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short communication

The mole of Peninsular Malaysia: notes on its identification and ecology

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A mole was first described as inhabiting Peninsular Malaysia by Chasen (1940), who recorded it from the Cameron Highlands, Pahang State. Its existence at the same locality was later reconfirmed by Cranbrook and Medway (1962). Its known distribution, at the higher elevations (1,000–2,000 m above sea level) of the Cameron Highlands in the Main Range of the Malay Peninsula (Cranbrook and Medway 1962; Medway 1978), make it the southernmost of the world's Talpidae (Corbet and Hill 1991). As only two specimens were reported by Chasen (1940) and only four by Cranbrook (1962), the systematics and ecology of this taxon have remained unclear.

Based on its external characters, the Malaysian mole (Fig. 1) has so far been identified as either *Euroscaptor micrura* or *E. klossi* (Chasen 1940; Cranbrook 1962; Yoshiyuki 1988; Hutterer 1993). Unfortunately, the classification of mole species, even at the generic level, in eastern and southeastern Asia is very confused. This confusion is partially due to the limited number of specimens available in museum collections for systematic study. In this paper we describe the results of a collecting expedition to obtain Malaysian moles, in particular the morphological characters on which species identification can be based, and breeding and food habits.

Study site and methods

Trapping was conducted on the BOH Estate, Ringlet, Cameron Highlands, Pahang, Malaysia from 10 to 14 January 2002 with permission from the Department of Wildlife and National Parks, Malaysia. We set mole traps (Hoga Co., Kyoto, Japan) around the Malaysian Nature Society (MNS)-BOH Nature Study Center (4°27'N, 101°26'E; Fig. 2) at an elevation of 1,400 m above sea level. The traps, consisting of a poly-vinyl chloride (PVC) cylinder (inner diameter 5 cm, length 10 cm), were of the hanging-type similar to "Duff's trap" described by Gorman and Stone (1990). When a mole enters the tube and pushes against a trigger, a steel wire connected to a spring is raised suddenly hanging the animal until it dies. As the traps have only single entrances, we usually set a pair of traps at each trap site. A total of 40 traps was used enabling us to set up to 20 pairs of traps at a time. The traps were set in mole tunnels at a depth of less than 5 cm from the soil surface on trails amongst tea plantations, in lawns, and in roadside banks. No bait was used.

The animals collected were measured and prepared as museum skins and fluid (70% ethanol) specimens. Some tissues (liver, skin and reproductive organs) were extracted for further study and preserved in suitable fixatives or media. The skulls were later removed from fluid specimens and cleaned to allow measurements to be taken.

In order to elucidate the taxonomic position of the Malaysian mole, we examined collections of Asian moles of the genus *Euroscaptor* and the related genus *Parascaptor*, deposited in the National Science Museum, Tokyo (NSMT-M), United States National Museum, Washington (USNM), and in the American Museum of Natural History, New York (AMNH) (see Appendix). In the USNM, there is one skin with a skull from the Himalayas that was identified as *E. micrura*, unfortunately, the rear part of the skull was damaged (USNM260741). We therefore compared only the palatal parts (palatal length, length of upper molars, and breadth across the molars) of the specimens.

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Fig. 1. The Malaysian mole, *Euroscaptor micrura*.

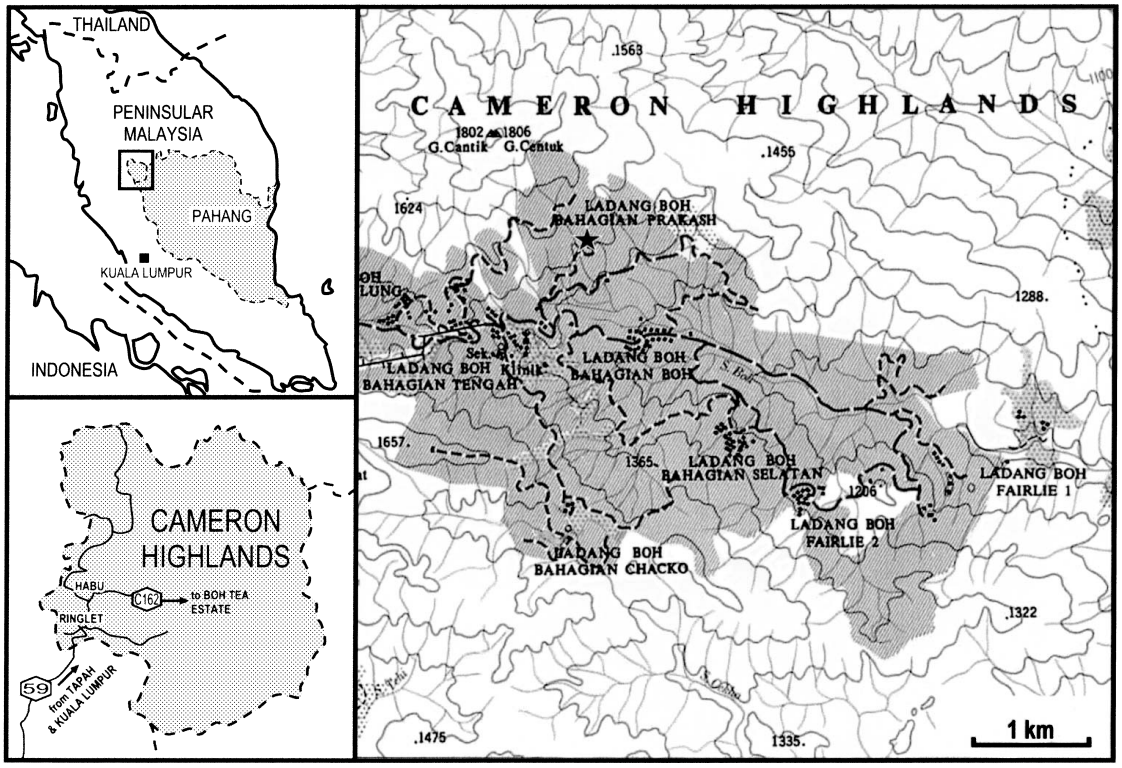

Fig. 2. The study site in the Cameron Highlands, Pahang, Peninsular Malaysia. A star indicates the exact collecting location near around the MNS-BOH Nature Study Center. Elevation is represented as meters above sea level.

Results and discussion

During the four trapping nights we obtained ten Malaysian moles (see Table 1). The specimens are now deposited at the Highland Animal Experimental Station of the Graduate School of Agricultural Sciences, Nagoya University, Japan (Specimen numbers SIK0550 to SIK0559; export certificate number WL(AP/HQ)0033/

Table 1. Collecting date and measurements of collected Malaysian moles.

Specimen No.	Sex	Date	Measurements*							
			Weight (g)	H. B. (mm)	Tail (mm)	F. foot (mm)	H. foot (mm)	Testis (mm)	Tail ratio (%)	Skull (mm)
SIK0550	♂	11, Jan., 2002	58.5	128.5	5.0	15.5 × 17.0	15.5	11.0 × 6.9	4.05	30.54
SIK0551	♂	ditto	57.0	130.0	5.0	15.5 × 15.5	16.0	11.0 × 6.7	4.00	31.10
SIK0552	♂	12, Jan., 2002	53.0	131.5	6.0	16.0 × 16.5	16.0	11.0 × 6.4	4.78	30.90
SIK0553	♀	ditto	43.6	130.0	5.5	15.0 × 15.5	14.5	—	4.42	—
SIK0554	♂	ditto	62.5	134.5	4.5	16.5 × 16.5	16.5	11.0 × 6.4	3.46	—
SIK0555	♂	13, Jan., 2002	57.5	131.5	5.5	16.0 × 16.5	15.0	11.1 × 7.0	4.37	31.07
SIK0556	♂	ditto	71.5	134.0	5.5	16.0 × 17.0	15.0	11.9 × 7.7	4.28	32.47
SIK0557	♂	ditto	64.0	131.0	6.0	16.0 × 17.0	16.0	12.2 × 7.0	4.80	32.00
SIK0558	♂	ditto	50.0	129.0	8.5	16.0 × 16.5	15.5	4.3 × 2.0	7.05	30.94
SIK0559	♂	14, Jan., 2002	56.0	131.5	5.5	15.5 × 16.0	15.0	10.8 × 6.8	4.37	—
Average of measurements			57.4	131.2	5.7	15.8 × 16.4	15.5	10.5 × 6.3	4.56	31.29

*: Weight; body weight, H. B.; head and body length, Tail; tail length, F. foot; length × width of fore foot, H. foot; length of hind foot, Testis; long × short diameters of testis, Tail ratio; tail length/H. B. length × 100, Skull; greatest length of skull, —; not measured.

2002). Half of them will be kept in the museum of the Department of Wildlife and National Parks, Kuala Lumpur, Malaysia.

The moles were trapped easily in surface tunnels running through the gardens and beneath pathways of the tea plantation during both day and night. As described by Cranbrook (1966), it seems that this species usually uses surface tunnels and does not construct large mounds or dig deeply into the ground.

As many as three moles were caught successively at a single site, indicating that tunnels are used by more than one individual. The extremely biased sex ratio of the animals collected (1 female: 9 males), implies that males are more active than females during January. With one exception (specimen SIK0558), testis size indicated that the males were reproductively active, indicating that January is probably within the breeding season.

In general, moles in temperate regions breed during spring and early summer (Abe 1967; Gorman and Stone 1990), however, male Malaysian moles may breed earlier than species in temperate regions (or may be reproductively active all year round), because of the aseasonal climate of their habitat (monthly mean air temperature range at the Cameron Highlands: 17.2–18.7°C). Cranbrook and Medway (1962) reported that one of three females collected in March was lactating and that the vaginas of the other two females were open. Given that the gestation period of moles is around four or five weeks (Lekagul and McNeely 1988; Gorman and Stone 1990), it is possible that Malaysian moles breed during winter and early spring. Further study is required to reveal the breeding habits of this species.

The stomach contents of seven moles were examined to reveal their food habits. Earthworms were the most common items found in all seven samples. There were also fragments of adult beetles and hymenopterans, as well as crickets, and lepidopteran and coleopteran larvae. In addition, one reptile, apparently a kind of blind snake was detected in the stomach of SIK0558. The results coincide well with Medway's (1978) description of the species' food habits.

The Malaysian mole is small (a characteristic of *Euroscaptor* species) and has previously been classified as a subspecies of either *E. klossi* or *E. micrura* (Chasen 1940; Cranbrook 1962; Yoshiyuki 1988), though Corbet and Hill (1991) inevitably considered these to be the same species because of the scarcity of comparable museum specimens for assessment of geographic variation. *Euroscaptor klossi* is a small mole first described from Thailand (Thomas 1929), whereas *E. micrura* is a larger mole from the Himalayas. The morphology of *E. micrura* is characterized by an extremely club-shaped tail (Stroganov 1948), which is shorter than that of *E. klossi* (Thomas 1929; Corbet and Hill 1991). According to Yoshiyuki (1988), the tail of *E. klossi* measures 16.5 mm in length, whereas that of *E. micrura* is 5.0 mm.

The Malaysian moles collected in this study have short tails (mean tail length = 5.7 mm), and the tail shape is similar to that previously described for *E. micrura*. The tail ratio of our specimens is concordant with the description of the Himalayan mole (Table 1). The dental formula of the specimens is I3/3, C1/1, P4/4, M3/3 = 44, coincident with the generic trait of *Euroscaptor*. When the specimens from Malaysia are compared with plots of

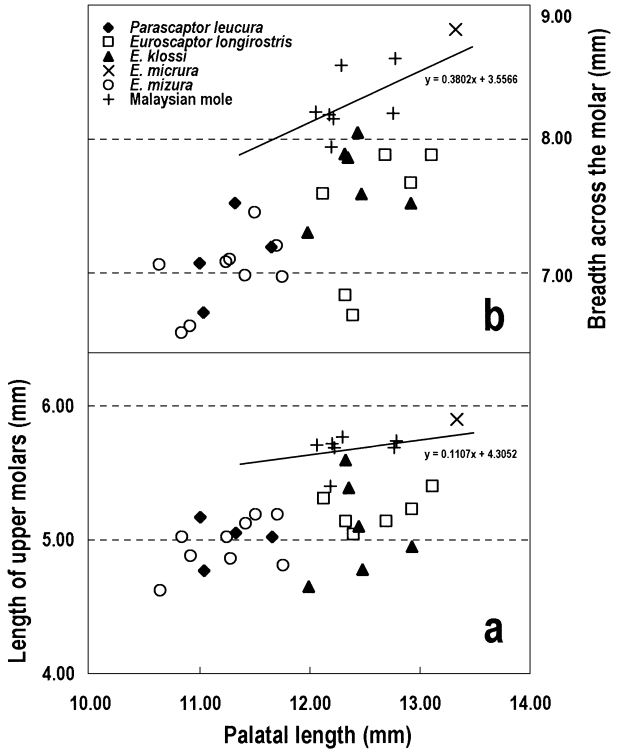

Fig. 3. Proportions of the length of upper tooth row (a) and breadth across the molars (b) to palatal length among *Parascaptor* and *Euroscaptor* species.

the length of upper molars (a) and the breadth across the molars (b) against palatal length among *Euroscaptor* and *Parascaptor* species (see Figure 3), it is clear that the Malaysian mole has larger upper molars and a relatively shorter and broader palate than any other members of the genera *Euroscaptor* and *Parascaptor* except *E. micrura*. The tail, skull and dental characters of the specimens collected during this study thus support Cranbrook's (1962) classification of the Malaysian mole as a subspecies of the Himalayan mole, *E. micrura*. Therefore our preliminary conclusion is that the Malaysian mole represents the southernmost population of *E. micrura*. A more detailed morphological analysis of further samples from other localities within the distribution of *Euroscaptor* spp. is ongoing.

Until this survey, no specimens of Malaysian moles were available for genetic studies, however, our collecting efforts were successful in providing ten specimens (the world's largest collection of this local population). The next step is to examine more species from other locations in order to make the classification of Asian moles more accurate. Evidence for the identification of the Malaysian mole based on genetic markers will also be presented in the future.

Although very limited information is available concerning the status of the Malaysian mole, this population is likely to have been negatively affected by land-use transformation from virgin montane forest to agricultural land in the 20th century and by the intensive use of pesticides (Ratnam et al. 1991). Recently, in the Malaysian highlands, a large-scale land development project for the Highland Highway is being undertaken (Malaysian Nature Society 1997, 2001). Given such environmental impacts, we stress that more attention should be paid to the Malaysian mole, a small but distinctive population confined to the Malaysian highlands.

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Appendix

Examined specimen deposited in the National Science Museum, Tokyo (NSMT-M), United States National Museum, Washington (USNM), the American Museum of Natural History, New York (AMNH), and in personal collection of senior author (SIK).

E. longirostris (6 specimens)
USNM253319, USNM258549, AMNH110505, AMNH110506, AMNH110507, AMNH110508

E. klossi (6 specimens)
USNM256898, USNM261090, AMNH87314, USNM320530, USNM320531, USNM320532

E. micrura (1 specimen)
USNM260741

E. mizura (9 specimens)
NSMT-M1543, NSMT-M3234, NSMT-M4275, NSMT-M8476, NSMT-M9502, NSMT-M13332, NSMT-M13340, NSMT-M26694, SIK0311

P. leucura (4 specimens)
USNM564413, AMNH114560, AMNH114561, AMNH115556