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## Contribution to the knowledge of aquatic Heteroptera (Hemiptera) of Greater Sulu, Philippines

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**A b s t r a c t :** This study reports on a short survey of the aquatic Heteroptera fauna (Nepomorpha and Gerromorpha) of the biogeographical subregion Greater Sulu, which has remained almost unstudied so far. Four species of Nepomorpha and 15 species of Gerromorpha are recorded. *Rhagovelia borbei* nov.sp. (Veliidae), a new species related to *R. cotabatoensis* HUNGERFORD & MATSUDA, 1961, is described from the island of Jolo. *Limnometra bruneiensis* MIYAMOTO, 1967, previously considered as an endemic species of Borneo, is now recorded from the Philippines for the first time.

**K e y w o r d s :** Heteroptera, Corixidae, Notonectidae, Mesoveliidae, Hydrometridae, Veliidae, Gerridae, *Rhagovelia*, fauna, new species, new records.

### Introduction

Greater Sulu in the south of the Philippines constitutes a biogeographical subregion of its own (e.g., ONG et al. 2002, HEADS 2013), consisting of the Sulu and the Tawi-Tawi Archipelagoes. Because of its geographical position, its fauna and flora are influenced by both Mindanao and Borneo. In contrast to most other regions of the Philippines, the water bugs (Heteroptera: Nepomorpha, Gerromorpha) of this region were never properly surveyed. Only two chiefly faunistic papers reported some taxa from this area based on the Danish Noona Dan Expedition, which stopped at Tawi-Tawi in October and November 1961 (WOLFF 1966): LANSBURY (1967) published three species records of Nepomorpha from Tawi-Tawi: Micronectidae: *Micronecta quadristrigata* BREDDIN, 1905; Pleidae: *Paraplea sobrina* (STÅL, 1860) (as *Plea sobrina*); Notonectidae: *Anisops tahitiensis* (see note under *Anisops rhomboides*). ANDERSEN (1967) mentioned a very wide-spread veliid from Tawi-Tawi: *Microvelia douglasi* SCOTT, 1874. The area has been avoided by tourists and researchers as it is a centre of piracy, kidnapping and militant Jihadist rebellion (Abu Sayyaf) until today.

During a one-week visit to the archipelago, the first author was able to gain new insights into the water bugs of this region, chiefly from the island of Jolo. Although some interesting habitats were not accessible for safety reasons, the sampled material even includes a new species of *Rhagovelia*. Thus, there are now records of 22 species from this area (six of Nepomorpha and 16 of Gerromorpha).

### Material and methods

The specimens were collected and then preserved in 96% ethanol. Subsequently, part of the material was dry-mounted to facilitate identification, dissections, and species description. The holotype of the new species will be deposited in the Philippine National Museum, Manila. The paratypes and the non-type material will be deposited in the Natural History Museum Vienna, in Ateneo de Manila University, and the second author's reference collection.

#### Sampling localities:

PA08: Sulu, Marungas Island, Hadji Panglima Tahil, N 6°06'07", E 120°57'29", 0 m a.s.l., rocky (volcanic) shoreline.

PA09: Sulu, Jolo Island, Patikul, Anuling, N 6°01'39", E 121°01'01", c. 90 m a.s.l., small, mainly very slow running creek in grassland and coconut plantations; used by the residents for bathing and washing of clothes; some fast sections of the creek shaded by *Ficus* trees.

PA10: Sulu, Jolo Island, Patikul, Tanduh Bagua, Family Beach, N 6°05'14", E 121°02'06", 0–10 m a.s.l.; rocky portion of the beach mainly of dead coral rocks; once a port of the infamous Abu Sayyaf, nowadays the area is a hangout and picnic area for locals.

PA11: Sulu, Jolo Island, Jolo Airport, N 6°03'12", E 121°01'11", c. 50 m a.s.l., pond, banks vegetated with grass.

PA12: Sulu, Jolo Island, Indanan, Camp Bud Datu, N 6°01'32", E 120°59'55", c. 190 m a.s.l., pool of a rain catchment, shaded by trees; water murky and full of decomposing leaves; a tourist spot and military camp.

PA13: Tawi-Tawi, Bongao Island, Bud Bongao Peak, N 5°01'01", E 119°44'43", c. 280 m a.s.l.; a man-made concrete pool, the water source of the park and a very small spring in a forested area.

For taxon list, within each family, the species are arranged alphabetically. Specimens of nymphs are not listed.

The description of the new species follows previous studies by ZETTEL et al. (2020) and (ZETTEL & LACINY 2021). Measurements are given in millimetres.

### List of species

#### Nepomorpha

##### Corixidae

##### *Agraptocorixa hyalinipennis* (FABRICIUS, 1803)

Material examined: PA12, 2 males, 6 females.

Distributional notes. This is a widely distributed species from India to New Guinea, including few records from the Philippines (CHEN et al. 2005).

## Notonectidae

### *Anisops nasutus* FIEBER, 1851

Material examined: PA11, 1 female.

Distributional notes. *Anisops nasutus* is widely distributed from India to Australia (CHEN et al. 2005). However, it seems uncommon in the Philippines, with few records from Bohol, Mindanao (NIESER et al. 2008, ZETTEL et al. 2012), and Camiguin (unpublished).

### *Anisops rhomboides* NIESER & CHEN, 1999

Material examined: PA12, 1 male, 3 females.

Distributional notes. *Anisops rhomboides* is a West Malesian species and has been so far recorded from Borneo, Sulawesi, and the Philippines (CHEN et al. 2005). Philippine records are sparse: Leyte, Mindanao, Mindoro, Palawan, and Tawi-Tawi (ZETTEL 2003a, ZETTEL et al. 2012, PELINGEN et al. 2020). The record from Tawi-Tawi was previously published under the name *A. tahitiensis* by LANSBURY (1967; nec *tahitiensis* sensu LUNDBLAD 1933) (see NIESER & CHEN 1999).

### *Anisops stali* KIRKALDY, 1904

Material examined: PA12, 1 male, 3 females.

Distributional notes. *Anisops stali* is distributed from the Philippines and Java in Indonesia eastwards to Australia (CHEN et al. 2005). Records from the Philippines are rare: Luzon, Mindoro, Negros, Cebu, and Mindanao (summarized by ZETTEL et al. 2012).

## Gerromorpha

### Mesoveliidae

#### *Mesovelia* cf. *horvathi* auct.

Material examined: PA12, 3 apterous males, 3 apterous females.

Notes. This species was previously treated under the name *Mesovelia horvathi* LUNDBLAD, 1933 (e.g., GAPUD 1986, FREITAG & ZETTEL 2012, ZETTEL 2014). However, in a recent study on the Indian fauna (JEHAMALAR et al. 2019), more details about this taxon – originally described from Java – became known, so that Philippine populations probably belong to one or several undescribed species (see also PELINGEN et al. 2020).

#### *Mesovelia vittigera* HORVÁTH, 1895

Material examined: PA11, 1 apterous male, 1 apterous female.

Distributional notes. This species is widely distributed in the tropics and subtropics of the Old World, from Africa to Australia and New Caledonia. However, genetic differences indicate that at least the easternmost populations may belong to another species (DAMGAARD et al. 2012).

## Hydrometridae

### *Hydrometra lineata* ESCHSCHOLTZ, 1822

**Material examined:** PA09, 1 macropterous male; PA11, 1 macropterous male, 1 macropterous female, 2 brachypterous females.

**Distributional notes.** This species has a wide distribution all over the Philippines (comp. GAPUD et al. 2003), and is also known from China, northern Borneo, and eastern parts of Indonesia (POLHEMUS & POLHEMUS 1995, YANG & ZETTEL 2005).

### *Hydrometra mindoroensis* POLHEMUS, 1976

**Material examined:** PA12, 2 micropterous males, 1 micropterous female.

**Distributional notes.** This species widely is distributed all over the Philippines (comp. GAPUD et al. 2003) and is also known from northern Borneo, Sulawesi, and New Guinea (POLHEMUS & POLHEMUS 1995, YANG & ZETTEL 2005).

## Veliidae

### *Halovelia bergrothi* ESAKI, 1926

**Material examined:** PA10, 8 males, 6 females.

**Distributional notes.** This species has a wide distribution in the Philippines – with previous records from Palawan, Mindoro, Luzon, Marinduque, Panay, Siquijor, Biliran, and Mindanao, and unpublished records from Polillo and Cebu. It is also known from Vietnam, Papua New Guinea, the Solomon Islands, New Caledonia, the Mariana Islands, the Caroline Islands, the Marshall Islands, and the Samoan Islands (ANDERSEN 1989, ZETTEL 1998, 2003).

### *Halovelia esakii* ANDERSEN, 1989

**Material examined:** PA10, 2 males, 3 females.

**Distributional notes.** This species is widely distributed in the Philippines; with previous records from Palawan, Mindoro, Luzon, Marinduque, Panay, and Mindanao and unpublished records from Negros, Bantayan, Cebu, Olango, and Panglao; it is also known from Indonesia, the Solomon Islands, and the western Caroline Islands (ANDERSEN 1989, ZETTEL 1998, 2003b).

### *Microvelia leveillei leveillei* (LETHIERRY, 1877)

**Material examined:** PA12, 22 apterous males, 3 macropterous males, 27 apterous females.

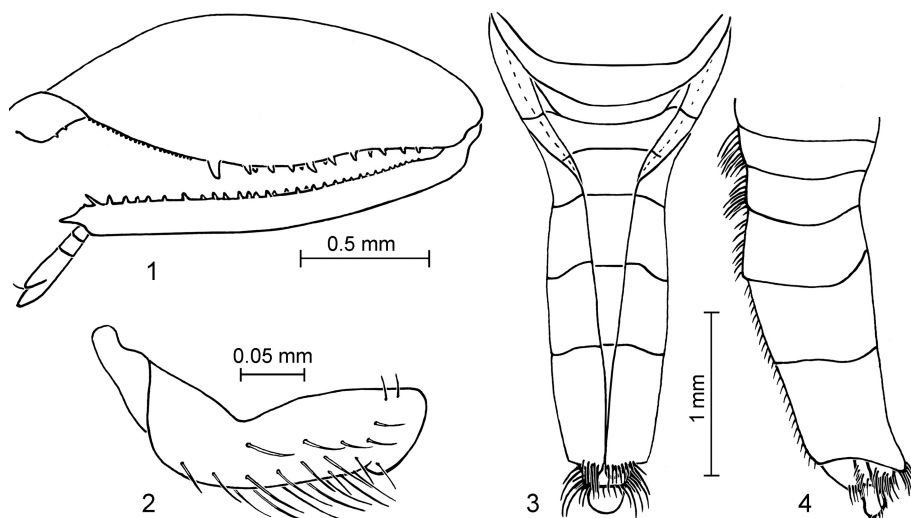
**Distributional notes.** This is a common species of stagnant water. The nominotypical subspecies has a wide distribution from India to the southern parts of China, the Philippines and the Lesser Sunda Islands (CHEN et al. 2005).

### *Rhagovelia borbei* nov.sp. (Figs 1–4)

**Etymology.** The new species is dedicated to Mr. Ian Borbe, who ensured the safety of the first author during his stay in the Sulu Archipelago.

**Type material.** Holotype (apterous male) and paratypes (1 apterous male, 5 apterous females, 2 macropterous males, 3 macropterous females) from locality PA09.

**Diagnosis.** Gracile species; body length (excluding wings) ca. 3.7–4.5 mm. Pronotum of apterous morph with a lobe covering mesonotum. Jugal at posterior region, a broad stripe anteriorly on propleuron and entire proepisterna with small black spinulae. Colour chiefly black. Head black, except labrum, juga, and rostrum (without apex) yellow. Prothorax yellow, but pronotal lobe except the narrow yellow margins black to blackish brown; coxae, trochanters, base and underside of pro- and metafemur yellow. – Male. Hind leg (Fig. 1): Metatrochanter with a few short denticles. Metafemur strongly enlarged (much less so in winged specimens); flexor side at basal third with dense, regular row of short denticles; distal two thirds with row of ca. 11 teeth of decreasing length; a broad area anterior (ventral) of these structures with irregular short dentition. Metatibia almost evenly curved, flexor side densely dentate, with an apical and a subapical tooth. Genitalia of moderate size. Paramere (Fig. 2) small, with almost straight distal part bearing a small, ventrally curved, blunt lobe. Proctiger slender, with weakly protruded lateral wings. – Female. Basal half of metafemur without or with 1–5 minute teeth; distal row consisting of 6–9 teeth of decreasing length, the first one usually strongly curved. Gonocoxa 1 with straight ventral outline. Proctiger directed posteriorly. Long, black pilosity on posterior part of gonocoxa 1, posterodorsal corner of sternum 7, laterotergite 8, and sides of tergite 8. – Apterous female. Abdomen (Figs 3, 4) curved dorsad, sides strongly converging anteriorly, very narrow posteriorly; posterior sterna curved dorsally over tergites, sides of sternum 7 touching in middle and covering tergite 7, or nearly so.



**Figs 1-4:** *Rhagovelia borbei* nov.sp.: (1) hind leg of apterous male (holotype). (2) Left paramere of male (holotype). (3) Abdomen of apterous female (paratype), dorsal aspect. (4) Same, lateral aspect. (Pilosity omitted in 1, partly omitted in 3 and 4.)

**Description of apterous male.** Measurements of holotype: Body length 3.72; maximum body width (at metapleura) 1.33. Head length 0.35, width 0.80; minimum eye distance 0.18. Pronotum length 0.85, width 1.22. Lengths of antennomeres, I 0.84, II

0.57, III 0.57, IV 0.49. Lengths of leg segments: profemur 1.02, protibia 1.14, protarsus  $0.03 + 0.03 + 0.24$ , mesofemur 1.73, mesotibia 1.38, mesotarsus  $0.07 + 0.44 + 0.72$ , metafemur 1.66, metatibia 1.60, metatarsus  $0.07 + 0.11 + 0.37$ .

Measurements of paratype ( $n = 1$ ): Body length 3.66; maximum body width (at metapleura) 1.31. Head width 0.79. Pronotum length 0.84, width 1.21.

Colour: Chiefly black. On head, labrum, juga, and rostrum (except apex) yellow. First antennomere with yellow basal half. Prothorax mainly yellow; yellow stripe at foremargin of pronotum uninterrupted (or with faint brownish midline), laterally narrowly connected with yellow propleura; pronotal lobe except the narrow margins black to blackish brown. Meso- and meta-acetabula partly yellow. All coxae and trochanters yellow; base and underside of pro- and metafemur yellow; mesofemur with a small yellowish-brown dot at base. Laterotergites and sterna laterally with narrow yellow stripe. Medial part of sternum 7, ventral parts of segment 8, and genitalia brown.

Pilosity: Dorsum of head and thoracic nota with long, curved, black setae; sides of thorax almost bare. Abdominal tergites with rather long black oblique setae. Laterotergites with short pilosity, but each with a single long seta close to apex of margin. Sterna with numerous long setae; ventral part with dense brush of oblique setae, notably on sides of sternum 7.

Structures: Head broader than anterior margin of pronotum. Juga flat, strongly inclined, moderately broad, apically with spinulae. Pronotum long, with a well-developed pronotal lobe, along midline about 2.5 times as long as head. Mesonotum not visible. Proepisterna bearing numerous small black spinulae. Propleuron with a broad anterior area bearing numerous spinulae, with dense row of black pits near hind margin; mesopleuron with scattered similar pits, metapleuron with few pits.

Profemur on extensor side lacking distinct concavity. Coxae and trochanters lacking black spinulae. Metatrochanter with several small denticles of different size. Hind femur (Fig. 1) strongly enlarged, dentition on flexor side rich: at basal third with straight, dense, almost regular row of ca. 20 minute denticles; distal two thirds with row of ca. 11 teeth of decreasing length, the first one not conspicuously long; a broad area anterior (ventral) of these structures with irregular short dentition. Metatibia almost evenly curved, flexor side densely dentate, with some longer teeth in apical fourth, with an apical and a subapical tooth.

Laterotergites strongly inclined. Anterior tergites strongly, posterior tergites slightly convex. Tergite 7 about 1.5 times as long as tergite 6, and 0.8 times as long as broad, shiny. Dorsal part of segment 8 similarly shiny. Sterna without median carina; sternum 7 posteriorly with large, hairless, half-ovate depression. Proctiger slender, with hardly protruded lateral wings. Paramere (Fig. 2) small, with almost straight distal part bearing a small, blunt, ventrally curved apical lobe.

**Description of apterous female.** Measurements ( $n = 5$ ): Body length 3.98–4.15; maximum body width (at metapleura) 1.41–1.46. Head width 0.78–0.80. Pronotum length 0.82–0.93, width 1.26–1.29.

Colour: similar to apterous male. Yellow stripe laterally on sterna posteriorly narrowed and rather brownish, almost lacking on sternum 7; yellowish-brown colour of medial parts of abdominal sterna more extended anteriorly in most specimens.

Pilosity of head and thorax similar as in male, on abdomen largely reduced except on apex.

Tergites 1–2 with short, grey, appressed pubescence; tergite 1 with some black standing setae; tergites 3–6 bare; tergite 8 completely beset with long black, chiefly posterolaterally directed setae. Laterotergites at margin with stripe of short pubescence, mesally bare. Sterna in middle with oblique setae, sterna 3 and 4 with conspicuous tufts of long setae, the following ones with scattered setae of decreasing length; posterodorsal corners on sternum 7 with tufts of long black setae. Gonocoxa 1 with short pilosity and dense, long setae in front of hind margin.

Structures: Head and thorax similar as in apterous male. Fore and middle leg (including mesofemur) unmodified. Metatrochanter with one, rarely up to four short denticles. Metafemur much more slender than in male, dentition of flexor side less developed: basal half of metafemur without dentition or with 1–5 minute teeth, a basal row of minute denticles, as present in male, lacking; distal row consisting of 6–9 teeth of decreasing length, the first one usually strongly curved; more anteriorly (ventrally) 4–5 denticles, more or less arranged in a row. Metatibia almost straight, dentition on flexor side much weaker than in male.

Abdomen (Figs 3, 4) elongated and curved dorsad; sides strongly converging anteriorly, very narrow posteriorly. Tergites 1–2 strongly convex, the following ones flat and narrow; tergite 5 almost twice as long as anteriorly wide; tergite 6 almost triangular (with very narrow hind margin); tergite 7 usually totally covered by sterna; tergite 8 directed posteriorly. Posterior sterna curved dorsally over tergites, sides of sternum 7 touching in middle and covering tergite 7, or nearly so; connexival corner strongly protruded, its apex rounded. Gonocoxa 1 with straight ventral outline; surface slightly concave. Proctiger directed posteriorly.

**Description of macropterous male.** Measurements ( $n = 2$ ): Body length 3.82–3.87; maximum body width (at pronotum) 1.51–1.58. Head width 0.80–0.81. Pronotum length 1.39–1.42.

Colour: Similar to apterous male. Forewing blackish, with 1–2 whitish streaks at base.

Pilosity on head, thorax, and sterna similar as in apterous male. Basal and lateral (anterior) veins of forewing with rows of rather short setae.

Structures: Head and thorax sides similar as in apterous male. Pronotum large, with protruding humeri. Forewing with four closed cells reaching distal fourth; dealate specimens unknown. Metafemur distinctly more slender and with narrower ventral area of denticles when compared to apterous male, basal row of denticles slightly longer; distal row of teeth of similar armature. Metatibia moderately curved, with moderate dentition at flexor side, subapical tooth indistinct.

**Description of macropterous female.** Measurements ( $n = 3$ ): Body length 3.98–4.45; maximum body width (at pronotum) 1.44–1.63. Head width 0.78–0.83. Pronotum length 1.38–1.50.

Colour: Similar to apterous female. Forewing blackish, with whitish streaks at base. Yellow lateral stripes on posterior sterna not reduced.

Pilosity: Setae on abdomen similar as in apterous female. Setae on forewing veins as in macropterous male.

Structures: Head and thorax sides similar as in apterous female. Pronotum and forewings as in macropterous male. Hindleg structures similar as in apterous female. Abdomen

broad, not upcurved; connexiva subparallel; sterna not curved over tergites; connexival corner more weakly protruded. Tergite 8, gonocoxa, and proctiger as in apterous female.

**Comparative notes.** *Rhagovelia borbei* nov.sp. is a species of the *R. papuensis* group, *R. cotabatoensis* subgroup (sensu ZETTEL 1996). The strongly converging connexiva of the apterous female are similar to that of *R. cotabatoensis* HUNGERFORD & MATSUDA, 1961 and *R. graindli* ZETTEL, 2012, but the dense, long pilosity at the apex of the female's abdomen immediately distinguishes the new species. Females of *R. tsouloufi* NIESER, ZETTEL & CHEN, 1997 from Salebabu Island (Talaud Archipelago, Indonesia) have a similar pilosity, but apterous specimens can be immediately distinguished from *R. borbei* nov.sp. by long, erect setae on connexivum 6, a straight, not upcurved abdomen, and a petiolate metafemur; in addition, this species lacks black spinulae on juga and propisterna (males and females) (compare to description in NIESER et al. 1997). In males, the ventroapical lobe of the paramere of this new species differs from the corresponding hook- or lobe-like structures of *R. cotabatoensis* and *R. graindli*.

## Gerridae

### *Halobates proavus* BUCHANAN-WHITE, 1883

**Material examined:** PA08, 6 apterous males, 5 apterous females.

**Distributional notes.** This species is widely distributed in the Philippines, and from the Andaman Sea to Vanuatu (ROMÁN-PALACIOS et al. 2018).

### *Limnogonus fossarum fossarum* (FABRICIUS, 1775)

**Material examined:** PA11, 1 apterous male, 3 macropterous males, 1 macropterous female.

**Distributional notes.** This is a common species in the Oriental and West-Pacific Realms. The nominotypical subspecies is distributed on the Asian mainland, Sri Lanka, southern Japan, Taiwan, Sumatra, northern Borneo, and the Philippines (ANDERSEN 1975, 1995).

### *Limnogonus hungerfordi* ANDERSEN, 1975

**Material examined:** PA09, 1 apterous male, 2 apterous females.

**Distributional notes.** This species is widely distributed in the Philippines. Its general distribution ranges from the Malay Peninsula westwards to New Guinea and north-eastern Australia (ANDERSEN 1975, 1995).

### *Limnometra bruneiensis* MIYAMOTO, 1967

**Material examined:** PA09, 1 macropterous female; PA12, 3 macropterous males, 3 macropterous females.

**Notes.** *Limnometra bruneiensis* was originally described from Brunei (MIYAMOTO 1967) and later recorded from other parts of Borneo (NIESER & CHEN 1992). It has never been recorded from the Philippines before. It can be distinguished from Philippine congeners by its combination of small size, slender build, dense pilosity on the flexor side of the male's profemur, a short but distinct third mesopleural stripe, and partly white antennomeres 3 and 4. Specimens from Jolo differ from those found on northern Borneo (Sabah, Malaysia) deposited in the Natural History Museum Vienna by dark (not whitish) apices



of the meso- and metafemora and slight differences in the lateral sclerite of the vesicula of males. Possibly, *L. bruneiensis* is a species complex, but more material from various parts of Borneo would be needed to draw conclusions. It is notable that macroptery in this species suggests good dispersal ability.

#### ***Limnometra ciliata* MAYR, 1865**

**M a t e r i a l   e x a m i n e d :** PA12, 1 apterous female.

Distributional notes. This is a species widely distributed in the Philippines, and from Thailand eastwards to the Fiji Islands and Guam (ANDERSEN 1995, ZETTEL & CHEN 2000).

#### ***Limnometra femorata* MAYR, 1865**

**M a t e r i a l   e x a m i n e d :** PA09, 2 macropterous females; PA12, 2 macropterous males, 5 macropterous females; PA13, 2 macropterous females.

Distributional notes. In the Philippines, this species is distributed, but uncommon. It was also recorded from Banggi Island offshore northern Borneo, Taiwan, and the Ryu-kyu Islands of Japan (ANDERSEN 1995, ZETTEL & CHEN 2000); previous records from Peninsular Malaysia, Sumatra, and Borneo refer to *L. spinosa* ZETTEL, 2002 (see ZETTEL 2002).

#### ***Rhagadotarsus kraepelini* BREDDIN, 1905**

**M a t e r i a l   e x a m i n e d :** PA09, 2 apterous males; PA11, 3 apterous females; PA12, 4 apterous males, 3 apterous females.

Distributional notes. This species is wide spread in the Oriental Region and Malesia, from Sri Lanka and South India eastwards to southern China and New Guinea (POLHEMUS & KARUNARATNE 1993); it is also probably widely distributed in the Philippines.

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### **Zusammenfassung**

Wir berichten über eine Erhebung der Wasserwanzenfauna (Nepomorpha und Gerromorpha) der biogeografischen Region Greater Sulu der Philippinen, welche bisher nahezu nicht untersucht war. Vier Arten der Nepomorpha und 15 der Gerromorpha werden nachgewiesen. *Rhagovelia borbei* nov.sp. (Veliidae), die mit *R. cotabatoensis* HUNGERFORD & MATSUDA, 1961 verwandt ist, wird von der Insel Jolo neu beschrieben. *Limnometra bruneiensis* MIYAMOTO, 1967, eine Art, die bisher als Endemit Borneos galt, wurde erstmals für die Philippinen festgestellt.

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