

Bonner zoologische Beiträge	Band 56	Heft 3	Seiten 185–200	Bonn, September 2009
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Climbing mice of the genus *Dendromus* (Nesomyidae, Dendromurinae) in Sudan and Ethiopia, with the description of a new species

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Abstract. The species of *Dendromus* occurring in Sudan and Ethiopia are revised. The forms of climbing mice referred to *Dendromus mystacalis* (Heuglin, 1863) from Sudan and other parts of Africa are compared with the typical population from Ethiopia. Ethiopian *D. mystacalis* differ from the other African populations in morphology and habitat. On the other hand, all populations from outside Ethiopia correspond in size and appearance and live in similar habitats. It is suggested that the lowland populations represent a different species. A new species, *Dendromus ruppi*, is described from the Imatong Mts., Sudan. It is a relatively large montane form, which was isolated during climatic changes in a Pleistocene postpluvial phase, and is probably endemic to these mountains.

Keywords. Sudan, Ethiopia, rodents, *Dendromus*, morphology, ecology, altitudinal distribution, habitat, new species.

1. INTRODUCTION

The genus *Dendromus* (African Climbing Mice) contains at least 12 species distributed throughout sub-Saharan Africa. Most species occur in S, C and E Africa (MUSSER & CARLETON 2005). Typical habitats are long grassland, bracken, dense scrub, grassy wetland, and subalpine or alpine vegetation.

Species are characterised by small size, soft brown or reddish-brown pelage and a long thin tail (100–160% of head and body length, depending on the species) and feet specialised for climbing. Several species have a black mid-dorsal stripe, and one has three black stripes. In some species the stripe is barely visible or even absent.

Most species of *Dendromus* climb with the aid of the long digits of the forefeet and hind feet. The opposable digit 5 of the hindfoot which can be opposed to contact digit 1 and the prehensile tail are especially important for climbing and balancing on twigs and grass stems. Some species have a nail rather than a claw on digit 5 of the hindfoot, and tend to be more terrestrial than others (ZIEKUR 2006). The mammary formula is 2 – 2 = 8.

The skull is small with a round braincase, a narrow rostrum, and a narrow and vertical zygomatic plate carrying a distinct masseteric knob at its lower anterior corner. Incisive foramina extend to the middle row of the upper M1. Upper incisors are small, orthodont, each with a single longitudinal groove. Cheek teeth are rather narrow; M2 is about half the size of M1; M3 is minute; cusps of M1 are

biserial (two cusps in each row), with additional small lingual cusps on a middle lamella of M1; on M2 additional cusps are expressed less or absent. The morphology of the skull and the dentition are very uniform in the genus but the pelage shows great variability in colour and marking. Differences in skull length usually are very small, and measurements often overlap broadly. Classification of the species is therefore often based on rather few details (HEIM DE BALSAC & LAMOTTE 1958; DIETERLEN 1971).

The distributional limits of many of the currently recognized 12 species (including 44 synonyms) of *Dendromus* are unresolved, and karyological information is missing for most species. The genus therefore is in need of further study and revision. As concerns systematics, it is one of the most difficult genera of African rodents. Earlier, the Dendromurinae were classified as a subfamily of the Muridae (e. g. THOMAS 1896; SIMPSON 1945; MUSSER & CARLETON 1993). CARLETON & MUSSER (1984) already questioned this systematic position. Results of DNA hybridisation and mitochondrial and nuclear gene sequence studies finally supplied the basis for grouping the Dendromurinae together with five further subfamilies in the family Nesomyidae within Muroidea (MUSSER & CARLETON 2005).

In this study, new specimens from the Imatong Mountains in Southern Sudan are described as a new species. The sample is compared with the related *Dendromus mystacalis* from Ethiopia and with several forms from East and Central Africa currently assigned to that species.

2. MATERIAL AND METHODS

The present paper continues my revisionary studies of the rodent fauna of the Sudanese Republic (DIETERLEN & RUPP 1978; HUTTERER & DIETERLEN 1981; DIETERLEN & NIKOLAUS 1985). The research is mainly based on collections obtained by Hans Rupp (†1979) and Gerhard Nikolaus in Ethiopia and Sudan between 1971 and 1983. Almost all the rodent material is housed in the Staatliches Museum für Naturkunde, Stuttgart, Germany (SMNS). Comparative material was studied in the following museum collections: Museum of Comparative Zoology (MCZ), Harvard University, Cambridge (Mass.), U.S.A.; Zoological Museum of the University of Copenhagen (ZMUC), Denmark; British Museum (Natural History), London, U.K.; Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK), Germany. In addition to the relevant literature, the author's fieldwork and taxonomic studies of several species of *Dendromus* in the Congolese Kivu Highland (Albertine Rift Valley) served for comparison (DIETERLEN 1969, 1971, 1976).

3. RESULTS

3.1. Species of *Dendromus* in the Sudan Republic

Only two species were recorded from the territory of the Sudan Republic so far: *D. mystacalis* by SETZER (1956), and *D. messorius* by MUSSER & CARLETON (2005). A record of *D. mesomelas* subspec. (SETZER 1956) was based on an incorrect determination. Most of the 17 specimens of *D. mystacalis* preserved in museum collections were collected by J. S. OWEN and H. HOOGSTRAAL. A third (new) species, to be described below, was collected by J. S. OWEN, H. RUPP, and G. NIKOLAUS.

Dendromus mystacalis lineatus Heller, 1911

Material from South Sudan (17). All nine localities are in the Equatoria Province, seven of them E of the Bahr el Jebel (White Nile) and S of Torit (Fig. 1): Issore (40 miles S of Torit), ZMUC 1753; Katire, ZMUC 14051, 14125;



Fig. 1. Distribution of *Dendromus mystacalis lineatus* in southern Sudan and northern Uganda. The region S of Torit shows seven collecting localities, the easternmost of which, Gilo, is also the type locality of *Dendromus ruppi* n. sp.

Laboni (45 miles S of Torit), ZMUC 1852; Loa (20 miles N of Nimule), MCZ 44790; Lokwi, FMNH 79936 and four further specimens; Magwe, ZMUC 14122; Obbo, FMNH67071, 67078, 98957, USNM 67072, 67073 (not seen). Two localities from W of the Bahr el Jebel: Lado (N of Juba, 5°06'), FMNH 43482, 43483; Yei, FMNH 85382 (possibly *D. messorius*).

Remarks. The following notes refer only to populations outside of Ethiopia, from where the ‘typical’ species was described by HEUGLIN (1863). The description of the species by BOHMANN (1942) was essentially correct, e. g. greatest length of skull GRLE) 19–21 mm, upper molar row (M1–M3) 3.0–3.2 mm; D 5 on hind foot always with a claw.

The geographical form closest to Sudan is *D. mystacalis lineatus*, described from Rhino Camp, on the White Nile in N Uganda. According to BOHMANN (1942) its distribution extends over S Sudan, N and W Uganda and from there to the Kivu Highland. For the Ituri region, this distribution was confirmed by HATT (1940), and for the Kivu region by DIETERLEN (1971) and VERSCHUREN et al. (1983). The form *D. acraeus* Wroughton, 1909 (type locality: Mt. Elgon, Kenya) is problematic. Studies of *D.*

mystacalis from Kenya and Uganda by DIETERLEN (unpubl.) show that *acraeus* (WROUGHTON 1909) can hardly be distinguished from *lineatus*.

BOHMANN (1942) considered *acraeus* as a distinct form but included it in the species *D. ruddi*. WROUGHTON (1909) wrote: “Typus *acraeus* and Typus *ruddi* belong to a sample in which *acraeus* represents the extreme with dark dorsal stripe, and *ruddi* the extreme without dorsal stripe.” Recently *ruddi* was included as a synonym in *D. messorius* (MUSSER & CARLETON 2005), a species mostly without a dorsal stripe. The type series (USNM) of *D. mystacalis lineatus* from Rhino Camp includes a specimen without a dorsal stripe, and in samples of *acraeus* it may also be missing, i.e. it seems that in both forms specimens without a dorsal stripe occur. In several other species of *Dendromus* the expression of the dorsal stripe can vary, from a complete stripe to no stripe at all. Because the ranges of *D. mystacalis* and *D. messorius* overlap, misidentifications may occur.

Description of *D. m. lineatus*. Dorsally brownish or reddish-brown. The hairs of the ventral side are white or whitish down to the root. The apical parts have sometimes a yellowish tinge. SETZER’s (1956) description of the dor-



Fig. 2. Three skins of *Dendromus mystacalis lineatus* (SMNS 14737, 14738, 14736) in dorsal and ventral view. The dark mid-dorsal stripe is mostly complete, and the underparts are whitish.

Table 1. Table 1. Comparison of body and skull measurements of adult *D. mystacalis* from different regions in NE, E, and S Africa: Ethiopia and Sudan (DIETERLEN unpubl.); Kivu, Congo (DIETERLEN 1971); E Africa (Kenya und Uganda, localities Kaimosi, Sirgoit and Rhino Camp, forms *whytei*, *ruddi*, *acraeus*, *lineatus*) after HOLLISTER (1919); South Africa after DE GRAAF (1981); Africa (without Ethiopia) complete data of specimens given by BOHMANN (1942) under the name *D. pumilio* (now a synonym of *D. mystacalis*). HOLLISTER (1919) used as skull length only the condylo-occipital-measure (*) in Table 1) which is almost exactly 10% shorter than the greatest skull length (occipito-nasal-length), here correspondingly converted. Skull measurements: GRLE, greatest length; M1–M3, length of upper molar row; INT, interorbital breadth; BRC–W, greatest width of braincase. RTL = relative tail length.

Region	HB	T	RTL	HF	EL	WT	GRLE	M1–M3	INT	BRC–W
Ethiopia	66.4	93.4	141%	17.3	13.7	—	21.52	3.35	3.23	9.79
	58–76	84–108		16–20	11–18		20.3–22.6	3.13–3.60	3.09–3.40	9.37–10.0
	n 10	n 10		n 10	n 9		n 6	n 7	n 6	n 5
Sudan	60	82	137%	17.2	11.9	—	19.6	3.14	—	—
	53–68	72–91		16–18	11–14		18.7–20.7	2.84–3.31		
	n 11	n 11		n 10	n 7		n 8	n 4		
DR Congo	63.6	77.5	122%	16.5	12.8	8.1	20.0	3.15	2.8	9.25
Kivu	53–73	63–83		16–18.5		4–12	18.8–21.3	3.0–3.5	2.6–3.4	8.9–9.6
n 18	n 18			n 18		n 18	n 11	n 11	n 11	n 11
East Africa	63.7	82.4	129%	—	—	—	19.25 *	3.03	2.9	9.17
	55–70	71–100					17.5–21.1	2.8–3.3	2.5–3.3	8.4–9.8
	n 29	n 29					n 29	n 28	n 29	n 26
South Africa	63.5	85	134%	16.5	14	8.2	—	—	—	—
	54–80	74–103		15–20	12–16	6–14				
	n 34	n 34		n 33	n 27	n 17				
Africa	—	—	—	—	—	—	19.4	3.10	2.87	9.33
							17.6–21.6	2.8–3.4	2.5–3.5	8.7–10.0
							n 47	n 48	n 71	n 66

sal stripe of eight specimens from South Sudan is correct: „The type specimen of *D. p. lineatus* has a pronounced mid-dorsal black stripe. None of the specimens in the present series shows this intense black stripe, but all agree with the remainder of the type series of *lineatus* in showing only a faint suggestion of this marking. It is quite apparent that Heller selected the most strikingly marked specimen, rather than an average one, to name as the type”. Most skins of the 17 *D. mystacalis* from South Sudan have the mid-dorsal stripe poorly developed and thus confirm SETZER’s description (Fig. 2). In three specimens the stripe is absent. In samples of Ugandan *lineatus* some specimens lack a dorsal stripe, but the dorsal colouration is exactly as in typical specimens.

Body and skull measurements. Measurements of body and skull (Table 1) show that the Sudanese specimens agree very well in size with other populations of *D. m. lineatus* and also with other forms of *D. mystacalis*. With the exception of the Ethiopian sample, all (so-called) *mystacalis* agree very well in size, appearance and characteristics of skull and dentition (Figs. 3, 4; see also DIETERLEN 1971; DIETERLEN & RUPP 1978).

Altitudinal distribution. *D. mystacalis* (except for the Ethiopian form) can be characterized as an inhabitant of the Afro-tropical moist savannah, preferring relative open grassy (dry and moist) biotopes. The altitudinal range of their habitats in S Sudan and N Uganda varies between 500 and 1000 m; the northernmost occurrence seems to be limited roughly by the 1400 mm-isohyete of annual precipitation. KINGDON (1974) wrote “It is a low altitude species and is not found much above 2000 m”. This may be true for many regions, but not everywhere. In Ethiopia (typical region of *D. mystacalis*) the distribution ranges from 1200 to 3800 m, predominantly between 2000 and 3000 m. NE and E Congo: Garamba NP 700–1000 m (MISONNE 1963; VERHEYEN & VERSCHUREN 1966); Ishango, Virunga NP 950 m (VERHEYEN al. 1983); Lwiro (Kivu Highland) ca. 1500–2000 m (DIETERLEN 1971, 1976). Kenya: Taita Hills ca. 1800 m, Kaimosi ca. 1800 m (HOLLISTER 1919). Tanzania: Oldeani ca. 2000–3000 m (DIETERLEN unpubl.). Malawi: Nyika Plateau ca. 2150 m (ANSELL & DOWSETT 1988). Southern Africa (incl. Zimbabwe, Zambia, Mozambique): DE GRAAF (1981; SKINNER & SMITHERS 1990).



Fig. 3. Skull of a large adult *Dendromus mystacalis lineatus* (SMNS 14748; greatest length of skull 21.17 mm) from the Kivu area, D. R. Congo. Note the rounded braincase, strong interorbital region, almost squarish zygomatic arches, and long incisive foramina.

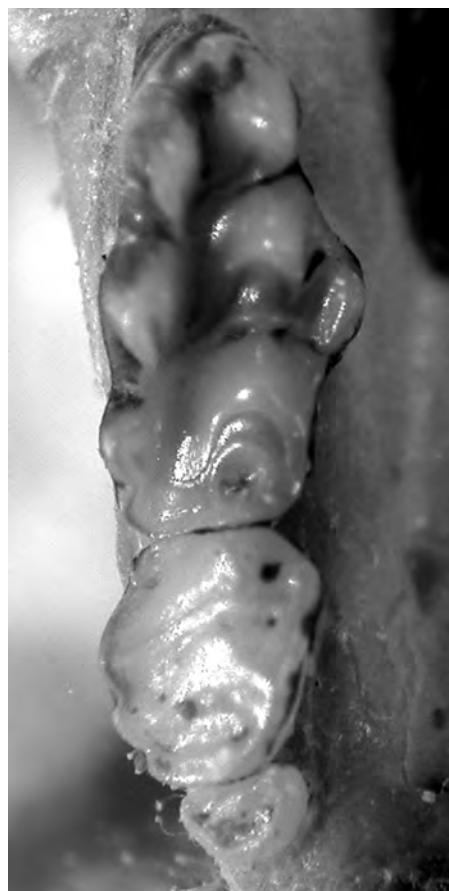


Fig. 4. Upper right molars of *Dendromus mystacalis lineatus* (SMNS 14750). Note the large M1 with biserial cusps and a longitudinal valley, separating the labial t3, t6, t9 from the lingual "t0", t2, t5, and t8. A "t4" is lingually attached to t5; the cusp pattern on M2 is still visible but heavily worn; M3 very small, as typical for the genus.

Habitat. In Ethiopia the species is “nearly always associated with long grass and bushes” (YALDEN et al. 1976; RUPP 1980). NE Congo, Garamba NP: dry savannah, but found there in moist habitats around swamps etc. (VERHEYEN & VERSCHUREN 1966). Congo (Kivu Highland): moist savannah, but only in relative dry grassy habitat mixed with bush vegetation, possibly due to competition with two other species of *Dendromus* (DIETERLEN 1971). N Kivu: «biotope caractéristique, végétation élevée, broussailleuse, que l'on trouve sur les bords des marais nombreux qui occupent les fonds de toutes les vallées» (MISONNE 1963). E Africa: “*D. mystacalis*... has adapted to cultivation quite readily ...” (KINGDON 1974). Southern Africa: grassland associated with rank vegetation, especially stands of high coarse grasses such as *Hyparrhenia* sp. at 1–2 m height (DE GRAAF (1981; SKINNER & SMITHERS 1990).

Nest. “This is the species to which the only positive tree-dwelling records are attached, but the habitats of the different forms and apparently of the same form in different locations, are variable” (ROSEVEAR 1969, on *D. mystacalis*). For East Africa KINGDON (1974) noted, “.. it is not unusual to find nests in garden shrubs, banana trees and banana bunches, in sweet potato vines, pineapples, palms and in thatched roofs. Their nests may be three metres or more from the ground but are generally lower down in thick herbaceous vegetation.” OWEN (1953) provided the following information on nest sites for Sudanese records of *D. mystacalis*: “in tree, in banana garden, under stone, swamp near river, tree near river.” The species is certainly more common than the small number of specimens in museum collections may suggest, probably because of its small size and weight (10 g). Moreover, because of its climbing habits it comes down to the ground where traps are placed only occasionally (DIETERLEN 1971).

Dendromus sp.

An almost unbelievable observation was reported by HEUGLIN & FITZINGER (1866) and HEUGLIN (1877) but never cited in the scientific literature: HEUGLIN collected specimens of *Dendromus* on the Nile island Argo near Dongola (19.13 N, 30.27 E) in N Sudan, that is, in the middle of the Nubian desert.

The original text (in German) of HEUGLIN & FITZINGER (1866) reads: “Anmerkung. Aus dieser Gattung kommen in Nubien, Ost-Sudan und Abyssinien verschiedene Arten vor. Leider sind Heuglin die beiden auf der Insel Argo bei Dongola und im Belegas-Thale in Abyssinien von ihm eingesammelten in Verlust geraten, bevor er dieselben genau untersuchen und die Art bestimmen konnte.“ HEUGLIN (1877) wrote: „Bisher kannte man nur

südafrikanische Vertreter der Gattung der Baummäuse (*Dendromys*). Mir ist es gelungen, mehrere hierher gehörige Arten in Nordostafrika aufzufinden. Leider sind mehrere der gesammelten Exemplare in Verlust gerathen, namentlich einige, welche wir in Vogelnestern auf der Insel Argo bei Dongolah erbeuteten, andere im Belegas-Thal...“. In brief, he collected several *Dendromus* in bird nests on the island of Argo but the specimens were unfortunately lost before they could be studied properly. HEUGLIN'S (1863) descriptions of two forms from Ethiopia, *D. mystacalis* and *D. pallidus* (now a synonym of *D. melanotis*), is good proof that he perfectly knew these rodents. Therefore there is no reason to question that his specimens from Argo Island were members of the genus *Dendromus*. HEUGLIN'S (1877) report suggests that he himself participated in the capture of the animals.

I became aware of this bibliographic record rather late, around 1995, but had already earlier (DIETERLEN 1971, p. 130) expressed the assumption that specimens of *Dendromus* could have existed along the White Nile in S Sudan during times of a more favourable climate. It is common notion now that *Dendromus* (and other animals) had the opportunity to disperse from the Upper Nile region in Uganda northwards as early as 10.000 yrs B.P., when the tropical rain forest began to extend northwards, along with the connected savannah belt. During that period the White Nile gained its role as a large river with an enormous climatical influence, as it has today (see KENDALL 1969; LIVINGSTONE 1975; HAMILTON 1982). In the absence of fossil evidence or recent records that could document a northward dispersion, we can however presume that abundant dry or moist grassland habitat suitable for species of *Dendromus* existed in the Bahr-el-Ghazal region.

It is not known whether *Dendromus* still exists on Argo Island. How did these animals reach that remote place? One possibility is by natural dispersal during a longer favourable (moist) Quaternary period (ca. 8000–3000 B.P.; see LIVINGSTONE 1975) in the Sahara. Then its historical occurrence on Argo Island would have been extremely isolated. An alternative would be a displacement on a ship during historical times along the White Nile (by more than 2000 km), or from the Ethiopian Highlands or the lower parts of the Blue Nile valley, or downstream the Atbara River.

Dendromus melanotis (A. Smith, 1834)

Not recorded from Sudan, but the presence of *D. melanotis spectabilis* Heller, 1911 cannot be excluded because it occurs at Rhino Camp, Uganda, just about 100 km away from the Sudanese border. The forms *spectabilis* and *nigifrons* True, 1892 are probably closely related and are

both treated as synonyms of *D. melanotis* by MUSSER & CARLETON (2005).

Dendromus messorius (Thomas, 1903)

Distributed in W Africa (Ghana to Cameroun), D. R. Congo, Uganda and Kenya. MUSSER & CARLETON (2005) recorded specimens from S Sudan, two from Torit (USNM 299 833–834), and another specimen from the former locality Gondokoro in the region of Juba. The form *ruddi* Wroughton, 1910 is known from Rhino Camp, Uganda. *Dendromus messorius* prefers moist habitats and was mostly recorded from open areas close to rain forest (HATT 1940; DIETERLEN 1971). The species can be confounded with *D. mystacalis* because of its white belly and the frequent absence of a mid-dorsal stripe. Both species may occur sympatrically (HATT 1940).

Dendromus ruppi n. sp. (Figs 5, 6, 7)

Dendromus mesomelas subsp.: Setzer 1956

Holotype. SMNS 27 572, skin (mounted on cardboard) and skull of adult female; field number 447; collected 23 April 1978 by Hans Rupp. Condition of skin and skull good. Standard measurements (in mm): Head and body length 74 mm, tail 112 mm, hindfoot 19 mm, ear 15 mm, weight 10 g.

Paratypes (17). ZMUC 10805, Gilo/ Sudan, leg. J. S. Owen; ZMUC 14121, Gilo, leg. J. S. Owen; ZMUC 14124, Gilo, leg. J. S. Owen; ZMUC uncatalogued, field no. 978, Gilo, leg. J. S. Owen; MCZ 45256, Gilo, leg. J. S. Owen; MCZ 45265, Gilo, leg. J. S. Owen; SMNS 27235, Gilo, leg. G. Nikolaus, field no. 386; SMNS 27236, Gilo, leg. G. Nikolaus, field no. 387; SMNS 27570, Gilo, leg. H. Rupp, field no. 388; SMNS 27571, Gilo, leg. H. Rupp, field no. 408; SMNS 27572, Gilo, leg. H. Rupp, field no. 447; SMNS 27573, Gilo, leg. H. Rupp, field no. 508; SMNS 27574, Gilo, leg. H. Rupp, field no. 540; SMNS 27575, Gilo, leg. H. Rupp, field no. 541; SMNS 30086 Gilo, leg. G. Nikolaus, field no. 1503; SMNS 30087, Gilo, leg. G. Nikolaus, field no. 1518; SMNS 30088 Gilo, leg. G. Nikolaus, field no. 1519.

Type locality. Gilo, Imatong Mts., East Equatoria, South Sudan; altitude ca. 1800–1900 m. Two habitats were noted by Rupp and Nikolaus: “near the potato farm” and “in grassy biotopes around a swamp”.

Diagnosis. A species of *Dendromus* resembling *D. mystacalis*, but clearly larger in head and body length and in



Fig. 5. Skins of 6 specimens of *Dendromus ruppi* n. sp. in dorsal and ventral view. From left to right: SMNS 27235, 27236, 27574, 27575, 30086, 30087 (all paratypes).

Table 2. Body and skull measurements of the specimens of *Dendromus ruppi* n. sp. collected in the area of Gilo.

Mus.	No.	age	HB	TL	HFL	EL	WT (g)	GRLE	M1–M3	INT	BRG–W
ZMUC	10805	—	82	91	20	14	—	—	—	—	—
ZMUC	14124	—	74	104	20	13	—	—	—	—	—
ZMUC	14121	—	79	106	20	17	—	c. 22.5	—	—	—
ZMUC	(978)	—	77	95	20	13	—	—	—	—	—
MCZ	45256	2	69	98	18	14	—	22.1	—	—	—
MCZ	45265	3	76	107	19	13	—	c. 23.0	—	—	—
SMNS	27235	3	75	110	20	15	12	23.3	3.63	3.4	11.0
SMNS	27236	2	74	108	20	15	15	22.1	3.53	3.3	10.7
SMNS	27570	—	72	98	19	15	11	—	—	—	—
SMNS	27571	5	74	110	19	14	10	—	3.38	—	—
SMNS	27572	3	74	112	19	15	10	22.4	3.47	3.4	10.3
SMNS	27573	—	63	98	19	14	8	—	3.56	—	—
SMNS	27574	4	69	109	21	16	11	—	3.54	—	—
SMNS	27575	3	70	99	20	16	10	—	3.64	—	—
SMNS	30086	2	81	115	22	18	15	23.9	3.61	3.5	11.1
SMNS	30087	2	69	94	20	16	10	22.4	3.50	3.3	10.1

absolute tail length: *D. mystacalis* 82.0 mm (Sudan), 93.4 mm (Ethiopia) vs. *D. ruppi* 103.4 mm. Underparts purely white, median dark stripe on dorsum and head present in all specimens studied. A tuft of white hairs is present at the ear basis.

Distribution. At present only known from the region of Gilo in the Imatong Mountains, Sudan.

Description. A small *Dendromus* resembling *D. mystacalis*, but clearly larger and with a much longer tail (Fig. 5). Characterized by white underparts, the hairs white from base to tip. Underparts well delimited from the typical brownish pelage on head and dorsum. The blackish mid-dorsal stripe is variable in length but never absent; normally extending from the neck back to the middle dorsum or even to the base of the tail; forward from the neck the stripe (the colour now changes to dark brown) may reach

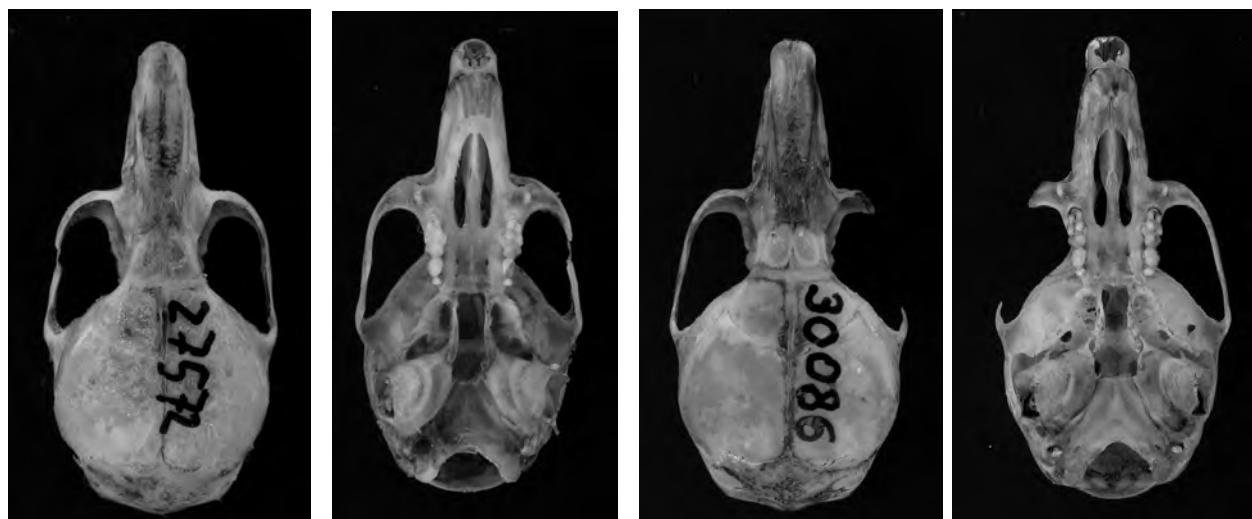


Fig. 6. Two skulls of *Dendromus ruppi* n. sp. in dorsal and ventral view. Left, SMNS 27572 (holotype), a specimen of medium size (22.4 mm); right, SMNS 30086, the largest specimen (23.9 mm). Note the well rounded braincase and the shape of the zygomatic arches compared to *D. mystacalis* (Fig. 3).

Table 3. A comparison of body and skull measurements of *Dendromus ruppi* n. sp., *D. mystacalis* from the South Sudanese lowland, and the Ethiopian *D. mystacalis*. Mean, range, and sample size given. RTL = relative tail length.

Species	HB	TL	RTL	HFL	EL	WT (g)	GRLE	M1–M3	INT	BRC–W
<i>D. ruppi</i> (Gilo)	73.6 63–82 n 16	103.4 91–115 n 16	140%	19.8 18–22 n 16	14.8 13–18 n 16	11.2 8–15 n 10	22.7 22.1–23.9 n 8	3.54 3.38–3.64 n 9	3.38 3.3–3.5 n 5	10.62 10.0–11.1 n 5
<i>D. mystacalis</i> (Sudan)	60 53–68 n 11	82 72–91 n 11	137%	17.2 16–18 n 10	11.9 11–14 n 7	—	19.6 18.7–20.7 n 8	3.14 2.84–3.31 n 4	—	—
<i>D. mystacalis</i> (Ethiopia)	66.4 58–76 n 10	93.4 84–108 n 10	141%	17.3 16–20 n 10	13.7 11–18 n 9	—	21.52 20.3–22.6 n 6	3.35 3.13–3.63 n 7	3.23 3.09–3.40 n 6	9.79 9.37–10.50 n 5



Fig. 7. Upper right molars of *Dendromus ruppi* n. sp. (SMNS 30086). Cusp pattern on M2 starting to wear down; M3 typically small.

its end between the eyes. A black hair spot on the heels, as typical for the genus. The hind feet are reddish brown. The short hairs on the ears are also reddish brown. There is a small but distinct spot of white hairs at the base of the ears. The upper side of the tail is pigmented dark but bears short light bristles. Mammary formula 2 – 2 = 8. D 5 of hind foot bearing a short claw.

The skull (Fig. 6) has the typical characteristics of the genus: rounded braincase, narrow zygomatic plate and a distinct masseteric knob at its lower anterior corner. Anterior edge of supraorbital bow smooth (not chambered). Upper incisors longitudinally grooved. M1-length about 57% of upper molar row, M2 ca. 35%, M3 minute. Molars (Fig. 7) rather narrow, breadth of M1, M2, M3 clearly larger than in *mystacalis* (see below). The posterior part of M1 behind its prominent t8 relatively broad in appearance (but similar to the same area of *D. mystacalis*). In most specimens t9 is worn down on the labial side and appears crater-like.

Measurements. Tables 2, 3.

Ecological and biological data. Three out of seven specimens in the SMNS were collected in a swamp near Gilo at c. 1800 m, and four in the area of the (so-called) “potato farm” above Gilo (c. 1900 m). The two MCZ specimens came from a “nest in olive tree” (SETZER 1956). The SMNS sample comprises six males and five females, collected between April 1978 and August 1979. A female caught in April 1978 had four embryos (13 mm in diameter); four males caught between April and July had testicle diameters of 3, 5, 5, and 6 mm, respectively.

Comparisons. *Dendromus mystacalis lineatus* in Sudan is a lowland species, with its highest altitudinal record in Katire at c. 1000 m, on the foothills of the Imatong Mts.

Table 4. Measurements of body and skull of *D. mystacalis* from Ethiopia. Age class 1 sem.-young adult, 2 young adult, 3 adult, 4 adult/old adult, 5 old adult.

Coll.No.	age class	HB	T	HF	E	WT (g)	GRLE	M1-M3	INT	BRG-W
BMNH 28.1.11.143	3	71	87	18	13	—	21.71	3.60	3.19	9.37
BMNH 128.1.11.144		—	61	94	18	15	—	—	—	—
BMNH 28.1.11.145	3	67	84	17	18	—	21.53	3.30	3.09	9.70
BMNH 28.1.11.146	1	58	89	16	14	—	20.27	3.24	3.17	—
BMNH 1934.2.24.88	—	58	87	16	13	—	—	—	—	—
BMNH 59.660	—	65	95	16	13	—	—	—	—	—
BMNH 70.655	4	76	105	17	12	—	22.31	3.42	3.40	9.78
BMNH 70.656	2	64	96	16	11	—	20.68	3.13	3.24	9.63
SMNS 23720	2	71	108	19.5	—	13	—	3.43	—	—
SMNS 23732	4	73	89	18	14	—	22.61	3.33	3.28	10.50
Mean range n	—	66.4 58–76	93.4 84–108	17.3 16–20	13.7 11–18	—	21.52 20.3–22.6	3.35 3.1–3.6	3.23 3.1–3.4	9.79 9.4–10.5
		n 10	n 10	n 10	n 9		n 6	n 7	n 6	n 5

Other populations (outside Ethiopia) are also known from lower altitudes (BOHMANN 1942; DIETERLEN 1971; KINGDON 1974; ANSELL & DOWSETT 1988). The typical *D. mystacalis* from the Ethiopian Highlands, however, is exclusively a high mountain animal. *D. ruppi* is also a highland species, known from the Imatong Mts. at altitudes between 1800 and 1900 m. On the neighbouring Mt. Kinyetti (3187 m, the highest peak in Sudan Republic) an occurrence at even higher altitudes may be possible up to about 2500 m.

D. ruppi and (non-Ethiopian) *D. mystacalis* share the white pelage of the underside and further characters, but *D. ruppi* is considerably larger in external, cranial, and dental measurements (length of upper molar row, Table 5). The dorsum of *D. ruppi* is darker than in *D. mystacalis* and always shows a mid-dorsal stripe. There are further differences in the breadth of the molars between *D. ruppi* ($n = 9$) and *D. mystacalis* ($n = 5$). M1 from “t1” to t6: *ruppi* 1.14 mm (1.02–1.21) vs. *mystacalis* 1.02 mm (0.98–1.05). M2: *ruppi* 0.97 mm (0.86–1.04) vs. *mystacalis* 0.83 mm (0.80–0.86). M3: *ruppi* 0.49 mm (0.47–0.53), no data available for *mystacalis*.

Comments. SETZER (1956) discussed two specimens of *Dendromus* from Gilo/Imatong Mts., South Sudan, in the MCZ: “These two specimens are somewhat darker than *D. mesomelas percivali* (now a synonym of *D. insignis*, according to MUSSER & CARLETON 2005) from Mount Gargues, British East Africa. The external measurements agree rather well with *percivali*, but the skulls of the Gilo specimens, even though adult, are markedly smaller... It is apparent that these animals from the Imatong Mountains are different from any of the surrounding kinds, but owing to the broken condition of the skulls and there being only the two specimens I feel it best to identify them only at the specific level.” SETZER (1956) did not know that J. S. Owen, the collector of the MCZ specimens, had already sent another four specimens from the same locality to the ZMUC at Copenhagen, which Setzer could not consider in his paper. He also failed to recognize that the specimens had entirely white underparts and therefore could not belong to *D. mesomelas*. In the latter species the hairs of the underside are brownish-grey with an always dark basis, only on the throat and in the anal region they can be whitish (BOHMANN 1942; ROSEVEAR 1969; DIETERLEN 1971). Contrary to Setzer’s statement, one of the

skulls of the specimens at Harvard (MCZ 45 256) was not damaged (measurements in Table 4) and the other (MCZ 45 265) had already been repaired by MCZ staff when I measured it in 1988 (Table 4). The occurrence of *D. mesomelas* (now *D. insignis*) in the mountains of South Sudan could be expected, because *D. insignis* was already known then from high altitudes of neighbouring Ethiopia, Kenya, and Uganda.

Besides the Imatong Mts., mountains neighbouring to the east (Dongotona and Didinga Mts.) could also be populated by *D. ruppi*, at least above 1800 m. For the present, however, *D. ruppi* must be regarded as a species endemic to the Imatong Mts. which became isolated as a result of climatic changes during a drier Pleistocene postglacial/pluvial phase in Equatorial Africa (RUPP 1980; LIVINGSTONE 1975).

Etymology. I dedicate this new species to my deceased friend and colleague Hans G. Rupp. Hans died on 15 June 1979 at the age of 32, after several weeks of severe illness in a hospital in Nairobi/Kenya, to where he had been transported from South Sudan. As a student of zoology at the University of Tübingen, Germany, he had begun extensive fieldwork for his doctoral thesis on rodents and their entoparasites in southern Sudan 17 months before. In the early 1970s he undertook a number of research travels to Ethiopia and published the results about systematics, distribution and ecology of Ethiopian rodents (DIETERLEN & RUPP 1976, 1978; RUPP 1980).

3.2. Species of *Dendromus* in Ethiopia

Four species of climbing mice are known within the territory of Ethiopia:

Dendromus mystacalis (Heuglin, 1863)

Holotype. SMNS 1055; a specimen collected by Heuglin in 1863 and sent to the *Stuttgarter Naturalienkabinett* (now SMNS) where it was registered under no. 1055 in the (Accession-) Catalogue for mammals, founded in 1837. The well-preserved specimen was mounted in a climbing posture on a short vertical branch, anchored in a wooden pedestal (Fig. 8). No skull is preserved. The inscription on the label reads: "1055 Typus! male *Dendromus mystacalis* Hgl. Eifaz, Abyss. v. Hgl. 1863". Based on its size and the measurements given by HEUGLIN (1863) the specimen was subadult. After 144 years of preservation the reddish-brown dorsal pelage has become dull and the (originally?) weakly developed mid-dorsal stripe disappeared. However, the blackish-grey basal part of the hairs remains unchanged. HEUGLIN's original description (in German) reads:



Fig. 8. Mounted holotype (SMNS 1055) of *Dendromus mystacalis* (HEUGLIN, 1863).

„Oberseite und Außenseite der Füße zart rostig ockerfarben; Unterseite ein eckig nach den Zügeln einspringendes Feld, das von den Halsseiten ausgeht und bis unter und vor das Auge reicht, sowie Innentheile der Behaarung der Füße rein weiß; beide genannte Farben streng von einander geschieden; auf der Rückenmitte schwache Andeutung eines graulichen Längsstreifes. Schnurrren schwärzlich; hinter der Ohrbasis ein hell ockerfarbiger Fleck; Schwanz lang, schlank, mit sehr zarten Härtchen ziemlich dicht besetzt; Nasenkuppe, Nägel und Zehenballen fleischfarbig. Auge mittelgroß, hervorstehend, braun; längs der Außenseite der oberen Schneidezähne eine starke Furche. Körperlänge 2" 5" (= 65 mm, given in the old German measurement Zoll). Schwanzlänge 3" (= 75 mm). Ohrhöhe stark 15" (= > 15 mm). Das Ohr zu beiden Seiten etwas um- und eingebogen; ausgebreitet so breit als hoch. Wir erbeuteten nur ein einziges Exemplar dieser zierlichen Art, und zwar im Horst eines Raubadlers, wo das Thierchen wohl 40 Fuß über dem Boden, seine Behausung aufgeschlagen hatte. Im Magen fand sich ein grüner Pflanzenschleim. Vorkommen in der Ebene von Eifag in Central-Abessinien, auf 6000 Fuß Meereshöhe.“

Table 5. Comparison of body and skull measurements summarized from published collections of *D. mystacalis* of Sudan (this paper); Congo (DIETERLEN 1971); East Africa (HOLLISTER 1919); South Africa (DE GRAAFF 1981), and Africa (globally, BOHMANN 1942), and those from the highlands of Ethiopia (this paper) (Data given by VERSCHUREN, VAN DER STRAETEN & VERHEYEN 1983 from Congo and Rwanda are not included but confirm the summarized measurements of Africa).

Measurement	Africa	Ethiopia
HB	63.5 mm (53–80) n 92	66.4 mm (58–76) n 10
T	82.0 mm (63–100) n 92	93.4 mm (84–108) n 10
HF	16.6 mm (15–20) n 61	17.3 mm (16–20) n 10
E	13.0 mm (10–17) n 52	13.7 mm (11–18) n 9
WT	8.15 g (4–14) n 35	—
GRLE	19.5 mm (17.5–21.6) n 88	21.52 mm (20.3–22.6) n 6
M1–M3	3.10 mm (2.8–3.5) n 91	3.55 mm (3.13–3.63) n 7
INT	2.87 mm (2.5–3.5) n 111	3.23 mm (3.09–3.40) n 6
BRC-W	9.30 mm (8.4–10.0) n 103	9.79 mm (9.39–10.50) n 5

Comparison of the holotype with further specimens collected. Since the type seems to have never been studied or compared, and Heuglin's description was barely consulted, a comparison with further *mystacalis* specimens from Ethiopia and other parts of Africa has probably not been undertaken. Annotations as to literature, distribution and collections can be found in the "Catalogue of the Mammals of Ethiopia" (YALDEN et al. 1976, 1996) and in papers with isolated data or single unpublished records. Yet, no critical comparisons of the Ethiopian *mystacalis* with all other forms designated as *mystacalis* seems to have taken place.

Material of Ethiopian *D. mystacalis* studied. BMNH 1934.2.24.88, Bab Bar Sir, Wuha River, 3 miles N of Lake Tana, Cheeseman Collection; BMNH 59.660, Sidamo (07.00 N/ 36.30 E), coll. F. K. Allison; BMNH 70. 655, Mouth of Didessa River (10.05 N/35.38 E), coll. Great Abbai Expedition 1968; BMNH 70. 656, Junction of Nile and Guder River, Blue Nile Gorge (09.50 N/ 37.41E), same Expedition; BMNH 28.1.11.142, 28.1.11.143, 28.1.11.144, 28.1.11.145, all from Dangila, S of Lake Tana (11.17 N/ 36.56 E); BMNH 28.1.11.146, Kolaj village, Domkan River (10.42 N/36.31 E), all by Cheeseman Collection; SMNS 1055, Eifag (Eifaz) (12.03 N/37.46 E), T. von Heuglin (holotype); SMNS 23720, Chencha (06.16 N/37.40 E), H. RUPP; SMNS 23732, Dorsey (Dorse) (06.13 N/37.40 E), H. Rupp.

Description. Generally little colour variation among the forms of *D. mystacalis*. The colour of the upper parts of Ethiopian specimens is very similar compared to other forms: a brownish- or ochre-grey (also reddish tinge) over the whole back and head. Only the terminal part (2–3 mm) of the pelage hairs is coloured as described, the basal part of the dorsal hairs is uniformly dark grey. The black mid-dorsal stripe is variable (Fig. 9): in four specimens the stripe is complete from neck to root of tail, in three other specimens the stripe is thin and not visible throughout its length, and in four there is no mid-dorsal stripe at all; see also YALDEN et al. (1976). No geographical variation in this character could be observed. The underside is pure white from chin to belly. Like in all species of the genus there is a dark spot of hairs just above the heels (DIETERLEN 1971). The hairs of the dorsal surface of the hind foot are somewhat reddish-brown as are the short hairs on the ears. The skin of the short-bristled tail is pigmented dark on the upper side and whitish below.

Localities and altitudes (Fig. 10). Altitudes mostly as given by collectors or/and authors. Alemaya, Lake 2100 m (09.21 N, 42.01 E); Axum, S of, 2100 m (14.08 N, 38.45 E); Bab Bahr, 3 miles N Lake Tana, 1800 m (12.16 N, 37.07 E); near Boralugu, 3000 m; Chencha, 9 km N, 2700 m (06.16 N, 31.40 E); Dangila, 2000–2100 m (11.17 N, 36.56 E); Debre Tabor, 2500 m (11.50 N, 38.02 E); Didessa River (mouth), 1200 m (10.08 N, 35.38 E);



Fig. 9. Skin of a *Dendromus mystacalis* (SMNS 23732) from Ethiopia.

Didessa River (near Guma), 1900 m; Domkan (Dibken), 2000 m; Dorse (Dorsey), S, 2600–3000 m (06.13 N, 37.40 E); Eifag (Eifaz, Ifag), 2000 m (12.03 N, 37.46 E); Guder River, junction of Nile, 1800 m (09.50 N, 37.41 E); Harennna Forest, 2000 m; Katcha, S Mt. Batu, 2400 m (06.42 N, 39.44 E); Kebre Mengist, 70 km NW. 1680 m (06.23 N, 38.35 E); Kolay (Golay), Domkan River, 1600 m (10.42 N, 36.31 E); Ladjo, NW Mt. Goba, 3850 m (07.08 N, 39.33 E); Masslo, c. 40 km SW Mt. Goba (06.42 N, 39.50 E); Menagasha Forest, c. 2800 m (08.55 N, 38.37 E); Mt. Badda, W (07.50 N, 39.45 E); (Mt.) Goba, 2800 m (07.01 N, 39.59 E); Sidamo, Arussi, 2500 m (07.40 N, 39.45 E); Simien Mts. National Park, 3100–3600 m (c. 13.15 N, 37.50 E). The altitudinal distribution varies between 1200 and 3850 m, with most records between 2000 and 3000 m. The collecting localities are scattered over a vast region encompassing large parts of the western and central highlands (YALDEN et al. 1976). *D. mystacalis* occurs in the vegetational zone of Woina Dega (ca. 1500–2300 m), including the (so-called) Highland Zone and the lower Montane Zone. Above Woina Dega the species ascends up to 2300–3300 m, reaching parts of the upper Montane and lower Temperate Zone (RUPP 1980).

Habitat. "This species has been recorded from a wide range of altitudes (900–3200 m) but is nearly always as-

sociated with long grass and bushes." (YALDEN et al. 1976). In the Menagesha Forest, BEKELE (1996) found *mystacalis* in bush vegetation (dominant plant *Carissa edulis*). Preferred habitats in the Simien Mountains National Park are Giant Heath (*Erica arborea*) forests with thick undergrowth (MÜLLER 1977; MUHMENTHALER 1999; WEHRLI 1999). Notes on biotopes and nests of *D. mystacalis* are as follows: Heuglin's type came from a nest 40 ft. high in a tree with an eagle's aerie. Three specimens of the Cheeseman collection (at Dangila) were taken at considerable height in trees: "in a straw bee hive, 30 feet from ground", "same grass nest in tree in high grassland", "same tree as in...". Similar observations were made in other regions of Africa. In East Africa the species often frequents disused weaver and bishopbird nests. In the Kivu region, however, nests of *D. cf. mystacalis* were never found in trees, but in the absence of trees and shrubs in dry grassy biotopes with *Melinis minutiflora* and other Gramineae; nests were found between stems of grass. *D. mystacalis* was rarely seen in moist grassy biotopes (DETERLEN 1971).

Comparisons. A comparison of body and skull measurements of *D. mystacalis* samples (Tables 1, 4, 5) from various regions of Africa, but excluding Ethiopian populations, revealed surprising results. Mean values for each character (Table 5) were compared with the relatively small Ethiopian sample. In most measurements a distinct difference exists between the true Ethiopian *mystacalis* and the remaining populations, particularly in the relative tail length, length of skull, and other skull measurements.

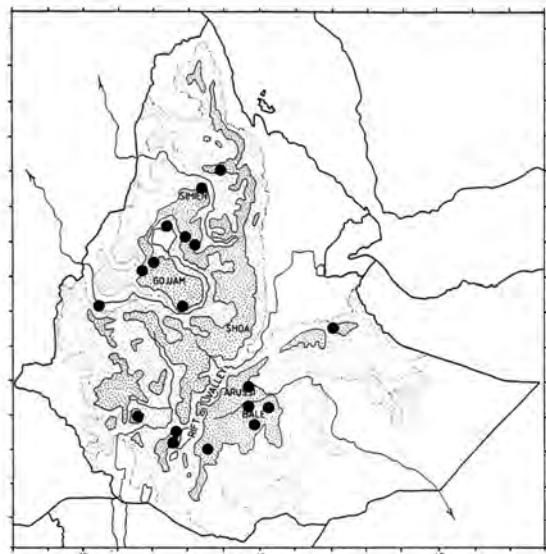


Fig. 10. Distribution of *Dendromus mystacalis* in Ethiopia.

A further difference is altitudinal distribution: Ethiopian *mystacalis* have a strictly montane distribution, while the forms which occur outside Ethiopia occur principally below 2000 m. These results question the conspecificity of all the described forms within *D. mystacalis*, an issue which should be addressed in the future, including genetic data. The description of HEUGLIN (1863) and the characters of the type specimen apply only to the Ethiopian populations. All the similar but clearly smaller non-Ethiopian forms, considered at present as part of *D. mystacalis*, may belong to one or more other species. The status of all the populations of *D. mystacalis* outside of Ethiopia should be reconsidered. The names *Dendromus ansorgei* Thomas & Wroughton, 1905 (Angola) and *D. jamesoni* Wroughton, 1909 (South Africa) are candidates for a possible lowland species.

Dendromus melanotis (A. Smith, 1834)

YALDEN et al. (1976, 1996) listed four specimens from three localities at altitudes between 1200 and 2500 m. Another specimen (AMNH 81119) was recorded by MUSSER & CARLETON (2005). Another three specimens not yet published were collected by H. Rupp near Chencha (2400–2700 m): two adults (SMNS 23721, 23722), one subadult (SMNS 23723). Measurements of the adults are: HB 64, 78 mm; T 85, 94 mm; HF 19, 19 mm; EL 15, 15 mm; GRLE 22.45, 22.51 mm; M1–M3 3.36, 3.51 mm; BRC–W 10.51, 11.04 mm.

No material of the form *pallidus*, described by HEUGLIN (1863) and listed as a synonym *melanotis* by MUSSER & CARLETON (2005), was available for study. Heuglin wrote “*Lippengegend und die Unterseite rein weiß*“ (area of the lips and underparts pure white), but without mentioning the grey basis of the white hairs, typical for *melanotis*, and without comparing it with his type specimen of *D. mystacalis*.

Dendromus insignis (Thomas, 1903)

The taxon *insignis*, formerly included in *D. mesomelas* by BOHMANN (1942) and MISONNE (1974), is considerably larger than the South African species *D. mesomelas*. OSGOOD (1936) was right to describe his record from the E slope of Mt. Albasso, Ethiopia, as *D. insignis abyssinicus*, now known by several more specimens from the highlands. Three specimens in the BMNH (72.1294, 72.1295, 76.113, leg. Largen et al. 1971) recorded from “Bale Dinschu” above 3000 m, and labeled as *D. mystacalis*, are unmistakably *D. insignis* (Dieterlen, unpubl.). Two further adult specimens from the same region were collected by H. RUPP and G. NIKOLAUS in 1971 and 1976 (SMNS

23724, 23983). Measurements: HB 68, 75 mm; T 103, 101 mm; HF 22/23, 21/22; EL 17, 12 mm; WT -, 10 g; GRLE -, 22.08 mm; M1–M3 3.52, 3.31 mm; BRC–W -, 10.94 mm.

Dendromus lovati (De Winton, 1899)

Endemic to Ethiopia. A distinctive small species, very different from all congeners (HB 68–90 mm, T 72–80 mm, WT 12–16 g). Not very common, at least not in trapping yields. Altitudinal distribution 2500 to 3550 m. Preferred habitats are grassland and giant heath (*Erica arborea*) forests (YALDEN et al. 1976, 1996; MÜLLER 1997; MUHMENTHALER 1999).

Material studied. One specimen from Ankober (SMNS 23927). leg. G. Nikolaus.

Acknowledgements. I express my sincere thanks to Dr. Paulina Jenkins for her kind help during my repeated visits of the British Museum of Natural History, London (BMNH). I am grateful to several curators for assistance in the following museums and for the loan of important specimens: Dr. Hans Baagoe, Zoological Museum of the University of Copenhagen (ZMUC); Dr. Maria Rutzmoser, Museum of Comparative Zoology (MCZ) at Harvard University, Cambridge (Mass.); the late Dr. Henry W. Setzer (in 1976) and Dr. Michael Carleton, United States National Museum (USNM), Smithsonian Institution, Washington D.C., Dr. Rainer Hutterer and Dr. Gustav Peters, Zoolisches Forschungsmuseum Koenig (ZFMK), Bonn. Some of these visits were supported by the Deutsche Forschungsgemeinschaft (DFG), Bonn. In 2006 my research as a visitor in the collections of the BMNH was supported by SYNTHESYS (the European Union-funded Integrated Infrastructure Initiative grant). My sincere thanks to both of these funding organisations. Dipl. Biol. Kathrin Marquart (Stuttgart) and Uwe Vaartjes (Bonn) kindly assisted in the preparation of figures.

Zusammenfassung. Die in Äthiopien und Sudan vorkommenden Arten der Gattung *Dendromus* (Rodentia: Dendromurinae) werden revidiert. Die zu *Dendromus mystacalis* (Heuglin, 1863) gerechneten Formen der Klettermäuse aus Sudan und anderen Regionen Afrikas werden mit der typischen Population aus Äthiopien verglichen. Äthiopische *D. mystacalis* unterscheiden sich von anderen afrikanischen Populationen in ihrer Morphologie und im Lebensraum, während alle Populationen außerhalb Äthiopiens sich in Größe, Erscheinung gleichen und in ähnlichen Lebensräumen leben. Eine neue Art, *Dendromus ruppi*, wird nach Material aus den Imatong Bergen im Süd-Sudan beschrieben. Sie ist eine relativ große Bergform, die vermutlich während klimatischer Schwankungen in einer postpluvialen Phase des Pleistozäns isoliert wurde. Die neue Art ist vermutlich endemisch für die Imatong Berge.

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Received: 05.01.2008

Accepted: 30.05.2009