A redefinition of _Umbrageocoris_ with new species and new combinations (Heteroptera, Lygaeoidea, Geocoridae)

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Abstract

The geocorine (Hemiptera: Heteroptera: Lygaeoidea: Geocoridae) true bug genus *Umbrageocoris* Kóbor, 2019 is redefined based on new morphological information from newly acquired specimens. Two new species are described: *U. boonei* sp. nov. from continental Indomalaya and *U. malipatili* sp. nov. from Australia; two new combinations are proposed: *U. elegantulus* (Distant, 1904), comb. nov., and *U. woodwardi* (Malipatil, 1994), comb. nov. (both transferred from *Geocoris* Fallén, 1814). Keys, diagnoses, and distribution data to the discussed species are provided. Hypotheses on the origin of *Umbrageocoris* and its relationship to other geocorine genera in the region are formulated. New country records: *U. elegantulus* (Papua New Guinea), *U. maai maai* (Thailand, Laos) and *U. woodwardi* (Papua New Guinea).

Key Words

big-eyed bugs, Geocorinae, Hemiptera, key, new placement, species description

Introduction

Geocoridae, commonly known as big-eyed bugs, are a moderately species-rich lygaeoid family exhibiting highly specialized morphology; yet their taxonomy and systematics are poorly understood (Readio and Sweet 1982; Malipatil 1994). Several species are of considerable agricultural importance as predators of various arthropod pests (Sweet 2000; Cassis and Gross 2002; Kóbor 2020). Representatives of the family are distributed in all terrestrial biomes of warm to moderate climate, including extreme habitats, e.g., deserts and high mountains. The largest and most diverse of the currently recognized five subfamilies is the nominotypical Geocorinae, with more than 220 described species in 18 valid genera (Dellapé and Henry 2022).

The recently described *Umbrageocoris* Kóbor, 2019 currently comprises two species, one of them with two subspecies (Kóbor 2019a, b). Representatives of the genus are known to be distributed from New Guinea and New Britain to Borneo and the Malay Peninsula (Kóbor 2019b). The study of materials deposited in collections in Europe and the US has resulted in new knowledge regarding the taxonomy and biogeography of the genus, and is presented in this study.

Methods

Specimens were borrowed from Bernice P. Bishop Museum, Honolulu, USA (BPBM), Muséum National d’Histoire Naturelle, Paris, France (MNHN), Natural History Museum, London, United Kingdom (BMNH), and the Snow Entomological Collections, University of Kansas, Lawrence, USA (SEMC); a paratype of *U. boonei* sp. nov. is deposited in the personal collection of the author (PCPK). Additional comparative material for representatives of the genera *Geocoris* Fallén, 1814, *Stylogeocoris* Mondandon, 1913 and *Germalus* Stål, 1862 were borrowed from the collection of Hungarian Natural History Museum (HNHM) and BMNH.
Results

Taxonomy

Genus Umbrageocoris Kóbor, 2019

Type species. Umbrageocoris kondorosyí Kóbor, 2019, by monotypy.

Redescription. General habitus ovoid, moderately elongate. Integument shiny, with sparse, silvery pubescence at least on abdominal venter. Head pentagonal; compound eyes large, reniform, slightly stylate; posterior edge of compound eyes touching anterior edge of pronotum. Ocular sulcus complete but shallow, slightly visible. Integument of vertex impunctate, with a thin longitudinal furrow of various length, at least present on clypeus. Antenniferous tubercles minute, not visible in dorsal view. Antennomere I shortest, graniform; antennomere II longest, cylindrical; antennomeres III and IV subequal in length; antennomere III cylindrical, antennomere IV fusiform. Clypeus with margins subparallel and apex rounded, surpassing the mandibular plates. Bucculae pointed, surpassing the mandibular plates; ventral margins converging, forming a Y- or cup-shaped labial trough which continues in a suture of variable length towards base of head (Figs 1, 2). Labiomeres I–II conspicuously stouter than labiomeres III–IV; labiomere I not reaching anterior margin of propleurite, labiomere II shorter than labiomere III, apex of labiomere IV reaching or slightly surpassing metacoxae. Thorax. Pronotum trapeziform with anterior edges and margin broadly convex, lateral margin slightly constricted. Integument shiny, deeply punctate; punctuation variably dense. Pronotal calliostoses and humeral angles at most moderately bulging. Scutellum elongate triangular, basal width less than length; variably punctate except at trifurcate carina. Trifurcate carina of scutellum complete or apically reduced. Apex of scutellum sharply pointed. Submacropterous, brachypterous and coleopterous wing morphs known. Submacropterous morph: hemelytron with margins of clavus converging apically, claval commissure reduced, indistinct; corium with lines of punctures along claval margin, Cu, and costal margin; punctuation variably present between M-R and costal margin in the apical half of corium. M-R of corium branching in apical third. Exocorium mostly narrow, sometimes slightly flared in apical half. Membrane at most slightly surpassing apex of abdomen. Metathoracic wing with hamus partly reduced, level of reduction variable (Figs 3, 4); intervannals present, basally fused. Thoracic pleurites and sternites with dense punctuation except prosternal collar, supracoxal lobes and peritremes of metathoracic scent efferent apparatus. Prosternite with a narrow, but conspicuously bulging collar. Peritreme bulbous with dorsal flange protruding, sometimes indented; vestibrar scar present, reaching metasternal venter; evaporatorium reduced to extreme surroundings of peritreme (Figs 5–10). Femora of prothoracic legs more incrassate than those of meso- and metathoracic legs. Legs covered with sparse, decumbent pubescence; fore femora with simple trichobothria in a single line, fore tibia with strong, dense setosity ventrally. Tarsomeres I and III of pro- and mesothoracic legs subequal in length, tarsomere II shortest. Tarsomere III of metathoracic leg conspicuously elongate, longer than combined lengths of tarsomeres I and II. Abdomen. Abdominal tergites III–V rugose medially; sutures of tergites 4/5 and 5/6 strongly curved medially; suture 4/5 elongate nearly reaching suture 5/6 (Fig. 15). Abdominal sternites with rugose spots subdorsally. Abdominal trichobothria on sternites III–IV with simple bothrium bearing a single sensilla, situated submedially, very close to each other in triangular arrangement (Fig. 11); trichobothria on sternites V–VII are subdorsal, either simple bothrium or trichome with microtrichia bearing a single sensilla, arrangement as in Fig. 3B. Genitalia. Posterior opening of male pygophore with pointed, short lateral processes, situated dorsolaterally; paramere with trunk moderately stout and blade slender, evenly curved (Fig. 13); gonoporal process of aedeagus with 10 coils. Female ovipositor short, bisecting only abdominal sternite 7 (Fig. 14). Comparative notes. Umbrageocoris displays a remarkable similarity to the Australian genus Stylogeocoris in general facies [studied species: S. biroi Montandon, 1913 (lectotype, HNHM) and S. elongatus (Distant, 1901) (lectotype and paralectotype, BMNH; non-types, PCPK)]. However, Umbrageocoris can be readily distinguished from the latter genus based on the combination of the following characters: integument of vertex...
Figures 1–4. Exoskeletal characters of *Umbrageocoris*: 1–2. Labial trough (indicated by arrow) of *U. kondorosyi* (1) and *U. malipatili* sp. nov. (2), 3–4. Metathoracic wing (arrow indicates hamus) of *U. kondorosyi* (3) and *U. elegantulus* (4) (images not to scale).
smooth, dorsum of head with a single longitudinal furrow of various extent medially (it might be finely punctate and dorsum of head with arculate grooves anteriad to ocelli in Stylogeocoris); labial through Y- or cup-shaped (V-shaped in Stylogeocoris); labiomere III longer than II (labiomeres II and III subequal in length in Stylogeocoris); margins of clavus converging gradually towards apex, claval commissure absent (margins of clavus subparallel, claval commissure short but distinct in Stylogeocoris); hamus of hemelytron partly reduced (complete in Stylogeocoris); peritreme rounded, evaporatorium reduced to surroundings of peritreme (peritreme auricular, evaporatorium covering most of the metapleurite in Stylogeocoris); sutures of abdominal tergites 4/5 and 5/6 not elongate, apex rounded as in Fig. 15).

Umbrageocoris can be distinguished from representatives of genus Geocoris distributed in the region [studied species: G. ochropterus (Fieber, 1844) (lectotype, BMNH); G. willeyi Kirkaldy, 1905 (syntype, BMNH)] by the combination of following characters: head pentagonal, posterior edge of compound eyes touching anterior edges of pronotum (head luminate, posterior edge of compound eyes encompassing anterior edges of pronotum in Geocoris); pronotum trapeziform with lateral margins slightly constricted medially (semicircular, lateral margins mostly not constricted in Geocoris); trifurcate carina of scutellum distinct, at most apically reduced (slightly distinct to completely reduced in Geocoris); hamus of metathoracic wing at most partly reduced, intervannals present, fused basally (hamus completely reduced and intervannals absent in Geocoris); apex of suture of abdominal tergites 5/6 obtuse (rounded in Geocoris sp., as in Fig. 18).

Umbrageocoris differs from representatives of Germalus [studied species: G. coloratus Distant, 1918 (syntype, BMNH); G. fuscovittatus Malipatil, 2013 (non-type, BMNH); G. victoriae Bergroth, 1895 (lectotype, BMNH)] by the following characters: ocular sulcus complete, but slightly visible (always well-defined in Germalus); labial through Y- or cup-shaped (U- or V-shaped in Germalus); labiomere III longer than II (labiomeres II and III subequal in length in Germalus); margins of clavus converging gradually towards apex, claval commissure absent (margins of clavus subparallel, claval commissure well-developed, distinct in Germalus); hamus of hemelytron partly reduced (complete in Germalus); peritreme rounded, evaporatorium reduced to surroundings of peritreme (peritreme auricular with dorsal supportive process, evaporatorium covering metapleurite and posterior half of mesopleurite in Germalus); sutures of abdominal tergites 4/5 and 5/6 elongated, suture 4/5 almost reaching margin of 5/6 (sutures of abdominal tergites 4/5 and 5/6 very short, strongly obtuse, as in Fig. 17).

**Distribution.** Representatives of the genus are distributed in continental Indomalaya and in the Indo-Australian Archipelago, from Laos to Northeast Australia (Northern Territories, Queensland, New South Wales).

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**Key to the species of Umbrageocoris**

1. Labial trough cup-shaped with suture short, at most reaching middle of venter of head (Fig. 2); hamus of metathoracic wing partly reduced (Fig. 4)..........................................................................................................................................................
   - Labial trough Y-shaped with suture surpassing middle of venter of head (Fig. 1); hamus of metathoracic wing almost complete (Fig. 3)............................................................................................................................................

2. Pronotum with an irregular fuscous marking only at callosities; median furrow of vertex short, not exceeding base of clypeus .............................................................. U. malipatili sp. nov.
   - Pronotum with extended dark brownish to blackish markings, anterior and posterior margins with pale ochraceous transversal bands; longitudinal median furrow extending from apex of clypeus to approximately middle of vertex ......

3. Vertex mostly blackish; transversal band at posterior margin of pronotum only present medially, not reaching humeral angles; dorsal flange of peritreme indented .................................................. U. elegantulus (Distant, 1918), comb. nov.
   - Vertex at most basally blackish; transversal band at posterior margin reaching humeral angles; dorsal flange of peritreme not indented.......................................................................................... U. woodwardi (Malipatil, 1994), comb. nov.

4. Humeral angles with fuscous spots; pronotum with coarse, relatively sparse punctuation, anterior and posterior margin widely impunctate (U. maii ssp.) ........................................................................................................................................
   - Humeral angles undecorated or if pronotum of dark ground colour then with ochraceous marking; pronotum with relatively dense punctuation; anterior and posterior margin narrowly impunctate............................................................................................................................

5. Pronotum anteriad to callosities with a single row of punctures, surrounding callosities; punctures posteriad to callosities forming transversal bands.......................................................................................... U. maii timorensis Kóbor, 2019
   - Pronotum anteriad to callosities with more than one row punctures; pronotum posteriad to callosities evenly punctate ........................................................................................................... U. maii maii Kóbor, 2019

6. Vertex and margins of pronotum dark ochraceous; pronotal callosities separated by multiple punctures ...................................................................................................................
   - Vertex entirely dark brownish or blackish, pronotum blackish with small, ochraceous spot at each humeral angle; pronotal callosities confluent........................................................................... U. kandorosyi Kóbor, 2019
Umbrageocoris kondorosyi Kóbor, 2019
Figs 1, 3, 5, 15

Diagnosis. *U. kondorosyi* can be distinguished from other species of the genus by the entirely blackish pronotum decorated with small ochraceous spots at humeral angles; irregular brownish spots covering most of the corium; confluent pronotal calllosities; and a narrow impunctate band at the posterior edge of pronotum, widened at humeral angles.

Distribution. Distributed across New Guinea and adjacent islands. The species inhabits mostly rainforests, but records from mangroves and grasslands are available too.

Umbrageocoris maai maai Kóbor, 2019
Figs 6, 20, 27


Description. Colouration: Head ochraceous with dark brownish irregular spot at base of eye stalks posteriorly. Antennomere I ochraceous with apex irregularly brownish; antennomeres II and III entirely dark brownish; antennomeres IV dark brownish with apex ochraceous. Labiomeres uniformly ochraceous. Thorax. Pronotum ochraceous with dark brownish punctuation, a dark brownish or dark fuscous transversal band across calllosities and irregular infuscate spot of various extent posteriorly to calllosities. Scutellum entirely dark brownish or blackish. Hemelytra semi-hyaline, ochraceous with dark brownish punctuation and an irregular infuscate spot at apical half of corium. Thoracic pleurites and sternites dark brownish except ochraceous prosternal collar, supracoxal lobes and peritreme. Abdomen dark brownish, undecorated.

Structure. Head. Eyes slightly stylate; ocular sulcus complete, but slightly visible, rather indistinct in apical half; Ocelli situated near ocular sulci, closer to each other than to compound eyes; ratio of ocellar distance to eye ocellus distance: 1: 1.16. Dorsum of head with median longitudinal furrow extending from apex of eye stalks to base of head. Relative lengths of antennomeres: 1.00: 2.40: 1.82: 4.36. Relative lengths of labiomeres: 1.00: 0.57: 0.81: 0.98. Thorax. Pronotum trapeziform with lateral margin not constricted; integument densely and deeply punctate at anterior margin and narrow pronotal calllosities; pronotum length to basal width: 1.00: 1.35. Scutellum with integument densely punctate except slightly bulging, complete triruncate carina; scutellum length to width: 1.00: 1.07. Corium submacropterous, membrane slightly surpassing apex of abdomen; corium punctate along margin of clavus, along Cu and between M-R and costa at apical half; exocorium uniformly narrow at entire length; membrane wrinkled. Thoracic sternites and pleurites densely punctate except narrow prosternal collar.
supracoxal lobes and peritreme. Peritreme bulbous, situated ventrolaterally; dorsal flange with distinct peritremal surface; evaporatorium restricted to surroundings of peritreme. Abdomen. Abdominal venter with sparse, decumbent pubescence; integument of abdominal sternites III-VII corrugate dorsolaterally.

**Measurements** (holotype). Body length: 3.11; head length: 0.62; head width: 1.51; lengths of antennomeres I-IV: 0.14–0.33–0.25–0.60; lengths of labiomeres I–IV: 0.47–0.27–0.38–0.46; pronotum length: 0.83; pronotum width: 1.39; scutellum length: 0.72; scutellum width: 0.79.

**Diagnosis.** *U. boonei* gen. nov. resembles both subspecies of *U. maaai* in colouration and markings. The new species can be distinguished from other representatives of the genus by lacking an impunctate “collar” on the pronotum and its highly extended trifurcate carina on the scutellum.

**Distribution.** The species is known from continental Indomalaya (Laos and Thailand) from the following ecoregions: Kayah-Karen montane rainforests, Luang Prabang montane rainforests, Southern Annamites montane rainforests, Chao Praya freshwater swamp forests, Indochina mangroves.

**Umbrageocoris malipatili** sp. nov.
https://zoobank.org/A5568832-84E7-4502-8741-97398F57F841

Figs 2, 7, 23, 28

**Material examined.** Holotype, f (MNHN): “MUSEUM PARIS / NOUV. GALLES DU SUD / COLL. NOUALHEER 1898”.

**Description.** Colouration: Head ochraceous, posterior part of eye stalks with irregular brownish marking. Eyes reddish, ocelli hyaline. Antennae missing in the single examined specimen. Labiomeres dark ochraceous. Thorax. Pronotum ochraceous with brownish punctuation and an infuscate transversal band across pronotal callosities. Scutellum entirely dark brownish. Hemelytra semi-hyaline, ochraceous with brownish punctuation and an irregular infuscate spot on the corium. Thoracic pleurites and sternites dark brownish except prosternal collar, supracoxal lobes and peritreme; propleurite with an ochraceous spot dorsally. Abdomen dark brownish both dorsally and ventrally with a whitish longitudinal band at dorsal part of sternites.

**Structure:*** Head. Median furrow of vertex short, hardly surpassing base of clypeus. Antennomeres missing. Labial trough Y-shaped with suture reduced,
reaching approximately midline of head. Relative lengths of labiomeres: 1.00: 0.85: 1.32: 1.38. Thorax. Pronotum with dense and deep punctation except anterior margin, pronotal callosities and posterior margin with humeral angles. Pronotal callosities confluent. Pronotum length to basal width: 1.00: 1.76. Scutellum with trifurcate carina apically reduced. Hemelytra submacropterous. Scutellum length to basal width: 1.00: 1.06. Clavus with an incomplete row of punctures at corial margin. Corium punctate along margin of clavus, Cu, between M-R and costa in apical half. Exocorium slightly widened subapically. Membrane short, not surpassing apex of abdomen.

**Measurements.** Body length: 4.20; head length: 0.53; head width: 1.66; lengths of labiomeres I–IV: 0.36–0.30–0.47–0.49; pronotum length: 0.88; pronotum width: 1.54; scutellum length: 0.88; scutellum width: 0.83.

**Diagnosis.** *U. malipatili* sp. nov. resembles *U. boonei* sp. nov. and both subspecies of *U. maai* in colouration and markings, but its cup-shaped labial trough and the presence of a minute furrow on its clypeus readily distinguishes it from the Indomalayan representatives of the genus.

**Distribution.** The single known specimen is from an unknown locality in New South Wales, Australia.

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**Umbrageocoris elegantulus** (Distant, 1904), comb. nov.

**Type material examined.** Lectotype, m (BMNH): circular blue syntype label // circular red type label // “el-elegantulus / Dist. [hw2] // 1903 – 322. // UNSW_ENT 00011372 // BMNH(E) / 1231237 // NHMUK 010591767 // Townsville, Qld / 16.12.02 / F. P. Dodd.”

**Additional material examined.** 1 m (SEMC): “NEW GUINEA: PAPUA / Koitake / 2. X. 1958 / J. L. Gressitt / Collector”.

**Diagnosis.** *U. elegantulus* resembles *U. woodwardi* in general appearance but can be distinguished from the latter species based on the following characters: vertex with extended blackish markings (vertex only marked basally in *U. woodwardi*); dorsal flange of peritreme indented (Fig. 9.) (not indented in *U. woodwardi*).

**Distribution.** The species was recorded from the northern parts of Australia in the following ecoregions: Arnhem...
land tropical savanna, Cape York Peninsula tropical savanna, Queensland tropical rainforests, Brigalow tropical savanna (Malipatil 1994). A specimen from Koitake, New Guinea (Southeastern Papuan rain forest ecoregion) was examined.

Remarks. This species was described as *Geocoris elegantulus* (Distant 1904) and cited as such by subsequent authors (Malipatil 1994; Cassis and Gross 2002). A careful examination of both type and non-type specimens available concluded that the species displays synapomorphies used to define *Umbrageocoris*, including the presence of a median groove on vertex, a Y- or cup-shaped labial trough, and the arrangement of sutures at abdominal tergites 4/5 and 5/6, thus the following new combination is here proposed: *Umbrageocoris elegantulus* (Distant, 1904), comb. nov.

Umbrageocoris woodwardi (Malipatil, 1994), comb. nov.
Figs 10, 24, 28


Diagnosis. U. woodwardi resembles U. elegantulus in general aspect, but it can be distinguished from the latter species based on the combination of the following characters: vertex with dark marking only basally (with more extensive dark markings in U. elegantulus); dorsal flange of peritreme simple (indented in U. elegantulus).

Distribution. Most of the published records of the species are from Western Australia, where the species inhabits Brigalow tropical savanna and Eastern Australian temperate forest habitats (Malipatil 1994). In the material deposited in the BPBM three specimens from the Central Range montane rain forests of New Guinea are present.

Remarks. Based on the specimens available as well as the original description and illustrations provided by Malipatil (1994) the species possesses a combination of characters diagnostic of *Umbrageocoris*, including the presence of a median longitudinal furrow on vertex, a cup- or Y-shaped labial trough, and the arrangement of sutures of abdominal tergites 4/5 and 5/6. The following new combination is accordingly proposed: *Umbrageocoris woodwardi* (Malipatil, 1994), comb. nov.

Discussion

*Umbrageocoris* displays character states shared with at least one of the other three geocorine genera present in the Indomalaya and the Indo-Australian Archipelago, viz., *Geocoris*, *Germalus* and *Stylogeocoris*, but also possesses a number of unique character states, most importantly the shape of the labial trough or the arrangement of suture of abdominal tergites 4/5 and 5/6. The genus was originally described as monotypic with the type species *U. kondorosyi* (Kóbor 2019a); later a second species with two subspecies, *U. maai maai* and *U. maai timorensis*, was added (Kóbor 2019b). An examination of additional materials resulted in the discovery of two undescribed species, *U. boonei* sp. nov. and *U. malipatili* sp. nov. A study of two Australian species formerly included in the species-rich and apparently not monophyletic genus *Geocoris*, *G. elengantulus* and *G. woodwardi*, resulted in the transfer of these species into *Umbrageocoris*.

Members of the genus *Umbrageocoris* apparently can be divided into an Australian and an extra-Australian lineage based on morphological differences. The Australian species (*U. elengantulus, U. malipatili* sp. nov. and *U. woodwardi*) share a shorter median longitudinal furrow on the head, reaching at most the middle of vertex (in non-Australian species this furrow always reaches the base of vertex); a cup-shaped labial trough (Y-shaped in non-Australian species); and a partly reduced hamus of the metathoracic wing (non-Australian species possess an almost complete hamus). Short-winged (brachypterous or coleopterous) and secondarily flightless species occur in all of the Australian species, whilst all known individuals of the non-Australian species are submacropterous. Based on morphological characters, the closest relative of *Umbrageocoris* appears to be *Stylogeocoris*, an endemic Australian genus, albeit the
relationship between the two genera should be examined in frames of a broader phylogenetic reconstruction. *Stylogeocoris* is suspected to be an old, isolated faunal element of Australian lygaeoids with an area shaped by the climatic oscillation in the Tertiary (Slater 1975). According to information available at present, the area of *Umbrageocoris* corresponds to that of *Stylogeocoris*. The presence of wing polymorphism and secondary flightlessness in Australian members of *Umbrageocoris* suggests that these species evolved for a long time in a relatively stable environment, as suggested by Slater (1977). Taking all of the above into account it is suspected that *Stylogeocoris* and *Umbrageocoris* are the members of the same very old fauna and they originate from a common ancestor. This hypothesis should be examined within a broader analysis of the phylogeny and phylogeography of the group.

Medially curved sutures of abdominal tergites 4/5 and 5/6 were proposed as a synapomorphy of the family Geocoridae (Henry 1997). However, the variability of this condition within the subfamilies and genera of the family has not been studied in detail. The present results suggest that this character displays generic level differences in the studied genera. A more extensive study of its taxonomic significance is therefore suggested and planned by the author.

Conclusions

The present work resulted in the redefinition of the genus *Umbrageocoris*, the description of two new species of the genus, and the revision of the generic placement of two species originally placed into the genus *Geocoris*. Based on the new morphological information a hypothesis regarding the origin of *Umbrageocoris* and its relationship to other geocorine taxa in the region was formulated. The comparative study of the sutures of abdominal tergites was proposed as a new exoskeletal character for defining genera in Geocoridae.

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