

ADDITIONAL DATA ON EASTERN PANTEPUI ORTHALICOIDEA LAND SNAILS (MOLLUSCA, GASTROPODA)

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Abstract Recent visits by a herpetologist to hitherto unexplored or ill-explored tepuis in the Pantepui area of Venezuela reveal three new species: *Plekocheilus* (P.) *sanderi*, P. (Eurytus) *annetae*, and P. (E.) *timoi*. This brings the total number of recognised species in the Pantepui to 27 land snails, of which 23 belong to the dominating superfamily Orthalicoidea.

Key words Amphibulimidae, anatomy, Bulimulidae, Guyana, Venezuela

INTRODUCTION

Conan Doyle (1912) coined the term 'Lost World' for the mysterious area of the tepuis in the area of Venezuelan Guayana (Huber 1995). Even today this region is still poorly known in many aspects and scientific discoveries can still be made. For example only recently the presence of cave systems in the sandstones of the Chimantá massif was documented (Aubrecht *et al.* 2013; see also Brewer-Carias & Audy 2011 for a comprehensive overview of the biota of this region). The study area of this paper is limited to the Eastern Pantepui region (Berry *et al.* 1995, Huber 1988), and specifically focusses on the Roraima and Yuraní tepuis within the Roraima massif, and on parts of the Chimantá, Los Testigos and Auyán massifs (Figs 1, 2).

The malacofauna of the Pantepui region has been hardly known for a long time. The first taxon was described in 1890 by G.B. Sowerby III on the basis of three specimens (Sowerby 1890). Due to the inaccessibility of the area the total number of specimens from this region available in scientific collections has been very low for nearly a century. During recent years, however, the number of taxa in the Orthalicoidea from the Pantepui region has grown slowly but steadily from 10 to 18 (Breure 2009, 2012, 2013, Breure & Schlögl 2010). Since this region is very difficult to research with most tepuis accessible only by helicopter, and mostly snails are collected as by-catch by biologists of other disciplines, the number of specimens is often extremely low, also due to the restricted time that is sometimes available for visiting a particular tepui. In recent reviews of

the land snail fauna of this region (Breure 2012, 2019) the total number of species recognised is 24, two of which from the Roraima massif and seven species from tepuis which form part of the Chimantá massif. The aim of this paper is to present additional data on the species from the Eastern Pantepui region.

MATERIAL AND METHODS

Material was studied from the collections of the Museum for Comparative Zoology, Cambridge, Mass. U.S.A. (MCZ), the Royal Belgian Institute of Natural Sciences, Brussels, Belgium (RBINS), Naturalis Biodiversity Center, Leiden, the Netherlands (RMNH), and the Museum für Naturkunde, Humboldt Universität, Berlin, Germany (ZMB); FMNH refers to the collection of the Field Museum of Natural History, Chicago, U.S.A., and UF to Florida Museum of Natural History, Gainesville, U.S.A. Specimens were dissected under a Wild M-5 microscope. Radula and mandibula were examined using a JEOL JSM-6480LV Scanning Electron Microscope. Measurements were taken following the method of Breure & Ablett 2011; abbreviations used are D, shell diameter; H, shell height; HA, height of aperture; LW, height of last whorl; W, number of whorls; WA, width of aperture.

SYSTEMATICS

Amphibulimidae P. Fischer, 1873

Plekocheilus (*Plekocheilus*) Guilding, 1828

Type species: *Voluta aurissileni* Born, 1780 by monotypy.

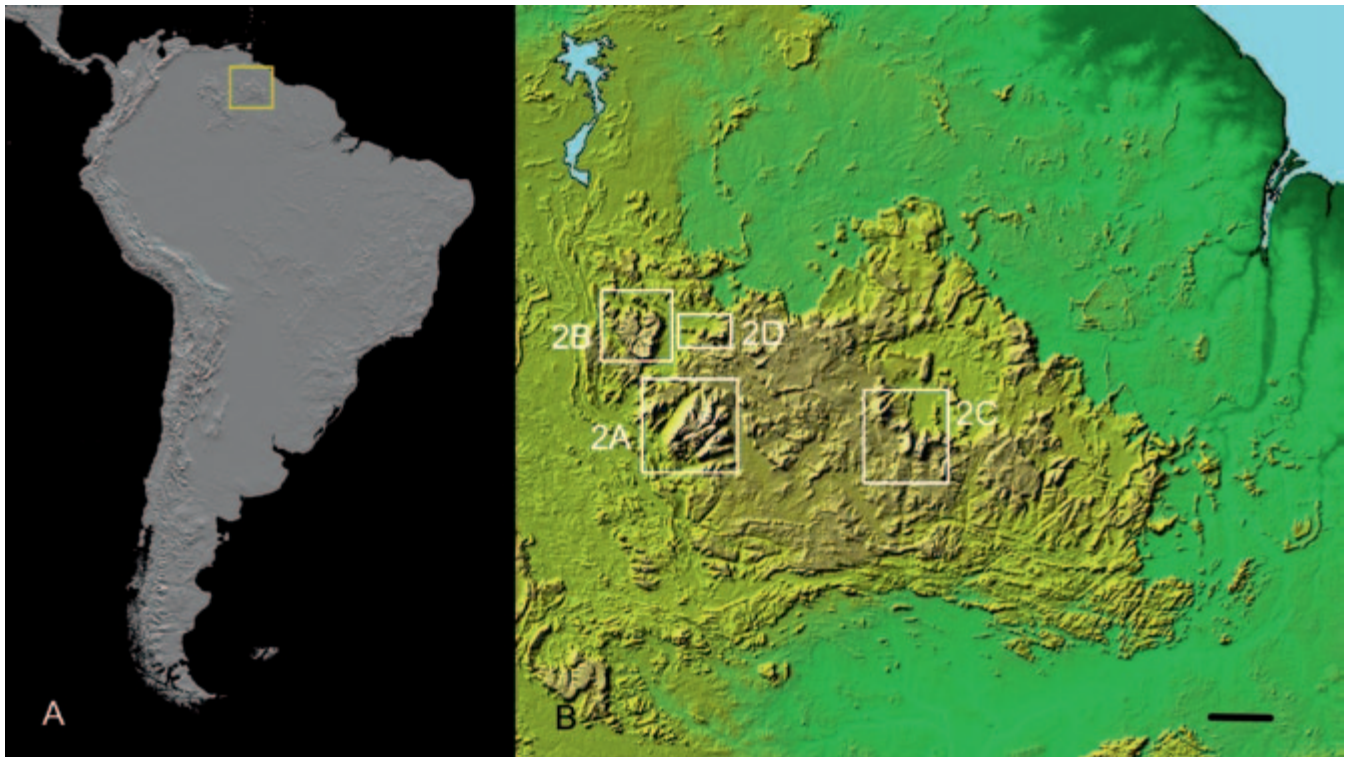


Figure 1 A Map of South America B Relevant part of Pantepui. The white boxes refer to the corresponding parts of Fig. 2. Scale 50km. Background figures courtesy of NASA JPL.

Plekocheilus (Plekocheilus) lintera (Sowerby III, 1890)
Fig. 3

Bulimus fulminans lintera Sowerby III, 1890: 582, pl. 56, fig. 12.

Plekocheilus (P.) fulminans lintera Sowerby III – Breure 2009: 27, figs 4A–D, 9A.

Plekocheilus (P.) lintera Sowerby III – Breure & Ablett 2011: 24, figs 25D–F, 25i – Breure 2013: 118, fig. 107B.

Type material Lectotype NHMUK 1889.4.25.1 (Breure 1978: 6).

Type locality “Mount Roraima, British Guiana”.

Material examined Venezuela, Roraima-tepui, Ulf leg. (ZMB 117723, three specimens); ibidem (ZMB 117724, one specimen).

Radula and mandibula Radula rows slightly V-shaped, radula formula C/1+L/1+M 50/2 (teeth type C–6, L–3, LM–10, LM–11; see Breure 1978, 1979). Central teeth monocuspid, triangular, first lateral teeth acute, monocuspid, next 15 lateromarginals bicuspid, with spatula-shaped

mesocones and ovate ectocones, the remaining 35 outer lateromarginals bicuspid, shifted, with rather blunt spatula-shaped mesocones and blunt deltoid ectocones, which may be bifid in some cases (Fig. 3A, 3B). Mandibula bow-shaped, ribbon-like, with a fused central part and up to 14 lateral plates on each side (Fig. 3C, 3D).

Distribution Roraima massif (Roraima-tepui).

Remarks The locality of the material from the ZMB-collection (“Roraima tepui”) is assumed to be in Venezuela, as the majority of this tepui lies within the border of this country; no further data could be obtained about the itinerary of the collector.

Plekocheilus (Plekocheilus) sanderi n. sp.
Figs 4, 5B

Diagnosis A relatively small species of *Plekocheilus* s.str. (up to 36.2), characterized by the reddish streaks on the last whorl axially arranged, the suture hardly descending in front, and the relatively weak malleation on the last whorl.

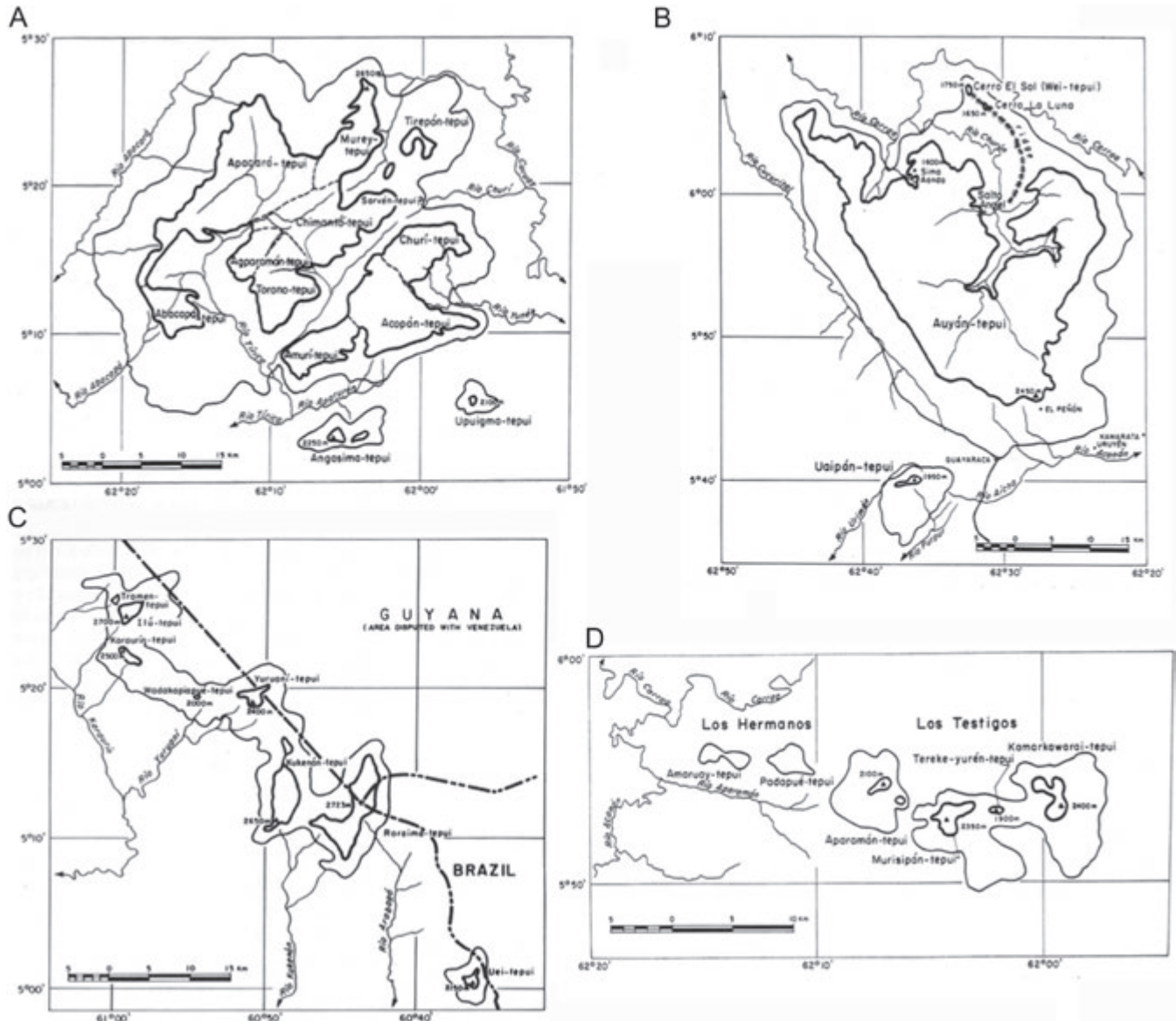


Figure 2 Maps of tepui areas showing locations mentioned in text. **A** Chimantá massif. **B** Auyán massif. **C** Roraima massif. **D** Los Hermanos and Los Testigos massifs. Light contour is slope area, dark contour is summit area. All from Huber (1995).

Description Shell up to 36.2mm, 1.81 times longer than wide, rather thin, imperforate, ovate, with slightly convex sides, color deep chestnut-brown, with faint reddish-brown streaks visible in translucent light axially arranged on the body whorl, somewhat undulating, the interstices twice as broad, protoconch eroded, the teleoconch sculptured with oblique axial riblets, the interstices as broad as the riblets, becoming a relatively weak malleation on the last whorl. Whorls hardly convex, the suture slightly impressed, hardly descending in front. Aperture 0.53 times the shell height, height/width ratio 1.63, sub-ovate, the length axis at an angle of 8 degrees

with the shell axis, peristome slightly expanded and narrowly reflexed, dark brown, columellar margin rounded, twisted, entering the aperture with a slight fold, parietal callus translucent, dull.

Type material Holotype RBINS MT.3236. Paratypes (subadult) RBINS MT.3237, one specimen; RMNH.MOLL.5003998, two specimens. All material P.J.R. Kok leg., 16 June 2012.

Type locality Venezuela, Edo. Bolívar, summit of Murisipán-tepui (5°52'03.6" N, 62°04'30.3" W), 2419m.

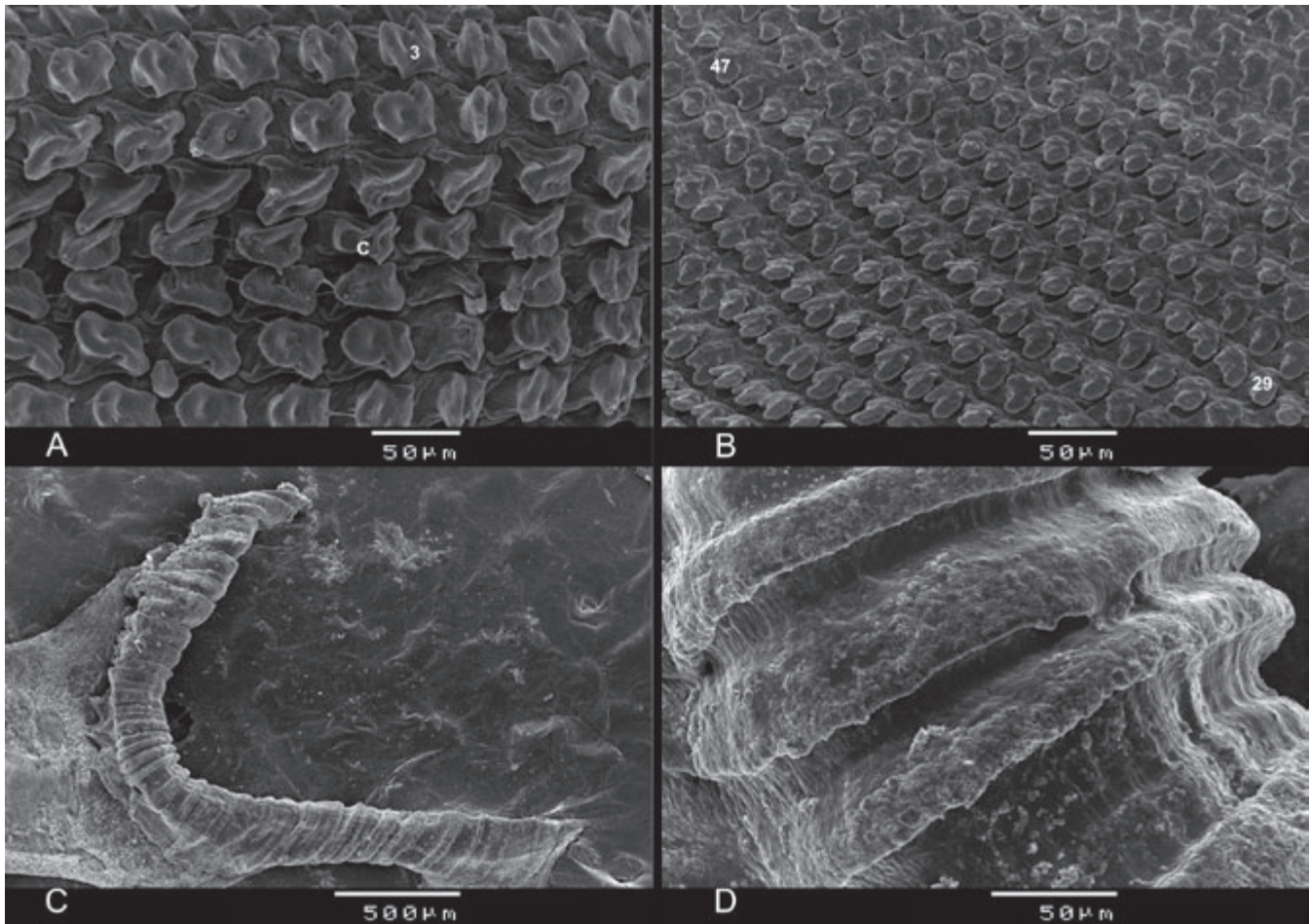


Figure 3 *Plekocheilus (P.) lintera* (Sowerby III, 1890). **A** Central part of radula. **B** Lateromarginal part of radula. **C** Overview of mandibula. **D** Central part of mandibula. Abbreviations: C, central teeth; numbers refer to teeth in transverse rows.

Dimensions See Table 1.

Distribution Los Testigos massif (Murisipán-tepui).

Etymology The species is named after my eldest son, H.J. Alexander Breure, as a belated gift for his 27th birthday on the day when the material was collected.

Remarks This new taxon is similar in shape to *Plekocheilus (P.) alticola* Haas, 1955, but (1) being much reduced in size (H=36.2 vs. 44.3mm), and (2) the reddish streaks on the last whorl axially arranged (not obliquely as in typical *alticola*). It may also be compared to *P. (P.) philippe* Breure, 2012, from which it differs in (1) being slightly smaller (H=36.2 vs. 39.3mm), (2) by having the suture descending in front, (3) by having a less extended spire. Finally this taxon resembles *P. (P.) vlceki* Breure & Schlögl, 2010, from which it

differs by (1) being larger (H 36.2 vs. 30.9mm), (2) having a less prominent columellar fold.

The living snail (Fig. 5B) is entirely dark blackish.

Plekocheilus (Plekocheilus) philippe Breure,
2012
Fig. 6

Plekocheilus (Plekocheilus) philippe Breure, 2012: 102, figs 2–4.

Type material Holotype RBINS MT.2576.

Type locality Venezuela, Edo. Bolívar, Angasima-tepui, 2121m.

Material examined Venezuela, Edo. Bolívar, Angasima-tepui (paratype RMNH.MOLL.172353).

Radula Radula rows slightly curved, radula formula C/1+L/1+M 56/2 (teeth type C–6, L–3,



Figure 4 *Plekocheilus (P.) sanderi* spec.n. A–D: Holotype RBINS MT.3236. D. Sculpture of dorsal side of last whorl. Scales 5mm.

LM-10, LM-11; see Breure 1978, 1979). Central teeth moncuspid, triangular, first lateral teeth acute, moncuspid, with hardly noticeable

ectocones, next 15 lateromarginals bicuspid, with spatula-shaped mesocones and ovate to acute ectocones, the remaining 40 outer lateromarginals



Figure 5 Living snails. **A** *Plekocheilus (Eurytus) timoi* spec.n. **B** *Plekocheilus (P.) sanderi* spec.n. Photos Ph.J.R. Kok.

Table 1 Dimensions of Pantepui *Plekocheilus* species

	Height shell	Diameter	Height aperture	Diameter aperture	Last whorl	Whorls			
<i>Plekocheilus juliani</i>	41.2	20.7	24.2	15.5	34.9	4.5	Abacapa-tepui		RBINS
<i>Plekocheilus sanderi</i>	36.2	20.3	20.1	12.2	29.6	4.7	Murisipan-tepui	holotype	RBINS
<i>Plekocheilus sanderi</i>	35.3	18.9	18.7	11.6	29.3	4+	Murisipan-tepui	paratype	RMNH
<i>Plekocheilus sanderi</i>	34.9	19.5	18.2	11.1	29.4	4.5	Murisipan-tepui	paratype	RMNH
<i>Plekocheilus sophiae</i>	51.8	27.3	27.3	15.3	43.1	4+	Yarani-tepui		RBINS
<i>Plekocheilus annetae</i>	37.7	21.8	20.6	13.4	33.9	3+	Uei-tepui	holotype	RBINS
<i>Plekocheilus annetae</i>	35.1	21.9	21.9	14.0	30.7	4.0	Uei-tepui	paratype	RBINS
<i>Plekocheilus timoi</i>	33.9	18.2	17.0	11.2	27.7	4.6	Auyan-tepui	holotype	RBINS

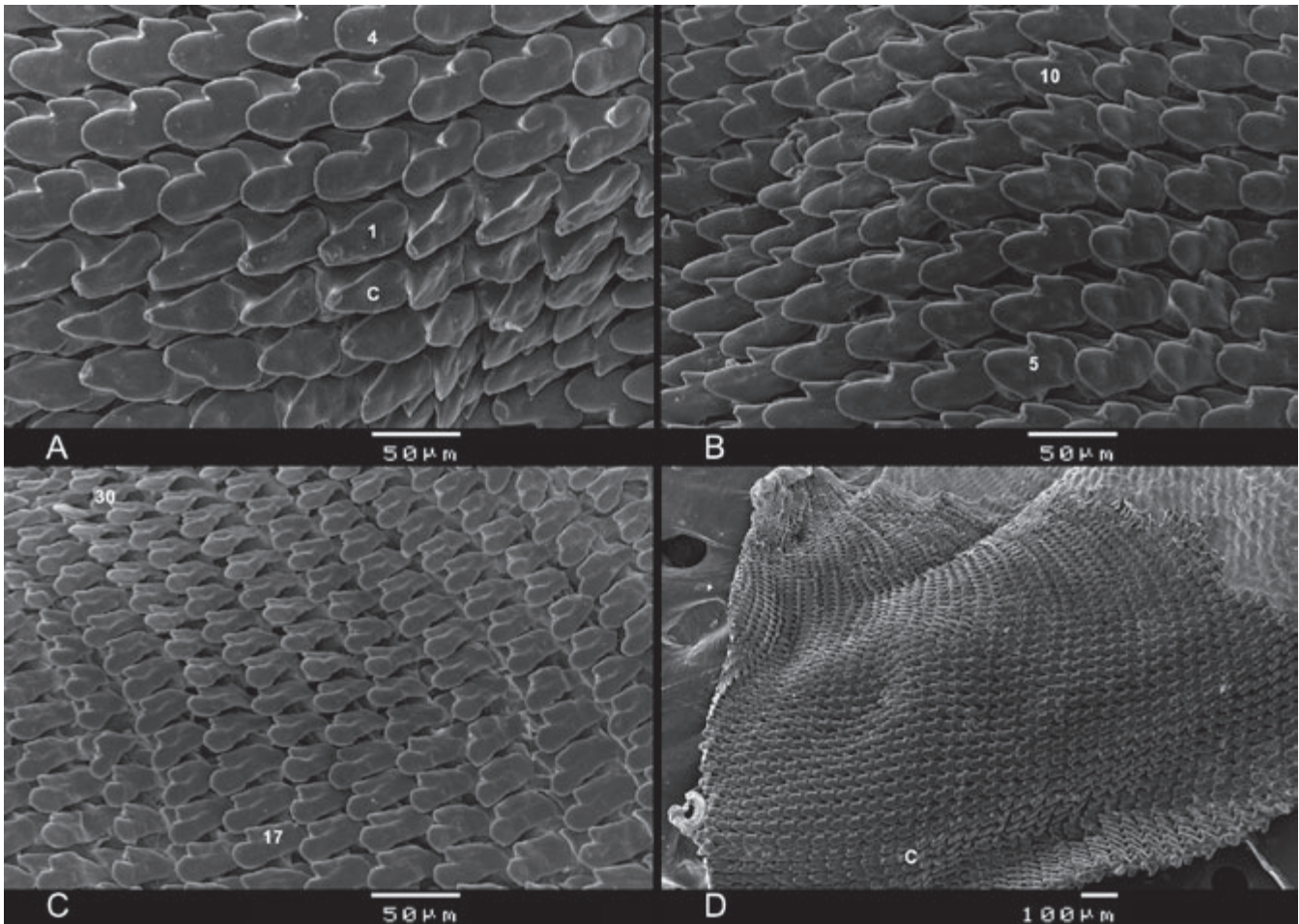


Figure 6 *Plekocheilus (P.) philippeii* Breure, 2012. **A** Central part of radula. **B–C** Lateromarginal part of radula. **D** Overview of radula.

bicuspid, shifted, with rather blunt spatula-shaped mesocones and blunt deltoid ectocones, partly bifid in some cases.

Distribution Chimantámassif (Angasima-tepui).

Plekocheilus (Eurytus) Albers, 1850

Type species: *Helix pentadina* d'Orbigny, 1835 by subsequent designation (Albers & Martens 1860: 195).

Plekocheilus (Eurytus) sophiae Breure, 2009
Figs 7–8

Plekocheilus (Eurytus) sophiae Breure 2009: 29, figs 5A–C, 9C – Breure 2013: 120, fig. 107F.

Type material Holotype UF 24413.

Type locality Venezuela, Edo. Bolívar, Yuraní-tepui, 2300m.

Material examined Venezuela, Edo. Bolívar, Yuraní tepui (5°18'50.4" N, 60°51'49.6" W), 2303m, Ph.J.R. Kok leg., 23–29 Nov. 2010 (RBINS INV.135001, one specimen). Genitalia Breure (1978: fig. 2) figured the genitalia of this taxon (at that time misidentified as *Plekocheilus blainvillleanus linterae*; this taxon was described by Sowerby III (1890) from the neighbouring Roraima-tepui). The new specimen collected has been dissected and confirms the published figure.

Radula and mandibula The radula components agree with the data presented for *Plekocheilus (Eurytus) mundiperditi* Haas, 1955 (Breure 1978: 239). The radula formula is C/1+LM 48/2 (Fig. 8A–C). Mandibula with narrowly elongate central plate and seven side plates of varying width. Fine transverse striae are especially visible on the lower side of the plates (Fig. 8D).



Figure 7 *Plekocheilus (Eurytus) sophiae* Breure, 2009. **A–C** RBINS INV.135001. **D** Living specimen. Photo Ph.J.R. Kok. Scale 5mm.

Distribution Roraima massif (Yuraní-tepui).

Remarks Living snails (Fig. 7D) are light brownish with slightly darker parts alongside the rim of the foot and in the neck of the animal, as a continuation of the dark brown to blackish tentacles.

Plekocheilus (Eurytus) annetae n. sp.
Fig. 10

Diagnosis A relatively small species of *Plekocheilus (Eurytus)*, up to 37.7mm, characterized by its dark colour, the glossy surface, and the growth striae partially superimposed by fine plicae.

Description Shell up to 37.7mm, 1.66 times longer than wide, rather thin, imperforate, (elongate-)subovate, with hardly convex sides, colour dark chestnut-brown, the upper whorls paler. Protoconch eroded, teleoconch sculptured with incassate growth striae and slightly impressed spiral bands, the growth striae partially superimposed by fine plicae of the cuticula (Fig. 10E). Whorls somewhat convex, the suture well impressed, hardly descending in front. Aperture 0.58 times the shell height, height/width ratio 1.54, ovate, the length axis at an angle of 10 degrees with the shell axis, peristome hardly expanded, dark brown, columellar margin nearly straight, hardly dilated above, twisted, entering

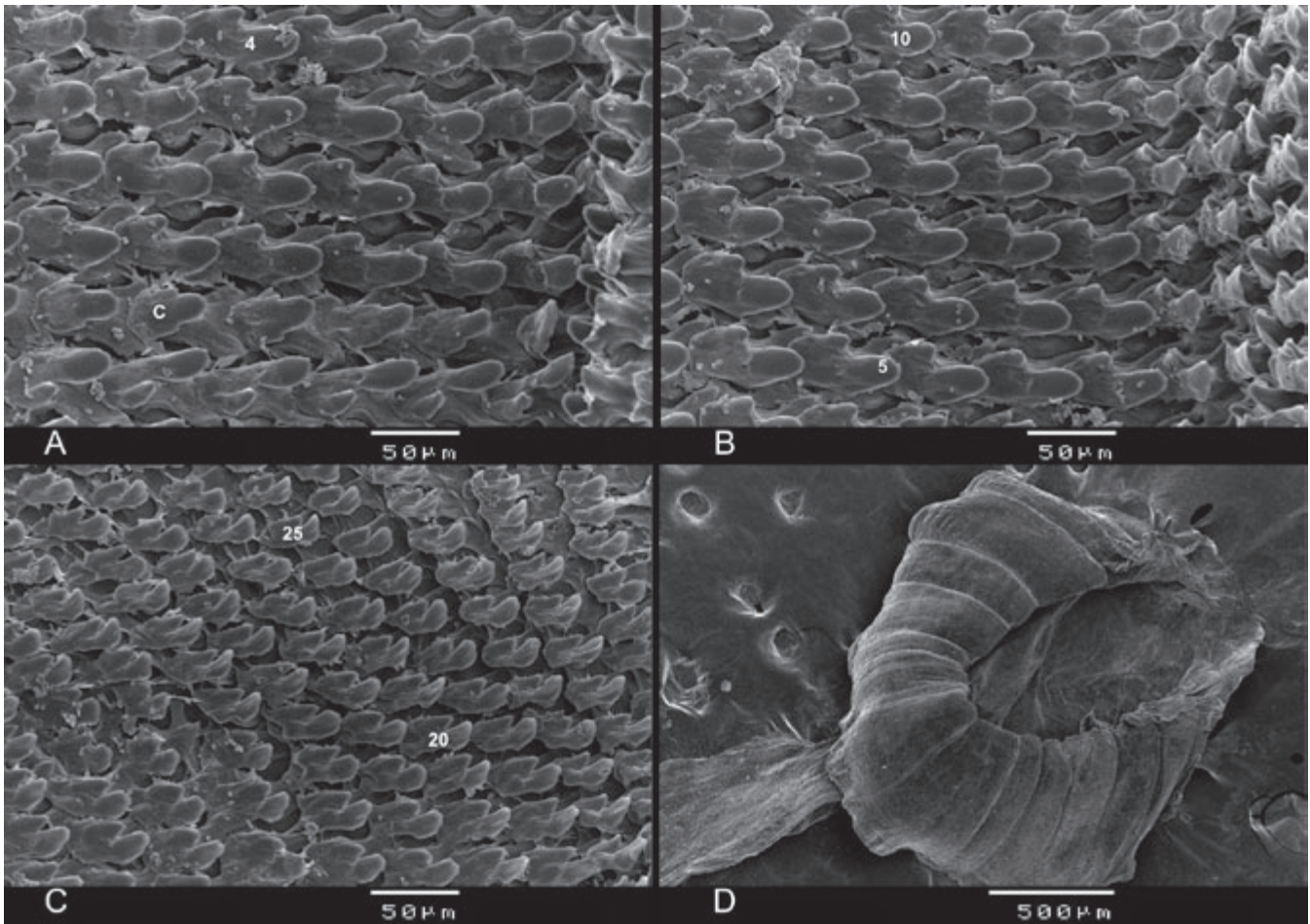


Figure 8 *Plekocheilus (Eurytus) sophiae* Breure, 2009. **A** Central part of radula. **B–C** Lateromarginal of radula. **D** Overview of mandibula.

the aperture with a thread-like fold, parietal callus translucent, dull.

Type material Holotype RBINS MT.3238; one subadult paratype RBINS MT.3239. All material Ph.J.R. Kok leg., 23 Nov. 2013.

Type locality Venezuela, Edo. Bolívar, Uei-tepui, 6° 06' 43.7" N 62° 32' 53.6" W, 1790m.

Dimensions See Table 1.

Distribution Auyán massif (Uei-tepui).

Etymology This species is named after my daughter, Anthonia C. Breure, who has a strong interest in South America and always takes the effort to look for snails during her travels.

Remarks The holotype is damaged, possibly by a predator, and lacks the top of the shell while the area behind the insertion of the lip to the

parietal wall has also been damaged but was repaired by the animal. The maximum attainable shell height as mentioned above thus is slightly underestimated. Paratype material is not fully grown. The specimens were collected in thick vegetation. This species resembles *Plekocheilus (Eurytus) mundiperditi* Haas, 1955 but differs in (1) being smaller (H=37.7 vs. 47.3), (2) the plicate striation of the cuticle on the last whorls being more continuous and not arranged in clearly separated spiral ('puckered') bands, and (3) the more shining surface. The new species may also be compared to *P. (E.) breweri* Breure & Schlägl, 2010, but differs by (1) being smaller (H=37.7 vs. 41.7), (2) a lower shell height/diameter ratio, and (3) the uniform dark chesnut-brown colour. Note the difference between this tepui north of Auyán-tepui and a similar named one located south-east of Roraima-tepui on the Roraima massif.

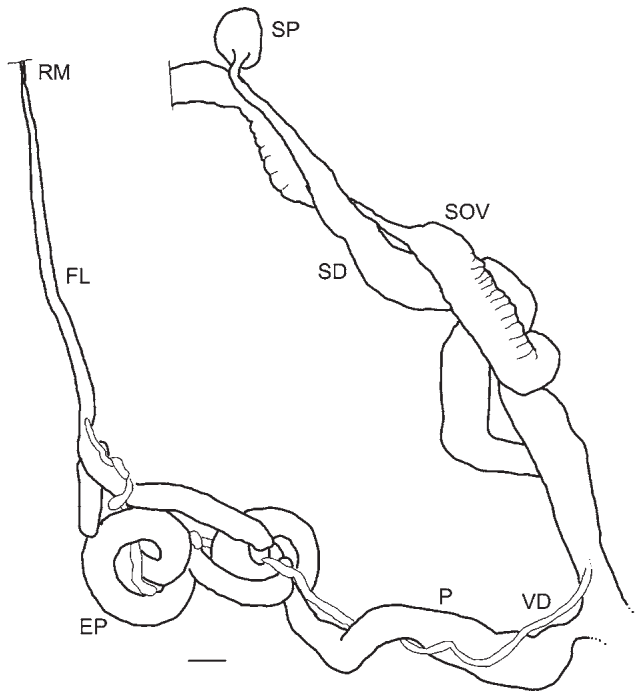


Figure 9 *Plekocheilus (Eurytus) sophiae* Breure, 2009. EP, epiphallus; FL, flagellum; P, penis; RM, retractor muscle; SD, spermathecal duct; SOV, spermoviduct; SP, spermatheca; VD, vas deferens. Scale line 1cm.

***Plekocheilus (Eurytus) timoi* n. sp.**
Figs 5A, 11

Diagnosis A relatively small species of *Plekocheilus (Eurytus)*, up to 33.9mm, characterized by its pale colour of the last whorl, the relatively smooth shell with irregular, somewhat malleated sculpture, with traces of granulation.

Description Shell up to 33.9mm, 1.86 times longer than wide, rather thin, imperforate, elongate-ovate, with hardly convex sides, colour pale tawny, the upper whorls darker to russet-brown, on the dorsal side of the penultimate and ventral side of ultimate whorl with narrow, obliquely descending reddish-brown streaks, apex pinkish. Protoconch eroded, teleoconch sculptured with incrassate growth striae and hardly impressed spiral bands, leading to an irregular, somewhat malleated pattern, with traces of very fine granulation. Whorls hardly convex, the suture hardly impressed, hardly descending in front. Aperture 0.50 times the shell height, height/width ratio 1.51, ovate, the length axis at an angle of 10 degrees with the shell axis, peristome hardly expanded and reflexed, pinkish, columellar margin nearly straight, hardly dilated above, twisted,

entering the aperture with a thread-like fold, no noticeable parietal callus.

Type material Holotype RBINS MT.3240, Ph.J.R. Kok leg., 19–22 Nov. 2013.

Type locality Venezuela, Edo. Bolívar, Auyán massif, Auyán tepui, 5° 45' 37.3" N 62° 31' 02.0" W, 2203m.

Dimensions See Table 1.

Distribution Auyán massif (Auyán-tepui).

Etymology This species is named after my youngest son, Timotheus S. Breure, who has decided to follow my footsteps with his career in sustainable development as soil scientist.

Remarks This novelty shows some resemblance with pale specimens of *Plekocheilus (Eurytus) mundiperditi* Haas, 1955, but may be separated by (1) the small size (H=33.9 vs. 47.3), (2) the irregular spiral impressions, and (3) the lack of 'puckered' spiral bands. The new species may also be compared to *P. (E.) breweri* Breure & Schlögl, 2010, but differs by (1) being smaller (H=33.9 vs. 41.7), (2) a lower shell height/diameter ratio, and (3) the uniform dark chesnut-brown colour of *P. breweri*. The single specimen obtained was collected during the night on a rock. The animal (Fig. 5A) is yellowish, with a pattern of grooves of a medium brownish colour.

***Plekocheilus (Eurytus) juliani* Haas, 1955**
Fig. 12

Plekocheilus [sic] (Eurytus) juliani Haas, 1955: 375, fig. 78.

Plekocheilus (Eurytus) juliani Haas– Breure 2009: 32, figs 5D–F, 9F – Breure & Schlögl 2010: 58 – Breure 2013: 118, fig. 107I.

Type material Holotype FMNH 49737.

Type locality Venezuela, Edo. Bolívar, Chimantá massif, Apacará-tepui, 2100m.

Material examined Venezuela, Edo. Bolívar, Chimantá massif, Apacará-tepui, Ph.J.R. Kok leg., 2011 (RBINS INV.135002, 1 specimen); ibidem, Amuri-tepui, Ph.J.R. Kok leg., 2–10 May 2012 (RBINS INV.135003, two subadult specimens).



Figure 10 *Plekocheilus (Eurytus) annetae* spec.n. A–C: Holotype RBINS MT.3238. D–E: Paratype RBINS MT.3239. E Sculpture on dorsal side of last whorl. Scales 5mm.

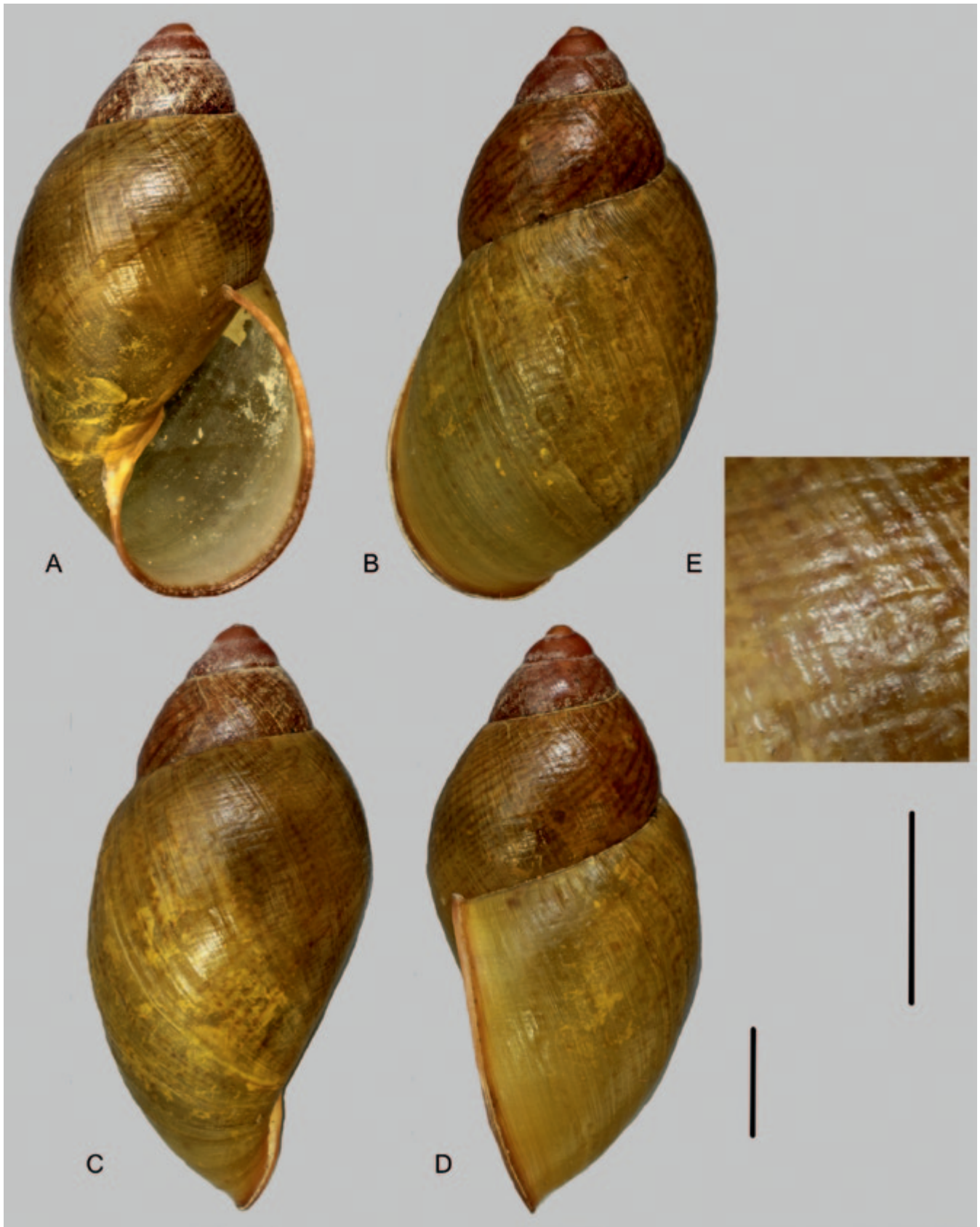


Figure 11 *Plekocheilus (Eurytus) timoi* spec.n. A–E: Holotype RBINS MT.3240. E Sculpture on dorsal side of last whorl. Scales 5mm.

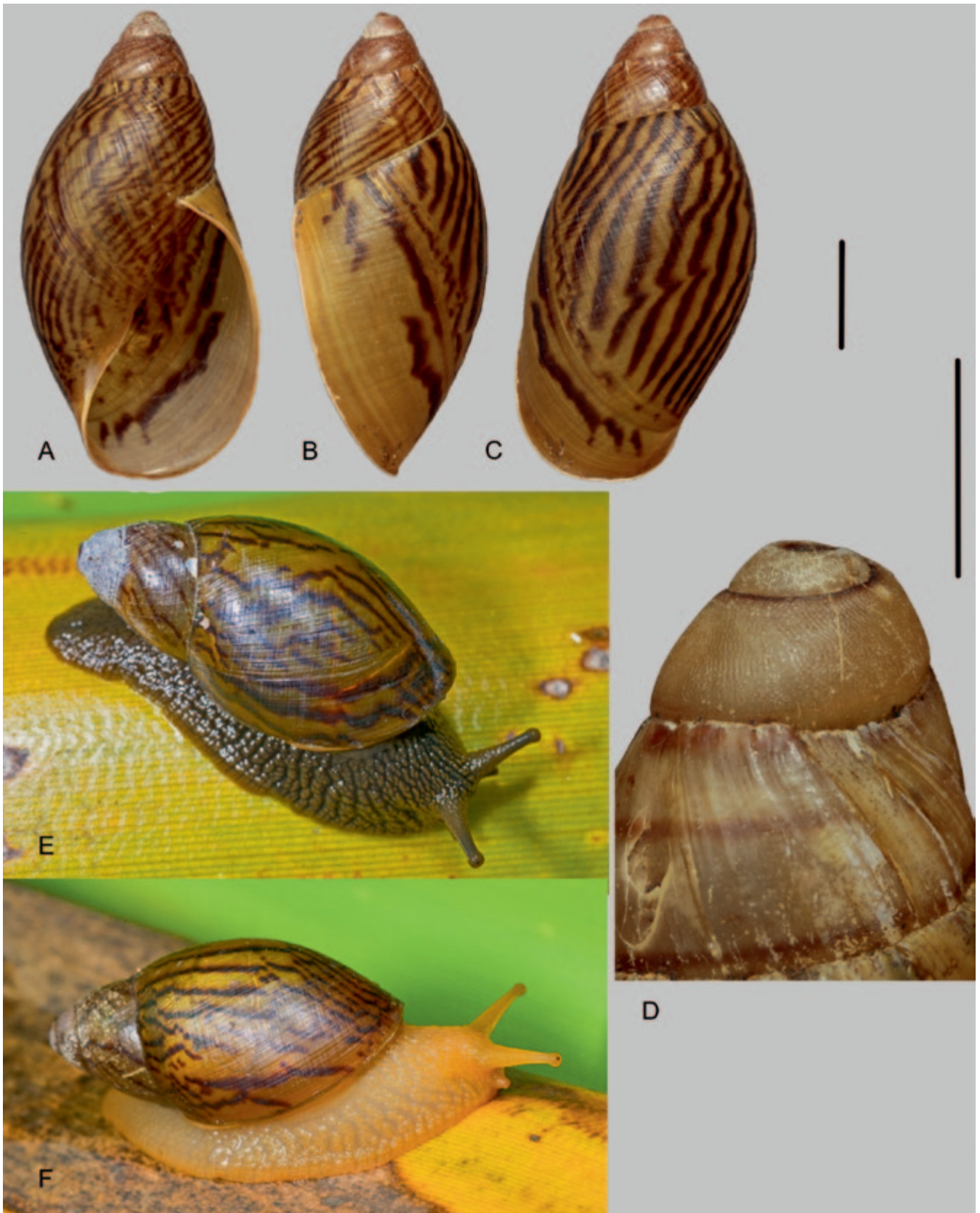


Figure 12 *Plekocheilus (Eurytus) juliani* (Haas, 1955). **A–D**: RBINS INV.135002. **D** Apex with protoconch sculpture. **E–F** Living specimens. Photos Ph.J.R. Kok. Scales 5mm.

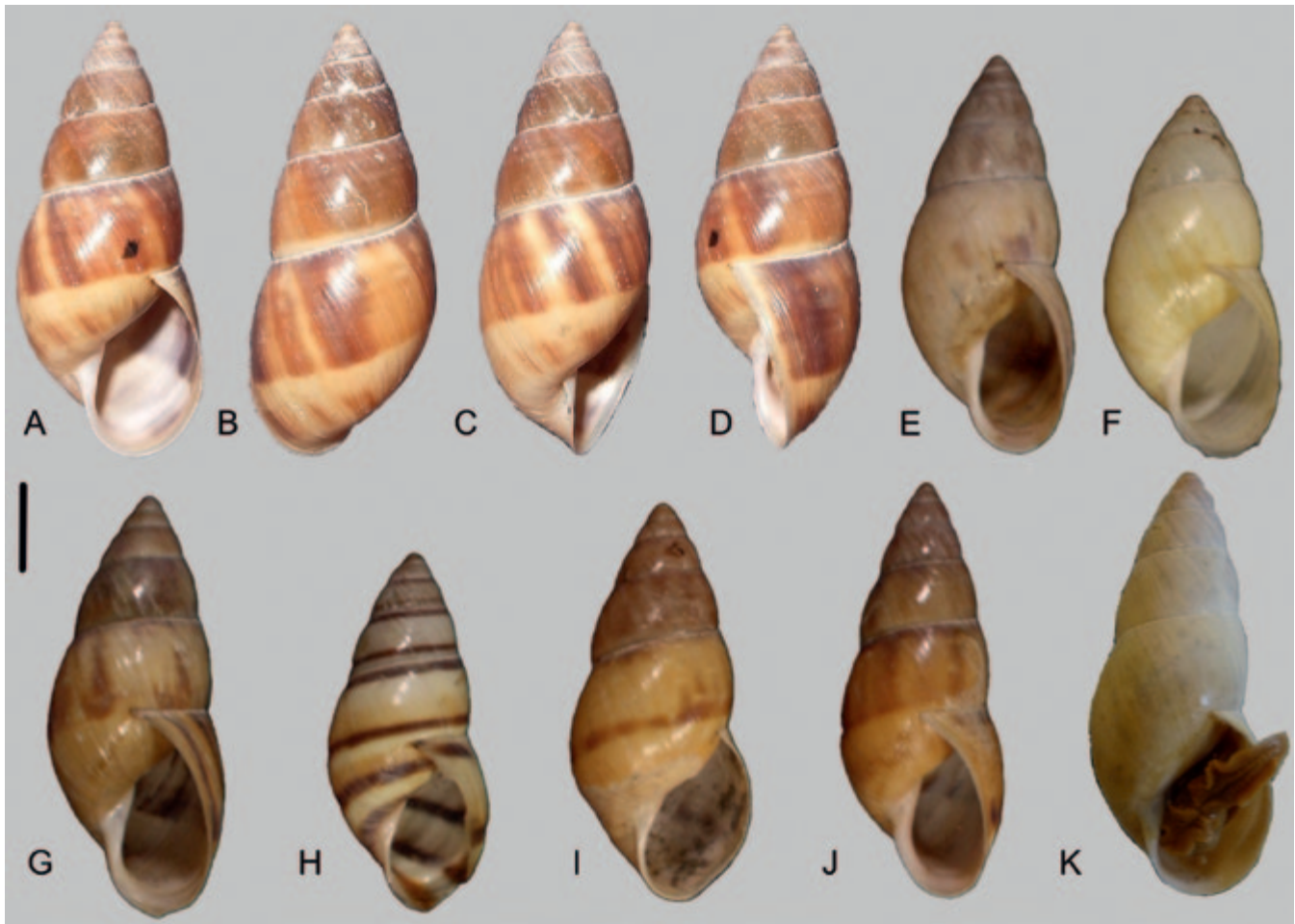


Figure 13 *Drymaeus (D.) extraneus* (Haas, 1955). A–D MCZ 137584. E–J MCZ 137583. K. ZMB 117725. Scale 5mm.

Distribution Chimantá massif (Aparará–tepui, Amuri–tepui, Churí–tepui).

Remarks Photographs taken in the field by Philippe Kok show that this species is polymorphic in body colour.

Bulimulidae Tryon, 1867

Drymaeus (Drymaeus) Albers, 1850

Type species *Helix hygrophylaea* d’Orbigny, 1835 by subsequent designation (Pilsbry 1898: 182).

Drymaeus (Drymaeus) extraneus (Haas, 1955)
Fig. 13

Bulimulus (Lissoacme) extraneus Haas, 1955: 382, fig. 82.

Drymaeus (Drymaeus) griffini Haas, 1955: 383, fig. 83.

Drymaeus (Drymaeus) extraneus Haas – Breure 2009: 40, fig. 8A–C – Breure 2013: 118, fig. 107D.

Type material Holotype FMNH 49736 (*extraneus*), 49734 (*griffini*).

Type locality Venezuela, Edo. Bolívar, Chimantá massif, Aparará–tepui, ca. 2100m (*extraneus*); western side of Abacapa–tepui, 1300m (*griffini*).

Material examined Venezuela, Edo. Bolívar, Roraima–tepui, SW slope, 2195m, P.S. Peberdy leg., 5–12.vi.1939 (MCZ 137583, 25 specimens; MCZ 137584, one specimen); Roraima–tepui, Ule leg. (ZMB 117725, two specimens in ethanol).

Ecology “Collected on leaves and ground” is mentioned on the field label that accompanies MCZ 137583. However, no mentioning was made of the species of plant these specimens were found on.

Distribution Roraima massif (Roraima–tepui), Chimantá massif (Aparará–tepui, Abacapa–tepui).

Remarks This species was hitherto only known from the Chimantá massif. The new locality is a range extension of ca. 140km. The ZMB material proved to be preserved in such state that it was impossible to dissect the specimens. The variation in colour pattern in this species is similar to *Drymaeus (D.) rex* Breure, 2009, and may be due to predation pressure (Breure unpublished data).

DISCUSSION

The malacofauna of this area is slowly unraveling (Sowerby III 1890; Oberwimmer 1931; Haas 1955; Breure & Eskens 1981; Breure 2009, 2012, 2013, 2019; Breure & Schlögl 2010), and becoming better known through the increased attention for these animals by explorers who visited the Pantepui region primarily for other studies. The new taxa described in this paper increase the dominance of the Orthalicoidea in the land snail fauna of the Pantepui region (sensu Huber 1988); see Breure 2013: fig. 112. However, it is to be expected that the number of species will still increase once unexplored tepuis are visited by researchers with a keen eye for land snails.

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