Additional notes on Orthalicidae from the Chimantá massif, Venezuelan Guayana, with descriptions of new species of *Plekocheilus* Guilding, 1828 (Mollusca: Gastropoda)

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Abstract

Two new species are described from Venezuelan Guayana, Chimantá massif: *Plekocheilus* (*P.* ) *vlceki* and *P.* (*Eurytus*) *breweri*. Some remarks are made on the ecology of the latter species in relation to birds. Finally some notes on conservation issues are made, highlighting possible threats by climate change.

Key words: Venezuela, taxonomy, ecology, endemism, new species, distribution

Introduction

For more than 100 years the malacofauna of the highlands in southern Venezuela, known as Guayana Highlands (Huber 1995a; Fig. 1A), has been hardly explored. Most of the year, their table-top mountains (‘tepuis’) are hidden in clouds and blankets of fog. Due to the inaccessibility of the area, very scant material is available in museum collections. So far 18 land snail species are known from Venezuelan Guayana (Thompson 2008, Breure 2009, Simone in press), of which 16 belong to the family Orthalicidae.

The Chimantá massif (approx. 05°15’ N 062°10’ W) is a series of tepuis in the eastern part of the Guayana Highlands (Fig. 1B). It has been mainly visited by botanists and herpetologists. Recently a Slovakian geological expedition explored the cave systems of these mountains. This paper reports on the malacological results of the recent expedition to Churí-tepui (Figs 1C, 5A), supplementing the recent revision by Breure (2009), describing new taxa and adding details on the ecology of the species.

Measurements are according to the method described by Breure (1974: figs. 2–3). Abbreviations used for the depositories of material treated in this paper: CB, private collection of C. Brewer-Carias, Caracas, Venezuela; FMNH, Field Museum of Natural History, Chicago, U.S.A.; JG, private collection of J. Grego, Banská Bystrica, Slovakia; MLSC, Museo de Historia Natural ‘La Salle,’ Caracas, Venezuela; MZSP, Museu de Zoologia, Universidade de São Paulo, São Paulo, Brasil; RMNH, National Museum of Natural History ‘Naturalis,’ Leiden, The Netherlands; SNMSZ, Slovak National Museum, Bratislava, Slovakia; UF, Florida Museum of Natural History, Gainesville, U.S.A.

Systematics

Family Orthalicidae Albers, 1860

Subfamily Bulimulinae Tryon, 1867
Genus *Plekocheilus* Guilding, 1828

Type species: *Voluta aurissileni* Born, 1780

For a detailed description of this genus and a key to subgenera, see Breure (1979). For a discussion of related species and their anatomy (if known) from Venezuelan Guayana, see Breure (2009).

**FIGURE 1.** A. Map of northern South America, showing Venezuelan Guayana (white rectangle) and Chimantá massif (white dot). B. Map of Chimantá massif, showing location of tepuis (modified after Huber 1995a). C. Churí-tepui. The three locations studied are indicated by arrows.

**Subgenus* Plekocheilus* Guilding, 1828 s. str.**

*Plekocheilus* (*Plekocheilus*) *vlceki* spec. nov.
(Figs 2A–2C, 3A, 3B, 4A)
**Diagnosis.** A small species of *Plekocheilus* s. str. (up to 30.9 mm) that is characterized by its almost uniform (dark-) yellowish to chestnut-brown colour, its finely malleated sculpture on the last whorl crossed by spiral lines and a rather strong columellar fold.


**Description.** Shell: Up to 30.9 mm high, 1.75 times longer than wide, imperforate, ovate, sides of spire slightly convex, moderately solid. Colour yellowish- to dark chestnut-brown; upper whorls lighter, whitish, eroded. Surface somewhat shining, with closely set riblets on the upper whorls, becoming finely malleated on the last whorl, crossed by spiral lines. Protoconch smooth (eroded). Whorls 4.0, rather flat, the last whorl slightly swollen; suture impressed, somewhat descending in front. Aperture elongate-ovate, somewhat pointed above, the stripes or spots from the outside shining through, in some specimens whitish inside, 1.6 times longer than wide, 0.51 times the total length; peristome thickened and strongly reflexed, dark brown. Columellar margin slightly curved, with a rather strong fold above, hardly and narrowly dilated above. Parietal wall with a thin, brownish callus.

Genitalia: Penis subcylindrical, contorted before passing into the epiphallus without external differentiation. Flagellum contorted subdistally, with a short, distally attached retractor muscle; ca. 1/3 the length of the penial complex. The vas deferens is attached to the penial complex, slightly darker in colour and relatively broad. Vagina short; spermathecal duct subcylindrical, its upper part somewhat slenderer before passing into the globose spermatheca.

Exterior of animal: Two living specimens of this new species were kept alive for more than three months in the laboratory. The colour of the animal is brownish- to yellowish-beige, with a slightly darker band on the dorsal side; the rim along the foot is also slightly darker (Fig. 3). In one of the animals the ocular tentacles were greyish-blackish towards the tips, in the other uniformly beige.

**Ecology.** The type material was collected on the floor of a canyon covered with a dense *Bonnetia* forest and low vegetation (Fig. 5F, 5G). Specimens described here were found on *Brocchinia tatei* (Bromeliaceae).

**Type material.** Holotype RMNH 114233, Venezuela, Estado Bolivar, Chimantá massif, Churí-tepui, Sima Nor-oeste, 2100 m, J. Schlögl leg., ii.2009. Paratypes, same data as holotype, RMNH 114234/1, 114195/1
juv., MZSP 92470/1, UF 434148/1.

Comparison with other taxa. This new taxon is conchologically similar to *Plekocheilus (P.) fulminans alticola* Haas, 1955 and *P. (P.) fulminans linterae* (Sowerby, 1890), both known from other tepui sites in Venezuelan Guayana (Breure 2009). It differs from *alticola* in (1) the absence of reddish-brown zig-zag streaks, and (2) being smaller. It differs from *linterae* in (1) being smaller, and (2) being stouter. Compared to both taxa, the columellar fold in *P. vlceki* is less pronounced.

**Remarks.** The extremely thin shell of one juvenile shows undulating reddish streaks on a light brown background. This may indicate that in this taxon the uniform colour of the shell is only reached in adulthood.

**Etymology.** Named in honour of Lukáš Vlček (Bratislava), a member of the Slovakian expedition that explored Chimantá in 2009. He discovered the snails at the localities where material of the taxa described in this paper was collected.

**FIGURE 3.** Living specimens of *Plekocheilus* spp. **A–B.** *P. (P.) vlceki* spec. nov., under laboratory conditions. **C–D.** *P. (E.) breweri* spec. nov., under natural conditions.
FIGURE 5. Habitat and localities of *Plekocheilus* species treated in this paper. A. Aerial view of Churi-tepui and surroundings from the North-east. B. *Brocchinia* with a flowering *Utricularia humboldtii* inside. C. Habitat of *P. breweri spec. nov.*, showing *Bonnetia* trees. D. Snail inside *Brocchinia hechtioides*. E. Bird nest in Cave Julián where empty shells of *P. breweri* were found on the ground below. F–G. Overview of Sima Nor-oeste, type locality of *P. (P.) vlčekii spec. nov.*
Subgenus *Plekocheilus* (*Eurytus*) Albers, 1850

Type species: *Helix pentadina* Orbigny, 1835

*Plekocheilus* (*Eurytus*) *brewer* spec. nov.
(Figs 2D–2G, 3C, 3D, 4B–4F)

**Diagnosis.** A medium-sized species of *Plekocheilus* (*Eurytus*) characterized by having oblique stripes of reddish- to blackish-brown, often with a yellowish ‘shadow’ besides the stripes on the last whorl. Sculptured with spiral, puckered bands of oblong granules.

**Description.** Shell: Up to 41.7 mm high, 1.84 times longer than wide, imperforate, slenderly ovate, sides of spire hardly convex, rather thin. Colour yellowish- to (light) chestnut-brown, with descending oblique, partly zig-zag stripes of reddish- to blackish-brown, on the penultimate whorl narrow, on the last whorl with a yellowish ‘shadow’ besides the darker stripes; upper whors lighter, whitish, eroded. Surface hardly shining, upper whors with growth striae, on the penultimate and last whorl also with spiral series of oblong granules, forming puckered bands (Fig. 2G). Protoconch smooth (eroded). Whors 4.1, rather flat, the last whorl decidedly swollen; suture impressed, somewhat descending in front. Aperture elongate-ovate, somewhat pointed above, the stripes from the outside shining through, whitish inside, 1.60 times longer than wide, 0.54 times the total length; peristome thin and hardly reflexed, whitish. Columellar margin slightly curved, with a very weak fold above, hardly and narrowly dilated above. Parietal wall with a thin, whitish callus.

Genitalia: Penis subcylindrical, distally with a somewhat swollen appendix, passing subdistally into the long epiphallus, which is partly contorted and tapering towards the transition to the flagellum. The flagellum is somewhat tapering, ca. 1/8 the total length of the penial complex. A small retractor muscle is distally attached. The vas deferens is free, shorter than the length of the penis and epiphallus. Vagina short; proximal part of spermathecal duct subcylindrical, its intermediate part widened before distally tapering towards the globose spermatheca. Spermoviduct very contorted; albumen gland moderately long.

The internal morphology is simple in cross-sections (Figs. 4D, 4E). All parts of the penial complex have longitudinal folds (Fig. 4F). The epiphallus enters the penis below the distal end (Fig. 4Ee). The vagina is actually shorter than it appears, as the bifurcation of spermathecal duct and spermoviduct is masked externally (Fig. 4Eb).

**Ecology.** This species was collected on the summit plateau in stands of *Brocchinia hechtioides* (Bromeliaceae; Fig. 5C), where it was found up to 1 m high. Living specimens are dark-grey to blackish-bodied (Figs 3C–D). Some specimens were found in *Brocchinia tatei* on the bottom of a canyon, 120 m deep, called Sima Nor-oeste (Figs 5F–G). Snails were observed inside the *Brocchinia* plants during day-time (Fig. 5D); in the evening they became active and were seen feeding on the leaves of these plants (Brewer-Carias, pers. comm.). *Brocchinia* is adapted to low-nutrient soils such as those of the tepuis, often rooted in plant debris on the barren rocks. Other plant species observed in this tubiform meadow community (*sensu* Huber 1995b), were the cup-shaped carnivorous *Heliamphora minor* (Sarraceniaceae) and the spiny rosettes of *Orectanthe ptaritepuyana* (Xyridaceae). *Brocchinia hechtioides*, which provides shelter to the snails, also frequently hosts *Utricularia humboldtii* (Lentibulariaceae) (Fig. 5B). This endemic species is carnivorous, too (Brewer-Carias 1978). Carnivory in plants is characteristic of conditions where light and moisture are abundant, but soil macronutrients, especially nitrogen, phosphorus and potassium, are severely limited (Givnish et al. 1984, Ellison 2006). Givnish et al. (1984) suggested that the genus *Brocchinia* is considered “in its way to carnivorism.” It is now suggested that the excrements of the snails—together with those of a *Prismsant* frog species that was also found sheltering in *Brocchinia* plants—adds to the debris from the insectivorous *Utricularia* and act as an additional nitrogen source that gives these plants a better competitive edge (Brewer-Carias, pers. comm.).

**Type material.** Venezuela, Estado Bolívar, Chimantá massif, Churí-tepui: Holotype RMNH 114235, 05°16’44.9"N 062°00’56.35"W, 2405 m (Fig. 1C locality 2 = type locality), J. Schlögl leg., ii.2009. Paratypes: same data as holotype, CB/2, MLSC/4, MZSP 92471/2, RMNH 114236/18, 114238/4 alc., SNMSZ 6892–
6895, UF 434147/3; Sima Nor-oeste, 2285 m (Fig. 1C locality 1), J. Schlögl leg., ii.2009. RMNH 114237/1 alc.; ibidem, B. Smida leg., JG/3, RMNH 114246/2.

Comparison with other taxa. This novelty seems conchologically similar to *Plekocheilus (Eurytus) fusitorsus* (Oberwimmer, 1931), but differs in (1) the sculpture on the last whorl; (2) being smaller (41.7 vs. 63.3 mm); (3) the less shining surface. It may also be compared to *P. (E.) mundiperditi* Haas, 1955, from which it differs in (1) being smaller (41.7 vs. 47.3 mm); (2) being more slender; (3) the different colour pattern.

**Etymology.** We take much pleasure to dedicate this species to Charles Brewer-Carias (Caracas), who during many years has stimulated scientific research in the Guayana Highlands and who has led many expeditions to this area.

*Plekocheilus (Eurytus) juliani* Haas, 1955

*Plecocheilus (Eurytus) juliani* Haas, 1955: 375, fig. 78. Type locality: Venezuela, State of Bolivar, northwest part of Chimantá massif, summit of Apacará-tepui, ca. 2100 m; holotype FMNH 49737.

**Material.** Venezuela, Estado Bolívar, Chimantá massif, Churí-tepui, 2130 m, J. Schlögl leg., ii.2009, RMNH 114247/1; ibidem, above central valley, B. Smida leg., ii.2009, RMNH 114248/1 juv. fragment. Both locality 3 on Fig. 1C.

**Remarks.** The only adult shell collected is characterized by dark chestnut-brown lightning zig-zag stripes on the last whorl, bordered by a yellowish ‘shadow’ and is thus somewhat different in colour pattern than the type material (refigured in Breure 2009). However, the sculpture corresponds quite well to that of the types and the material is tentatively referred to this species.

**TABLE 1.** Measurements of species described in this paper. Abbreviations: D, shell diameter; H, shell height; HA, height of aperture; LW, height of last whorl; W, number of whorls; WA, width of aperture.

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<td>RMNH 114234</td>
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| **Plekocheilus (Eurytus) breweri spec. nov.** |     |     |     |     |     |     |
| Holotype         | 417 | 220 | 220 | 136 | 356 | 41  |
| RMNH 114236      | 372 | 211 | 203 | 126 | 326 | 40  |
| RMNH 114236      | 379 | 207 | 203 | 127 | 324 | 42  |
| RMNH 114236      | 394 | 212 | 212 | 130 | 337 | 39  |
| RMNH 114236      | 383 | 211 | 207 | 131 | 324 | 41  |
| RMNH 114236      | 392 | 214 | 207 | 130 | 337 | 43  |
| RMNH 114239      | 385 | 208 | 205 | 130 | 330 | 42  |

**Discussion**

During the expedition in February 2009, broken shells were found in one of the caves; the shells were located ca. 2 m under the nest of a bird (Fig. 5E). Although we have been unable to make direct observations of birds related to the presence of the shells, three bird species were spotted in the direct vicinity that could be candidates for ownership of the nest: the rufous-collared sparrow (*Zonitrichia capensis*), the tepui swift (*Cypseloides phelpsi*) and the white-collared swift (*Streptoprocne zonaris*). These are all known to occur on
the Chimantá massif (Huber 1992). It is, however, unlikely that the nest belongs to *Z. capensis*, as it is known to nest on the ground. The other two species are reported to nest on cliffs or other vertical walls, often in dark places (Hilty 2002). Since *C. phelpsi* nests in colonies and the nest observed was the only one in the cave, it probably belongs to *S. zonaris* (M. Foster, pers. comm.). Further observations should clarify the relation between snails and birds.

Although this area is still undersampled, there is some evidence that most species are highly restricted in range. In terms of the IUCN categories and criteria for red-listing threatened species (IUCN 2001), *Plekocheilus vlceki* and *P. breweri* are likely to meet the distribution-based criteria for listing as Critically Endangered. The same category (or the category Endangered) may apply to other land snails of the upper and highlands of Venezuelan Guayana (Breure 2009, Simone in press, Thompson 2008). Currently, the Chimantá massif is part of the Canaima National Park (Huber 1995c, Huber & Foster 2003), and—also due to the relatively inaccessibility of the area—threats may not appear immediate. However, as Nogué et al. (2009) have shown, the tepui habitats are severely threatened under likely scenarios of climatic change. It is not clear yet how this will affect these snail species.

Prior to the discovery of the two new taxa described herein, three species of *Plekocheilus* were known from the Chimantá massif: *P. fulminans alticola* Haas, 1955, *P. juliani* Haas, 1955 and *P. mundiperditi* Haas, 1955 (Breure, 2009). All taxa have been reported from the north-western part of the massif and the adjacent Auyán and Aparamán-tepuis. It is remarkable that the south-eastern part of Chimantá is home to two different taxa, while the nearest distance between the two parts is only ca. 3 km (Fig. 1B). The occurrence of *P. juliani* needs further corroboration. The relationships between the nominate taxon *P. fulminans* (Nyst, 1845) (occurring in northern Venezuela) and the Guayanan subspecies need further clarification. A preliminary morphometric analysis casts some doubts on the subspecific status of the Guayanan taxon. However, the number of specimens available is too low to make a statistical analysis possible.

While mollusc collecting in this area was done until now as a side-line, the findings reported in this paper show that a focussed search may yield additional taxa and may improve our understanding of the ecology in this ecosystem. It is expected that further collecting on these and other tepuis may reveal additional new taxa and further enhance our knowledge of this fascinating habitat.

Acknowledgements

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References


