFa = 62$. The X chromosome was metacentric, and the Y chromosome was dot-like acrocentric. The autosomal set contained 15 pairs of meta-submetacentric and 1 pair of acrocentric chromosomes (Figure 2).

Although 2 species of the genus *Talpa*, *T. levantis* and *T. caucasica*, were karyotyped from Turkey

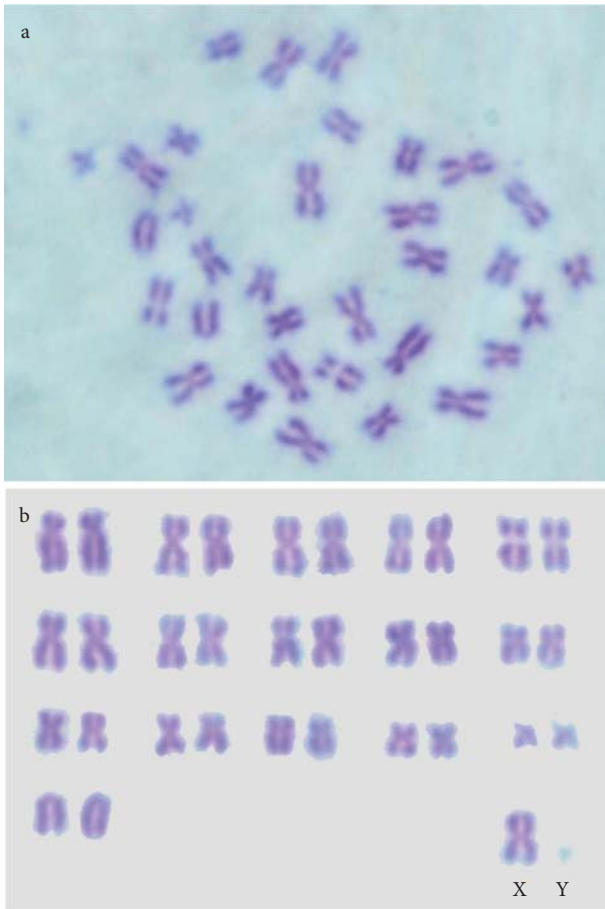


Figure 2. Karyotype of *T. davidiana* from Kızıldağ high plateau in Adana (Male: $2n = 34$, $NF = 66$).

(Kefelioğlu and Gençoğlu, 1996), the karyotype of *T. davidiana* has remained unknown since the identification of the species. Kefelioğlu and Gençoğlu (1996) stated that *T. levantis* has $2n = 34$ and $NFa = 64$, all bi-armed autosomal chromosomes, and a metacentric X chromosome; the Y chromosome was

the smallest and dot-like. *T. caucasica* has $2n = 38$ and $NFa = 62$; 11 pairs of autosomal chromosomes were meta-submeta-subtelocentric, and 5 pairs were acrocentric (Kefelioğlu and Gençoğlu, 1996). *T. europaea* from the Balkan Peninsula has a karyotype of $2n = 34$, $NF = 68$, and $NFa = 64$ (Todorovic et al., 1972; Gornung et al., 2008). Therefore, *T. davidiana* differs karyologically from *T. levantis*, *T. caucasica*, and *T. europaea*. As seen in Table 3, *Talpa europaea* and *T. levantis* do not have acrocentric autosomal chromosomes, while *T. caucasica* has 5 pairs, and *T. davidiana* has 1 pair. Furthermore, the diploid chromosome number of *T. caucasica* is $2n = 38$; in the other 3 species the number is $2n = 34$ (Table 3).

Morphology

Cranial and external measurements are given in Table 1. Skull and teeth drawings and photos are given in Figures 3, 4, and 5. Père David's moles from Kızıldağ and Meydanakbes (type locality of *Scaptochirus davidianus*) are smaller than those from other localities (Table 1). The smaller size may be due to the age of the samples from Kızıldağ. More samples are needed for a better and more meaningful comparison. Rostral breadth across molars is 28.6%–33.2% of the condylobasal length (30.5% on average) in *T. davidiana* and less than 28% in other mole species in Turkey (Kryštufek and Vohralik, 2001). This proportion is 30.33% and 31.69% in the 2 samples from Kızıldağ and, therefore, suitable for *T. davidiana*. Additionally, the rostral breadth across canines is 14.91% and 15.13% of the condylobasal length in the 2 samples from Kızıldağ (Table 1). These proportions are similar in the *T. davidiana* samples from Kryštufek et al. (2001). The locality nearest to Kızıldağ is Meydanakbes, and the measurements

Table 3. Karyological data of mole species in Turkey ($2n$: diploid chromosome number, NF : fundamental number, NFa : autosomal fundamental number, M : metacentric, d : dotlike, $biar.$: biarmed, $acro.$: acrocentric).

Species	$2n$	NF	NFa	Sex chr.		Autosomes		Reference
				X	Y	biar.	acro.	
<i>Talpa europaea</i>	34	68	64	M	d	16	-	Todorovic et al., 1972
<i>T. levantis</i>	34	68	64	M	d	16	-	Kefelioğlu and Gençoğlu, 1996
<i>T. caucasica</i>	38	66	62	M	d	11	5	Kefelioğlu and Gençoğlu, 1996
<i>T. davidiana</i>	34	68	64	M	d	15	1	Current study

of samples from Kızıldağ are more similar to those of the type specimen from Meydanakbes. Consequently, morphological peculiarities of the specimens from Kızıldağ are suitable for *T. davidiana*. The measurements in mole samples from the east (Hakkari and Tatvan) are larger. Animals seem to be getting smaller from east to west. However, it is not correct to speculate on geographic trends using only a few samples.

Dentition

Several living members of the family Talpidae possess the primitive eutherian dental complement of 3 incisors, 1 canine, 4 premolars, and 3 molars in

each jaw quadrant (Ziegler, 1971). Ziegler (1971) showed various combinations of reduced and lost teeth over the wide geographic range of the genus *Talpa*. The number of teeth in the 2 samples from Kızıldağ and samples recorded by previous researchers are given in Table 3. Although both animals in the current study were taken from the same area in Kızıldağ, their dental patterns were different. Sample 5647 ♂ had 3.1.3.3 (i.c.p.m.m) in the lower left side, 2.1.3.3 in the lower right side, and 3.1.3.3 in both upper sides (Figures 3–5). The total number of teeth was 39 as in the holotype. However, sample 5648 ♀ had 3.1.2.3 in both lower sides and 3.1.3.3 in both upper sides. In this sample, the total

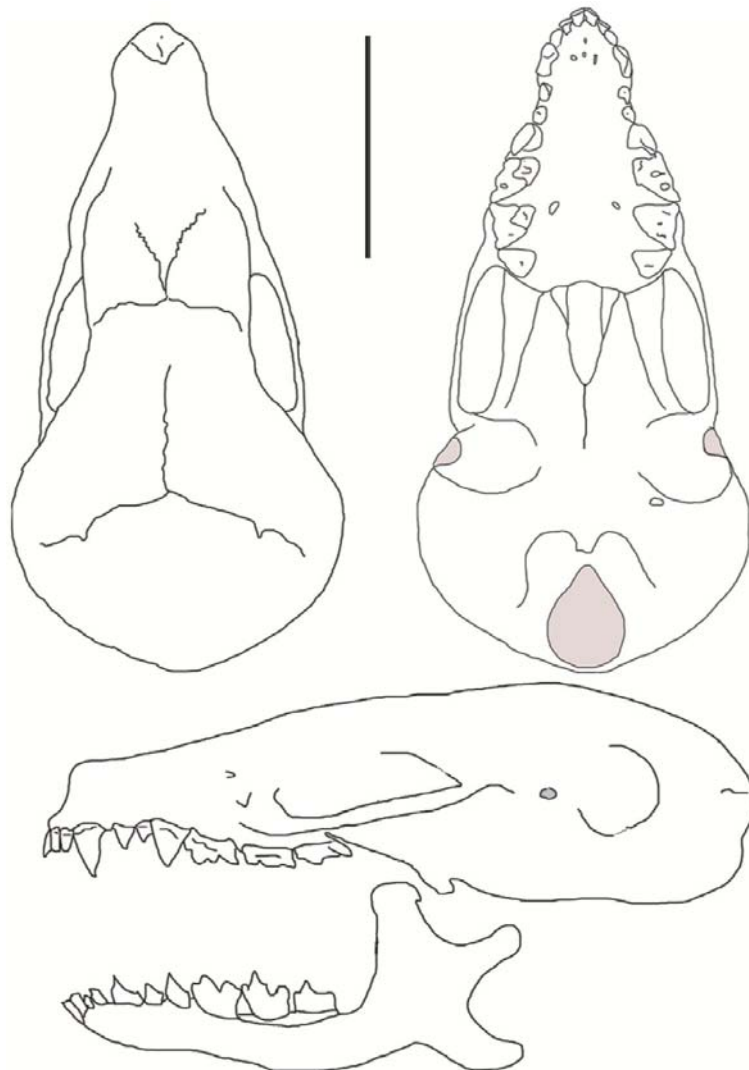


Figure 3. Skull of *T. davidiana*. Dorsal, ventral, and lateral view (5647 ♂). Scale bar = 1 cm.

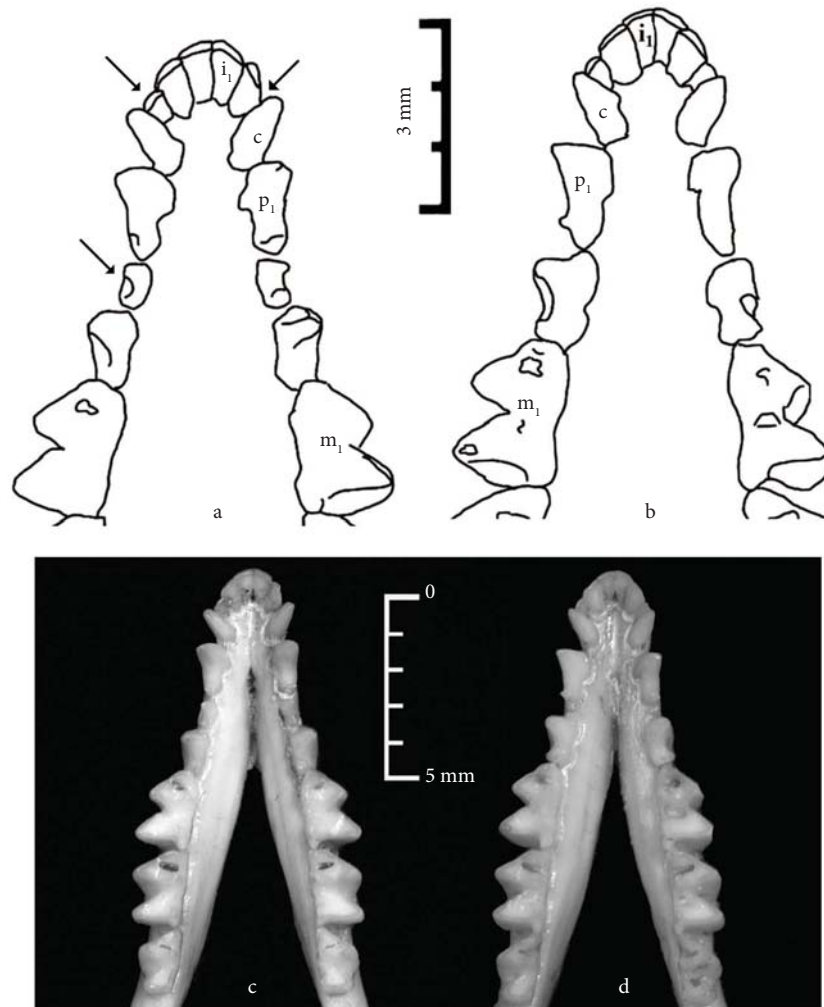


Figure 4. Teeth on lower jaw. a,c: 5647 ♂; b,d: 5648 ♀.

number of teeth was 38. This sample was the only *T. davidiana* individual recorded to date that had only 2 premolars in the lower jaw sides (Table 3; Figures 3, 4). Body and skull measurements in samples from the east (Hakkari and Iran) and the west (Tatvan, Meydanakbes, and Kızıldağ) differed; they also have different teeth patterns (Figure 4; Table 3). Kryštufek et al. (2001) evaluated the small number of teeth, 38 in *T. davidiana* from Tatvan (Table 4), noting that it may just be a case of extreme oligodonty and a byproduct of size reduction in marginal populations of *T. davidiana*. A similar situation was also the case for specimens from Kızıldağ with 38 and 39 molars and small body size (Table 1; Figures 3, 4).

Pelvis

Pelvic measurements are given in Table 2, and the shapes of the pelvises in the 2 samples examined are given in Figure 6. In Turkish moles, hip bone shape conforms to the europeoidal morphotype in *T. europaea* and caecoidal morphotype in *T. levantis*, *T. caucasica*, and *T. davidiana* (Doğramacı, 1989b; Kryštufek and Vohralik, 2001; Kryštufek et al., 2001). However, 1 pelvis examined from Kızıldağ conformed to the europeoidal morphotype and 1 seemed to be an intermediate form when compared to the pelvis form reported by Doğramacı (1989b), Kryštufek and Vohralik (2001), and Kryštufek et al. (2001), who examined mole samples from Hakkari and Iran. Therefore, pelvis shape in samples from

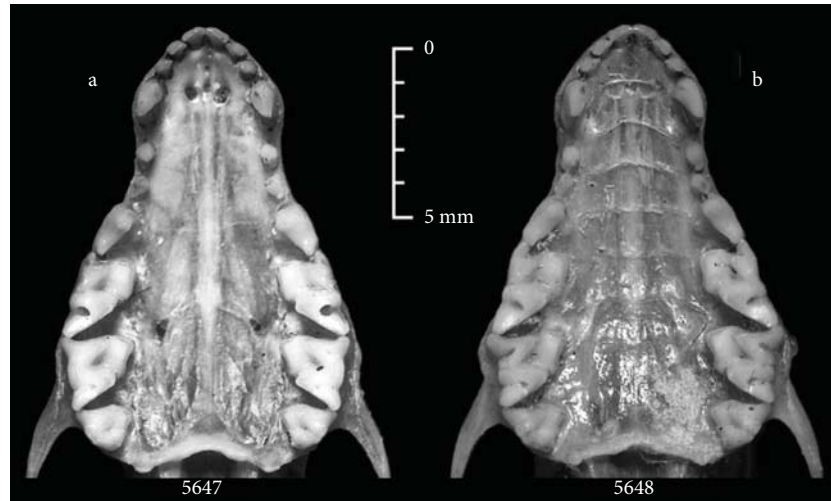


Figure 5. Teeth on upper jaw. a: 5647 ♂, b: 5648 ♀.

Table 4. Variation in the number teeth in *T. davidiana* samples from Turkey and Iran. (N): sample size.

Locality	Reference	(N)	I	C	P	M	i	c	p	m	Total
5647 ♂ (Kızıldağ)	Current study	(1)	3	1	3	3	2/3	1	3	3	39
5648 ♀ (Kızıldağ)	Current study	(1)	3	1	3	3	3	1	2	3	38
Iran, Ghilan, 12 km W Chalus	Kryštufek et al. (2001)	(4)	3	1	4	3	3	1	4	3	44
Hakkari	Kryštufek et al. (2001)	(5)	3	1	4	3	3	1	4	3	44
Tatvan	Kryštufek et al. (2001)	(3)	3	1	3	3	2	1	3	3	38
Meydanakbes	Kryštufek et al. (2001)	(1)	3	1	3	3	2/3	1	3	3	39
Typical number for the genus <i>Talpa</i>	Kryštufek et al. (2001)		3	1	4	3	3	1	4	3	44

Meydanakbes and Kızıldağ may be different just as the teeth patterns are different. On the other hand, pelvis measurements of the Kızıldağ samples are smaller than the measurements of *T. davidiana* samples reported from Hakkari by Doğramacı (1989b). Just like body and cranium measurements, pelvis measurements of the Kızıldağ samples are smaller than the pelvis measurements of Hakkari samples (Table 2).

Distribution

The possible distribution area of *T. davidiana* in Turkey was mapped in Figure 1.

The 2 samples (1 male and 1 female) were collected from a garden between houses in the Kızıldağ high

plateau of Adana Province (Figure 1). The collection distance between the 2 samples was about 40 m.

All records of *T. davidiana* from Iran, Hakkari, and Tatvan were from high altitudes over 1000 m, mostly around 2000 m a.s.l. However the altitude of Meydanakbes is only about 400 m a.s.l., and the habitat seemed unsuitable for *T. davidiana* (Kryštufek et al., 2001). For this reason Kryštufek et al. (2001) argue that the type specimen should be from high altitudes in the east or in the north of Meydanakbes. Kryštufek et al. (2001) speculated that the suitable areas around Meydanakbes were Bozdağ (ca. 90 km distant) and Engizek Mountain (ca. 80 km distant). The altitude of Kızıldağ is 1575 m a.s.l. When we checked similar altitudes around Meydanakbes we found that the peaks of the Amanos Mountains, located ca. 20 km

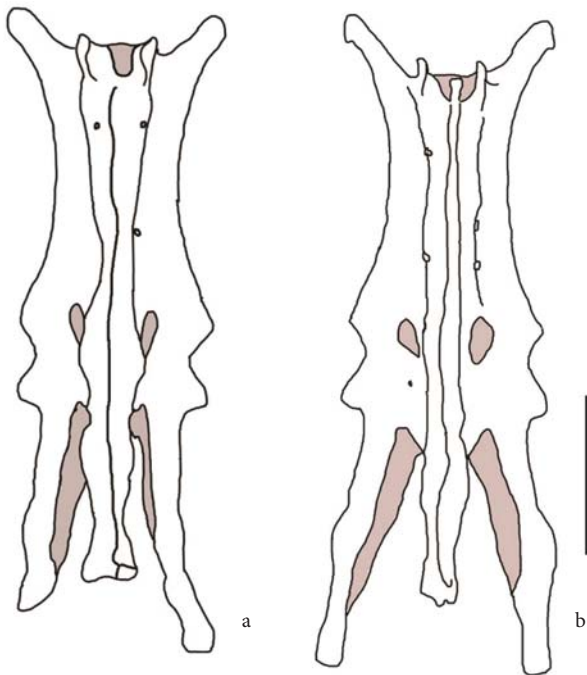


Figure 6. Pelvis of *T. davidiana* from Kızıldağ high plateau, Adana. a: 5647 ♂, intermediate morphotype; b: 5648 ♀, europeoidal morphotype. Scale bar = 5 mm.

west of Meydanakbes, are about 2000 m a.s.l. and possibly suitable for *T. davidiana*. Recently, Benda and Obuch (2009) recorded a humerus from a *Talpa* specimen in a fresh *Tyto alba* pellet from western Syria. This specimen was considered *T. davidiana* for biogeographic reasons. The altitude of the pellet collection site was ca. 370 m a.s.l.

The altitudes of records and habitat type of *T. davidiana* imply that a high altitude corridor on the mountains between Tatvan and the Kızıldağ area may be a way to elucidate the distribution pattern (Figure 1). The mountain range forming the boundary between East and Southeast Anatolia may include undiscovered subpopulations of *T. davidiana*, and research should be focused on this area. West and south of the Kızıldağ high plateau, and given the results of Benda and Obuch (2009), south of the type locality may also contain such subpopulations.

This study presents important contributions in the areas of karyology, morphology, and distribution of *T. davidiana* and suggests the necessity of further studies in new areas within the species distribution range.

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