TWO NEW SPECIES OF *RHAGOVELIA* (HETEROPTERA: VELIIDAE) FROM VIETNAM: FIRST RECORDS OF THE *R. PAPUENSIS* GROUP FROM SOUTH-EASTERN ASIA

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Rhagovelia polymorpha sp. n. and *R. yangae* sp. n. are described from Vietnam. They represent the first records of the *R. papuensis* species group from south-eastern Asia, and form a distinct subgroup, which is named the *R. polymorpha* subgroup.

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The genus *Rhagovelia* Mayr, 1865 has a circum-tropical distribution and is probably the most diverse genus of the Gerromorpha. Because of poor dispersal abilities, many *Rhagovelia* species are endemic to small areas, especially on islands. Consequently, in the Indo-Australian Region the highest species diversities are found in the Philippines, Borneo, Sulawesi, and New Guinea (e.g., Lansbury 1993, Nieser et al. 1997, Polhemus & Polhemus 1988, and Zettel 1994, 1995 & 1996). In comparison with these relatively small areas, which are inhabited by more than 30 species each, the *Rhagovelia* fauna of the whole Asian mainland appears poor. Only four species are known from India (Lundblad 1936, Thirumalai 1994, Zettel 2000) and approximately fifteen species (eight described) from Southeast Asia (Polhemus 1990, Yang & Polhemus 1994, Zettel 2000, 2001 and unpublished data).

Polhemus & Polhemus (1988) made the first attempt to distinguish monophyletic species groups in the Oriental and western Pacific regions. According to that study, only two species groups are distributed on the mainland of Southeast Asia: the *R. sarawakensis* group and the *R. sumatrensis* group. However, *Rhagovelia sumatrensis*, an exceptionally widely distributed species (from India to Lombok in Indonesia), was included in the *R. sarawakensis* group only two years lat-

er (Polhemus 1990), an opinion, which has been followed by Nieser et al. (1997) and Zettel (2000). Except for the species treated in this paper, all described and known undescribed species, which inhabit the mainland of Southeast Asia, belong to the *R. sarawakensis* group. Here, the first records of the *R. papuensis* group from Vietnam and the whole Southeast Asian mainland are presented. Since its first definition by Polhemus & Polhemus (1988), this group was known from two isolated distribution areas, one in Sri Lanka and southern India and a large one from Taiwan to north-eastern Australia, with a gap which is now partly filled by the new discoveries. The two new Vietnamese species form a new subgroup within the *Rhagovelia papuensis* group, whose relationships are discussed.

MATERIAL AND METHODS

Material studied consists of dry-mounted and alcohol preserved specimens. Material was studied with a Leica Wild M10 and a Nikon SMZ800 binocular microscope; studies on parameres were made with a Nikon LABOPHOT-2 compound microscope. Preparation of drawings was done with the help of a camera lucida fixed to these microscopes. Measurements refer to the holotype, the allotype, or the single winged

Figs. 1-9. *Rhagovelia polymorpha*. – 1-2, Male holotype; 1, right hind leg in lateral view; 2, right metafemur in ventral view. – 3-5, Male paratypes; 3, right hind leg in lateral view; 4, right metafemur in ventral view; 5, left paramere. 6-9, Female paratypes; 6, right hind leg; 7, abdomen in dorsal view; 8, apex of abdomen in lateral view; 9, apex of abdomen in ventral view.

specimen, if no variations are given. Measurements of antennomeres and leg segments are given relative to antennomere 2 or to mesofemur, respectively. Other measurements are given in millimetres.

The material is deposited in the following collections:

- NHMW Natural History Museum Vienna, Austria
- ZMHU Zoological Museum, Hanoi University of Science, Vietnam
- ZRC Zoological Reference Collection, National University of Singapore

TAXONOMY

Rhagovelia polymorpha sp. n.
(figs. 1-9, 19)

Type material. – Holotype (apterous ♂) and allotype (apterous ♀): VIETNAM: Ha Tinh province, Vu Quang National Park, Khe Lim, GPS 18°16.416'N 105°26.467'E, 290 m, leg. Tran A.D., 24 April 2003 (ZMHU). – Paratypes: 14♂, 14♀ apterous, same locality as holotype (NHMW, ZMHU, ZRC).

Description

Apterous male. – Body length 3.2 - 3.6 mm (holotype: 3.5 mm); length of second antennomere 0.45 mm; length of mesofemur 1.90 mm.

Colour: body mainly black; pronotum anteriorly completely yellow until proacetabula, posteriorly variably coloured, usually black, but in some specimens with yellowish hind margin, and in smallest specimens uniformly light reddish brown; meso- and metacetabula apically yellow; connexiva (most lateral areas of sternites and laterotergites) usually brown, in smaller specimens yellow; juga, anteclypeus, rostrum, and propisterna mainly yellowish; antenna and legs mainly black, basal half of first antennomere, all coxae and trochanters (except apex of mesotrochanter), basal half of profemur, basal fifth and whole ventral side of metafemur yellow; in small specimens yellow colour slightly more extended, first antennomere nearly completely yellowish, ventral surface of mesofemur yellowish.

Pilosity: body with numerous black, semi-erect setae and with short, appressed yellow pubescence; legs with very long black setae.

Juga with a few black spicula apically; propisterna and mesosternum with numerous black spicula; relative lengths of antennomeres as 2.1 : 1 : 1.3 : 1.3; pronotum long, medially 2.3 times as long as eye, covering mesonotum completely or nearly so; pronotum laterally along hind margin with row of pits; meso- and metapleura with few indistinct pits, with numerous spicula.

Relative lengths of leg segments (relative to mesofemur = 100): profemur 58, protibia 61, protarsus 1+1+15, mesofemur 100, mesotibia 76, mesotarsus 3+30+41, metafemur 97, metatibia 83, metatarsus 4+6+20; meso- and metacoxa with a few black spicula only laterally; metatrochanter with 1-4 small black granules (3 in holotype) ventrally and some black spicula dorsally; metafemora of holotype (figs. 1, 2) strongly incrassate, 2.7 times as long as wide (measured without teeth), on ventral surface strongly armed; in ventral aspect (fig. 2), teeth and granules arranged in four more or less straight rows: two basomedially and two disto-laterally; basal rows consisting of short granules; anterior distal row consisting of 1-3 small granules at base and 7-8 long teeth distally, these subequal in length; posterior distal row consisting of 5-6 short teeth, first tooth moved slightly to posterior surface, second tooth longest, following teeth decreasing in length; in paratypes, metafemur variably incrassate and its armature relatively variable in number and length of teeth, but basic pattern similar in all specimens: metafemur 2.5-3.4 times as long as wide; on ventral view, in bigger specimens, teeth arranged in two lateral rows with 2 distinctively larger teeth at anterior distal part, small granules at basal part arranged in one straight row (in median) and nearly straight

row at internal-lateral side; in smaller specimens (figs. 3, 4), teeth arranged in two lateral rows with 1 larger tooth at the middle part, small granules forming two rows at basal part (fig. 4); metatibia of holotype (fig. 1) stout and strongly curved, on inner side with numerous short teeth, one very long subapical tooth, and two apical teeth; in paratypes, metatibia variable, in bigger specimens strongly to slightly curved, subapical and apical teeth distinctively longer than other teeth, in smaller specimens (fig. 3) nearly straight, with subapical and apical teeth hardly longer than other teeth.

Pregenital segments of abdomen weakly modified, relatively stout; fifth tergite 1.6 times as wide as long; seventh tergite 1.2 times as long as sixth and 1.1 times as long as wide at posterior margin; tergite 7 slightly shining; sternites 2-7 with weakly developed median carina, sternite 7 lateral of carina shallowly impressed.

Genital segments: small and weakly modified; segment 8 small, subcylindrical; pygophore subovate, at hind margin weakly truncate; proctiger relatively slender, baso-laterally weakly dilated; paramere (fig. 5) small, curved dorsad, in lateral view with ventral margin evenly curved, lateral surface set with numerous long setae.

Apterous female. – Body length 3.4-3.6 mm (allotype: 3.6 mm); colour similar as in males, except connexiva orange or yellow, mesofemur ventrally bright to dark yellowish in all specimens; pilosity similar to that in males, except black setae on dorsum of thorax and abdomen mostly absent (only with some setae on connexiva), and yellow short pilosity on tergites and laterotergites sparser; many structural characteristics as in male; hind leg less incrassate and with reduced armature: metatrochanter without granules but with black spicula; metafemur (fig. 6) 4.3-4.6 times as long as wide (4.3 in allotype), basally without rows of granules, posterior distal part consisting of a row of 6-7 teeth of decreasing length (7 in allotype), anterior distal row consisting of 4-5 small granules; metatibia (fig. 6) straight, on inner side without armature.

Abdomen (figs. 7-9) without conspicuous modifications; connexiva evenly and moderately converging; laterotergites sloped laterodorsad; tergites (fig. 7) relatively broad, fifth tergite 1.8 times as wide as long, seventh tergite 1.2 times as long as sixth and as long as wide at anterior margin; eighth tergite approximately 1.6 times as wide as long, with evenly convex hind margin; tergites 7 and 8 and sternite 7 on ventral area shining; in lateral view (fig. 8) posterior end of connexivum rectangular, ventral area of sternite 7 slightly produced caudad (fig. 9); gonocoxa simple, plate-like, mainly exposed (except ventral part); proctiger small, relatively slender, directed straight caudad.

Macropterous morphs. – Unknown.

Figs. 10-18. *Rhagovelia yangae*. – 10-11, Male holotype; 10, right hind leg in lateral view; 11, metafemur in ventral view. – 12-14, Male paratypes; 12, right hind leg in lateral view; 13, right metafemur in ventral view; 14, left paramere. – 15-18, Female paratypes; 15, abdomen in dorsal view; 16, apex of abdomen in lateral view; 17, right hind leg; 18, left fore wing, in situ.

Comparative notes

See Discussion and Comparative notes of the following species.

Etymology

The specific epithet refers to the fact that this species

is extremely polymorphic regarding colour, size, and armature of hind legs.

Distribution

Vietnam: Ha Tinh province, Vu Quang (fig. 19).

Habitats

Rhagovelia polymorpha sp. n. has been found on a small stream in a forested area, with a moderate to slow water flow, in partial shade, bottom with rock or sand.

Rhagovelia yangae sp. n. (figs. 10–19)

Type material. – Holotype (apterous ♂) and allotype (apterous ♀): VIETNAM: Da Nang Province, Ba Na – Nui Chua, GPS: 15°59.615'N 107°59.466'E, 1340 m, leg. Tran A.D., 26 May 2003 (ZMHU). – Paratypes: 9♂, 8♀ apterous, 1♀ macropterous, same locality as holotype (NHMW, ZMHU, ZRC).

Description

Apterous male. – Body length 3.2–3.7 mm (holotype: 3.7 mm); length of second antennomere 0.41 mm; length of mesofemur 1.84 mm.

Colour: body mainly black; pronotum anteriorly with a yellow mark approximately as wide as vertex on head, posteriorly black; all acetabula apically yellow; connexiva (most lateral areas of sternites and laterotergites) usually black, in smaller specimens dark brown; juga, anteclypeus, rostrum, and proepisterna mainly yellowish; antenna and legs mainly black, basal three fourths of first antennomere, all coxae and trochanters (except apex of mesotrochanter), profemur (except apex dorsally), ventral sides of meso- and metafemur, and basal fourth of metafemur yellow; extension of yellow colour slightly varying.

Pilosity: body with numerous black, semi-erect setae and with short, appressed yellow pubescence; legs with very long black setae.

Juga with a few black spicula apically; proepisterna and mesosternum with numerous black spicula; relative lengths of antennomeres as 2.0 : 1 : 1.2 : 1.3; pronotum long, medially 2.4 times as long as eye, covering mesonotum completely or nearly so; pronotum laterally along hind margin with row of pits; meso- and metapleura with a few indistinct pits, with numerous spicula.

Relative lengths of leg segments (relative to mesofemur=100): profemur 58, protibia 62, protarsus 1+1+14, mesofemur 100, mesotibia 79, mesotarsus 3+34+43, metafemur 90, metatibia 80, metatarsus 4+6+19; meso- and metacoxa with few black spicula only laterally; metatrochanter with 1–5 small black granules (3 in holotype) ventrally and some black spicula dorsally; metafemora of holotype (figs. 10, 11) strongly incrassate, 2.6 times as long as wide (measured without teeth), on ventral surface strongly armed; in ventral aspect (fig. 11), teeth and granules only partly arranged in rows: basal half with numerous, mostly dispersed granules; anterior distal row consisting of 5–6 small granules at base and 8 teeth distally, these decreasing in length dis-

tally; posterior distal row consisting of 3–4 relatively widely spaced teeth and 4 closely set teeth near apex; space between distal rows with dispersed granules; in paratypes, metafemur variably incrassate and its armature relatively variable in number and length of teeth, but basic pattern similar: metafemur 2.6–3.2 times as long as wide; on ventral view, in bigger specimens, teeth of different length arranged in two lateral rows at distal part, small granules at basal part arranged in two rows and some not in a distinct row; in smaller specimens (figs. 12, 13), basoposteriorly with row of granules continuing posterior distal row, and baso-anteriorly with granules not arranged in straight row; metatibia of holotype (fig. 10) stout and strongly curved, on inner side with numerous short teeth, one very long subapical tooth, and two apical teeth (fig. 10); in paratypes, metatibia variable, in bigger specimens strongly to slightly curved with 1–2 subapical teeth and 2 apical teeth distinctively longer than other teeth, in smaller specimens (fig. 12) nearly straight, with subapical and apical teeth hardly longer than other teeth.

Pregenital segments of abdomen weakly modified, stout; fifth tergite 2.3 times as wide as long; seventh tergite 1.2 times as long as sixth and 0.9 times as long as wide at posterior margin; tergite 7 slightly shining; sternites 2–7 with weakly developed median carina, sternite 7 lateral of carina shallowly impressed.

Genital segments: small and weakly modified; segment 8 small, subcylindrical; pygophore subovate, at hind margin weakly truncate; proctiger relatively slender, baso-laterally weakly dilated; paramere (fig. 14) small, curved dorsad, in lateral view with ventral margin S-curved, lateral surface set with numerous long setae.

Apterous female. – Body length 3.5–3.8 mm (allotype: 3.7 mm); colour similar as in males, except connexiva lighter brown in some specimens; pilosity similar as in males, except black setae on dorsum of thorax and abdomen and on legs shorter, and short pilosity on tergites and laterotergites less dense; many structural characteristics as in male; hind leg less incrassate and with reduced armature: metatrochanter without granules but with some black spicula; metafemur (fig. 17) 4.1–4.5 times as long as wide (4.4 in allotype), basally without granules, but with 1–2 small teeth in some specimens, posterior distal row consisting of 4–7 teeth of decreasing length (4 and 6 in allotype), anterior distal row consisting of few small granules; metatibia (fig. 17) straight, on inner side without armature.

Abdomen (figs. 15, 16) without conspicuous modifications; connexiva evenly and moderately converging; laterotergites sloped laterodorsad; tergites (fig. 15) broad, fifth tergite 2.0 times as wide as long, seventh tergite 1.1 times as long as sixth and 0.8 times as long as width at anterior margin; eighth tergite approximately 1.8 times as wide as long, with evenly convex

Fig. 19. Localities of *Rhagovelia polymorpha* and *R. yangae* in Vietnam.

hind margin (fig. 15); tergites 7 and 8 and sternite 7 on ventral area shining; in lateral view (fig. 16) posterior end of connexivum rectangular, ventral area of sternite 7 slightly produced caudad; gonocoxa simple, platelike, mainly exposed (except ventral part); proc-tiger small, relatively slender, directed straight caudad.

Macropterous female. – Characteristics similar to those of apterous female; body length (without wings) 3.6 mm; pronotum large, with strongly developed humeri; fore wings (fig. 18) slightly surpassing apex of abdomen, blackish brown, with light stripes at base inconspicuous; metafemur relatively slender, 4.6 times as long as wide, with basal 'row' indicated only by one tooth, distal row consisting of 7 teeth; abdominal carinae reaching base of tergite 3.

Macropterous male. – Unknown.

Comparative notes

Rhagovelia yangae sp. n. is closely related with *R. polymorpha* sp. n. The two species can be distinguished in all morphs by the colour of the pronotum, which has a complete yellow band in *R. polymorpha*, but a yellow transverse patch about as wide as the ver-

tex in *R. yangae*. The colour of the connexiva, although variable in both species, is darker in *R. yangae* than in *R. polymorpha*. The abdomen (in both sexes) is wider in *R. yangae* than in *R. polymorpha* (comp. figs. 7 and 15), but slightly variable in both species. The armature of the metafemur of the males is constantly different: with only two basal rows of granules in *R. polymorpha* (figs. 2, 4) and with more than two rows or completely dispersed granules in *R. yangae* (figs. 11, 13). The shape of the parameres of the two species is diagnostic (figs. 5, 14).

Etymology

This species is gratefully dedicated to Mrs. Yang Chang Man, chief curator of the Raffles Museum of Biodiversity Research, National University of Singapore, for her kind support of the authors' work on South East Asian aquatic bugs.

Distribution

Vietnam: Da Nang Province, Ba Na – Nui Chua Mountain (fig. 19).

Habitats

Rhagovelia yangae sp. n. has been found on a very small stream near the summit of a high mountain (over 1300 m) in central Vietnam. The stream is in shade, with a moderate water flow, bottom with sand and big rocks.

DISCUSSION

The definition of the *R. papuensis* group by Polhemus & Polhemus (1988) was largely followed by Lansbury (1993), Nieser & Chen (1993) and Zettel (1996). Nieser et al. (1997) re-defined the group in a narrower sense by excluding some species from Sulawesi because of the distinctive characteristics of winged specimens. At first glance, the *R. papuensis* group seems to be one of the very ancestral clades in *Rhagovelia*, because similar forms are known from the Neotropical Region and Madagascar and the habitus is similar to the other two genera of Rhagoveliinae, i.e. *Tetraripis* Lundblad, 1936 and *Chenevelia* Zettel, 1996. Because the group is mainly based on plesiomorphic characteristics, – i.e. long pronotum, complete wing venation, relatively long abdominal carinae of macropterous forms, absence of strong pilosity on forewing, and absence of self-mutilation of wings (Nieser et al. 1997) – polyphyly of the group cannot be excluded (Polhemus & Polhemus 1988). On the other hand, most species presently assigned to the *R. papuensis* group have not only very similar general appearances, but they have also numerous morphological characteristics in common, so that a monophyly is not unlikely. However, this must be proven in a

world-wide analysis of species groups.

For the restricted area of the Philippine Islands, Zettel (1996) defined and keyed four subgroups of the *R. papuensis* group: two (*R. luzonica* and *R. agilis* subgroups) are endemic to the Philippines; one (*R. kawakamii* subgroup) is distributed from Taiwan to northern Borneo; and one (*R. cotabatoensis* subgroup) is distributed from the Philippines to Borneo and Sulawesi. Except the two mentioned clades, there are no other forms in Borneo. Regarding the rich *Rhagovelia* fauna of Sulawesi, many species of the *R. papuensis* group should be included in the *R. cotabatoensis* subgroup, but there are some very distinctive species, which probably belong to undescribed subgroups. The rich species diversity east of Weber's Line has not been studied in detail by the authors so far. *Rhagovelia tibialis* Lundblad, 1936 (from southern India) and *R. ceylanica* Lundblad, 1936 (from Sri Lanka and southern India) show no close affinities to each other or to any subgroup from Southeast Asia and the West Pacific islands.

Rhagovelia polymorpha sp. n. and *R. yangae* sp. n. form a distinct subgroup, which is here named the *R. polymorpha* subgroup. It shares several characteristics with the *R. kawakamii* subgroup, which is probably the most closely related clade: stout body; black spicula on juga and proepisterna; common armature of metafemur (figs. 1-4, 10-13); S-curved metatibia of male; and upcurved distal part of paramere (figs. 5, 14). In contrast to the *R. kawakamii* subgroup the following important characteristics are found in the *R. polymorpha* subgroup: light stripe at base of forewing indistinct; meso- and metapleura of thorax with indistinct pits, but with black spicula; metatrochanter of male with reduced number of granules; metatibia of male with subapical spine (only distinct in large specimens, figs. 1, 10), sternites of male with median carina, but not flattened ventrally; genitalia of male small; paramere apically not divided; sternite 7 of female posteromedially with small lobe covering ventral base of gonocoxa (fig. 9). The last characteristic distinguishes *R. polymorpha* sp. n. and *R. yangae* sp. n. from all other studied species of the *R. papuensis* group.

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