

## Moles (Insectivora, Talpidae, Talpinae) of Vietnam

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**Abstract** Field surveys were conducted in Tam Dao National Park (Vinh Phuc Province), Sa Pa (Lao Cai Province) and Nguyen Binh District (Cao Bang Province) in northern Vietnam, and Dong Giang District (Quang Nam Province) and Chu Yang Sin National Park (Dak Lak Province) in mid- to southern Vietnam. Three species of talpine moles (*Euroscaptor longirostris*, *E. parvidens* and *Mogera latouchei*) belonging two genera were collected in the field surveys. The genus *Mogera* was recorded for the first time in Vietnam. Although the morphological characters of Vietnamese *E. longirostris* and *M. latouchei* are not identical to those of Chinese populations, determining whether the differences were caused by geographic variation is difficult. These species are allopatrically distributed in northern (*E. longirostris* and *M. latouchei*) and southern Vietnam (*E. parvidens*). In northern Vietnam, *E. longirostris* and *M. latouchei* were collected in Sa Pa and Nguyen Binh, and had nearly peripatric distributions by high and low elevations. In previous studies, *E. klossi* was collected in Sa Pa, but examination of voucher specimens preserved in the Natural History Museum (London) suggest that those specimens were misidentified two species in distinct genera (*E. longirostris* and *M. latouchei*), matching our field collections in Sa Pa. We conclude that three species of talpine moles occur in Vietnam. Brief species descriptions are given in this paper.

**Key words:** *Euroscaptor*, *Mogera*, field survey, morphological examination

### Introduction

Four genera of moles (*Euroscaptor*, *Mogera*, *Parascaptor* and *Scaptochirus*) are found in East Asia (Kawada, 2005) and they are distinguished by their dental formula according to Dobson (1883). The genera *Euroscaptor* and *Mogera* are distributed in subtropical Asian countries. The genus *Euroscaptor* is identified by the dental formula I3/3, C1/1, P4/4, M3/3=44, which is the same as the European genus *Talpa*. Miller (1940a) described genus *Euroscaptor* as distinct from *Talpa* because of the shape of the penis, and this view is supported by the morphology of auditory ossicles (Stroganov, 1945), molecular phylogenetic data (Shinohara *et al.*, 2004) and karyology (Kawada *et al.*, 2002, 2005). The genus *Euroscaptor* included six species in a previous taxo-

nomic review (*E. grandis*, *E. klossi*, *E. longirostris*, *E. micrura*, *E. mizura* and *E. parvidens*; Hutterer, 2005). Recently, Kawada *et al.* (2008) separated the Malaysian mole *E. malayana* from *E. klossi*. Genus *Euroscaptor* was recorded in China, Thailand, Nepal, Vietnam and Japan between 1880 and 1940, but morphological distinctions and variation within the species have not been documented, outside of Yoshiyuki (1988) and Kawada *et al.* (2008). The species-level taxonomy needs to be re-evaluated, as well.

The genus *Mogera* has been well studied on the Japanese Islands (Imaizumi, 1960; Abe, 1967; Yokohata, 2005). This genus is characterized by a dental formula of I3/2, C1/1, P4/4, M3/3=42 and includes at least five species, *M. imaizumii*, *M. insularis*, *M. tokudae*, *M. uchidai* and *M. wogura*. Based on karyological data,

these species should be split, and *M. etigo* and *M. robusta* are considered distinct species. *Mogera insularis* is the only species distributed in a subtropical region, including Taiwan, Hainan Island (Isl.) and Southwestern China, and includes three possible subspecies, *M. i. hainana* (Hainan Isl.), *M. i. insularis* (Taiwan) and *M. i. latouchei* (S.W. China) (Hutterer, 2005). Taxonomic treatments of these subspecies are controversial; for example, Stroganov (1948) treated *M. latouchei* as a full species. The second Taiwanese species, *Mogera kanoana*, was recorded in southeastern Taiwan and has morphological characters more similar to *M. latouchei* than to the Taiwanese *M. insularis* (Kawada *et al.*, 2007). Based on morphological data, Kawada *et al.* (2007) suggested that *M. latouchei* was distinct from Taiwanese moles.

The distribution of moles in Vietnam was first reported by Osgood (1932) based on specimens collected by the Jean Delacour expedition in Sa Pa (previously called Chapa), in the Lao Cai Province of northern Vietnam. These specimens were identified as Kloss's mole, *Talpa klossi*. Subsequently, Miller (1940a) established the new genus *Euroscaptor*, with the type species as *Talpa klossi*, and described the small toothed mole *Euroscaptor parvidens* from the Donai River basin (currently the Dong Nai River basin) in Blao (currently Bao Loc) in southern Vietnam (Miller, 1940b).

In western Vietnam, the Annamese Mountains stretch from north to south, and are connected to the mountainous zone of Yunnan Province in China and to Laos in the north. This subtropical alpine region represents a possible distribution range for moles, but almost no biological information about Vietnamese moles has been published.

In northern Vietnam, some insectivorous mammals have been collected (Lunde *et al.*, 2004, 2007), but mole species were not examined. To thoroughly evaluate the small mammal fauna in Vietnam, it is also important to collect mole specimens. For this purpose, we surveyed the moles in Vietnam. We compared the morpho-

logical characters of our samples with museum specimens. Here, we report the results of our field surveys and discuss species identification of Vietnamese moles.

## Materials and Methods

### Field surveys

We conducted five field surveys in northern Vietnam and two field surveys in mid- to southern Vietnam (Fig. 1). Sa Pa, Lao Cai Province, is located near the Chinese border, 350 km north of Hanoi City. In Sa Pa, we set 20 traps in two different localities: trails to Phan Si Pang peak in Hoang Lien National Park (about 2000 m above

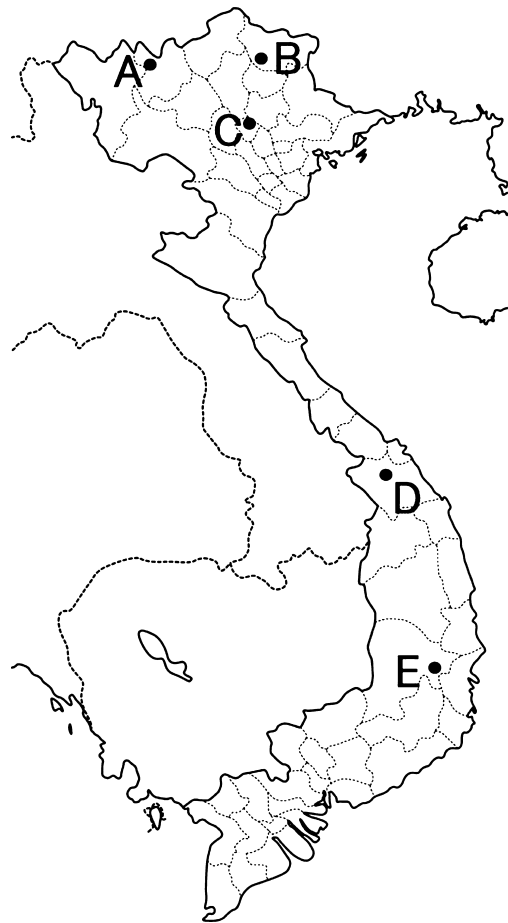


Fig. 1. Localities of field surveys conducted in this study. A, Sa Pa; B, Nguyen Binh; C, Tam Dao; D, Dong Giang; E, Chu Yang Sin.

sea level), and farms on the southern slope of Sa Pa township (about 1400 m above sea level). We trapped from 17 to 19 and from 19 to 22 November 2005 at the first and second sites, respectively. Nguyen Binh, Cao Bang Province, is a relatively dry environment. We found mole tunnels at 600 to 1000 m above sea level and set 20 traps. Farmland was present to 800 m above sea level at this site. Tam Dao National Park, Vinh Phuc Province, is about 80 km north of Hanoi City (about 950 m above sea level). In Tam Dao National Park, many chayote farms surround the town. We set 25 mole traps in these farms from 7 to 11 September 2004. In Chu Yang Sin National Park, Dak Lak Province (about 400 m above sea level), we set 5 mole traps in the secondary forest from 20 to 26 March 2005, and 20 mole traps from 23 to 27 November 2006. In the Dong Giang area, Quang Nam Province (about 450 m above sea level), we set 30 mole traps along the trail to Azinh Village.

Obtained specimens were measured, photographed and sacrificed. Tissues for chromosomal and molecular studies were preserved in Aminio Max II medium and 70% ethanol, respectively. Specimens were deposited in the Department of Vertebrate Zoology, Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, as stuffed skins, skulls and fluid bodies.

#### **Methods of specimen examination**

Museum specimens were examined for a comparison of morphological characters. Two mole specimens from Sa Pa identified as *Talpa (Euroscaptor) klossi* by Osgood (1932) were deposited in the Natural History Museum, London. Comparative specimens from Indochinese countries were observed in the Smithsonian Natural History Museum, Washington, D.C. (USNM), the American Museum of Natural History, New York (AMNH), the Natural History Museum, London (BM), Le Musee National d'Historire Naturelle, Paris (MNHN) and the National Museum of Nature and Science, Tokyo (previously the National Science Museum, Tokyo; NSMT-M).

The external and skeletal morphology of 48 mole specimens from East Asia were compared with specimens obtained from the above-mentioned field surveys and those in the senior author's personal collection (SIK).

Genus was first determined by counting tooth number. External measurements were recorded as follows: head and body length (HB), tail length (T), fore foot length (FFL), fore foot width (FFW) and hind foot length (HF). For male specimens, short and long diameters of the testis were also recorded. The tail ratio (TR) was calculated as the T to HB. Additionally, two skull measurements (palatal width and length of the upper molar row) were taken from all specimens and used in a comparison of relative measurements to skull size (greatest length of the skull).

## **Results and Discussion**

### ***Field survey results and morphological characters of specimens***

We collected 47 mole specimens during the field surveys from 2004 to 2006 in Tam Dao, Sa Pa, Nguyen Binh, Chu Yang Sin and Dong Giang. External measurements of these specimens are shown in Table 1.

The specimens from Tam Dao (SIK0774–0789), Sa Pa (SIK0820–0822), Nguyen Binh (SIK0865–0868), Chu Yang Sin (SIK0852–0854) and Dong Giang (SIK0850, 0851, 0855–0864) had a dental formula of I3/3, C1/1, P4/4, M3/3=44 (Fig. 2a), characteristic of the genus *Euroscaptor*. These moles were slightly larger than nine other specimens from Sa Pa and Nguyen Binh (Table 1).

Three moles from Sa Pa (SIK0823–0825) and six moles from Nguyen Binh (SIK0869–0874) had a dental formula of I3/2, C1/1, P4/4, M3/3=42 (Fig. 2b), and are thus considered members of the genus *Mogera*. These two genera, *Euroscaptor* and *Mogera*, occurred in the high-elevation mountainous region and the lowland farmland near the township, respectively, in Sa Pa and Nguyen Binh. Among the species of *Mogera*, only *M. latouchi* is known to be distrib-

Table 1. Specimens' data of collected moles. BW; body weight (g), H&B; head and body length (mm), T; tail length (mm), FFL; fore foot length without claw (mm), FFB; fore foot breadth (mm), HF; hind foot length without claw (mm), HF; hind foot length without claw (mm), Testis; long×short diameters of testis (mm). Tail ratio (%) was calculated as T/HB×100.

No.	Species name	Sex	Date	Locality	Measurements									
					BW	H&B	T	FFL	FFB	HF	Testis	Tail ratio		
SIK0774	<i>Euroscaptor longirostris</i>	♂	7 Sep. 2004	Tam Dao National Park, Vinh Phuc	62.00	123.0	15.5	17.5	16.5	16.0	11.50×6.90	12.60		
SIK0775	<i>Euroscaptor longirostris</i>	♂	8 Sep. 2004	Tam Dao National Park, Vinh Phuc	62.00	120.5	14.5	16.5	16.5	15.5	6.85×4.90	12.03		
SIK0776	<i>Euroscaptor longirostris</i>	♀	9 Sep. 2004	Tam Dao National Park, Vinh Phuc	51.70	119.0	14.0	15.0	14.5	14.5		11.76		
SIK0777	<i>Euroscaptor longirostris</i>	♂	9 Sep. 2004	Tam Dao National Park, Vinh Phuc	61.80	127.5	16.5	17.0	17.0	16.5	3.05×2.60	12.94		
SIK0778	<i>Euroscaptor longirostris</i>	♂	9 Sep. 2004	Tam Dao National Park, Vinh Phuc	76.70	125.5	15.0	16.5	16.0	16.0	11.40×6.90	11.95		
SIK0779	<i>Euroscaptor longirostris</i>	♂	9 Sep. 2004	Tam Dao National Park, Vinh Phuc	76.20	127.5	15.0	17.0	16.5	16.0	10.85×7.10	11.76		
SIK0780	<i>Euroscaptor longirostris</i>	♂	9 Sep. 2004	Tam Dao National Park, Vinh Phuc	55.50	121.0	14.0	16.5	16.0	15.0	4.00×2.35	11.57		
SIK0781	<i>Euroscaptor longirostris</i>	♂	10 Sep. 2004	Tam Dao National Park, Vinh Phuc	54.50	121.0	15.0	17.0	16.5	15.5	3.20×2.50	12.40		
SIK0782	<i>Euroscaptor longirostris</i>	♂	10 Sep. 2004	Tam Dao National Park, Vinh Phuc	62.10	123.0	15.5	17.0	17.0	15.5	3.90×2.70	12.60		
SIK0783	<i>Euroscaptor longirostris</i>	♂	10 Sep. 2004	Tam Dao National Park, Vinh Phuc	66.00	124.0	17.0	16.0	15.5	16.0	3.85×2.50	13.71		
SIK0784	<i>Euroscaptor longirostris</i>	♂	10 Sep. 2004	Tam Dao National Park, Vinh Phuc	76.20	126.5	14.5	17.0	16.5	16.0	11.60×6.50	11.46		
SIK0785	<i>Euroscaptor longirostris</i>	♂	10 Sep. 2004	Tam Dao National Park, Vinh Phuc	59.60	123.0	15.0	15.5	15.0	15.0	9.35×6.20	12.20		
SIK0786	<i>Euroscaptor longirostris</i>	♂	10 Sep. 2004	Tam Dao National Park, Vinh Phuc	52.20	120.0	14.5	15.5	15.5	16.0	9.60×5.70	12.08		
SIK0787	<i>Euroscaptor longirostris</i>	♂	11 Sep. 2004	Tam Dao National Park, Vinh Phuc	53.40	126.0	16.0	16.0	16.0	15.5	4.20×2.40	12.70		
SIK0788	<i>Euroscaptor longirostris</i>	♂	11 Sep. 2004	Tam Dao National Park, Vinh Phuc	69.30	124.0	16.5	16.0	16.0	15.5	11.85×6.50	13.31		
SIK0789	<i>Euroscaptor longirostris</i>	♂	6 Sep. 2004	Tam Dao National Park, Vinh Phuc	58.70	125.5	14.5	16.5	16.0	15.5	2.15×2.05	11.55		
SIK0820	<i>Euroscaptor longirostris</i>	♀	17 Nov. 2005	Hoan Lien NP, Sa Pa, Lao Cai	48.30	119.5	15.0	16.5	16.5	15.5		12.55		
SIK0821	<i>Euroscaptor longirostris</i>	♂	18 Nov. 2005	Hoan Lien NP, Sa Pa, Lao Cai	47.40		17.5	16.0	16.5	15.5	4.9×2.9			
SIK0822	<i>Euroscaptor longirostris</i>	♀	19 Nov. 2005	Hoan Lien NP, Sa Pa, Lao Cai	25.80	106.0	16.0	15.0	14.5	15.5		15.09		
SIK0865	<i>Euroscaptor longirostris</i>	♂	18 Dec. 2006	Nguyen Binhh Dist., Cao Bang	44.20	125.0	17.0	15.0	15.5	15.0	3.10×2.20	13.60		
SIK0866	<i>Euroscaptor longirostris</i>	♀	18 Dec. 2006	Nguyen Binhh Dist., Cao Bang	42.30	117.0	17.0	15.0	15.5	15.5		14.53		
SIK0867	<i>Euroscaptor longirostris</i>		18 Dec. 2006	Nguyen Binhh Dist., Cao Bang										
SIK0868	<i>Euroscaptor longirostris</i>		18 Dec. 2006	Nguyen Binhh Dist., Cao Bang										
SIK0850	<i>Euroscaptor parvidens</i>	♀	27 Nov. 2006	Dong Giang, Quang Nam	31.20			13.5	13.0					
SIK0851	<i>Euroscaptor parvidens</i>	♂	27 Nov. 2006	Dong Giang, Quang Nam	59.40	140.0	6.0	15.5	15.0	14.5	12.45×8.00	4.29		
SIK0852	<i>Euroscaptor parvidens</i>	♀	26 Nov. 2006	Chu Yang Sin National Park, Dak Lak	60.00	132.7	7.8			15.0		5.88		
SIK0853	<i>Euroscaptor parvidens</i>	♂	27 Nov. 2006	Chu Yang Sin National Park, Dak Lak	58.00	124.2	7.0			14.9		5.64		
SIK0854	<i>Euroscaptor parvidens</i>	♂	27 Nov. 2006	Chu Yang Sin National Park, Dak Lak	47.00	138.5	6.5	15.0	16.5	15.5	7.40×5.75	4.69		
SIK0855	<i>Euroscaptor parvidens</i>	♀	30 Nov. 2006	Dong Giang, Quang Nam	51.20	137.0	7.0	14.5	15.0	13.5		5.11		
SIK0856	<i>Euroscaptor parvidens</i>	♂	30 Nov. 2006	Dong Giang, Quang Nam	63.50	142.0	6.5	15.0	15.5	14.5	13.80×7.50	4.58		
SIK0857	<i>Euroscaptor parvidens</i>	♂	30 Nov. 2006	Dong Giang, Quang Nam	54.90	139.0	7.0	15.5	15.0	15.0	13.00×7.90	5.04		
SIK0858	<i>Euroscaptor parvidens</i>	♂	1 Dec. 2006	Dong Giang, Quang Nam	53.00	136.5	6.0	16.0	15.5	15.0	13.45×7.65	4.40		
SIK0859	<i>Euroscaptor parvidens</i>	♀	1 Dec. 2006	Dong Giang, Quang Nam	50.20	133.5	8.0	15.5	15.0	14.0		5.99		
SIK0860	<i>Euroscaptor parvidens</i>	♀	1 Dec. 2006	Dong Giang, Quang Nam	37.30	129.5	5.5	15.0	15.0	14.0		4.25		
SIK0861	<i>Euroscaptor parvidens</i>	♂	1 Dec. 2006	Dong Giang, Quang Nam	57.70	137.5	9.0	16.5	16.5	15.5	14.50×7.70	6.55		

Table 1. Continued.

No.	Species name	Sex	Date	Locality	Measurements								
					BW	H&B	T	FFL	FFB	HF	Testis	Tail ratio	
SIK0862	<i>Euroscaptor parvidens</i>	♀	1 Dec. 2006	Dong Giang, Quang Nam	55.60	134.5	8.0	14.5	15.0	14.5			5.95
SIK0863	<i>Euroscaptor parvidens</i>	♂	29 Nov. 2006	Dong Giang, Quang Nam									
SIK0864	<i>Euroscaptor parvidens</i>	♂	29 Nov. 2006	Dong Giang, Quang Nam									
SIK0823	<i>Mogera latouchei</i>	♀	20 Nov. 2005	Town of Sa Pa, Lao Cai	48.50	115.0	15.0	14.5	15.0	14.5			13.04
SIK0824	<i>Mogera latouchei</i>	♂	21 Nov. 2005	Town of Sa Pa, Lao Cai	47.10	109.5	15.5	16.0	16.0	14.5		6.0×4.0	14.16
SIK0825	<i>Mogera latouchei</i>	♂	21 Nov. 2005	Town of Sa Pa, Lao Cai	49.20		15.0	15.5	16.0	14.0		5.4×3.4	
SIK0869	<i>Mogera latouchei</i>		23 Dec. 2006	Nguyen Binhh Dist., Cao Bang									
SIK0870	<i>Mogera latouchei</i>	♂	24 Dec. 2006	Nguyen Binhh Dist., Cao Bang	51.80	114.0	14.5	15.5	15.5	15.5		9.10×6.75	12.72
SIK0871	<i>Mogera latouchei</i>	♂	24 Dec. 2006	Nguyen Binhh Dist., Cao Bang	43.80	114.0	14.0	15.0	15.0	15.0		8.80×5.00	12.28
SIK0872	<i>Mogera latouchei</i>	♂	24 Dec. 2006	Nguyen Binhh Dist., Cao Bang	43.50	115.0	12.0	14.5	15.0	13.5		7.30×4.90	10.43
SIK0873	<i>Mogera latouchei</i>	♀	25 Dec. 2006	Nguyen Binhh Dist., Cao Bang	38.10	107.0	13.5	14.5	14.5	14.0			12.62
SIK0874	<i>Mogera latouchei</i>	♀	25 Dec. 2006	Nguyen Binhh Dist., Cao Bang	33.00	103.0	13.0	14.0	13.5	14.0			12.62



Fig. 2. Labial views of the lower tooth rows of *E. longirostris* (SIK0821) (a) and *M. latouchei* (SIK0825) (b) collected in Sa Pa. The arrow indicates the lower third incisor of *Euroscaptor*. Note that the lower canine of talpine moles is a small incisor-like tooth.

uted in southwestern China. Vietnamese *Mogera* had blackish fur (Fig. 3a), a relatively short snout with a rectangular furless portion on the ventral side (Fig. 3b) and a rod-shaped long tail (Fig. 3c). The skull was slender in the rostral region. The opening of the auditory bulla was long, wide and oval. These characters coincide with those of *M. latouchei*; however, a comparison to Chinese *M. latouchei* showed that Vietnamese individuals were larger and had a more robust skull. Therefore, *Mogera* moles from Sa Pa and Nguyen Binh were tentatively identified as *M. latouchei*.

The species of *Euroscaptor* was rather difficult to identify because of the taxonomic confusion of this genus in East Asia. The fur of *Euroscaptor* moles from Tam Dao and Nguyen Binh was dark brown (Fig. 4a); in contrast, all moles from Sa Pa had slate black fur with dorsal white spots (Fig. 4b). The fur was denser in the moles from Sa Pa than in those from Tam Dao and Nguyen Binh. The nostris was slender and tapered in the rhinarium (Fig. 4c). The tail was long and club-shaped (Fig. 4d), though slightly shorter in specimens from Sa Pa (Fig. 4e). We concluded that these differences among populations reflect local variation.



Fig. 3. External morphology of *M. latouchei* from Sa Pa (SIK0823). a, Dorsal view of the body; b, dorsal view of the nostris; c, dorsal view of the tail.

Southern Vietnamese *Euroscaptor* (from Dong Giang and Chu Yang Sin) had more brownish fur (Fig. 5a). These specimens appeared unusual in that the head and body length was very long compared to body weight, fore foot length and hind foot length (Table 1). The tail was much shorter than in northern Vietnamese *Euroscaptor* moles, and the pubic region was greatly enlarged posteriorly (arrow in Fig. 5a, b). The rhinarium was rounded in the dorsal view (Fig. 5c) and the snout was slender with many small protuberances, corresponding to the positions of the vibrissae (Fig. 5d). From a dorsal view, most of the tail vertebrae were inside of the hip (Fig. 5d), and only tail hair could be seen outside. The tail ratios of these northern and southern *Euroscaptor*

moles were 10–13% and 4–6%, respectively (Table 1). Thus, northern and southern moles can be clearly differentiated based on external morphology.

A two-dimensional plot of the upper molar row to the greatest length of the skull of *Euroscaptor* museum specimens and from the collected samples is shown in Fig. 6. Skull length in *Euroscaptor* ranged from 27 to 37 mm and the length of upper molar row of most specimens showed a linear relationship with skull length. Most specimens that deviated from the pattern had skulls 32–35 mm in length and a relatively short molar length. This group included some specimens from the type locality of *E. longirostris* and the holotype of *E. parvidens*

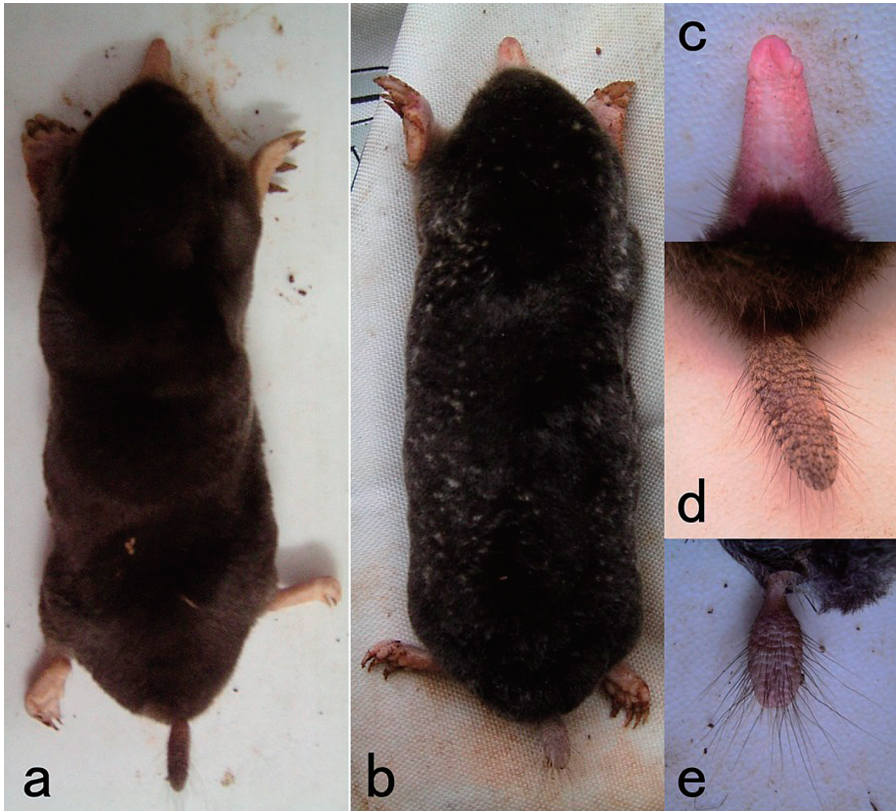


Fig. 4. External morphology of *E. longirostris*. a, Dorsal view of a specimen from Tam Dao (SIK0786); b, dorsal view of a specimen from Sa Pa (SIK0820), with white spots on the back; c, dorsal view of the nostris (SIK0822); d, dorsal view of the tail of a specimen from Cao Bang (SIK0865); e, dorsal view of the tail of a specimen from Sa Pa (SIK0822).

(USNM258342). All specimens from Vietnam collected in the present field surveys were also members of this group. Here, we call this short molar type the “*longirostris*-type”, which includes all Vietnamese mole specimens, and another type (including *E. grandis*, *E. klossi*, *E. malayana*, *E. micrura* and *E. mizura*) the “*klossi*-type”.

The lower premolar row was also a good diagnostic character with which to distinguish between these two groups. The tips of the lower second to fourth premolars are arranged linearly in the *longirostris*-type; thus, the second premolar was clearly smaller than the third (Fig. 7a). In contrast, the second and third lower premolars of the *klossi*-type were almost identical in height and the fourth premolar was much taller (Fig.

7b).

The skull of the *longirostris*-type has a slender rostrum. This character is quite typical in *E. longirostris* from the type locality in China. The skulls of moles from northern Vietnam were slender but the outline of the palatal region was gently curved at the position of the fourth premolar. The relationship between the greatest length of the skull and palatal length is shown in Fig. 8. The northern Vietnamese *Euroscaptor* had larger skulls but fell on an extension of the clinal line of Chinese *E. longirostris*. In the examination of northern Vietnamese *Euroscaptor* based on these characters, all specimens were considered *E. longirostris*.

The upper molar row of southern Vietnamese *Euroscaptor* was shorter than that of northern

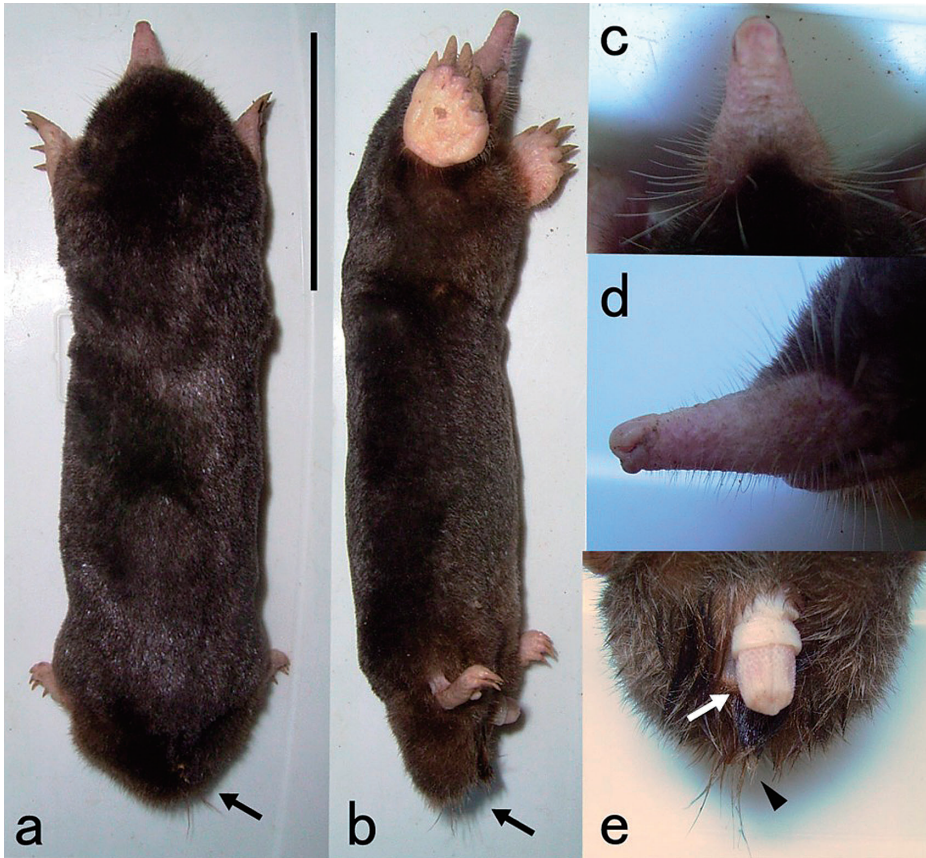


Fig. 5. External morphology of *E. parvidens* from Dong Giang (SIK0856). a, Dorsal view of the body; b, lateral view of the body; c, dorsal view of the nostris; d, lateral view of the nostris; e, dorsal view of the tail. Black arrows, the white arrow and the arrowhead indicate the large pubic area, the penis and the rudimentary tail, respectively.

Vietnamese *Euroscaptor* (Fig. 6). This result coincides with the original description of *E. parvidens*, which was characterized by small molars (Miller, 1940b). We examined the upper molar shape of the obtained specimens. The moles collected in southern Vietnam (Dong Giang and Chu Yang Sin) had first and second upper molars with a small torigon basin surrounded by a W-shaped ridge, protocone and two weak subcusps, the metaconule and paraconule, giving an overall isosceles triangular appearance (Fig. 9a). This morphology matches that of the holotype of *E. parvidens*. Northern *Euroscaptor* had first and second premolars with skewed triangular shapes caused by the anterior position of the protocone and degenerated paraconule (Fig. 9b), coinciding

with *E. longirostris* from the type locality.

#### **Identification of museum specimens of moles from Vietnam**

Eleven mole specimens from Vietnam are deposited in museums as follows: USNM258342 (holotype of *E. parvidens*), 320528–320533; NMHN1959.1794, 1959.1795; and BM33.4.1.147, 33.4.1.148. Among these, USNM258342 was the type specimen of *E. parvidens*, but the other specimens were misidentified. The labels of eight specimens (USNM320528–320533; NMHN1959.1794, 1959.1795) indicate they were collected from the type locality of *E. parvidens* (Bao Loc) and Dalat City in southern Vietnam. These specimens have



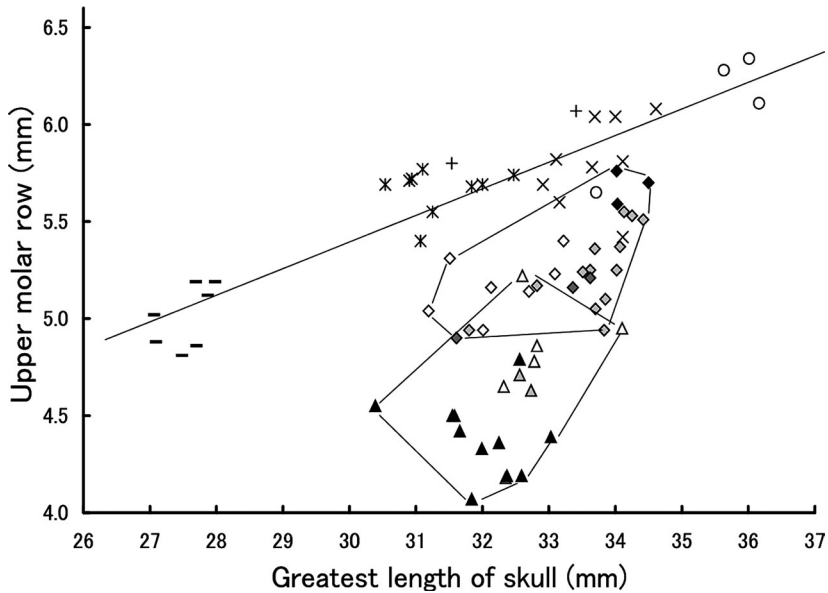


Fig. 6. Scatterplot of the greatest length of the skull and the length of the upper tooth row. A regression line including *E. mizura* (—), *E. micrura* (×), *E. malayana* (\*), *E. grandis* (○) and *E. klossi* (+) is also shown. *Euroscaptor longirostris* and *E. parvidens* are indicated by diamonds and triangles, respectively, and their variations are outlined. Open diamonds, *E. longirostris* from China; light gray diamonds, *E. longirostris* from Tam Dao; dark gray diamonds, *E. longirostris* from Sa Pa; black diamonds, *E. longirostris* from Nguyen Binh; open triangles, *E. parvidens* including the type specimen; gray triangles, *E. parvidens* from Chu Yang Sin; black triangles, *E. parvidens* from Dong Giang.

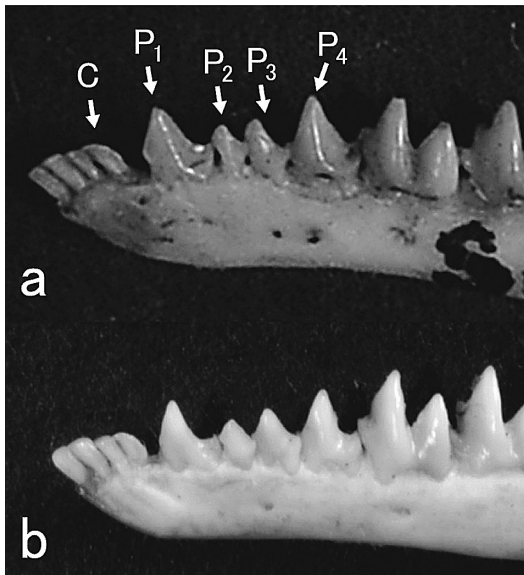


Fig. 7. Comparison of the lower premolar rows. a, *E. klossi* from Thailand (NSMT-M34363); b, *E. longirostris* (SIK0865). C, canine; P<sub>1</sub>, first premolar; P<sub>2</sub>, second premolar; P<sub>3</sub>, third premolar; P<sub>4</sub>, fourth premolar.

very small molars and short tails. These characters are similar to the type specimen of *E. parvidens*, but have much smaller skulls than the type specimen. The greatest length of the skull of the holotype was 34.10 mm and deviated from the other specimens' range (32.32–32.82 mm). The shape of the skull was not similar to that of the holotype, but the dental characters shown in Fig. 9 were consistent in all museum specimens of southern Vietnamese moles and in the specimens collected in our field surveys. These specimens were misidentified as *Euroscaptor klossi* and *Euroscaptor longirostris* in the USNM and NMHN collections, respectively. We correctly identified these specimens as *E. parvidens*.

Two specimens in the BM (BM33.4.1.147, 33.4.1.148) were collected in Chapa (Sa Pa) by the Jean Delacour Expedition and identified as *Talpa klossi* by Osgood (1932). One specimen (BM33.4.1.147) had only two incisors in the lower jaw, and the other (BM33.4.1.148) had

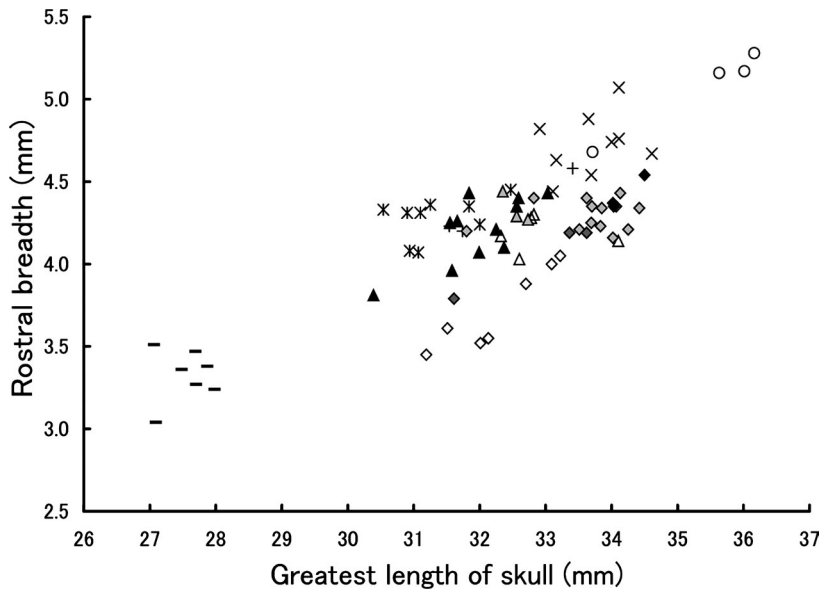


Fig. 8. Scatterplot of the greatest length of the skull and the length of the upper tooth row. Symbols are the same as those in Fig. 6.

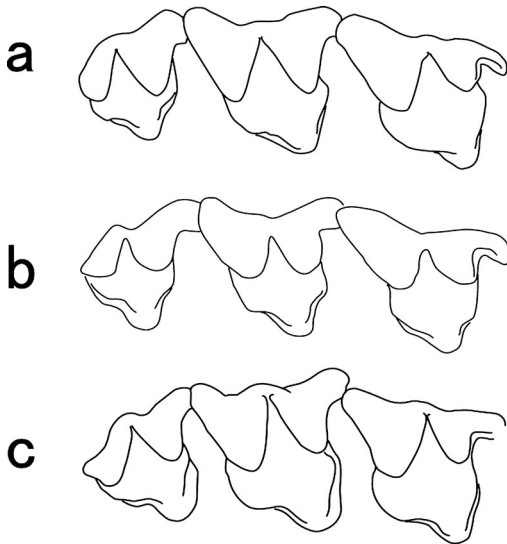


Fig. 9. Outlines of the first to third upper molars. a, *E. longirostris* (SIK0865); b, *E. parvidens* (SIK0860); c, *E. klossi* from Thailand (NSMT-M34363).

three incisors. These resembled specimens collected from low and high elevations in Sa Pa during our fieldwork; thus, they were respectively identified as *M. latouchei* and *E. longirostris*.

#### *Taxonomy of Vietnamese moles*

The three mole species in Vietnam are described below.

#### *Euroscaptor longirostris* (Milne-Edwards, 1870)

*Talpa klossi*: Osgood, 1932, Field Museum of Natural History, Zoological Series 18: 193–339.

Type specimen. NMHN1970.251 mounted skin with broken skull. A type series is also present (NMHN1970.251a, 251b and 251c).

Type locality. Moupin, Szechuan, China.

This species was previously only known from Szechuan and Yunnan provinces in southwestern China, but was misidentified in northern Vietnam. The type series was collected by Armand David, a French missionary, from 1860 to 1870 in Szechuan, China. Although all specimens in the type series had broken skulls, the diagnostic character is a very slender and long rostrum. We also determined that this species has small molars (Fig. 6).

*Euroscaptor longirostris* from northwestern and northeastern Vietnam are morphologically variable, especially in fur denseness, coloration, tail shape and length (Fig. 4). In comparisons

among specimens from East Asia, some species from Nepal, Thailand and peninsular Malaysia have a linear relationship between the greatest length of the skull and upper molar length. The length of the upper molar row is shorter in *E. longirostris* than in other species (Fig. 6). Specimens from Sa Pa, Tam Dao and Nguyen Binh in northern Vietnam have a similar molar shape with a weakly developed metaconule, which gives the upper molars a triangular appearance (Fig. 9b). In the mandibles, the tips of the cusps of the lower second to fourth premolars are linearly arranged in *E. longirostris*, but *E. micrura* and *E. klossi* have small second and third premolars and a much larger fourth premolar, with a dramatic size difference between the third and fourth premolars (Fig. 7). The edge between the distal subcusp and the main cusp of the lower first premolar is strongly constricted in this species. The rear part of the mandible is elongated and widely spaced. These specimens have broad rostrums; thus, this character leads us to conclude that a deviation exists between northern Vietnamese and Chinese *E. longirostris*. Previously, little information on variation within Chinese *E. longirostris* was available; thus, determining whether the differences between Chinese and northern Vietnamese moles indicate local variation is impossible. Although this study did not find clear differences in skull shape or skeletal morphology, these local populations are possibly cryptic species.

The known distribution of *E. longirostris* in Vietnam is Sa Pa, Nguyen Binh and Tam Dao. In Sa Pa and Nguyen Binh, *M. latouchei* is present at lower elevations; thus, these two species may be competitors, as has been shown in Japanese *Mogera*. In the Japanese species, the larger species occupies the soft and fertile soil environment in river plains, but this is not the case in Vietnam. Although the preferred habitat is mountainous deciduous forest, this species may inhabit farms in Tam Dao due to the absence of competitive species.

In Osgood's (1932) paper, the moles collected in Sa Pa were misidentified as *Talpa* (*Euroscap-*

*tor*) *klossi*, which is distributed in western and northern Thailand. Specimens described in Osgood (1932) are deposited in BM and the Field Museum of Natural History, Chicago. We examined the specimens deposited in BM and recognized that the specimens with three incisors (BM33.4.1.148) do not match *E. klossi* in the above-mentioned characters.

One female (SIK0776) collected in Tam Dao was pregnant with two and one fetuses in the right and left uterus, respectively. Thus, the breeding season in this location likely occurs in September and the litter size is around three.

#### ***Euroscaptor parvidens* (Miller, 1940)**

*Talpa parvidens*: Miller, 1940. Journal of Mammalogy 21: 203–204.

*Euroscaptor klossi*: Abramov *et al.*, 2007. Russian Journal of Theriology 5: 85–92.

Type specimen. USNM258342, skin, skull and fluid body. Type locality. Blao, Annam, Vietnam.

This species was described in 1940 by Miller based on a specimen collected by Poilane from Blao (presently Bao Loc) in southern Vietnam. The species name '*parvidens*' means 'small teeth'; thus, this is a characteristic that diagnoses it from other species of *Euroscaptor*. We checked the type and some additional specimens deposited in the USNM and MNHN, and the specimens collected by the authors. Their morphological characters were consistent.

Externally, this species has a much longer body with a shorter tail than other moles from northern Vietnam and other locations (Table 1). Although the short-tailed mole, *E. micrura*, and the Malaysian mole, *E. malayana*, have similar tail lengths, most of the proximal tail vertebrae in *E. parvidens* are under the huge hip (Fig. 5). This feature gives the appearance of forward-located legs and a rounded hip.

This mole can be easily distinguished from any other *Euroscaptor* species. The skull of this species is similar to that of *E. longirostris*, but the most obvious difference is the shape of the upper molars. The upper molars of this species

are conspicuously small and with rather developed subcusps in both the mesial and distal position of the protocone (paraconule and metaconule), giving the molar the appearance of an isosceles triangle.

The protocone of the upper first and second molars is in the middle of these molars (Fig. 9). The relative size of the upper molar row to the skull is the smallest among the known species of Talpidae (Fig. 6). The skull of the holotype is much larger than that of the other examined specimens, but these morphological characters are consistent. Collection and examination of more specimens are needed to determine inter-specific size variation.

This species is known from middle to south Vietnam, the type locality (Bao Loc) (Miller, 1940), Dalat in Lam Dong Province (USNM and NMNH collections), Chu Yang Sin National Park and Dong Giang (our survey). A specimen from Quoc Phuong National Park, deposited in the Hanoi University Museum, also resembles this species. Abramov *et al.* (2007) reported a mole from Ngoc Linh Nature Reserve in Kon Tum Province and identified it as *E. klossi*. We hypothesize that this mole is *E. parvidens* based on its external morphology, particularly the tail and hip features. A specimen from the Boloven Plateau of Laos (AMNH87314, identified as *E. klossi*) is similar to this species, although its identification requires further consideration because of slight differences in aspects of the molars and in rostral shape. Although Wang (2003) described *E. parvidens* as distributed in Jinping, southern Yunnan, China, morphological characters of those species need to be examined in detail.

This species was a Critically Endangered Species in previous versions of the IUCN Red List; thus, more distribution data are needed.

#### *Mogera latouchei* Thomas, 1907

*Talpa klossi*: Osgood, 1932. Field Museum of Natural History, Zoological Series 18: 193–339.

Type specimen. BM 98.8.17.1, skin and skull.

Type locality. Fujien, China.

The original distribution of this species was restricted to southern China (type locality, Fujien Province). This species was long considered a subspecies of *M. insularis* in Taiwan, but was recently reconsidered as a full species (Kawada *et al.*, 2007). Diagnostic characters for this species are small size, dark fur (Fig. 3) and the wide auditory opening of the skull. The auditory opening is quite distinct from any other *Mogera* species.

In Osgood's (1932) report, he misidentified this species as *E. klossi*. We examined a specimen deposited in BM (BM33.4.1.147) that Osgood examined; it had only two incisors in the mandible. Therefore, this specimen collected in Sa Pa is considered a species of *Mogera*. This specimen and some collected in our surveys were slightly larger than individuals typical of Chinese populations, notwithstanding the large auditory bulla mentioned above. Thus, we identified northern Vietnamese *Mogera* as *M. latouchei*—the first record in Vietnam.

This species has a scattered distribution in northern Vietnam, where its habitats are rural natural forests and also near residences. This species was collected at lower elevations (1700 m) in Sa Pa Town. The upper and lower distribution limits are unknown in Sa Pa. In Nguyen Binh, *M. latouchei* was collected at 600 to 800 m elevation, and *E. longirostris* was collected above 800 m; thus, these two species are peripatrically distributed in high and low areas. In both localities, *M. latouchei* was often found in farmland. Therefore, these fields are considered a good habitat for this species.

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