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Authors: Hemp, Claudia, and Kehl, Siegfried

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Taxonomic changes and new species of the flightless genus Parepistaurus Karsch, 1896 (Orthoptera: Acrididae, Coptacridinae) from mountainous East Africa

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Claudia Hemp and Siegfried Kehl

(CH) University of Würzburg, Dept. Animal Ecology and Tropical Biology (Zoology III), Am Hubland , 97974 Würzburg, Germany. Email: claudia.hemp@uni-wuerzburg.de
(SK) Bayreuth University, Dept. Animal Ecology II, 95440 Bayreuth, Germany. Email: siegfried.kehl@uni-bayreuth.de

Abstract

Two new species of the flightless genus *Parepistaurus,* occurring on high mountains of northern Tanzania, are described in this paper. *P. hanangensis* n. sp. is an inhabitant of the montane zone of Mt Hanang, a solitary volcano of northwestern Tanzania. *P. uguenoensis* n. sp. occurs in the North Pare Mts, a mountain range of the northern branch of the Eastern Arc chain. Both species have their closest relatives in species of adjacent situated mountain areas, as seen in their morphology and molecular phylogeny. Phylogenetic reconstructions were performed for three genes [16S rRNA gene, cytochrome oxidase subunit I (COI) and the histone gene H3], using different assumptions on sequence evolution. The closest relative of *P. uguenoensis* is *P. deses* from Mt Kilimanjaro, a geologically young volcano. The closest morphological and molecular relative of *P. hanangensis* is *P. manyara*, distributed along mountainous ranges of the rift-valley escarpment. The molecular relationship of the investigated taxa suggests that the subspecies of *P. deses* should receive species status.

Key words

new species, molecular phylogeny, Orthoptera, Eastern Arc, Tanzania, Mt Hanang, North Pare

Introduction

The genus *Parepistaurus* presently contains 20 species (Eades & Otte 2010) and is distributed over East to southern Africa, with its center of diversity in East Africa. Besides coastal forms, many species have adapted to montane habitats and are restricted to single mountain massifs or mountain ranges. A revision of this genus was conducted by Green (1998), listing all species, their distribution and referring to morphological relationships between the species. Green (1998) described 10 new *Parepistaurus* species and two new subspecies of *P. deses*.

The genus *Parepistaurus* is morphologically and ecologically very uniform. Species of this genus are flightless, the tegmina being reduced to oval lobes, not touching each other medially. External morphology provides little information on the phylogenetic relationship of the species. A good character separating species of *Parepistaurus* is found in the epiphallus of the males, while most females can only be identified by association with the males. All species dwell in forested areas, preferably along forest edges and beside forest clearings. Here they rest and feed on herbs of the undergrowth. Many species, especially the males, have a white patch on their abdomen, giving them camouflage, probably most effective against birds: this whitish patch gives them the appearance of a bird dropping when resting on leaves. Males of most species also show a typical ivory-white patch, with a dark shiny area beside it, on the lateral pronotum (Fig. 4 A, B).

Most taxa of *Parepistaurus* were molecularly screened by Schultz (2007). Three genes (COI, 16S and Histone 3) were analysed to generate a molecular phylogeny of the investigated taxa. We recalculated these data for this study. Data on the molecular methods are published at http://deposit.ddb.de/cgi-bin/dokserv?idn=987484451. A more detailed analysis of the implications drawn from the molecular phylogeny is in preparation (Hemp *et al*. in prep.).

The aim of this paper is to describe two new species of *Parepistaurus*. Further it is proposed that the subspecies of *P. deses* each receive full species status.

Materials and Methods

Samples.—Parepistaurus specimens were collected in areas of the East African countries Kenya and Tanzania. The total body length refers to the midline length of the insect.

Identification.—Parepistaurus species were identified using Green (1998). The material was checked again in the entomological collection of the National Museums of Kenya, Nairobi, at the Natural History Museum, London, and the Museum für Naturkunde, Berlin.

Terminology.— Terminology follows Green (1998).

Depositories.— ZMHB: Museum für Naturkunde, Zentralinstitut der Humboldt-Universität zu Berlin; BMNH: Natural History Museum London, UK; NMKE: Entomological Department National Museums of Kenya, Nairobi. All other material remains in the collection of C. Hemp.

Molecular phylogenetic reconstructions.—The molecular phylogenetic analysis is based on a combined dataset of the 16S rRNA gene, the cytochrome oxidase subunit I gene (COI) and the histone gene H3. A Bayesian analysis was performed in MrBayes (V3.1.2, Huelsenbeck & Ronquist 2001) with 60 million generations (two independent runs consisting of four Markov-chains, samplefreq=1000, partitioned by gene, models unlinked, rateprior = variable). Bootstrap analyses were performed with 500 replicates and 100 random-addition replicates, TBR-branch swapping and the multtrees option in PAUP (Swofford 2000). See Hemp *et al.* (in prep.) for details on phylogenetic reconstructions and DNA sequencing.

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Results

Molecular Phylogeny

The phylogenetic tree based on the three genes Histone 3, COI and 16S (Fig. 5) suggests that the subspecies of *P. deses* should receive species status since taxa currently listed as subspecies are molecularly not more closely related to each other than are taxa (to each other) which were originally described as separate species. Thus it is proposed to re-establish *P. vansomereni* and give species status to *P. nairobii* and *P. manyara*. *P. uguenoensis* n. sp. of the North Pare mountains is the sister taxon of *P. deses*, occurring in the Mts Kilimanjaro/Meru area. The sister species to *P. hanangensis* n. sp., restricted to Mt Hanang, is *P. manyara*; it occurs in forests in adjacent mountainous areas of the rift valley escarpment.

Taxonomy

Parepistaurus uguenoensis n. sp. C. Hemp

Holotype, male.— Tanzania, North Pare mountains, Kindoroko forest reserve, on herbs at lower border of montane forest, 1750 m, UTM zone 37 M 03 50 063 m E 95 83 438 m S, March 2001, C. Hemp coll.; depository ZMHB.

Paratypes.— All Tanzania, all North Pare mountains: one female, same collection data as holotype, but April 2001; depository ZMHB; one male, same collection data as holotype; depository BMNH. One female, same collection data as holotype but April 2001; depository BMNH. One male, same collection data as holotype, but April 2001; depository NMKE. One female, same collection data as holotype, but April 2001; depository NMKE.

Additional paratype material examined.— All from Tanzania, all North Pare mountains, all C. Hemp coll., 40 males, 30 females, Kindoroko forest reserve, 1750 m, on herbs along forest edge and on ruderal vegetation, February 2001, March 2001, April 2001, October 2006; 1 male, border coffee-banana plantation - *Hyparrhenia* grassland, 1320 m, September 2001; 1 male, 1 female, on herbs in undergrowth of banana-coffee plantation, 1650 m, September 2002; 1 male, 1 female, on herbs in banana plantation, 1320 m, June 2006; 1 male, Kiverenge Hill, grassland along forest edge, 1470 m, June 2006; 1 female, coffee-banana plantation, 1550 m, June 2006; 1 male, Ngofi forest reserve, ruderal vegetation along forest edge, 1600 m, June 2006.

Description.— **Male:** medium sized, moderately slender. General coloration brown, black and green patterned (Fig. 4 A). **Head and antennae.** Antennal length about 7.5 mm, 20 or 21 segments. Compound eyes of moderate dimension and spacing for genus. Frontal ridge flat, coarsely pitted. Fastigium of vertex hexagonal, almost flat. Behind this hexagonal structure, carinulae of vertex weak, and between these a very faint longitudinal carina. **Thorax.** Pronotum tectiform and rugose. Median carina moderately strong, bilateral depressions of metazona pronounced. Posterior margin of pronotum obtuse angulate, rounded at apex. Prosternal process

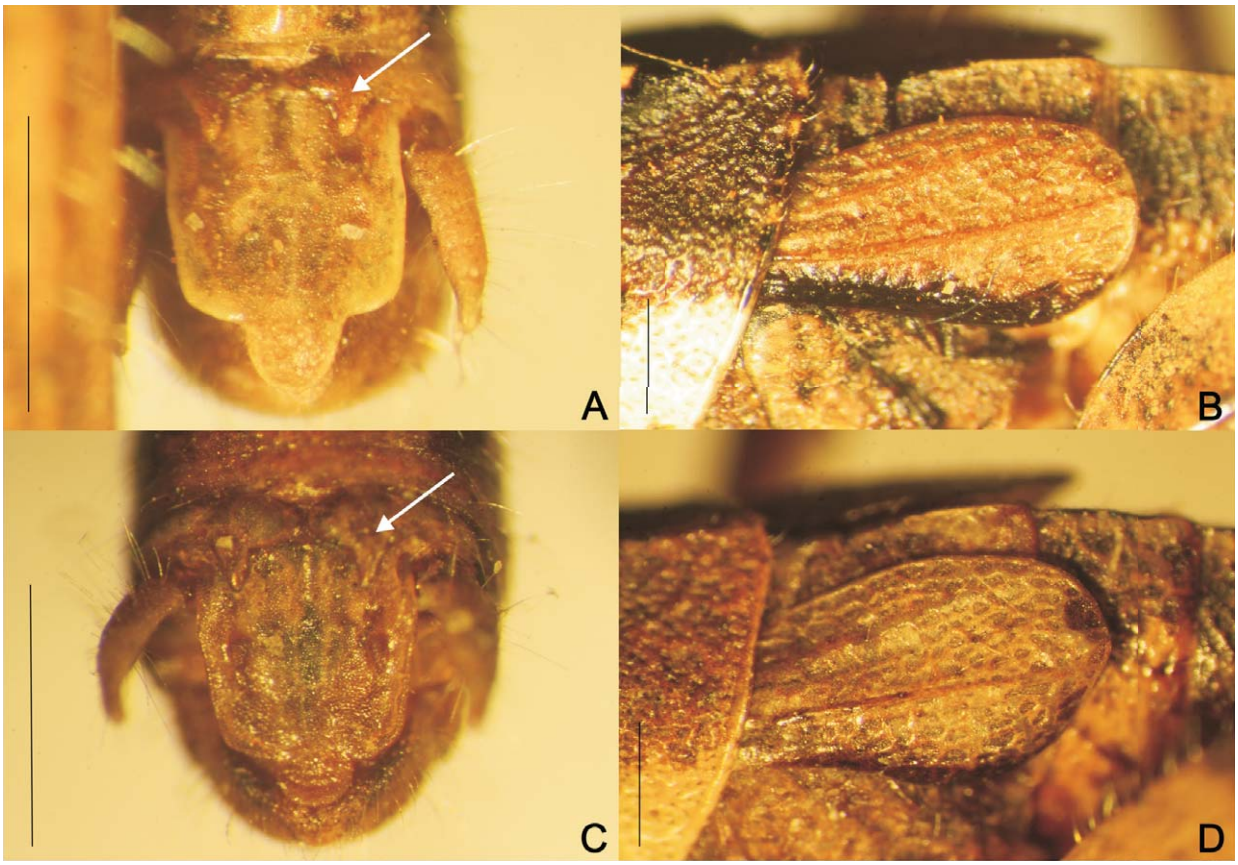


Fig. 1. Detail of *Parepistaurus* species: **A.** Male supra-anal plate of *P. uguenoensis*, arrow indicates furcula; **B.** Tegmen of male *P. uguenoensis*; C. Supra-anal plate of male *P. hanangensis*, arrow indicates furcula; D. Tegmen of male *P. hanangensis*. Scale bar: 1 mm.

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pyramidal. Typical color pattern with an ivory patch at posterior margin of lateral sides of pronotum and anterior glossy black area.
Tegmina. Tegmen lobiform, typical for genus (Fig. 1. B), extending just beyond posterior margin of first tergite. Apical area very rarely with small stigma, ventral margin of tegmen with black fascia. Hind wing vestigial. **Legs.** Fore and mid legs green or brown. Hind femur relatively slender, length:width ratio 3:78 (10 measured specimens). Outer fascia of hind femur ochre-brown, with two dark brown to black ventrolateral bands; inner fascia ochreous with black longish median fascia, and small black patch at posterior end of inner femur. Hind tibiae orange at apical two thirds of their length. Tibial spines with dark tips, proximal 2 or 3 spines completely darkened.
Abdomen. Tergites 5 and 6 with typical white patch, remaining abdomen light brown or yellow brown, pleura and sternites often reddish. Furcula of last abdominal tergite robust, apices blunt (Fig. 1 A). Tenth tergite clearly divided between the furcular prongs. Supra-anal plate with almost parallel margins, posterior shoulders rounded, apical lobe elongated and evenly rounded; submarginal tubercles weak. Cercus round in cross-section, slightly narrowing, apical section more distinctly narrowed and round; whole cercus slightly incurved (Fig. 1 A) and shorter than supra-anal plate. Subgenital plate elongate globose. Lophi of epiphallus with distinct inner conical projection (Fig. 2 B). Inner shoulder smoothly rounded. Anterior face of lophi textured, except for lower and outer areas, extending down to inner shoulders. Aedeagus of typical form for genus (see Green 1998).
Female: similar to male, but larger and more robust. Tegmen as in male. Subgenital plate as in Fig. 3 A, similar to *P. deses* and *P. nairobii* but posterior margins beside median structure projecting more.

Measurements, male.— (mm) (N = 10) Ratio antennal length: head and pronotum: 1.32-1.44 (mean: 1.39). Head width: 3.1-3.5 (mean: 3.25). Interocular distance 0.3-0.4 (mean: 0.33). Pronotal length 3.1-4.0 (mean: 3.56). Maximal pronotal width: 3.2-3.5 (mean: 3.30). Prozona: metazona: 1.07-1.33 (mean: 1.22). Tegminal length: 2.2-3.2 (mean: 2.6). Hind femur length: 9.2-10.5 (mean: 9.65). Hind femur length: width: 3.54-3.77 (mean: 3.67). Body length: 12.5-13.5 (mean: 12.9).

Measurements, female.— (mm) (N = 5): Ratio antennal length:head and pronotum: 0.93-1.17 (mean: 1.1). Head width: 3.5-3.8 (mean: 3.7). Interocular distance 4.0 (mean: 4.0). Pronotal length 4.5-5.0(mean: 4.72). Maximal pronotal width: 4.2-4.6 (mean: 4.52). Prozona: metazona: 0.95-1.10 (mean: 1.00). Tegminal length: 3.5-3.9 (mean: 3.7). Hind femur length: 11.7-13.0 (mean: 12.5). Hind femur length: width: 3.34-3.77 (mean: 3.58). Body length: 15.0-19.0 (mean: 17.4).

Habitat.— In the herb layer of submontane and montane banana-coffee plantations, submontane and montane forest edge and clearings in the North Pare mountains from 1300 m to 1800 m.

Etymology.—The species name "*uguenoensis*" is derived from the old name of the western part of the North Pare mountains, the Ugueno mountains.

Diagnosis.— Green (1998) divided *Parepistaurus* into two main groups based on the shape of the supra-anal plate. A first group has the plate with subparallel or laterally bulging margins, and a second group has it tapering: distinctly narrower at posterior end than at its base. *P. uguenoensis* belongs to the first group, in which the supra-anal plate has parallel margins.

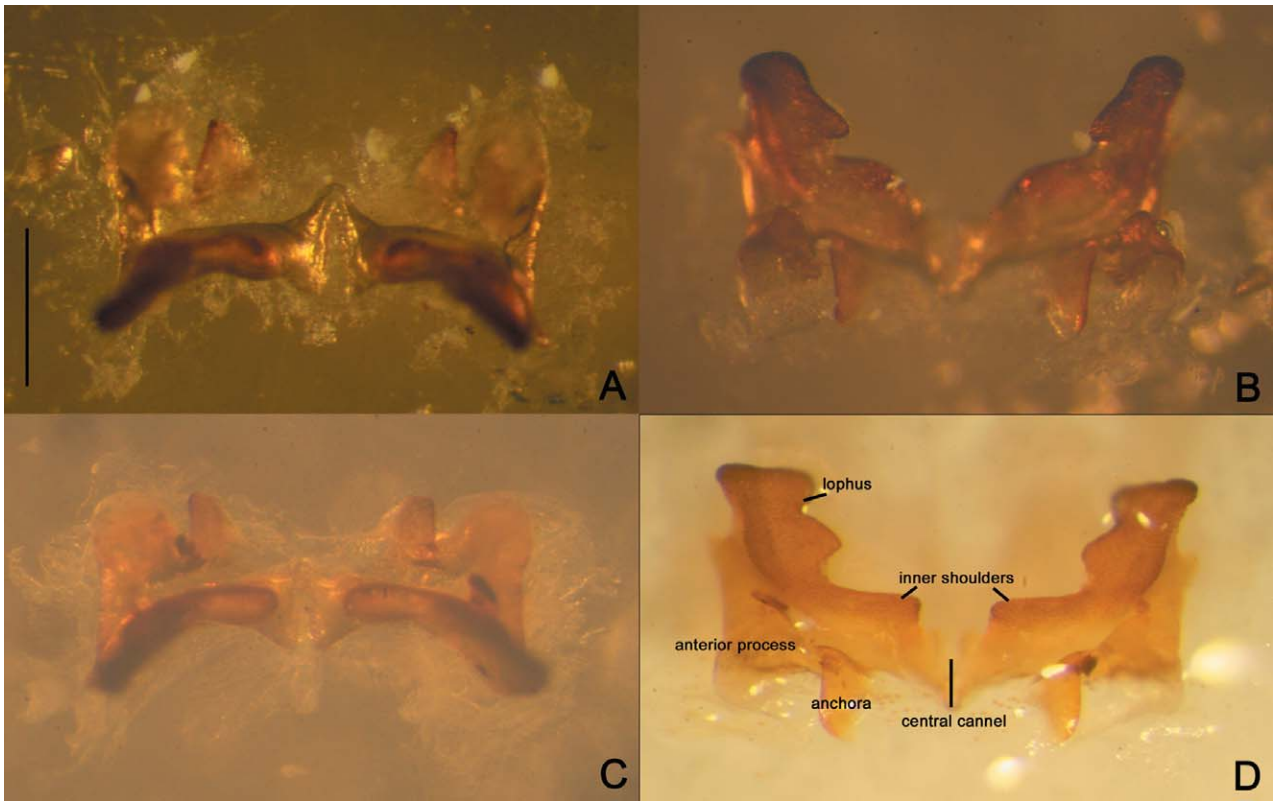


Fig. 2. Male phallic complex. A. *P. uguenoensis*, epiphallus, dorsal aspect; B. *P. uguenoensis*, epiphallus, anterior aspect; C. *P. hanangensis*, epiphallus, dorsal aspect; D. *P. hanangensis*, epiphallus, anterior aspect. Scale bar: 0.5 mm.

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Table 1. Saltatoria species co-occurring with *P. uguenoensis* in the North Pare mountains. **1:** *Hyparrhenia* grasslands adjacent to coffee-banana plantation, 1320 m. **2:** Coffee-banana plantation, 1320 m. **3:** Coffee-banana plantation, 1550 m. **4:** Submontane forest, Kiverenge Hill, 1400 m. **5:** Montane forest, Kiverenge Hill, 1600 m. **6:** Kindoroko forest reserve, lower montane forest border, forest edge and ruderal vegetation, 1750 m. **7:** Kindoroko forest reserve, forest clearing, 1800 m. **D:** Distribution. **w**: widespread, **r**: restricted distribution, **e**: endemic to the North Pares

	1	2	3	4	5	6	7	D
Geophilous species								
Morphacris fasciata (Thunberg, 1815)		x	x					w
Openland (grassland) species								
Coenona brevipedalis Karsch, 1896						x		r
Epacrocatantops curvicercus (Miller, 1929)	x							w
Gymnobothrus temporalis flexuosus (Schulthess Schindler, 1898)		x						w
Gymnobothrus temporalis temporalis (Stål, 1876)	x		x			x		w
Heteropternis couloniana (Saussure, 1884)						x		w
Humbe tenuicornis (Schaum, 1853)	x							w
Odontomelus brachypterus (Gerstaecker, 1869)		x	x	x		x		r
Oxyaeida poultoni Ramme, 1929						x		w
Paracinema tricolor (Thunberg, 1815)			x					w
Peronura clavigera Karsch, 1889				x				w
Phlesirtes sp.		x				x		r
Phymateus aegrotus (Gerstaecker, 1869)						x		w
Pnorisa squalus (Stål, 1861)	x							w
Ruspolia differens (Serville, 1838)	x		x	x				w
Forest edge species								
Acanthacris ruficornis (Fabricius, 1787)						x		w
Amytta sp.		x	x			x	x	e
Chromothericles uguenoensis Hemp, 2009						x	x	e
Eupropacris vana (Karsch, 1896)		x						r
Heteracris trimaculata Grunshaw, 1991		x				x		r
Horatosphaga heteromorpha (Karsch, 1889)	x	x	x					r
Horatosphaga parensis Hemp, 2002					x	x	x	r
Ixalidium sp.		x	x	x	x	x		e
Melanoscirtes kibonotensis uguenoensis Hemp 2010			x			x	x	e
Parepistaurus uguenoensis n. sp.	x	x	x	x	x	x		e
Peronura uguenoensis Hemp, 2002				x				r
Rhainopomma uguenoensis Hemp, 2007			x		x	x	x	e
Forest species								
Aerotegmina kilimandjarica Hemp, 2001					x	x	x	r
Anthracites sp.						x		e
cf. Lunidia viridis Hemp, 2010				x	x			r
Meconematinae						x	x	e
Phaneroptera sparsa Stål, 1857			x			x		w
Plangia graminea (Serville, 1838)				x				w

P. ugenoensis is thus different from species of the *Parepistaurus deses* group *sensu* Green (1998), in not having a tapering supra-anal plate; this group includes *P. ugenoensis*' molecularly closest relative *P. deses* from Mt Kilimanjaro and the (coastal and further south-distributed) species, *P. mupundui*, *P. johnseni*, *P. eburlineatus*, *P. inhaca* and *P. pugui*.

The male cerci of *P. uguenoensis* are distinctly shorter than the supra-anal plate, thus differentiating it from *P. felix* and *P. pseudofelix*, which have male cerci longer than the supra-anal plate.

The cercus of male *P. uguenoensis* is laterally slightly flattened and slightly curved inward, but not to the degree seen in *P. browni* or *P. crassicercus*; it becomes distinctly narrower from base to apex and thus differs from *P. crassicercus*, where it is blunt and stout.

The furcula of its last abdominal tergite is moderately to strongly developed, differentiating *P. uguenoensis* from *P. pygmaeus* (which has a similar supra-anal plate and similarly shaped cerci), from *P. intermedius*, (both *P. pygmaeus* and *P. intermedius* occur on adjacent mountain ranges of the Eastern Arc chain) and from *P. lindneri*, the second *Parepistaurus* species occurring in the Mts Kilimanjaro/Meru area.

P. lobicercus has male cerci with an expanded inner area absent in *P. uguenoensis*. In contrast to *P. jagoi* and *P. robertsoni*, in which species the supra-anal plate is raised laterally making it trough-like, the supra-anal plate of *P. uguenoensis* is flat.

P. tenuicercus is easily distinguished from *P. uguenoensis* by the shape of the lateral tegmina, which are of normal shape in *P. uguenoensis*, but reduced in *P. tenuicercus*.

Finally *P. uguenoensis* can be separated from *P. zanzibaricus* in the shape of the furcula of the last abdominal tergite, the shape of the male cerci, which are shovel-like expanded in *P. zanzibaricus* and the shape of the supra-anal plate, which is bulging in *P. zanzibaricus*.

The male epiphallus in *P. uguenoensis* is very similar to *P. deses* from Kilimanjaro. However, the shoulders (Fig. 2 B) are more evenly rounded and shallower than in *P. deses*.

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Co-occurring Saltatoria species.— Table 1 gives an overview of Saltatoria species recorded in habitats together with *P. uguenoensis*. Seven permanent plots were established in the North Pare mountains and were revisited several times. Besides widespread forms typical of open land in the submontane and montane zones of East African mountains, several species were noted that are endemic to the North Pare mountains or restricted to the Eastern Arc chain. Widespread species occur over large parts of Africa, while species listed under "restricted" occur in East Africa – but in most cases only on a few of the North Pares adjacent mountains.

Parepistaurus hanangensis n. sp. C. Hemp

Holotype, male.—Tanzania, Mt Hanang, ruderal vegetation, 1900 m, UTM zone 36 M 0769816 m E 9505197 m S, May 2006, C. Hemp coll.; depository ZMHB. Paratypes: All Tanzania, all Mt Hanang: one female, above Katesh, embarkment dam, 2000 m, January 2008, depository ZMHB. One male, grassland, 2600 m, January 2008, depository BMNH. One female, above Katesh, water intake, 2000 m, January 2008, depository BMNH. One male, above Katesh, water intake, 2000 m, January 2008, depository NMKE. One female, grassland/hedge 1900 m, May 2006, depository NMKE.

Additional paratype material examined.— All Tanzania, all Mt Hanang, all C. Hemp coll., 2 males, lower border of montane forest, bushland 1950-2000 m, May 2006; 2 females, disturbed forest 2000 m, January 2008; 1 male, 1 female, disturbed forest/clearings, 1850 m, January 2008; 1 female, above Katesh, water intake, 2000 m, January 2008.

Description.—**Male.** Medium sized, moderately slender. General coloration brown to tawny with pattern of white and black on the pleura and the abdomen (Fig. 4 C). **Head and antennae.** Antennae comparatively short, antennal length 1.1× that of head and pronotum, 20 or 21 segments. Compound eyes of moderate dimension and spacing for genus. Frontal ridge very broad and flat, coarsely pitted, constricted at height of ocellus. Fastigium of vertex hexagonal, with conspicuous lateral ridges forming a deep pit between. Behind this hexagonal structure carinulae of vertex strongly developed and between these well-developed longitudinal carina. **Thorax.** Pronotum tectiform and rugose. Median carina moderately strong, bilateral depressions of metazona pronounced. Posterior margin of pronotum obtuse angulate, rounded at apex. Prosternal process pyramidal, short and very broad at base, tip pointed. Typical pattern with an ivory patch at posterior margin of lobes of pronotum and anterior glossy black area at anterior margin. **Tegmina.** Tegmen lobiform, not evenly rounded but somewhat pointed at posterior margin with dark pigmented stigma in most specimens (Fig. 1 D) extending to about middle of 3rd abdominal tergite. Hind wing vestigial. **Legs.** Fore and middle legs brown. Hind femur relatively slender, length: width ratio 3.8-3.9 (5 measured specimens). Outer fascia of hind femur ochre-brown, with three dark brown to black ventrolateral small patches; on upper fascia of hind femur three darker maculae and inner fascia ochreous with two black longish patches; distant black patch small, second band large, covering most of inner fascia of hind femur (Fig. 4 C). Hind tibiae orange, tibial spines with dark tips, proximal 2-3 spines completely darkened. **Abdomen.** In most specimens tergites 5 and 6 with typical white patch (but mostly not very conspicuously developed); remaining abdomen light brown or yellow brown, pleura and sternites brown, only subgenital plate in some specimens reddish. Furcula of last abdominal tergite well developed, projecting backward, apices pointed (Fig. 1 C). Tenth tergite clearly divided between furcular prongs. Supra-anal plate tapering, broader at its base and then steadily diminishing towards its tip. Posterior shoulders rounded, apical lobe comparatively small, u-shaped; submarginal tubercles elongated, weak. Cercus slightly flattened, tip slightly decurved (Fig. 1 C) and shorter than supra-anal plate. Subgenital plate elongate globose. Lophi of epiphallus with broad v-shaped excavation (Fig. 2 D). Inner shoulder abruptly almost 90° rounded, thus similar to *P. manyara*. Aedeagus of typical

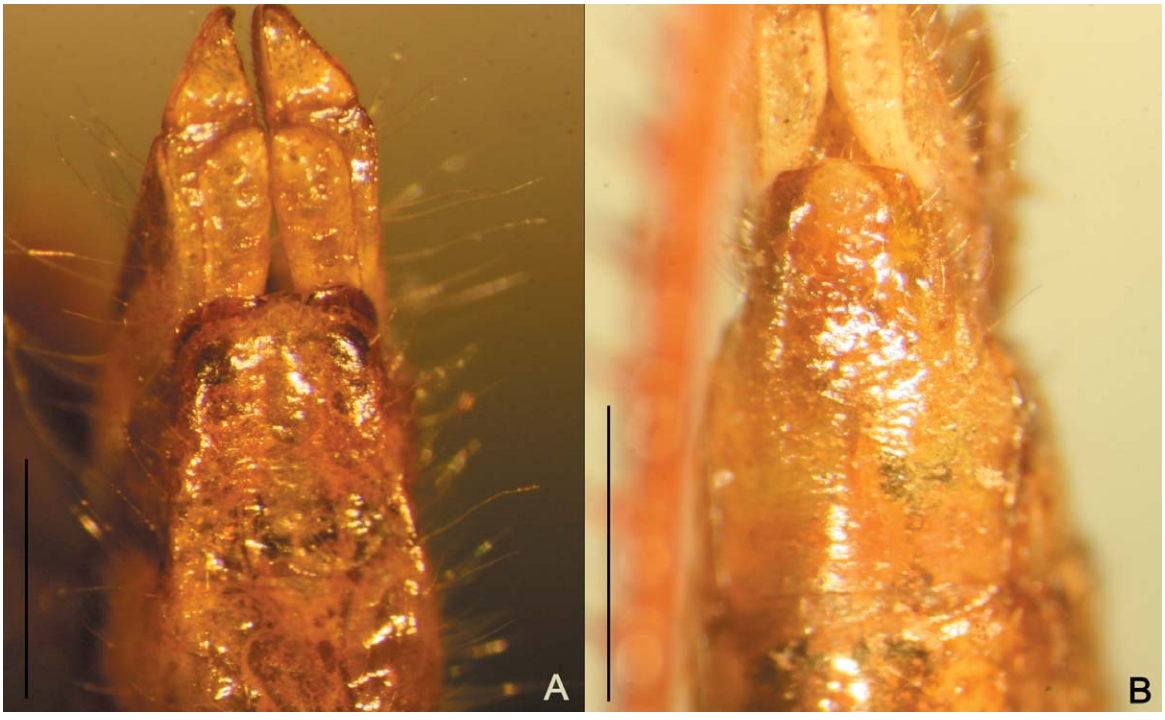


Fig. 3. Female subgenital plates. **A.** *P. uguenoensis*. **B.** *P. hanangensis*. Scale bar: 1 mm.

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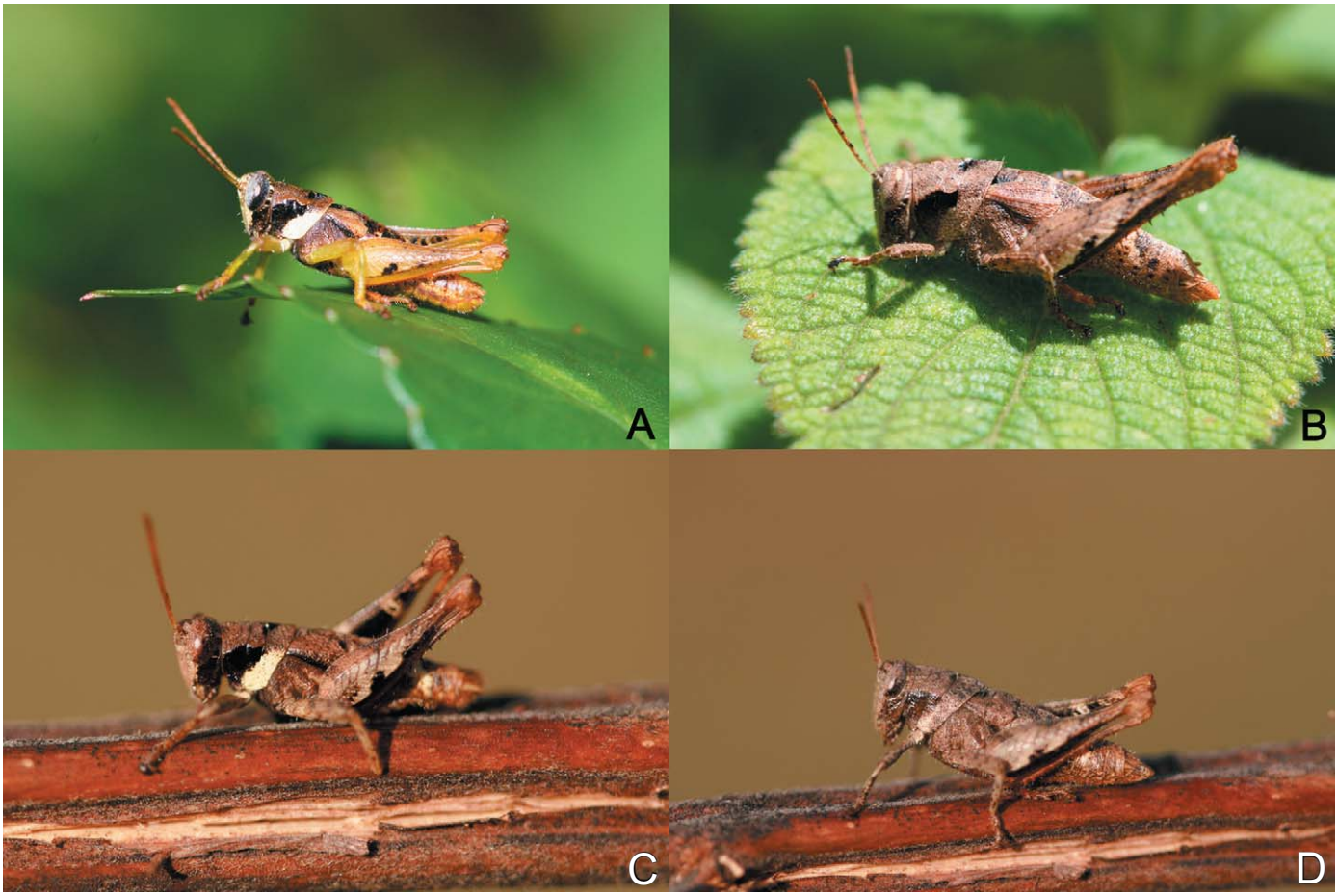


Fig. 4. A. Male *P. uguenoensis* on *Impatiens* sp., North Pare mountains, lower border of Kindoroko forest reserve, 1750 m. **B.** Female *P. uguenoensis*, same locality as male. **C.** Male *P. hanangensis*, southern slopes of Mt Hanang, above Katesh, forest clearing 2000 m. **D.** Female *P. hanangensis*, same locality as male.

form for genus (see Green 1998).

Female: Similar to male, but larger and more robust. Tegmen as in male. Subgenital plate as in Fig. 3 B. Similar to *P. deses*, but median tip of posterior margin more rounded and not as pronounced as in *P. deses*.

Measurements, male.— (mm) (N = 7): ratio antennal length:head and pronotum: 1.09-1.28 (mean: 1.17). Head width: 3.0-3.2 (mean: 3.1). Inter-ocular distance: 0.3-0.4 (mean: 0.35). Pronotal length: 3.3-3.5 (mean: 3.4). Maximal pronotal width: 3.0-3.2 (mean: 3.1). Prozona: metazona: 1.07-1.16 (mean: 1.13). Tegminal length: 2.6-2.9 (mean: 2.7). Hind femur length: 8.8-9.7 (mean: 9.0). Hind femur length: width: 3.67-4.22 (mean: 3.84). Body length: 11.5-13.0 (mean: 12.0).

Measurements, female.— (mm) (N = 7): Ratio antennal length:head and pronotum: 0.87-0.96 (mean: 0.91). Head width: 3.4-3.8 (mean: 3.6). Inter-ocular distance: 0.5 (mean: 0.5). Pronotal length 4.5-5.0 (mean: 4.8). Maximal pronotal width: 4.4-5.6 (mean: 4.8). Prozona: metazona: 1.0-1.1 (mean: 1.0). Tegminal length: 3.4-4.0 (mean: 3.6). Hind femur length: 11.1-12.5 (mean: 11.8). Hind femur length: width: 3.66-4.46 (mean: 4.0). Body length: 16.0-19.0 mm (mean: 17.4).

Diagnosis.— *P. hanangensis* belongs to the group of *Parepistaurus* species with a tapered supra-anal plate. The apical lobe of the supra-anal plate is distinctly developed, distinguishing *P. hanangensis* from *P. mupundui*, which has a triangular supra-anal plate. The tegmen of the male is typical for the genus, thus different from *P. johnseni* which has reduced tegminal lobes. The subgenital plate is rounded and subglobose and therefore different from those *Parepistaurus* species with an attenuated, subconical to acutely conical subgenital plate, *P. eburlineatus* and *P. inhaca*. The posterior margin of the pronotum lacks a median indentation, thus differentiating *P. hanangensis* from *P. pugui*. *P. deses* has very slender male cerci which are longer than the rather stout cerci of *P. hanangensis*, and the protuberances of the supra-anal plate of *P. deses* are very strongly developed, while they are longish and weakly developed in *P. hanangensis*. *P. nairobii* has less prominent submarginal tubercles on the supra-anal plate as well, but the male cerci are, as in *P. deses*, longer than the supra-anal plate, while in *P. hanangensis* the cerci are about as long as the supra-anal plate. Although the cerci of *P. nairobii* are more robust than those of *P. deses*, they are still more slender in *P. nairobii* than in *P. hanangensis*, which has comparatively more robust male cerci. In *P. vansomereni* the lateral margins of the supra-anal plate are distinctly bulging and the tips of the cerci, which are robust at the base, are spathulate. In *P. hanangensis* the lateral margins of the supra-anal plate are slightly undulating and continuously narrowing towards their posterior ends; the male cerci are not spathulate at their tips.

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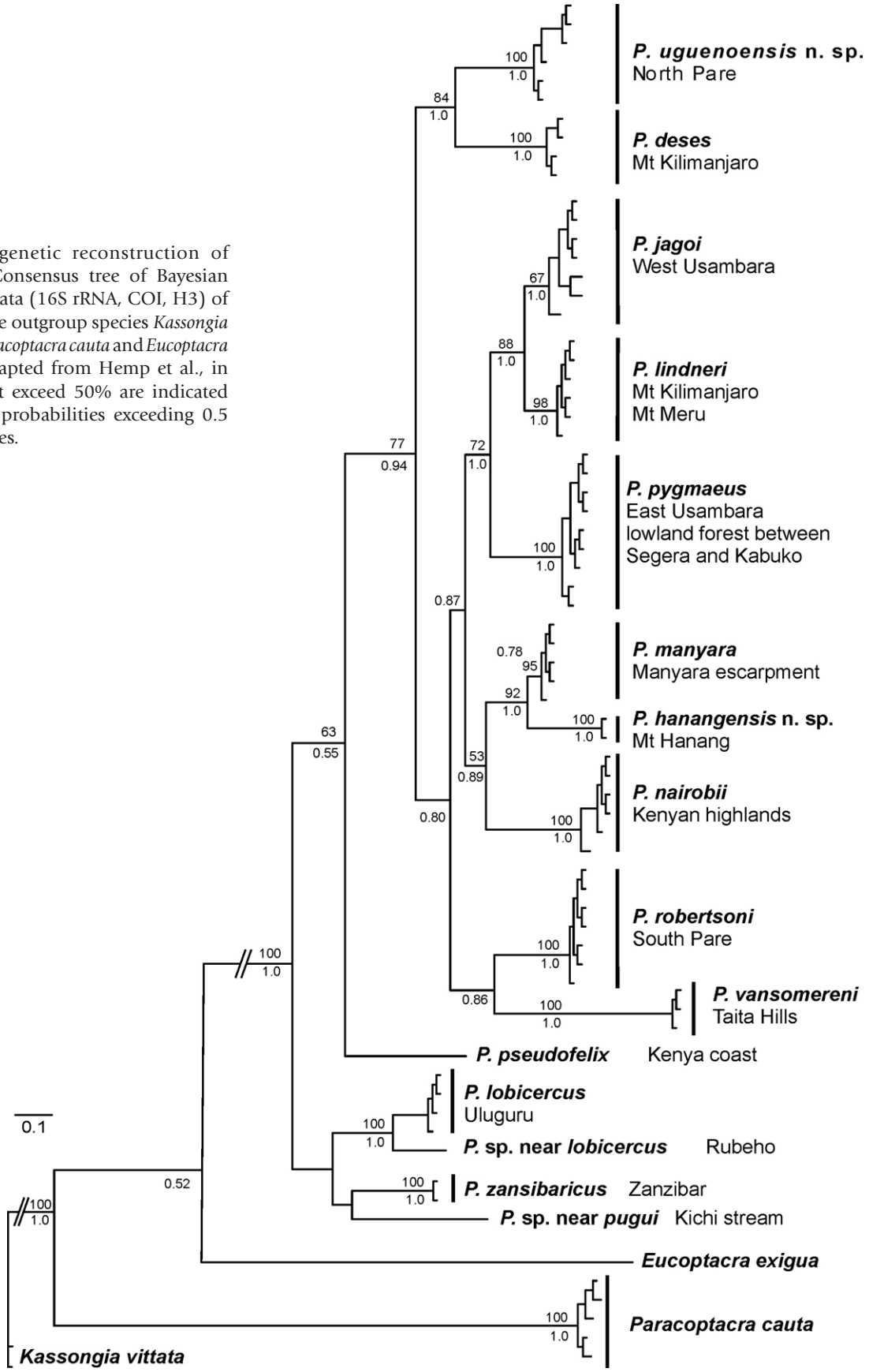


Fig. 5. Molecular phylogenetic reconstruction of the genus *Parepistaurus*. Consensus tree of Bayesian interference of combined data (16S rRNA, COI, H3) of 15 *Parepistaurus* taxa and the outgroup species *Kassongia vittata* (Hemiacridinae), *Paracoptacra cauta* and *Eucoptacra exigua* (Coptacridinae). Adapted from Hemp et al., in prep. Bootstrap values that exceed 50% are indicated above branches; posterior probabilities exceeding 0.5 are indicated below branches.

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Morphologically and molecularly the closest relative to *P. hanangensis* is *P. manyara*, geographically the closest species, inhabiting forest communities at montane elevations on the Manyara escarpment (*e.g.*, Nou forest reserve, Marang forest, see also Green 1998). Both species have wide spaced, rather robust, furculae of the last abdominal tergite, a tapered supra-anal plate with faintly developed longish tubercles and robust male cerci. However, compared to *P. hanangensis* the supra-anal plate is broader at its base and more strongly and evenly tapering towards its tip with shallowly rounded shoulders and an apical lobe which is comparatively broad at its base in *P. manyara*. The lateral margins of the supra-anal plate of *P. hanangensis* are undulating and not as strongly tapering towards their tip, the shoulders are more pronounced and the apical lobe is not as broad at its base as in *P. manyara*. The epiphallus of *P. hanangensis* and *P. manyara* are very similar as well. However, the excavation of the lophus is large in *P. hanangensis*, while it is much smaller in *P. manyara* and the apex of the lophus is of different shape between both species.

Habitat.—On ruderal vegetation, along the lower border of the montane forest and in forest clearings as well as on montane grass and bushland on the southern slopes of Mt Hanang between 1850 and 2600 m.

Co-occurring Saltatoria species.—For data of coenology see Hemp & Hemp 2008, Hemp 2009b and Hemp *et al*. 2009.

Discussion

Parepistaurus is a flightless taxon with its highest diversity in East Africa. Focus of this study was on East African taxa. Fig. 5 shows that coastal forms gave rise to inland taxa distributed over the Eastern Arc chain, the inland volcanoes and escarpments and the Kenyan highlands. All species are closely related, as seen in their morphology and molecular phylogeny. Taxa that were previously placed as subspecies under *P. deses*, proved not to be more closely related to each other than, *e.g.*, species from the northern branch of the Eastern Arc are related to each other. Therefore it is proposed here to re-establish *P. vansomereni* from the Taita Hills and give species status to the remaining subspecies of *P. deses*, 1) *P. manyara* occurring at montane elevations of the forested rift valley escarpment between the Lakes Manyara and Eyasi, *e.g.*, the Marang forest reserve and the Nou forest reserve and 2) *P. nairobii*, a widespread species in the Kenyan highlands, *e.g.*, around Nairobi, Mt Machakos and Mt Sabuk.

Parepistaurus has only a few relatives in southern Africa. Most species are found in the Eastern Arc mountains of Tanzania and the volcanoes and highlands of the rift valley. A similar pattern is found in Lentulidae, with representatives of this group in southern Africa (many monotypic genera), but with a high diversity in East Africa, where just a few genera show geologically young radiations (Schultz *et al.* 2007, Hemp *et al.* 2007, Hemp & Hemp 2008). As seen in Fig. 5, *Parepistaurus* ancestors probably spread from coastal habitats further inland along the chain of the northern branch of the Eastern Arc and then "jumped", via the volcanoes of the rift-valley system further west, also reaching the Kenyan highlands. These processes, causing the high diversity of *Parepistaurus* in mountainous Tanzania, are of rather young origin geologically, since the volcanoes thrown up with the uplift of the rift valley, such as Mt Kilimanjaro and Mt Meru, are no older than 1-2 million years (Nonnotte *et al.* 2008). Speciation of *Parepistaurus* may be interpreted as dependent on topography in connection with climatic fluctuations, enabling taxa to spread and become isolated. This stands in contrast to the theory suggesting that a long-lasting stable climate causes a high diversity, *e.g.*, in the Eastern Arc mountains [Rodgers & Homewood 1982, Lovett 1988, Iversen (1991) or Fjeldså *et al.* (1997)].

An analogous distribution pattern is seen in lentulid species of the genus *Rhainopomma*. *Rhainopomma* is restricted to the Eastern Arc chain and species are morphologically very similar, which is also reflected in their molecular phylogeny. However, *Rhainopomma* did not spread further west, being confined to the Eastern Arc Mountains, while *Parepistaurus* did spread to the young volcanoes further west. This was explained by Hemp *et al.* (2010) by an already occupied niche in Lentulidae. When the ancestors of *Rhainopomma* reached the Kilimanjaro/Meru area, another species of the lentulid genus *Altiusambilla* probably already occupied the ecological niche also occupied by *Rhainopomma* in the Eastern Arc range. This impeded the establishment of pioneer specimens having reached the volcano area via vegetation corridors from the Eastern Arc range to the Kilimanjaro/Meru region. Perhaps these events occurred together in the same waves that brought a second *Parepistaurus* and a member of *Melanoscirtes*, of which only the latter established due to unoccupied niches on the geologically young mountains.

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