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RESEARCH PAPER

The genus *Xenobates* (Hemiptera: Veliidae) in the Philippines: overview and description of two new species

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Abstract. The Philippine species of *Xenobates* Esaki, 1927 are reviewed, with the exception of the *Xenobates argentatus* complex. Two species are described as new: *Xenobates nypicola* sp. nov. and *X. riedli* sp. nov. The presence of *Xenobates murphyi* Andersen, 2000 in the Philippines is confirmed. The taxonomically unresolved *Xenobates argentatus* complex is represented in the Philippines by at least six morphologically very similar species, but the typical *X. argentatus* Andersen, 2000, a species described from Thailand, must be excluded from the Philippine fauna. An identification key to the hitherto described species of the Philippines is provided. All species are illustrated. *Xenobates* species inhabit a wide variety of mangrove habitats along the Philippine coasts; *Xenobates nypicola* sp. nov. typically inhabits coastal swamps with *Nypa fruticans*.

Key words. Hemiptera, Heteroptera, Veliidae, Haloveliinae, *Xenobates*, new species, taxonomy, mangrove, Philippines, Oriental Region

Zoobank: http://zoobank.org/urn:lsid:zoobank.org:pub:71F65F83-C39D-470A-9483-107C527E4FD9

Introduction

Haloveliinae presently consist of six genera, of which two inhabit freshwater and four various coastal habitats. Among the marine Haloveliinae, *Xenobates* Esaki, 1927 is most poorly studied. Considering described as well as several undescribed species, its known distribution area ranges from Sri Lanka to New Caledonia (Andersen 2000) and hitherto 21 species have been described (Andersen 2000, Polhemus & Polhemus 2006). The lack of a thorough taxonomic revision of *Xenobates* was caused by the untimely passing of Dr. Nils Møller Andersen of the Zoological Museum Copenhagen in 2004 (Spence & Damgaard 2008), as he had worked on this project for about a decade. Published results of Andersen's studies remain fragmentary, dealing mainly with the fauna of Australia (Andersen & Weir 1999) and the Malay Peninsula (Andersen 2000). At the end of 2004, the species-rich material of *Xenobates* collected by the first author in the Philippines and loaned to N. M. Andersen was returned from Copenhagen to the Natural History Museum Vienna. This material and several subsequent collections are the basis of this study.

In 2005, the third author received a grant from the Austrian Exchange Service (ÖAD) for a research visit to the Natural History Museum Vienna and taxonomic training. A revision of the Philippine *Xenobates* material was the main goal. As this project turned out to be more complicated than expected, with more and more specimens having been collected and more types of almost all *Xenobates* species loaned from various institutions, it could not be finished during the three months of the research stay. The work was thus interrupted and only recently completed in a reduced format, resulting in the manuscript at hand.

In this paper we present an overview of the Philippine *Xenobates* fauna, which consists of three species plus a hitherto not fully resolved species complex. Two species have been recorded from the Philippines in the past by

Andersen (2000): *Xenobates murphyi* Andersen, 2000 from Cebu Island and *X. argentatus* Andersen, 2000 from Palawan and Mindanao. The type localities of these species lay in Singapore and south Thailand, respectively. The presence of *X. murphyi* in the Philippines is hereby confirmed, but *X. argentatus* was identified as a complex of numerous very similar species. The studied material from the Philippines alone consists of approximately six morphospecies with partly allopatric and partly sympatric distribution. In an ecological study on the marine Hemiptera of Badian, Cebu Island, Bendanillo et al. (2016) recorded two unidentified species of *Xenobates*. A taxonomic study on Philippine *Xenobates* was not carried out previously.

Diagnoses and differential diagnostic characteristics of *Xenobates* were published, e.g., by Andersen & Weir (1999), Andersen (2000) and Chen et al. (2005); the latter work also summarized the scarce biological information. Habitat notes on all described species refer to tree mangroves (e.g., Lansbury 1989, Andersen & Weir 1999, Andersen 2000). However, one Philippine species (*Xenobates nypicola* sp. nov.) was collected in great numbers in coastal *Nypa fruticans* Wurmb swamps (Arecaceae). Such habitat preferences distinguish the "mangrove bugs", genus *Xenobates*, from the two other marine genera of Haloveliinae, which also occur in the Philippines in a considerable number of species: The coral bugs, genus *Halovelia* Bergroth, 1893, inhabit coasts with both coral rocks and sea grass meadows. Species of *Haloveloides* Andersen, 1992 can be found in various habitats including rocky sea shores and mixed-water sections of streams and rivers including lotic sections of river mangroves (e.g., Andersen 1992; Zettel 2003, 2006), but not (as *Xenobates*) in the quiet areas of mangroves.

Material and methods

This taxonomic study is based on 758 specimens of three species chiefly collected by Mr. Clister Pangantihon MSc, the first and the third author in many parts of the Philippines. More than 2000 specimens of the *X. argentatus* complex were not considered in this study, as well as all immatures, which were occasionally present in the samples. Most specimens collected by Mr. Pangantihon and the first author were killed in ethyl-acetate vapour and then dry mounted on paper cards. Some specimens of larger series were preserved secondarily, after softening, in 70% ethanol. The material collected by the first author is shared between NHMW and UPLB, that by Mr. Pangantihon shared between ZCVA and UPLB. Specimens of the third author will be deposited in USC. The holotypes will be sent to PNM, some reference specimens will be given to NMPC, ZMUC and ZRC on an exchange basis.

Most of the material was collected at a time when it was not common practice to collect GPS data in the field. The locality data usually include the names of island, municipality, and barangay (smallest administrative unit).

List of repositories:

NHMW	Natural History Museum, Vienna, Austria;
NMPC	National Museum, Prague, Czech Republic;
PNM	Philippine National Museum, Manila, Philippines;
UPLB	Museum of Natural History, University of the Philippines, Los Baños, Laguna, Philippines;
USC	University of San Carlos, Cebu City, Philippines;
ZCVA	Herbert Zettel Collection, Vienna, Austria;
ZMUC	Zoological Museum, University of Copenhagen, Denmark;
ZRC	Zoological Reference Collection, Lee Kong Chian Natural History Museum, National University of Singapore (NUS).

Terminology of morphological structures follows Andersen (2000) and previous publications by the first author (e.g., Zettel 2006). A Leica WILD M10 binocular microscope (magnifications up to 128×) was used to examine specimens, take measurements, and prepare verbal descriptions.

Measurements (in millimetres) refer to the maximum length or width of the respective structure, if not stated otherwise.

Description and acronyms of characters measured and indices computed:

AI	antenna index: length of antenna / body length (♂ and ♀);
AL	total length of antenna (♂ and ♀);
BL	body length (♂ and ♀);
BLI	average of body lengths of females / average of body lengths of males;
BW	maximum body width (♂ and ♀);
MfHI	mesofemoral hair index: length of longest seta on anterior face of mesofemur / maximum femur width (♂ and ♀);
MfHL	mesofemoral hair length: length of longest seta on flexor face of mesofemur (♂ and ♀);
MLI	middle leg index: length of mesofemur + mesotibia + mesotarsus in relation to body length (♂ and ♀);
MpHI	mesopleural hair index: length of longest seta dorsally on mesopleuron in relation to median pronotal length (♀ only);
MpHL	length of longest seta dorsally on mesopleuron (♀ only);
MPnL	median pronotal length (♀ only);
MsfL	mesofemur length (♂ and ♀);
MsfW	maximal mesofemur width (♂ and ♀);
MtsfWI	maximal metafemur width / maximum mesofemur width (♂ and ♀);
MsTaI	mesotarsal index: length of mesotarsus / length of mesotibia (♂ and ♀);
MtaL	mesotarsus length (♂ and ♀);
MtfW	maximal metafemur width (♂ and ♀);
MtiL	mesotibia length (♂ and ♀).

As a rule, five randomly selected specimens of a sex are taken from each of those localities, which are noted in the paragraph "measurements" with the sign "#", followed by the number given in the material sections. In the collection of NHMW, the specimens used for measurements are marked with a round orange paper label.

Images. Stacked digital images (Figs 1–8) were taken with a Leica DFC450 camera attached to a Leica Z16APO optics carrier, using Leica Application Suite V3.8. Images were stacked with ZereneStacker 64-bit and processed with Adobe Photoshop 7.0.

Drawings (Figs 9–20, 23–26) were made using a camera lucida fixed to a Leica WILD M10 binocular microscope. Drawings of the parameres (Figs 21, 22) were made with an OLYMPUS BX40 microscope with a camera lucida at a magnification of 400×.

Taxonomy

Haloveliinae Esaki, 1930

Key to the genera of Haloveliinae

(modified from Andersen 1992)

1 Eyes very large, interocular width smaller than half of head width. Antennomere 1 shorter than 3. Protibia of male without grasping comb. Freshwater species. .. 2
– Eyes small to moderate in size, interocular width at least as large as half of head width, often much larger. Antennomere 1 in most species longer than 3. Protibia of male with or without grasping comb. Marine species (also in estuaries). 3
2 Body with yellow marks. Antennomere 2 longer than 1. Metatarsomeres subequal in length. .... ***Strongylovelia*** Esaki, 1924
– Body without yellow marks. Antennomere 2 shorter than 1. Metatarsomere 1 about half as long as 2. (No records from the Philippines.) .... ***Entomovelia*** Esaki, 1930
3 Eyes moderate in size, interocular width smaller than two thirds of head width. Pronotum in most species with pale markings (Figs 1–8). Protibia of male without grasping comb. 4
– Eyes small, interocular width larger than two thirds of head width. Pronotum in most species entirely black, rarely with small reddish markings. Protibia of male with grasping comb. 5
4 Mesofemur length less than 0.9 times body length. Mesotarsus length less than 0.4 times mesotibia length. In most species with rich pale colour and spots of silvery pilosity (Figs 1–8). ***Xenobates*** Esaki, 1927
– Mesofemur length more than 0.9 times body length. Mesotarsus length about 0.6 times mesotibia length. Almost all species dark coloured, with or without scattered silvery pilosity. .... ***Haloveloides*** Andersen, 1992
5 Abdomen of female strongly constricted at segment 6. Male with swelling on abdomen anteriorly (following Polhemus & Polhemus 2006). (No records from the Philippines.) .... ***Ocheovelia*** Polhemus & Polhemus, 2006
– Abdomen of female and male without such modifications. ..... ***Halovelia*** Bergroth, 1893
Note. As no synapomorphies for *Halovelia* could be proposed (Polhemus & Polhemus 2006), *Ocheovelia* appears to be a clade of highly modified species of *Halovelia*.

Xenobates Esaki, 1927

Type species. *Microbates seminulum* Esaki, 1926 (original designation).

Diagnosis (modified from Andersen 2000). Small Veliidae (BL 1.2–2.9 mm; males smaller than females), of robust, ovate built; in some species the female's abdomen posteriorly more convergent, almost pointed. Only apterous morph known. Head and pronotum of almost all species with yellow, orange, or pale brown markings (Figs 1–8). Eyes of moderate size, larger than in *Halovelia* and *Haloveloides*, interocular width as long as half of head width or only slightly longer. Antenna (Figs 9–12) slender, length about half to three fourths of body length; in most species antennomere 1 longer than 3. Pronotum very short (Figs 1–8). Foreleg of male without modification on protrochanter and lacking a grasping comb on protibia. Middle legs relatively short when compared to *Halovelia* and *Haloveloides*; extensor face of mesofemur (Figs 13–16), mesotibia, and mesotarsus with rows of setae, that are often long, but in some species short and inconspicuous; mesotarsus length less than 0.4 times mesotibia length; mesotarsomere 1 longer than 2. Metafemur of male (Figs 17, 19) at most slightly thickened (near base, not in middle). Metatarsomere 1 much longer than 2. Abdomen relatively short and tapering in width posteriorly in both sexes. Segment 8 with genitalia clearly protruded from segment 7. Parameres (Figs 21, 22) long, symmetrical, and falciform.

Comparative notes. In the field, *Xenobates* can usually be identified easily, because *Xenobates* inhabits mangroves and *Nypa* swamps, habitats where the related genera cannot be found regularly. Morphologically, *Xenobates* is characterized by extended areas bearing silvery hair patches, a relatively short middle leg (compared to *Halovelia* and *Haloveloides*), and relatively large eyes (compared to *Halovelia*). Males do not possess a protibial grasping comb (in contrast to *Halovelia*). Many species of *Xenobates* possess a row of long setae on the extensor side of the mesofemur, which is unknown from other haloveliine genera.

Taxonomically important characteristics. Species of *Xenobates* show only little intraspecific variability, which makes identification relatively safe. On the other hand, there are not many differentiating characters between species. Colouration is relatively stable in species, the orange to yellow patches vary little in their extension. An exception is *X. nypicola* sp. nov., a relatively light-coloured species, where the shadings of brown considerably vary between specimens. Pilosity and setiferation offer important characters for species discrimination. The species have differently extended silvery patches on their dorsum. The arrangement of setae on the legs, and the length of setae on the extensor side of mesofemora are further important characters. *Xenobates nypicola* sp. nov. can be immediately identified by the numerous setae on its antennae. Females often possess characteristic setae on the posterior segments of the abdomen. Morphometry is an important tool for identification as well. The relative length of antennae, of individual leg segments, eye size etc. help to distinguish species. Males have secondary sexual characters on their abdominal sternites (humps, grooves, carinae) that are very important to distinguish closely related species, e.g., in the *X. argentatus* complex, or *X. riedli* sp. nov. from *X. singaporensis* Andersen, 2000. In contrast, the small genitalia offer little help for species identification; usually there are only discrete differences in the paramere shape. In females, the main differences are found on the dorsum of the abdomen; besides setiferation, the relative width of tergites can be used for species differentiation. The terminal structures of females are simple.

Habitats. The restriction to mangroves and swampy saline environments (*Nypa* swamps) strongly contrasts with the habitats of other marine Haloveliinae. An exception is *Xenobates seminulum* (Esaki, 1926), which has been reported from open offshore waters at considerable distances from the edge of the mangrove front (Polhemus & Polhemus 2006). The typical habitats of *Halovelia* are rocky shores, mostly coral reef flats. The same habitat is inhabited by a few species of *Haloveloides* (in *Haloveloides* s.str.), but most species are found in the intertidal section of rivers.
Distribution. Indo-West Pacific. From Sri Lanka to New Caledonia (Andersen 2000).

Key to the Philippine species of *Xenobates*

(except for the *X. argentatus* complex)

1 Mesofemur with row of long setae at extensor side (MfHI > 1.1; Figs 13–15). Silvery pilosity on dorsum restricted to few patches (Figs 1–6). 2
– Mesofemur without row of long setae at extensor side (Fig. 16). Silvery pilosity on dorsum strongly extended (e.g., Figs 7, 8). ..... ***X. argentatus* complex**
2 Antennomeres 2–4 with numerous long setae (Fig. 9). Middle legs, especially the mesotarsus short (MLI 1.37–1.64, MsTaI 0.42–0.55). ..... ***X. nypicola* sp. nov.**
– Antennomeres 4 without, 2 and 3 without or with very few long setae (Figs 10–12); middle legs, especially the mesotarsus long (MLI > 1.71, MsTaI > 0.61). 3
3 Antenna long (AI ♂♂ 0.76–0.84, ♀♀ 0.63–0.71; Fig. 10). Abdomen of female posteriorly narrow (Fig. 26). Anterior sternites of male with distinct medial swelling (Fig. 24). ..... ***X. riedli* sp. nov.**
– Antenna relatively short (AI ♂♂ 0.52–0.61, ♀♀ 0.46–0.51; Fig. 11). Abdomen of female broad, trough-shaped (Fig. 6). Anterior sternites of male evenly and slightly convex. ..... ***X. murphyi*** Andersen, 2000

Xenobates nypicola sp. nov.

(Figs 1, 2, 9, 13, 17, 18, 21, 23, 25)

Type locality. Philippines, Negros Oriental Province, Amlan, *Nypa fruticans* swamp at Mag-abo, ca. N 9°28′, E 123°13′.
Type material. Holotype: ♂ (PNM), **PHILIPPINES: Negros Oriental:** Amlan, Mag-abo, stream reaching sea, leg. H. Zettel. Paratypes (152 ♂♂ 244 ♀♀; NHMW, NMPC, PNM, UPLB, USC, ZCVA, ZMUC, ZRC) from the following localities: **PHILIPPINES: Negros Oriental:** 46 ♂♂ 61 ♀♀, collected with the holotype [#1]; 15 ♂♂ 36 ♀♀, the same locality, leg. C. V. Pangantihon [#1a]; 6 ♂♂ 26 ♀♀, south of Amlan, Bio-os, leg. H. Zettel [#2]; 5 ♂♂ 12 ♀♀, the same locality leg. C. V. Pangantihon [#2a]; 10 ♂♂ 23 ♀♀, Sibulan, Ajong, leg. H. Zettel [#3]; 8 ♂♂ 8 ♀♀, the same locality, leg. C. V. Pangantihon [#3a]. **Polillo:** 8 ♂♂ 28 ♀♀, east of Panuculan, mangrove, leg. H. Zettel & C. V. Pangantihon [#4]. **Masbate Island:** 47 ♂♂ 52 ♀♀, mangrove at road Mobo – Uson (km 16 from Masbate proper), leg. H. Zettel [#5]. **Bantayan Island:** 2 ♀♀, Balidbid, 4 km northwest of Santa Fe, leg. H. Zettel [#6]. **Camotes Islands**: 5 ♂♂ 4 ♀♀, Pacijan Island, San Francisco, mangrove at road to Poro, leg. H. Zettel [#7]. **Mindanao: Surigao del Sur:** 2 ♂♂ 2 ♀♀, Tago, Duot Suong, leg. C. V. Pangantihon [#8].

Diagnosis. Smallest species of *Xenobates* (BL ♂♂ 1.20–1.38, ♀♀ 1.45–1.68). Dorsum partly orange brown, connexiva light orange brown to dark brown (Figs 1, 2). Antennomeres 2–4 with numerous long setae (Fig. 9), 1 clearly shorter than 3. All femora (Figs 13, 17, 18), pro- and mesotibia, and mesotarsus with rows of long setae. MfHI high (♂♂ 1.33–1.60, ♀♀ 1.82–2.36); MLI (♂♂ 1.56–1.71, ♀♀ 1.37–1.48) and MsTaI (♂♂ 0.50–0.55, ♀♀ 0.42–0.59) low. Metafemur weakly incrassate (Figs 17, 18). – Male: abdominal venter without swelling, with very shallow impression medially on sternites 2–4 (Fig. 23). Paramere short (Fig. 21). – Female: abdomen trough-shaped (Fig. 25).
Description. *Male*. *Measurements* (mm; n = 10; #1, 4): BL 1.30 (1.20–1.38); BW 0.65 (0.63–0.68); AL 1.01 (0.94–1.05); MsfL 0.92 (0.90–0.98); MfHL 0.15 (0.14–0.17); MtiL 0.77 (0.75–0.80); MtaL 0.41 (0.38–0.43); MsfW 0.10 (0.09–0.11); MtfW 0.08 (0.07–0.09). – Indices: AI 0.78 (0.76–0.80); MLI 1.62 (1.56–1.71); MfHI 1.44 (1.33–1.60); MsTaI 0.53 (0.50–0.55); MtsfWI 0.79 (0.67–0.86).

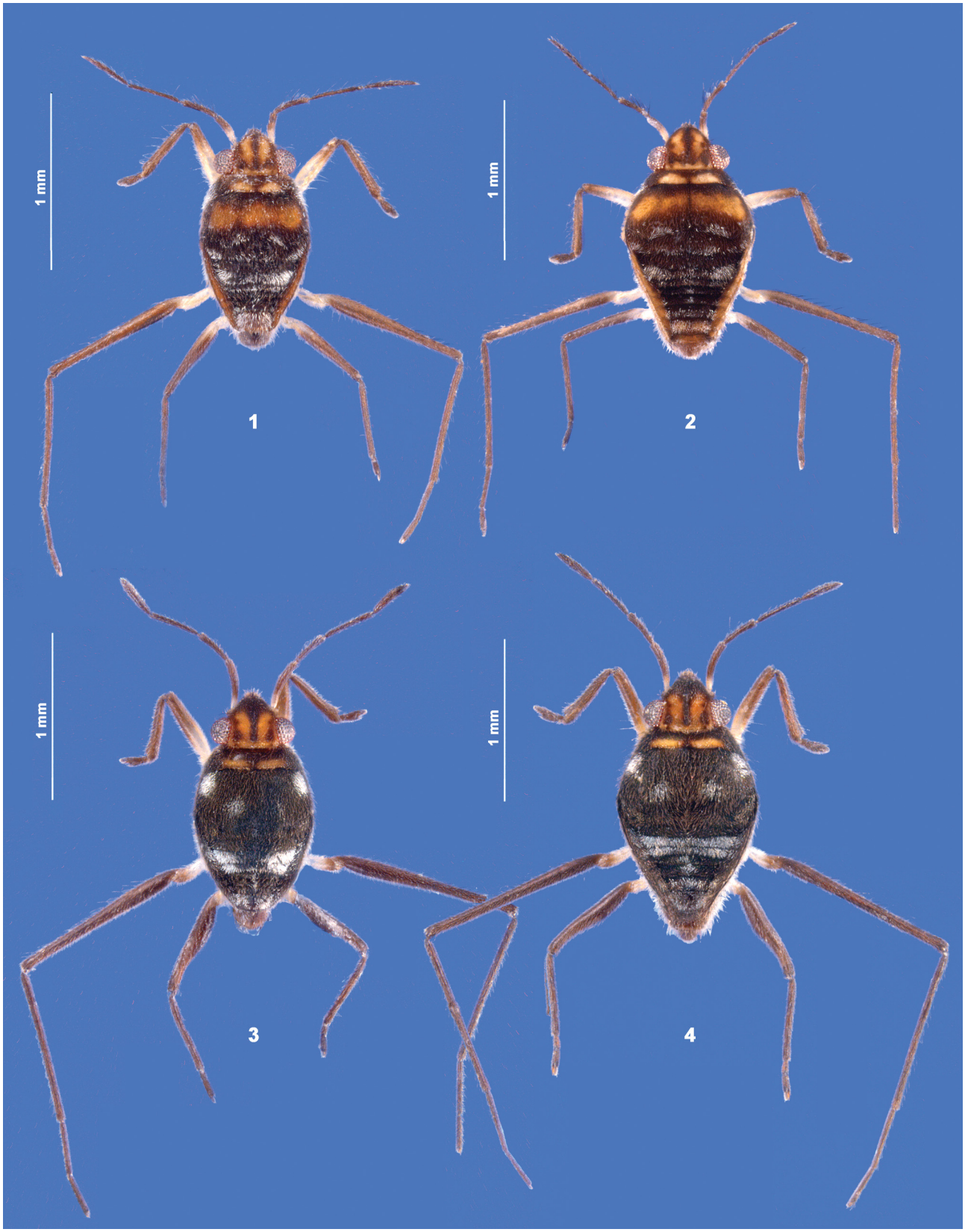
Colour (Fig. 1). Ground colour black to dark brown. Head dorsally with two longitudinal pale orange to yellow marks and pronotum with pair of yellow spots near middle of hind margin (in some specimens almost confluent); around these yellow marks orange to pale brown. Disc of mesonotum to large extent yellowish orange to orange-brown. Dorsal portions of meso- and metapleuron, and all sternites, entire laterotergites and tergite 7 variable orange to brown. Pro- and mesacetabulum largely, metacetabulum narrowly pale yellow. Sternites variably orange-brown to dark brown. Antenna dark brown, except for pale yellow base. On legs coxae, trochanters, almost entire profemur, and underside of meso- and metafemur pale yellow; remaining parts medium to dark brown.

Pilosity. Dorsum of body with inconspicuous pale hair layer. Thoracic pleura with very oblique and moderately long dark setae. Connexival margin with long oblique setae. Segment 8 with long setae. Dorsum with relatively few and diffuse patches of silvery pilosity. Lower parts of thoracic pleura with uninterrupted stripe of silvery pilosity. Hind margins of metasternum and sternites with transverse stripes of short white pilosity, somewhat longer on sternites 6 and 7. Antennomeres 2–4 with numerous long setae (Fig. 9). Profemur on flexor side with one, protibia on extensor side with two rows of long setae. Mesofemur (Fig. 13) on extensor side with one row of very long oblique setae (longer than mesofemur width); in addition, single rows with somewhat shorter setae on both extensor and flexor side, and on extensor sides of mesotibia and mesotarsus. On hind leg, only flexor side of metafemur with row of setae (Fig. 17).

Structure. Body relatively slender, almost fusiform. Head anteriorly pointed. Eyes comparatively large; interocular width as long as half of head width. Antenna long. Pronotum very short. Legs slender. Metafemur hardly thickened, slenderer than mesofemur. Abdomen moderately convergent posteriorly; connexival margins slightly convex. Tergites moderately wide, tergite 7 about 1.6 times as wide as long. Sternites 2–5 slightly depressed in middle, forming shallow groove (Fig. 23). Sternite 7 transversely concave. Segment 8 distoventrally with blunt median carina, on both sides slightly depressed. Genitalia small. Paramere (Fig. 21) comparatively short and stout, distally weakly curved, without setae.

Female. *Measurements* (mm; n = 10; #1, 4): BL 1.53 (1.45–1.68); BW 0.85 (0.80–0.90); AL 0.97 (0.89–1.05); MsfL 0.96 (0.90–1.00); MfHL 0.15 (0.14–0.19); MpHL 0.10 (0.09–0.11); MPnL 0.10 (0.09–0.11); MtiL 0.83 (0.75–0.95); MtaL 0.43 (0.38–0.48); MsfW 0.08 (0.07–0.08); MtfW 0.07 (one value). – Indices: AI 0.63 (0.59–0.68); MLI 1.44 (1.37–1.48); MfHI 2.00 (1.82–2.36); MsTaI 0.52 (0.42–0.59); MtsfWI 0.93 (0.91–1.00); MpHI 1.02 (0.86–1.33).

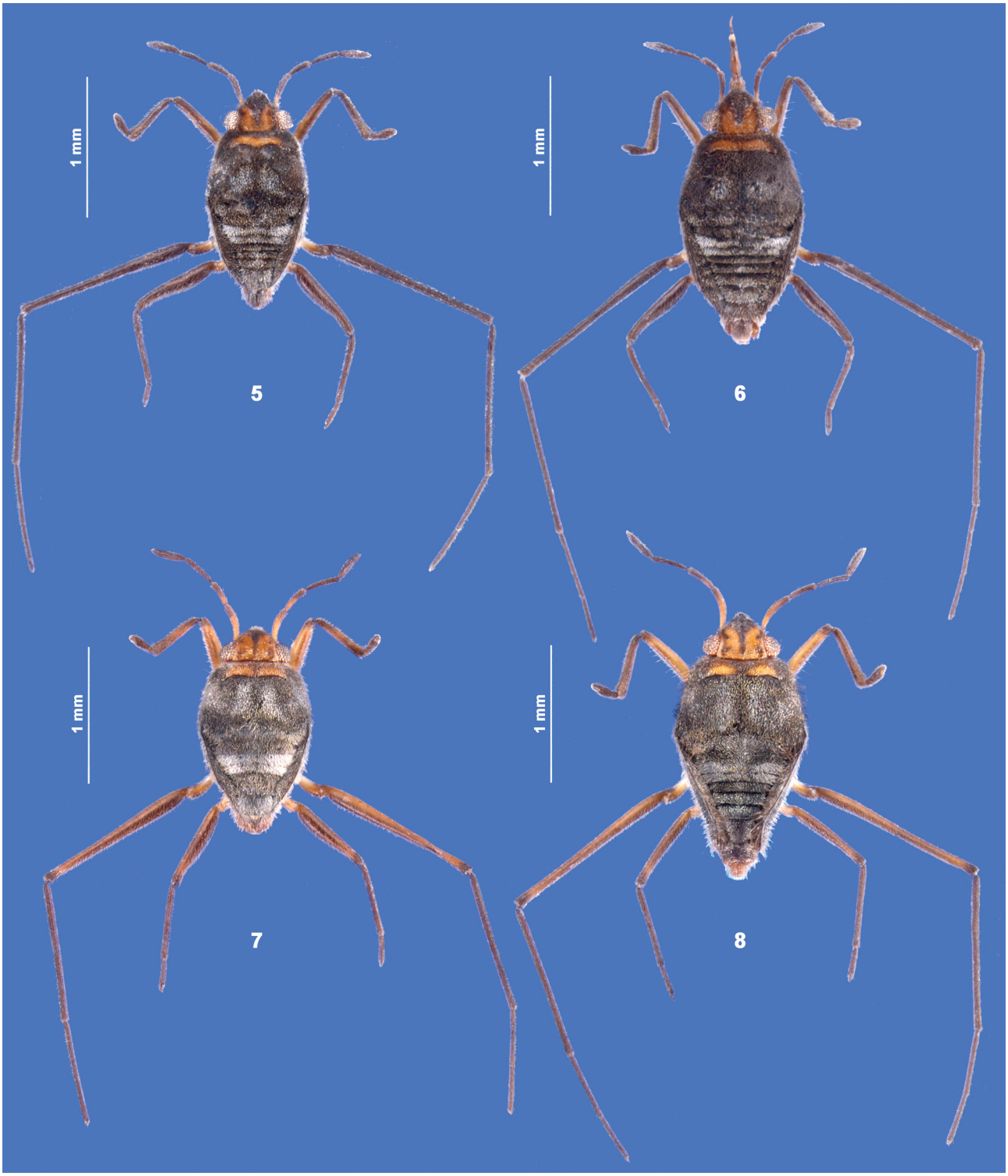
Colour. Similar as in male. Laterotergites and dorsal margins of sternites on average paler. Medial parts of sternites dark.



Figs 1–4. Habitus of 1, 2 – *Xenobates nypicola* sp. nov. and 3, 4 – *Xenobates riedli* sp. nov.; (1, 3 – males, 2, 4 – females).

Pilosity. Similar as in male. Oblique setae on thorax sides longer and more conspicuous. Hind margin of mesometanotum sublaterally with a few long setae. Long black setae on connexival margins longer and more upright. Laterotergite 7 with few oblique black setae directed posteromedially. Tergite 7 with some black setae, mostly on sides. Sternites 2–5 with even, extremely short whitish pilosity, 6 and 7 with slightly longer pilosity, only 7 with fringe of whitish hairs at hind margin. Pilosity of antennae and legs similar as in male; longest setae on mesofemur about twice as long as mesofemur width.

Structure. Body clearly larger (BLI: 1.18) and stouter than in male. Thorax more strongly widened posteriorly. Legs similar as in male, except for slenderer meso- and metafemur (therefore, MsHI higher). Abdomen in dorsal view trapezoidal (Fig. 25), connexival margins almost evenly converging (only slightly bowed). Laterotergites steeply raised. All tergites much wider than long, 1–6 slightly convex, 7–8 flat. Tergite 7 more than 2.5 times as wide as long, horizontal. Tergite 8 about 3 times as wide as long, directed dorsolaterally. Proctiger semicircular in dorsal aspect. Apex of sternite 7 in lateral view downcurved.



Figs 5–8. Habitus of 5, 6 – *Xenobates murphyi* Andersen, 2000 and 7, 8 – *Xenobates* cf. *argentatus* Andersen, 2000 from Cebu; (5, 7 – males, 6, 8 – females).

Gonocoxa 1 largely concealed by sternite 7.

Comparative notes. *Xenobates nypicola* sp. nov. is one of the most striking species of the entire genus. The numerous long setae on the legs and especially on the antennae (Fig. 9) are highly diagnostic. Small size, light colouration (Figs 1, 2), proportions of antennomeres (1 < 3), short mesotarsi, and the groove on abdominal sternites 2–5 of males (Fig. 23) are additional characteristics that distinguish *X. nypicola* sp. nov. from all other Philippine species of *Xenobates*.

Etymology. The species epithet is a Latinized noun in apposition meaning "inhabitant of *Nypa* (swamp)".

Habitats. In Negros, this small species was collected in large numbers in small puddles in *Nypa fruticans* swamps during low tide. Such swamps seem to be the species' preferred habitat, although it was also found in large mangrove stands on Masbate, Negros, Bantayan, and Pacijan islands. We never found any other species of Gerromorpha in *Nypa fruticans* swamps.

Distribution. Widely distributed in the Philippines: records from Polillo, Masbate, Negros, Bantayan, Pacijan, and Mindanao.

Xenobates riedli sp. nov.

(Figs 3, 4, 10, 14, 19, 20, 22, 24, 26)

Type locality. Philippines, Camotes Islands, Pacijan Island, San Francisco, mangrove along road to Poro (near bridge), ca. N 10°39′, E 124°23′.

Type material. Holotype: ♂ (PNM): **PHILIPPINES: Camotes Islands:** Pacijan Island, San Francisco, mangrove at road to Poro, leg. H. Zettel. Paratypes (18 ♂♂ 27 ♀♀; PNM, NHMW, UPLB, USC) from the following localities: **PHILIPPINES: Camotes Islands:** 11 ♂♂ 15 ♀♀, collected with the holotype [#1]; 3 ♀♀, Pacijan Island, south coast at Unidos, leg. H. Zettel [#2]. **Burias Island:** 2 ♀♀, San Pasqual, Mabuhay, Taberna, leg. H. Zettel [#3]; 2 ♀♀, San Pasqual, Mabini, leg. H. Zettel [#4]; 7 ♂♂ 5 ♀♀, San Pasqual, near town, leg. H. Zettel [#5].

Diagnosis. Small species (BL ♂♂ 1.40–1.48 mm, ♀♀ 1.68–1.75 mm). Dorsum black with distinct yellowish marks on head and pronotum (Figs 3, 4). Antennomere 2 with two, 3 and 4 without long setae (Fig. 10). Mesofemur (Fig. 14) and mesotibia with rows of long setae. Long setae on profemur and protibia scarce and less distinct. MfHI high (♂♂ 1.14–1.27, ♀♀ 1.23–1.75); MLI high (♂♂ 1.85–1.98, ♀♀ 1.72–1.82); MsTaI medium (♂♂♀♀ 0.61–0.66). Metafemur incrassate. – Male: Abdominal venter with swelling (Fig. 24) that lacks steep declivity on sternite 6. Paramere moderately long (Fig. 22). – Female: Abdomen strongly narrowed posteriorly (Fig. 26).

Description. ***Male.*** *Measurements* (mm; n = 5; #1): BL 1.46 (1.40–1.48); BW 0.75 (0.73–0.75); AL 1.17 (1.13–1.20); MsfL 1.18 (1.15–1.20); MfHL 0.12 (0.11–0.14); MtiL 0.96 (0.95–0.98); MtaL 0.62 (0.60–0.63); MsfW 0.10 (0.10–0.11); MtfW 0.11 (0.11–0.12). – Indices: AI 0.80 (0.76–0.84); MLI 1.89 (1.85–1.98); MfHI 1.23 (1.14–1.27); MsTaI 0.65 (0.63–0.66); MtsfWI 1.08 (1.07–1.13).

Colour (Fig. 3). Ground colour black. Head dorsally with four longitudinal yellow marks; two medial broad and confluent at base, two lateral ones at eye margin narrow and in some specimens connected with medial ones at base. Pronotum with pair of transverse yellow stripes at hind margin. Underside of head and acetabula yellow. Posterior sternites orange to yellow. Antenna blackish brown, except for pale yellow base (ca. one fourth to one third). On legs coxae and trochanters yellow, except for brown apex of mesotrochanter. Femora, tibiae, and tarsi dark brown, except for base of profemur that is to a varying extent yellow.

Pilosity. Dorsum of body with inconspicuous grey to brown hair layer. Thoracic pleura and connexival margins with short, oblique dark setae. Meso-metanotum with four roundish patches of silvery pilosity, one pair near middle and one pair anterolaterally. Tergites 2, 3, and 7 entirely covered by silvery pilosity, tergites 4–6 with narrow medial patches (in some specimens indistinct). Lower parts of thoracic pleura with uninterrupted stripe of silvery pilosity. Venter with short, white, almost uniform pilosity. Antennomeres 2 with two standing setae, 3 and 4 without such setae (Fig. 10). Profemur on flexor side and protibia on extensor side with few long setae. Mesofemur on extensor side with one row of very long oblique setae (longer than mesofemur width).

Structure. Body moderately slender, fusiform. Head anteriorly moderately pointed. Eyes moderately large; interocular width slightly more than half of head width. Antenna long. Pronotum very short. Legs slender. Metafemur thickened, in basal third wider than mesofemur. Abdomen convergent posteriorly; connexival margins distinctly convex. Tergites moderately wide, tergite 7 about 1.6 times as wide as long. Sternites 2–6 with roundish swelling, from sternites 5 to 7 evenly sloping, in lateral view without steep declivity on sternite 6 (Fig. 24). Sternite 7 transversely convex. A median carina of segment 8 at most weakly indicated. Genitalia small. Paramere (Fig. 22) moderately long and very slender, distally weakly curved, without setae.

Female. *Measurements* (mm; n = 7; #1, 3): BL 1.70 (1.68–1.75); BW 0.91 (0.88–0.95); AL 1.15 (1.10–1.18); MsfL 1.29 (1.25–1.33); MfHL 0.14 (0.11–0.15); MpHL 0.12 (0.11–0.13); MPnL 0.10 (0.09–0.11); MtiL 1.07 (1.05–1.10); MtaL 0.68 (0.65–0.70); MsfW 0.09 (one value); MtfW 0.11 (0.10–0.11). – Indices: AI 0.68 (0.63–0.71); MLI 1.78 (1.72–1.82); MfHI 1.52 (1.23–1.75); MsTaI 0.63 (0.61–0.65); MtsfWI 1.18 (1.15–1.25); MpHI 1.23 (1.00–1.38).

Colour (Fig. 4). Similar as in male.

Pilosity. Similar as in male. Oblique setae on thorax sides much longer and more conspicuous. Hind margin of meso-metanotum medially with a few moderately long setae. Connexival margins only anteriorly with a few oblique setae. Laterotergites 6 and 7 with few oblique black setae directed posteromedially. Posterior half of tergite 8 with dense brush of posteriorly directed setae. Sternites 2–7 with even, extremely short whitish pilosity, 7, in addition, with fringe of whitish setae at hind margin. Pilosity of antennae and legs similar as in male; longest setae on mesofemur on average about 1.5 times as long as mesofemur width.

Structure. Body clearly larger (BLI: 1.16) than in male. Thorax more strongly widened posteriorly. Legs similar as in male, except for slenderer meso- and metafemur (therefore, MsHI higher). Abdomen in dorsal view subtriangular (Fig. 26), connexival margins anteriorly strongly, posteri-

orly moderately converging. Laterotergites steeply raised, 6 and 7 vertical. All tergites much wider than long, 1–6 flat, 8 slightly convex and directed posterodorsally. Tergite 7 about 1.7 times as wide as long, horizontal. Tergite 8 about 1.5 times as wide as long, directed dorsolaterally. Proctiger semicircular in posterodorsal aspect. Apex of sternite 7 in lateral view downcurved. Gonocoxa 1 hardly visible in caudal view.

Comparative notes. *Xenobates riedli* sp. nov. is closely related with *X. singaporensis*. Both species share, e.g., similar mesofemoral row of setae, medially interrupted pale pronotal marking, medial swelling on anterior sterna of males, and posteriorly strongly narrowed abdomen of females. However, males of *X. riedli* sp. nov. differ in much shorter parameres and less pronounced swelling on the abdominal venter, which evenly slopes down on sternites 5–7 (Fig. 24). The same structure is higher and forms a step between sternites 6 and 7 in *X. singaporensis*. Females of *X. riedli* sp. nov. can be distinguished from females of *X. singaporensis* by less convergent connexival margins and tergite 7 being much wider than long (Fig. 26).

Etymology. The first author dedicates this species to the memory of his university teacher Prof. Dr. Rupert Riedl, the famous Austrian marine biologist, evolutionary biologist, conservationist, and member of the Club of Rome, who passed away on September 19, 2005.

Habitats. This species has been collected in extensive mangrove stands and seems relatively rare.

Distribution. So far only known from two small islands in the Central Philippines, Pacijan and Burias.

Xenobates murphyi Andersen, 2000

(Figs 5, 6, 11, 15)

Type locality. Singapore, Pulau Ubin, mangrove creek, outside trees on raising tide.

Material examined (138 ♂♂ 169 ♀♀; NHMW, NMPC, PNM, UPLB, USC, ZCVA). **PHILIPPINES: Polillo Island:** 1 ♂, east of Panuculan, mangrove, leg. H. Zettel & C. V. Pangantihon [#1]. **Oriental Mindoro:** 6 ♂♂ 4 ♀♀, Calapan City, Silonay, leg. C. V. Pangantihon [#2]. **Burias Island:** 51 ♂♂ 81 ♀♀, San Pasqual, south of San Rafael, mangrove area, leg. H. Zettel [#3]; 2 ♂♂ 4 ♀♀, San Pasqual, Mabuhay, Taberna, mangrove, leg. H. Zettel [#4]; 2 ♂♂ 1 ♀, San Pasqual, mangrove near town, leg. H. Zettel [#5]. **Ticao Island:** 4 ♀♀, 2 km north of San Fernando, "Toplean" coast, leg. H. Zettel [#6]. **Bantayan Island:** 24 ♂♂ 18 ♀♀, Balidbid, ca. 4 km northwest of Sta. Fe, mangrove, leg. Zettel [#7]; 7 ♂♂ 10 ♀♀, the same locality, leg. C. V. Pangantihon [#7a]. **Cebu Island:** 3 ♀♀ (paratypes of *X. murphyi*), Moalboal, coast, leg. H. Zettel [#8]; 3 ♂♂ 7 ♀♀, north of Cebu City, Liloan, mangrove remnants at Marine Station, leg. H. Zettel & C.V. Pangantihon [#9]; 1 ♂, Argao, Talo-ot, leg. J. P. Bongo [#10]. **Camotes Islands:** 1 ♀, Pacijan Island, south coast, Unidos, mangrove, leg. H. Zettel [#11]; 1 ♀, Poro Island, Poro, Cagcagan, Punta Lo-oc Beach, leg. H. Zettel [#12]. **Mindanao: Surigao del Norte Province:** 16 ♂♂ 16 ♀♀, Hikdop Island, south and southwest coasts, leg. H. Zettel [#13]; 23 ♂♂ 11 ♀♀, Bayagnan Island, southwest coast, mangrove, leg. H. Zettel [#14]. **Surigao del Sur Province:** 8 ♂♂ 12 ♀♀, Tago, Duot Suong, leg. C. V. Pangantihon [#15].

Diagnosis. Medium-sized species (BL ♂♂ 1.53–1.65 mm, ♀♀ 1.70–1.78 mm). Dorsum black with orange (often relatively dark) marks on head and pronotum (Figs 5, 6). Antennomere 2 with one (♂) or three (♀) long setae (Fig. 11). Mesofemur (Fig. 15) and mesotibia with rows of long setae; long setae on profemur and protibia scarce and less distinct. MfHI high (♂♂ 1.00–1.46, ♀♀ 1.08–1.64); MLI high (♂♂ 1.92–2.14, ♀♀ 1.94–2.06); MsTaI moderate (♂♂ 0.67–0.74, ♀♀ 0.71–0.76). Metafemur hardly incrassate. – Male: Abdominal venter slightly and evenly convex. Paramere moderately long. – Female: Abdomen trough-shaped. Connexival margins thick, appearing swollen.

Redescription of male. *Measurements* (mm; n = 10; #7, 14): BL 1.57 (1.53–1.65); BW 0.77 (0.75–0.78); AL 0.86 (0.80–0.95); MsfL 1.34 (1.28–1.38); MfHL 0.11 (0.09–0.14); MtiL 1.11 (1.08–1.13); MtaL 0.78 (0.74–0.81); MsfW 0.09 (0.09–0.10); MtfW 0.12 (0.11–0.12). – Indices: AI 0.55 (0.52–0.61); MLI 2.06 (1.92–2.14); MfHI 1.20 (1.00–1.46); MsTaI 0.70 (0.67–0.74); MtsfWI 1.23 (1.15–1.31).

Colour (Fig. 5). Ground colour black. Head dorsally with broad, U-shaped, orange mark. Pronotum with uninterrupted transverse orange stripe at hind margin. Underside of head orange or yellow. Acetabula yellow. Ventral side of abdominal segment 8 orange to yellowish brown. Antenna dark brown, except for pale yellow basal third. On legs, coxae and trochanters yellow, except for brown apex of mesotrochanter. Femora, tibiae, and tarsi brown, except for base of profemur that is to a varying extent yellow.

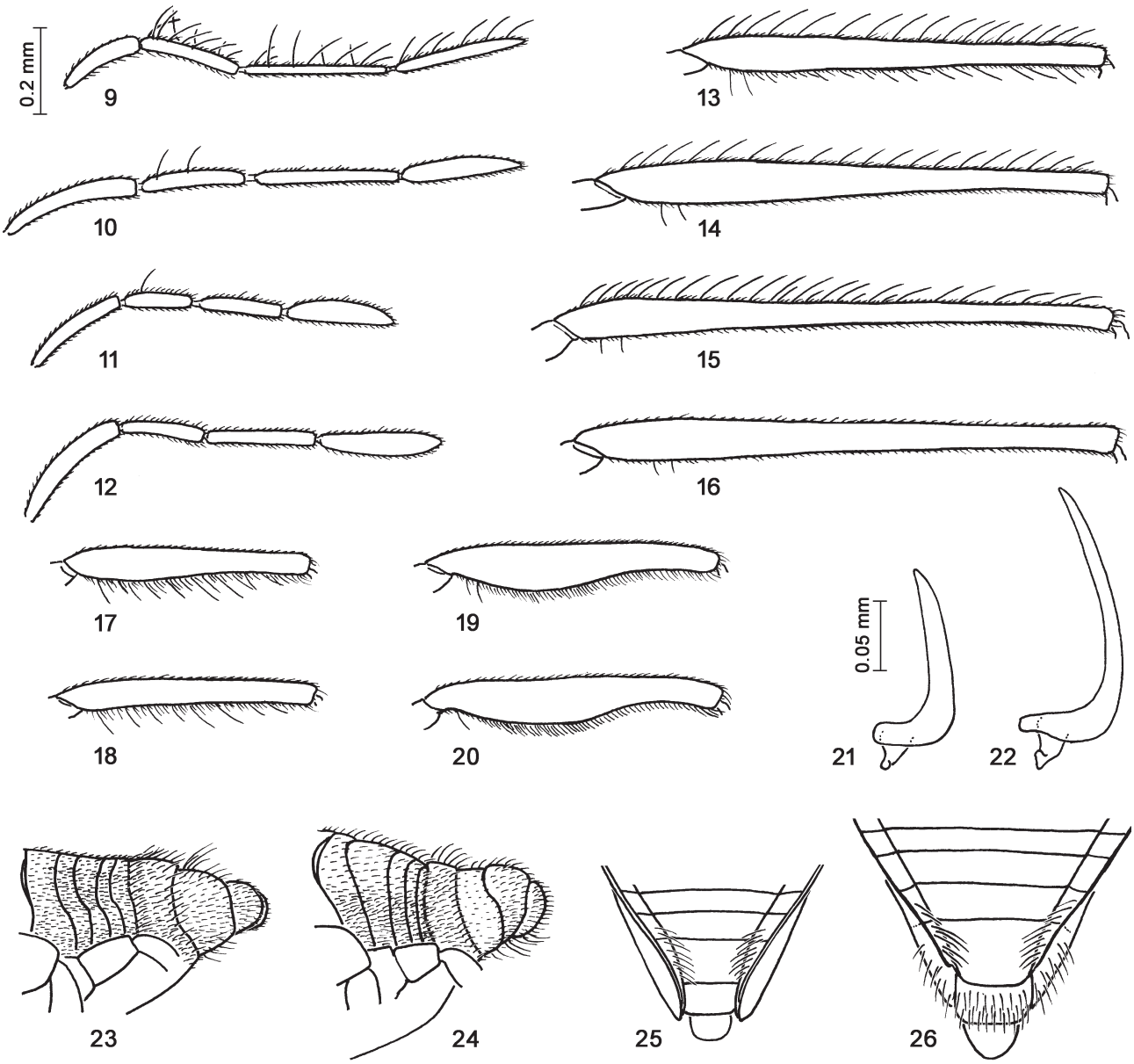
Pilosity. Dorsum of body with inconspicuous brown hair layer. Thoracic pleura with short, oblique dark setae. Meso-metanotum posteromedially with pair of indistinct patches of dispersed silverish pilosity. Abdominal tergites and laterotergites almost entirely covered with dispersed silverish pilosity, denser only at sides of tergites 2 and 3. Lower parts of thoracic pleura with uninterrupted stripe of silvery pilosity. Venter with short, white, almost uniform pilosity. Antennomeres 2 usually with single seta, 3 and 4 without such setae (Fig. 11). Profemur on flexor side and protibia on extensor side with few long setae. Mesofemur on extensor side with one row of very long oblique setae (subequal or longer than mesofemur width).

Structure. Body slender, fusiform. Head anteriorly moderately pointed. Eyes moderately large; interocular width slightly more than half of head width. Antenna short. Pronotum very short. Legs slender. Metafemur thickened, in basal third slightly wider than mesofemur. Abdomen convergent posteriorly; connexival margins weakly convex. Tergites moderately wide, tergite 7 about 1.5 times as wide as long. Venter of abdomen almost unmodified, weakly swollen in anterior part. Genitalia small. Paramere long and falciform, distally without setae.

Redescription of female. *Measurements* (mm; n = 10; # 7, 14): BL 1.73 (1.70–1.78); BW 0.95 (0.93–0.98); AL 0.84 (0.80–0.90); MsfL 1.39 (1.33–1.45); MfHL 0.11 (0.09–0.13); MpHL 0.09 (0.08–0.11); MPnL 0.09 (0.08–0.11); MtiL 1.18 (1.15–1.23); MtaL 0.87 (0.83–0.90); MsfW 0.08 (0.08–0.09); MtfW 0.11 (0.10–0.11). – Indices: AI 0.49 (0.46–0.51); MLI 1.99 (1.94–2.06); MfHI 1.33 (1.08–1.64); MsTaI 0.74 (0.71–0.76); MtsfWI 1.27 (1.15–1.36); MpHI 0.98 (0.79–1.15).

Colour (Fig. 6). Similar as in male.

Pilosity. Similar as in male. Oblique setae on thorax sides much longer and conspicuous. Connexival margins only anteriorly with a few oblique setae. Laterotergites 6



Figs 9–26. 9–12 – antennae (males): 9 – *Xenobates nypicola* sp. nov., 10 – *X. riedli* sp. nov., 11 – *X. murphyi* Andersen, 2000, 12 – *X.* cf. *argentatus* Andersen, 2000. 13–16 – mesofemur (males): 13 – *X. nypicola* sp. nov., 14 – *X. riedli* sp. nov., 15 – *X. murphyi* Andersen, 2000, 16 – *X.* cf. *argentatus.* 17–20 – metafemur: 17–18 – *X. nypicola* sp. nov. (17 – male, 18 – female); 19–20 – *X. riedli* sp. nov. (19 – male, 20 – female). 21–22 – parameres: 21 – *X. nypicola* sp. nov., 22 – *X. riedli* sp. nov. 23–24 – abdominal venter of males, oblique ventrolateral view: 23 – *X. nypicola* sp. nov., 24 – *X. riedli* sp. nov. 25–26 – posterior portion of abdomen of females, dorsal view: 25 – *X. nypicola* sp. nov., 26 – *X. riedli* sp. nov. All drawings to the same scale, except for parameres. Pilosity schematic, in Figs 25 and 26 only characteristic long setae drawn.

and 7 with some moderately long posteromedially directed black setae; the other laterotergites at most with some dispersed setae. Posterior half of tergite 8 with brush of rather short posteriorly directed setae. Sternites 2–7 with even, short whitish pilosity, 7, in addition, with fringe of short whitish setae at hind margin. Antennomere 2 usually with 2, 3 with one standing seta. Pilosity of legs similar as in male; length of setae on mesofemur quite variable.

Structure. Body larger (BLI: 1.10) and much stouter than in male. Thorax strongly widened posteriorly. Legs similar as in male, except for slightly slenderer metafemur. Abdomen in dorsal view trough-shaped. Connexival margins thick, appearing swollen, anteriorly almost straight, posteriorly moderately converging. Laterotergites anteriorly more steeply raised than posteriorly. All tergites much wider than long, 1–6 flat, 8 slightly convex and directed posterodorsally. Tergite 7 about 2.5 times as wide as long, horizontal. Tergite 8 about twice as wide as long, horizontal. Proctiger semicircular. Apex of sternite 7 in lateral view subrectangular and slightly rounded. Major part of gonocoxa 1 exposed.

Comparative notes. *Xenobates murphyi* was described based on material from Singapore, West Malaysia, northern Borneo, and the coast of Moalboal, Cebu Island (only females). The Philippine populations of *X. murphyi* differ only slightly from those originating from the type locality in Singapore. Males do not show significant differences. Females from the Philippines and from Bangka Island near

Sulawesi have a relatively stout body and a richer pilosity, especially on hind margin of tergite 8. However, the ratio body length / body width varies considerably within one and the same population and overlaps slightly between different populations. Those female paratypes from Pulau Tioman which were available for this study have been stored in alcohol and may have lost part of the pilosity as observed in other alcohol-stored specimens. Therefore, the authors believe that *X. murphyi* is a widely distributed, slightly varying species.

Habitats. Along sea shores in mangroves, including smallest mangrove remnants.

Distribution. Malay Peninsula (West Malaysia, Singapore; Andersen 2000), Borneo (East Malaysia; Andersen 2000), Bangka Island near Sulawesi (Indonesia), Philippines: Polillo, Mindoro, Burias, Ticao, Bantayan, Cebu (Andersen 2000), Pacijan, Poro, Hikdop, Bayagnan.

Xenobates argentatus complex

(Figs 7, 8, 12, 16)

Notes. The *Xenobates argentatus* complex comprises all those Philippine species that are lacking long setae on the extensor side of the mesofemur (Fig. 16). In the Philippine species, the silvery pilosity of the dorsal surface is strongly extended. In the wider *X. argentatus* group we can include *X. solomonensis* Lansbury, 1989 from Papua New Guinea and the Solomon Islands, *X. caudatus* Andersen & Weir, 1999 from Papua New Guinea, *X. major* Andersen & Weir, 1999 and *X. spinoides* Andersen & Weir, 1999 from Australia, *X. pictus* Andersen, 2000 from the Malay Peninsula and Borneo, and *X. maculatus* Andersen, 2000 from Borneo. In the Philippines, at least six morphologically very similar species belong to the *X. argentatus* complex. They have either allopatric or sympatric distributions, the latter indicating that they are biological species. Species distinction in the archipelago can be chiefly based on small differences in the primary and secondary sexual characteristics of males. Andersen (2000) also recorded *X. argentatus* (type locality: Phuket Island, Thailand) from the Philippines (Palawan and Mindanao). However, after recognizing the complexity of very similar, locally distributed species, the identification of these populations is preliminary.

Distribution of the *X. argentatus* group. Widely distributed from southern Thailand to the Solomon Islands. Probably no distributional limit in the Philippines, although the entire genus is presently unknown from the north of Luzon and the offshore islands in the north of the country (but this might be due to lack of sampling, because there are mangrove habitats in these areas). So far, we have seen records from 15 islands and islets (in alphabetical order): Bantayan, Bayagnan, Bohol, Burias, Cebu, Hikdop, Leyte, Luzon, Olango, Pacijan, Palawan, Polillo, Ponson, Samar, and Siquijor.

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References

ANDERSEN N. M. 1992: A new genus of marine water striders (Hemiptera, Veliidae) with five new species from Malesia. *Entomologica Scandinavica* **22**: 389–404.

ANDERSEN N. M. 2000: The marine Haloveliinae (Hemiptera: Veliidae) of Singapore, Malaysia and Thailand, with six new species of Xenobates Esaki. *Raffles Bulletin of Zoology* **48 (2)**: 273–292.

ANDERSEN N. M. & WEIR T. 1999: The marine Haloveliinae (Hemiptera: Veliidae) of Australia, New Caledonia, and southern New Guinea. *Invertebrate Taxonomy* **13**: 309–350.

BENDANILLO F. E., YURONG R. R., ROBLE N. D., YEE J. C. & SOTTO F. B. 2016: Species composition, abundance and distribution of seawater bugs (Order Hemiptera: Class Insecta) in Badian, Cebu, Philippines. *Journal of Aquatic Science* **4 (1)**: 1–10.

ESAKI T. 1924: On the curious halophilous water strider, Halovelia maritima Bergroth (Hemiptera: Gerridae). *Bulletin of Brooklyn Entomological Society* **14**: 29–34.

ESAKI T. 1926: The water-striders of the subfamily Halobatinae in the Hungarian National Museum. *Annales Historico-Naturales Musei Nationalis Hungarici* **23**: 117–164.

ESAKI T. 1927: An interesting new genus and species of Hydrometridae (Hem.) from South America. *Entomologist* **60**: 181–184.

ESAKI T. 1930: New or little-known Gerridae from the Malay Peninsula. *Journal of the Federated Malay States Museum* **16**: 13–24.

LANSBURY I. 1989: Notes on the Haloveliinae of Australia and the Solomon Islands (Insecta, Hemiptera, Heteroptera: Veliidae). *Reichenbachia* **26**: 93–109.

POLHEMUS J. T. & POLHEMUS D. A. 2006: The marine Heteroptera of Far Eastern New Guinea and adjacent archipelagoes (Insecta, Gerromorpha). *Denisia* **19**: 927–982.

SPENCE J. R. & DAMGAARD J. 2008: Nils Møller Andersen (21. November 1940 – 12. May 2004): Systematist, evolutionary biologist, colleague and friend. *Insect Systematics and Evolution* **39**: 461–474.

ZETTEL H. 2003: Notes on the marine Haloveliinae (Insecta: Heteroptera: Veliidae) of the Philippines, with descriptions of four new species, identification key, and classification of all species of Haloveloides Andersen, 1992. *Annalen des Naturhistorischen Museums in Wien, Series B* **104** [2002]: 163–181.

ZETTEL H. 2006: On the knowledge of Philippine marine Heteroptera: two new subgenera and four new species of Haloveloides Andersen, 1992 (Veliidae: Haloveliinae). *Denisia* **19**: 743–754.