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Contribution to the study of the female genitalia of twelve *Fulvius* species (Heteroptera, Miridae, Cylapinae)[1]

I. Sadowska-Woda, F. Chérot & J. Gorczyca

Abstract: Until now, the female genital structures of Cylapinae, and particularly those of Fulvinii, have been poorly known. We describe for the first time the ovipositor and vagina of *Fulvius bifenestratus* Poppius 1909 from Indonesia, of *F. bisbistillatus* (Stål 1860) from Peru, *F. breddini* Reuter 1902 from French Guyana, *F. constanti* Gorczyca 2004 from Papua New Guinea, *F. dimidiatus* Poppius 1909 from Malaysia, *F. discifer* Reuter 1907 from Yemen, *F. gamboensis* Carvalho & Costa 1994 from Mexico, *F. geniculatus* Van Duzee 1933 from Galapagos Islands, *F. major* Schmitz 1970 from Central African Republic, *F. oxycarenoides* (Reuter 1878) from Near East (Turkey, Iran), *F. tanzanicus* Gorczyca 2000 from Tanzania, and of *F. variegatus* Poppius 1909 from Pacific Area. We briefly compare the described structures with those of other Cylapinae. Some characters of the valvulae (shape of apical part, presence of tubercles, presence of teeth), parieto-vaginal rings (shape of margins, associated sclerites), and lateral oviducts appear to be of diagnostic value to species separation.

Key words: Cylapinae, female genital structures, *Fulvius*, Heteroptera, Miridae.

Introduction

Male genital structures have been used in the taxonomy of Miridae (Insecta, Heteroptera) for nearly 100 years, Knight (1916) being among the earliest users. Their usefulness for the diagnosis and phylogenetic analysis of plant bugs is obvious (Kerzhner & Konstantinov 1999; Chérot 2002). Female genital structures, however, were studied only more recently, less frequently, and often in less detail. Kullenberg (1941), Slater (1950), Davis (1955), and Schmitz (1968) summarized available data and described for the first time the genital structures of numerous species. More recently, valvulae, parieto-vaginal rings, or posterior wall were used to discriminate species (e.g., Fontes 1981; Clayton 1982) or in phylogenetic analyses (e.g., Schwartz & Foottit 1998; Chérot 2002).

At present, the female genital structures of the little known subfamily Cylapinae, and particularly of the tribe Fulvinii, are poorly investigated. *Fulvius* Stål 1862 is the largest genus within the Cylapinae, with more than 70 species in the World, but the female genitalia of *Fulvius*' species remains virtually unknown. Alone Schmitz (1970), Yasunaga (2000), and Chérot et al. (2006) briefly described several structures of *F. major* Schmitz 1970 (without figure), *F. anthocoroides* (Reuter 1875), and *F. borgesi* Chérot et al. 2006. The morphology of the species in *Fulvius* is relatively similar. Numerous species were described mainly based on male genital structures (e.g., Carvalho & Costa 1994). Consequently, identification of female specimens is often difficult or even impossible, even though female genital structures were successfully used to separate species in other Cylapinae, including Fulvinii (e.g., Chérot & Gorczyca (1999) in the genus *Cylapofulvidius*). Moreover, the structural complexity of the female genitalia of Miridae – including Fulvinii – provides many taxonomically useful characters, particularly for phylogenetic analyses.

[1]The authors are very happy to dedicate the work to their prominent colleague and friend Ernst Heiss.

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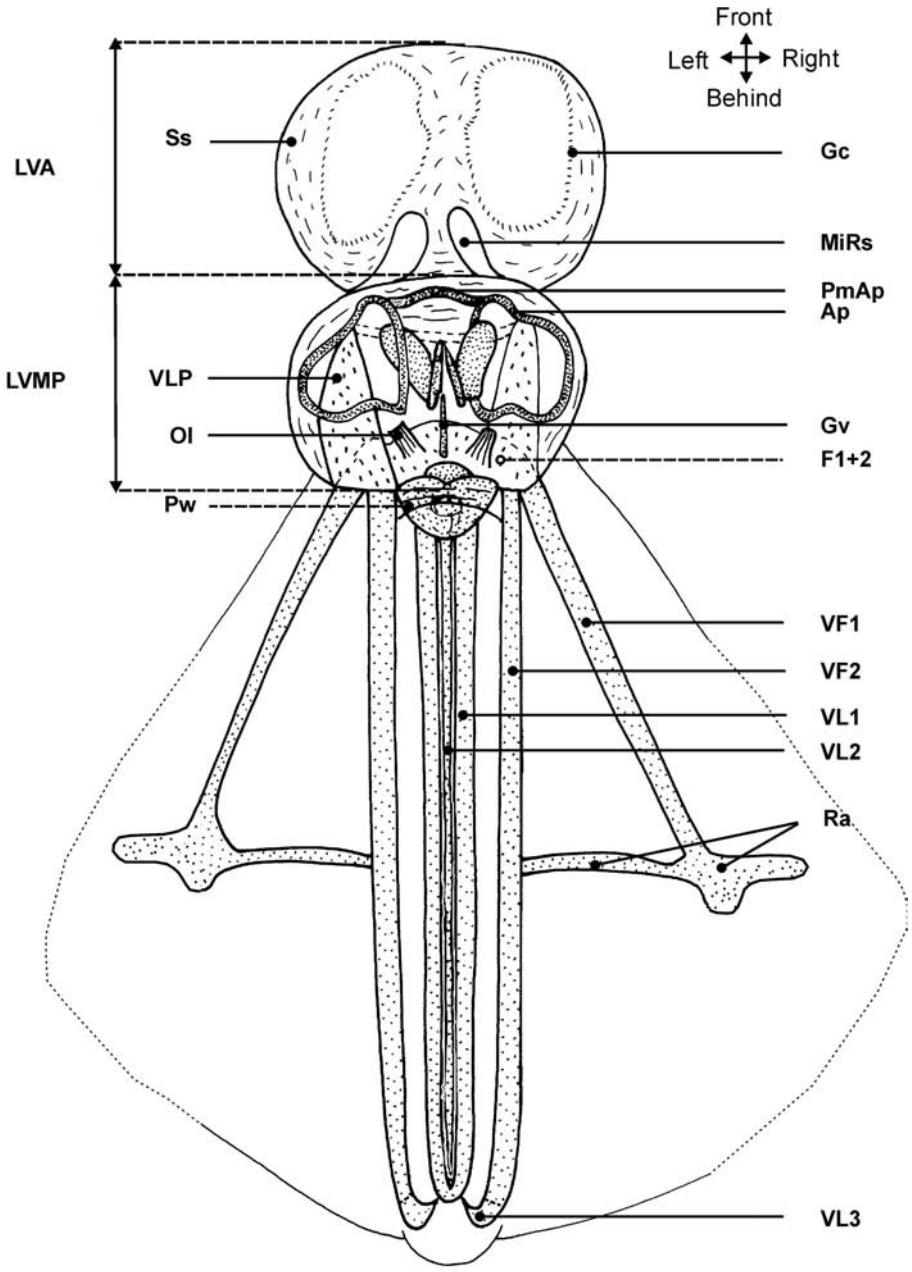

Fig. 1: Schematic view of female genital structures of a Miridae (according to CHÉROT (2002: 112, Fig. 5.101, slightly modified), mainly based on several *Rhinomiridius*, Cylapinae, Rhinomirini, from Africa). Ap: parieto-vaginal ring; F1: first fibula; F2: second fibula; Gv: vermiform gland; LVA: anterior lobe of vagina; LVMP: medio-posterior lobe of vagina; MiRs: pair of small sacs or fold of median lobe in the light of anterior lobe, still unknown in Cylapinae (and added on the schematic view to topologically place the structure, described from some Mirini); Ol: lateral oviduct; PmAp: sclerites lying medially the inner margins of parieto-vaginal rings; Pw: posterior wall; Ra: ramus; Ss: Anterior sac, seminal sac or depository; VF1: first valvifer (or gonocoxite), valvifer 1, viii or outer valvifer; VF2: second valvifer (or gonocoxite), valvifer 2, ix or inner valvifer; Vl1: first valvula (or gonaphophyse), valvula 1, viii or outer valvula; Vl2: second valvula (or gonaphophyse), valvula 2, xi or inner valvula; Vl3: third valvula or valvula 3.

In this paper we contribute to the study of the female genital structures of twelve species of the genus *Fulvius*, representing the hypothetical main clades of the genus (SADOWSKA-WODA 2005). We hope these data will be useful for future works on the genus.

Material and Methods

We describe for the first time the ovipositor and vagina of the following twelve species: *F. bifenestratus* POPPIUS 1909 from Indonesia, *Fulvius bisbistillatus* (STÅL 1860) from Peru, *F. breddini* REUTER 1902 from French Guyana, *F. constanti* GORCZYCA 2004 from Papua New Guinea, *F. dimidiatus* POPPIUS 1909 from Malaysia, *F. discifer* REUTER 1907 from Yemen, *F. gamboensis* CARVALHO & COSTA 1994 from Mexico, *F. geniculatus* VAN DUZEE 1933 from Galapagos Islands, *F. major* SCHMITZ 1970 from Central African Republic, *F. oxycarenoides* (REUTER 1878) from Near East (Turkey, Iran), *F. tanzanicus* GORCZYCA 2000 from Tanzania and *F. variegatus* POPPIUS 1909 from the Pacific Area. If possible, several specimens from different localities were analyzed to take into account individual variability. Origin of investigated specimens is given for each species in the "examined specimens" section.

The following acronyms are used: BPBM: Department of Entomology Collection, Bernice P. Bishop Museum, Hawaii, USA; IRSNB: Institut royal des Sciences naturelles de Belgique, Brussels, Belgium; ULB: Free University of Brussels, Brussels, Belgium; MRAC: Musée royal de l'Afrique Centrale, Tervuren, Belgium; SU: Department of Zoology, University of Silesia, Poland; ZIN: Zoological Institute RAS, St. Petersburg, Russia; ZMC: Zoological Museum, Helsinki University, Finland.

Terminology of the female genital structures in Miridae is purely descriptive and relatively complex. It was summarized by SCHMITZ (1968) and CHÉROT (2002). In the present work, we use some terms of SLATER (1950), DAVIS (1955), SCHMITZ (1968), ROSENZWEIG (1997), or CHÉROT (2002); and we give some frequently used synonyms to avoid ambiguity. We analyse systemati-

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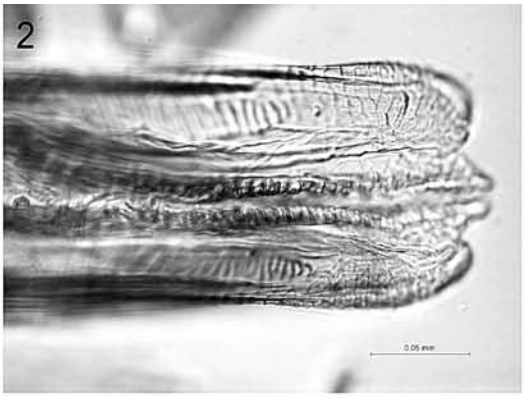

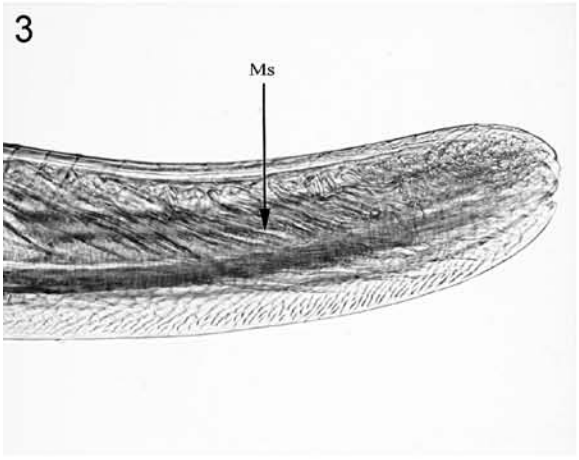

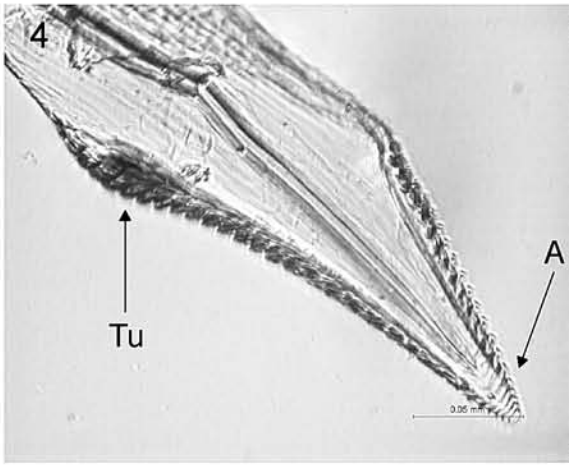

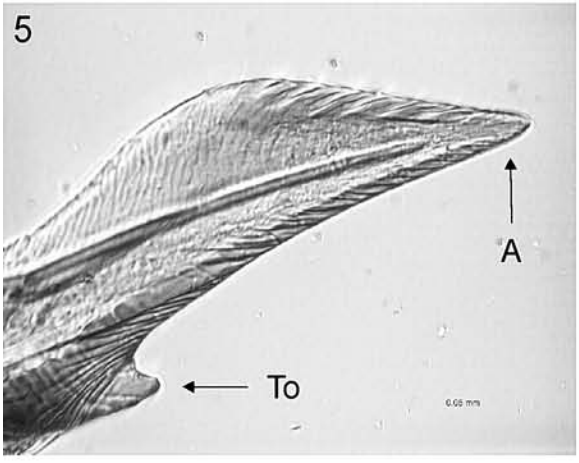

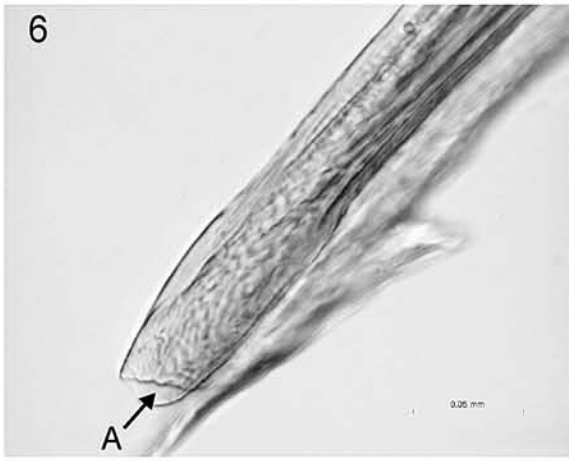

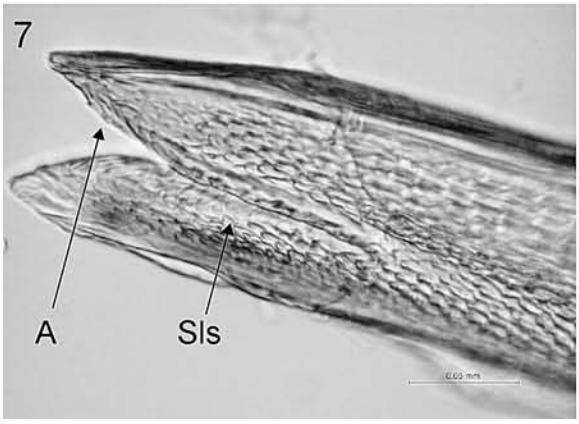

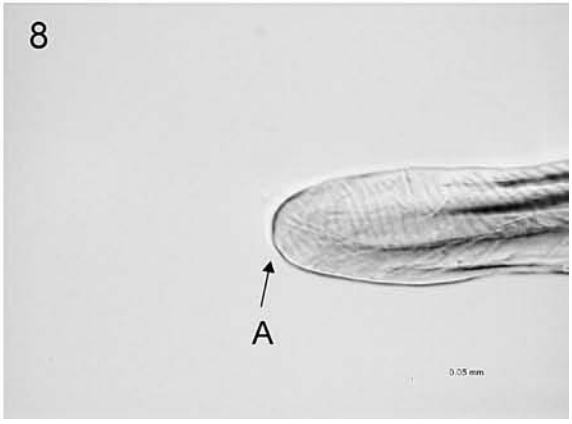

Figs 2-8: *Fulvius* spp. (**2**) *Fulvius constanti* Gorczyca 2004. Apex of ovipositor. (**3**) *Fulvius discifer* Reuter 1907. Apex of ovipositor. (**4-5**) *Fulvius bisbistillatus* (Stål 1860) (**4**) Apex of valvula 1 (**5**) Apex of valvula 2 (**6-8**) *Fulvius bifenestratus* Poppius 1909 (**6**) Apex of valvula 1 (**7**) Apex of valvula 1, other view (**8**) Apex of valvula 2. A: apex; Ms: membranous structure; Sls: scalelike structure; To: tooth; Tu: tubercle.

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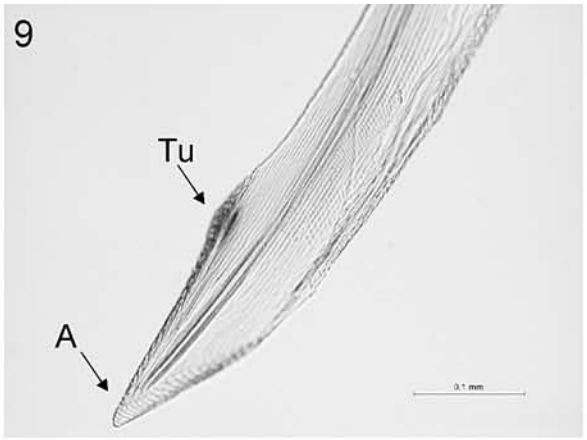

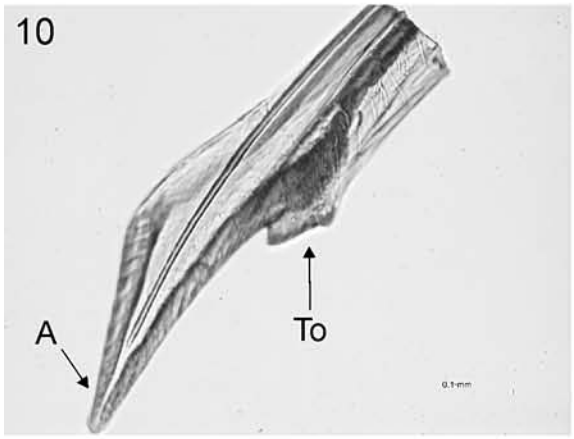

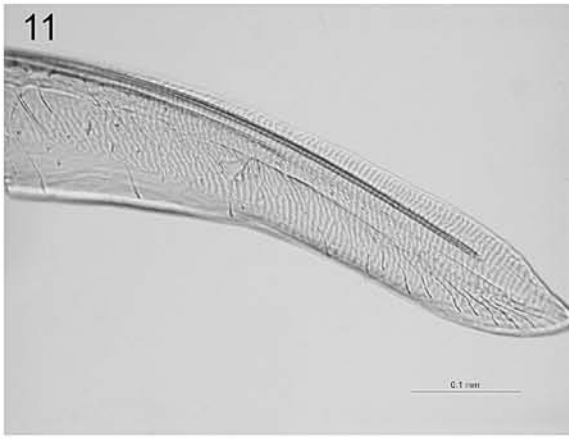

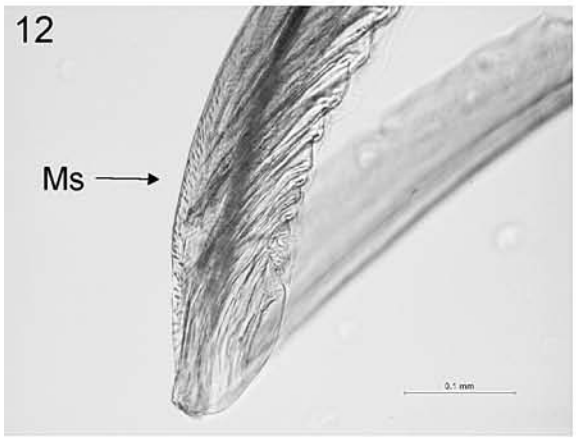

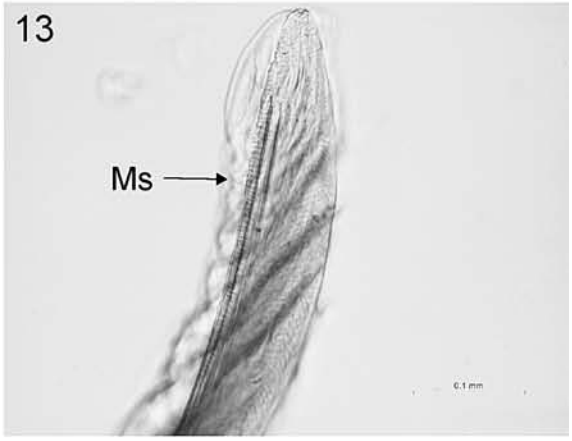

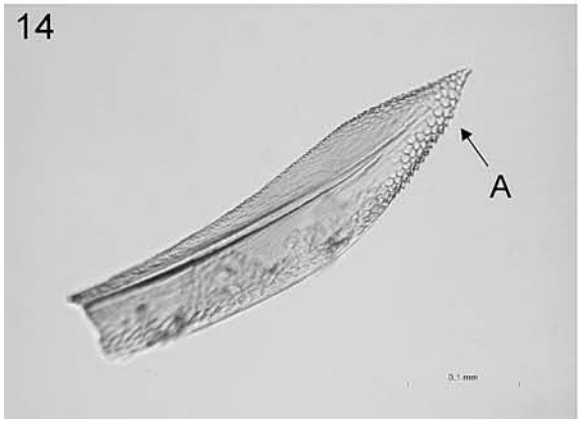

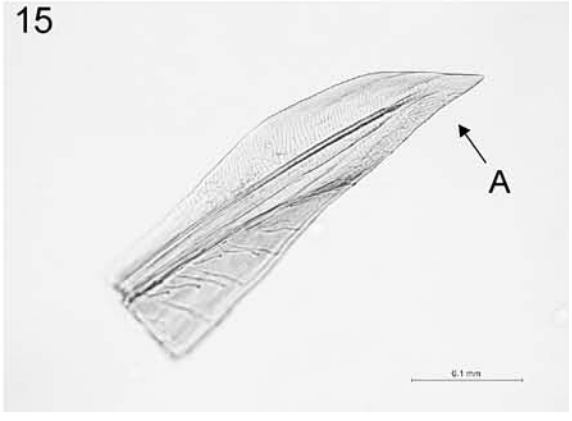

Figs 9-15: *Fulvius* spp. (**9-10**) *Fulvius breddini* Reuter 1902 (**9**) Apex of valvula 1 (**10**) Apex of valvula 2 (**11-13**) *Fulvius discifer* Reuter 1907 (**11**) Apex of valvula 1 (**12**) Membranous structure between second valvulae (**13**) Apex of valvula 2 (**14-15**) *Fulvius variegatus* Poppius 1909 (**14**) Apex of valvula 1 (**15**) Apex of valvula 2. A: apex; Ms: membranous structure; To: tooth; Tu: tubercle.

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cally 22 characters, listed hereafter (and depicted on our figure 1, a hypothetical Cylapine vagina). Because it is heuristic, we adopt a style consistent with phylogenetic analysis, even if a cladistic analysis of the genus *Fulvius* and related taxa is beyond of the scope of our paper.

Character 1: Membranous structure between second valvulae, with two observed states: absent (Fig. 2), present (Figs 3, 12, Ms).

Character 2: Sscalelike to toothlike outgrowths ventrolaterally on apex of first valvulae, with two observed states: absent (Fig. 11), present (Figs 4, 9, 14A).

Character 3: Shape of apex of first valvulae, with three observed states: triangular (Figs 4, 9, 14), slightly rounded (Fig. 11), straight (Fig. 6).

Character 4: Shape of apex of second valvulae, with two observed states: triangular (Figs 5, 10, 15), almost rounded, gently curved and eventually enlarged (Fig. 8, 13).

Character 5: Scalelike outgrowths ventrally on apex of first valvulae, with two observed states: absent (Figs 4, 9, 11, 14), present (Fig. 7, Sls).

Character 6: Basal tubercle of inner margin of apex of first valvulae, with two observed states: absent (Fig. 14), present (Figs 4, 9, Tu).

Character 7: Tooth on basal part of apex of second valvulae, with two observed states: absent (Fig. 15), present (Figs 5, 10, To).

Character 8: Shorter distance between parieto-vaginal rings, with two observed states: longer than the length of their larger axis (Figs 16, 17), shorter than or approximately equal to the length of their larger axis (Fig. 18).

Character 9: Shape of parieto-vaginal rings anterior margins, with three observed states: convex (Fig. 25), straight (Fig. 18), concave to S-like (Fig. 20). According to CHÉROT (2002), the parieto-vaginal rings (Ap) can be divided into four parts (or margins) at its inflexion points: anterior margin (Fig. 17, AmAp), posterior margin (Fig. 17, PomAp), inner margin (Fig. 17, ImAp) and outer margin (Fig. 17, OmAp).

Character 10: Shape of posterior margins of parieto-vaginal rings, with three observed states: convex (Fig. 25), straight (Fig. 27), concave to S-like (Figs 19-20).

Character 11: Shape of inner margins of parieto-vaginal rings, with three observed states: convex (Fig. 16), acute (Fig. 27), absent (Fig. 18).

Character 12: Shape of outer margins of parieto-vaginal rings, with three observed states: convex (Fig. 25, 27), straight (Fig. 29), acute (Fig. 31).

Character 13: Prolongation of anterior margins of parieto-vaginal rings, with three observed states: absent (Figs 16, 25), present not fused (Fig. 17, S), present fused (Fig. 18).

Character 14: Prolongation of posterior margins of parieto-vaginal rings, with three observed states: absent (Figs 16, 25), present not fused (Fig. 26, S), present fused (Fig. 18).

Character 15: Prolongation of inner margins of parieto-vaginal rings, with three observed states: absent (Figs 16, 25), present fused (Fig. 26, PmAp) or inner margin absent (Fig. 18).

Character 16: Prolongation of outer margins of parieto-vaginal rings, with two observed states: absent (Figs 16, 25), present not fused (Figs 18, 21, S).

Character 17: Ring of glandular areas on the anterior sac, seminal sac, or depository with two observed states: absent (Fig. 19), present (Fig. 21).

Character 18: Connection of seminal sac to median part of vagina, with two observed states: large, mirinae-like (Fig. 19), narrow (Figs 23-24, 29-30, 31, 33).

Character 19: Structure of anterior margins of dorsal labiate plate (DLP), with three observed states: margins not thickened (Fig. 29), thickened (Fig. 17, AmDLP), DLP slightly sclerotized or unsclerotized (Figs 18 and 27 to compare with 20).

Character 20: Structure of posterior margins of dorsal labiate plate, with three observed states: margins not thickened (Fig. 29), thickened (Figs 17, 26, PmDLP), DLP slightly sclerotized or unsclerotized (Figs 18, 27 to compare with 20).

Character 21: Ventral labiate plate (VLP), with two observed states: slightly sclerotized (Fig. 16), sclerotized, large (Fig. 20).

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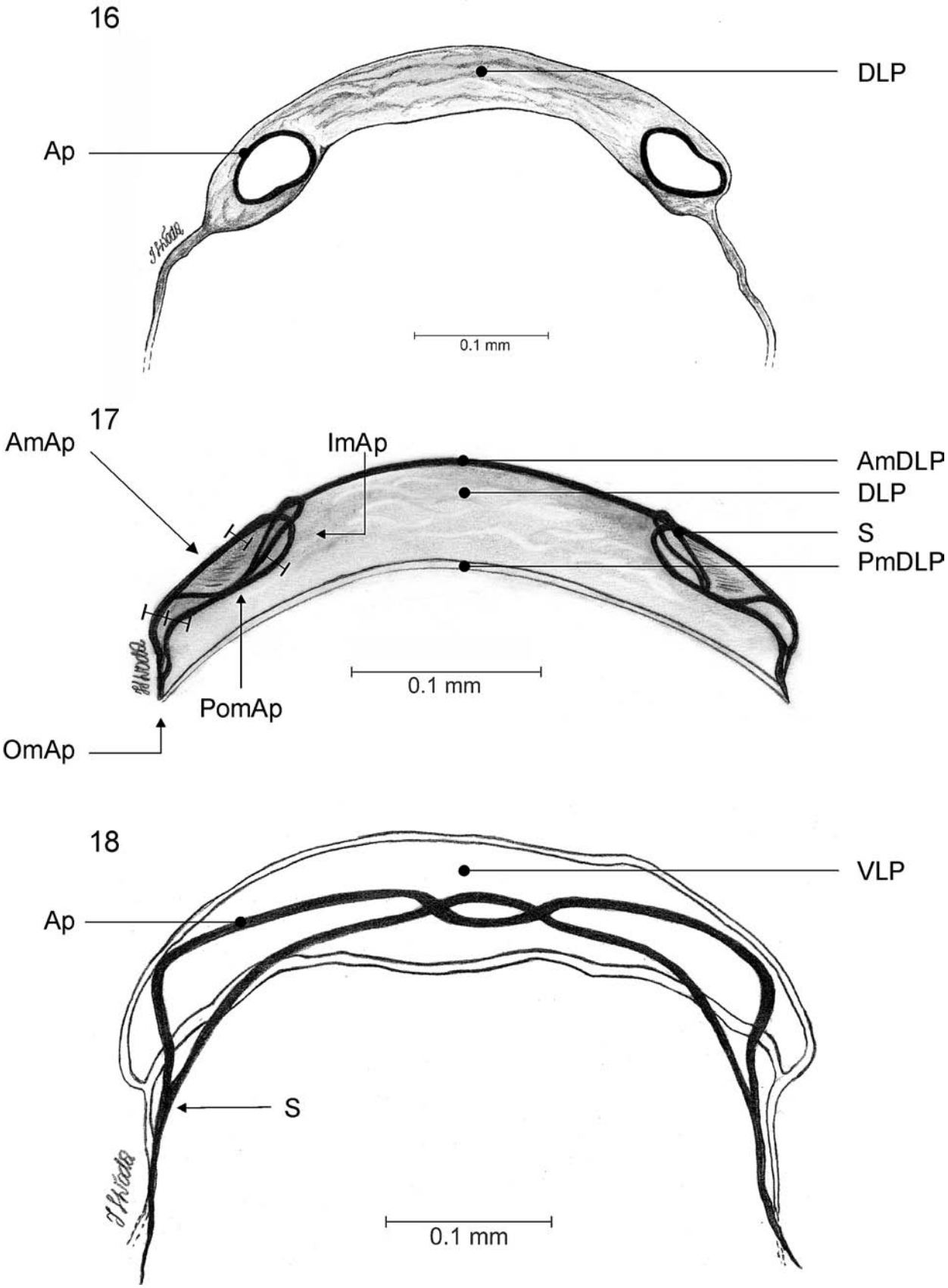

Figs 16-18: *Fulvius* spp., Dorsal labiate plate and parieto-vaginal rings in dorsal view. (**16**) *Fulvius bisbistillatus* (Stål 1860) (**17**) *Fulvius bifenestratus* Poppius 1909 (**18**) *Fulvius dimidiatus* Poppius 1909. AmAp: anterior margin of Ap; AmDLP: Anterior margin of DLP; Ap: Parieto-vaginal rings; DLP: dorsal labiate plate; ImAp: inner margin of Ap; PmDLP: posterior margin of DLP; PomAp: posterior margin of Ap; S: sclerites (see description); VLP: ventral labiate plate.

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Character 22: Confluence of lateral oviducts, with three observed states: lateral oviducts conflating into a median common dorsal sac (Fig. 23), lateral oviducts conflating into a circular submedian common dorsal sac (Fig. 33), lateral oviducts not conflating (Fig. 19).

Abbreviations for the structures used (mainly on the plates) are all quoted in the figure captions and listed by alphabetical order hereafter (they are not strictly speaking acronyms of the English names of structures but short codes):

A: apex (of valvulae 1 or 2); AmAp: anterior margin of Ap; AmDLP: Anterior margin of DLP; Ap: parieto-vaginal ring; AmVLP: anterior margin of VLP; AS: A structure; BS: B structure; DLP: dorsal labiate plate; F1: first fibula; F2: second fibula; Gc: ring of seminal sac; Gv: vermiform gland; ImAp: inner margin of Ap; LVMP: medio-posterior lobe of vagina; MiRs: pair of small sacs or fold of median lobe in the light of anterior lobe, still unknown in Cylapinae (and added on the schematic view of Fig. 1 to topologically place the structure, described from some Mirini); Ms: membranous structure; Ol: lateral oviduct; PmAp: sclerites lying medially the inner margins of parieto-vaginal rings; PLVA: anterior lobe of vagina; PmAp: medial plate; PmDLP: posterior margin of DLP; PomAp: posterior margin of Ap; Pw: posterior wall; Ra: ramus; RlcDS: ringlike common dorsal sac; S: sclerites (cf. description); Sls: scalelike structure; Ss: Anterior sac, seminal sac or depository; To: tooth; Tu: tubercle; VF1: first valvifer (or gonocoxite), valvifer 1, viii or outer valvifer; VF2: second valvifer (or gonocoxite), valvifer 2, ix or inner valvifer; Vl1: first valvula (or gonaphophyse), valvula 1, viii or outer valvula; Vl2: second valvula (or gonaphophyse), valvula 2, ix or inner valvula; Vl3: third valvula or valvula 3; VLP: ventral labiate plate.

Results

Fulvius bifenestratus Poppius 1909

Examined specimens: 1 ♀: Indonesia: British N. Borneo, Tawau, Quoin Hill, Cocoa Res. Sta., 5.ix.1962 / Y. Hirashima, Light Trap, Bishop; 2 ♀ ♀: Indonesia: Fulvius bifenestratus Pop., det. J. Gorczyca, 1999 / Indonesia: P.I., Misamis Or.; Mt. Balatukan, 15 km; S.-W. of Gingoog, 1000-2000, 1-5.v.1960 / H. Torrevillas Collector; 1 ♀: Indonesia: Fulvius bifenestratus Pop., det. J. Gorczyca / Indonesia: North Borneo (SE) / Forest Camp, 19km, N. of Kalabakan; 60 km, 18.x.1962, K.J. Kuncheria Collector, Bishop (BPBM).

Description. Membranous structure between second valvulae absent. Apex of first valvulae straight (Fig. 6). Apex of second valvulae almost rounded, gently curved (Fig. 8). Scalelike to toothlike outgrowths ventrolaterally on first valvulae absent. Scalelike outgrowths of first valvulae present ventrally (Fig. 7). Tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac large, devoid of ring, its connection to median part of vagina narrow. Parieto-vaginal rings (Ap, Fig. 17) clearly separated, their margins complex: anterior margins (AmAp) convex, posterior margins (PomAp) sigmoid, outer margins (OumAp) acute, devoid of any prolongation, inner margins (ImAp) convex. In dorsal view with elongated sclerite (S) originating from anterior margins and partially hiding the middle of inner margins. No medial sclerites (PmAp). Dorsal labiate plate (DLP) large, anterior and posterior margins (AmDLP and PmDLP respectively) slightly thickened. Ventral labiate plate slightly sclerotized. Dorsal wall very slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) indistinct. Lateral oviducts not conflating into a common dorsal sac. Posterior wall membranous.

Fulvius bisbistillatus (Stål 1860)

Examined specimens: 4 ♀ ♀: Peru: Loreto, Tournavista Rd. km 3, 34 km W. Pucallpa, 300 m., 30.v.1971, at light, R.T. & J. C. Schuh / *Fulvius bisbistillatus* Stål, det. J. Gorczyca (ZIN).

Description. Membranous structure between second valvulae absent. Apex of first and second valvulae triangular (Figs 4-5). Scalelike to toothlike outgrowths ventrolaterally on first valvulae present. Scalelike outgrowths on first valvulae absent ventrally. Tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae present. Seminal sac unknown (damaged in our specimens). Parieto-vaginal rings (Ap, Fig. 16) clearly separated, margins convex. Outer margins devoid of any prolonga-

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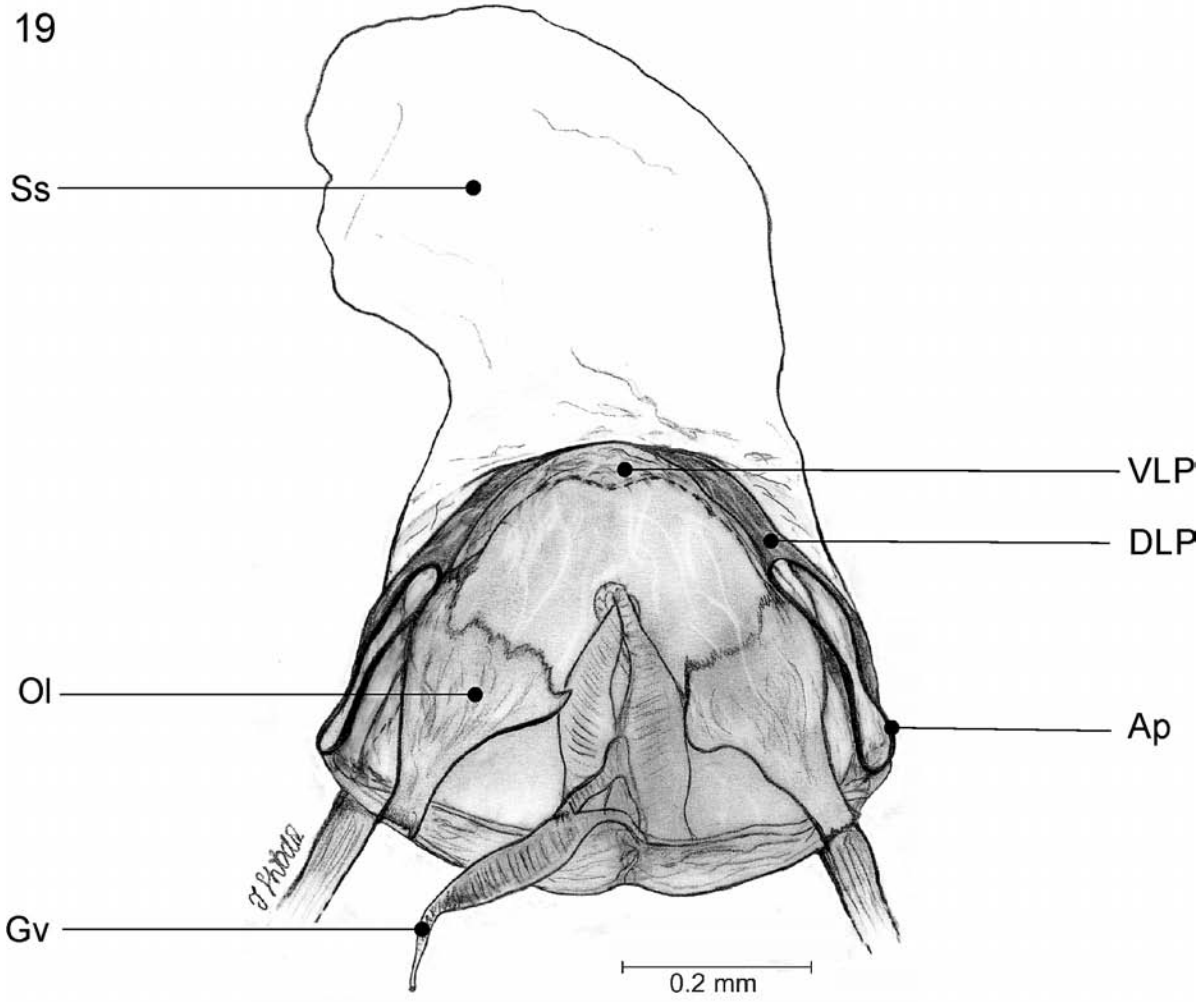

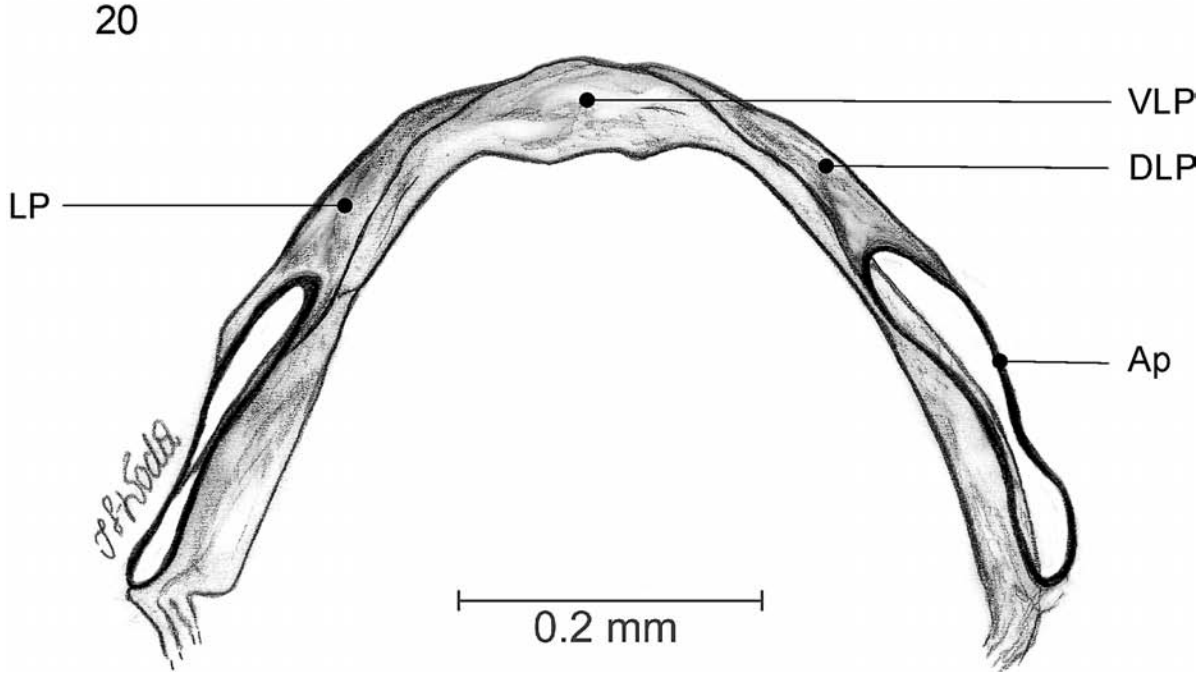

Figs 19-20: *Fulvius breddini* Reuter 1902, Vagina. (**19**) Vagina in dorsal view (**20**) Parieto-vaginal rings, dorsal labiate plate and ventral labiate plate in dorsal view. Ap: Parieto-vaginal rings; DLP: dorsal labiate plate; Gv: vermiform gland; Ol: lateral oviduct; Ss: anterior or seminal sac; VLP: ventral labiate plate.

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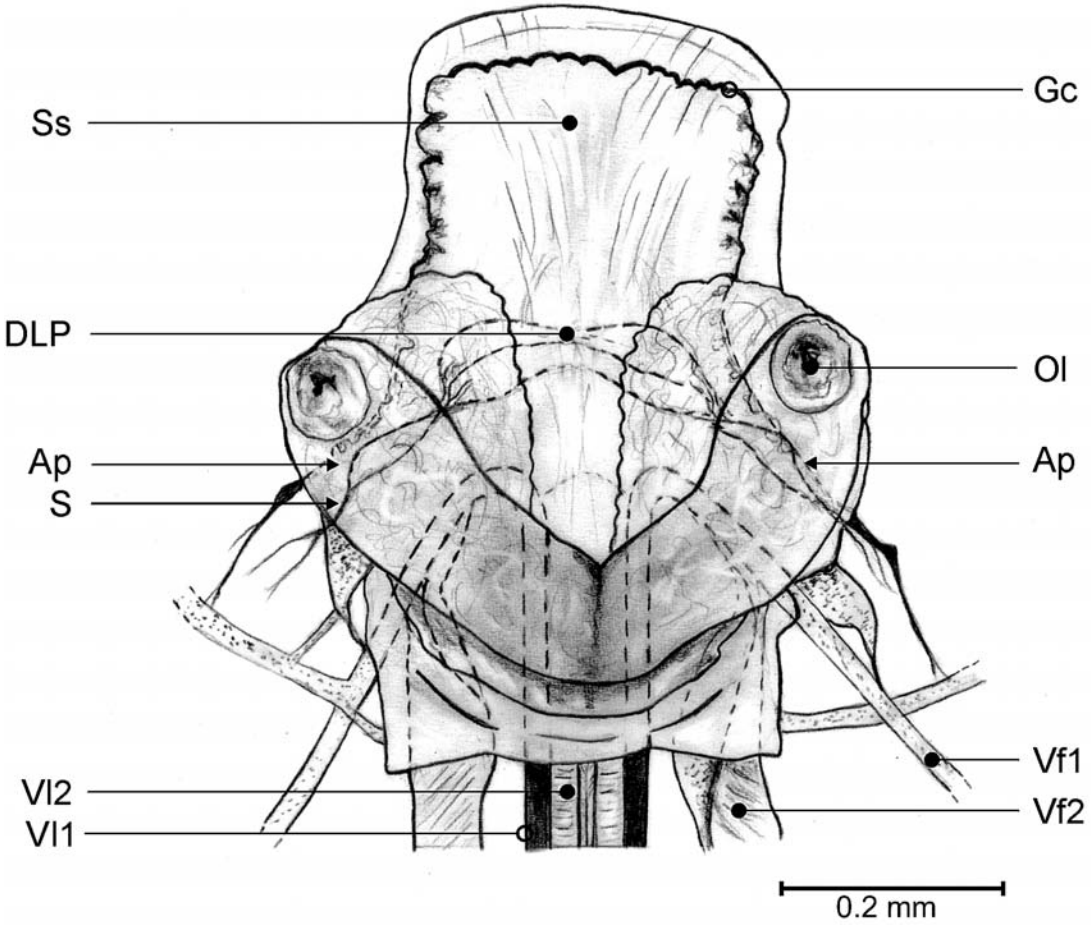

Fig. 21: *Fulvius constanti* Gorczyca 2004. Vagina in dorsal view. Ap: Parieto-vaginal rings; DLP: dorsal labiate plate; Gc: contour of glandular area; Ol: lateral oviduct; S: sclerite (see description); Ss: anterior or seminal sac; Vf1 and Vf2: valvifers 1 and 2 (or viii and ix); Vl1 and Vl2: valvulae 1 and 2 (or viii and ix).

tion. No medial sclerites. Dorsal labiate plate (DLP) large, anterior and posterior margins slightly thickened. Ventral labiate plate slightly sclerotized. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) short and stout. Lateral oviducts very large, not conflating. Posterior wall membranous.

Fulvius breddini Reuter 1902

Examined specimens: 2 ♀ ♀: French Guyana: Guyane Fr(ançaise) [= French Guyana], 22 km N.-W. Régina, p(oint) k(ilométrique) 79 [= km 79], Route N(ationa)le 2 [= national road number 2], 4° 25'N. 52°19'W., 100 m., V. Gusarov, 28.vi-21.vii.1995 (ZIN).

Description. Membranous structure between second valvulae absent. Apex of first valvulae and second valvulae triangular (Figs 9-10, respectively). Scalelike to toothlike outgrowths ventrolaterally on first valvulae present. Scalelike outgrowths of first valvulae absent ventrally. Tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae present. Seminal sac large, devoid of ring, its connection to median part of vagina large. Parieto-vaginal rings (Ap, Figs 19-20) clearly separated, elongated, their anterior and posterior margins medially concave, inner and outer margins convex, lacking of any prolongation. No medial sclerites. Dorsal labiate plate (DLP) large, medial part partially hidden in dorsal view by the ventral labiate plate (VLP). Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) short and stout. Lateral oviducts very large, not conflating. Posterior wall membranous.

Fulvius constanti Gorczyca 2004

Examined specimens: 2 ♀ ♀: Papua New Guinea: Coll.I.R.Sc.N.B., Canopy Mission Papua New Guinea (Madang prov.), Baiteta 08.vi.1993, Light trap M1, Leg. Olivier Missa (IRSNB).

Description. Membranous structure between second valvulae absent (Fig. 2). Apex of first valvulae slightly rounded. Apex of second valvulae straight. Outgrowths of first valvulae absent. Tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac (Fig.

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21, Ss) large, with a large, unique, ring (Gc). Connection of seminal sac to median part of vagina large, mirine-like. Parieto-vaginal rings (Ap) elongated, clearly separated, margins narrow. Lateral margins of rings reduced, posterior margin concave, anterior margins convex. Inner margins devoid of any prolongations. Outer margins extended by a narrow sclerite (S). Dorsal labiate plate (DLP) reduced. Ventral labiate plate slightly sclerotized. Dorsal wall slightly sclerotized, devoid of sclerite. Vaginal projection and MiRs absent. Vermiform gland reduced. Lateral oviducts very large, apparently conflating. Posterior wall membranous.

Fulvius dimidiatus Poppius 1909

Examined specimens: 2 ♀♀: Indonesia: N-Sumatra, Brastagi - Toba, 20.vii.(19)80, Heiss / *Fulvius dimidiatus* Poppius, det. J. Gorczyca 1999 (SU).

Description. Membranous structure between second valvulae present. Apex of first valvulae slightly rounded. Apex of second valvulae gently curved. Outgrowths of first valvulae, tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac large, devoid of ring, its connection to median part of vagina narrow. Parieto-vaginal rings (Ap, Fig. 18) elongated, medially fused by the anterior and posterior margins. Anterior margins straight, posterior margins locally concave, outer margins slightly sigmoid, inner margins absent. Anterior and posterior margins of each ring medially extended and fused. Posterior and outer margins basally fused in a elongated sclerites (S). Dorsal labiate plate slightly sclerotized. Ventral labiate plate (VLP) large, anterior, lateral and posterior margins thickened. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland elongated, thin toward apex. Lateral oviducts not conflating into a common dorsal sac. Posterior wall membranous.

Fulvius discifer Reuter 1907

Examined specimens: 3 ♀♀: Yemen: Al. Kadan, x.2001, van Harten & Abdul Haq / *F. discifer* Reuter 1907, det J. Gorczyca (SU).

Description. Membranous structure between second valvulae present (Figs 3, 12, Ms). Apex of first valvulae slightly rounded (Fig. 11). Apex of second valvulae gently curved (Fig. 13). Outgrowths of first valvulae, tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac large, devoid of ring, its connection to median part of vagina narrow. Parieto-vaginal rings (Ap, Fig. 22) elongated, slightly separated. Anterior and posterior margins of the rings practically straight, inner and outer margins acute. No medial sclerite. Dorsal labiate plate large, the anterior and posterior margins not thickened. Ventral labiate plate slightly sclerotized. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) elongated. Lateral oviducts large, conflating into a common dorsal sac. Posterior wall membranous.

Fulvius gamboensis Carvalho & Costa 1994

Examined specimens: 3 ♀♀: Mexico: Veracruz, Estación Biol(ogía) Tropical "Los Tuxtlas", 20 km N. Catemaco, trop(ical) Forest, light, h. = 20 m., Rojas 8 Colin, 14-18.ix.(19)89 / *F. gamboensis* Carvalho & Costa, det. J. Gorczyca 2004 (ZIN).

Description. Membranous structure between second valvulae absent. Apex of first and second valvulae triangular. Scalelike to toothlike outgrowths ventrolaterally on first valvulae present. Scalelike outgrowths of first valvulae absent ventrally. Tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae present. Seminal sac large, devoid of ring. Parieto-vaginal rings (Ap, Fig. 27) elongated, slightly separated. Anterior and posterior margins of the rings practically straight, inner margins acute, outer margins convex. No medial sclerite. Dorsal labiate plate slightly sclerotized. Ventral labiate plate (VLP) sclerotized, large, anterior and posterior margins slightly thickened. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland unknown to us. Lateral oviducts very large, not conflating. Posterior wall membranous.

Fulvius geniculatus Van Duzee 1933

Examined specimens: 1 ♀: Galapagos: Récolté dans humus en forêt humide [= collected in humus, in wet forest] / Galapagos: Isabela, Sud, à l2 km de la côte [= Isabella, South, to 12 km of the coast], alt(itude) 250 m., xi.1964, N. Leleup /

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Fulvius geniculatus VAN DUZEE, G. Schmitz det. 1970; 1 ♀: Galapagos: Coll. I.R.Sc.N.B., Galapagos Isl., Isabela (846), Alt. 900 m., 23.v.1991, Leg. L. Baert, K. Desender & J.P. Maelfait, IGn°27720 / *Fulvius geniculatus* VAN DUZ., Det. Carpintero; 1 ♀: Galapagos: Coll. I.R.Sc.N.B., Galapagos Isl., Isabela (878), Cerro Azul, ICA 013, Alt. 80 m., 19-25.v.1991, Leg. L. Baert, K. Desender & J.P. Maelfait, IGn°27720 / *Fulvius geniculatus* VAN DUZ. Det. Carpintero; 1 ♀: Galapagos: Coll. R.I.Sc.N.B., Galapagos, I. San Cristobal, 27-28.iii.1986, 500m., réc(olte): L. Baert, Stat. 175 / *Fulvius geniculatus* V. DUZEE, J.C.M. Carvalho det., 1987 (IRSNB).

Description. Membranous structure between second valvulae absent. Apex of first and second valvulae triangular. Scalelike to toothlike outgrowths ventrolaterally on first valvulae present. Scalelike outgrowths of first valvulae absent ventrally. Tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae present. Seminal sac large, devoid of ring, its connection to median part of vagina large. Parieto-vaginal rings (Fig. 25, Ap) clearly separated, rounded, devoid of any prolongation. No medial sclerites (PmAp). Dorsal labiate plate (DLP) large, its anterior margin strongly thickened. Ventral labiate plate slightly sclerotized. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) short and stout. Lateral oviducts very large, not conflating. Posterior wall membranous.

Fulvius major SCHMITZ 1970

Examined specimens: 2 ♀♀: Central African Republic: La. Maboke; 6-9.vi.(19)73, Linnavuori (IRSNB); 1 ♀: Ghana: Tafo, 1.iii.(19)66 / *F. major* SCHMITZ, det. J. Gorczyca, 1996 (SU).

Description. Membranous structure between second valvulae present. Apex of first valvulae slightly rounded. Apex of second valvulae gently curved. Outgrowths of first valvulae, tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac (Figs 23-24, Ss) large, with small rings (Gc), its connection to median part of vagina narrow. Parieto-vaginal rings (Ap) elongated, slightly separated, posterior margin concave, other margins convex. Inner and outer margins devoid of any prolongation. Ventral labiate plate (VLP) large, sclerotized, crescent-shaped, anterior and posterior margins

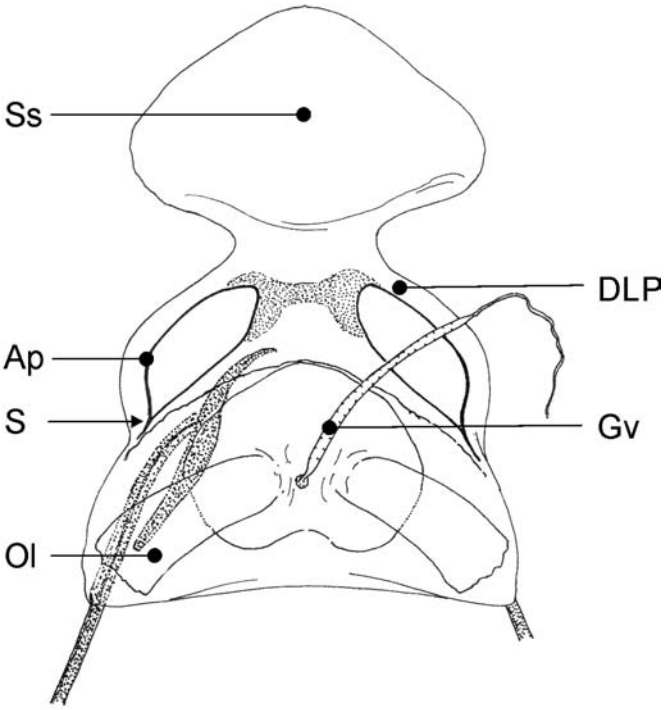

Fig. 22: *Fulvius discifer* REUTER 1907. Vagina in dorsal view, by the courtesy of G. Schmitz. Ap: Parieto-vaginal rings; DLP: dorsal labiate plate; Gv: vermiforme gland; Ol: lateral oviduct; S: sclerite (see description); Ss: anterior or seminal sac.

thickened. Dorsal labiate plate slightly sclerotized. Dorsal wall slightly sclerotized, including two sub-medial lines of tubular sclerites. Vaginal projection and MiRs absent. Vermiform gland (Gv) elongated. Lateral oviducts large, apparently conflating into a common dorsal sac. Structures A of posterior wall elongated, totally separated by the B structure sensu CHÉROT (2002).

Remark: In his original description, SCHMITZ (1970: 503) wrote "Vagin sans boucles adéno-pariétales visibles" i.e. "vagina devoid of parieto-vaginal rings". This is surprising. SCHMITZ (1970) did not include any figure of *Fulvius* female genital structures in his work. However, at this time, he was preparing a review of Afrotropical Cylapinae. Unfortunately, this work was never finished, and the majority of his specimens were restudied by GORCZYCA (2000). In the original unpublished Schmitz's drawings, made available to us by Schmitz himself, we found a figure similar to our Fig. 23, annotated by Schmitz as "*F. major*" (our Fig. 24). The parieto-vaginal rings, although smaller than those of our specimens, are nevertheless obvious.

Fulvius oxycarenoides (REUTER 1878)

Examined specimens: Holotype (♀): Mus. Zool. H: fors, Spec. typ. No 9108, *Fulvius oxycarenoides* (REUT.), Spec. typ Reuter / Greece: Aetolia, Mus.

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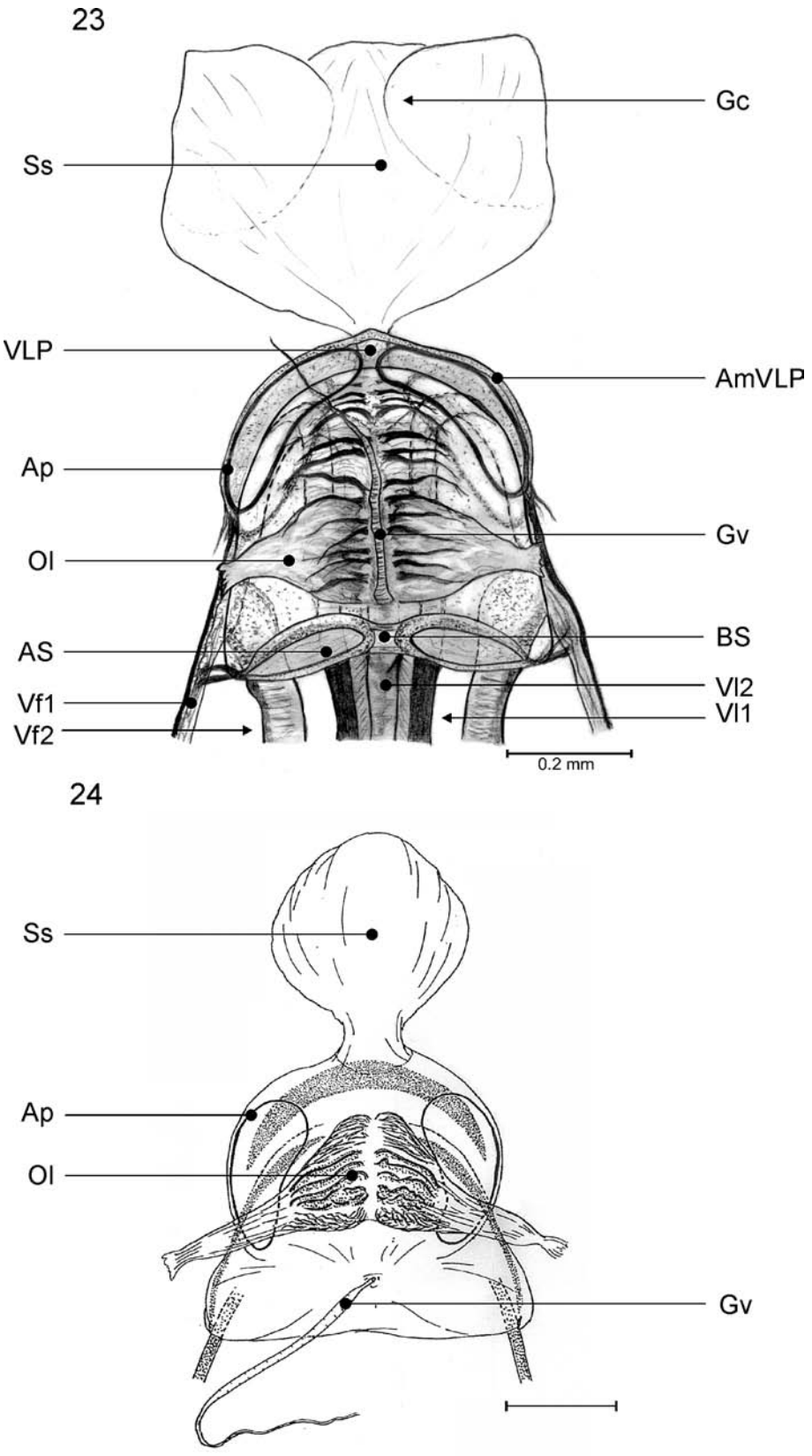

Figs 23-24: *Fulvius major* Schmitz 1970, Vagina. (**23**) Vagina in dorsal view (**24**) The same, by the courtesy of G. Schmitz. AmVLP: anterior margin of VLP; Ap: Parieto-vaginal rings; AS: A structure; BS: B structure; Gc: contour of glandular area; Gv: vermiform gland; Ol: lateral oviduct; Ss: anterior or seminal sac; Vf1 and Vf2: valvifers 1 and 2 (or viii and ix); Vl1 and Vl2: valvulae 1 and 2 (or viii and ix); VLP: ventral labiate plate.

Zool. Helsinki, N: 28681, Mus. Hels. Coll. O.M. Reuter / Holotypus female / *Fulvius punctum-album* female, G. Schmitz det. 1968 / 683.111 / Holotype; 1 ♀: Mus. Zool. Helsinki, Loan N° HE 04 - 32 / Female: Persia sept(entrional): "-or, ostium, fl. Kara-su", 15.vii.1914, Kiritshenko, Coll. Lindberg / *Fulvius oxycarenoides* Reuter female, G. Schmitz det. 1970 (ZMC).

Description. Membranous structure between second valvulae present. Apex of first valvulae slightly rounded. Apex of second valvulae gently curved. Outgrowths of first valvulae, tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac (Figs 29-30, Ss) large, devoid of ring, its connection to median part of vagina narrow. Parieto-vaginal rings (Ap) elongated, slightly separated, anterior and posterior margins gently curved, inner margins acute, outer margin straight. Inner margins devoid of any prolongations. Outer margins extended by a narrow sclerites (S). Dorsal labiate plate (DLP) large, anterior and posterior margins not thickened. Ventral labiate plate slightly sclerotized. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) elongated. Lateral oviducts large, apparently convoluted, not conflating into a common dorsal sac. Posterior wall membranous.

Fulvius tanzanicus Gorczyca 2000

Examined specimen: Paratype (♀): Tanzania: Mts Uluguru, Kimboza, 600 m, 24-30.vii.(19)71 / Coll. Mus. Tervuren, Mission Mts Uluguru, L. Berger, N. Leleup, J. Debecker, vii-viii.(19)71 (MRAC).

Description. Membranous structure between second valvulae present. Apex of first valvulae slightly rounded. Apex of second valvulae almost rounded, gently curved. Outgrowths of first valvulae, tubercle of first valvulae's inner margins and tooth basally on apex of second valvulae absent. Seminal sac (Figs 31 and 33, Ss) large, devoid of ring, its connection to median part of vagina slightly narrowed. Parieto-vaginal rings (Ap) elongated, slightly separated, posterior margin straight, anterior and outer margins convex, inner margins acute. Outer margins devoid of any prolongations. Inner margins extended by a narrow sclerite (PmAp). Dorsal labiate plate (DLP) large, anterior and posterior margins slightly thickened. Ven-

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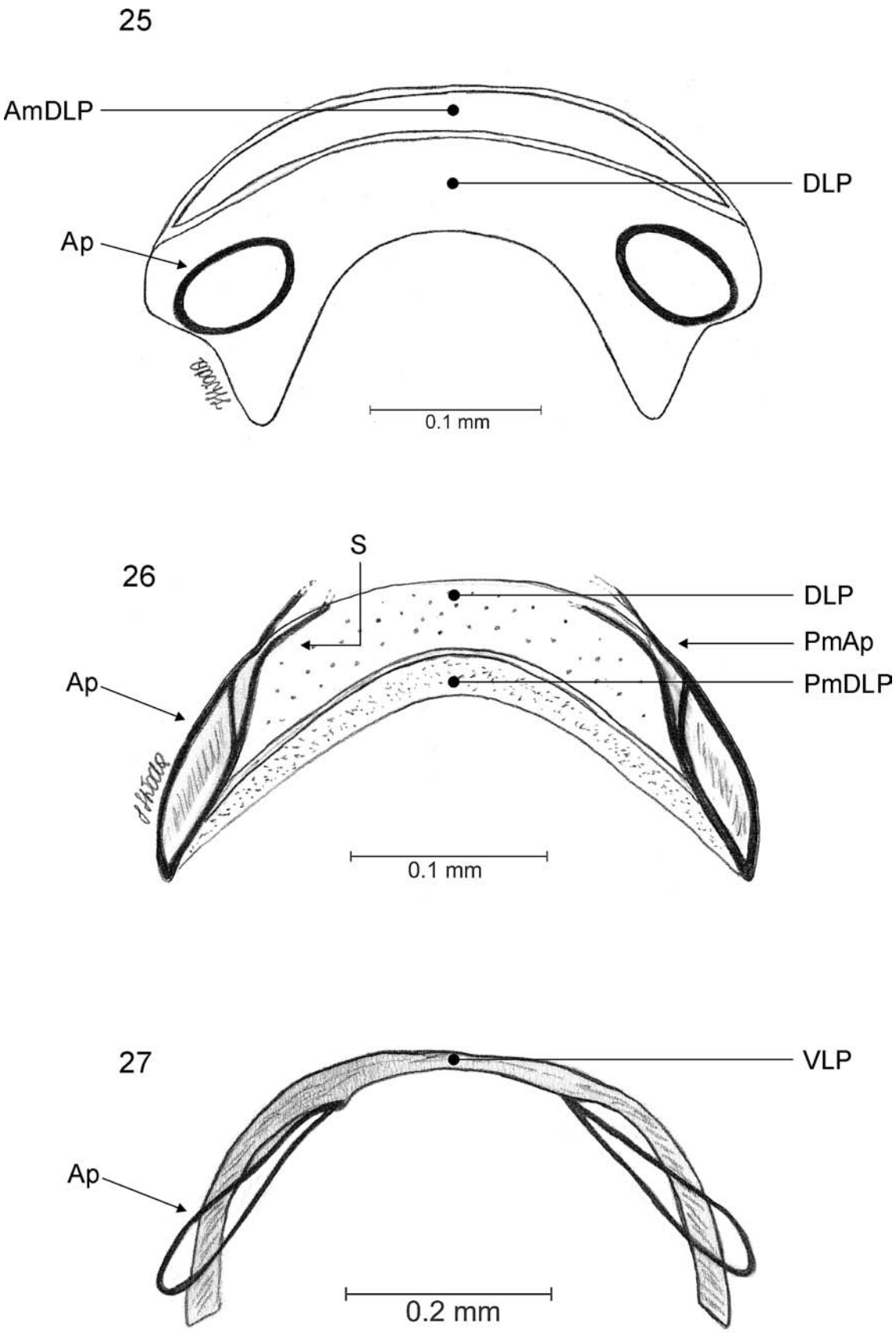

Figs 25-27: *Fulvius* spp., Dorsal labiate plate, ventral labiate plate and parieto-vaginal rings in dorsal view (**25**) *Fulvius geniculatus* Van Duzee 1933 (**26**) *Fulvius variegatus* Poppius 1909 (**27**) *Fulvius gamboensis* Carvalho & Costa 1994. AmDLP: Anterior margin of DLP; Ap: Parieto-vaginal rings; DLP: dorsal labiate plate; PmAp: medial plate; PmDLP: posterior margin of DLP; S: sclerites (see description); VLP: ventral labiate plate.

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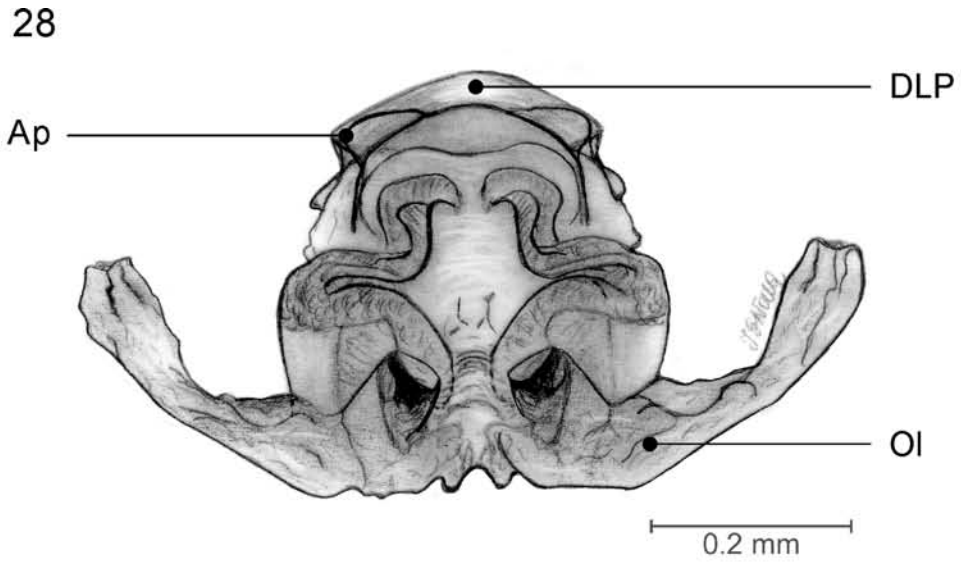

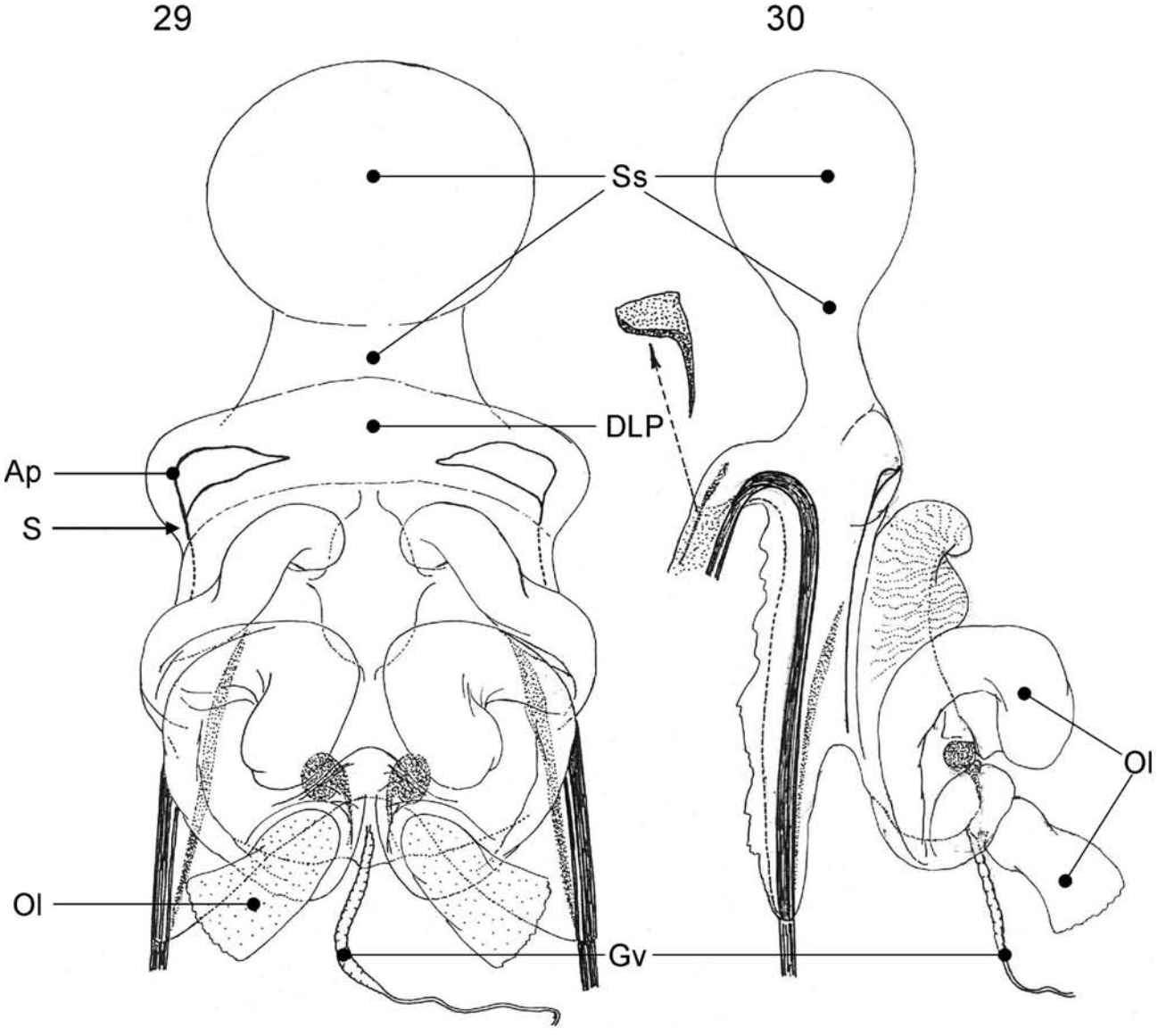

Figs 28-30: *Fulvius oxycarenoides* (REUTER 1878), Vagina. (**28**) Dorsal labiate plate and parieto-vaginal rings in dorsal view (**29**) Vagina in dorsal view by the courtesy of G. Schmitz (**30**) The same, in lateral view, by the courtesy of G. Schmitz. Ap: Parieto-vaginal rings; DLP: dorsal labiate plate; Gv: vermiform gland; Ol: lateral oviduct; S: sclerites (see description); Ss: anterior or seminal sac.

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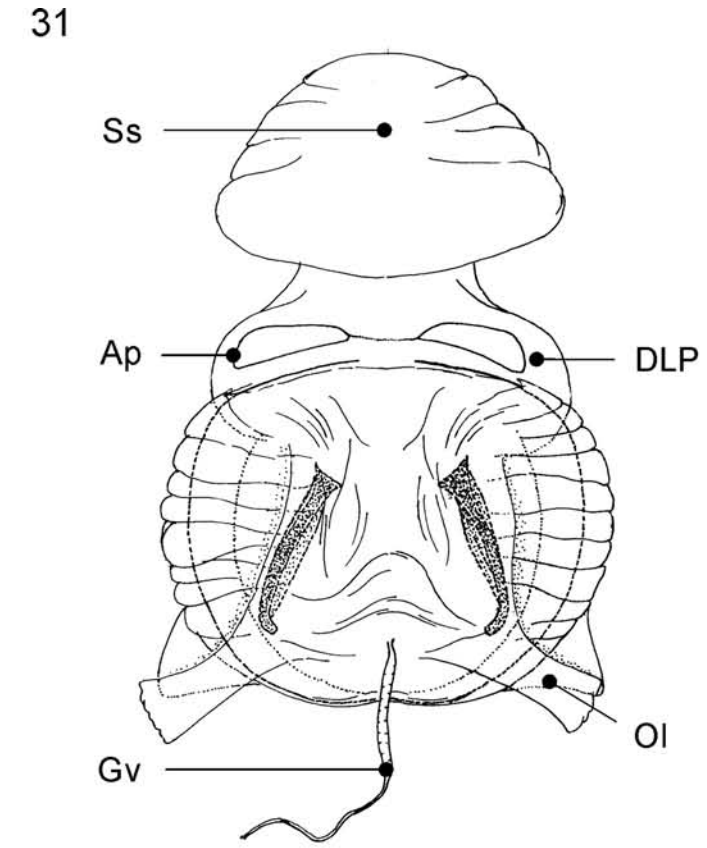

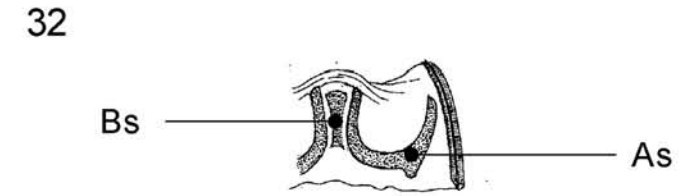

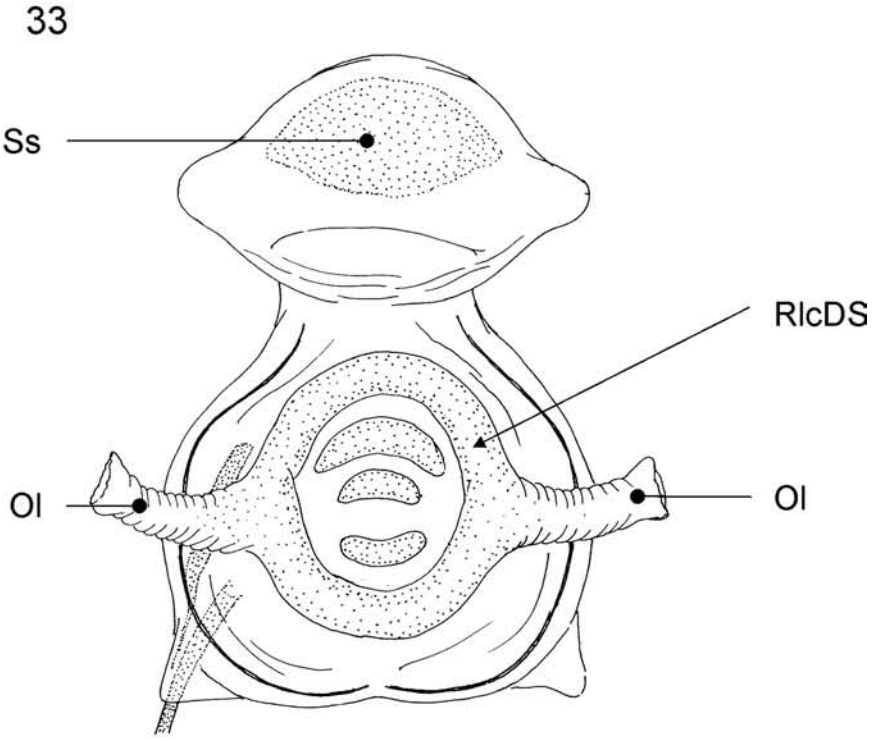

Figs 31-32: *Fulvius tanzanicus* Gorczyca 2000. (**31, 33**) Vagina, respectively in dorsal and in ventral views, by the courtesy of G. Schmitz (**32**) Right part of posterior wall, in dorsal view, by the same author. Ap: Parieto-vaginal rings; As: A structure; Bs: B structure; DLP: dorsal labiate plate; Gv: vermiform gland; Ol: lateral oviduct; RlcDS: ringlike common dorsal sac; Ss: anterior or seminal sac.

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tral labiate plate slightly sclerotized. Dorsal wall strongly sclerotized, including three sub median crescent-shaped sclerites. Vaginal projection and MiRs absent. Vermiform gland (Gv) elongated. Lateral oviducts large, apparently conflating into a circular ringlike common dorsal sac. Posterior wall membranous, including three totally separated sclerites, a B structure sensu CHÉROT (2002) and two hook-like A structures. No E or H structure.

Fulvius variegatus POPPIUS 1909

Examined specimens: 1 ♀: New Hebrides: Efate I., Port-Vila, 0-100 m, iii.1980, N.L.H. Krauss, Bishop Museum Acc. #1980.128 / *Fulvius variegatus* POP. det. J. Gorczyca; 1 ♀: Papua New Guinea: N.-E.: Madang Prov., Baku Forest St(atio)n, 80 m, 4-12.ii.1978, At light, W.C. Gagné, Coll. Bishop Museum Acc. #1980 / *Fulvius variegatus* POP. det. J. Gorczyca 1998; 1 ♀: Papua New Guinea: Morobe Distr(ict), Wau, 5.viii.1972, C.G.E. Scudder, Bishop Museum Coll., Acc. 1981-512 / M.V. Light Trap, G.G.E. Scudder / *Fulvius variegatus* POPP., det. J. Gorczyca (BPBM).

Description. Membranous structure between second valvulae absent. Apex of first and second valvulae triangular (Figs 14-15). Scalelike to toothlike outgrowths ventrolaterally on first valvulae present. Scalelike outgrowths of first valvulae ventral surface, tubercle of first valvulae's inner margin and tooth basally on apex of second valvulae absent. Seminal sac unknown (damaged in our specimens). Parieto-vaginal rings (Ap, Fig. 26) clearly separated. Their anterior and posterior margins straight, their outer and inner margins acute. A pair of elongated sclerites (S, PmAp) originate from posterior and inner margins. Dorsal labiate plate (DLP) large, posterior margin thickened. Ventral labiate plate slightly sclerotized. Dorsal wall slightly sclerotized. Vaginal projection and MiRs absent. Vermiform gland (Gv) reduced. Lateral oviducts large, conflating into a common dorsal sac. Posterior wall membranous.

Discussion

As for males, the genital structures of females of *Fulvius* are amazingly variable between species compared to their morphology. According to our observations, structures of the valvulae (shape of apical part, presence of tubercles, presence of teeth), the parieto-vaginal rings (shape of margins, associated sclerites) and the lateral oviducts seem to be of diagnostic value for species separation or to be species-group specific; but those hypotheses needs further studies.

We provide hereafter a first comparison between the female genitalia of the analyzed *Fulvius*-species and the other Cylapinae of which female genital structures are already known, e.g.,

Austrovannius scutica CASSIS et al. 2003 (Vanniini, sometimes classified in Palaucorinae)
Austrovannius xepenehense CASSIS et al. 2003
Bothriomiris gotohi YASUNAGA 2000 (Bothriomirini)
Cylapofulvius punctatus POPPIUS 1909 (Fulviini)
Cylapofulvidius lineolatus CHÉROT & GORCZYCA 1999 (Fulviini)
Cylapofulvidius thailandicus CHÉROT & GORCZYCA 1999
Cylapofulvidius webbi CHÉROT & GORCZYCA 1999
Cylapofulvidius zetteli CHÉROT & GORCZYCA 1999
Cylapomorpha michikoae YASUNAGA 2000 (Cylapini)
Fulvius anthocoroides (REUTER 1875) (Fulviini)
Fulvius major SCHMITZ 1970
Fulvius borgesi CHÉROT et al. 2006
Hemiophthalmocoris caligans SCHMITZ 1970 (Fulviini)
Hemiophthalmocoris convexus GORCZYCA 2000
Hemiophthalmocoris sulawesicus GORCZYCA & CHÉROT 2002
Mimofulvius pentatomus SCHMITZ 1978 (Fulviini)
Peritropis advena KERZHNER 1972 (Fulviini)
Punctifulvius kerzhneri SCHMITZ 1978 (Fulviini)
Rhinomiridius aethiopicus POPPIUS 1909 (Rhinomirini)
Rhinomiridius ogoouensis ODHIAMBO 1968
Rhinomiridius dentatus CHÉROT & GORCZYCA in GORCZYCA & CHÉROT 1998
Vanniopsis crobylos CASSIS et al. 2003 (Vaniini)

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Vanniopsis howense CASSIS et al. 2003
Vanniusoides asprokara CASSIS et al. 2003
(Vaniini)
Vanniusoides melafrons CASSIS et al. 2003
Yamatofulvius miyamotoi YASUNAGA 2000
(Fulviini)

Synthetically:

The posterior wall of Cylapinae is frequently membranous, undivided, apparently difficult to use into species identification and classification. However, the posterior walls of the genera *Cylapofulvius*, *Cylapofulvidius* (CHÉROT & GORCZYCA 1999: 218, Fig. 13; 220, Figs 14, 16 and 18), *Punctifulvius* (YASUNAGA 2000: 196, Fig. 54), *Rhinomiridius* (GORCZYCA & CHÉROT 1998: 52, Figs 95-104 and GORCZYCA 2000: 160, Figs 48 B-C, E-F, H-I), and *Yamatofulvius* (YASUNAGA 2000: 202, Fig. 73) are more complex, subdivided in several sclerites. The posterior wall of *Fulvius anthocoroides* (REUTER 1875) (YASUNAGA 2000: 190, Fig. 27) is also divided, into A structures (or inter-ramal sclerites) and B structure (or dorsal structure + median process), a typical structural arrangement in Mirinae and Orthotylinae, but apparently not in Cylapinae.

The vaginal projection and MiRs are absent in all investigated *Fulvius*-species, as in a majority of Miridae. These structures were not described in the subfamily Cylapinae yet.

The lateral oviducts are large, frequently separated, and sometimes conflating into a common dorsal sac (*F. constanti*, *F. discifer*, *F. major*, *F. variegatus*). The circular ringlike common dorsal sac of *Fulvius tanzanicus* might be unique to this species. With respect to other Cylapinae, *Mimofulvius pentatomus* SCHMITZ 1978 (SCHMITZ 1978: 186, 189, Fig. 10) and *Rhinomiridius* spp. (GORCZYCA & CHÉROT 1998: 52, Figs 89-91 and GORCZYCA 2000: 160, Figs 48A, D, G) possess non conflating lateral oviducts, in contrast to *Cylapomorpha michikoae* YASUNAGA 2000 (YASUNAGA 2000: 186, Fig. 7) and *Peritropis advena* KERZHNER 1972 (YASUNAGA 2000: 193, Fig. 45).

The dorsal wall of practically all investigated *Fulvius*-species is membranous and lacks sclerites as described e.g. for *Rhinomiridius* spp. (GORCZYCA & CHÉROT 1998; GORCZYCA 2000). The folds of *M. major* may be unique to this taxon.

The parieto-vaginal rings are often clearly separated, in contrast to, e.g., *Cylapofulvius* and *Mimofulvius* (CHÉROT & GORCZYCA 1999: 218, Fig. 12 and SCHMITZ 1978: 186, Fig. 10, respectively), where they are very close to each other, or in contrast to *Punctifulvius kerzhneri* and *Yamatofulvius* spp. (YASUNAGA 2000: 196, 202, Figs 53, 77), where they are fused. However, there are also some exceptions within *Fulvius*: in some cases the rings are close together (*F. discifer*, *F. major*), in other cases they are connected via sclerites (by prolongations of the ring's anterior and posterior margins in *F. dimidiatus*, by a medial sclerite in *F. tanzanicus*). The strange sclerites of *F. bifenestratus* are probably unique for this species.

The parieto-vaginal rings of investigated *Fulvius*-species are practically never reduced or absent, in contrast to some African *Hemiophthalmocoris* (GORCZYCA & CHÉROT 2002: 59, Figs 6, 8) and *Cylapomorpha* species (YASUNAGA 2000: 186, Fig. 7). However, according to YASUNAGA (2000: 189-190, Fig. 26), *Fulvius anthocoroides* lacks any parieto-vaginal ring. *Bothriomiris gotohi* YASUNAGA 2000 (YASUNAGA 2000: 205, Fig. 86) and some other recently described species of the *Vannius*-complex (CASSIS et al. 2003) also possess reduced parieto-vaginal rings.

The shape of the parieto-vaginal rings apparently is species-specific, as in numerous other Miridae.

Prolongations of the lateral margins occur quite frequently in *Fulvius* species (i.e., *F. constanti*, *F. dimidiatus*, *F. discifer*, *F. oxycarenoides*) and they are similar to those of other Cylapinae (e.g., *Mimofulvius pentatomus* cf. SCHMITZ 1978: 186, Fig. 10). However, these prolongations can also be absent, e.g., in the genera *Hemiophthalmocoris* or *Rhinomiridius* (GORCZYCA & CHÉROT 2002: 59, Figs 4, 6, 8 and GORCZYCA & CHÉROT 1998: 52, Figs 89-91 or GORCZYCA 2000: 160, Figs 48 A, D, G, respectively).

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The dorsal labiate plate (DLP) is large and clearly visible in most cases, but sometimes it is slightly sclerotized or even unsclerotized (e.g., *F. dimidiatus*, *F. gamboensis*, *F. major*). According to YASUNAGA (2000), the DLP is unsclerotized in *F. anthocoroides* (p. 190, Fig. 26), *Peritropis advena* (p. 193, Fig. 45) and *Punctifulvius kerzhneri* (p. 196, Fig. 53) and reduced in *Yamatofulvius* species (p. 202, Figs 69, 77).

The ventral labiate plate is slightly sclerotized in most cases, but sometimes it is strongly sclerotized and large (e.g., *F. breddini*, *F. dimidiatus*, *F. major, Mimofulvius* cf. SCHMITZ 1978: 186, Fig. 10 Sc). According to YASUNAGA (2000), the sclerotized VLP occurs in all species with sclerotized DLP.

The seminal sac is large and its connection to the median part of the vagina is sometime narrow as in *Punctifulvius* (YASUNAGA 2000: 196, Fig. 53), *Sahlbergella*, and *Helopeltis* (Bryocorinae, see SCHMITZ 1987: 5, Figs 9-10; 1988: 95, Figs 3-5), but in contrast to a majority of Mirinae or to *Mimofulvius* (SCHMITZ 1978: 186, Fig. 10).

The seminal sac is generally devoid of rings, sometimes it bears a unique common ring (*F. constanti*) or a double ring (*F. major*). According to YASUNAGA (2000), the ring is absent in *Fulvius anthocoroides* (cf. p.190, Fig. 26), *Peritropis advena* (cf. p. 193, Fig. 45), and *Mimofulvius* (SCHMITZ 1978: 186, Fig. 10), but present in *Punctifulvius kerzhneri* (cf. p. 196, Fig. 53) and *Yamatofulvius* spp. (cf. p. 202, Figs 69, 77).

At present, it is difficult to provide a phylogenetic treatment of *Fulvius* based solely on female genital structures. We have not yet found a potential autapomorphy for the genus in the structures. Consequently, the monophyly of the genus cannot be asserted on the base of our limited study (small number of species and character states, few potential outgroups available). Additional studies are needed to clarify the phylogenetic relationships within the tribe Fulviini, as well as within the genus *Fulvius*. However, according to our observations and literature survey, we are confident that female genital structures will be very useful for such studies.

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Zusammenfassung

Die weiblichen Genitalstrukturen der Cylapinae und besonders jene der Fulvinii sind bislang wenig bekannt. Wir beschreiben erstmals den Ovipositor und die Vagina von *Fulvius bifenestratus* POPPIUS 1909 aus Indonesien, *Fulvius bisbistillatus* (STÅL 1860) aus Peru, *F. breddini* REUTER 1902 aus Französisch Guyana, *F. constanti* GORCZYCA 2004 aus Papua Neu Guinea, *F. dimidiatus* POPPIUS 1909 aus Malaysien, *F. discifer* REUTER 1907 aus Yemen, *F. gamboensis* CARVALHO & COSTA 1994 aus Mexico, *F. geniculatus* VAN DUZEE 1933 von den Galapagos Inseln, *F. major* SCHMITZ 1970 aus der Zentralafrikanischen Republik, *F. oxycarenoides* (REUTER 1878) aus dem Nahen Osten (Türkei, Iran), *F. tanzanicus* GORCZYCA 2000 aus Tansania und von *F. variegatus* POPPIUS 1909 aus dem Pazifischen Raum. Wir vergleichen die beschriebenen Strukturen mit denen anderer Cylapinae. Einige Merkmale der Valven (Form der apikalen Teile, Vorhandensein von Tuberkeln oder Zähnen), der vaginalen Sklerite (Form der Ränder, Sklerite), und der lateralen Ovidukte sind von diagnostischem Wert zur Unterscheidung der Arten.

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