



A featherwing beetle without wings: re-discovery and second species of *Rioneta* (Coleoptera: Ptiliidae) from the Uluguru Mountains, Tanzania

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Abstract

The type species of the monotypic beetle genus *Rioneta* Johnson, 1975, previously known from three specimens, is re-discovered in the Uluguru Mountains, Tanzania. A second sympatric species, *R. inexpectata* **sp.n.**, is described. The relatively rare event of apparently obligate aptery in Ptiliidae is reported. The genus *Rioneta*, as well as *Leptinla* Johnson, 1985, are removed from the non-monophyletic Ptiliini and transferred to the tribe Ptinellini.

Key words: Taxonomy, beetle

Introduction

The coleopteran family Ptiliidae (featherwing beetles) includes the smallest species within the order, seldom exceeding 1.0 mm in body length. There are about 600 species described (Newton & Thayer, 2005), while the actual numbers are expected to be considerably higher. The majority of the species, usually associated with rotting organic matter, are capable of flight, and are normally widely distributed.

The description of the wingless *Rioneta uluguruensis* Johnson, 1975, then a new genus, was based on three specimens from the isolated Uluguru Mountains in Tanzania, a part of the East Arc mountain chain characterised by an unusually high degree of endemism (Lovett & Wasser, 1993). No additional records of the genus were known until 2002 when a series of about 100 specimens was extracted by the author from the forest litter in the Ulugurus. This discovery also brought to light a smaller number of wingless specimens belonging to another, apparently undescribed species of the same genus.

The purpose of this paper is to re-introduce the genus *Rioneta* to science and to describe its second species. Morphological features of adult *Rioneta* beetles, particularly those related to its assumed aptery, will be extensively illustrated and discussed in an attempt to place the genus within the poorly developed phylogenetic framework of the family.

Material and methods

Fresh specimens of *Rioneta* were collected by sifting forest leaf litter with a sifter. The leaf litter samples obtained were placed into Winkler funnels for about 24 hours to extract arthropod inhabitants. Specimens were later either glued on pinned cards or slide mounted in Euparal medium on microscope slides. For the lat-

ter procedure the beetles were macerated in hot solution of KOH for about 24 hours, than rinsed in 70% ethanol and gradually transferred into 100% iso-propanol. Some specimens were prepared for Scanning Electron Microscopy (FEI (Philips) XL 30 ESEM TMP). Habitus images (Figs 1–4) were taken using digital microscope cameras and the Analysis software. Line drawings were prepared with the help of a compound microscope with camera lucida.

***Rioneta* Johnson, 1975**

Johnson 1975: 719 (generic description)

Hall 2000: 240 (list of Ptiliini genera)

Type species. *Rioneta uluguruensis* Johnson, 1975, by original designation.

Diagnosis. The genus *Rioneta* can be distinguished from the majority of other Ptiliidae by the complete absence of hind wings and some correlating modifications of the pterothorax and abdominal tergites such as a markedly transverse scutellum (Fig. 23), reduced ridges of the metathorax (Fig. 24), the absence of fingerprint-shaped wing-folding patches on abdominal tergites II–V (Fig. 15) and the highly reduced or absent palisade fringe on the posterior edge of abdominal tergite VII (Fig. 15). From the few other wingless genera of Ptiliidae (members of the subfamily Cephaloplectinae distributed in the Neotropical and Australian Regions and the monotypic genus *Malkinella* Dybas, 1960 restricted to the Cape Province of South Africa) the genus *Rioneta* is easily distinguished by the presence of complete lateral longitudinal grooves on the metaventricle (Fig. 11) and by the unique ring-shaped spermatheca with the sperm pump located inside the ring (Figs 1, 4, 10, 29, 30, 34, 35).

Description. General appearance. Body large (1.0 mm and larger); dorsal body surface dull, not shiny; dorsal body pubescence with many short recumbent setae; elytral setae not forming longitudinal rows; body neither markedly flattened nor thickened in vertical dimension; body greyish; color of antennae similar to that of body; wings absent; wing polymorphism absent or unknown. **Head.** Posterior of eyes without transverse groove or foveae dorsally; frons without protuberances; head capsule with transverse ridge originating from maxillary base and extended laterad, straight, oblique, single, not reaching eyes; temples behind eyes without transverse carina; genal ridge to accommodate antennae in repose absent; transverse row of pore-like structures on neck absent ventrally; medial projection of tentorial bridge absent or inconspicuous; tentorial bridge moderately bent at middle (Fig. 4); posterior edge of eyes not abruptly cut in frontal plane, without concavity to accommodate pronotum; eyes present, markedly reduced in size, not markedly protruding; interfacetal setae present in posterior part of eyes; antennae of medium length, with 11 antennomeres; with their apices reaching hind pronotal edge; antennomere 3 not widened proximally; antennomeres 4–7 of medium length, about 3–4 times as long as wide; antennal club loosely delimited, composed of 3 antennomeres; apical antennomere not dumbbell-shaped; basal ring present on antennomeres 8–11; apical part of each of two penultimate antennomeres clearly narrowed and elongated into tube; modified thickened setae on two apical antennomeres present, organized in 2 and 3 groups of 5–7 setae (Fig. 8). **Pronotum.** Dorsal pronotal grooves absent; short longitudinal ridges on pronotum absent; prothoracic hind angles rounded, not pointed posteriorly, not or slightly expanded posteriorly; lateral ridges on pronotum present, fully separating dorsal and lateral surfaces of pronotum; lateral margins of pronotum not serrate, without sinuation in basal half; anterior edge of pronotum markedly narrower than posterior; posterior edge of pronotum straight at middle; ventral prosternal process absent. **Pterothorax.** Elytra short and truncate, exposing at least tergites VII to X; medial and posterior edges of elytra without microserration; hind wings absent; groove of alacrista with microserration; alacrista without single seta-like spur in posterior part (= metascutellar spur) absent; mesocoxal acetabula narrowly separated by less than 1/4 acetabular diameter; mesoventral collar clearly delimited, extending laterally to shoulders; disc of mesoventrite (=mesosternal elevation) with longitudinal carina along midline; disc of mes-

oventrite without clearly contrasting dark spot at centre; disc of mesoventrite not spatulate; posterior apex of mesoventral intermesocoxal process extending beyond middle of mesocoxal acetabula; mesoventral foveae absent; meso-metaventral suture straight, directed laterad and anteriorly, not indented, 1.5X times as long as diameter of mesocoxal acetabulum; lateral longitudinal keel on each side of metaventrite (not to be confused with metaventral lines) present and reaching posterior edge of metaventrite (Fig. 11); metendosternal arms internally moderately divergent; metendosternite not forked; metacoxae moderately separated by less than twice diameter of mesocoxal acetabulum; metaventrite with posteriorly oriented teeth mediad to metacoxae; metaventral lines absent; metathoracic episterna not or vaguely visible in ventral view; hind femoral plates (=metacoxal laminae) large and subequal in surface size to mesocoxal acetabula; suture connecting outer point of metacoxal acetabulum with internal hind angle of metepisternum long, about as long as metacoxal anterior edge. **Abdomen.** Laterotergites present on abdominal segments III–VII, prominent, covering margins of respective tergites; palisade fringe along posterior margin of tergum VII markedly reduced in size or absent; fingerprint-shaped groups of wing-folding microridges on tergites II–V absent; pair of abdominal glands present (Fig. 26); tergite IX without granular microsculpture, without transverse row of pores basally; tergites VIII and IX fully fused to form a single plate (Figs 13, 27); tergite X discrete; pygidial hind margin with single obtuse apical projection, without fan-shaped group of posteriorly oriented setae; spiracular opening present on tergite VIII; abdominal sternite VIII without cavities; abdominal sternite III without longitudinal keels (=femoral lines); length of abdominal sternites VIII 1–1.5X that of any of sternites III–VII; male abdominal sternite IX with anteriorly directed handle-like projection (Fig. 33); aedeagus oriented asymmetrically in abdomen, more than 2X as long as wide (Fig. 31); parameres absent; spermatheca ring-shaped (Figs 10, 29, 30).

Monophyly. As currently defined, the genus *Rioneta* is almost certainly monophyletic. Both of its species are similar morphologically with the body proportions being the only feature to differentiate them (Figs 1–4). Both species share a number of morphological traits, which are either rare, or unique in Ptiliidae, which strongly suggests monophyly of the genus. These characters are: (01.) aptery, with complex of associated morphological modifications (see below), (02.) lateral longitudinal keel on each side of metaventrite (Fig. 11), (03.) fully fused abdominal tergites VIII and IX (Figs 13, 14, 27), (04.) shape of markedly elongate abdominal glands with long duct (Fig. 26), and (05.) unique shape of spermatheca forming a closed ring with sperm pump located in same surface inside the ring (Figs 29, 30).

Biology. Both species of *Rioneta* were collected from forest leaf litter in wet and apparently primary tropical rainforest at altitudes between 2,000 and 2,500 meters. Guts of at least some Euparal-mounted specimens contained fungal spores (Fig. 1).

Distribution. As currently known, the genus *Rioneta* is strictly endemic to the Uluguru Mountains in central Tanzania, a part of the East Arc mountain chain. Both known collecting records (Johnson, 1975 and the present one) are from the southern part of the Ulugurus on the western slope of Lukwangule Plateau (S07°07'33" E037°36'16") just above the village of Tchenzema.

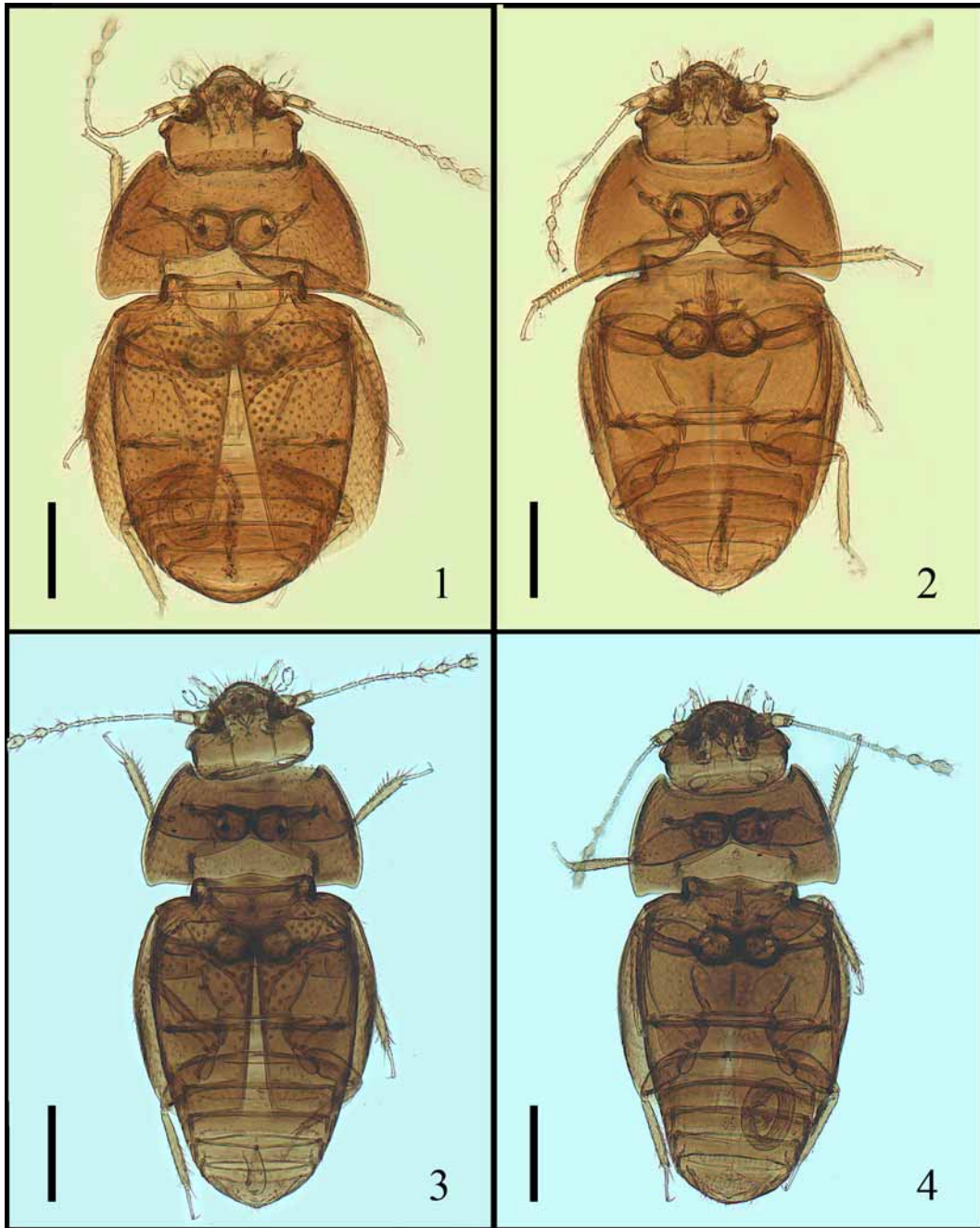
Rioneta uluguruensis Johnson, 1975

(Figs 1, 2, 5–35)

Diagnosis. Differs from *R. inexpectata* by markedly wider body (Figs 1, 2).

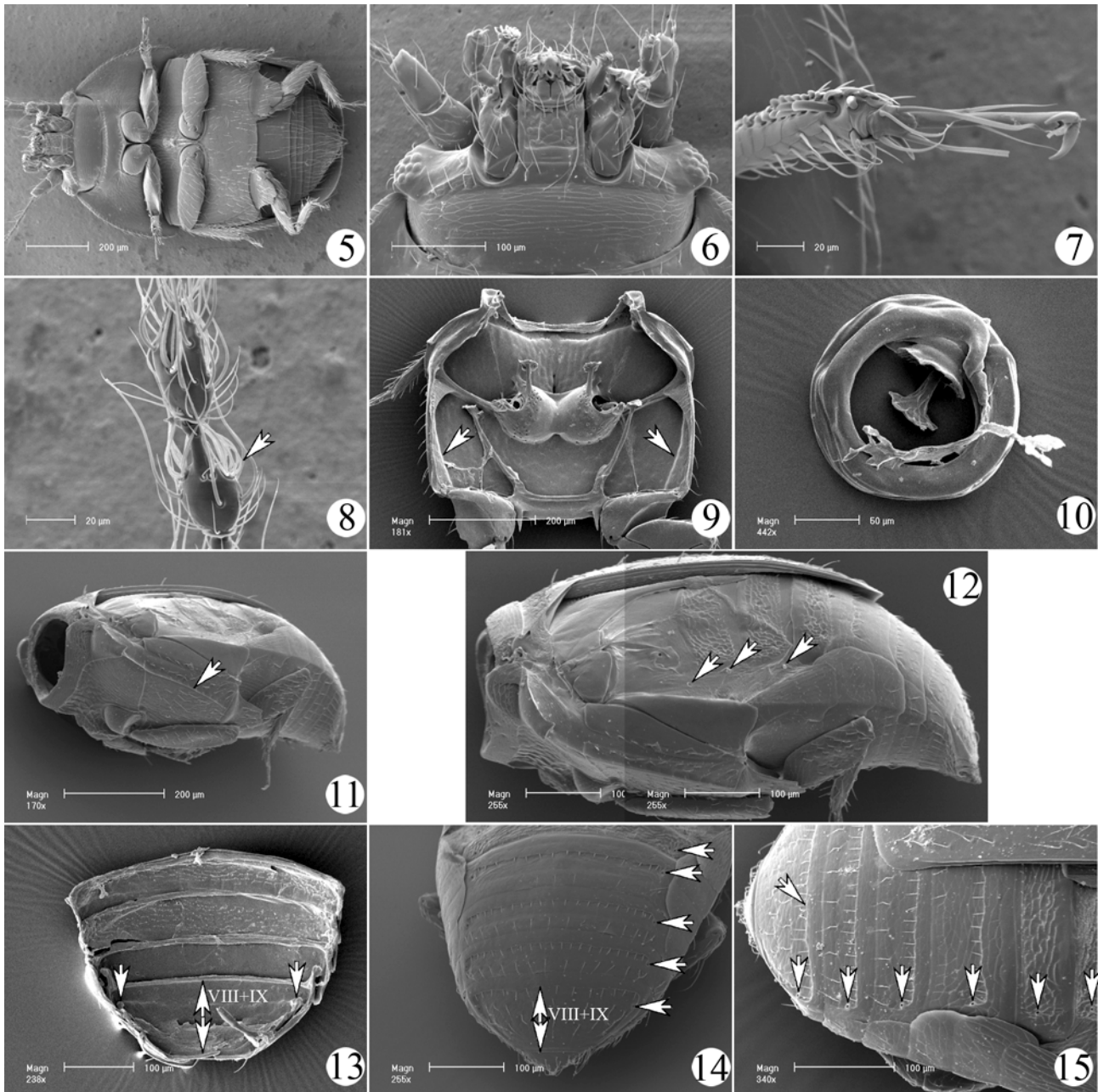
Description. With the characters of the genus. Body length 1.10–1.13 mm (mean 1.12 mm, n=3), pronotal length 0.29–0.31 mm (mean 0.30 mm; n=3); pronotal width 0.58–0.62 (mean 0.60; n=3); ratio pronotal width/length 1.93–1.98 (mean 1.96; n=3).

Material studied. Holotype (dry mounted on card, female) in the collection of the Musée Royal de l'Afrique Centrale, Tervuren [MRAC]: "Holotypus" (printed on pink label); "Tanzanie: Mts Uluguru/ Lukwangule Plateau/ alt. 2400–2600 m./ humus, 2–22/VII/71" (printed on white label); "Coll. Mus. Tervuren/



FIGURES 1–4. Habitus images of *Rioneta* beetles. 1—*R. uluguruensis*, female, dorsal; 2—*R. uluguruensis*, male, ventral; 3—*R. inexpectata* sp. n., male, dorsal; 4—*R. inexpectata* sp. n., female, ventral. Scale = 0.2 mm.

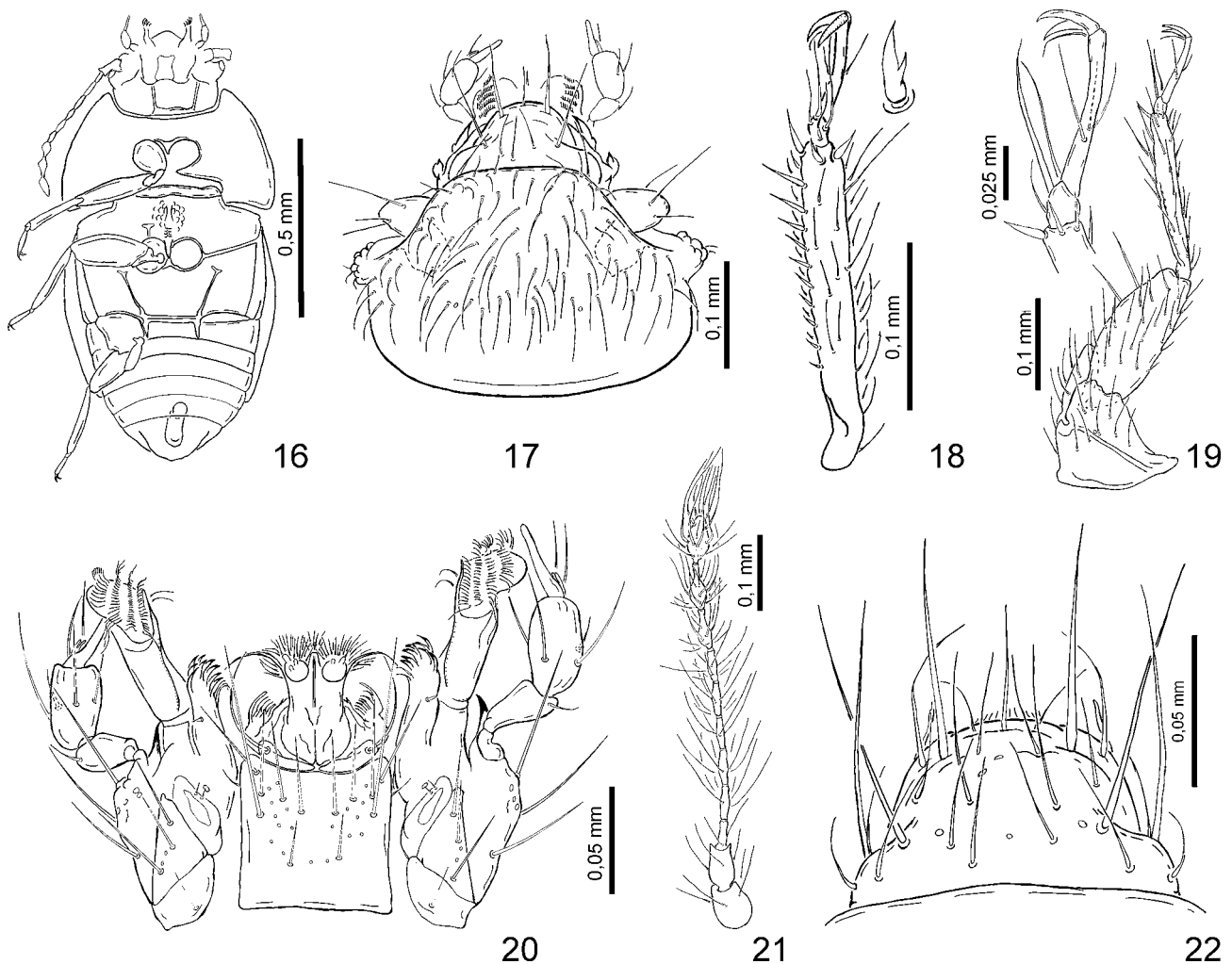
Mission Mts Uluguru/ L. Berger, N. Leleup/ J. Debecker V/Viii/71” (printed on white label); “Holotype female/ *Rioneta/ uluguruensis* sp. n./ det. C. Johnson 1974” (written on white label). Paratype (dry mounted on card, male): similarly labelled. Additional material: 20 dry mounted, 10 mounted on Euparal microscope slides and about 100 stored in alcohol: “Tanzania: Uluguru Mts., W slope between Tchenzema vil. and Lukwangule Plateau, H-2200 m. Oct. 19–21, 2002, V. Grebennikov leg.” (MRAC, Canadian National Collection of Insects, Arachnids, and Nematodes [CNC]).



FIGURES 5–15. SEM images of *Rioneta uluguruensis*. 5—habitus, ventral; 6—head, ventral; 7—left fore-tarsus, ventral; 8—two apical antennomeres, arrow showing groups of sensillae, ventral; 9—internal surface of meso- and metathorax with metendosternite, two arrows show internal part of lateral longitudinal keel on each side of metaventricle, dorsal; 10—spermatheca and sperm pump, ventral; 11—pretorax and abdomen, arrow showing lateral longitudinal keel on left metaventricle, left elytron removed, fronto-lateral; 12—pterothorax and abdomen, lateral, left elytron removed, three arrows showing spiracles I–III, respectively; 13—internal surface of abdominal tergites V–X, double-pointed central arrow showing fused tergites VIII and IX, two lateral arrows showing remnants of internal apodemae of tergite IX, dorsal; 14—abdominal apex, both elytra removed, dorsal, vertical double-pointed arrow showing fused tergites VIII and IX, horizontal arrows showing spiracles VIII–IV; 15—right part of abdomen, right elytron removed, dorsal, oblique arrow showing posterior edge of tergite VII without wing cleaning (=toiletry) device, vertical arrows showing spiracles VIII–III.

***Rioneta inexpectata* sp. n.**
(Figs 3, 4)

Diagnosis. Differs from *R. uluguruensis* by markedly narrower body (Figs 3, 4).

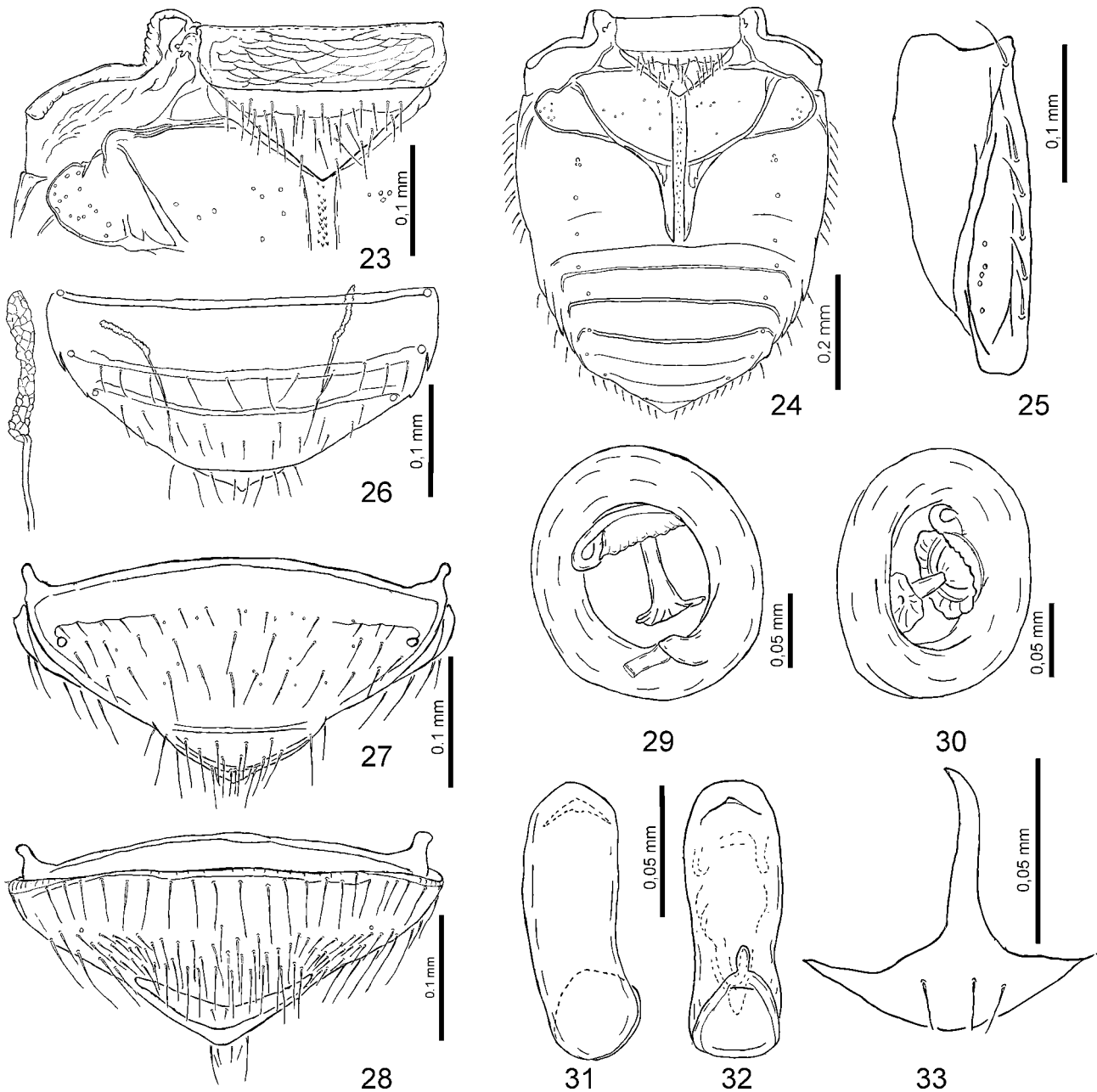


FIGURES 16–22. *Rioneta uluguruensis*, details of morphology. 16—habitus, ventral, left legs omitted, aedeagus and metendosternite shown; 18—head, dorsal, antennomeres 2–11 omitted; 18—left fore-tarsus and tibia, ventral (separately shown enlarged bifurcate spine on apical part of tibia); 19—right hind leg, ventral (separately shown enlarged tarsus with two visible apical tarsomeres); 20—mouthparts (maxillae, mentum, and labium), ventral; 21—right antenna, dorsal; 22—clypeus, dorsal.

Description. With the characters of the genus. Body length 1.07–1.19 mm (mean 1.13 mm, n=4), pronotal length 0.27–0.29 mm (mean 0.28 mm; n=4); pronotal width 0.47–0.51 (mean 0.49; n=4); ratio pronotal width/length 1.73–1.80 (mean 1.77; n=4).

Material studied. Holotype (dry mounted on card, not sexed): “Tanzania: Uluguru Mts., W slope between Tchenzema vil. and Lukwangule Plateau, H-2200 m. Oct. 19–21, 2002.V. Grebennikov leg.” (MRAC). Paratypes: 39 (of them 27 dry mounted on cards and 12 mounted on two Euparal microscope slides; with same data as the holotype (MRAC, CNC).

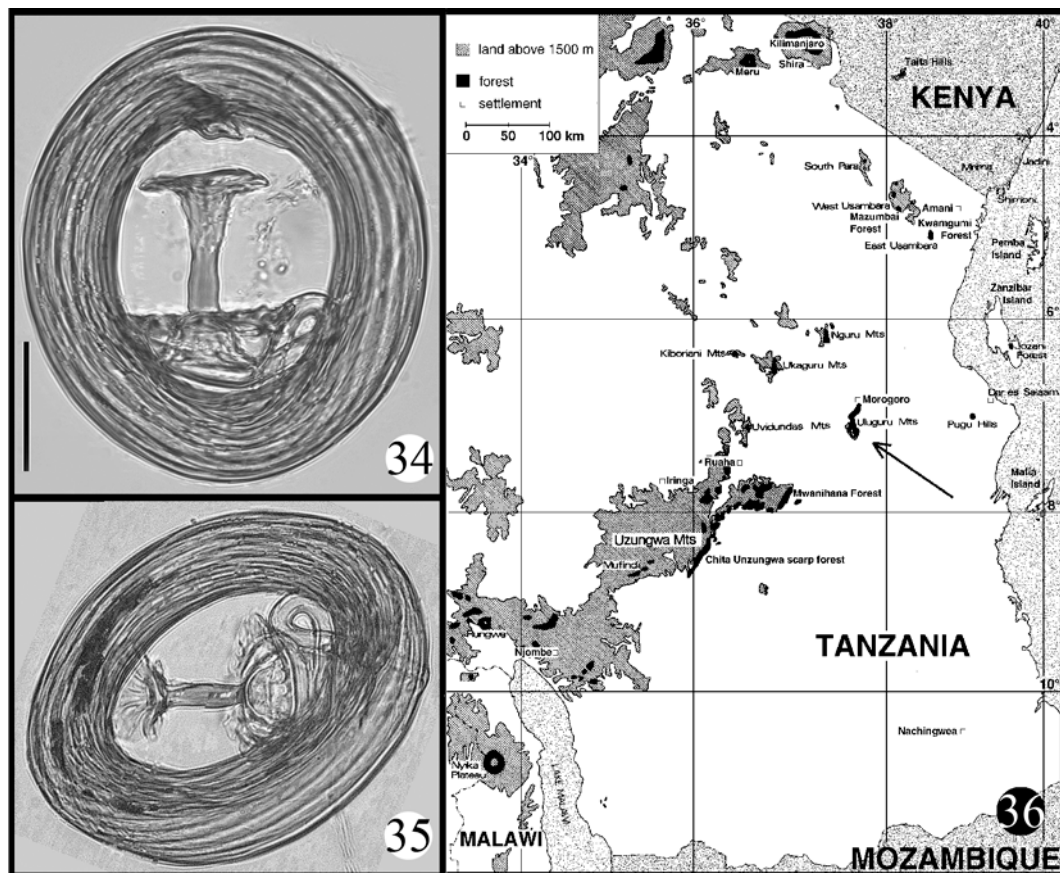
Etymology. The specific epithet is the Latin adjective *expectatus* (= *expectatus*), -a, -um (awaited, looked for) negated by the prefix *in* and referring to the unexpected discovery of this species.



FIGURES 23–33. *Rioneta uluguruensis*, details of morphology. 23—mesonotum, mesoscutellum, basal part of metascutellum, mesopleuron and basal part of metapleuron, elytra omitted, dorsal; 24—pterothorax and abdomen, elytra omitted, dorsal; 25 — left metapleuron, lateral; 26—apex of abdomen showing location of internal glands, dorsal (separately on the left showing right internal gland, enlarged); 27—fused abdominal tergites VIII–IX and partly fused tergite X, dorsal; 28—abdominal sternites VIII–IX, male, ventral; 29, 30—spermatheca and sperm pump, partly oblique; 31, 32— aedeagus with apex directed upwards, dorsal (31) and ventral (32); 33—abdominal sternite IX, male, ventral.

Aptery and phylogenetic affinities of *Rioneta*

Wing di- and polymorphism is a well-known phenomenon in Ptiliidae (Dybas, 1978), when the same species exists in at least two morphs: one winged and another wingless. Reduction of wings is normally accompanied by correlated morphological modifications such as tighter elytral locking, reduction of metathorax (Fig. 24), loss of abdominal wing-folding and cleaning (= toiletry) devices (Fig. 15), reduction of eyes in size and number of facets, and partial reduction of body pigmentation (Thayer, 1992). Hall (2003) hypothesized that within



FIGURES 34–36. 34, 35—*Rioneta uluguruensis*, spermatheca, transparent light microscopy images, scale 0.05 mm; 36—map of Eastern Arc Mountains with arrow showing Uluguru Mountains, the type locality and known area of distribution of both *Rioneta* species.

Ptiliidae the ability to produce wingless forms might be a synapomorphic feature uniting members of the tribe Ptinellini (cited as “Pterycini”, nomen nudum).

A peculiarity of *Rioneta* is that no fully-winged specimens are known for either species. While it is not improbable that subsequent collecting records may result in such a discovery, their relative number in populations is not expected to be significant. The wet and densely-forested Uluguru Mountains, the only known locality for both species, are relatively small in size (Fig. 36) and are surrounded by vast areas of dry savannah seemingly not suitable for *Rioneta* beetles. It seems plausible to assume that fully-winged specimens of *Rioneta* with high dispersal capacity, if they indeed exist, would be negatively selected by being swept by wind to a dry unsuitable habitat. A similar scenario was proposed for *Bambara intricata* (Dybas, 1966), a ptiliid beetle inhabiting the Bahama Islands, where only 7% of specimens retain fully-developed wings (Dybas, 1978).

Relationships of *Rioneta* within the almost non-existent phylogenetic framework of the main Ptiliidae lineages are rather obscure. If one considers aptery as an advanced stage of wing polymorphism, this genus demonstrates affinities with the tribe Ptinellini (sensu Hall, 2005). This view is supported by the presence in *Rioneta* of the asymmetrically-located tube-like aedeagus (Fig. 2) and abdominal glands (Fig. 26), although their elongated shape and long duct differ markedly from what is found in other Ptinellini taxa. The latter taxonomic assemblage, however, is itself poorly delimited and its monophyly has never been demonstrated (Hall, 2003). It should also be noted that the monotypic genus *Leptinla* Johnson, 1985 from Mauritius, currently maintained in the non-monophyletic Ptiliini (Hall, 2005), was assigned by the author to “Pterycini” (=Ptinellini). I therefore suggest removing both *Rioneta* and *Leptinla* from Ptiliinae: Ptiliini and have assigned them to Ptiliinae: Ptinellini pending subsequent critical reassessment of both tribes.

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