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A NEW GENUS OF MICROPTEROUS MIRIDAE FROM SINGAPORE MANGROVES (INSECTA: HEMIPTERA: HETEROPTERA)

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ABSTRACT. — A new ground-dwelling cimicomorphan Heteroptera taxon, *Mangalcoris miniatus* new genus, new species, is described from beneath wet intertidal timber in Southeast Asian mangrove swamps and tentatively placed in the family Miridae, subfamily Cylapinae. Individuals of this species are uniformly micropterous, and the difficulties in assessing family placement in the context of this and other reductional character states exhibited by this taxon are discussed. Notes on the habits and habitats of this odd intertidal species are also provided. Figures are provided of the male and female dorsal and lateral habitus, leg and pretarsal structures, and male genitalia.

KEY WORDS. — Heteroptera, Miridae, new genus, new species, mangroves

INTRODUCTION

The hemipterous ground fauna of Southeast Asian mangroves is poorly documented apart from some of the Gerromorpha, for which Singapore records are briefly mentioned by Murphy (in press), or included in species descriptions by Polhemus & Polhemus (1989) and Andersen (2000). A few Saldidae (*Saldoida armata*, *Saldula sonneveldti*), the gelastocorid *Nerthra macrothorax*, some seed-feeding rhyparochromine Lygaeidae, and undescribed species of Enicocephalidae and Schizopteridae are also known. Most of these insects are truly inter-tidal, ground-running forms which survive tidal inundation in air-filled cavities among leaf litter or in decayed wood, emerging to hunt during the demersal stage. Brachyptery or microptery is a common feature among these ground-living mangrove insects and Tanokuchi (1989) makes comments on this with respect to the diverse fauna of beetles in the family Pselaphidae (Coleoptera) found in the same habitat. A most interesting addition to this small fauna is the micropterous cimicomorphan bug described below, whose lack of wing characters contributes to the difficulty of assigning it to a family or subfamily.

MATERIAL AND METHODS

The specimens listed in the Material Examined section were hand-collected using an aspirator, preserved in 80% alcohol in the field, and subsequently vouchered in alcohol. The holotype of *Mangalcoris miniatus* as well as the majority of the paratypes are housed in the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC), with one pair of paratypes also deposited in the Bishop Museum, Honolulu, Hawaii, USA (BPBM).

In the descriptions below, colour information is taken from specimens immersed in ethanol. All measurements are given in millimeters.

Mangalcoris, new genus

Type species. — *Mangalcoris miniatus*, new species, by present designation. Gender of genus masculine.

Diagnosis. — A deep-bodied, uniformly sclerotised, micropterous cimicomorphan with extremely attenuate wings and elongate appendages. Integument finely shagreened, with simple uniform setation. Tarsi two segmented, bearing long, symmetrical, uniformly curved and tapered claws without pseudarolia and a single long, simple curved seta representing the arolium. Colouration bright red.

Description. — Head ovoid, vertex and frons domed, clypeus vertical, gula short, with bucculae undeveloped. Compound eyes small, widely spaced, moderately protuberant, with two posterior setulae. Ocelli absent in both sexes (Fig. 1A–D).

Antennae long, slender, filiform. Rostrum long, reaching onto basal abdomen.

Prothorax short, simple, domed, without carinae, collar or dorsal impressions. Prosternum prominent, shield-shaped. Mesonotum exposed, scutellum not evident (Fig. 1B, D; Fig. 2B); forewing transversely ovoid, without venation, separated mid-dorsally to expose narrow metanotum which is weakly sclerotised. Hind wings entirely absent. Meso- and metathoracic spiracles anterior and lateral, in intersegmental membrane beneath preceding segment. Metepisternum and metacetabula modified into prominent lateral evaporatoria, gland openings diastomate, widely separated but opening into a common transverse groove behind prominent metasternum, each orifice with complex valve and apodeme. Glands lateral but sharing a common median reservoir.

Legs attenuate, coxae without adhesive pads, trochanters without trichobothria, femora with subapical discoidal pits, meso- and metafemora bearing ventrolateral trichobothria. Tibia with weakly developed apical spurs, pro- and mesotibiae with apical combs, metatibia without. All tarsi elongate, similar on all legs (in both sexes), 2-segmented (Fig. 4A), basitarsus very short, acute beneath, protarsus bearing a long ventral apical seta not differentiated on meso- and meta-basitarsi. Pretarsus bearing long, smooth, equal, uniformly curved and tapered claws, pseudarolia absent (Fig. 4B); unguitractor plate transversely ridged, pseudarolia represented by single long, simple curved seta slightly displaced from ventral midline.

Abdomen in both sexes with pregenital segments symmetrical, well sclerotised, strongly overlapping, with laterotergites folding but not clearly delimited by membrane, bearing small, simple spiracles on segments 2–7; sternites well sclerotised, setose, continuously fused with laterotergites; spiracle I absent; trichobothria not evident. Dorsal abdominal glands persistent in adults (both sexes) but hidden in intersegmental membrane between tergites II and III, with reservoir protruding on maceration.

Male abdominal segment VIII symmetrical, solidly fused, with bridge separating anal and genital apertures. Pygophore symmetrical with conspicuous protractor, retractor and lateral apodemes. Parameres asymmetrical. Gonopore framed by slightly asymmetrical sclerites, aperture with longitudinal ribs, gonoduct flexible, not sclerotised anteriorly. Vesica with large basal apparatus, one ventral digitiform appendage, distal section coarsely spiculate, and possibly with a short lateral lobe only minutely spiculate (Fig. 3C), margins of vesical spicules smooth and lacking serrations.

Female ovipositor laciniate (Fig. 2A), typical of family Miridae in all details. First valvulae finely toothed, narrow inner ramus broadening dorsally, with strong gonangulum. First valvulae dilate at base in wall of vulva to enclose a pair of smooth, ovate, mirror-like structures (possibly muscle insertions). Second valvula basally united above, strongly toothed dorsally with major teeth alternating on each side. Strong outer ramus bearing second valvifer which has a small basal hair plate and well-defined apical gonoplac.

Female internal structures typical of family Miridae (cf. Davis, 1955). Ventral seminal depository large, saccular, lying below common oviduct. Cuticular part of each lateral oviduct well developed, ending in a strongly fluted section from which arises a crown of microtubules. Long, narrow, dorsal, tubular spermathecal gland inserted between lateral oviducts.

Remarks. — Many details of *Mangalcoris* morphology conform closely with available interpretations of Miridae by Slater (1950), Davis (1955), Kullenberg (1947), and Scudder (1959), including the diagnostic presence of meso- and metafemoral trichobothria. We follow the nomenclature of Matsuda (1976) rather than that of Dupuis (1970) although the latter is more detailed and useful in interpretation. The pretarsus of this taxon shows a number of highly reductional character states, including the apparent absence of parempodia, and the pseudarolia represented by a single long, curving seta slightly displaced from the ventral midline of the tarsus, suggesting one of these typically paired structures (Schuh, 1976) has been secondarily lost.

***Mangalcoris miniatus*, new genus, new species**
(Figs. 1–4)

Type material. — SINGAPORE: Holotype male, Mandai Kechil mangroves, under intertidal wood at 2.6 m above datum, near abandoned house, under trees, 9 Apr.1990, coll. D. H. Murphy (ZRC). Paratypes (adults only) – SINGAPORE: 4 males, 7 females, 32 immatures, same data as holotype, D. H. Murphy (ZRC, BPBM). THAILAND: 2 males, 1 female, Ranong mangroves, in *Rhizophora* timber on ground, 14 Nov.1987, coll. D. H. Murphy (ZRC); 1 female, Ranong, 28 Jul.1988, coll. D. H. Murphy (ZRC).

Diagnosis. — This species may be recognised by its micropterous form (Figs. 1, 2), red colouration (Fig. 1), the shapes of the male parameres (Figs. 2D, E; 3A, B), and its preference for intertidal mangrove habitats.

Description. — Micropterous male: Body form short and relatively broad, length 1.65, maximum width (across basal abdomen) 0.60; wings micropterous, appendages slender (Figs. 1A, B; 2B); general colouration bright red (Fig. 1A, B).

Head short, declivant, length 0.30, width 0.40; antennae with all segments long, segment I stout, segments II–IV longer, more slender (Figs. 1B; 2B), segments III and IV finely annulate, bearing erect setae with lengths 3× the diameter of these respective segments, lengths of segments I–IV = 0.40, 0.80, 1.00, 1.70. Labrum short; rostrum long, stout (Fig. 1A), length 0.95, reaching abdominal segment III.

Pronotum length 0.20, width 0.45, anterior margin weakly concave in posterior direction, lateral margins weakly divergent posteriorly, posterior margin weakly curved in posterior direction. Wing pads small, micropterous, transversely ovate.

Legs elongate, femora stout, tibiae and tarsi slender; middle and hind femora with 5 and 2 ventrolateral trichobothria respectively; lengths of leg segments as follows: fore leg femur/tibia/tarsal I/tarsal II = 0.80, 0.90. 0.10, 0.30; middle leg femur/tibia/tarsal I/tarsal II = 0.70, 0.80. 0.10, 0.30; hind leg femur/tibia/tarsal I/tarsal II = 1.00, 1.05. 0.20, 0.40.

Abdomen with all tergites exposed, lateral margins bowed outward.

Genitalia with parameres asymmetrical, blunt; left almost straight (Fig. 3A), right strongly hooked (Fig. 3B); aedeagus as in Fig. 3C.

Micropterous female: Similar to male in general structure and colouration, but slightly larger in overall size (Fig. 1C, D); length 1.30 mm, maximum width (across basal abdomen) 0.50 mm.

Remarks. — *Mangalcoris miniatus*, new genus, new species, is a very long-limbed micropterous cimicomorphan bug found under wet intertidal timber in Southeast Asian mangroves. It was initially collected in Thailand, with subsequent collections from Singapore, and there is every reason to expect a wider distribution in this specialised habitat along the intervening Southeast Asian coastline. The bright red immatures are conspicuous, but to the naked eye are likely to be dismissed as trombiculid mites, which are also common in such mangrove habitats. Adults are less conspicuous, the heavier sclerotisation concealing the red pigment, which, however, is still present. When collected by aspirator, the distinctive "bug" odour indicates the presence of repellant glands.

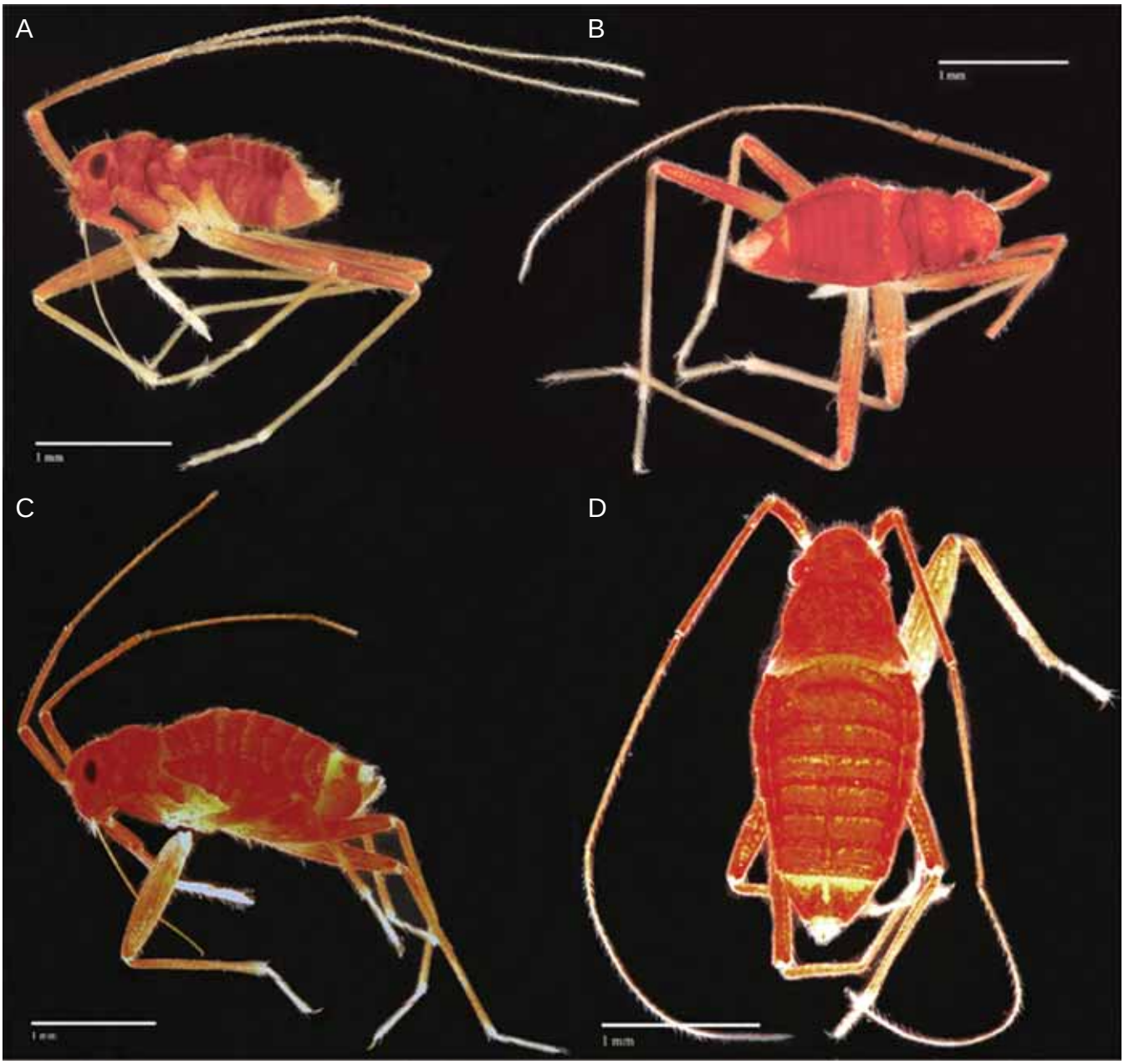

Fig. 1. *Mangalcoris miniatus*, new genus, new species, paratype specimens from Singapore, Mandai Kechil mangrove. A, B, male; C, D, female. A, C, lateral views; B, D, dorsal views.

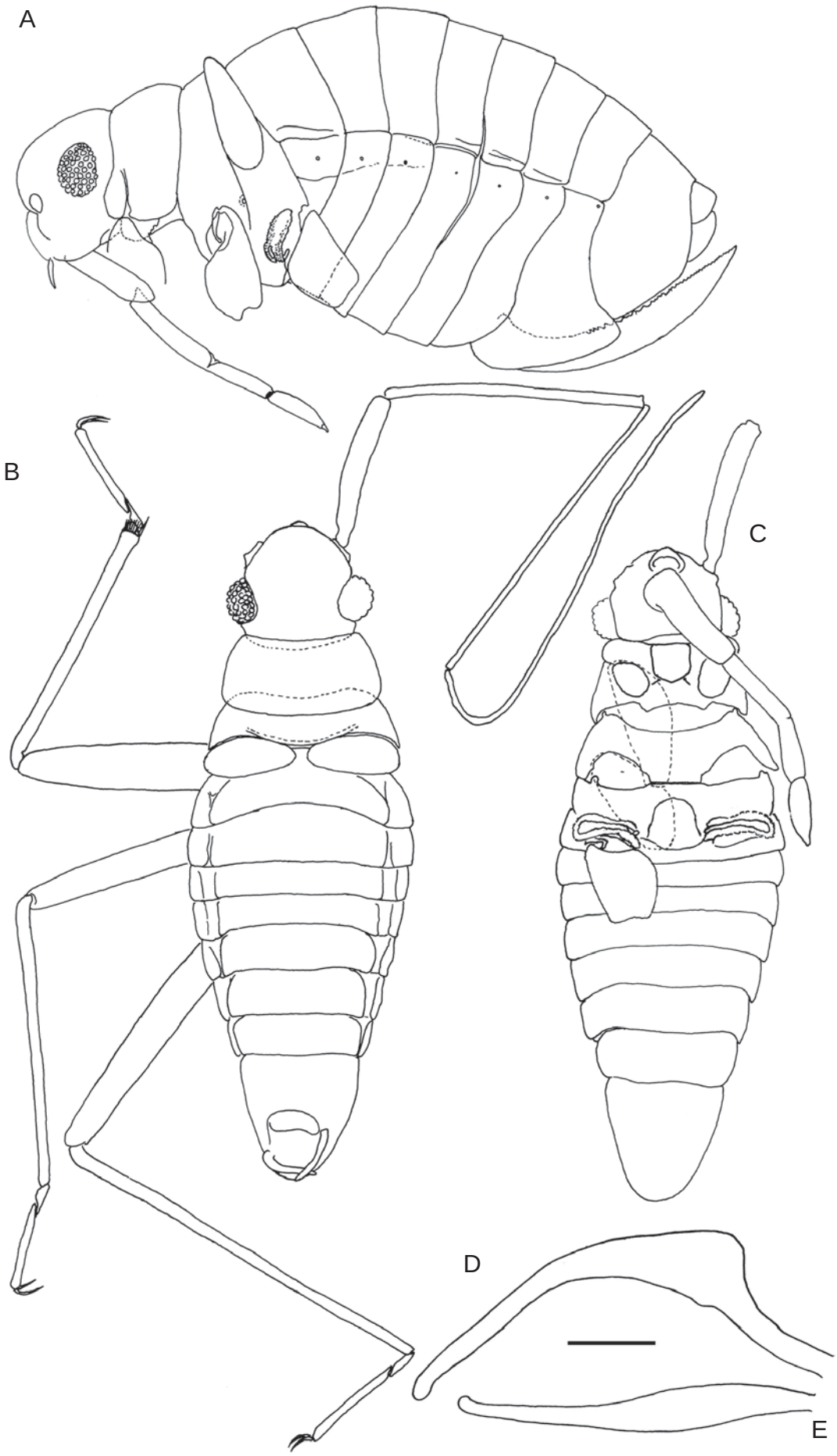

Fig. 2. *Mangalcoris miniatus*, new genus, new species, paratype specimens from Singapore, Mandai Kechil mangrove. A, female; B–E, male. A, body, lateral view; B, body and appendages, dorsal view; C, body, ventral view; D, E, male parameres.

When first studied, it was suspected that this taxon might represent an undescribed family. In most of the older works, the heteropteran families are sorted on rather superficial characters of tarsal formula, presence or absence of ocelli, segmentation of the rostrum, and general habitus. Although this is adequate for most typical members of these families, it has long been known that aberrant genera exist whose placement can be difficult (McAtee & Malloch, 1924), particularly if they possess reduced wing development. One such form led China & Myers (1929) to an important reassessment on the cimicoid families, and many later workers have been critical of reliance on the traditional character suites.

This problem becomes especially difficult when dealing with species which are micropterous in both sexes, where important features of wing venation are unavailable. Fortunately recent work has emphasised the taxonomic importance of genitalic, trichobothrial, and pretarsal structures, and the characteristic scent gland apparatus, so that assigning such forms to higher taxa is no longer as speculative as it once was (Schuh & Slater, 1995). Based on an extensive character analysis, we believe that a strong case can be made for placing the following new species in the family Miridae, subfamily Cylapinae, in spite of several aberrant features subsequently discussed.

The diastome scent gland apparatus, 4-jointed rostrum, absence of trichobothria (except in Miridae), and adult metathoracic spiracle lying ventral and anterior are among the defining apomorphies of Cimicomorpha, as defined by Leston et al. (1954). This definition was further developed by Stys & Kerzhner (1975) and summarised by Schuh (1986). The older concept of "cimicoid families" in the sense of China & Myers (1929) approximates this more restricted grouping though it is no longer used in its original form.

The resemblance of the tarsi in *Mangalcoris* to those of *Plokiophila* China, 1953 (see China & Myers, 1929) is quite striking, and in keys in older works the species runs to Microphysidae (from which the Plokiophilidae were subsequently separated). A more detailed appraisal of its characters however, quickly makes clear that the tarsus is the only structural resemblance between *Mangalcoris* and the Plokiophilidae. The male genitalia are not symmetrical, insemination is not haemocoelic, a laciniate ovipositor is present with its outer plate undivided, scent ostioles are prominent, and the basal joint of the rostrum is long with its apical joint cylindrical.

Disregarding the tarsi (and the unavailable wing structures), the full complement of available characters is otherwise

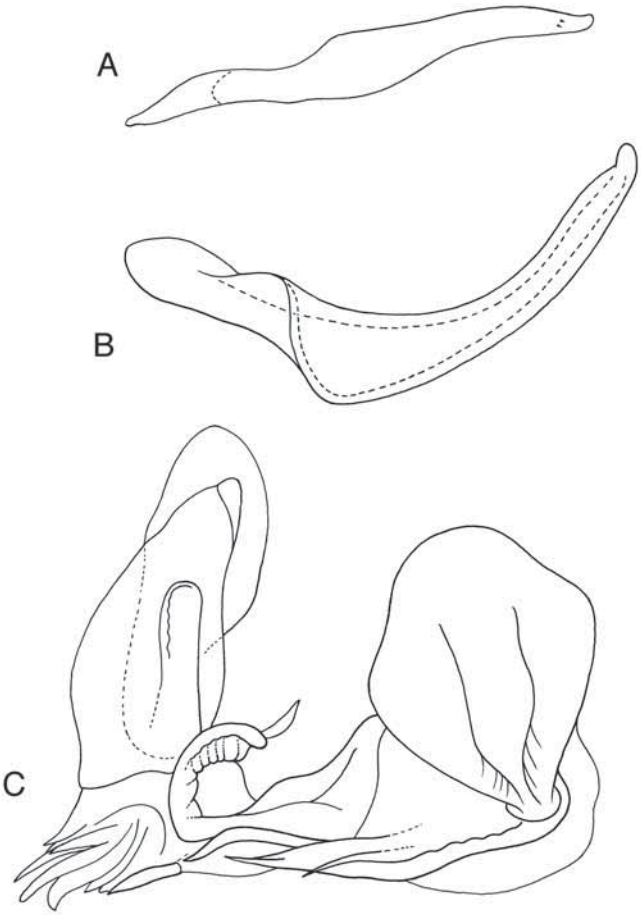

Fig. 3. *Mangalcoris miniatus*, new genus, new species. A, male left paramere; B, male right paramere; C, male vesica (partially inflated).

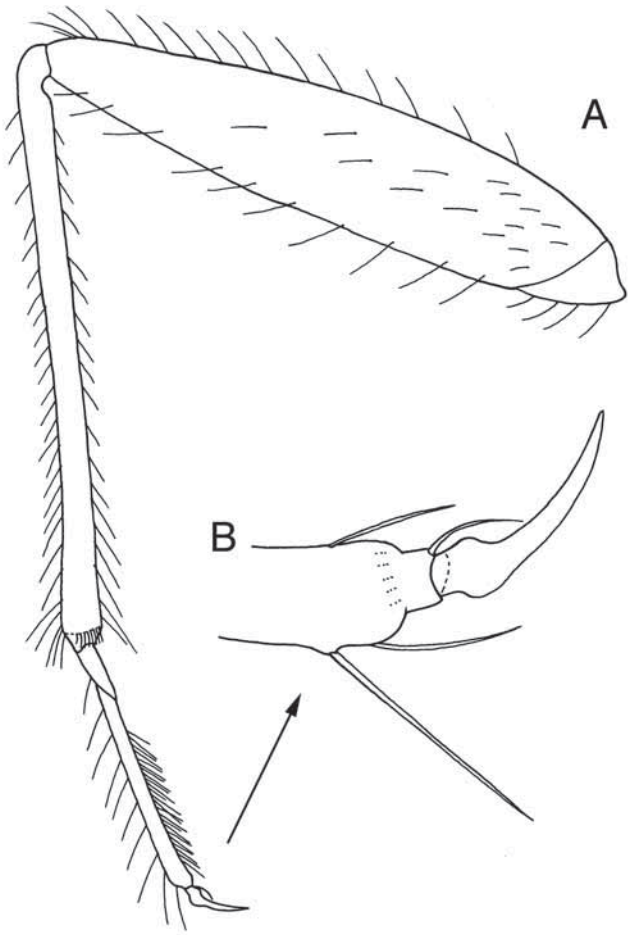

Fig. 4. *Mangalcoris miniatus*, new genus, new species. A, male hind leg; B, detail of pretarsal structures.

typical of Miridae, in particular: 1) ocelli absent in both sexes (although this may also be linked to the uniformly apterous condition in all life stages); 2) rostrum with an elongated basal segment; 3) ovipositor lanceolate; and 4) trichobothria present on the middle and hind femora. In addition to these classic mirid characters, the following character states are present which also argue for placement in this family: 1) male with asymmetrical parameres; 2) development of a secondary phallotreme and lobate vesica (cf. Kelton, 1959); 3) female internal reproductive system with spermatheca nonfunctional and reduced to a tubular spermathecal gland; 4) lateral oviducts basally with chitinous lining; 5) ventral seminal pouch present (cf. Scudder, 1959; Davis, 1955; Matsuda, 1976); and 6) female ovipositor laciniate with discrete gonopore (cf. Scudder, 1959).

Assuming the present family placement is correct, *Mangalcoris miniatus* runs to the mirid subfamily Cylapinae, tribe Cylapini, in the key provided by Carvalho (1955). The two segmented tarsi and membranous vesica with sclerotised spicules are consistent with this placement in the Cylapinae. The Cylapinae are known to include several brachypterous forms, with most of these in the Fulviini. Members of the latter, however, have an elongate head of very different form to that of *Mangalcoris*, often possess claws with a subapical tooth, and usually have a well-developed collar on the pronotum. By contrast, the tribe Vaniini also contains a number of brachypterous species which show much greater similarities to *Mangalcoris*; these include *Vanniopsis howense* from Lord Howe Island, and *Austrovannius scutica* and *A. xepenehense* from New Caledonia (Cassis et al., 2003); the latter two species live in leaf litter or on fallen logs, an ecology not unlike that of *Mangalcoris*, although not in an intertidal setting.

In addition, the aedeagus of *Mangalcoris* is similar in some respects to that of *Vanniopsis howense*, with a large basal apparatus and a membranous distal section, and also similar in some respects to that of *Kanakamiris krypton* (Cassis & Monteith, 2006), also a member of the Vaniini. This same general ground plan of the aedeagus, but with a more highly spinose distal section, is also seen in the genera *Afrovannius* (Gorczyca, 1997), *Fulvius* (Gorczyca, 1998), and *Xenocylapidius* (Gorczyca, 1999).

We have examined further cylapine material in the ZRC collection of a fungal feeding species provisionally placed near *Rhinocylapus* Poppius, 1909. There are few similarities, indicating that a placement in the cylapine tribe Rhinomirini is not logical, but it is worthy of note that this is the only mirid in the ZRC collection that possesses femoral pit organs similar to those seen in *Mangalcoris*.

In consideration of the above, we assign *Mangalcoris miniatus* to the Miridae, subfamily Cylapinae, without suggesting a firm tribal placement, but with a comment that it will most likely fall into the Vaniini when a broader assessment of cylapine genera is eventually conducted, although it lacks the spatulate parempodia that are a key synapomorphy for the *Vannius* complex (Cassis et al, 2003). We would further note that Cassis et al. (2003) assigned the Vaniini to the Cylapinae as *incertae sedis*, indicating they were not entirely comfortable with this taxonomic placement, and highlighting the uncertain phylogenetic affinities of this entire putative clade of mirid taxa.

Ecological notes. — Among the more aberrant features of *Mangalcoris*, apart from the micropterous condition (which is not uncommon across Miridae as a whole), is the reductional form of the tarsus and pretarsus. The general morphology of the tarsal segments is exactly as illustrated for *Plokiophila* and although the tarsal claws are symmetrical, the single non-central aroliar seta might be considered a step towards asymmetry. We speculate that there may be convergent evolution of character states here, possibly linked to an inverted mode of life. Plokiophilidae inhabit the webs of spiders and Embioptera, and it is possible they are adapted to hang upside down as a result. Similarly, *Mangalcoris* have a distinctive habit of spending all their time on the undersides of timber pieces in mangrove estuaries, and if the piece they occupy is turned upright they quickly retreat to the underside again. They do not emerge to forage on the upper side at night, nor do they move to the top side even if the timber is strongly illuminated from beneath.

Living *Mangalcoris* have been successfully maintained for up to a week in the lab on an inverted agar plate during attempts (so far unsuccessful) to study their feeding behaviour. The aim of these experiments was to test whether they would feed on microbiota introduced when non-nutrient plates were seeded with rotted timber from the natural habitat. Although fungi, nematodes, harpacticoids and other small organisms were available to them, no successful feeding was seen. However, during early stages of such culture they did appear to forage actively and frequently probed the substrate with their stylets. Unfortunately, by the time potential prey had multiplied significantly, the agar surface deteriorated and the bugs became entrapped. Agar is evidently an unsatisfactory substrate for these insects, and they spend a large amount of time cleaning their legs and antennae when confined to it. The general culture technique however, may still prove to be a promising one if an alternative transparent substrate, such as silica gel, is utilised, although this remains to be tested.

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