

The First Record of *Anourosorex* (Insectivora, Soricidae) from Western Myanmar, with Special Reference to Identification and Karyological Characters

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(Received 3 March 2014; accepted 26 March 2014)

Abstract We collected six mole shrews in Tiddim Town of Chin State, western Myanmar. They were captured in a human-modified artificial environment, although mole shrews usually inhabit forests. External and skull measurements indicated that the species was *Anourosorex assamensis*, previously known only as an endemic species of the Assam region of India. This is the first record of this species from Myanmar. Karyological examination revealed the species was diploid with a fundamental autosomal number of $2n=50$ and $NFa=96$. These numbers correspond to the Taiwanese species *A. yamashinai*, but several differences were apparent in chromosomal morphology and the position of secondary chromosomal constrictions. The karyological information suggests *A. assamensis* is a full species separate from *A. squamipes* in China.

Key words: Mole shrew, *Anourosorex assamensis*, morphological identification, karyotype.

Introduction

Mole shrews, the genus *Anourosorex* Milne-Edwards, 1872, are semifossorial shrews known in East Asia from the Himalayas to Taiwan and include four species: *A. assamensis* Anderson, 1875, *A. squamipes* Milne-Edwards, 1872, *A. schmidi* Petter, 1963, and *A. yamashinai* Kuroda, 1935 (Hutterer, 2005). Previously, the genus *Anourosorex* was considered to be monotypic and all individuals were considered to be *A. squamipes* (Hoffmann, 1987, Corbet and Hill, 1992, Hutterer, 1993); however, the genus shows enough morphological variation that it was later divided into four subspecific taxa (Motokawa and Lin, 2002). Later, Motokawa *et al.* (2004) reported that the “*squamipes*” type species and the Taiwanese form “*yamashinai*” carried distinct characters based on conventionally stained

karyotypes, and should therefore be considered separate species. After that, Hutterer (2005) reclassified all four *Anourosorex* as four distinct species based on size differences.

The distribution of the mole shrew in Myanmar is restricted to the eastern montane zone bordering China (Hoffmann, 1987) and lowland areas near Putao City of Kachin State (Kawada *et al.*, 2012). All these species have been identified as *A. squamipes*, but only one specimen from Putao City was tentatively identified.

In contrast, the Assam mole shrew *A. assamensis* was originally described by Anderson (1875) and believed to be endemic to the Assam region of India. We recently collected this species in western Myanmar. Here, we present data on the first record of this species from Myanmar and examine the karyotype of the species to evaluate its taxonomic placement.

Materials and methods

We conducted a field survey from 5 to 7 December 2012, in Tiddim Town, Chin State, Myanmar (GPS: 23°21'41" N, 93°38'59" E; 1700 a.s.l.). The first author set 20 Sherman live traps along a ditch (approximately 50 cm wide by 80 cm deep) between the stone walls of adjacent residences (Fig. 1a, b). Collected animals were photographed, measured, and prepared as stuffed skins at the collecting location. The residual parts

of body were fixed in 70% ethanol and prepared as skeletal specimens in the laboratory. Species identification was performed by comparing external morphological measures and the CIL (condyloincisive length) of the skull with reference to Motokawa and Lin (2002). To collect chromosomal samples, tail vertebrae were preserved in AmnioMAX™ II media (Gibco, Carlsbad, CA, USA) in the field, and later treated for karyological study by ordinal procedures including fibroblast cell culture and air-drying in the

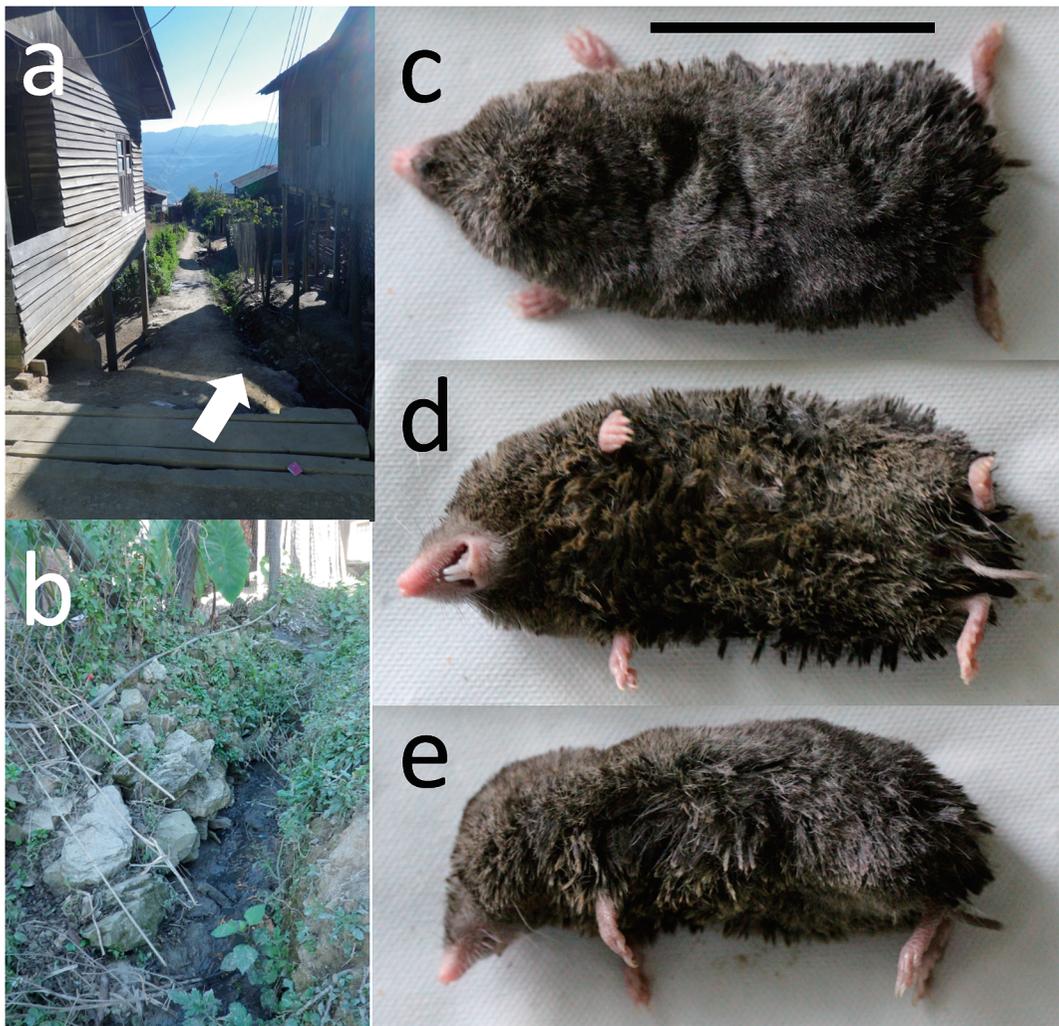


Fig. 1. Collecting locality and obtained female *Anourosorex assamensis* (NSMT-M43004). Trapping site was artificial ditch along the unpaved road between residents (a). We set the traps along the ditch walled by stones (b, as magnified photo indicated by arrow in a). The dorsal (d), ventral (d) and lateral (e) views of *A. assamensis*. The scale bar indicates 50 mm.

Table 1. Specimens' collecting data and measurements.

NSMT-M	Sex	Date	Measurements*				
			BW	HB	T	HF	CIL
43003	♀	6, Dec., 2012	21.4	96.5	13.5	15.5	26.14
43004	♀	6, Dec., 2012	27.3	112.0	14.0	16.0	26.95
43005	♂	6, Dec., 2012	21.5	107.0	14.0	15.0	25.65
43008	♀	7, Dec., 2012	28.7	114.0	17.0	15.0	27.33
43009	♀	7, Dec., 2012	25.7	104.0	14.0	14.5	26.22
43011	♂	7, Dec., 2012	23.8	111.0	13.0	15.5	26.93

*BW, body weight (g); HB, head and body length (mm); T, tail length (mm); HF, hind foot length (mm); CIL, condyloincisive length (mm).

laboratory. Specimens are preserved in the National Museum of Nature and Science, Tokyo, Japan.

Results and discussion

Over 2 nights of trapping, we collected six mole shrews (specimens' codes: NSMT-M43003, 43004, 43005, 43008, 43009, and 43011; four females and two males) (Fig. 1c–e, Table 1). Generally, mole shrews are forest-dwelling mammals (Allen, 1938); however, we found them in ditches using the gaps in artificial stone walls. In other dried gutters near the collection site and around residences, we captured three house musk shrews, *Suncus murinus* (Linnaeus, 1766). These two shrews appear to segregate their habitats in response to wet or dry conditions.

The external morphological traits of *A. assamensis* are very similar to other *Anourosorex* species, and only size differences have previously been considered. As Mandal and Das (1969) noted, the specimens from Tiddim lacked a small ochraceous tawny spot on the cheek (Fig. 1e), which was typically present in the southwestern Chinese species according to Allen (1938). Mandal and Das (1969) also mentioned that the tail and nail colors differed between the two populations. The specimens from Tiddim had brownish tails and whitish nails, which match the reported characters of *A. assamensis*, but these characters may not be good indicators of taxonomic distinction. In the context of skull morphology, Moto-kawa and Lin (2002) noted that the mastoid process of *A. assamensis* is well developed. Indeed,

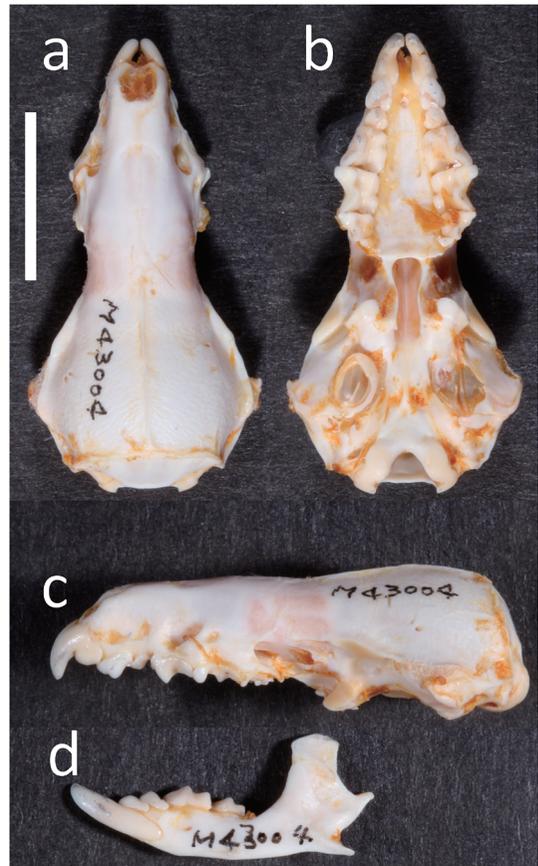


Fig. 2. The dorsal (a), ventral (b) and lateral (c) views of the cranium and lingual view of the mandible (d) of a female *A. assamensis* (NSMT-M43004). The scale bar indicates 10mm.

the skull we collected possessed very wide mastoid processes (Fig. 2).

The external measurements and CIL of each skull are shown in Table 1. These mole shrews

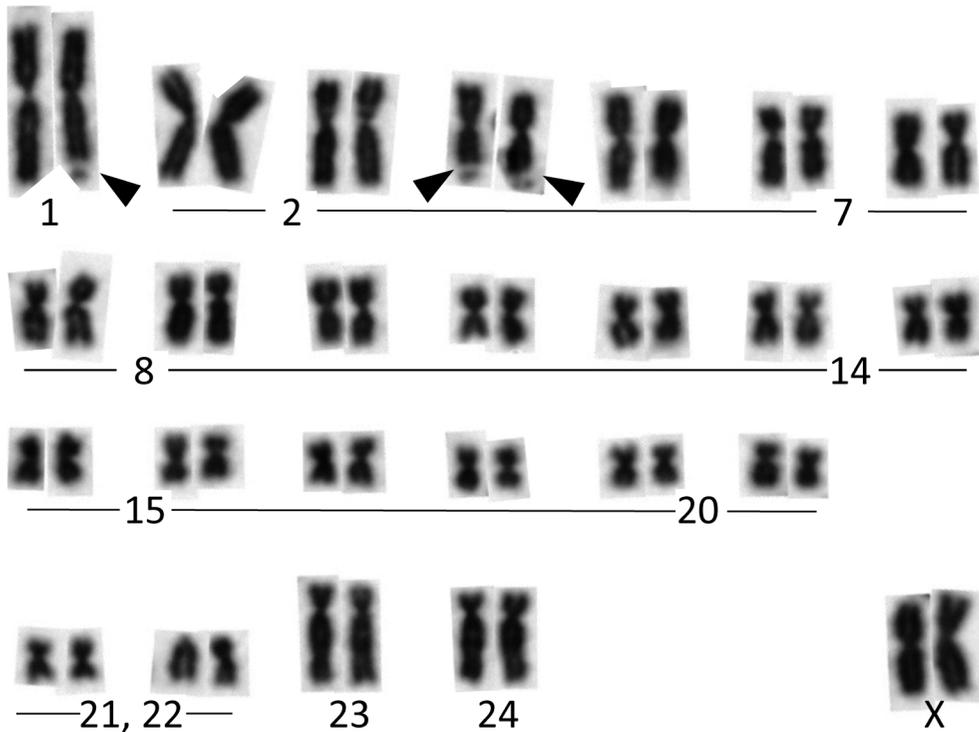


Fig. 3. The female conventional karyotype of *A. assamensis* (NSMT-M43004). The arrowheads indicate secondary constrictions.

were relatively large in overall size, especially shown by the means \pm SD of the HB (length of the head and body) and CIL as 107.02 ± 6.45 and 26.54 ± 0.63 mm, respectively. These values correspond to those of mole shrews collected from the Assam region of India (HB: 102.78 ± 9.43 , CIL: 26.53 ± 0.73), and are larger than specimens from Sichuan (HB: 93.97 ± 7.97 , CIL: 24.90 ± 0.73), Yunnan (HB: 94.40 ± 3.51 , CIL: 25.02 ± 1.08), and Vietnam (HB: 93.08 ± 3.66 , CIL: 24.45 ± 0.48) (mean \pm SD according to Motokawa and Lin, 2002). Therefore, we identified the mole shrews from Tiddim as typical of *A. assamensis*. Kawada *et al.* (2012) reported one mole shrew in Putao, Kachin State, northern Myanmar, and external measurements. This individual was also considered *A. assamensis*.

Motokawa and Lin (2002) estimated that the distribution areas of two forms, *assamensis* and *squamipes*, of Asian continent were bordered by the Irawaddy River. Our record in Tiddim and a

specimen from Putao by Kawada *et al.* (2012) reinforce their estimation by the occurrences of *A. assamensis* in the western edge of Myanmar. Molur *et al.* (2005) denoted the altitudinal distribution of *Anourosorex* in India and Buhtan (possibly includes *A. assamensis* and *A. schmidi*) bound from 1500 to 3100 a.s.l. Therefore, the habitat in Putao (460m a.s.l.) was exceptionally lower record as commented by Kawada *et al.* (2012), regardless of Tiddim (1700m a.s.l.). Further collecting activities may allow their distribution area to widen.

We observed conventional karyotypes of two females (NSMT-M43004, 43008). Figure 3 shows the conventional karyotype of *A. assamensis* from Tiddim. The karyotype included 50 chromosomes, consisting of 23 large to small metacentric or submetacentric pairs and two large subtelocentric pairs (NFa=96). Because only female individuals were examined, we were unable to identify sex chromosomes. Thus, we

tentatively estimated the X pair as one of large-sized metacentric pairs according to Motokawa *et al.* (2004). In a previously examined karyotype of the genus *Anourosorex*, diploid numbers of *A. squamipes* from Sichuan Province of China and *A. yamashinai* from Taiwan were $2n=48$ and $2n=50$, respectively. Furthermore, the karyotype of *A. yamashinai* carried two subtelocentric pairs in autosomal complement, differing from the karyotype of *A. squamipes* (Motokawa *et al.*, 2004). Therefore, the present karyotype of *A. assamensis* from western Myanmar is similar to that of *A. yamashinai*, despite the geographic segregation.

The first metacentric pair of *A. assamensis* was notably larger than the second one (Fig. 3). This character was not found in two allies (Motokawa *et al.*, 2004) and appears to be unique in this species. Additionally, secondary constrictions were located at the distal end of the long arms of chromosome no. 1 and the other large-sized pair (Fig. 3, arrows), the former of which was heteromorphic in appearance. Similar features of secondary constrictions were observed in the distal short arms of the two metacentric pairs in *A. squamipes* and the one small-sized metacentric pair in *A. yamashinai*. This suggests that the tandem fusion or other complex chromosomal rearrangements contributed to the variation in the nucleolus organizing region.

These karyological data suggest that the mole shrew from Assam and western Myanmar are independent species, with *A. assamensis* separate from *A. squamipes*. This information partially supports the recent taxonomic revision by Hutterer (2005), who classified four species in this genus. Similar karyological studies are needed in another species, *A. schmidi*, and more detailed karyological comparison using differential staining methods are needed to better understand the diversity of the genus *Anourosorex*.

Acknowledgments

We appreciate our gratitudes to Prof. Motoyoshi Satake, Dr. Kohei Kazuma, Dr. Haruka Asa-

hina, Mr. Yutaka Agatsuma, and Ms. Reiko Nakamura for supports of field work in collecting locality. This study was partially supported by Grant-in-Aids for Scientific Research nos. 24370035 and 25300016 from the Ministry of Education, Culture, Sports, Science and Technology of Japan.

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