BASTERIA, 71: 221-227, 2007

Gulella (Juventigulella) ngerezae spec. nov. (Gastropoda, Pulmonata, Streptaxidae), a new endemic land snail from the Ukaguru Mountains, Tanzania

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A new species of land-snail (Streptaxidae: *Gulella*) from montane forest in the Ukaguru Mountains (Tanzania) is described and attributed to subgenus *Juventigulella* Tattersfield on shell characters. There are shell and radular resemblances to certain other *Gulella* species not in subgenus *Juventigulella*, emphasising the need for revisionary work. This is the second endemic snail described from the Ukagurus, a recognised area of endemism but one from which few land snails have been collected.

Key words: Gastropoda, Pulmonata, Streptaxidae, *Gulella*, taxonomy, endemism, montane forest, Eastern Arc Mountains, Tanzania, East Africa

INTRODUCTION

Tattersfield (1998) described three new species of *Gulella* L. Pfeiffer, 1865, from forests in Tanzania and grouped them into a new subgenus, *Juventigulella* Tattersfield, based on shared features of shell size, shape and apertural dentition. He concluded that there remained "much to be learned about the smaller elements in the Tanzanian and East African terrestrial mollusc faunas". The present paper affirms this by describing a new species which, although assigned to *Juventigulella*, shares certain features with Tanzanian species assigned to other (or no) subgenera of *Gulella*, emphasising the need for taxonomic work in this understudied group.

The new species was collected in 2004 from a single site in Mamiwa Kisara North Forest Reserve, on one of the highest ridges of the Ukaguru Mountains, Morogoro Region, Tanzania. The reserve, an important water catchment for the Gairo area, is characterised by forests of the 'Eastern Arc' type on acidic lithosols overlying Precambrian gneiss, with a mean annual rainfall of around 1400 mm (Lovett & Pocs, 1993). Among many other molluscs, a total of five specimens of the new species were found by direct searching (20 person-hours) of leaf litter and rotting wood in an area (approx. 200 m^2) of broken-canopy montane forest at 1700 m elevation, about 0.5 km inside the northern reserve boundary.

Land molluscs already reported from montane forest in the Ukaguru massif include the endemic *Pseudopeas ukaguruense* Verdcourt, 1996 (Subulinidae) (Verdcourt, 1996) and two unnamed, undescribed streptaxids listed by Verdcourt (2006). These are ("*Gulella (Primigulella)* sp. cf. *usagarica* [Crosse, 1885]") from "Mnyera Ridge" and ("*Gulella (Aenigmigulella)* sp.") from "Mamiwa Ridge" (Verdcourt, 2006). Both of these can be traced back to Verdcourt (1978) where they were listed as "*Gulella (Primigulella)* sp." and "*Gulella* sp. nov." respectively. Although each was represented only by a single juvenile shell, Verdcourt's descriptions are sufficient to be sure that neither of the streptaxids is conspecific with the new species described here. Both these taxa, and *P. ukaguruense*, were the product of incidental collecting by the botanist D. J. Mabberley in 1972 (Verdcourt, 1978, 1996), after which it seems no substantial mollusc collections have been made in the Ukaguru montane forests. With the Ukaguru Mountains forming part of the famous

Eastern Arc, a region characterised by high rates of endemism across many taxonomic groups (see Burgess et al., 2007, for a recent review) it is likely that further land snails endemic to Ukaguru remain to be discovered.

In the following description, collections are abbreviated as follows: NMW, National Museum of Wales, Cardiff, UK (NMW accessions in zoology have a "Z" following the initials); NMT, National Museums of Tanzania, Dar es Salaam, Tanzania.

DESCRIPTION

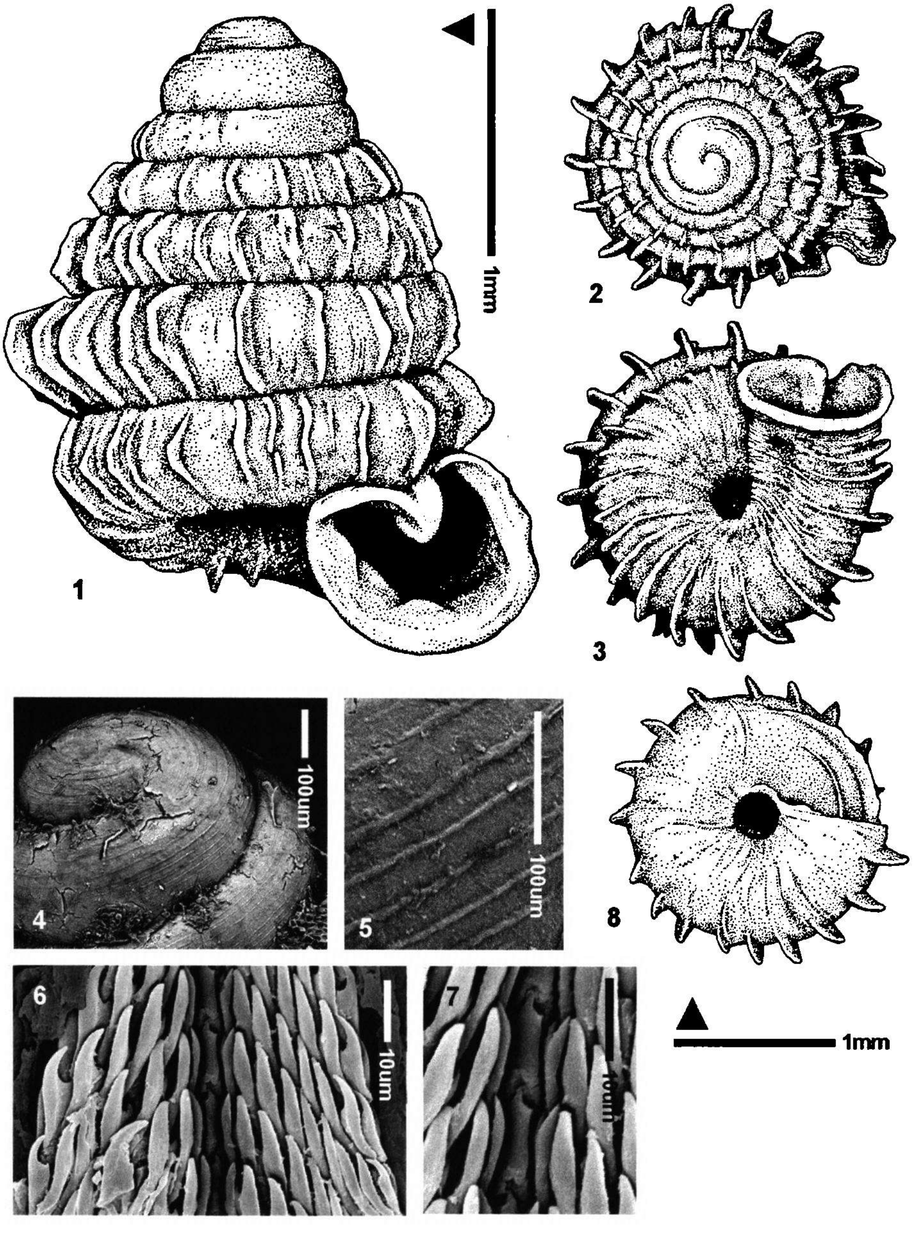
Gulella (Juventigulella) ngerezae spec. nov. (figs 1-8)

Material examined. – Tanzania, Morogoro Region, Kilosa District, Mamiwa Kisara North Forest Reserve (approx. 6°25′ S, 36°57′E), at 1700 m, found by direct searching of wet leaf litter and rotting wood, 30.vi.2004, leg. C. F. Ngereza, P. Tattersfield, and B. Rowson. This is the type locality. Holotype: one live-collected adult, a little worn (NMW.Z.2004.016.00002). Paratypes 1-5 (data as above): four live-collected juveniles (NMW.Z.2004.016.00003-5 and NMT), and one dead-collected juvenile (NMW.Z.2004.016.00006). Specimens preserved in 80% ethanol, except for paratype 4 (NMW.Z.2004.016.00005) preserved in 96% ethanol at -35°C, and paratype 2 (shell dried and coated for SEM examination).

Diagnosis. – A species of *Gulella* (sensu lato) with a small, characteristically-shaped shell with open umbilicus, spiral apical sculpture, and semi-regular radial lamellae. In the adult the peristome is complete and has a v-shaped parietal tooth, a weak basal swelling, and a weak columellar swelling. Younger juveniles have a weak parietal keel.

Description of holotype – Shell of the only known adult specimen (figs. 1-3) small (h2.25 mm x w1.95 mm), of 5.75 whorls, subconical, with apex wide and slightly mucronate, and body whorl narrower than, and slightly displaced below preceding whorl. Umbilicus open, perspective and slightly eccentric. Surface of protoconch (first two whorls) as viewed under a light microscope (×60 magnification) finely, irregularly granular with faint traces of spiral threads, apparently worn away in many places. Surface of subsequent whorls characteristically interrupted at semi-regular intervals by slightly curved radial lamellae, these typically running from suture to suture and increasing in size and curvature on later whorls. In contrast, lamellae of apertural side of body whorl less prominent and not extending to umbilicus. Shell surface between lamellae of faint, irregular radial striae, becoming strong only on last third of body whorl. Last quarter of body whorl slightly constricted by a weak, broad spiral depression on columellar side. Peristome subcircular, complete, reflected and well-demarcated from attachment to penultimate whorl by a deep suture. Apertural dentition consisting of (1) a strong, v-shaped parietal tooth, projecting a little out of aperture (thus creating a small notch or sinus in palatal part of peristome) and continuing into aperture as a short lamella; (2) a weak basal swelling or tooth, set just behind the peristome; (3) a weak columellar swelling or tooth, set just behind the peristome. In addition, a second bulge (but not thickening of the shell) occurs on the columella, set just behind (2) and (3), corresponding to the depression on the columellar side of the body whorl.

Additional description from paratypes (all juveniles). – Surface of protoconch (first two whorls) much less worn, very finely granular with numerous fine spiral threads,



Figs 1-8. Holotype and paratypes of *Gulella (Juventigulella) ngerezae* spec. nov., NMW. 1-3, holotype; 4-5, apical sculpture of paratype 2; 6-7, radula of holotype, 8, bottom view of paratype 5 showing parietal keel.

about 13 on the second whorl (figs 4 & 5). Umbilicus open and perspective at all growth stages. Apertural dentition of juveniles limited to a very weak mid-parietal keel entering the aperture in young specimens (paratype 5; fig. 8); this keel not present in the aperture of more fully-grown specimens (other paratypes), so evidently not continuous with adult parietal tooth.

Dimensions. – See table 1.

Table 1. Details of the six known specimens. Shell height and width measurements in mm. Width measurements include lamellae. *Shell of paratype 5 broken back a little to expose parietal keel (fig. 5).

Status	Accession number	State	Height	Width	Whorls
Holotype	NMW.Z.2004.016.00002	Live adult	2.25	1.95	5.75
Paratype 1	NMT	Live juv.	1.45	1.80	4.5
Paratype 2	NMW.Z.2004.016.00003	Live juv.	1.55	1.80	5
Paratype 3	NMW.Z.2004.016.00004	Live juv.	1.55	1.75	4.75
Paratype 4	NMW.Z.2004.016.00005	Live juv.	1.50	1.80	4.75
Paratype 5	NMW.Z.2004.016.00006	Dead juv.	1.45	1.70	4.5*

Anatomy. – Radulae were extracted from the holotype and from paratype 2. Radula long, narrow, of v-shaped rows (fig. 6). Central tooth elongate, about the same length of the ninth lateral tooth, with a central cusp that interlocks with the base of the central tooth of the following row (fig. 7). Lateral teeth monocuspid, elongate, tall but strongly recurved, with an elongate area of basal attachment, lacking a basal anchor sensu Aiken (1981). One half-row comprises 7-9 lateral teeth, the second, third and fourth teeth being the largest, with the eighth and ninth being the smallest. I could not determine the number of rows owing to the very small size of the radula, but it is at least 30 and probably not more than 60. Other anatomy unknown.

Distribution. – Known only from the type locality. Numerous surveys in other parts of East Africa have not found this species (e.g. those listed in Seddon et al., 2005; NMW, unpublished).

Etymology. – This species is dedicated to my Tanzanian colleague Mrs Christine Fishaa Ngereza of NMT, for her invaluable help with all aspects of NMW's work in Tanzania since 1997.

DISCUSSION

I consider *G. (J.) ngerezae* unmistakable among the East African fauna (see diagnosis). However, there are resemblances to the following five small, East African species, which have been compared directly with the holotype:

1. *Gulella (Juventigulella) amboniensis* Tattersfield, 1998. – *G. (J.) ngerezae* resembles this species in size, the strong radial lamellae, and in the parietal keel of young juveniles. It differs in adult apertural dentition and in having spiral embryonic sculpture. It is a moot point whether the overall shell shape of the two species is considered similar or different, *G. (J.) amboniensis* being conical rather than subconical, but also being the least strictly con-

ical (*i.e.*, highest-spired) of the three species originally assigned to *Juventigulella* by Tattersfield (1998). I consider *G. (J.) ngerezae* intermediate in shape between *G. (J.) amboniensis* and *G. peakei continentalis* (see below). *G. (J.) amboniensis* is known from montane forest in the East Usambara Mountains in NE. Tanzania and the nearby coastal forest (Tattersfield, 1998).

2. *G. (J.) habibui* Tattersfield, 1998. – *G. (J.) ngerezae* resembles this species in size and in the parietal keel of young juveniles. It differs in being relatively higher-spired, in having stronger radial lamellae, in adult apertural dentition, and in having spiral embryonic sculpture. *G. (J.) habibui* is known from montane and lowland forest from various sites in NE. Tanzania (Tattersfield, 1998).

3. *G. (J.) spinosa* Tattersfield, 1998. – *G. (J.) ngerezae* resembles this species in size and shape (juveniles of *G. (J.) spinosa* may yet prove to have a parietal keel), but differs in many other respects. *G. (J.) spinosa* is known from montane forest on Kilimanjaro, Tanzania, and in the Taita Hills, Kenya (Tattersfield, 1998; Lange et al., 2001).

4. *G. kimbozae* Verdcourt, 2004. – *G. (J.) ngerezae* resembles this species in the complete peristome and strong radial lamellae, and in having a spiral element to the embryonic sculpture (that of *G. kimbozae* is described as "spirally punctate striate" by Verdcourt, 2004) but differs in many other respects. *G. kimbozae* is known only from lowland forest at Kimboza, in the foothills of the Uluguru Mountains, Tanzania.

5. *G. peakei continentalis* van Bruggen, 1975. – *G. (J.) ngerezae* resembles this species in the complete peristome and strong radial lamellae. Young juveniles of *G. p. continentalis* also have a parietal keel (van Bruggen, 1975), although there are differences in the apertural dentition, size and shape; *G. p. continentalis* also lacks spiral embryonic sculpture. The radula of *G. peakei* (presumably subsp. *continentalis*) from eastern South Africa was described and figured by Aiken (1981), who noted that it was unique among the South African *Gulella* radulae he studied in several respects. The radula of *G. (J.) ngerezae* resembles that of *G. p. continentalis* in the general form, number, and relative size of the laterals, but differs considerably in the form of the central tooth, which was said to be "minute [and] amorphous" by Aiken (1981). The central tooth of *G. (J.) ngerezae* is relatively large and characteristically-shaped in comparison. These comments apply to the subspecies *G. peakei continentalis* but one can assume that the relationship with the extinct Aldabran subspecies *G. p. peakei* van Bruggen, 1975, is similar. *G. p. continentalis* is known from many localities from eastern South Africa to Tanzania, Kenya and Uganda (Rowson, in press).

All the above named species except *G. p. continentalis* are restricted to forest in Tanzania or the Eastern Arc Mountains. Based on current data, *G. (J.) ngerezae* is the most restricted of these species with the exception of *G. kimbozae*, and may prove to be endemic only to the Ukaguru Mountains. It is worth noting that *G. (J.) ngerezae* shares morphological features with species of *Juventigulella* as well as with species not currently assigned to that subgenus, and that in overall shell form it appears transitional between *G. (J.) amboniensis* and *G. peakei*, with which it also shows a radular resemblance. Inevitably, my attribution of the new species to *Juventigulella* thus expands the morphological content of the subgenus. The apparently complex patterns of similarities and differences between these species warrant further analysis, as potential synapomorphies of *Juventigulella* or an as yet un-circumscribed larger group of species currently assigned to *Gulella* sensu lato.

Special mention may be made of the spiral striae on the embryonic whorls, a feature that none of the above East African species shares with *G. (J.) ngerezae*. Features of the protoconch arise early in ontogeny, so might be considered phylogenetically important according to von Baer's 'first law' (to paraphrase: general, i.e. primitive, features of a group appear earlier in ontogeny than special, i.e. derived, features). If this were the case, they should be given greater weighting in systematic studies. A survey of the known African Streptaxidae suggests this weighting has not been consistently applied, and indeed that embryonic sculpture has not been considered of particular importance in the group. Pilsbry's (1919) monograph on the terrestrial molluscs of the Congo basin, and the subsequent revision of his groups by later authors, will serve as an example. Although Pilsbry (1919) used embryonic sculpture as a subgeneric or generic character in other families, the situation is different in his large streptaxid subfamily Ptychotrematinae. Pilsbry circumscribes the Ptychotrematine subgenus *Ennea* H. & A. Adams, 1855, on teleoconch characters, and groups together species having embryonic spiral striae with species having smooth embryonic whorls. The type species of the then monotypic subgenera *Avakubia* Pilsbry, 1919, and *Conogulella* Pilsbry, 1919, have embryonic spiral striae, but so does at least one species that Pilsbry (1919) assigns to *Gulella* sensu lato (no subgenus named) on teleoconch characters. Embryonic spiral striae were evidently not considered sufficient to define a subgenus. Pilsbry's (1919) subgenus *Tortigulella* Pilsbry was founded on two otherwise dissimilar species with decussate embryonic sculpture including a spiral element, but has since been expanded by Verdcourt (2006) to include East African species with different embryonic sculpture. The subgenus *Parennea* Pilsbry, 1919, was founded on species with smooth embryonic sculpture (or those for which no data was given), but has since been expanded by Adam & Van Goethem (1978) to include several species with decussate embryonic sculpture. If, as is very likely, each of these classifications are intended to reflect phylogeny, the current arrangement implies repeated evolutionary loss or gain of the various forms of embryonic sculpture. Protoconch features are thus homoplasious and likely to be of limited phylogenetic value among African streptaxids, while teleoconch characters have been given greater weight in past revisions. It will be intriguing to examine the systematic value of juvenile teeth – an ontogenetically early teleoconch feature – now that more data on them is becoming available. Furthermore, the superficially juvenile appearance of certain species of *Juventigulella*, and other streptaxid taxa, raises the question of whether ontogenetic shifts have been more important in streptaxid evolution than changes in the protoconch. Such shifts could explain the shell form of *G.* (*J.*) *ngerezae* being intermediate between that of *G.* (*J.*) *amboniensis* and *G. peakei*; one wonders what might explain the evolution in either direction.

ACKNOWLEDGEMENTS

I am indebted to Peter Tattersfield (NMW) and Christine Ngereza (NMT), with whom the material was collected, NMW for funding the fieldwork, the Tanzanian authorities who granted research permits and access, and to the people of the Mandege area near Mamiwa Kisara who assisted with the survey. Mary Seddon and Peter Tattersfield (NMW) provided comments on the manuscript and Anna Holmes helped with SEM facilities.

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