TWO NEW GENERA AND THIRTY NEW SPECIES OF MICROVELIINAE (HETEROPTERA: VELIIDAE) FROM THE EAST PAPUA COMPOSITE TERRANE, FAR EASTERN NEW GUINEA

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Two new genera and 30 new species of Microveliinae are described from the East Papua Composite Terrane of far eastern New Guinea. This geologically defined region, including the Papuan Peninsula and the D'Entrecasteaux, Louisiade, and Marshall Bennett island groups, is hypothesized by geologists to have formed as a discrete microcontinent in the early Tertiary before being sutured to greater New Guinea in the Miocene, and retains a highly endemic aquatic Heteroptera biota. The new taxa described from this area are as follows: *Rheovelina* gen. n. containing type species *R. petrophila* sp. n. from extreme southeastern New Guinea, *R. robinae* sp. n. from the D'Entrecasteaux Islands, *R. insularis* sp. n. from Tagula and Rossel islands, *R. anomala* sp. n. from Misima Island, *R. truncata* sp. n. from the Owen Stanley Range of southeastern New Guinea, *R. asymmetrica* sp. n. from the Owen Stanley Range of southeastern New Guinea, *R. basilaki* sp. n. from Basilaki Island, and *R. fonticola* sp. n. from the Cape Nelson Peninsula of southeastern New Guinea; *Brechivelina* gen. n. containing type species *B. tufi* sp. n. from the Cape Nelson Peninsula of southeastern New Guinea; *Tanyvelia minima* sp. n. from extreme southeastern New Guinea; *T. tagulana* sp. n. from Tagula Island; *T. papuana* sp. n. from the Owen Stanley Range of southeastern New Guinea; *Aegilipsicola peninsularis* sp. n. from extreme southeastern New Guinea; *A. auga* sp. n. from the Owen Stanley Range of southeastern New Guinea; *Tarsovelia louisiadensis* sp. n. from Misima and Tagula islands; *Neusterensifer sagarai* sp. n. from extreme southeastern New Guinea; *N. femoralis* sp. n. from extreme southeastern New Guinea plus Normanby, Sariba and Basilaki islands; *N. hunteri* sp. n. from southeastern New Guinea plus Normanby, Sariba, Sideia, and Basilaki Islands; *N. kula* sp. n. from Goodenough and Fergusson islands; *N. dentrecasteaux* sp. n. from Goodenough and Fergusson islands plus the Cape Nelson Peninsula of southeastern New Guinea; *N. louisidae* sp. n. from Tagula and Rossel islands; *N. yela* sp. n. from Rossel Island; *N. sulcata* sp. n. from Tagula Island; *N. misima* sp. n. from Misima Island; *N. muyuw* sp. n. from Woodlark Island; *N. aviavi* sp. n. from the Lakekamu Basin of southeastern New Guinea; *N. microrivula* sp. n. from the Lakekamu Basin of southeastern New Guinea; *N. bowutu* sp. n. from the Bowutu Mountains of southeastern New Guinea; *N. goilala* sp. n. from the Owen Stanley Range of southeastern New Guinea; and *N. tufi* sp. n. from the Cape Nelson Peninsula of southeastern New Guinea. Shaded dorsal habitus figures are provided for *Rheovelina petrophila* and *Neusterensifer femoralis*, and illustrations of diagnostic morphological characters are given for all new genera and species, accompanied by distribution maps. New distribution records are also provided for *Tarsovelia alta* J. Polhemus & D. Polhemus, and *Neusterensifer lubu* D. Polhemus & J. Polhemus. A revised key in provided for all genera of New Guinea Microveliinae, and new or revised keys to all species are provided for *Rheovelina*, *Tanyvelia*, *Aegilipsicola* and *Tarsovelia*; a regional key is also provided for the 16 species of *Neusterensifer* occurring in the Papuan Peninsula and adjacent island groups.

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Fig 1. A general delimitation of the land masses comprising the East Papua Composite Terrane as defined by Pigram & Davies (1987).

The island of New Guinea contains a remarkable and highly endemic assemblage of genera and species in the subfamily Microveliinae, many of which are still undescribed. The current paper builds on previous contributions by Polhemus & Polhemus (1994, 2000a, 2000b) which provided descriptions for six of the more distinctive genera within this regional biota. Additional collecting since that time has brought further new genera and new species to our attention, as well as providing additional distributional information for certain previously described species.

In particular, the present paper focuses on the microveliine fauna of far eastern New Guinea and nearby archipelagos, and is based on recent collections in Central, Oro and Milne Bay Provinces of Papua New Guinea. These provinces, which include the 'tail' of mainland New Guinea plus the adjacent D'Entrecasteaux Islands, Marshall Bennett Islands, and Louisiade Archipelago, encompass a large portion of a tectonically defined geological province known as the East Papua Composite Terrane, or EPCT (Pigram & Davies 1987). Because the EPCT has had a geological history largely independent of the remainder of New Guinea, existing as an isolated microcontinent for a considerable period, it has developed a distinctive suite of endemic aquatic Heteroptera, including Microveliinae, and still retains a unique faunal signature in comparison to the main body of the island (Polhemus & Polhemus 1998). This paper is the first in a series of reports documenting elements of this biota, and attempting to use the resultant biogeographic information to resolve lingering uncertainties regarding the

pattern and timing of the EPCT's offshore assembly and subsequent integration into greater New Guinea.

REGIONAL TECTONIC SETTING

The EPCT, as defined by Pigram & Davies (1987), comprises all of New Guinea and its proximal islands east of the Aure Scarp and south of the Ramu-Markham fault zone (Fig. 1), and represents a complex geological unit containing at least six discrete tectonic sub-terrains within it. These include the partially metamorphosed remains of a Late Cretaceous island arc (the Owen Stanley terrane) in the south, a broad sheet of mantle-derived ophiolite (the Bowutu terrane) in the north, and an extensive exposure of formerly submarine basalts (the Kutu terrane) in the east (Pigram & Davies 1987). This tectonic amalgamation now forms the eastern section of New Guinea, from approximately the Purari River basin eastward through the Louisiade Archipelago (Fig. 1).

The earliest volcanism along the south facing island arc that would later form the initial core of the EPCT occurred in the Late Cretaceous, approximately 70 million years (Myr) ago, and continued until this arc collided in the Paleocene, 62-57 Myr ago, with a sliver of Australian craton rifted off the northern margin of Australia by the opening of the Coral Sea (Davies et al. 1996; Davies et al. 1997; Hill & Hall 2003). This enlarged offshore microcontinent then converged on mainland New Guinea from the northeast, eventually suturing to the main island in the Late Oligocene to Early Miocene, 28-22 Myr ago (see Davies et al. 1997

for a series of diagrams illustrating these events). During this same period extensive exposures of Middle Eocene to Late Miocene submarine volcanics and sediments were also uplifted along the southern and eastern margins of the progressively enlarging EPCT, forming the far eastern tip of the modern Papuan Peninsula.

Throughout this same time span, the Solomon Sea and Woodlark Basin were the site of periodic subduction and island arc formation from the Late Cretaceous or Early Paleocene, 70–65 Myr ago, onward and the islands created there appear to contain fragments of many of the terranes more broadly exposed in the modern Papuan Peninsula. Following the suturing of the onshore sections of the EPCT to greater New Guinea, the offshore eastern section of the EPCT began to split open along the Woodlark Rift. This dismembered the old proto-Louisiades island arc, shifting portions of it, such as Woodlark Island, hundreds of kilometers northward toward the Solomons (Hamilton 1979, Abers et al. 2002). In very recent geological time, during the last 5 Myr from the Pliocene onward, the D'Entrecasteaux Islands have risen as exhumed metamorphic core complexes bouyed by mantle compensation along the axis of the Woodlark rift at its western end (Abers et al. 2002). The northward crustal motion produced by the rapidly opening Woodlark Rift has been accommodated by southward subduction of the Solomon Sea microplate beneath the Woodlark Basin via the Trobriand Trench, resulting in the recent volcanism seen in the D'Entrecasteaux and Amphlett islands, and in the Tufi region of the northeastern Papuan Peninsula at the western apex of the rift.

The EPCT thus represents a relatively old geological unit within the Melanesian region, and one that existed as a separate island for at least 25 million years, accounting for its pronounced faunal signature and significant degree of biotic endemism. Given its tectonically complex history, it is thus likely to contain biotic elements that arrived initially by overwater dispersal during its offshore phase and underwent insular diversification, and other elements that subsequently arrived by overland dispersal following its collision with proto-New Guinea; this mixed biota was then subjected to vicariance by the dislocation of the islands along the EPCT's eastern flank. As such, it provides a challenging area for deciphering faunal histories and their relationship to regional tectonics.

The modern topography of the EPCT, including the offshore D'Entrecasteaux Islands and Louisiade Archipelago, is generally mountainous, with numerous swift, high gradient streams dropping directly toward the sea. The surface petrology is predominantly metamorphic, and the streams typically cascade over high waterfalls in their middle reaches, formed by expo-

sures of this metamorphic bedrock. These waterfall zones have proven to support rich microveliine biotas, both on the wet rock faces bordering the falls themselves, and in the bedrock-rimmed plunge pools below. Many of the new species documented in the current paper were collected in association with such habitats.

TAXONOMIC ANALYSIS

In this paper we describe two new genera and 30 new species of Microveliinae from the EPCT. As with previous papers in this series, the speciose and cosmopolitan genus *Microvelia* is not considered; species in that genus, which has several distinct lineages throughout New Guinea, will be dealt with in subsequent publications.

The initial results from our work on the EPCT Microveliinae clearly support certain aspects of the geological history proposed above:

- 1.) Within the genus *Neusterensifer*, a group of species referred to herein as the "*femoralis* group" is confined to the greater EPCT. Members of this group share various combinations of the following synapomorphic character states unique within the genus: orange brown coloration; a setiferous tumescence on the posteromedial margin of the male hind femur; posteriorly convergent female connexiva with tufts of stiff black setae arising from their inner faces and projecting vertically between the appressed connexival margins; and narrowing and prolongation of female abdominal tergite VII into a finger-like posterior projection. Representatives of the *femoralis* group are found throughout the EPCT, even on such widely dispersed fragments as Woodlark Island, the Louisiade Archipelago, and the D'Entrecasteaux Islands; such a distribution is congruent with the concept of an initially intact land mass harboring a distinct insular biota that was subsequently subdivided by tectonic events.

- 2.) The hygroptetric genus *Rheovelina* is endemic to the EPCT and shares a distribution similar to that of the *femoralis* group of *Neusterensifer*, with the exception of Woodlark Island. By contrast, another hygroptetric microveliine genus, *Aegilipsicola*, which exhibits nearly identical ecological preferences, occurs in similar hygroptetric habitats throughout greater New Guinea and on the Raja Ampat Islands to the west, but does not occur on the offshore island groups derived from the EPCT. This suggests that *Aegilipsicola* evolved in western or central New Guinea and dispersed eastward into what are now the onshore sections of the EPCT following their accretion to New Guinea in the Late Tertiary, while *Rheovelina* evolved in the east, on the EPCT itself, and has never managed to disperse beyond the EPCT terranes it originally occupied. Both genera may now be found sympatrically on seeps in

the Owen Stanley Range, although in such cases *Aegilipsicola* is invariably the numerically dominant taxon. A third hygropterid genus, *Brechivelia*, is also endemic to the EPCT, but known to date only from the Tufi area of the Cape Nelson peninsula, where it occurs sympatrically with *Rheovelina*.

3.) In contrast to the preceding patterns, the genera *Tanyvelia* and *Tarsovelia* reach their greatest diversity on New Guinea itself, but also have disjunct endemics on the old islands of the Louisiade Archipelago. Neither genus is known from the geologically younger islands of the D'Entrecasteaux group, and their current distributions are compatible with the hypothesis that the Louisiades represent isolated remnants of a formerly more extensive Owen Stanley terrane, that extended as a continuous range of mountains far to the southeast of the current eastern terminus of New Guinea.

Cladistic analyses of all the above groups will eventually provide more insight into the processes underlying these distributional patterns.

MATERIALS AND METHODS

Collections of Microveliinae were made by visual searching, hand netting, and localized pyrethrin fogging of riparian logs and hygropterid habitats. Specimens obtained were preserved in 80% ethanol, then transported to the Bishop Museum in Honolulu and subsequently to the Smithsonian Institution in Washington, DC for preparation. Descriptions of color, structure and setiferation were taken from dry, point-mounted specimens. All measurements are given in millimeters, and were taken using an ocular micrometer on a Leica M 10 dissecting microscope. CL numbers following collection locality data refer to a coding system used by the authors to cross-reference specimens with photographs and metadata.

The holotypes of the new species described herein are deposited in the National Museum of Natural History, Smithsonian Institution (USNM); paratypes are held in that collection, and in the Bishop Museum, Honolulu (BPBM), and the J. T. Polhemus collection, Englewood, Colorado (JTPC).

Revised key to genera of New Guinea Microveliinae

1. Body dorsoventrally flattened, strongly sexually dimorphic, males much smaller than females; dorsum of female thorax and basal abdomen depressed, often with patches of waxy secretion laterally on thorax (Polhemus & Polhemus 2000a, fig. 8); middle claws and downcurving arolium modified into thin narrow blades (Polhemus & Polhemus 2000a, fig. 10)

- *Phoreticovelina* Polhemus & Polhemus
- Body not dorsoventrally flattened, not strongly sexually dimorphic, males only slightly smaller than females; dorsum of female thorax and basal abdomen not depressed, without patches of waxy secretion; claws and arolia may or may not be modified 2
- 2. Large species, length of males 3.25-3.50 mm, of females 3.80-4.10 mm.; middle and hind tarsi with both arolia and both claws modified into leaf-like blades (Polhemus & Polhemus 2000a, fig. 3); males with abdominal sternites II-V tumid medially, produced ventrally, sternite VIII with a large dagger-like structure directed anteriorly, acuminate distally (Polhemus & Polhemus 2000a, figs. 2, 4)
- *Papuavelina* Polhemus & Polhemus
- Smaller species, length of males not exceeding 3.0 mm, females not exceeding 3.2 mm.; tarsi with arolia and claws not modified into leaf-like blades; male abdominal sternites sometimes modified, but not as above 3
- 3. Middle tarsi subequal in length to middle tibia (Polhemus & Polhemus 1994, fig. 9); light markings on hemelytra restricted to basal angles; fore femur of male at least slightly modified for phoresy *Tarsovelia* Polhemus & Polhemus
- Middle tarsi distinctly shorter than middle tibia; light markings on hemelytra may be restricted to basal angles, or may occur also on distal portions; fore femur may or may not be modified for phoresy 4
- 4. Second antennal segment clearly longer (1.1/1) than first segment; male abdominal segment VIII strongly asymmetrical (fig. 17)
- *Brechivelia* gen. n.
- Second antennal segment subequal to or shorter than first segment; male abdominal segment VIII symmetrical, or nearly so 5
- 5. Claws extremely long (Polhemus & Polhemus 2000a, fig. 18), clearly much longer than first tarsal segment; light hemelytral markings of macropters or micropters entirely bright greyish to light bluish pruinose 6
- Claws relatively short, subequal to or shorter than first tarsal segment; light hemelytral markings not bright pruinose 7
- 6. Head without highly contrasting markings; rostral cavity demarcated by strongly raised carina; only macropterous and micropterous morphs known (Polhemus & Polhemus 1994, fig. 5; Polhemus & Polhemus 2000b, fig. 13), with the former predominant
- *Aegilipsicola* Polhemus & Polhemus
- Head with highly contrasting longitudinal light stripes (fig. 2); rostral cavity not demarcated by

- strongly raised carina; apterous and micropterous forms predominant *Rheovelina* gen. n.
7. Antennae long, $\frac{3}{4}$ or more of body length (Polhemus & Polhemus 1994, fig. 1); comb on fore tibia $\frac{3}{4}$ the length of the tibia; pale markings of forewing tinged with bluish pruinose, occurring only in cells on basal half of wing *Tanyvelia* Polhemus & Polhemus
- Antennae shorter, clearly less than $\frac{3}{4}$ of body length; comb on fore tibia less than $\frac{3}{4}$ length of tibia (except in *Neusterensifer compacta*), if comb on fore tibia $\frac{3}{4}$ length of tibia then male proctiger bearing elongate process and female abdominal tergites VII and VIII forming an anal plate (see below); pale markings of forewing white, variable in distribution 8
8. Male genitalia rotated 90° sinistrally and highly modified, bearing a long sinuate anteriorly directed sword-like process arising from the proctiger (figs. 39-44); female abdominal tergites VII-VIII deflected ventrad forming an anal plate; forewing frequently with elongate pale streaks in basal cells, sometimes accompanied by much smaller pale spots in distal cells *Neusterensifer* Polhemus & Polhemus
- Male genitalia usually in normal orientation, in some cases rotated sinistrally to a slight degree, but less than 90°, and always without a long sword-like process arising from the proctiger; female abdominal tergites VII-VIII not deflected ventrad, not forming an anal plate; forewing lacking pale areas basally, but frequently with multiple prominent pale spots distally *Microvelia* Westwood

Rheovelina gen. n.
(figs. 2-15)

Type-species: *Rheovelina petrophila* Polhemus & Polhemus
sp. n.

Description

Size. – Micropterous form, length of males 2.00-2.50 mm., females 2.20-2.50 mm.; submacropterous form, length of males 2.39-2.50 mm., females 2.55-2.61 mm.; macropterous form, length of males 2.20 mm., females 2.50-2.90 mm.; general body characteristics and size not sexually dimorphic, males and females similar.

Colour. – Ground colour brown, with yellowish markings; head with two prominent yellowish longitudinal stripes (fig. 2); pronotum anteriorly with a yellowish transverse stripe behind vertex of head, interrupted medially; connexiva mostly yellowish, dark at intersegmental sutures; female abdominal tergites VI-VIII yellowish, much darker in males; venter

mostly yellowish. Wings in macropterous forms dark brown to black with pale pruinose lavender markings consisting of one or two elongate streaks laterally past middle in basal cells, followed by 3-5 small to large irregular spots on distal $\frac{3}{4}$ in distal cells.

Structural characters. – Micropterous, submacropterous and macropterous forms known; shape narrow-elongate (figs. 2, 12). Eyes globose, exerted but not beyond anterolateral pronotal angles, separated by slightly more than twice the width of an eye, slightly removed from anterior pronotal margin, with moderate length ocular setae. Head declivant anteriorly, posterior margin sloping caudo-dorsally, with usual three pairs of facial trichobothria plus numerous short setae; vertex with prominent median sulcus; gular region short, plainly visible, rostral cavity closed posteriorly. Rostrum reaching to middle of mesosternum (fig. 12), segment I short, enclosed in rostral cavity, segment IV about twice the length of I, almost four times longer than II, segment III more than 5 times as long as II. Antennae slender, segments III and IV very long, total length about $\frac{3}{4}$ of body length.

Pronotum very slightly raised medially, with weak median carina anteriorly; collar weakly formed, absent medially, evident behind eyes laterally; anterior and posterior lobes set off by a transverse row of obscure foveae, evanescent laterally; entire dorsum densely set with short to moderate length decumbent golden setae; with large triangular patches of silvery setae behind eyes; posterior lobe with numerous small foveae, humeri not prominent, broadly rounded posteriorly, not modified, covering metanotum. Thoracic venter not diagnostic, with weakly formed tubercles on either side of mesosternal midline on posterior margin opposing an unmodified metasternum. Metasternal scent gland opening (omphalium) small but visible, marked by a small tubercle; scent channels prominent, curving slightly anterad to base of metacetaulae. Wing pads present but barely visible in some micropters, not visible in others, reaching tergite IV in brachypters; wings in macropterous forms reaching past tip of abdomen, bearing 4-5 closed cells, consisting of two elongate cells basally, two more elongate cells centrally, and occasionally another single smaller cell distally.

Abdomen broad, several species with two (1+1) foveae on either side of midline between tergites I and II appearing silvery; without longitudinal carinae on tergites; tergites II-VI subequal in length, I shorter, VII longer. Abdominal sternites set off from laterosternites by hair-free glabrous oval lacunae; male ventrites VII-VIII variously modified.

Legs slender, long, hind legs much longer than others; anterior femur set beneath with short light setae, unmodified in males; anterior tibia of male with a comb of minute black setae occupying $\frac{2}{3}$ of tibial length; middle and hind femora set ventrally with long

Fig 2. *Rheovelia petrophila*, micropterous female, dorsal habitus. Young Sohn illustration.

slender setae; all tarsi long (fig. 2), claws extremely long, slender; both up- and down curving arolia long, slender (fig. 3).

Male ventrite VII variously modified (figs. 4-11), genital segments small to prominent, ventrite VIII variously modified, bent sharply ventrad in several species; pygophore unmodified; parameres small, triangular, symmetrical, hidden; proctiger not modified; tergite IX rounded, protruding. Female with tergite VIII on same plane as VII, sometimes truncate posteriorly; proctiger forming an anal plate or lid, bent ven-

trad, concealing gonocoxae and genital opening; anal cone often visible, sometimes sharp, projecting.

Etymology

The generic name *Rheovelia* is derived from *rheos* (Gr.), flow, stream, referring to the wet vertical rock habitat, and *Velia*, the nominate genus of the family. Gender feminine.

Comparative notes

Rheovelia differs from all other microveline genera

Fig. 3. *Rheovelina petrophila*, male middle tarsus.

of the region by possessing very long slender claws (fig. 3) coupled with a short gula and rostral cavity not demarcated by a strongly raised carina; it is known from the micropterous, submacropterous and macropterous morphs, with the former predominant in most populations sampled. The closest Papuan genus in general appearance and ecology, *Aegilipsicola* J. Polhemus & D. Polhemus, has similarly long slender claws (shared with *Aegilipsovelia* J. Polhemus of the New World tropics), but with a long gula and rostral cavity clearly demarcated by a strongly raised carina, and is not known only from micropterous morphs, with macropterous morphs predominating instead. The hemelytral markings of both genera, when visible wings are present, are bright pruinose greyish to light bluish or lavender.

A related genus, *Brechivelia* (described subsequently in this paper), has long but somewhat thickened claws (fig. 18) and a similar rheophilic ecology. It is easily distinguished by its asymmetrical male abdominal segment VIII, and extremely long antennae (figs. 16, 17).

Biological notes

Species of *Rheovelina* are obligatorily hygropetric, occurring on the sloping to vertical seeping rheocrenes that form adjacent to the waterfalls and riparian

bedrock exposures typical of high gradient streams in eastern New Guinea and proximal islands. They typically prefer open bedrock substrates without a covering of moss or algae, generally in shaded situations, and have never been observed skating on pools or other standing water surfaces, even when such pools immediately adjoin their moist bedrock habitats. In this regard their ecological preferences are nearly identical to those of the genus *Aegilipsicola*, which occurs throughout the main island of New Guinea and is occasionally sympatric with *Rheovelina* in the Owen Stanley Range.

For additional notes see discussions under individual species below.

Distribution

Far eastern New Guinea and adjacent islands (Basilaki, Normanby, Fergusson, Misima, Tagula, Rossel) (figs. 13-15).

The genus *Rheovelina* as currently understood is confined to land masses derived from the East Papua Composite Terrane, including the Papuan Peninsula, Basilaki Island, the D'Entrecasteaux Islands, and the Louisiade Archipelago. Despite intensive recent searches in suitable habitats on the isolated EPCT fragment of Woodlark Island, the genus has yet to be collected there.

Key to the species of *Rheovelina*

Note: the following key is primarily applicable to males, but will work for females of certain species. For many species, particularly those occurring on particular islands, geographical provenience will indicate the species involved; in other cases, females will need to be indentified by association with males.

1. Male abdominal ventrite VIII largely withdrawn into ventrite VII, directed ventrally, bearing a large anteriorly directed process extending anteriorly over at least the posterior margin of ventrite VII (figs. 4-7) 2
- Male abdominal ventrite VIII not withdrawn into ventrite VII, not directed ventrally, without an obvious anteriorly directed process, instead with a small raised ridge or process on posterior margin (figs. 8-11) 5
2. Anteriorly directed process of male ventrite VIII short, triangular, barely reaching over posterior margin of ventrite VII (fig 7); female with proctiger directed ventrally, not visible in lateral view; Basilaki Island *R. basilaki* sp. n.
- Anteriorly directed process of male ventrite VIII long, reaching at least middle of ventrite VII (figs. 4-6); female with proctiger directed posteriorly, visible in lateral view 3
3. Anteriorly directed process of male ventrite VIII

Figs. 4–11. *Rheovelina* species, ventral view of male terminal abdomen, with detail of processes on ventrite VIII. – 4, *R. petrophila*; 5, *R. asymmetrica*; 6, *R. truncata*; 7, *R. basilaki*; 8, *R. insularis*; 9, *R. robinae*; 10, *R. fonticola*; 11, *R. anomala*.

- truncate to slightly concave distally (fig. 6); western Owen Stanley Range *R. truncata* sp. n.
- Anteriorly directed process of male ventrite VIII in the shape of a broad-headed dagger, distally triangular, slightly to strongly asymmetrical (figs. 4, 5) 4
 - 4. Anteriorly directed process of male ventrite VIII long, almost reaching anterior margin of ventrite VII (fig. 4); ventrite VII simple, not tumid, with paired (1+1) depressions laterally (fig. 4); female connexiva distally raised, acute, projecting (figs. 2, 12); extreme eastern Papuan Peninsula *R. petrophila* sp. n.
 - Anteriorly directed process of male ventrite VIII shorter, reaching about half way to anterior margin of ventrite VII (fig. 5); ventrite VII with paired (1+1) tumescences anteriorly, set with long semi-erect setae; female connexiva distally flat, not raised, blunt, not projecting; western Owen Stanley Range *R. asymmetrica* sp. n.
 - 5. Posterior process of male ventrite VIII simple, a ventrally directed truncate triangular ridge with a distinct deep notch; ventrite VII tricarinate (Fig. 9); D'Entrecasteaux Islands *R. robiniae* sp. n.
 - Posterior process of male ventrite VIII with one or two obvious notches, resulting in two or three protuberances (figs. 8, 10, 11); ventrite VII at most bicarinate 6
 - 6. Posterior process of male ventrite VIII with two notches, resulting in a rounded median protuberance flanked by two smaller protuberances (Fig. 10); Cape Nelson Peninsula *R. fonticola* sp. n.
 - Posterior process of male ventrite VIII with only a median notch (figs. 8, 11) 7
 - 7. Posterior process of male ventrite VIII with two triangular protuberances (Fig. 8); Tagula and Rossel Islands *R. insularis* sp. n.
 - Posterior process of male ventrite VIII with two sharp pointed protuberances (Fig. 11); Misima Island *R. anomala* sp. n.

***Rheovelina petrophila* sp. n.**
(figs. 2-4, 12, 13)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., headwater reach of Goilayoli River above bridge crossing on road from Watunou to Huhuna, 18.5 km. ENE of Alotau, 275 m. [900 ft.], 10°18'43"S, 150°37'16"E, water temp. 24.5 °C., 6 April 2002, 10:00-13:00 hrs., CL 7161, D. A. & J. T. Polhemus (USNM, JTPC). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 13 micropterous males, 8 micropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM); 10 micropterous males, 17 micropterous females, Cloudy Mountains, headwater tributary to upper Watuti River, S. of Gele-malaia, 715 m. [2350 ft.], 10°29'50"S, 150°13'58"E, water temp. 22 °C., 10 April 2002, 16:00-17:30 hrs., CL 7175, D. A. Polhemus (USNM, JTPC, BPBM); 1 micropterous male, 3

micropterous females, Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, midreach and waterfall approx. 2.5 km. above mouth, 45-75 m. [150-250 ft.], 10°19'39"S, 150°34'36"E, water temp. 24.5 °C., 5 April 2002, 09:45-16:30 hrs., CL 7163, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.15-2.20 mm ($\bar{x}$ = 2.19, n = 5); width 0.85-0.90 mm ($\bar{x}$ = 0.86, n = 5). Micropterous female, length 2.30-2.35 mm ($\bar{x}$ = 2.33, n = 5); width 0.90-1.00 mm, ($\bar{x}$ = 0.95, n = 5).

Colour. – Micropterous male: ground colour dark brown, head, anterior pronotum, connexiva, abdominal tergites VI -VIII with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two broad longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe transversely yellowish brown between eyes, interrupted medially; large triangular patches of silvery hairs present anterolaterally, extending behind vertex. Wing pads tiny, barely visible. Abdomen brown; paired foveae (1+1) between tergites I and II with silvery hairs; connexiva broadly orange brown, irregularly darker at sutures; tergites VI-VIII extensively marked with orange brown. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.52, width 0.60; width of eye/interocular space, 0.12/0.37. Pronotum long, posterior margin evenly curving, not angulate, humeri obscure; length (midline)/width, 0.45/0.85.

Abdominal tergites with II-V subequal, tergite VI longest, tergite VII retracted and not visible (0.08, 0.07, 0.06, 0.10, 0.40, hidden, respectively), abdominal venter bearing short, fine, pale setae; ventrites VI-VII slightly flattened and raised; ventrite VII excavated posteriorly to accommodate anteriorly directed process of segment VIII; first genital segment (segment VIII) curved downward into a vertical orientation, posteroventral margin bearing an asymmetrical anteriorly-directed, glabrous, angulate dagger-like projection (fig. 4), clothed with long setae laterally, this projection conforming to the medial concavity of ventrite VII.

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3-4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.30 : 0.15 : 0.55 : 0.65.

Fig. 12. *Rheovelina petrophila*, micropterous female, lateral habitus. Young Sohn illustration.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.52 : 0.28 : 0.0; of middle leg, 0.90 : 0.75 : 0.05 : 0.12; of hind leg, 1.10 : 1.50 : 0.10 : 0.40.

Paramere small, triangular, hidden; proctiger not modified.

Micropterous female: Similar to male in general structure and coloration, but larger. Connexiva raised to about 45°, broadly separated posteriorly, evenly tapering toward tip of abdomen, posterolateral angles acute, produced posteriorly; abdominal venter unmodified.

Etymology

The name *petrophila* describes the affinity of this species for damp vertical rock surfaces.

Distribution

Eastern New Guinea (fig. 3).

Comparative notes

Rheovelina petrophila is easily separated from the other species of the genus by the ventrally directed abdominal segment VIII of the male, bearing a prominent dagger-like projection, and female with distinctly protruding posterior connexival angles.

Biological notes

The Goilayoli River at the type locality was a clear, cool upland stream set in a narrow, channel partially incised in bedrock, and heavily shaded by primary upland rain forest. The bed profile of the main stream consisted of pools 0.5–1.3 m. deep alternating with small cascades at transverse bedrock sills and shallow riffles of cobble and gravel. Numerous seeping bedrock faces were present along the margins of the main chan-

nel, and several small, steeply dropping tributaries entered from the surrounding rain forest hills, with stair-step bed profiles of alternating vertical seeps and small pools. The type series of *R. petrophila* was taken from the vertical seeps along both the main channel and the tributaries, with the insects being particularly abundant next to small, trickling waterfalls on the tributaries. The insects appeared to be obligatorily hypogetric, and were never observed skating on pools.

Rheovelina robinae sp. n.

(figs. 9, 13)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Fergusson Island, east coast, cascading tributary to Mebulibuli Creek, S. of Basima, 0.9 km. upstream of mouth, 15 m. [50 ft.], water temp. 24.5 °C., 24 August 2002, 13:30–14:30 hrs., 9°30'41.7"S, 150°52'06.0"E, CL 7181, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., D'Entrecasteaux Islands: 17 micropterous males, 18 micropterous females, same data as holotype (USNM, JTPC, BPBM); 6 micropterous males, 7 micropterous females, D'Entrecasteaux Islands, Fergusson Island, east coast, Yaya River, N. of Mebulibuli Point, 0–60 m. [0–200 ft.], water temp. 25.8 °C., 23 August 2002, 10:00–16:30 hrs., 9°30'34.3"S, 150°52'51.1"E, CL 7178, D. A. & J. T. Polhemus (USNM); 1 micropterous male, 1 micropterous female, Fergusson Island, east coast, upper Awaetowa River and rocky tribs., W. of Basima, 575–650 m. [1885–2130 ft.], water temp. 22 °C., 27 January 2003, 10:00–14:00 hrs., 9°30'34.3"S, 150°48'17.3"E, CL 7225, D. A. & J. T. Polhemus (USNM); 1 micropterous female, Normanby Island, south coast, upper Apatabuia River and rocky tribs., above

Bunama, 1.38 km. above mouth, 60–90 m. [195–295 ft.], water temp. 23.5 °C., 29 January 2003, 09:00–01:00 hrs., 10°07'04.0"S, 151°09'07.2"E, CL 7228, D. A. & J. T. Polhemus (USNM); 12 micropterous males, 16 micropterous females, Normanby Island, east coast, Golupona Stream above Yeluyelua, 90 m. [295 ft.], water temp. 23 °C., 30 January 2003, 08:00–13:00 hrs, 10°02'53.3"S, 151°15'35.3"E, CL 7232, J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.33–2.40 mm ($\bar{x}$ = 2.37, n = 4); width 0.70–0.75 mm ($\bar{x}$ = 0.74, n = 4). Micropterous female, length 2.40–2.50 mm ($\bar{x}$ = 2.45, n = 4); width 0.80–0.90 mm, ($\bar{x}$ = 0.85, n = 4).

Colour. – Micropterous male: ground colour dark brown, head, anterior pronotum, connexiva, abdominal tergites VI–VIII with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two broad longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe transversely yellowish brown between eyes, interrupted medially; large triangular patches of silvery hairs present anterolaterally, extending behind vertex. Wing pads not visible. Abdomen brown; paired foveae (1+1) between tergites I and II without silvery hairs; connexiva broadly orange brown, irregularly darker at sutures; tergites VI–VIII extensively marked with orange brown. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.55, width 0.60; width of eye/interocular space, 0.12/0.40. Pronotum long, posterior margin evenly curving, not angulate, humeri obscure; length (mid-line)/width, 0.50/0.80.

Abdominal tergites with II–V subequal, tergite VI longest, tergite VII retracted and not visible (0.20, 0.12, 0.15, 0.15, 0.30, hidden, respectively), abdominal venter bearing short, fine, pale setae; ventrites IV–VI medially depressed; ventrite VII tricarinate, posteriorly transversely carinate and slightly excavated (fig. 9); first genital segment (segment VIII) extending posteriorly, posteroventral margin bearing a ventrally directed truncate triangular protuberance without a notch (fig. 9).

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.30 : 0.20 : 0.55 : 0.63.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.70 : 0.50 : 0.28 : 0.0; of middle leg, 1.00 : 0.90 : 0.05 : 0.30; of hind leg, 1.20 : 2.06 : 0.08 : 0.40.

Paramere small, triangular, hidden; proctiger not modified.

Micropterous female: Similar to male in general structure and coloration, but larger. Connexiva raised to about 45°, broadly separated posteriorly, evenly tapering toward tip of abdomen, posterolateral angles truncate, not produced posteriorly; abdominal venter unmodified.

Etymology

The name *robinae* is in honor of Robin Polhemus, the wife of the first author.

Distribution

Eastern New Guinea, D'Entrecasteaux Islands (fig. 13).

Comparative notes

Rheovelina robinae may be separated from the other species of the genus by the tricarinate abdominal ventrite VII of the male, male abdominal ventrite VIII bearing a small truncate projection without a notch, and the widely separated truncate posterior connexival angles of the female.

Biological notes

The type locality was a small, splashing cascade partially shaded by lightly disturbed lowland rain forest, and dropping 1.5 m. over a vertical exposure of dark bedrock. This cascade lay just above a riverside trail on a tributary to Mebulibuli Creek, a much larger, rocky stream draining the hills of eastern Fergusson Island. The insects were found in abundance on the wet bedrock exposures adjacent to the cascade itself, in company with *Ochterus* and *Hebrus* species. At the nearby Yaya River, *R. robinae* was taken in a similar situation at a small cascade flanked by seeping rock faces on the main channel of a clear, 0.3–1.0 m. deep creek surrounded by primary rain forest.

Rheovelina insularis sp. n.

(figs. 8, 13)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Rossel [Yela] Island, Woa River and rocky tributaries, from head of estuary to 4 km. upstream, 0–150 m. [0–500 ft.], 11°20'36.7"S, 154°07'06.4"E, water temp. 23 °C., 31 August–1 September 2002, CL 7196, D. A. & J. T. Polhemus

(USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago: 23 micropterous males, 21 micropterous females, Rossel Island, same data as holotype (USNM, JTPC, BPBM); 14 micropterous males, 16 micropterous females, Tagula [Sudest] Island, Kolukolu Creek, near Araeda village, 0–105 m. [0–350 ft.], 11°26'44.7"S, 153°25'56.8"E, water temp. 23 °C., 30 August 2002, 11:00–16:00 hrs., CL 7194, D. A. & J. T. Polhemus (USNM, BPBM); 16 micropterous males, 5 micropterous females, Tagula [Sudest] Island, Kalitau Creek, bedrock face on small trib. approx. 1 km. upstream from head of estuary, 30 m. [100 ft.], 11°21'51.7"S, 153°14'26.0"E, water temp. 24.4 °C., 29 August 2002, 09:30–14:30 hrs., CL 7190, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.15–2.25 mm ($\bar{x}$ = 2.20, n = 4); width 0.60–0.70 mm ($\bar{x}$ = 0.64, n = 4). Micropterous female, length 2.35–2.40 mm ($\bar{x}$ = 2.39, n = 4); width 0.70–0.80 mm, ($\bar{x}$ = 0.76, n = 4).

Colour. – Rossel Island specimens: Micropterous male: ground colour dark brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two broad longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe transversely yellowish brown between eyes, interrupted medially; large triangular patches of silvery hairs present antero-laterally, extending behind vertex. Wing pads not visible. Abdomen brown; paired foveae (1+1) between tergites I and II without silvery hairs; connexiva broadly yellowish, infused with brown, with an irregular median longitudinal stripe; tergite I with two (1+1) quadrate yellowish spots; tergites II–VIII extensively marked with orange brown, becoming lighter distally. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declinant anteriorly; length 0.50, width 0.57; width of eye/interocular space, 0.15/0.40. Pronotum long, posterior margin evenly curving, not angulate, humeri obscure; length (mid-line)/width, 0.48/0.70.

Abdominal tergites with II–V subequal, tergite VI longest, tergite VII retracted and not visible (0.15, 0.10, 0.12, 0.12, 0.27, hidden, respectively); connexiva most widely separated at tergite IV, then evenly converging toward tip of abdomen but not meeting; abdominal venter bearing short, fine, pale setae; ventrite VII with an anteriorly directed triangular carina, excavate behind; first genital segment (segment VIII) extending posteriorly, posteroventral margin bearing

a ventrally directed truncate triangular protuberance, with a notch (fig. 8).

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with some silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.35 : 0.20 : 0.62 : 0.70.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.70 : 0.55 : 0.27 : 0.0; of middle leg, 0.90 : 0.80 : 0.05 : 0.32; of hind leg, 1.13 : 1.50 : 0.07 : 0.42.

Paramere small, triangular, hidden; proctiger not modified.

Micropterous female: Similar to male in general structure and coloration, but larger. Connexiva raised to about 30° to 45°, narrowly separated posteriorly, most widely separated at tergite IV, then evenly tapering toward tip of abdomen, posterolateral angles acute, curved inward; abdominal venter unmodified.

Etymology

The name *insularis* is in recognition of the occurrence of this species on the most remote islands of the Louisiade Archipelago.

Distribution

Tagula and Rossel Islands, Louisiade Archipelago (fig. 13).

Comparative notes

Rheovelina insularis may be separated from the other micropterous species of the genus by the triangular carina on ventrite VII of the male, segment VIII bearing a small truncate projection with a notch, and female with weakly convergent and acute protruding posterior connexival angles. It is known only from the micropterous form, separating it from *R. anomala*.

Although there are slight differences between the populations of this species from Rossel and Tagula islands, we have not considered this variation significant enough to warrant separate species or subspecies status. In the Tagula specimens the ground coloration is much darker in comparison to those from Rossel, and the light markings are yellowish brown to orange brown. The general pattern of the pale markings on the head, pronotum and abdomen of the Tagula forms is similar to that of the Rossel forms, but these markings are less extensive and barely evident on abdominal tergites II–IV and on the inner part of the connexiva. In Tagula males, the abdominal connexiva converge evenly toward the posterior apex of the ab-

Fig. 13. Distribution of *Rheovelia* species in the far eastern New Guinea region.

domen, whereas in the Rossel males they bow outward and are most widely separated adjacent to tergite IV. Despite these minor differences, all other external characteristics, including the pregenital structures, are the same between the two populations.

Biological notes

The Woa River at the type locality was a broad, clear river in a cobble bed, surrounded by undisturbed primary rain forest and flowing northeastward from the slopes of Mt. Mbo on western Rossel Island. In its upper midreach the river channel became set with scattered large boulders and confined between bedrock walls, with the bed profile consisting of alternating small rapids and deep pools. The type series of *R. insularis* was taken from seeps along the bedrock walls bordering the channel in this reach, and from sloping to vertical bedrock seeps on steeply dropping tributaries that joined the main river at various points.

On Tagula Island, a series of *R. insularis* was taken from a heavily shaded, steeply dropping tributary to Kalitau Creek, a small, clear stream in a very rugged bed of metamorphic bedrock and cobbles. The insects were found along the tributary at a point where a near-

ly dry waterfall face with only remnant seeping flow rose above a narrow plunge pool. Another series was taken further east on Tagula from vertical faces of wet, unshaded metamorphic bedrock at Kolukolu Creek, where this stream cascaded over a 20 m. high waterfall into the head of a mangrove estuary. In all these cases the specimens of *Rheovelia* were found only on open bedrock faces with a thin, nearly laminar flow of water, further illustrating the hygropetric ecology of this genus.

Rheovelia anomala sp. n. (figs. 11, 15)

Material examined. – Holotype, submacropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Misima Island, north coast, Guwana Creek, near Nulia village, 15–30 m. [50–100 ft.], water temp. 22 °C., 3 September 2002, 10:00–12:00 hrs., 10°39'22.8"S, 152°41'16.5"E, CL 7201, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Misima Island: 82 submacropterous males, 88 submacropterous females, same data as holotype (USNM,

JTPC, BPBM); 6 submacropterous males, 6 submacropterous females, south coast, wet bedrock faces on headwater trib. of Keyana Creek, above Bwagabwaga village, 305–335 m. [1000–1100 ft.], water temp. 22.5 °C., 4 September 2002, 10:00–12:00 hrs., 10°40'33.8"S, 152°40'44.9"E, CL 7206, D. A. & J. T. Polhemus (USNM); 1 macropterous male, 1 macropterous female, 25 submacropterous males, 32 submacropterous females, south coast, small waterfall at Awamuluwa, W. of Bwagabwaga village, 15 m. [50 ft.], water temp. 24.6 °C., 4 September 2002, 10:00–10:15 hrs., 10°41'07.8"S, 152°40'12.1"E, CL 7208, D. A. & J. T. Polhemus (USNM).

Description

Size. – Submacropterous male, length 2.35–2.45 mm ($\bar{x}$ = 2.40, n = 4); width 0.70–0.75 mm ($\bar{x}$ = 0.74, n = 4). Submacropterous female, length 2.70–2.80 mm ($\bar{x}$ = 2.72, n = 4); width 0.80–0.90 mm, ($\bar{x}$ = 0.86, n = 4).

Colour. – Submacropterous male: ground colour dark brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two prominent longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe transversely yellowish brown between eyes, interrupted medially; large triangular patches of silvery hairs present anterolaterally, extending behind vertex. Wing pads extending onto tergite IV, dark, narrowly bright bluish pruinose basally, tiny grey spot at distal $\frac{2}{3}$, distally bright white. Abdomen brown; paired foveae (1+1) between tergites I and II not visible; connexiva broadly yellowish, irregularly darker at sutures; tergites V–VIII extensively marked with orange brown, becoming lighter distally. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.50, width 0.62; width of eye/interocular space, 0.15/0.60. Pronotum long, posterior margin forming an obtuse angle, humeri prominent; length (midline)/width, 0.75/0.80.

Abdominal tergites with II–V subequal, tergite VI longest, tergite VII shortest (0.15, 0.15, 0.12, 0.15, 0.30, 0.10, respectively); abdominal venter bearing short, fine, pale setae; ventrite VII medially flattened, margins of flat area weakly carinate, posterior margin V-shaped, excavate behind; first genital segment (segment VIII) extending posteriorly, posteroventral margin bearing a ventrally directed truncate triangular protuberance, with a notch.

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with

longer, erect, pale, pilose setae; all femora with silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.37 : 0.22 : 0.60 : 0.65.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.75 : 0.62 : 0.32 : 0.0; of middle leg, 0.95 : 0.90 : 0.06 : 0.35; of hind leg, 1.25 : 1.65 : 0.08 : 0.40.

Paramere small, triangular, hidden; proctiger not modified.

Submacropterous female: Similar to male in general structure and coloration, but larger. Connexiva raised to about 30° basally, infolded and convergent posteriorly, evenly tapering toward tip of abdomen, posterolateral angles truncate, curved inward; abdominal venter unmodified.

Macropterous female: Similar to submacropterous female in general structure and coloration with following exceptions: length 2.90 mm.; width (across pronotal humeri) 1.10 mm.; pronotum expanded, dark brown with fine punctations overlain with short recumbent gold setae, posterior margin angulate, humeri prominent, rounded. Wings extending beyond tip of abdomen, forewing bearing 4 closed cells, general coloration brown, veins black, outer basal cell with large silvery pruinose patch filling basal angle and extending posteriorly half the length of the cell, outer distal cell with filled with bluish pruinosity on basal half, inner basal cell without pale markings, posterior half of the wing with 4 small, irregular, bright white patches arranged transversely, lying basal to a very large, longitudinally elongate bright white patch extending medially nearly to wing apex.

Macropterous male: Similar to macropterous male in general structure and colour.

Etymology

The name *anomala* refers to the predominantly submacropterous state of this species, in contrast to other *Rhevelia* species which are predominantly micropterous.

Distribution

Eastern New Guinea, Misima Island (fig. 15).

Comparative notes

Rhevelia anomala may be separated from the other species of the genus by the medially flattened and posteriorly V-shaped ventrite VII of the male (fig. 11), segment VIII bearing a small truncate projection with a notch (fig. 11), and female with weakly convergent and acute protruding posterior connexival angles.

Biological notes

Guwana Creek at the type locality was a swift, moderately clear stream dropping steeply out of the sheer mountains of western Misima through a bed of metamorphic boulders and bedrock. The stream profile consisted of waterfalls, rapids and pools, some of the latter up to 2.0 m. deep. The waterfalls were bordered by rheocrenes and standing pools in bedrock, and the type series of *R. anomala* was taken from these open rheocrenes and spray-wetted boulders adjacent to the falls, where the species was extremely abundant.

Rheovelina truncata sp. n.
(figs. 6, 14, 85)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Central Prov., Owen Stanley Range, trib. to Mas River, 1.9 km. SW of Fane, 1220–1250 m. [4000–4100 ft.], wet rock face above small side spring, 8°33'33.0"S, 147°04'12.2"E, water temp. 20.5 °C., 5 October 2003, 10:45–12:30 hrs., CL 7258, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Central Prov.: 1 micropterous male, 1 micropterous female, same data as holotype, D. A. Polhemus (USNM, JTPC); 1 micropterous male, Owen Stanley Range, small cascade and seeps on trib. to Hane River, 1.3 km. SSE of Fane, 1280 m. [4200 ft.], 8°33'49.2"S, 147°05'14.0"E, water temp. 20 °C., 4 October 2003, 08:30–09:30 hrs., CL 7255, D. A. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.35–2.40 mm ($\bar{x}$ = 2.38, n = 3); width 0.85–0.90 mm ($\bar{x}$ = 0.88, n = 3). Micropterous female, length 2.35 mm (n = 1); width 0.95 mm, (n = 1).

Colour. – Micropterous male: ground colour dark brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two broad longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe transversely yellowish brown between eyes, width of stripe equal to separation from anterior margin, interrupted medially; large triangular patches of silvery hairs present anterolaterally, extending behind vertex. Wing pads not visible. Abdomen brown; paired foveae (1+1) between tergites I and II with silvery hairs; connexiva broadly yellowish, infused with irregular brown marks at each suture; tergite I with two (1+1) weak lighter spots; tergites V–VIII extensively marked with orange brown, becoming lighter distally. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.60, width 0.70; width of eye/interocular space, 0.20/0.42. Pronotum long, posterior margin evenly curving, not angulate, humeri obscure; length (midline)/width, 0.55/0.90.

Abdominal tergites with II longer than III–VI, tergite VII longest (0.25, 0.15, 0.15, 0.15, 0.20, 0.35 respectively), abdominal venter bearing short, fine, pale setae; ventrite VII weakly depressed medially, excavate behind; first genital segment (segment VIII) directed ventrally, bearing an asymmetrical truncate anteriorly directed process (fig. 6), curved in side view, extending anteriorly over much of ventrite VII.

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with some silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.35 : 0.20 : 0.60 : 0.75.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.75 : 0.55 : 0.30 : 0.0; of middle leg, 1.00 : 1.00 : 0.10 : 0.35; of hind leg, 1.40 : 1.70 : 0.12 : 0.40.

Paramere small, triangular, hidden; proctiger not modified.

Micropterous female: Similar to male in general structure and coloration, but larger. Connexiva raised to about 20°, widely separated posteriorly, evenly tapering toward tip of abdomen, posterolateral angles weakly acute, but not pointed, forming weak triangles, not convergent; abdominal ventrite VII weakly sinuate posteriorly; protruding proctiger forming an acute angle.

Etymology

The name *truncata* refers to the truncate male process on ventrite VIII.

Distribution

Southeastern New Guinea, Central Province (fig. 14).

Comparative notes

Rheovelina truncata may be separated from the other micropterous species of the genus by the unique process of the male segment VIII, and the female with widely separated and weakly acute posterior connexival angles, slightly more prominent than in *R. robiniae*. It is known only from the micropterous form, separating it from *R. anomala*.

Biological notes

The type series was taken from a shaded, seeping exposure of metamorphic bedrock next to a small spring pool containing a few taro plants, on a trickling tributary to a swift mountain stream in the Auga River valley of the central Owen Stanley Range. The insects were captured by applying a light pyrethrin fog to the rock face and picking them up as they fell into the tiny pool below. A few additional specimens were taken syntopically with *Aegilipsicola auga* on wet bedrock faces on a tributary to the Hane River near Fane (fig. 85). The two taxa appeared to segregate habitat on the rheocene, with *A. auga* on open rock faces, and *R. truncata* in areas with a mosaic of bedrock and small scattered moss clumps.

Rheovelina asymmetrica sp. n.

(figs. 5, 14)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Central Prov., Owen Stanley Range, hill stream trib. to upper Mimani River, 2.7 km. NE of Dorobisoro, 580–685 m. [1900–2250 ft.], 9°27'22.8"S, 147°57'02.8"E, water temp. 21.5 °C., 8 October 2003, 09:30–12:30 hrs., CL 7262, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Central Prov.: 1 micropterous male, 6 micropterous females, same data as holotype (USNM, BPBM, JTPC).

Description

Size. – Micropterous male, length 2.35–2.40 mm ($\bar{x}$ = 2.37, n = 2); width 0.85–0.90 mm ($\bar{x}$ = 0.87, n = 2). Micropterous female, length 2.50–2.70 mm ($\bar{x}$ = 2.58, n = 6); width 0.95–1.10 mm, ($\bar{x}$ = 1.02, n = 6).

Colour. – Micropterous male: ground colour blackish brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two very broad longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe with a transverse yellowish stripe between eyes, interrupted medially; large triangular patches of silvery hairs present anterolaterally, extending behind vertex. Wing pads not visible. Abdomen brown; paired foveae (1+1) between tergites I and II without silvery hairs; connexiva broadly yellowish, infused with brown at sutures; tergite I weakly infused with yellowish; tergites II–VIII weakly marked with orange brown, becoming lighter distally. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.57, width 0.67; width of eye/interocular space, 0.15/0.40. Pronotum long, posterior margin evenly

curving, not angulate, humeri obscure; length (mid-line)/width, 0.50/0.87.

Abdominal tergites with II longer than III–VI, tergite VII longest (0.23, 0.17, 0.13, 0.13, 0.17, 0.35 respectively), abdominal venter bearing short, fine, pale setae; ventrite VII tumid, anteriorly with paired (1+1) tumescences set with long semi-erect setae, with paired carina extending posteriorly to the margins enclosing sternite VIII, posteriorly excavated; first genital segment (segment VIII) directed ventrally, bearing an asymmetrical dagger-like anteriorly directed process (fig. 5), this process laterally set with long setae, curved in side view, extending anteriorly over about half of ventrite VII.

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with some silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.35: 0.20 : 0.60 : 0.67.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.70 : 0.60 : 0.30 : 0.0; of middle leg, 1.00 : 0.98 : 0.10 : 0.30; of hind leg, 1.40 : 1.70 : 0.13 : 0.40.

Paramere small, triangular, hidden; proctiger not modified.

Micropterous female: Similar to male in general structure, but larger, coloration of abdominal tergites lighter. Connexiva raised to about 15°, widely separated posteriorly, evenly tapering toward tip of abdomen, posterolateral angles short, almost right angles, not raised, not curved inward; abdominal ventrite VII with a small median posterior button-like protuberance, protruding proctiger forming an acute angle.

Etymology

The name *asymmetrica* refers to the asymmetrical dagger-like process on ventrite VIII of the male.

Distribution

Southeastern New Guinea, Central Province (fig. 14).

Comparative notes

Rheovelina asymmetrica may be separated from its closest congener, *R. petrophila*, by the more asymmetrical process on male ventrite VII, which does not extend as far anteriorly over ventrite VII (extending only about halfway, versus almost reaching to the anterior margin in *R. petrophila*). In addition, ventrite VII of *R. asymmetrica* is somewhat tumid, with paired (1+1) tumescences anteriorly, on either side of depressed

midline, set with long semi-erect setae, and with paired (1+1) carinae extending posteriorly to the margins enclosing ventrite VIII; in *R. petrophila*, ventrite VII lacks these modifications, but has a pair (1+1) of depressions laterally.

The females of these two species also differ in their abdominal terminalia. In *R. asymmetrica* the connexiva are only slightly raised, and not sharp or produced, whereas in *R. petrophila* the connexiva are raised and distally acute, projecting beyond tergite VIII posteriorly, with a tuft of dark setae extending posteriorly from each. In addition, the anal cone of *R. asymmetrica* forms an acute triangle extending posteriorly, whereas in *R. petrophila* it is button-like.

Biological notes

The type series was taken from a wet exposure of metamorphic bedrock shaded by primary rain forest, bordering a cascade on a steeply dropping hill stream draining the flanks of the Mimani River valley on the southern flank of the Owen Stanley Range. The insects were very localized in their distribution, being absent on other nearby rock faces of similar appearance, and were not abundant.

Rheovelina fonticola sp. n. (figs. 10, 14)

Material examined. – Holotype, submacropterous male: PAPUA NEW GUINEA, Oro Prov., Kofure River, W. of Tufi, 0–45 m. [0–150 ft.], small trib. with waterfall, 9°04'58.2"S, 149°16'38.7"E, water temp. 28 °C., 25 January 2004, 09:30–14:00 hrs., CL 7304, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Oro Prov.: 2 macropterous males, 2 submacropterous males, 1 submacropterous female, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC).

Description

Size. – Submacropterous male, length 2.00–2.05 mm ($\bar{x}$ = 2.02, n = 3); width 0.50–0.65 mm ($\bar{x}$ = 0.58, n = 3). Submacropterous female, length 2.20 mm. (n = 1); width 0.70 (n = 1).

Colour. – Submacropterous male: ground colour dark brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish brown. Head with two broad longitudinal stripes on vertex, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe transversely yellowish brown between eyes, not interrupted medially; large triangular patches of silvery hairs present anterolaterally, extending behind vertex. Wings reaching onto tergite VI, blackish brown, each with two pruinose lavender streaks basally, two small spots medially, tips pruinose, all bright bluish grey.

Abdomen light to dark brown; paired foveae not visible; connexiva broadly yellowish, infused with brown, with an irregular median longitudinal stripe; tergites II–VIII extensively marked with orange brown, becoming lighter distally. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – submacropterous male: head of moderate length, declivant anteriorly; length 0.40, width 0.55; width of eye/interocular space, 0.10/0.30. Pronotum long, posterior margin broadly angulate, humeri prominent; length (midline)/width, 0.60/0.70.

Abdominal dorsum with only tergites with V–VII visible beyond abbreviated wings (lengths = 0.10, 0.15, 0.25 respectively); abdominal venter bearing short, fine, pale setae; ventrite VII on a plane with ventrite VI, excavate behind, excavation bordered on each side by a carina; first genital segment (segment VIII) extending posteriorly, anteroventral margin with a thin sclerotized transverse ridge, posteroventral margin bearing a ventrally directed truncate triangular protuberance, with two notches, resulting in three joined protuberances (fig. 10).

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with some silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.23 : 0.15 : 0.55 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.50 : 0.50 : 0.15 : 0.0; of middle leg, 0.70 : 0.75 : 0.05 : 0.17; of hind leg, 0.90 : 1.10 : 0.07 : 0.30.

Paramere small, triangular, hidden; proctiger not modified.

Macropterous male: Similar to submacropterous male in general structure and coloration, but with following exceptions: body length 2.20 mm; maximum width (across humeral angles of pronotum) 0.80 mm; pronotum length/width = 0.62/0.80; wings longer, reaching past tip of abdomen, bearing 5 closed cells, consisting of two elongate cells basally, two more elongate cells centrally, and a single smaller cell distally; pattern of pruinose lavender markings on hemlytra similar to brachypter basally, but with one elongate spot laterally past middle, followed by 4–5 small to large irregular spots on distal $\frac{3}{4}$, and a single large irregular spot subapically.

Submacropterous female: Similar to male in general structure and coloration, but slightly larger. Connexiva not raised, widely separated posteriorly, evenly taper-

Fig. 14. Distribution of *Rheoveelia* species on New Guinea.

ing toward tip of abdomen, posterolateral angles truncate, not curved inward, tips each with a small sharp tuft of setae; abdominal venter unmodified, proctiger deflected ventrad, anal cone button-like, protruding.

Etymology

The name *fonticola* derives from 'fontis' L., spring, and 'cola', dweller, inhabitant.

Distribution

Southeastern New Guinea, Cape Nelson Peninsula (fig. 14).

Comparative notes

Rheoveelia fonticola may be separated from the other species of the genus by its small size, the two separate protuberances of the male ventrite VIII, and by the more extensive pruinose markings on the hemelytra. The predominance of submacropterous and macropterous morphs is unusual among *Rheoveelia* species.

Biological notes

The type locality was a small, cascading tributary to the Kofure River, a moderately large, rocky stream cutting a deep gorge above the head of the Maclaren Harbor fjord near Tufi. The type series of *R. fonticola* was taken from a wet, vertical exposure of volcanic bedrock adjacent to a small cascade and plunge pool, at a point just above the confluence of the tributary with the main river.

Rheoveelia basilaki sp. n.

(figs. 7, 15, 84)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Basilaki Is., Kalawai River and rocky trib., 5-145 m. [20-475 ft.], 10°36'50.6"S, 151°01'14.4"E, water temp. 26.5 °C., pH 8.27, 17 January 2004, 09:00-14:00 hrs., CL 7294, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 1 macropterous female, 13 micropterous males, 22 micropterous females, same data as holotype (USNM, BPBM, JTPC); 16 micropterous males, 19 micropterous females, Basilaki Is., Guigoila River, trib. with waterfall, 0-15 m. [0-50 ft.], 10°36'26.7"S, 150°59'37.8"E, water temp. 26.5 °C., 18 January 2004, 09:00-13:30 hrs., CL 7296, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.10-2.15 mm ($\bar{x}$ = 2.12, n = 5); width 0.85-0.90 mm ($\bar{x}$ = 0.84, n = 5). Micropterous female, length 2.20-2.30 mm ($\bar{x}$ = 2.24, n = 5); width 0.95-1.00 mm, ($\bar{x}$ = 0.98, n = 5).

Colour. – Micropterous male: ground colour blackish brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish to leucine. Head with two very broad longitudinal stripes on vertex, posterior part except medially, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe with a transverse yellowish stripe between eyes, interrupted medially; large triangular patches of silvery hairs present antero-laterally, extending behind vertex. Wing pads white, present as tiny buds, barely visible. Abdomen brown; paired foveae (1+1) between tergites I and II with silvery hairs; connexiva broadly yellowish, infused with

brown at sutures; tergite I weakly infused with yellowish brown; tergites V–VIII weakly marked with orange brown, becoming lighter distally. Legs leucine basally, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.45, width 0.63; width of eye/interocular space, 0.12/0.40. Pronotum long, posterior margin evenly curving, not angulate, humeri obscure; length (mid-line)/width, 0.43/0.85.

Abdominal tergites with II longer than III–VI, tergite VII longest (0.20, 0.15, 0.12, 0.12, 0.15, 0.30 respectively); abdominal venter bearing short, fine, pale setae; ventrite VII tumid, anteriorly with paired (1+1) tumescences flanked by angled depressions, with paired carina extending posteriorly to the margins enclosing sternite VIII, posteriorly and anteriorly excavated; first genital segment (segment VIII) directed ventrally, bearing a triangular anteriorly directed process (fig. 7), extending anteriorly over posterior margin of ventrite VII.

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with longer, erect, pale, pilose setae; all femora with some silvery setae on basal half, best seen in light from behind insect; all legs unarmed, lacking setal tufts or other modifications. Antennae thickly clothed with short to long setae, segment I also bearing 3–4 long, spine-like black setae.

Antennal formula I : II : III : IV; 0.30 : 0.16 : 0.55 : 0.63.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.50 : 0.25 : 0.0; of middle leg, 0.77 : 0.75 : 0.10 : 0.25; of hind leg, 1.10 : 1.37 : 0.10 : 0.35.

Paramere small, triangular, hidden; proctiger not modified.

Micropterous female: Similar to male in general structure, but larger, coloration of abdominal tergites lighter. Connexiva raised to about 30°, widely separated posteriorly, evenly tapering toward tip of abdomen, posterolateral angles short, acute, very slightly raised, and curved inward; abdominal ventrite VII unmodified, proctiger deflected ventrad, withdrawn, anal cone not visible.

Macropterous female: Similar to submacropterous male in general structure and coloration, but with following exceptions: body length 2.50 mm; maximum width (across humeral angles of pronotum) 1.10 mm; pronotum length/width = 0.70/1.10; wings longer, reaching to tip of abdomen, bearing 4 closed cells, consisting of two elongate cells basally, plus two more elongate cells centrally; wings predominantly black, outer basal cell mostly filled by an elongate pale bluish pruinose streak, inner distal cell bearing a large, rough-

ly circular white patch, outer distal cell bearing an irregular, partly interrupted white streak, apex of wing beyond distal cells with a narrow longitudinal white streak medially.

Macropterous male. Unknown.

Etymology

The name *basilaki* is a noun in apposition and refers to the type locality, Basilaki Island.

Distribution

Basilaki Island (fig. 15).

Comparative notes

Rheovelina basilaki may be separated from its closest congeners (those species in which males bear a prominent anteriorly directed process on ventrite VIII) by the shorter triangular shape of the process (fig. 7). The females are unique in the genus in having the the proctiger strongly deflected ventrad and withdrawn, and the anal cone not visible in lateral view.

Biological notes

The Kalawai River at the type locality was a moderately large, swift, clear stream descending from a rain forested catchment on northern Basilaki Island. The type series of *R. basilaki* was taken from vertical wet exposures of metamorphic bedrock adjacent to a large waterfall approximately 20 m. in height along the midreach of the main river channel; additional specimens were taken from similar seeping bedrock faces that formed small rheocrenes along tributary streamlets above the main fall. Another series of *R. basilaki* was taken in a similar situation on a tributary to the Guiagoila River, where a swift, rocky stream shaded by primary rain forest cascaded over a sloping exposure of metamorphic bedrock with flanking rheocrenes (fig. 84). In all these cases, as is typical for species of *Rheovelina*, the insects were found on open rock surfaces lightly wetted by seeping flow.

Zoogeographic notes

The remarkable presence of an apparently endemic species of *Rheovelina* on Basilaki indicates that this island, although not particularly large or tall in comparison to others in the region, may be of considerable age, and may also have been isolated east of the China Strait for a prolonged period of time. Although narrow, each of the straits in the sequential series separating the eastern terminus of New Guinea from Sariba, Sideia, and Basilaki islands in turn is over 60 m. deep, and each would have represented a persistent water barrier throughout all but the lowest sea level stands of the Pleistocene (Voris 2000, Dickinson 2001). This degree of isolation appears to have been sufficient to produce speciation in certain elements of the island's

Fig. 15. Distribution of *Rheoveelia* and *Brechivelia* species in the far eastern New Guinea region.

microveliine biota, such as *Rheoveelia*, but not among others, such as *Neusterensifer*, where common species are shared with the Cloudy Mountains of nearby mainland New Guinea. The presence of an endemic *Rheoveelia*, coupled with the island's underlying metamorphic geology, indicates that it may be part of the same old and fragmented mountain chain that appears again further to the southeast as the Louisiade Islands.

Brechivelia gen. n.

(figs. 15-18)

Type-species: *Brechivelia tufi* Polhemus & Polhemus sp. n.

Description

Size. – Micropterous form, length of males 2.25–2.35 mm., females 2.50–2.70 mm; general body characteristics and size slightly sexually dimorphic, males more slender and slightly smaller than females.

Colour. – Ground colour blackish brown, with yellowish brown markings; head weakly marked with yellowish brown, without clearly defined markings; pronotum anteriorly with a yellowish brown transverse stripe behind vertex of head, weakly interrupted medially; connexiva mostly brown, darker at interseg-

mental sutures; abdominal tergites with a median pruinose line, thin basally, wider and more prominent distally; venter mostly yellowish, darker laterally and on metasternum.

Structural characters. – Only micropterous form known, shape narrow-elongate (fig 16). Eyes globose, exerted but not beyond anterolateral pronotal angles, separated by more than twice the width of an eye, slightly removed from anterior pronotal margin, with moderate length ocular setae. Head declivant anteriorly, posterior margin sloping caudo-dorsally, with usual three pairs of facial trichobothria plus numerous short setae; vertex with prominent median sulcus; gular region short, plainly visible, rostral cavity closed posteriorly, weakly carinate. Rostrum reaching to middle of mesosternum, segment I short, enclosed in rostral cavity, segment IV about twice the length of I, almost four times longer than II, segment III more than 7 times as long as II. Antennae very long and slender, segments I to IV subequal in length, very long, total length subequal to body length.

Pronotum very slightly raised medially, with weak median carina; collar weakly formed, absent medially, evident behind eyes laterally; anterior and posterior lobes set off by a transverse row of obscure foveae,

evanescent laterally; entire dorsum sparsely set with short decumbent setae; with large triangular patches of silvery setae behind eyes; posterior lobe with numerous small foveae, humeri not prominent, broadly rounded posteriorly, not modified, mostly covering metanotum. Metanotum laterally pruinose. Thoracic venter not diagnostic, with tubercles on either side of mesosternal midline on posterior margin opposing an unmodified metasternum. Metasternal scent gland opening (omphalium) visible, marked by a small tubercle; scent channels prominent, curving slightly anterod to base of metacetabulae. Wing pads not visible in micropters.

Abdomen broad, with two (1+1) glabrous foveae on either side of midline between tergites I and II; without longitudinal carinae on tergites; tergites I–VII subequal in length, VIII slightly longer. Abdominal sternites set off from laterosternites by hair-free glabrous oval lacunae; male ventrites VII–VIII variously modified.

Legs slender, long, hind legs much longer than others, hind tibia almost as long as body; anterior femur set beneath with short light setae, unmodified in males; anterior tibia of male with a comb of minute black setae occupying $\frac{4}{5}$ of tibial length; middle and hind femora set ventrally with short slender setae; all tarsi long (fig. 16), claws extremely long, somewhat thickened; both up- and down curving arolia long, slender (fig. 18).

Male ventrite II carinate, II to VII unmodified, genital segments prominent, modified, segment VIII expanded on right side to accommodate large, backwardly curving process arising from proctiger (fig. 16); parameres absent or vestigial; proctiger with large, backwardly curving process on right side (fig. 17) and smaller, angulate process on left side (fig. 17). Female with tergite VIII on almost the same plane as VII, slightly sloping, rounded posteriorly; proctiger prominent, bent slightly ventrad, gonocoxae visible.

Etymology

The generic name *Brechivelia* is derived from *Brecho* (Gr.), wet, steep, referring to the wet vertical rock habitat, and *Velia*, the nominate genus of the family. Gender feminine.

Distribution

New Guinea, Cape Nelson Peninsula, Tufi area (fig. 15).

Comparative notes

Comparative notes. – *Brechivelia* differs from all other microveliine genera of the region by possessing very long but rather stout claws (fig. 18), coupled with a short gula and rostral cavity demarcated by a weakly raised carina, and a highly modified and asymmetrical

male proctiger (fig. 17); in addition, it is known only from the micropterous morph. The most closely related Papuan genera, *Aegilipsicola* Polhemus & Polhemus and *Rheovelina* gen. n., have similarly long but quite slender claws (shared with *Aegilipsovelia* of the New world tropics), but have the male proctiger unmodified. *Aegilipsicola* has a long gula and rostral cavity clearly demarcated by a strongly raised carina. *Rheovelina* shares with *Brechivelia* the short gula, but the male abdominal segment VIII is essentially symmetrical, and the antennal ratios of the two genera are greatly different. The very long slender antennae are shared with *Tanyvelia*, but in the latter segment two is shorter than one, and neither of them are as long as three or four.

Biological notes

As with the previously described *Rheovelina*, with which it is occasionally sympatric, the single known species of *Brechivelia* is obligatorily hygropetric, occurring on vertical seeping rheocrenes emerging from bedrock exposures adjacent to small cascades. In combination with *Rheovelina* and *Aegilipsicola*, it forms part of a remarkable local biota of rheophilic Microveliinae endemic to the New Guinea region.

Zoogeographic notes

As currently understood, *Brechivelia* is confined to rheocene habitats in the deep, shady canyons draining the Nelson Range, an isolated set of Quaternary volcanoes less than 2 million years old (Bain et al. 1972). These volcanoes appear to have formed in conjunction with tectonic extension along the Woodlark Rift, creating an island-like enclave of mountain habitat well removed from the much older main cordillera of medial New Guinea. Although the areas lying between the Nelson Range and the nearest high massifs of the central mountains, such as Mt. Suckling and Mt. Dayman, are imperfectly surveyed, the fact remains that *Brechivelia* has yet to be found elsewhere on New Guinea or nearby islands. It therefore seems possible that *Brechivelia* may represent a locally endemic genus that evolved on the Nelson Range itself and has yet to spread into the remainder of the EPCT or beyond.

Brechivelia tufi sp. n.

(figs. 15–18)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Oro Prov., Kofure River and small tribs. with waterfalls, W. of Tufi, 0–45 m. [0–150 ft.], 9°04'58.2"S, 149°16'38.7"E, water temp. 28 °C., 25 January 2004, 09:30–14:00 hrs., CL 7304, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Oro Prov.: 9 micropterous males, 13

Fig. 16. *Brechivelia tufi*, dorsal habitus.

micropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC).

Description

Size. – Micropterous male, length 2.25–2.35 mm ($\bar{x}$ = 2.30, n = 4); width 0.60–0.70 mm ($\bar{x}$ = 0.66, n = 4). Micropterous female, length 2.50–2.75 mm ($\bar{x}$ = 2.61, n = 6); width 0.80–0.90 mm, ($\bar{x}$ = 0.86, n = 6).

Colour. – Micropterous male (see generic description): ground colour blackish brown, head, anterior pronotum, connexiva, abdominal tergites with yellowish brown to orange brown markings; venter mostly yellowish. Head without prominent markings, lower part yellowish brown. Pronotum dark blackish brown; laterally narrowly lighter brown; anterior lobe with a transverse yellowish stripe between eyes, weakly interrupted medially; large triangular patches of silvery pruinose present anterolaterally, extending behind vertex. Wing pads not visible. Abdomen brown; paired foveae (1+1) between tergites I and II glabrous; connexiva broadly yellowish, infused with brown at sutures; tergite I weakly infused with yellowish; tergites I and II silvery pruinose laterally, II–VII with a median pruinose line, more pronounced distally. Legs leucine to yellow, upper surfaces marked with brown distally on femora, becoming more uniform on tibiae and tarsi.

Structural characters (see generic description). – Micropterous male: head of moderate length, declivant anteriorly; length 0.40, width 0.55; width of eye/interocular space, 0.13/0.30. Pronotum long,

posterior margin evenly curving, not angulate, humeri obscure; length (midline)/width, 0.55/0.75.

Abdominal tergites with II longer than III–VI, tergite VII longest (0.15, 0.11, 0.11, 0.12, 0.12, 0.25 respectively); abdominal venter bearing short, fine, pale setae; ventrites II to VII unmodified; first genital segment (segment VIII) modified, expanded on right side and slightly twisted to enclose the asymmetrical proctiger; ventrite VIII depressed on right side anteriorly, then curving ventrad creating a sheath for arm on right side of the proctiger (fig. 16).

Legs clothed with numerous short, appressed, pale setae, intermixed on ventral surface of fore femur with slightly longer, erect, pale, pilose setae; fore tibia with grasping comb over $\frac{4}{5}$ of length; all legs unarmed, lacking setal tufts or other modifications. Antennae very long, slender, thickly clothed with short setae, segment I also bearing several long, spine-like black setae.

Antennal formula I : II : III : IV; 0.55 : 0.60 : 0.65 : 0.70.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.90 : 0.75 : 0.25 : 0.0; of middle leg, 1.07 : 1.10 : 0.10 : 0.25; of hind leg, 1.40 : 2.00 : 0.20 : 0.30.

Parameres absent or vestigial; proctiger with large, backwardly curving process on right side (fig. 17) and smaller, angulate process on left side (fig. 17).

Micropterous female: Similar to male in general structure, but larger, broader, coloration of abdominal tergites lighter, tergites I–III broadly silvery pruinose laterally. Connexiva raised, almost vertical, separated posteriorly, evenly tapering toward tip of abdomen, posterolateral angles short, almost right angles, not raised, slightly curved inward, set with medially directed long black setae; abdominal ventrite VII unmodified; tergite VII shelf-like, extending beyond connexival angles, protruding proctiger quadrate, anal cone angular, gonocoxae visible.

Etymology

The name *tufi*, a noun in apposition, refers to the type locality in the Tufi area of Cape Nelson on the north coast of New Guinea.

Distribution

Southeastern New Guinea, Cape Nelson Peninsula (fig. 15).

Comparative notes

Brechivelia tufi is easily separated from other Papuan Microveliinae by the extremely long slender legs and antennae, the latter with all segments subequal in length (fig. 16), and by the unique modifications of the male proctiger (fig. 17).

Biological notes

Most specimens were taken from a huge mossy boulder wetted by spray near the bottom of a high (c. 30 m) waterfall with modest flow. This locality was in a slot canyon in dark volcanic rock that did not receive sunlight for most of the day. Additional specimens were taken from a wet, vertical volcanic bedrock face adjacent to a trickling cascade on another tributary further upstream, also in a shaded situation.

Tanyvelia Polhemus & Polhemus

Tanyvelia Polhemus & Polhemus 1994: 63 (type species *Tanyvelia missim* Polhemus & Polhemus 1994, monobasically).

Discussion. – The genus *Tanyvelia* was described by Polhemus & Polhemus (1994) to hold *Tanyvelia missim* from the Wau area in the Owen Stanley Range of eastern New Guinea; these same authors (Polhemus &

Polhemus 2000a) subsequently described a second species, *T. bosavi*, taken from the remote upper elevations of Mt. Bosavi, an isolated Pliocene volcano lying south of the central ranges in southern New Guinea. Three more new species are described herein from the East Papua Composite Terrane. To date, all members of this genus have been taken from localities in Papua New Guinea, and none are currently known from Indonesian western New Guinea, despite intensive collecting of Microveliinae in that latter area during recent years. This may indicate that the genus evolved on the EPCT, since four of the five species are confined to that tectonic unit.

Species of *Tanyvelia* are characterized by having very long, slender antennae; an elongate male proctiger (Polhemus & Polhemus 1994: fig. 4); and a slender, acuminate male paramere (Polhemus & Polhemus 1994: fig. 3). Male genitalic structures are not particularly informative for species separation in *Tanyvelia*, with the shapes of the proctiger and paramere being similar throughout all species. By contrast, the modifications of the female connexiva and male pregenital ventral abdomen are diagnostic.

For further discussion of structural characters in this genus see Polhemus & Polhemus (1994, 2000a).

Figs. 17, 18. *Brechivelia tufi*, male, structural details.— 17. Proctiger; 18. Hind tarsus.

Revised key to the species of *Tanyvelia*

[Note: In the revised key given by D. & J. Polhemus (2000a:102) ventrite VIII was inadvertently given as ventrite VII.]

1. Body length less than 2.00 mm; male abdominal ventrite VIII unmodified, lacking medial carina or sulcus, or modified setal patches 2
- Body length exceeding 2.20 mm; male abdominal ventrite VIII bearing medial carina or sulcus, and may have modified setal patches; basal abdominal tergites pruinose or black 3
2. Yellowish brown coloration on anterior margin of pronotum extending across entire width of pronotum and onto anterolateral areas; micropterous form with apex of pronotum angulate (Fig. 20), extending posteriorly across center of metanotum to base of abdominal tergite II; eastern New Guinea *T. minima* sp. n.
- Yellowish brown coloration on anterior pronotum confined to a narrow transverse patch on central portion (Fig. 21), yellowish brown coloration not extending onto anterolateral sections; micropterous form with apex of pronotum rounded (Fig. 21), not extending across central section of metasternum or reaching base of abdominal tergite II; Tagula Island *T. tagulana* sp. n.

19

20

21

Figs. 19-21. *Tanyvelia* species. – 19, *T. papuana*, micropterous female, dorsal habitus, appendages omitted; 20-21, Pronotum of micropterous form. – 20, *T. minima*; 21, *T. tagulana*.

3. Male abdominal ventrite VIII bearing an anteriorly directed triangular medial carina set with an erect tuft of stiff dark setae (Polhemus & Polhemus 1994: fig. 14); male abdominal ventrite VII depressed centrally to form an anteriorly directed triangular sulcus; male abdominal ventrites III-V broadly depressed centrally, forming a broad concavity on underside of abdomen; basal abdominal tergites of both males and females pruinose
..... *T. missim* Polhemus & Polhemus
- Male abdominal ventrite VIII lacking an anteriorly directed triangular medial carina; male abdominal ventrite VII lacking a triangular sulcus medially, but bearing a weakly depressed longitudinal median line; male abdominal ventrites III-V not depressed medially; basal abdominal tergites of both males and females black, lacking pruinosity 4
4. Male abdominal ventrite VIII bearing a narrow longitudinal medial impression (Polhemus &

Polhemus 1994: fig. 13), flanked by small patches of semi-erect setae; male fore tibial comb $\frac{4}{5}$ the length of tibia; female connexiva folded inward over tergites V-VII

- *T. bosavi* Polhemus & Polhemus
- Male abdominal ventrite VIII bearing a narrow longitudinal medial shining sulcus; male fore tibial comb $\frac{1}{2}$ the length of tibia; female connexiva almost upright along tergites V-VII (fig. 19)
..... *T. papuana* sp. n.

Tanyvelia minima sp. n.

(figs. 20, 22)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Cloudy Mountains, rocky stream 1 km. above Gadowalai village, S. of Gelemlaia, 135 m. [450 ft.], water temp. 24.5 °C., 12 April 2002, 10:00-10:30 hrs., 10°28'57"S, 150°14'27"E, CL 7176, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 2 macropterous males, 2 macropterous females, 3 micropterous males, 1 micropterous female, same data as holotype (USNM); 2 macropterous males, 2 macropterous females, 5 micropterous males, 2 micropterous females, Cloudy Mountains, headwater tributary to upper Watuti River, S. of Gelemlaia, 715 m. [2350 ft.], 10°29'50"S, 150°13'58"E, water temp. 22 °C., 10 April 2002, 16:00-17:30 hrs., CL 7175, D. A. Polhemus (USNM, JTPC, BPBM); 7 micropterous males, 4 micropterous females, headwater reach of Goilayoli River above crossing on road from Watunou to Huhuna, 18.5 km. ENE of Alotau, 275 m. [900 ft.], 10°18'43"S, 150°37'16"E, water temp. 24.5 °C., 6 April 2002, 10:00-13:00 hrs., CL 7161, D. A. & J. T. Polhemus (USNM); 1 micropterous male, Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, midreach and waterfall approx. 2.5 km. above mouth, 45-75 m. [150-250 ft.], 10°19'39"S, 150°34'36"E, water temp. 24.5 °C., 5 April 2002, 09:45-16:30 hrs., CL 7163, D. A. & J. T. Polhemus (USNM); 2 micropterous males, 1 micropterous female, Basilaki Is., Kalawai River and rocky trib., 5-145 m. [20-475 ft.], 10°36'50.6"S, 151°01'14.4"E, water temp. 26.5 °C., pH 8.27, 17 January 2004, 09:00-14:00 hrs., CL 7294, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 1.95-2.08 mm ($\bar{x}$ = 2.01, n = 5); width 0.60-0.70 mm ($\bar{x}$ = 0.65, n = 5). Micropterous female, length 2.15-2.25 mm ($\bar{x}$ = 2.20, n = 2); width 0.80-0.85 mm ($\bar{x}$ = 0.82, n = 2). Macropterous male, length 2.20-2.22 mm ($\bar{x}$ = 2.21, n = 2); width 0.85-0.90 mm ($\bar{x}$ = 0.87, n = 2). Macropterous female, length 2.35-2.40 mm ($\bar{x}$ = 2.37, n = 2); width 1.00-1.05 mm ($\bar{x}$ = 1.02, n = 2).

Colour. – Micropterous male: ground colour dark brown to black, venter and connexiva tinged with orange brown. Head dark dorsally, orange brown ventrally; rostrum yellowish brown on basal three segments, piceous distally; eyes dark red to black. Pronotum with anterior lobe entirely pale yellowish brown across entire width, this coloration extending laterally onto extreme upper section of propleura; disc and collar dark brown. Metanotum exposed laterally, black, overlain with faint silvery pruinosity. Micropterous wing pads black, apices sometimes embrowned. Abdomen dark brown, orange brown medioventrally and narrowly along connexival margins, tergites uniformly dark brown to black and lacking pruinosity in both males and females; a narrow longitudinal brown line present on tergites III–VI. Antennae with segments I and II yellowish brown, segments III and IV medium brown. Legs pale yellowish basally and on tarsi, all tibiae and distal tips of femora embrowned.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.35, width 0.51; width of eye/interocular space, 0.15/0.28. Pronotum length/width, 0.55/0.70; posterior lobe with apex angulate (fig. 20), covering central section of metanotum, humeri moderately produced; entire pronotum set with very short pale recumbent setae. Abdominal tergites not shining, thickly set with short recumbent pale setae, plus a few longer setae at posterolateral angles of connexiva, connexiva angled broadly outward; tergites II–VII progressively greater in length (0.10, 0.10, 0.10, 0.10, 0.12, 0.18 respectively). Abdominal venter set with short appressed pale setae; ventrites III–VI not depressed, bearing a narrow, glabrous, longitudinal median line; ventrite VII lacking longitudinal medial depression or modified setal tufts. Legs, antennae thickly clothed with short to moderate length semi-erect pale setae, with a few scattered longer setae on antennal segment I and posterior margins of middle femora. Legs unarmed, tibial comb on fore femur extending for about $\frac{1}{2}$ the length of the femur.

Antennal formula, segments I : II : III : IV; 0.35 : 0.27 : 0.50 : 0.57.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.58 : 0.55 : 0.16 : 0.0; of middle leg, 0.70 : 0.70 : 0.10 : 0.18; of hind leg, 0.75 : 1.00 : 0.13 : 0.20.

Paramere slender and acuminate, very similar in shape to that previously illustrated for *T. missim* (Polhemus & Polhemus 1994: fig. 3).

Micropterous female: Similar to micropterous male in general structure and coloration.

Macropterous male: Similar to micropterous male in general structure and coloration, with following exceptions: Pronotum enlarged, tumid centrally, apex broadly angulate, humeri prominent, sub-quadrate.

Wings extending to tip of abdomen, black, bearing 4 closed cells in basal half of wing, basal cell lying inward from subcosta with basal half white overlain by faint lavender tint, 3 remaining cells all with small white spots internally, distal half of wing tinged with golden pruinosity on distal half except for veins black, distal membrane lacking pale markings; erect pale setae present basally on subcostal, cubital, medial, radial and anal veins.

Macropterous female: Similar to macropterous male in general structure and coloration, with following exceptions: Pronotum with short erect setae on posterior lobe near apex (most evident when viewed laterally). Connexiva erect, folded slightly inward over distal portions of wings.

Etymology

The name “minima” refers to the size of this species, the smallest known in the genus.

Distribution

Far eastern New Guinea and adjacent Basilaki Island (fig. 22).

Comparative notes

Tanyvelia minima sp. n. and the superficially similar *T. tagulana* sp. n. (see below) are separable from the previously described *Tanyvelia missim* (Polhemus & Polhemus 1994) and *Tanyvelia bosavi* (Polhemus & Polhemus 2000a) plus *Tanyvelia papuana* sp. n. (described subsequently herein) by their small size (body length less than 2.0 mm), the unmodified abdominal ventrites VI and VII in males, the absence of a medial depression on male abdominal ventrites III–V, and the orange brown abdominal venter in both sexes.

Both *T. missim* and *T. bosavi* exceed 2.25 mm in body length, *T. papuana* is 2.20 mm in body length, and all have modifications to abdominal ventrite VII; in the former it bears an anteriorly directed triangular medial carina set with an erect tuft of stiff dark setae, while the latter two bear a narrow longitudinal sulcus or a medial impression flanked by small patches of semi-erect setae. Abdominal ventrites III–VI are also broadly depressed medially in *T. missim*, in contrast to the unmodified state seen in *T. minima* or *T. bosavi*. The coloration of the basal abdominal tergites is also diagnostic, being orange brown in *T. minima*, pruinose in *T. missim*, and uniformly black in *T. bosavi* and *T. papuana*.

Tanyvelia minima may in turn be separated from *T. tagulana* by its more extensive yellowish brown coloration on the anterior pronotum, and by the angulate posterior pronotal margin in micropterous forms (fig. 20), which transgresses the central portion of the metanotum and touches the base of abdominal tergite II (the first abdominal tergite visible).

The currently known species of *Tanyvelia* form two obvious groups, with the three larger species that exhibit abdominal modifications occurring in south central and central New Guinea, while the two smaller species that lack abdominal modifications occur on the Papuan Peninsula and in the Louisiade Archipelago.

Biological notes

The type series of *T. minima* was taken from a clear, cascading stream descending through a bed of rounded, mossy boulders, and heavily shaded by disturbed lowland rain forest. The insects were taken from just above the water surface on the wet edges of large boulders bordering pools below small cascades.

Tanyvelia tagulana sp. n. (figs. 21, 22)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Sudest [Tagula] Island, Kolukolu Creek, near Araeda village, 0–105 m. [0–350 ft.], 11°26'44.7"S, 153°25'56.8"E, water temp. 23 °C., 30 August 2002, CL 7194, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Tagula [Sudest] Island: 5 micropterous males, 12 micropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length 1.90–2.10 mm ($\bar{x}$ = 2.02, n = 3); width 0.65–0.68 mm ($\bar{x}$ = 0.66, n = 3). Micropterous female, length 2.05–2.15 mm ($\bar{x}$ = 2.12, n = 3); width 0.80–0.85 mm, ($\bar{x}$ = 0.82, n = 3).

Colour. – Micropterous male: ground colour dark brown, venter and connexiva tinged with orange brown. Head dark dorsally, orange brown ventrally; rostrum pale yellowish on basal three segments, piceous distally; eyes dark red to black. Pronotum with anterior lobe bearing a transverse yellowish brown patch centrally, this yellowish brown coloration not extending laterally to margins of propleura; disc and collar dark brown. Metanotum exposed across entire width, dark brown laterally, orange brown centrally. Micropterous wing pads dark brown. Abdomen dark brown, orange brown medioventrally and faintly along connexival margins, tergites dark brown, tergite II with faint pruinosity laterally. Antennae with segments I and II yellowish brown, segments III and IV medium brown. Legs pale yellowish brown, apices of all femora medium brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.35, width 0.55; width of eye/interocular space, 0.12/0.30. Pronotum length/width, 0.45/0.70; posterior lobe

with apex broadly rounded (fig. 21), not covering central section of metanotum, humeri not produced or angulate; entire pronotum set with very short pale recumbent setae. Metanotum with lateral sections slightly raised, central section slightly depressed. Abdominal tergites not shining, thickly set with very short recumbent pale setae, connexiva angled broadly outward; length of metanotum 0.11; tergites II–VII progressively greater in length (0.09, 0.09, 0.09, 0.10, 0.10, 0.20 respectively). Abdominal venter set with short appressed pale setae; ventrites I–VI unmodified, bearing a narrow, glabrous, longitudinal median line; ventrite VII slightly depressed posteromedially, lacking modified setal tufts. Legs and antennae thickly clothed with short to moderate length semi-erect pale setae, with a few scattered longer setae on antennal segments I and II. Legs unarmed, tibial comb on fore femur extending for about 0.40 the length of the femur.

Antennal formula, segments I : II : III : IV; 0.30 : 0.25 : 0.50 : 0.58.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.55 : 0.52 : 0.22 : 0.0; of middle leg, 0.65 : 0.75 : 0.10 : 0.15; of hind leg, 0.75 : 0.95 : 0.12 : 0.20.

Paramere slender and acuminate, very similar in shape to that previously illustrated for *T. missim* (Polhemus & Polhemus 1994: Fig. 3).

Micropterous female: Similar to male in general structure and coloration, with following exceptions: abdominal tergites blackish, connexival margins broadly orange brown, silvery pruinosity present on lateral sections of abdominal tergite II, extreme posterior margin of tergite V, central sections of abdominal tergites VI and VII; connexival margins outwardly reflexed adjacent to abdominal tergites II–VI, folded inward over lateral portions of tergites VII and VIII, connexival margins on infolded sections bearing thick fringes of moderately long, stiff black setae; lateral portions of abdominal tergites II and III and infolded portions of connexiva reddish brown.

Macropterous form: Unknown.

Etymology

The name 'tagulana' refers to the Tagula Island type locality.

Distribution

Louisiane Archipelago (fig.22).

Comparative notes

Tanyvelia tagulana is a small species that is similar in many respects to *T. minima* from far eastern New Guinea, but may be separated from that species by the less extensive yellowish brown coloration on the anterior pronotum, which is confined to single transverse spot centrally (fig. 21), and the rounded posterior

Fig. 22. Distribution of *Tanyvelia* species in the far eastern New Guinea region.

pronotal margin in micropterous forms (fig. 21), which does not transgress the central portion of the metanotum.

Biological notes

The type series was taken from a small, shallow, heavily shaded tributary to Kolukolu Creek on north-western Tagula Island. Along this stream, the insects were found in only one reach where a low, damp sill of bedrock bordered a clear, shallow pool. The insects were dislodged by splashing this bedrock exposure, and did not appear to skate on the pool itself.

Tanyvelia papuana sp. n. (figs. 19, 23)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Central Prov., Owen Stanley Range, trib. to upper Mimani River, 2.7 km. NE of Dorobisoro, 580–685 m. [1900–2250 ft.], 9°27'22.8"S, 147°57'02.8"E, water temp. 21.5 °C., 8 October 2003, 09:30–12:30 hrs., CL 7262, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Central Prov.: 5 micropterous males, 5 micropterous fe-

males, same data as holotype (USNM, JTPC); 8 micropterous males, 8 micropterous females, Owen Stanley Range, trib. to upper Mimani River, 2.0 km. NE of Dorobisoro, 565 m. [1850 ft.], 9°27'20.8"S, 147°56'25.5"E, water temp. 22.5 °C., 7 October 2003, 13:40–14:20 hrs., CL 7261, D. A. Polhemus (USNM, BPBM); 1 micropterous female, Owen Stanley Range, trib. to upper Mimani River, 2.9 km. NE of Dorobisoro, 640–670 m. [2100–2200 ft.], 9°27'18.7"S, 147°56'52.9"E, water temp. 22.5 °C., 8 October 2003, 12:45–13:30 hrs., CL 7263, D. A. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.25–2.30 mm ($\bar{x}$ = 2.25, n = 5); width 0.70–0.75 mm ($\bar{x}$ = 0.71, n = 5). Micropterous female, length 2.45–2.70 mm ($\bar{x}$ = 2.54, n = 9); width 0.80–0.95 mm, ($\bar{x}$ = 0.86, n = 9).

Colour. – Micropterous male: ground colour dark brown to black, venter, abdominal tergites and connexiva tinged with orange brown. Head dark dorsally, orange brown ventrally; rostrum yellowish to leucine on basal three segments, piceous distally; eyes dark red to black. Pronotum with anterior lobe entirely pale

Fig. 23. Distribution of *Tanyvelia* species on New Guinea.

yellowish orange across entire width, this coloration extending laterally onto extreme upper section of propleura; disc and collar dark brown. Metanotum exposed laterally, black, overlain with faint silvery pruinosity. Micropterous wing pads not visible. Abdomen dark brown, orange brown medioventrally and narrowly along connexival margins, tergites uniformly dark brown to black and lacking pruinosity in both males and females; a narrow longitudinal orange brown line present on tergites V-VII. Antennae with segments I and II yellowish brown, segments III and IV medium brown. Legs pale yellowish basally and on tarsi, all tibiae and distal tips of femora embrowned.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly; length 0.47, width 0.60; width of eye/interocular space, 0.15/0.30. Pronotum length/width, 0.55/0.72; posterior lobe with apex broadly rounded, covering central section of metanotum, humeri slightly produced; entire pronotum set with very short pale recumbent setae. Abdominal tergites not shining, thickly set with short recumbent pale setae, plus a few longer setae at posterolateral angles of connexiva, connexiva angled broadly outward; abdominal tergites II-VI subequal in length, tergite VII longer (0.18, 0.13, 0.13, 0.15, 0.15, 0.25 respectively). Abdominal venter set with short appressed pale setae; ventrites III-VI not depressed, bearing a narrow, glabrous, longitudinal median line; ventrite VII with a small V-shaped excavation posteriorly, and a small V-shaped notch. Legs, antennae thickly clothed with short to moderate length semi-erect pale setae, with a few scattered longer setae on antennal segment I and posterior margins of middle femora.

Legs unarmed, tibial comb on fore femur extending for about $\frac{1}{2}$ the length of the femur.

Antennal formula, segments I : II : III : IV; 0.50 : 0.35 : 0.57 : 0.75.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.70 : 0.65 : 0.25 : 0.0; of middle leg, 0.90 : 0.95 : 0.12 : 0.25; of hind leg, 1.05 : 1.20 : 0.20 : 0.30.

Paramere slender and acuminate, very similar in shape to that previously illustrated for *T. missim* (Polhemus & Polhemus 1994: fig. 3).

Micropterous female: Similar to micropterous male in general structure and coloration, with following exceptions: pronotal humeri evident, connexiva almost vertical basally, becoming weakly reflexed distally (fig. 19).

Macropterous male and female: Unknown.

Etymology

The name *papuana* refers to the Papuan Peninsula, to which this species is endemic.

Distribution

Owen Stanley Range of southeastern New Guinea (fig. 23).

Comparative notes

Tanyvelia papuana sp. n. is separable from the previously described *Tanyvelia missim* (Polhemus & Polhemus 1994) and *Tanyvelia bosavi* (Polhemus & Polhemus 2000a) in having the male ventrite VII with a sharp triangular notch in the posterior margin, and ventrite VIII with a narrow glabrous median sulcus. In

addition, *T. papuana* may be separated from the closely related *T. bosavi* by the length of the male fore tibial comb ($\frac{1}{2}$ as long as the tibia in *T. papuana*, $\frac{4}{5}$ as long in *T. bosavi*), and the almost upright female connexiva (fig. 19), as compared to state in *T. bosavi* in which the connexiva which are folded over and appressed onto tergites V-VII. *Tanyvelia tagulana* and *T. minima* differ from *T. papuana* by their small sizes (body length less than 2.0 mm), and the unmodified abdominal ventrites VII and VIII in males. See notes under *T. minima* for further discussion.

Biological notes

The type locality was a clear, rocky, heavily shaded creek in primary premontane rain forest, descending steeply through a bed of mixed rock types including volcanics, quartz and greenschist. The insects were found along the margins of small pools set amid cobbles and boulders.

Aegilipsicola Polhemus & Polhemus

Aegilipsicola Polhemus & Polhemus 1994: 60 (type species *Aegilipsicola rapida* Polhemus & Polhemus 1994, monobasic).

Discussion. – For diagnostic structural characters of this genus see discussion in Polhemus & Polhemus (1994).

Revised key to the species of *Aegilipsicola* occurring on New Guinea

1. Venter of male first genital segment deeply excavate basally, the posterior margin of this depression bordered by 2-3 small sclerotized tubercles (figs. 27-29); posterolateral apices of female connexiva variable, may be produced and sharply angulate (fig. 25), rounded or gently angulate (figs. 24, 26), or unmodified 2
- Venter of male first genital segment deeply excavate basally, the posterior margin of this depression lacking sclerotized tubercles, but bounded by a narrow, upraised, lip-like carina (Polhemus & Polhemus 2000a: fig. 19); posterolateral apices of female connexiva produced and sharply angulate, folded inward over wing tips (Polhemus & Polhemus 2000a: fig. 21) *A. iriana* Polhemus & Polhemus
2. Male fore femur with a broad, dark tubercle near middle of ventral margin; posterolateral angles of female connexiva produced and strongly angulate (fig. 25), folded inward over tips of wings *A. peninsularis* sp. n.
- Male fore femur with either a small, compact tuft of dark setae ventrally on distal third, or unmodified; female connexiva not sharply angulate, ei-

ther gently angulate (fig. 26) or rounded (fig. 24), if angulate then not folded inward over tips of wings 3

3. Male fore femur unmodified, lacking a compact tuft of dark setae ventrally (Polhemus & Polhemus 2000a: fig. 17); legs mostly brown above; female connexiva with posterolateral angles rounded, folded inward over lateral portions of abdominal tergites VI and VII (Polhemus & Polhemus 2000a: fig. 17) *A. robiniae* Polhemus & Polhemus
- Male fore femur with small, compact tuft of dark setae ventrally on distal third (Polhemus & Polhemus 2000a: fig. 16); legs dark yellowish above; female connexiva with posterolateral angles gently angulate, upright, not (or rarely) folded inward over lateral portions of abdominal tergites VI and VII 4
4. Venter of first genital segment (ventrite VIII) with two prominent tubercles along lateral margins of depression, plus a smaller tubercle posteriorly (fig. 28); raised posterior part of female connexiva smoothly curving dorsally, angulate distally (fig. 26) *A. rapida* Polhemus & Polhemus
- Venter of first genital segment (ventrite VIII) with three small tubercles posteriorly, the middle tubercle largest (fig. 29); raised posterior part of female connexiva with a small dorsally directed angle at distal $\frac{3}{4}$, smoothly rounded distally (fig. 24) *A. auga* sp. n.

Aegilipsicola peninsularis sp. n. (figs. 25, 27, 30)

Material examined. – Holotype, macropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, midreach and waterfall approx. 2.5 km. above mouth, 45-75 m. [150-250 ft.], 10°19'39"S, 150°34'36"E, water temp. 24.5 °C., 5 April 2002, 09:45-16:30 hrs., CL 7163, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 25 macropterous males, 30 macropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.90 ($\bar{x}$ = 2.90, n = 5); width 1.00-1.02 mm ($\bar{x}$ = 1.00, n = 5). Micropterous female, length 3.15-3.20 mm ($\bar{x}$ = 3.17, n = 5); width 1.05-1.10 mm, ($\bar{x}$ = 1.09, n = 5).

Colour. – Macropterous male: ground colour black dorsally, marked with yellowish brown ventrally. Head black, ventral surface yellowish brown, eyes red, antennae dark brown; rostrum golden yellow, terminal joint piceous. Pronotum with anterior lobe nar-

Figs. 24-29. *Aegilipsicola* species, structural details. – 24-26, Lateral view of female terminal abdomen: 24, *A. auga*, with detail of postero-lateral angle of connexivum; 25, *A. peninsularis*; 26, *A. rapida* Polhemus & Polhemus, with detail of postero-lateral angle of connexivum; 27-29, Ventral view of male terminal abdomen: 27, *A. peninsularis*; 28, *A. rapida* Polhemus & Polhemus, with detail of process on ventrite VIII; 29, *A. auga*, with detail of process on ventrite VIII.

rowly, transversely orange brown on either side of midline, this coloration extending laterally to inner eye margins; lateral portions black but thickly covered with silvery pubescence; posterior lobe black. Thoracic and abdominal venter greyish brown, acetabulae and central portion of abdomen yellowish brown. Legs predominantly dark brown above, with all coxae, trochanters, basal femora and ventral surfaces yellowish brown. Hemelytra black, each forewing bearing 2 elongate bluish-grey pruinose streaks confined within cells at basal angles, plus 1–4 additional small pruinose streaks on distal third.

Structural characters. – Macropterous male: head of moderate length, declivant anteriorly; length 0.35; width of eye/interocular space, 0.13/0.33. Pronotum long, posterior lobe broadly tumescent, apex broadly angulate, humeri evident but not raised; length/width, 0.93/1.02. Hemelytra long, extending slightly beyond tip of abdomen.

Head, posterior lobe of pronotum, and veins on basal half of hemelytra bearing numerous short, curling golden setae; lateral sections of anterior lobe of pronotum thickly covered with long, recumbent, silvery setae; legs and antennae thickly covered with recumbent pale setae, intermixed with slightly longer, semi-erect pale setae on tibiae and antennal segments; abdominal venter set with very short appressed fine setae. Abdominal ventrites III–VI with a glabrous longitudinal midline stripe; ventrite VI with a roughly trapezoidal raised area centrally, with its broad base directed anterad, flanked by a pair (1+1) of shallow, rounded depressions; ventrite VII with a pair (1+1) of strong depressions laterally on basal half to either side of midline, these depressions contiguous with those on ventrite VI, flanking a broad longitudinal medial carina centrally; first genital segment (ventrite VIII) deeply excavated anteromedially, the posterior margin of this concavity constricted to create a smaller secondary depression, the point of constriction marked by a pair (1+1) of small angulate processes with dark apices (fig. 27). Fore femora with a broad, dark tumescence on ventral margin just basal to midpoint.

Antennal formula I : II : III : IV; 0.50 : 0.30 : 0.65 : 0.60.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.85 : 0.67 : 0.33 : 0.0; of middle leg, 1.08 : 1.10 : 0.10 : 0.40; of hind leg, 1.60 : 2.05 : 0.10 : 0.47.

Paramere small and thumb-shaped, very similar in shape to that previously illustrated for *A. rapida* (Polhemus & Polhemus 1994: Fig. 8).

Macropterous female: Similar to male in general structure and coloration, but somewhat larger; fore femur and abdominal venter unmodified. Forewing with the outer of the two large bluish basal streaks interrupted near posterior terminus to produce a third

small detached streak; distal one third of the wing bearing 2–3 elongate lavender streaks. Connexiva with posterolateral apices sharply produced and angulate (fig. 25), folded slightly inward over distal portion of wings but not touching.

Etymology

The name 'peninsularis' refers to the slender peninsula formed by the eastern terminus of the Owen Stanley Range along the northern side of Milne Bay, the area from which the type series was collected.

Distribution

Eastern New Guinea (fig. 30).

Comparative notes

Easily separated from previously described species in the genus by the tumescence on the male fore femur coupled with the sharply angulate posterolateral angles of the female connexiva (fig. 25) and the sculpturing of the male pregenital abdomen (fig. 27).

Biological notes

The Upalai River at the type locality was a clear, rocky stream descending steeply through a bed of stream-rounded rocks and boulders in a narrow, shady valley retaining an original cover of undisturbed primarily lowland to premontane rain forest. The type series of *A. peninsularis* was taken from wet bedrock exposures surrounding a deep plunge pool at the base of a 20 m high waterfall along the river's upper midreach. As with all *Aegilipsicola* species, which are obligatorily hygropetric, the insects ran swiftly over the vertical to sloping wet bedrock faces bordering the water, but did not venture onto the surface of the plunge pool itself.

Aegilipsicola auga sp. n. (figs. 24, 29, 30, 85)

Material examined. – Holotype, macropterous male: PAPUA NEW GUINEA, Central Prov., Owen Stanley Range, small cascade and seeps on trib. to Hane River, 1.3 km. SSE of Fane, 1280 m. [4200 ft.], 8°33'49.2"S, 147°05'14.0"E, water temp. 20 °C., 4 October 2003, 08:30–09:30 hrs., CL 7255, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Central Prov.: 66 macropterous males, 51 macropterous females, same data as holotype (USNM, BPBM, JTPC); 2 macropterous males, 5 macropterous females, Owen Stanley Range, seeps along upper Mimani River, 1.70 km. NE of Dorobisoro, 535 m. [1750 ft.], 9°27'25.1"S, 147°56'15.2"E, water temp. 23.5 °C., 7 October 2003, 13:00–15:00 hrs., CL 7260, D. A. Polhemus (USNM).

Description

Size. – Macropterous male, length 2.60–2.75 mm

Fig. 30. Distribution of *Aegilipsicola* species on New Guinea.

($\bar{x}$ = 2.67, n = 7); width 0.80–0.90 mm ($\bar{x}$ = 0.85, n = 7). Macropterous female, length 2.95–3.10 mm ($\bar{x}$ = 3.03, n = 6); width 0.90–1.05 mm, ($\bar{x}$ = 0.98, n = 6).

Colour. – Macropterous male: ground colour black, tinged with yellowish brown ventrally on prothorax and abdomen. Head black, set with appressed golden setae; posterior margin and two (1+1) longitudinal regions lying between eyes and medial furrow brown. Pronotum with anterior lobe narrowly, transversely orange brown on either side of midline, this coloration extending laterally to inner eye margins; lateral portions black but thickly covered with silvery pubescence; posterior lobe black, set with appressed golden setae. Abdomen greyish black ventrally, central portion broadly brown, acetabulae and first genital segment brownish yellow. Antennae brown, first segment lighter. Legs brown above, brownish yellow below. Hemelytra black, bearing four (2+2) elongate bluish-grey pruinose streaks at basal angles, confined within the basal cells, plus four additional small pruinose spots on distal third of each.

Structural characters. – Macropterous male: head of moderate length, declivant anteriorly; length 0.35, width 0.60; width of eye/interocular space, 0.12/0.30. Pronotum long, humeri evident but not raised; length/width, 0.80/0.90. Hemelytra long, extending beyond tip of abdomen.

Abdominal tergites covered by wings; abdominal venter set with very short appressed fine setae; ventrite V and VI slightly flattened, sloping dorsad; posterior half of ventrite VII broadly depressed medially; first genital segment (ventrite VIII) deeply excavated ven-

trally, the posterior margin of this concavity bounded by a thin, raised, plate-like trilobed process (fig. 29). Legs and antennae thickly clothed with short inconspicuous setae, without longer setae. Middle and posterior legs unarmed, fore femur with a raised setal tuft.

Antennal formula I : II : III : IV; 0.35 : 0.25 : 0.65 : 0.60.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.55 : 0.25 : 0.0; of middle leg, 0.95 : 0.90 : 0.10 : 0.30; of hind leg, 1.20 : 1.50 : 0.12 : 0.37.

Paramere small and thumb-shaped, very similar in shape to that previously illustrated for *A. rapida* (Polhemus & Polhemus 1994: fig. 8).

Macropterous female: Similar to male in general structure and coloration, but somewhat larger. Forewing set with scattered long dark setae, bearing five small pruinose spots on distal third. Connexiva usually vertical, strongly raised and plate-like along tergite VII, dorsally with a small sclerotized triangular projection, distally rounded (fig. 24), extending onto tergite VIII; rarely folded inward and touching over distal portion of wings, tergite VIII plate-like, extending over tergite IX.

Etymology

The name 'auga' refers to the type locality, a tributary to the Auga River near Fane, in the Owen Stanley Range. The spelling 'Auga' is that adopted by the local people of the region, although the river appears as the 'Aura' on many maps.

Distribution

Owen Stanley Range of southeastern New Guinea (fig. 30).

Comparative notes

Superficially similar to *Aegilipsicola rapida* (Polhemus & Polhemus 1994), which has a similar armature of the male foreleg (Polhemus & Polhemus 2000a: fig. 16), but separable on the basis of the ventral male abdominal sculpturing (compare figs. 28, 29), and the structure and details of the female connexival apices (compare figs. 24, 26). In *A. rapida* the ventral excavation of the male first genital segment is flanked posteriorly by several tubercles laterally plus one on the posterior margin (fig. 28), while in *A. auga* there are three tubercles grouped together on the posterior margin (fig. 29). On male abdominal ventrite VII, the anterior half is unmodified in *A. auga*, while in *A. rapida* there are paired depressions anteriorly. The female connexival apices of both *A. auga* and *A. rapida* are plate-like, usually lying widely separated and in a vertical orientation; *A. auga* has a small triangular dorsal projection at distal $\frac{3}{4}$ of the plate-like raised portion which is smoothly rounded posteriorly (fig. 24), whereas *A. rapida* has the raised portion smoothly curving dorsally but angulate posteriorly (fig. 26).

Biological notes

The type series was taken from a vertical face of wet metamorphic bedrock adjacent to a cascading tributary of the Hane River (a tributary to the Auga) at a point where this tributary crossed a contour trail running along the side of the Hane River gorge (fig. 85). The surrounding slopes were covered with disturbed upland rain forest, and due to their aspect the wet bedrock faces on which *A. auga* occurred remained in shade for much of the day. Individuals of *A. auga* were found abundantly in this habitat, but were not present on the wettest parts of the rheocrone, being absent in areas with visible laminar flow.

Another short series of this species was taken further east in the Owen Stanley Range in the riparian zone of the Mimani River, which drains the southern flanks of the range near Mt. Obree. Here the insects were again found on a riverside exposure of wet bedrock wetted by seepage, and partially shaded by overhanging vegetation.

Tarsovelia Polhemus & Polhemus

Tarsovelia Polhemus & Polhemus 1994: 63 (type species *Tarsovelia alta* Polhemus & Polhemus 1994, by original designation).

Discussion. – For diagnostic structural characters of this genus see discussion in Polhemus & Polhemus (1994).

Revised key to the species of *Tarsovelia*

Discussion. – This revised key builds upon the version presented in Polhemus & Polhemus (2000a), and is most effectively used in combination with the illustrations of the male fore femora and parameres provided in Polhemus & Polhemus (1994, 2000a and 2000b). As noted in these previous works, females of *Tarsovelia* are often confusingly similar, and for the most part lack good specific characters. For this reason, the key below treats males only; females are best determined by association with sympatrically collected males.

Males

1. Fore femur with either a patch of short, stiff, pale hairs or a patch of short, dense, dark hairs on ventral surface 2
 - Fore femur lacking patch of short, stiff hairs or short, dense, dark hairs on ventral surface 6
2. Fore femur with a patch of short, dense, dark hairs near central portion of ventral margin; Mt. Bosavi area of southeastern New Guinea *T. bosavi* Polhemus & Polhemus
 - Fore femur with a patch of pale, short, stiff hairs on ventral surface 3
3. Fore femur slender basally, slightly expanded distally, bearing a patch of short, stiff, pale hairs in the central section of the ventral face 4
 - Fore femur slightly expanded basally, slender and gently arcuate distally, bearing a patch of short, stiff, pale hairs basally on ventral face; abdominal venter orange brown; central ranges of western New Guinea *T. dani* Polhemus & Polhemus
4. Fore femur with patch of short, stiff, pale hairs extending inward from the middle of the ventral face to the beginning of the narrowed basal section; Vogelkop Peninsula *T. arfak* Polhemus & Polhemus
 - Fore femur with patch of short, stiff, pale hairs extending distally from middle of ventral face toward tip of femur 5
5. Hair patch on ventral face of fore femur with short setae, these setae not becoming longer distally; abdominal venter reddish to yellowish brown; south central highlands of Papua New Guinea *T. kikori* Polhemus & Polhemus
 - Hair patch on ventral face of fore femur with setae becoming longer distally; abdominal venter black; northern central ranges of western New Guinea *T. ziwa* Polhemus & Polhemus
6. Fore femur constricted to greater or lesser extent when viewed laterally, due to concavity of ventral surface; ventral surface of body dark brown to black 7
 - Fore femur not constricted basally when viewed

Figs. 31-33. *Tarsovelia lousiadensis*, male, structural details.
– 31, Foreleg; 32, Proctiger. 33, Paramere.

- laterally, lacking a basal concavity on ventral surface; ventral surface of body orange brown 8
7. Ventral concavity on fore femur long and shallow, extending along basal half of femur (fig. 31); fore femur when viewed laterally attaining its greatest thickness on distal half (fig. 31); middle tibia twice as long as basal tarsal segment; Louisiade Archipelago *T. lousiadensis* sp. n.
- Ventral concavity on fore femur short, occupying extreme basal section of femur; fore femur when viewed laterally attaining its greatest thickness on basal half; middle tibia only 1.75X the length of basal tarsal segment; Raja Ampat Islands *T. rajana* Polhemus & Polhemus
8. Anterior lobe of pronotum in macropterous forms with orange brown coloration limited to a transverse spot at center, this coloration separated from propleurae by dark bands along lateral pronotal margins; fore femur with a small, carinate ridge centrally on ventral face; paramere of

relatively even width throughout, apex slightly expanded and bulb-like; south central mountains of western New Guinea

- *T. reclusa* Polhemus & Polhemus
- Anterior lobe of pronotum in macropterous forms entirely orange brown, this coloration extending laterally onto propleurae; fore femur lacking small, carinate ridge on central section of ventral face; paramere tapering throughout its length, apex very slightly expanded but not bulb-like; central mountains of Papua New Guinea
- *T. alta* Polhemus & Polhemus

Tarsovelia lousiadensis sp. n.
(figs. 31-34)

Material examined. – Holotype, macropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Sudest [Tagula] Island, Kolukolu Creek, near Araeda village, 0-105 m. [0-350 ft.], 11°26'44.7"S, 153°25'56.8"E, water temp. 23 °C., 30 August 2002, CL 7194, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago: 4 macropterous males, 11 macropterous females, Tagula [Sudest] Island, same data as holotype, D. A. & J. T. Polhemus (USNM, BPBM); 11 macropterous males, 8 macropterous females, Misima Island, north coast, Guwana Creek, near Nulia village, 15-30 m. [50-100 ft.], 10°39'22.8"S, 152°41'16.5"E, water temp. 22 °C., 3 September 2002, 10:00-12:00 hrs., CL 7201, D. A. & J. T. Polhemus (USNM); 65 macropterous males, 46 macropterous females, Misima Island, south coast, Keyana Creek, above Bwagabwaga village, 305-335 m. [1000-1100 ft.], 10°40'33.8"S, 152°40'44.9"E, water temp. 22.5 °C., 4 September 2002, 10:00-12:00 hrs., CL 7206, D. A. & J. T. Polhemus (USNM, JTPC).

Description

Size (Tagula Island population). – Macropterous male, length 2.50-2.70 mm ($\bar{x}$ = 2.50, n = 4); width 1.00-1.02 mm ($\bar{x}$ = 1.00, n = 4). Macropterous female, length 2.85-3.05 mm ($\bar{x}$ = 2.92, n = 5); width 1.05-1.12 mm, ($\bar{x}$ = 1.08, n = 5). Micropterous forms unknown.

Size (Misima Island population). – Macropterous male, length 2.40-2.60 mm ($\bar{x}$ = 2.53, n = 7); width 1.00-1.05 mm ($\bar{x}$ = 1.02, n = 7). Macropterous female, length 2.90-3.05 mm ($\bar{x}$ = 2.97, n = 5); width 1.05-1.15 mm, ($\bar{x}$ = 1.11, n = 5). Micropterous forms unknown.

Colour. – Macropterous male: ground colour black to dark brownish black, venter slightly lighter. Head dark brownish black; eyes dark red; rostrum yellowish brown basally, piceous distally. Pronotum with a transverse orange brown patch centrally, this orange brown coloration not extending onto lateral margins

of pronotum or reaching propleurae; disc and humeri blackish brown. Wings dark brown, basal angles yellowish white, this white coloration extending posteriorly past the apex of the pronotum; interior section of central cell and raised patch on distal subcosta black. Abdomen black, embrowned ventrally. Antennae dark brown. Coxae, trochanters, and basal $\frac{4}{5}$ of fore femur, bases of middle and hind femora dark yellow to yellowish brown, remainder of legs dark brown.

Structural characters. – Macropterous male: head of moderate length, declivant anteriorly; length 0.50, width 0.58; width of eye/interocular space, 0.17/0.37. Pronotum long, apex rounded, length/width, 0.90/1.00; humeri, prominent, raised. Abdominal tergites not visible.

Abdominal venter not modified, set with short appressed setae.

Legs and antennae thickly clothed with short appressed gold setae, intermixed with scattered slender erect dark setae; fore femur lacking patches of dark setae ventrally, but ventral surface thickly set with numerous short, stiff, erect, pale setae. Legs unarmed; fore femur slightly incrassate on distal half (fig. 31).

Antennal formula I : II : III : IV; 0.25 : 0.28 : 0.35 : 0.40.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.60 : 0.25 : 0.0; of middle leg, 0.95 : 0.90 : 0.45 : 0.35; of hind leg, 0.75 : 0.95 : 0.20 : 0.25.

Paramere slender, tip rounded, slightly expanded (fig. 33); proctiger broadly rounded, apex very slightly angulate (fig. 32).

Macropterous female: Similar to male in general structure and coloration, but somewhat larger; anterior lobe of pronotum with two (1+1) tufts of stiff erect black setae to either side of midline, similar setae also present on propleura; wing costal margin slightly concave on posterior 0.20 of its length, bearing numerous short, curling, dark setae; fore femur slender, tapering evenly, not expanded as in male.

Micropterous form: Unknown.

Etymology

The name 'lousiadiensis' refers to the Louisiade Archipelago, to which this species is endemic.

Fig. 34. Distribution of *Tarsovelia lousiadiensis*.

Fig. 35. *Neusterensifer femoralis*, male, dorsal habitus. Young Sohn illustration.

Distribution

Louisiade Archipelago (fig. 34).

Comparative notes

Keys to *T. alta* in Polhemus & Polhemus (2000b), but easily separated from that species by the generally dark brown rather than orange-brown coloration; the more restricted orange-brown coloration on the ante-

rior pronotum, which is interrupted laterally by a dark band along the pleural region, rather than extending continuously across the pleural region to join with the orange-brown coloration of the thoracic venter as in *T. alta*; the differently shaped male fore femur, which is slightly constricted on the basal half rather than thickened basally as in *T. alta* (compare fig. 31 in this paper to fig. 13 in Polhemus & Polhemus 1994); and

the differently shaped male paramere (fig. 33).

Although occupying different high islands separated by a significant water gap, the populations on both Tagula and Misima islands are morphologically similar, and are treated as conspecific herein.

Biological notes

Tarsovelia lousiadensis was abundant along the margins of rocky upland streams on Tagula and Misima Islands, generally preferring eddies sheltered by overhanging rocks in areas of otherwise swift flow. At the Kolukolu Creek type locality the insects were found immediately above a large waterfall, along the margins of the main channel in an area of relatively smooth flow. For further description of this locality see the discussion under *Rheovelina insularis*.

Zoogeographic notes

The presence of this *Tarsovelia* species in the Louisiade Archipelago is surprising, given that the genus is otherwise known only from mainland New Guinea to the west of the Kokoda Gap in the Owen Stanley Range, and on Batanta Island in the Raja Ampat group. It is also notable that recent surveys of suitable habitats at elevations in excess of 600 m. in both the Cloudy Mountains of far southeastern mainland New Guinea, and on the D'Entrecasteaux Islands, failed to produce collections of this genus. The occurrence of *T. lousiadensis* on Tagula and Misima therefore lends support to the hypothesis of Pigram & Davies (1987) that the Louisiades may be isolated remnants of a formerly larger and more extensive Owen Stanley tectonic terrane that formed in the Eocene, and implies that *Tarsovelia* may be a relatively old component of the New Guinea microveliine biota.

Tarsovelia alta J. Polhemus & D. Polhemus

Tarsovelia alta J. Polhemus & D. Polhemus 1994: 64.

Material examined. – PAPUA NEW GUINEA, Central Prov.: 1 macropterous male, 3 macropterous females, Owen Stanley Range, Om Creek, trib. to upper Udabe River, 1.85 km. SSE of Woitape, 1585 m. [5200 ft.], 8°33'27.7"S, 147°15'21.8"E, water temp. 19 °C., 2 October 2003, 12:00-12:30 hrs., CL 7251, D. A. Polhemus (USNM); 43 macropterous males, 19 macropterous females, Owen Stanley Range, tributary streamlet to Hane River, 1.0 km. SSE of Fane, 1310-1370 m. [4300-4500 ft.], 8°33'32.7"S, 147°05'23.7"E, water temp. 20 °C., 4 October 2003, 11:00-12:30 hrs., CL 7256, D. A. Polhemus (USNM).

Distributional notes

This species was originally described from Mt. Kaindi, above Wau, and the new records from the Woitape and Fane areas serve to extend its range further to the southeast along the upland axis of the Owen Stanley Range.

Biological notes

This species was abundant at the Hane River, a swift, clear mountain stream in a bed of boulders and cobbles, flowing out of a catchment covered in nearly undisturbed montane rain forest. *Tarsovelia alta* occurred here in sheltered eddies and side pools along the main channel, out of the full force of the current.

Neusterensifer Polhemus & Polhemus

Neusterensifer Polhemus & Polhemus 1994: 67 (type species *Neusterensifer compacta* Polhemus & Polhemus 1994, by original designation).

Discussion. – For diagnostic structural characters of this genus see discussion in Polhemus & Polhemus (1994).

In using the descriptions and keys below, it is very important to bear in mind that in *Neusterensifer* the more commonly encountered 'wingless' forms are actually micropterous, so that the first abdominal tergite is covered by the metanotum. The first visible tergite dorsally in both males and females is therefore tergite II. In males, the best way to ascertain tergite numbering is count anteriorly from the cylindrical first genital segment, which represents tergite VIII. Similarly, in females one may count anteriorly from the proctiger, which represents tergite IX.

Ventrally, abdominal ventrite I is barely visible as a vertical plate lying between the metasternum and well-developed abdominal ventrite II. By working backward from this it is possible to see that the final connexival segment is formed by the laterotergites of abdominal segment VII, thus as in the abdominal tergites, the first visible connexivum anteriorly is segment II. Similarly, in males the first genital segment is ventrite VIII, and the ventrite immediately anterior to it, which is often highly modified with sulci, tumescences and setal tufts is ventrite VII (for similar considerations in regard to *Rhagovelina*, and illustrations of segment numbering, see Polhemus & Polhemus 1988).

Key to species of *Neusterensifer* occurring on the Papuan Peninsula and nearby island groups

Discussion. – The genus *Neusterensifer* is large and complex, and because further species are in the process of description by the authors, a revised key to the entire genus is not presented at this time. Instead, the key below treats all species known to occur on the land masses comprising the EPCT, including the Papuan Peninsula east of 146° E longitude (ie., roughly south-east of a line drawn through the base of the peninsula from Lae to Kerema), the D'Entrecasteaux Islands, the Marshall Bennett Islands, the Louisiade Archipelago, and the islands immediately east of the China Strait. No species from the geographical region thus defined

36

37

38

Figs. 36-38.
Neusterensifer species, male
hind femur. – 36, *N. goilala*;
37, *N. muyuwu*; 38, *N. tufi*.

is known to range more widely into the remainder of greater New Guinea except for *N. lubu*, which occurs westward as far as the Kikori River catchment, and reaches the eastern limits of its range in the Lakekamu River catchment, thus barely straying into the bounds of the EPCT region as defined in this paper.

Males

1. Ventral abdomen with dense, prominent, roughly ovate to circular paired patches of short dark setae to either side of midline on one or more ventrites (most typically ventrite VII), often separated by a deep depression or sulcus running along the longitudinal midline of the ventrite (figs. 39, 40, 41, 43, 44) 2
- Ventral abdomen lacking any paired patches of dense dark setae to either side of midline, although such patches may be present singly on various ventrites along the longitudinal midline of the abdomen (fig. 42); more diffuse patches of longer golden to golden brown setae may be present laterally on the abdominal ventrites, but these patches never dense or roughly circular to ovate in shape 14

2. Paired patches of dark setae present on ventrite VII only (figs. 39, 40, 41, 44) 3
- Paired patches of dark setae present on ventrites other than ventrite VII, or on other ventrites in addition to ventrite VII (fig. 43) 9
3. Hind femur with a prominent tumescence on central section of hind margin, this tumescence set with dense dark setae, distal section of femur beyond tumescence often slightly concave on hind margin (figs. 35-37) 4
4. Hind femur lacking a prominent tumescence on central section of hind margin, femur either unmodified or with hind margin bearing only an incipient indication of a tumescence or slightly more dense setiferation (fig. 38) 7
4. Abdominal ventrite II strongly produced into a sharp, angulate, posteroventrally projecting spur; process on male proctiger multisinuate and acuminate (fig. 62); eastern Papuan Peninsula plus Sariba, Basilaki, and Normanby islands (fig. 70) *N. femoralis* sp. n.
- Abdominal ventrite II not strongly produced into a sharp spur; process on male proctiger not multisinuate and acuminate, either tapering or ex-

- panded at apex (figs. 68, 69, 76) 5
5. Abdominal ventrite VI with medial section produced anteriorly as a narrow, slightly rising carina with a small patch of dark setae at apex, this carina nearly bisecting ventrites III-V (fig. 44); large species for genus, overall body length equal to or exceeding 2.9 mm; process on male proctiger with apex expanded and blunt when viewed ventrally (fig. 76); occurring above 1000 m. in the Owen Stanley Range (fig. 82) *N. goilala* sp. n.
 - Abdominal ventrite VI not produced anteriorly as a narrow carina that bisects ventrites III-V (figs. 40, 41); smaller species, overall body length less than or equal to 2.6 mm; process on male proctiger tapering to acute tip, not expanded at apex when viewed ventrally (figs. 68, 69) 6
 6. Abdominal ventrites VI and VII with sides of central sulcus parallel, the flanking tufts of dark setae similarly parallel and not convergent anteriorly (fig. 40); ventrite VI with a single small patch of dense dark setae centrally; Tagula Island (fig. 75) *N. sulcata* sp. n.
 - Abdominal ventrites VI and VII with central sulcus V-shaped, with flanking tufts of dark setae converging inward toward each other anteriorly (fig. 41); ventrite VI lacking a small patch of dense dark setae centrally; Woodlark Island (fig. 70) *N. muyuv* sp. n.
 7. Ventral abdomen with a broad and relatively shallow longitudinal sulcus on ventrites IV-VII, this sulcus divided along midline by a narrow setiferous carina traversing ventrites III-VI; process on proctiger rounded and thumb-shaped in ventral view with apex not expanded (fig. 63b), but cup-shaped in lateral view after dissection (fig. 63a); eastern mainland of New Guinea plus Sariba, Sideia, Basilaki and Normanby islands (fig. 74) *N. hunteri* sp. n.
 - Ventral abdomen with deep longitudinal sulcus along midline of ventrite VII at least; ventrites III-VI with prominent patches of dark setae centrally (fig. 39); process on proctiger expanded distally when viewed ventrally, extreme apex produced to varying degrees (figs. 72, 73); Goodenough and Fergusson Islands or northern Papuan Peninsula 8
 8. Ventrites VI and VII both longitudinally sulcate medially; ventrites III-V with a medial carina bearing prominent patches of dark setae that progressively narrow and diminish on each succeeding ventrite going posteriorly; apex of process on proctiger only slightly produced beyond the expanded head (fig. 72); Goodenough and Fergusson Islands (fig. 64) *N. kula* sp. n.
 - Only ventrite VII longitudinally sulcate medially; ventrites III-VI with a medial carina bearing prominent patches of dark setae that progressively widen and enlarge on each succeeding ventrite going posteriorly (fig. 39); apex of process on proctiger acuminate and highly produced beyond the expanded head (fig. 73); northern Papuan Peninsula (fig. 74) *N. tufti* sp. n.
 9. Paired patches of dark setae present on ventrite VI only; southern Papuan Peninsula 10
 - Paired patches of dark setae present on either ventrites V and VI (fig. 43), or VI and VII 11
 10. Abdominal ventrite VI sharply raised posteromedially to form a pair of angulate tumescences slightly separated by a shallow sulcus along the longitudinal midline, apices of these tumescences black and bearing sparse tufts of long gold setae; ventrite VII with a pair of low, longitudinally elongate tumescences to either side of midline, central portion of posterior margin not modified or angulate *N. aviavi* sp. n.
 - Abdominal ventrite VI lacking a pair of angulate tumescences, instead bearing two very large, transversely ovate patches of short dark setae; abdominal ventrite VII lacking elongate tumescences, central portion of posterior margin angulate and projecting posteriorly over base of ventrite VIII *N. lubu* Polhemus & Polhemus
 11. Paired patches of dark setae present on ventrites V and VI (fig. 43); Goodenough and Fergusson Islands plus eastern Papuan Peninsula (Fig. 75) *N. dentrecasteaux* sp. n.
 - Paired patches of dark setae present on ventrites VI and VII 12
 12. Patches of dark setae on ventrite VI located close to longitudinal midline of segment and nearly touching each other; process on male proctiger short, apex blunt (fig. 65); Rossel Island (fig. 74) *N. yela* sp. n.
 - Patches of dark setae on ventrite VI widely separated from each other by longitudinal median sulcus; process on male proctiger tapering, apex angulate (figs. 77, 80); Papuan Peninsula 13
 13. Process on male proctiger slender, gently curved, apex acute (fig. 77); Bowutu Mountains, northern Papuan Peninsula (fig. 78) *N. bowutu* sp. n.
 - Process on male proctiger thicker, apex with small indentation (fig. 80); southern Papuan Peninsula (fig. 82) *N. microrivula* sp. n.
 14. Ventral abdomen with a single patch of dark setae centrally on ventrite VI (fig. 42); eastern Papuan Peninsula (fig. 64) *N. sagarai* sp. n.
 - Ventral abdomen without a patch of dark setae centrally on ventrite VI 15
 15. Ventral abdomen with ventrite VII sulcate along longitudinal midline, this sulcus V-shaped when viewed from above, widening posteriorly; lateral margins of medial sulcus bearing long gold setae,

Figs. 39–44.

Neusterensifer species, male terminal abdomen, ventral view. – 39, *N. tufti*; 40, *N. sulcata*; 41, *N. muyuu*; 42, *N. sagarai*; 43, *N. dentrecasteaux*; 44, *N. goilala*.

these setae becoming slightly denser and darker to form a pair of diffuse lateral patches on ventrite VII; process on proctiger short, blunt, not distally expanded (fig. 66); Misima Island (fig. 75)

..... *N. misima* sp. n.

- Ventral abdomen with ventrite VII broadly depressed along longitudinal midline, but not deeply sulcate; lateral margins of medial sulcus bearing long gold setae, but these setae not forming a pair of slightly denser and darker patches on ventrite VII; process on proctiger short, strongly expanded distally (fig. 67); Rossel and Tagula islands (fig. 70) *N. louisidadae* sp. n.

Females

1. Connexival margins convergent and touching together to greater or lesser degrees at posterior apices 2
 - Connexival margins separated from each other for entire lengths, not touching at any point 13
2. Connexival margins strongly convergent and closely appressed along entirety of segment VII, and sometimes segments V and VI as well 3
 - Connexival margins touching only at extreme posterior apices, not appressed along entirety of segment VII, and sometimes segments V and VI as well 10
3. Abdominal tergite VII produced into a finger-

- like, posteriorly directed, setiferous projection that extends beyond the posterior margins of connexival segment VII (figs. 45, 46, 49-52) ... 4
- Abdominal tergite not produced into a finger-like, posteriorly directed projection extending beyond posterior margins of connexival segment VII (fig. 47, 48, 53-60) 6
 - 4. Posterior projection on abdominal tergite VII short and thumb-like, barely extending beyond posterior margins of connexival segment VII (fig. 52); posterolateral angles of connexival segment V lacking tufts of stiff black setae on inner faces; southern Papuan Peninsula (fig. 82) *N. microrivula* sp. n.
 - Posterior projection on abdominal tergite VII long, prominent and finger-like, extending well beyond posterior margins of connexival segment VII (figs. 46, 51) 5
 - 5. Posterolateral angles of connexival segment V with tufts of stiff black setae on inner faces, so that abdomen possesses two acuminate, upright tufts of black setae when viewed laterally (fig. 46); Tagula Island (fig. 75) *N. sulcata* sp. n.
 - Posterolateral angles of connexival segment V lacking tufts of stiff black setae on inner faces, so that abdomen possesses only a single acuminate tuft of black setae when viewed laterally (fig. 51); Bowutu Mountains, northern Papuan Peninsula (fig. 78) *N. bowutu* sp. n.
 - 6. Connexival margins closely convergent and tightly appressed along segment VII only 7
 - Connexival margins closely convergent and tightly appressed along segments VI and VII or V-VII 9
 - 7. Hind femur lacking a tumescence; connexival segment VII bearing an acuminate tuft of stiff black setae originating on the central inner faces of the segment and projecting upward between the appressed margins (figs. 47, 55); Louisiade Archipelago 8
 - Hind femur bearing a small tumescence along posterior margin; outer margins of connexival segment VII bearing stiff, erect black setae along entire length, with these setae forming a prominent, acuminate, posteriorly directed tuft at the posterolateral angles (fig. 53), but lacking an acuminate tuft of stiff black setae originating on central inner faces of segment and projecting upward between appressed margins; Papuan Peninsula plus Sariba, Basilaki, and Normanby islands (fig. 70) .. *N. femoralis* sp. n.
 - 8. Overall coloration dark brown; connexiva tightly appressed on segments VI and VII, completely covering underlying tergites, tergite V not visible from above; posterolateral angle of connexivum with a brushy tuft of stiff black setae when viewed laterally (fig. 55); Rossel and Tagula islands (fig. 70) *N. louisidae* sp. n.
 - Overall coloration orange brown; connexiva tightly appressed on segment VII only, leaving tergites V visible from above; posterolateral angle of connexivum with acuminate tuft of stiff black setae when viewed laterally (fig. 47); Misima Island (fig. 75) *N. misima* sp. n.
 - 9. Connexival margins closely appressed only along segments VI and VII; connexival segments VI and VII lacking acuminate tufts of stiff black setae projecting upward from between appressed margins, but outer margins of segment VII fringed with numerous long, stiff black setae (fig. 56); margins of connexival segment VII sloping strongly downward posteriorly when viewed laterally (fig. 56); occurring above 1000 m. in the Owen Stanley Range (fig. 82) *N. goilala* sp. n.
 - Connexival margins closely appressed along segments V-VII; connexival segments VI and VII bearing acuminate tufts of stiff black setae originating on their central inner faces and projecting upward between the appressed margins, appearing as a pair of acuminate tufts when viewed laterally (fig. 48); margins of connexival segment VII not sloping strongly downward when viewed laterally (fig. 48); Rossel Island (fig. 74) *N. yela* sp. n.
 - 10. Abdominal tergite VII produced into a finger-like posteriorly-directed, setiferous projection that extends beyond the posterior margins of connexival segment VII (fig. 45, 49, 50) 11
 - Abdominal tergite not produced into a finger-like posteriorly-directed projection extending beyond posterior margins of connexival segment VII (fig. 54); eastern mainland of New Guinea plus Sariba, Sideia, Basilaki and Normanby islands (fig. 74) *N. hunteri* sp. n.
 - 11. Connexival segment VII in lateral view with a small, acuminate, upwardly-directed tuft of stiff black setae lying immediately anterior to the large tuft of stiff black setae on the projecting process of abdominal tergite VII (figs. 45, 49); Woodlark Island and D'Entrecasteaux Islands 12
 - Connexival segment VII in lateral view lacking a small, acuminate, upwardly-directed tuft of stiff black setae immediately anterior to the large tuft of stiff black setae on the projecting process of abdominal tergite VII (fig. 50); northern Papuan Peninsula (fig. 74) *N. tufi* sp. n.
 - 12. Finger-like process on tergite VII when viewed laterally projecting to or beyond the posterior margin of the abdomen (fig. 45); inner faces of connexival segments VI set with patches of long, stiff black setae posteriorly; small tuft of stiff black setae arising from inner faces of connexival segments VII near their middle and projecting

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Figs. 45-52. *Neusterensifer* species, female terminal abdomen, lateral view. – 45, *N. kula*; 46, *N. sulcata*; 47, *N. misima*; 48, *N. yela*; 49, *N. muyuu*; 50, *N. tufi*; 51, *N. bowutu*; 52, *N. microrivula*.

- upward and between the appressed connexival margins (fig. 45); Goodenough and Fergusson islands (fig. 64) *N. kula* sp. n.
- Finger-like process on tergite VII when viewed laterally not projecting beyond the posterior margin of the abdomen (fig. 49); inner faces of connexival segments VI lacking patches of long, stiff black setae; posterolateral angle of connexival segment VII bearing small acuminate tuft of stiff black setae (fig. 49); Woodlark Island (fig. 70) *N. muyuw* sp. n.
 - 13. Posterolateral angles of connexival segment VII produced into angulate projections, which may be either upright or infolded over tergite VII (figs. 59, 60); southern Papuan Peninsula 14
 - Posterolateral angles of connexival segment VII not produced into angulate projections (figs. 57, 58); eastern Papuan Peninsula or D'Entrecasteaux Islands 15
 - 14. Angulate projections at posterolateral angles of connexival segment VII upright, angling backward when viewed laterally (fig. 60) *N. lubu* Polhemus & Polhemus
 - Angulate projections at posterolateral angles of connexival segment VII folded inward over lateral sections of tergite VII (fig. 59) *N. aviavi* sp. n.
 - 15. Inner margins of connexival segments V-VII with a thick fringe of dark setae (fig. 58); Goodenough and Fergusson Islands plus eastern Papuan Peninsula (fig. 75) *N. dentrecasteaux* sp. n.
 - Inner margins of connexival segments V-VII lacking a thick fringe of dark setae (fig. 57); eastern Papuan Peninsula (fig. 64) *N. sagarai* sp. n.

Neusterensifer sagarai sp. n.
(figs. 42, 57, 61, 64)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, terminal reach, 0–20 m. [0–65 ft.], 10°20'28"S, 150°34'23"E, water temp. 26–26.5 °C., 4 April 2002, 09:30–12:00 hrs., CL 7162, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 2 micropterous males, 12 micropterous females, same data as holotype (USNM, BPBM); 2 micropterous males, 2 micropterous females, clear rocky stream at Tautili, SW of Alotau, 30 m. [100 ft.], 10°29'05"S, 150°06'33"E, water temp. 27 °C., 31 January 2002, 10:30 hrs., CL 7159, D. A. Polhemus (USNM); 7 micropterous males, 15 micropterous females, Gumini River at road bridge, SW of Alotau, 15 m. [50 ft.], 10°19'08.0" S, 150°14'06.8" E, water temp. 30 °C. (main channel), 28 °C. (shaded side pools), 21 January 2004, 10:30–14:00 hrs., CL 7174, D. A. & J. T. Polhemus (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length = 2.05–2.20 mm ($\bar{x}$ = 2.12, n = 5); width 0.85–1.00 mm ($\bar{x}$ = 0.92, n = 5). Micropterous female, length 2.25–2.45 mm ($\bar{x}$ = 2.34, n = 5); width 0.90–1.00 mm, ($\bar{x}$ = 0.96, n = 5).

Colour. – Micropterous male: Ground colour dark brown, marked with orange brown on anterior pronotum and connexiva; patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II–V, along anterior margin of pronotum, and on sides of thorax and abdomen. Head dark brown; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum dark brown, becoming orange brown anterolaterally, bearing a pair (1+1) of elongate transverse yellowish brown spots to either side of midline behind anterior margin. Metanotum and abdominal tergites dark brown, laterotergites blackish below connexiva; connexiva orange brown on outer halves and ventrally. Antennae medium brown. Legs generally medium brown, with coxae, trochanters, basal femora and all ventral surfaces pale yellowish to yellowish brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.45, width 0.57; width of eye/interocular space, 0.12/0.35. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.38/0.85. Metanotum length 0.17. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.10 : 0.08 : 0.07 : 0.07 : 0.10 : 0.25.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous short, erect black setae; legs and antennae thickly clothed with short pale setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of fore and middle tibiae, posterior margins of middle and hind femora; fore femur ventral margin straight, not modified, bearing numerous short, erect pale setae along entire length, intermixed with evenly spaced comb of 10 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur with numerous short, erect pale setae along posterior margin, lacking tumescences or specialized setal tufts.

Abdominal venter set with short appressed gold setae, and scattered longer dark setae; central section of ventrite VII depressed, forming a broad concavity on underside of terminal abdomen, lateral sections of this concavity extending forward onto ventrite VI, isolating a small medial tumescence bearing a dense tuft of short black setae (fig. 42); ventrite V also slightly tumescent medially, bearing a few short black setae

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Figs. 53-60. *Neusterensifer* species, female terminal abdomen, lateral view. – 53, *N. femoralis*; 54, *N. hunteri*; 55, *N. louisidadae*; 56, *N. goilala*; 57, *N. sagarai*; 58, *N. dentrecasteauxi*; 59, *N. aviavi*; 60, *N. lubu*.

along posterior margin; ventrites I-IV unmodified. Proctiger produced anteriorly into a moderately long, broad, blade-like process with a widened apex (fig. 61). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.30 : 0.24 : 0.28 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.57 : 0.50 : 0.21 : 0.0; of middle leg, 0.70 : 0.68 : 0.13 : 0.25; of hind leg, 0.75 : 0.95 : 0.10 : 0.25.

Micropterous female: Similar to micropterous male in general structure and colour, with following exceptions: metanotum and abdominal tergites II-IV with small patches of silvery setae laterally, abdominal tergite V covered with silvery setae for its entire width on posterior half, abdominal tergite VI covered with silvery setae across its entire width on posterior $\frac{2}{3}$, abdominal tergites VII and VIII bearing a few scattered silvery setae on posterior halves, tergite VII also with a transverse tuft of long, posteriorly-directed black setae along posterior margin, tergite VIII and proctiger lying in a nearly vertical orientation; connexiva broadly separated, bowing outward, margins gradually convergent posteriorly, posterolateral connexival angles simple, rounded, not produced, lacking tufts of black setae (although tuft of setae on posterior margin of tergite VII can give the appearance of a connexival tuft when insect is viewed laterally) (fig. 57); lateral sections of abdominal ventrites curving upward to bases of connexival segments, set with numerous long erect black setae, extreme lateral margins adjoining connexival bases with patches of silvery setae; abdominal venter, fore femur, hind femur unmodified; anterior margins of all tibiae and posterior margins of middle and hind femora bearing scattered very long, slender, erect black setae.

Macropterous form: Unknown.

Etymology

The name '*sagarai*' is a noun in apposition and refers to the Sagarai River basin of far southeastern New Guinea, where this species was first collected.

Distribution

Far eastern New Guinea (fig. 64).

Comparative notes

Neusterensifer sagarai is a small, brown species with relatively few modifications. Males may be recognized by the single black setal tuft medially on abdominal ventrite VI (fig. 42) and the shape of the process on the proctiger (fig. 61). Females may be separated from others occurring in far eastern New Guinea by their open connexiva which lack tufts of black setae, and by the transverse patch of long, posteriorly-directed black setae along the posterior margin of abdominal tergite VII (fig. 57).

Biological notes

This species occurs in small pockets of protected water amid cobbles along the margins of lower stream midreaches in both the Milne Bay and Sagarai River catchments. It is notably absent from higher gradient upper midreach and headwater areas with greater current velocities lying above 50 m. elevation.

At the Upalai River type locality this species was found only along the lower midreach of the river where it exited from a narrow valley and made a transition from a high gradient bed of rocks and boulders to a low gradient bed of gravel and cobbles. Along the higher gradient upper midreach of the river, by contrast, *N. sagarai* dropped out and was replaced by *N. femoralis* and *N. hunteri*; for further habitat notes on this locality see the discussion under *Aegilipsicola peninsularis*.

Neusterensifer femoralis sp. n.

(figs. 35, 53, 62, 70)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., headwater reach of Goilayoli River above crossing on road from Watunou to Huhuna, 18.5 km. ENE of Alotau, 275 m. [900 ft.], 10°18'43"S, 150°37'16"E, water temp. 24.5 °C., 6 April 2002, 10:00-13:00 hrs., CL 7161, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 6 macropterous males, 1 macropterous female, 20 micropterous males, 17 micropterous females, same data as holotype (USNM, JTPC, BPBM); 1 macropterous female, 6 micropterous males, 14 micropterous females, Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, midreach and waterfall approx. 2.5 km. above mouth, 45-75 m. [150-250 ft.], 10°19'39"S, 150°34'36"E, water temp. 24.5 °C., 5 April 2002, 09:45-16:30 hrs., CL 7163, D. A. & J. T. Polhemus (USNM); 2 macropterous males, 3 macropterous females, streamlet and roadside seeps above Huhuna on road to Watunou, 11.2 mi. ENE of Alotau, 260 m. [850 ft.], 10°18'19"S, 150°36'56"E, water temp. 28 °C., 6 April 2002, 14:00-15:00 hrs., CL 7164, D. A. & J. T. Polhemus (USNM); 6 micropterous males, 14 micropterous females, Cloudy Mountains, headwater tributary to upper Watuti River, S. of Gelemalaia, 715 m. [2350 ft.], 10°29'50"S, 150°13'58"E, water temp. 22 °C., 10 April 2002, 16:00-17:30 hrs., CL 7175, D. A. Polhemus (USNM, BPBM); 2 micropterous males, 1 micropterous female, Sariba Is., Padi Stream, 0-105 m. [0-350 ft.], 10°35'37.1"S, 150°42'02.5"E, water temp. 26.5-28.5 °C., pH 7.7-8.0, 14 January 2004, 09:45-14:00 hrs., CL 7285, D. A. & J. T. Polhemus (USNM); 1 micropterous male, 1 micropterous female, Basilaki Is., Kalawai River and rocky trib., 5-145 m. [20-475 ft.], 10°36'50.6"S, 151°01'14.4"E, water temp. 26.5 °C., pH 8.27, 17 January 2004, 09:00-14:00 hrs., CL

Figs. 61-63.

Neusterensifer species, process arising from male proctiger. – 61, *N. sagarai*, ventral view; 62, *N. femoralis*, ventral view; 63 a, b, *N. hunteri*: a, lateral view, b, ventral view.

7294, D. A. & J. T. Polhemus (USNM); 6 macropterous males, 4 macropterous females, 41 micropterous males, 55 micropterous females, D'Entrecasteaux Islands, Normanby Island, south coast, upper Apatabuia River and rocky tribs., above Bunama, 60-90 m. [195-295 ft.], 10°07'04.0"S, 151°09' 07.2"E, water temp. 23.5 °C., 29 January 2003, 09:00-01:00 hrs., CL 7228, D. A. & J. T. Polhemus (USNM, JTPC, BPBM); 3 micropterous males, 4 micropterous females, D'Entrecasteaux Islands, Normanby Island, east coast, upper Dibuya River and rocky tribs., W. of Yeluyelua, 245 m. [800 ft.], 10°02'46.2"S, 151°14'53.0"E, water temp. 24 °C., 30 January 2003, 09:30-12:30 hrs, CL 7231, D. A. Polhemus (USNM).

Description

Size. – Micropterous male, length = 2.15-2.25 mm ($\bar{x}$ = 2.19, n = 6); width 0.95-1.00 mm ($\bar{x}$ = 0.97, n =

6). Micropterous female, length 2.33-2.55 mm ($\bar{x}$ = 2.45, n = 6); width 0.95-1.05 mm, ($\bar{x}$ = 0.99, n = 6). Macropterous male, length = 2.40 mm (n = 1); width 1.10 mm (n = 1). Macropterous male, length 2.40-2.55 mm ($\bar{x}$ = 2.49, n = 4); width 1.10-1.15 mm ($\bar{x}$ = 1.11, n = 4). Macropterous female, length 2.50-2.70 mm ($\bar{x}$ = 2.62, n = 4); width 1.10-1.20 mm, ($\bar{x}$ = 1.16, n = 4).

Colour. – Micropterous male: Ground colour orange brown, marked with yellowish brown on anterior pronotum and legs; patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II-VII, along anterior margin of pronotum, and on sides of thorax and abdomen (fig. 35). Head orange brown; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, darker posteromedially, bearing a pair (1+1) of elongate transverse yellowish brown spots to

either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, extreme lateral and posterior margins of metanotum and abdominal tergites black, laterotergites blackish below connexiva, connexiva entirely orange brown, somewhat lighter along dorsolateral margins. Antennae dark brown. Legs generally medium brown, with coxae, trochanters, basal femora and all ventral surfaces pale yellowish white.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.35, width 0.60; width of eye/interocular space, 0.17/0.40. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.45/0.90. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.12 : 0.10 : 0.07 : 0.10 : 0.10 : 0.30.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, erect black setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of fore and middle tibiae, basal posterior margin of middle femur; fore femur ventral margin sinuate, weakly biconcave, bearing numerous short, stiff black setae along entire length, intermixed with evenly spaced comb of 10 long, erect, pilose black setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur with bulging tumescence centrally on posterior margin (fig. 35), this tumescence thickly set with short, stiff black setae.

Abdominal venter set with short appressed gold setae, and scattered longer dark setae; central sections of ventrites III–VI depressed, forming a deep, narrow longitudinal concavity on underside of abdomen; ventrite II strongly produced medially into an acute, ventrally projecting process, posteromedial margin of this process forming a low, sharp carina continuing posteriorly from base of process down center of medial abdominal depression and traversing ventrites III–V; ventrite VII bearing two (1+1) raised ovate tumescences to either side of midline covered with patches of dense dark setae. Proctiger produced anteriorly into a relatively long, multi-sinuate, blade-like process with an acute apex (fig. 62). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.35 : 0.30 : 0.40 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.60 : 0.55 : 0.30 : 0.0; of middle leg, 0.80 : 0.75 : 0.12 : 0.25; of hind leg, 0.90 : 1.00 : 0.12 : 0.28.

Micropterous female: Similar to micropterous male

in general structure and colour, with following exceptions: metanotum and abdominal tergites II and III with small patches of silvery setae laterally, abdominal tergites IV and V covered with silvery setae for their entire widths on posterior halves, abdominal tergites VI and VII lacking silvery setae, abdominal tergite VIII with scattered silvery setae centrally; connexiva convergent posteriorly, meeting over and covering abdominal tergites VI, VII and basal margin of tergite VIII, connexival segments VI and VII with brush of erect black setae along dorsal margins, posterolateral connexival angle of segment VII simple, rounded, not produced, but bearing a slender tuft of elongate, posteriorly directed black setae (fig. 53); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with numerous long erect black setae, extreme lateral margins adjoining connexival bases with patches of silvery setae; abdominal venter unmodified; fore femur not modified; hind femur with small tumescence near middle of posterior margin, this tumescence thickly covered with very short dark setae; anterior margin of middle tibia and posterior margins of middle and hind femora bearing scattered very long, slender, erect black setae.

Macropterous male: Similar to micropterous male in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, brown, set with fine dark punctations, humeri weakly tumescent, apex rounded; wings complete, matte black, extending past tip of abdomen, bearing 4 closed cells, inner basal cell with white streak at basal angle, remaining 3 cells with small elongate white spots near posterior apices, costal margin bearing numerous long, stiff, erect black setae.

Macropterous female: Similar to micropterous male in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, brown, set with fine dark punctations, apex rounded, humeri weakly tumescent; wings complete, matte dark brown, extending past tip of abdomen, forewing bearing 4 closed cells, inner cells with white streaks filling basal angles, 2 distal cells with small elongate white spots near posterior apices, costal margin bearing numerous long, stiff, erect black setae.

Etymology

The name '*femoralis*' refers to the distinctively modified male hind femur.

Distribution

Far eastern New Guinea and adjacent Sariba, Basilaki and Normanby islands (fig. 70).

Comparative notes

Neusterensifer femoralis is a distinctive species with a suite of unusual modifications. Males are immediately

recognizable by the tumescent hind femur (fig. 35), the bisinuate ventral surface of the fore femur, the acuminate projection on abdominal ventrite II, the setiferous tumescences on abdominal ventrite VII, and the sinuate process on the proctiger (fig. 62). Females are easily recognized by the small tumescence on the hind femur, the posteriorly convergent connexiva, and the acuminate tufts of stiff dark setae at the posterior angles of the connexiva (fig. 53). No other species of *Neusterensifer* currently known has the highly modified male abdominal ventrite II seen in *N. femoralis*, although the structure is reminiscent of the character state seen in the genus *Papuavelia* from western New Guinea. The incrassate male hind femur and longitudinally sulcate male ventral abdomen are unusual character states shared with other *Neusterensifer* species occurring in the D'Entrecasteaux, Marshall Bennett and Louisiade island groups, and in the Papuan Peninsula.

Females of *N. femoralis* can be confused with those of *N. hunteri*, with which this species is often syntopic, but that latter species lacks the tail-like tuft of setae projecting posteriorly from the connexival angles (compare figs. 53, 54). Similar to the male characters discussed above, the posteriorly convergent female connexiva with the apices bearing projecting acuminate tufts of black setae are a character state also shared with other *Neusterensifer* species found on the offshore islands east of New Guinea proper.

Biological notes

This species occurs on small, standing pools in bedrock adjacent to rocky streams, and on the pools of small headwater streamlets. A habitat description of the Goilayoli River type locality may be found in the discussion under *Rheovelina tephrofila*.

Neusterensifer hunteri sp. n. (figs. 54, 63a, 63b, 74, 84)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., headwater reach of Goilayoli River above bridge crossing on road from Watunou to Huhuna, 18.5 km. ENE of Alotau, 275 m. [900 ft.], 10°18'43"S, 150°37'16"E, water temp. 24.5 °C., 6 April 2002, 10:00-13:00 hrs., CL 7161, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 1 macropterous female, 42 micropterous males, 35 micropterous females, same data as holotype (USNM, JTPC, BPBM); 1 macropterous male, 1 macropterous female, 13 micropterous males, 18 micropterous females, Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, midreach and waterfall approx. 2.5 km. above mouth, 45-75 m. [150-250 ft.], 10°19'39"S, 150°34'36"E, water temp. 24.5 °C., 5 April 2002, 09:45-16:30 hrs., CL 7163, D. A. & J. T. Polhemus (USNM);

1 macropterous male, 4 micropterous males, 2 micropterous females, Upalai River at Haluwia, 13.7 km. E. of Alotau on East Cape road, terminal reach, 0-20 m. [0-65 ft.], 10°20'28"S, 150°34'23"E, water temp. 26-26.5 °C., 1 February 2003, CL 7162, J. T. Polhemus (USNM); 6 micropterous males, 3 micropterous females, streamlet and roadside seeps above Huhuna on road to Watunou, 11.2 mi. ENE of Alotau, 260 m. [850 ft.], 10°18'19"S, 150°36'56"E, water temp. 28 °C., 6 April 2002, 14:00-15:00 hrs., CL 7164, D. A. & J. T. Polhemus (USNM); 1 macropterous female, 3 micropterous males, 6 micropterous females, Cloudy Mountains, headwater tributary to upper Watuti River, S. of Gelemalaia, 715 m. [2350 ft.], 10°29'50"S, 150°13'58"E, water temp. 22 °C., 10 April 2002, 16:00-17:30 hrs., CL 7175, D. A. Polhemus (USNM, BPBM); 1 macropterous female, 3 micropterous males, 4 micropterous females, Cloudy Mountains, rocky stream 0.6 mi. above Gadowalai village, S. of Gelemalaia, 135 m. [450 ft.], water temp. 24.5 °C., 12 April 2002, 10:00-10:30 hrs., 10°28'57"S, 150°14'27"E, CL 7176, D. A. Polhemus (USNM); 12 micropterous males, 9 micropterous females, Sariba Is., Padi Stream, 0-105 m. [0-350 ft.], 10°35'37.1"S, 150°42'02.5"E, water temp. 26.5-28.5 °C., pH 7.7-8.0, 14 January 2004, 09:45-14:00 hrs., CL 7285, D. A. & J. T. Polhemus (USNM); 1 micropterous male, 2 micropterous females, Sideia Is., hill streamlet in south central interior, 35-40 m. [110-130 ft.], 10°36'16.8"S, 150°50'55.6"E, water temp. 26.5 °C., 15 January 2004, 10:00-11:00 hrs., CL 7287, D. A. & J. T. Polhemus (USNM); 1 micropterous male, 2 micropterous females, Sideia Is., river in south central interior, 10°35'59.3"S, 150°50'53.7"E, 20 m. [65 ft.], water temp. 29 °C., 15 January 2004, 11:30-14:00 hrs., CL 7288, D. A. & J. T. Polhemus (USNM); 1 micropterous male, Sideia Is., Kwabunamoa River, terminal reach, sea level, 10°35'04.5"S, 150°50'51.2"E, water temp. 27 °C., 16 January 2004, 11:00-13:00 hrs., CL 7292, D. A. & J. T. Polhemus (USNM); 7 micropterous males, 4 micropterous females, Basilaki Is., Kalawai River and rocky trib., 5-145 m. [20-475 ft.], 10°36'50.6"S, 151°01'14.4"E, water temp. 26.5 °C., pH 8.27, 17 January 2004, 09:00-14:00 hrs., CL 7294, D. A. & J. T. Polhemus (USNM); 2 micropterous males, 2 micropterous females, Basilaki Is., Guigoila River and trib. with waterfall, 0-15 m. [0-50 ft.], 10°36'26.7"S, 150°59'37.8"E, water temp. 26.5 °C., 18 January 2004, 09:00-13:30 hrs., CL 7296, D. A. & J. T. Polhemus (USNM); 12 micropterous males, 23 micropterous females, D'Entrecasteaux Islands, Normanby Island, south coast, lower Apatabuia River and nearby coastal springs at Bunama, 0-10 m. [0-35 ft.], 10°07'51.7"S, 151°08'47.7"E, water temp. 26 °C., 28 January 2003, 16:00-18:00 hrs., CL 7226, D. A. & J. T. Polhemus (USNM, JTPC). PAPUA NEW GUINEA, Cen-

tral Prov.: 6 micropterous males, 9 micropterous females, Owen Stanley Range, trib. to upper Mimani River, 2.0 km. NE of Dorobisoro, 565 m. [1850 ft.], 9°27'20.8"S, 147°56'25.5"E, water temp. 22.5 °C., 7 October 2003, 13:40-14:20 hrs., CL 7261, D. A. Polhemus (USNM); 8 micropterous males, 9 micropterous females, Owen Stanley Range, trib. to upper Mimani River, 2.7 km. NE of Dorobisoro, 580-685 m. [1900-2250 ft.], 9°27'22.8"S, 147°57'02.8"E, water temp. 21.5 °C., 8 October 2003, 09:30-12:30 hrs., CL 7262, D. A. Polhemus (USNM); 2 micropterous males, 10 micropterous females, Owen Stanley Range, trib. to upper Mimani River, 2.9 km. NE of Dorobisoro, 640-670 m. [2100-2200 ft.], 9°27'18.7"S, 147°56'52.9"E, water temp. 22.5 °C., 8 October 2003, 12:45-13:30 hrs., CL 7263, D. A. Polhemus (USNM).

Description

Size. – Micropterous male, length = 2.15-2.20 mm ($\bar{x}$ = 2.15, n = 6); width 0.90-0.95 mm ($\bar{x}$ = 0.91, n = 6). Micropterous female, length 2.30-2.60 mm ($\bar{x}$ = 2.41, n = 6); width 0.95-1.00 mm, ($\bar{x}$ = 0.97, n = 5). Macropterous male, length 2.30 mm ($\bar{x}$ = 2.30, n = 2); width 1.10-1.15 mm ($\bar{x}$ = 1.12, n = 2). Macropterous female, length 2.60-2.70 mm ($\bar{x}$ = 2.65, n = 2); width 1.20 mm, ($\bar{x}$ = 1.20, n = 2).

Colour. – Micropterous male: Ground colour medium brown, marked with orange brown on connexiva and anterior pronotum, legs yellowish brown; patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II-VII, along anterior margin of pronotum, and on sides of thorax and abdomen. Head medium brown; eyes red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum medium brown, becoming orange brown anterolaterally, bearing a pair (1+1) of elongate transverse yellowish brown spots to either side of midline behind anterior margin. Metanotum and abdominal tergites I and II medium brown, somewhat lighter centrally orange brown dorsally, abdominal tergites III-VII darker brown, laterotergites blackish below connexiva, connexiva entirely orange brown. Antennae dark brown. Legs with coxae, trochanters, basal $\frac{4}{5}$ of femora yellowish brown, apices of femora, tibiae and tarsi medium brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.43, width 0.57; width of eye/interocular space, 0.12/0.40. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.35/0.85. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II-VII, respectively: 0.10: 0.10 : 0.08 : 0.06 : 0.08 : 0.30.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numer-

ous long, slender, erect black setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I-III, anterior margins of all tibiae, posterior margin of hind femur; fore femur with ventral margin very weakly sinuate and biconcave, bearing numerous short, stiff pale setae along entire length, these setae thicker near base of femur, intermixed with evenly spaced comb of 10 long, erect, pilose black setae; middle tibia with posterior margin bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur slightly incrassate centrally along posterior margin, this incipient tumescence thickly set with numerous short, stiff pale setae.

Abdominal venter set with short semi-recumbent gold setae; central sections of ventrites IV-VII depressed, forming a broad longitudinal concavity on underside of abdomen; ventrite II tumescent centrally, posteromedial extension of this tumescence forming a prominent, sharp carina continuing posteriorly from posterior margin of ventrite II, across ventrite III, and down center of medial abdominal depression, traversing ventrites IV-VI, this carina bearing numerous short gold setae; ventrite VII bearing two (1+1) small, raised, ovate tumescences to either side of midline covered with patches of dense dark setae. Proctiger produced anteriorly into a relatively short, broad, thumb-like process with a small angular projection at apex (fig. 63b), this process cup-shaped when dissected and viewed laterally (fig. 63a). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.35 : 0.25 : 0.40 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.58 : 0.50 : 0.24 : 0.0; of middle leg, 0.75 : 0.70 : 0.10 : 0.18; of hind leg, 0.85 : 0.95 : 0.10 : 0.25.

Micropterous female: Similar to micropterous male in general structure and colour, with following exceptions: metanotum and abdominal tergites II-IV with small patches of silvery setae laterally, abdominal tergite V entirely covered with silvery setae for its entire width, abdominal tergites VI and VII blackish and faintly pruinose but lacking silvery setae, tergite VIII with scattered silvery setae across entire width on posterior $\frac{2}{3}$; connexiva convergent posteriorly, meeting over and covering posterior half of abdominal tergite VII and anterior half of abdominal tergite VIII, posterolateral connexival angles simple, rounded, not produced, but bearing a slender, posteriorly directed tuft of elongate black setae (fig. 54); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with numerous long erect black setae, extreme lateral margins adjoining connexi-

Fig. 64. Distribution of *Neusterensifer* species in the far eastern New Guinea region.

val bases with patches of silvery setae; abdominal venter unmodified; fore femur not modified; hind femur very weakly swollen centrally on posterior margin, this area thickly covered with very short, pale, upright setae; anterior margins of all tibiae and posterior margins of middle tibia hind femur bearing scattered very long, slender, erect black setae.

Macropterous male: Similar to micropterous male in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, brown, set with fine dark punctations, apex rounded, humeri weakly tumescent; wings complete, matte black, extending past tip of abdomen, forewing bearing 4 closed cells, outer basal cell with broad white streak filling basal angle, 2 distal cells lightly maculate with white centrally, costal margin bearing numerous long, stiff, erect black setae.

Macropterous female: Similar to macropterous male in general structure and colour, but with pale maculation in distal cells of forewing more obscure.

Etymology

The name '*hunteri*' refers to the first author's son, Hunter Polhemus.

Distribution

Eastern New Guinea and adjacent Sariba, Sideia, Basilaki and Normanby islands (fig. 74).

Comparative notes

Neusterensifer hunteri is relatively small, orange-brown species that exhibits an incipient development of the character states seen *N. femoralis*, with which it is often syntopic on the hill streams of far eastern New Guinea and nearby islands. The overall coloration trends more toward medium brown with orange brown accents, rather than being generally orange brown with yellowish brown highlights as in *N. femoralis*. The male has a broader longitudinal sulcus on the ventral abdomen bisected by a much more prominent, setiferous medial carina; lacks the large, pointed, posteriorly-directed process on ventrite II typical of *N. femoralis*; has the hind femur only incipiently swollen along the posterior margin (similar to fig. 38); and has a much shorter and differently shaped process on the male proctiger (compare figs. 62, 63). Females of *N. hunteri* have only a single small tuft of black setae at the posterior angles of the connexiva (fig. 54), rather than a brushy tuft basal to the angle with a second more acuminate tuft below as in *N. femoralis* (fig. 53).

Biological notes

At the type locality this species was taken from shallow pools at the bases of small cascades that descended in a step-like series down a bedrock chute on a narrow tributary gully to the Goilayoli River, in the mountains east of Alotau. This area was heavily shaded by primary upland rain forest. For further description of this locality see the discussion under *Rheovelina petrophila*.

In general, *N. hunteri* seems to be an adaptable species that is capable of exploiting diverse habitats ranging from coastal springs to rocky streams (fig. 84) and small first order upland streamlets, perhaps accounting for its broad distributional range in eastern Papuan Peninsula and nearby islands (fig. 74). It is most commonly encountered at spring heads or along first order streams, and rarely along the margins of larger lowland rivers, where in the Milne Bay area one instead finds *N. sagarai*.

Neusterensifer louisidae sp. n. (figs. 55, 67, 70)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Rossel [Yela] Island, Woa River and rocky tributaries, approx. 4 km. upstream from estuary, 0-150 m. [0-500 ft.], 11°20'36.7"S, 154°07'06.4"E, water temp. 23 °C., 31 August-1 September 2002, CL 7196, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago: 21 micropterous males, 21 micropterous females, Rossel [Yela] Island, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM); 15 micropterous males, 27 micropterous females, Tagula [Sudest] Island, Kalitau Creek, 1 km. upstream from head of estuary, 0-30 m. [0-100 ft.], 11°21'51.7"S, 153°14'26.0"E, water temp. 24.4 °C., 29 August 2002, 09:30-14:30 hrs., CL 7190, D. A. & J. T. Polhemus (USNM); 2 micropterous males, 1 micropterous female, Tagula Island, small spring fed stream near Kalitau Creek, 45 m. [150 ft.], 11°21'29.7"S, 153°14'39.9"E, water temp. 26 °C., 29 August 2002, 10:00-12:00 hrs., CL 7192, D. A. & J. T. Polhemus (USNM, BPBM); 1 micropterous female, Tagula Island, Kolukolu Creek, near Araeda village, 0-105 m. [0-350 ft.], 11°26'44.7"S, 153°25'56.8"E, water temp. 23 °C., 30 August 2002, 11:00-16:00 hrs., CL 7194, D. A. & J. T. Polhemus (USNM, BPBM).

Description

Size (Rossel Island population). – Micropterous male, length 2.20-2.30 mm ($\bar{x}$ = 2.25, n = 5); width 0.90-0.95 mm ($\bar{x}$ = 0.91, n = 5). Micropterous female, length 2.50-2.85 mm ($\bar{x}$ = 2.66, n = 5); width 0.95-1.05 mm, ($\bar{x}$ = 1.00, n = 5).

Size (Tagula Island population). – Micropterous

male, length 2.25-2.35 mm ($\bar{x}$ = 2.29, n = 5); width 0.90-1.00 mm ($\bar{x}$ = 0.95, n = 5). Micropterous female, length 2.75-2.95 mm ($\bar{x}$ = 2.85, n = 5); width 1.00-1.10 mm, ($\bar{x}$ = 1.05, n = 5).

Colour. – Micropterous male: Ground colour dark brown, marked with orange brown on connexiva; patches of short, shining, silvery pubescence present along anterior margin of pronotum, on sides of thorax and abdomen, laterally on metanotum and abdominal tergites II-V, across entire posterior half of abdominal tergite VI, and covering entire abdominal tergite VII. Head dark brown; rostrum yellowish brown, fuscous medially, piceous distally. Pronotum dark brown, becoming orange brown anterolaterally, bearing a pair (1+1) of elongate transverse yellowish brown spots to either side of midline behind anterior margin. Metanotum and abdomen generally dark brown dorsally, central sections of metanotum and abdominal tergite I becoming orange brown, extreme lateral and posterior margins of metanotum and abdominal tergites blackish, connexiva entirely orange brown, laterotergites below connexiva blackish. Antennae dark brown. Legs generally medium brown, with coxae, trochanters, and basal femora pale yellowish white.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.40, width 0.62; width of eye/interocular space, 0.12/0.37. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.40/0.80. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II-VII, respectively: 0.14 : 0.10 : 0.08 : 0.10 : 0.10 : 0.32.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, erect golden setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I-III, anterior margins of fore and middle tibiae, basal posterior margin of middle femur; fore femur with ventral margin very weakly sinuate, bearing moderately short, erect, brushy black setae along entire length, these setae more numerous basally and intermixed with evenly spaced comb of about 14 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length along posterior margin, longest and most basal of these setae with length approximately equal to 1/3 that of tibia; hind femur simple and unmodified, lacking setal tufts.

Abdominal venter set with numerous erect, moderately long gold setae; central sections of ventrites IV-VII depressed, forming a deep longitudinal sulcus on underside of abdomen; ventrites II and III slightly raised centrally, densely setiferous. Proctiger produced anteriorly into a relatively short, broad, blade-like

process with expanded, palmate apex (fig. 67). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.40 : 0.30 : 0.45 : 0.52.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.60 : 0.57 : 0.30 : 0.0; of middle leg, 0.90 : 0.85 : 0.13 : 0.25; of hind leg, 0.90 : 1.10 : 0.20 : 0.30.

Micropterous female: Similar to micropterous male in general structure and colour, with following exceptions: metanotum and abdominal tergites II and III with small patches of silvery setae laterally, abdominal tergite IV lacking silvery setae, abdominal tergite V entirely covered with silvery setae, abdominal tergites VI and VII hidden; connexiva convergent posteriorly, meeting over and covering abdominal tergites VI-VII plus base of tergite VIII, posterolateral connexival angles simple, obtusely angulate, bearing a brushy tuft of stiff black setae, the posterior portion of this brushy tuft denser and somewhat acuminate (fig. 55), lateral sections of abdominal ventrites black, curving upward and inward to bases of connexival segments, extreme lateral margins adjoining connexival bases with broad patches of silvery setae; abdominal venter and legs unmodified.

Macropterous form: Unknown.

Etymology

The name '*lousiadae*' refers to the Louisiade Islands, to which this species is endemic.

Distribution

Lousiade Archipelago (fig. 70).

Comparative notes

Neusterensifer lousiadae occurs on both Rossel and Tagula islands, and is easily separated from the other *Neusterensifer* species in the Louisiade Archipelago by its dark brown coloration, male abdominal structures (fig. 67), and female connexival modifications (fig. 55). The venter of the male abdomen has a broad longitudinal sulcus centrally that is not nearly as deep or narrow as that seen in *N. sulcata* from Tagula or *N. yela* from Rossel, and unlike those two species has no specialized setal patches. The apex of the process on the proctiger is also different in shape from that in *N. sulcata* and *N. yela*, being palmate rather than elongate (compare figs. 65, 67, 68). Females of *N. lousiadae* are easily separated from the two above species by the structure of the abdomen, having no posteromedial projection, and connexiva with only a single setal tuft, at the posterior angles (compare figs. 46, 48, 55).

Biological notes

On Rossel Island his species was taken from standing pools in exposures of metamorphic bedrock adja-

cent to the upper Woa River, occurring sympatrically with *N. yela*. On Tagula Island *N. lousiadae* was taken from similar standing pools in rockholes next to a waterfall cascading over a sloping face of metamorphic bedrock, in company with *N. sulcata*.

Further habitat description of the Woa River type locality may be found in the discussion under *Rheovelina insularis*.

Neusterensifer yela sp. n.

(figs. 48, 65, 74)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Rossel [Yela] Island, Woa River and rocky tributaries, approx. 4 km. upstream from estuary, 0-150 m. [0-500 ft.], 11°20'36.7"S, 154°07'06.4"E, water temp. 23 °C., 31 August-1 September 2002, CL 7196, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Rossel [Yela] Island: 19 micropterous males, 15 micropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length 2.40-2.60 mm ($\bar{x}$ = 2.50, n = 5); width 0.90-1.05 mm ($\bar{x}$ = 0.99, n = 5). Micropterous female, length 2.85-3.00 mm ($\bar{x}$ = 2.92, n = 5); width 1.00-1.10 mm, ($\bar{x}$ = 1.04, n = 5).

Colour. – Micropterous male: Ground colour light orange brown, marked with yellowish brown on anterior pronotum and legs; very small patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II-VII, and along anterior margin of pronotum. Head light orange brown; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum light orange brown, bearing a pair (1+1) of faintly indicated elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen light orange brown dorsally, lateral margins of metanotum and all abdominal tergites plus extreme posterior margins of metanotum and abdominal tergites II and III narrowly black, laterotergites below connexiva narrowly black along sutures and adjoining spiracles; connexiva entirely light orange brown. Antennae orange brown, segment IV darker. Legs generally yellowish brown with tarsi darker, coxae, trochanters, basal femora and all ventral surfaces pale yellowish white.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.55, width 0.65; width of eye/interocular space, 0.20/0.40. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.48/0.92.

Metanotum length 0.22. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.15 : 0.10 : 0.08 : 0.08 : 0.12 : 0.42.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, slender, erect black setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of fore and middle tibiae, basal posterior margin of middle femur; fore femur ventral margin sinuate, weakly biconcave, bearing numerous short, stiff black setae along entire length, intermixed with evenly spaced comb of 10 long, erect, pilose black setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur with incipient tumescence centrally on posterior margin, this area moderately set with very short, stiff black setae.

Abdominal venter set with short appressed gold setae, and scattered longer erect gold setae; abdominal ventrite II forming a small conical tumescence centrally, ventrite III unmodified, central sections of ventrites IV–VII strongly depressed, forming a deep, narrow, longitudinal sulcus on underside of abdomen; ventrite VI with dense patch of short, stiff black setae centrally, these setae lying on either side of medial sulcus and directed inward toward its longitudinal axis, lateral sections of ventrite VII to either side of sulcus forming a pair (1+1) of strongly raised, longitudinally ovate tumescences bearing thick tufts of short, stiff black setae along along their central axes. Proctiger produced anteriorly into a moderately long, relatively slender, thin, transparent, blade-like process with a rounded apex (fig. 65). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.45 : 0.35 : 0.48 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.80 : 0.60 : 0.33 : 0.0; of middle leg, 1.00 : 0.95 : 0.15 : 0.35; of hind leg, 1.10 : 1.10 : 0.15 : 0.35.

Micropterous female: Similar to micropterous male in general structure and colour, with following exceptions: metanotum and abdominal tergite II with very limited patches of silvery setae laterally, abdominal tergite IV bearing silvery setae on posterior half, abdominal tergite VIII with numerous silvery setae, tergite VIII and proctiger lying in nearly vertical orientation; connexiva strongly and suddenly convergent posteriorly, meeting over and covering abdominal tergites V–VII, connexival segments VI and VII with scattered moderately long erect black setae along dorsal margins, these setae becoming more dense at posterior angle of segment VI, forming a small, acuminate, posteriorly-directed tuft (fig. 48), posterolateral

connexival apices of segment VII slightly produced and angulate, another acuminate tuft of stiff black setae arising on the inner margins of connexival segments VII and projecting upward between the appressed dorsal margins of the segments (fig. 48); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases black, overlain with patches of silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter, fore femur, and hind femur unmodified.

Macropterous form: Unknown.

Etymology

The name '*yela*' is a noun in apposition, and refers to the traditional Melanesian name for Rossel Island.

Distribution

Louisiade Archipelago (fig. 74).

Comparative notes

Neusterensifer yela is an orange-colored species from Rossel Island, and is easily distinguished from the syntopic *N. lousiadae* by the highly incised posteroventral male abdomen, bearing large longitudinally ovate hair patches flanking the medial sulcus on ventrite VII, and by the elongate, blade-like process of the male proctiger, which comes to a rounded rather than palmate apex (compare figs. 65, 67). The male hind femur shows an incipient development of the swelling and dark hair patches on the central portion of the posterior margin (similar to the character state shown in fig. 38) that is seen in a much more extreme form in *N. femoralis* from far eastern New Guinea and proximate islands (fig. 35). The female is easily distinguished by the strongly infolded connexiva and the pair of acuminate black setal tufts near the posterior apex of the abdomen (fig. 48), best seen in lateral view.

Biological notes

This species was taken from small, cut off overflow pools near the mouth of a tributary to the Woa River, and in standing pools in exposures of metamorphic bedrock adjacent to the upper reaches of this same river; in the latter situation it occurred sympatrically with *N. lousiadae*. A more extensive habitat description of the Woa River type locality may be found in the discussion under *Rheovelina insularis*.

Neusterensifer sulcata sp. n.
(figs. 46, 68, 75)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Sudest [Tagula] Island, Kolukolu Creek,

near Araeda village, 0-105 m. [0-350 ft.], 11°26'44.7"S, 153°25'56.8"E, water temp. 23 °C., 30 August 2002, CL 7194, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Tagula [Sudest] Island: 56 micropterous males, 73 micropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM); 8 micropterous males, 19 micropterous females, Kalitau Creek, 1 km. upstream from head of estuary, 0-30 m. [0-100 ft.], 11°21'51.7"S, 153°14'26.0"E, water temp. 24.4 °C., 29 August 2002, 09:30-14:30 hrs., CL 7190, D. A. & J. T. Polhemus (USNM); 6 micropterous males, 9 micropterous females, small spring fed stream near Kalitau Creek, 45 m. [150 ft.], 11°21'29.7"S, 153°14'39.9"E, water temp. 26 °C., 29 August 2002, 10:00-12:00 hrs., CL 7192, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.05-2.20 mm ($\bar{x}$ = 2.13, n = 5); width 0.87-1.00 mm ($\bar{x}$ = 0.95, n = 5). Micropterous female, length 2.45-2.60 mm ($\bar{x}$ = 2.53, n = 5); width 1.00-1.05 mm, ($\bar{x}$ = 1.06, n = 5).

Colour. – Micropterous male: Ground colour light orange brown, marked with darker brown on dorsal thorax and abdomen, legs yellowish brown; small patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II-VIII, and along anterior margin of pronotum. Head orange brown, darker along midline; eyes silvery red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, darker centrally and at punctations on posterior lobe, bearing a pair (1+1) of faintly indicated elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, lateral and extreme posterior margins of metanotum and all abdominal tergites narrowly black, posterior portion of tergite VI plus all of tergites VII and VIII medium to dark brown, laterotergites below connexiva narrowly black along sutures and adjoining spiracles; connexiva entirely light orange brown. Antennae medium brown. Legs generally yellowish brown with tarsi darker.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.35, width 0.60; width of eye/interocular space, 0.10/0.35. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.37/0.90. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II-VII, respectively: 0.12 : 0.10 : 0.08 : 0.08 : 0.07 : 0.25.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, slender, erect golden setae; legs and antennae

thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I-III, anterior margins of all tibiae, posterior margin of middle femur; fore femur ventral margin sinuate, weakly biconcave, bearing numerous short, stiff black setae along entire length, intermixed with evenly spaced comb of 10 long, erect, pilose black setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to 1/3 that of tibia; hind femur with a tumescence centrally on posterior margin, this tumescence thickly set with very short, stiff black setae.

Abdominal venter set with short appressed gold setae, and scattered much longer erect gold setae; abdominal ventrite II forming a small tumescence centrally, this tumescence contiguous with a low carina continuing posteriorly on midline of ventrites III-V, ventrite VI forming a small tumescence anteromedially bearing a tuft of fine gold setae, depressed posteromedially to form a small sulcus, ventrite VII strongly depressed along longitudinal midline, forming a deep, narrow sulcus, anterior end of this sulcus contiguous with medial sulcus on posterior section of ventrite VI, lateral sections of ventrite VII to either side of sulcus bearing a pair (1+1) of thick, longitudinally ovate tufts of short, stiff black setae (fig. 40). Proctiger produced anteriorly into a moderately long, acuminate, blade-like process with a sharply angulate apex (fig. 68). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.37 : 0.30 : 0.40 : 0.47.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.53 : 0.27 : 0.0; of middle leg, 0.80 : 0.75 : 0.08 : 0.23; of hind leg, 0.85 : 0.95 : 0.07 : 0.20.

Micropterous female: Similar to micropterous male in general structure, but with following exceptions: overall coloration darker orange brown to rusty brown, metanotum and abdominal tergites II-IV with patches of silvery setae laterally, abdominal tergite V bearing silvery setae on posterior half, abdominal tergite VI hidden beneath infolded connexiva, abdominal tergite VII produced into posteriorly-directed, finger-like medial process, apex of this process projecting under and beyond posterior angles of connexival segment VII and over base of tergite VIII, abdominal tergite VIII with a few scattered silvery setae, this tergite plus proctiger lying in nearly vertical orientation; connexiva strongly and suddenly convergent posteriorly, meeting over and covering abdominal tergites VI and VII, connexival segments V-VII with a few moderately long erect black setae along dorsal margins, these setae forming a small, diffuse tuft at posterior angle of segment V, another acuminate tuft of stiff black setae arising on the inner margins of connexival segments

Figs. 65-69.

Neusterensifer species, process arising from male proctiger. — 65, *N. yela*, ventral view; 66, *N. misima*, ventral view; 67, *N. louisidae*, ventral view; 68, *N. sulcata*, ventral view; 69, *N. muyuu*, ventral view.

VII and projecting upward between the appressed dorsal margins of the segments, posterolateral connexival angle of segment VII obtusely angulate, not produced (fig. 46); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases broadly black, overlain with a few silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter and fore femur unmodified, and hind femur slightly tumescent and setiferous centrally on posterior margin.

Macropterous form: Unknown.

Etymology

The name '*sulcata*' refers to the deep sulcus on the abdominal venter of the male.

Distribution

Louisiade Archipelago (fig. 75).

Comparative notes

Neusterensifer sulcata is an orange-brown species endemic to Tagula (or Sudest) Island, the largest island in the Louisiade Archipelago. It is superficially similar in structure and coloration to *N. yela* from nearby Rossel Island, but may be easily separated from that species by the following characters: in *N. sulcata* the ground colour is darker orange brown with more extensive overlying dark markings; in males of *N. sulcata* the medial sulcus on the ventral abdomen transgresses only ventrite VII and the base of ventrite VI (fig. 40), rather than occurring on ventrites IV-VII as in *N. yela*, the apex of the process on the male proctiger is acuminate, not rounded as in *N. yela* (compare figs. 65, 68), and the male hind femur is tumescent on its posterior margin, reminiscent of the character state in *N. femoralis* (fig. 35), rather than incipiently tumescent as in *N. yela*; and females of *N. sulcata* possess a finger-like projection with a setiferous apex on abdominal tergite VII (fig. 46), and have the connexiva covering only tergites VI and VII, rather than tergites V-VII as in *N. yela*.

Fig. 70. Distribution of *Neusterensifer* species in the far eastern New Guinea region.

Biological notes

This species was taken in great abundance from standing pools set amid exposures of metamorphic bedrock adjacent to waterfalls on the midreach of Kolukolu Creek, a relatively large, swift stream in a partially shaded bed draining the northern slopes of Tagula Island. Further notes on this locality may be found in the discussion under *Rheovelina insularis*.

Neusterensifer misima sp. n. (figs. 47, 66, 75)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Misima Island, north coast, Guwana Creek, near Nulia village, 15–30 m. [50–100 ft.], 10°39'22.8"S, 152°41'16.5"E, water temp. 22 °C., 3 September 2002, 10:00–12:00 hrs., CL 7201, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., Louisiade Archipelago, Misima Island: 2 macropterous females, 29 micropterous males, 68 micropterous females, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM); 3 micropterous males, 6 micropterous females, south coast, Keyana Creek, above Bwagabwaga vil-

lage, 305–335 m. [1000–1100 ft.], 10°40'33.8"S, 152°40'44.9"E, water temp. 22.5 °C., 4 September 2002, 10:00–12:00 hrs., CL 7206, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.05–2.10 mm ($\bar{x}$ = 2.09, n = 5); width 0.80–0.90 mm ($\bar{x}$ = 0.85, n = 5). Micropterous female, length 2.30–2.45 mm ($\bar{x}$ = 2.35, n = 5); width 0.95–1.00 mm ($\bar{x}$ = 0.97, n = 5). Macropterous female, length 2.60–2.70 mm ($\bar{x}$ = 2.65, n = 2); width 1.10–1.15 mm ($\bar{x}$ = 1.12, n = 2).

Colour. – Micropterous male: Ground colour orange brown, marked with yellowish brown on pronotum and legs; small patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II and III plus V–VII, along anterior margin of pronotum, and laterally on thorax and abdomen. Head orange brown; eyes blackish red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, bearing a pair (1+1) of elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, lateral and extreme posterior margins of metanotum and abdominal ter-

gites I and II narrowly black, laterotergites below connexiva narrowly black along sutures and adjoining spiracles; connexiva entirely light orange brown. Antennae medium brown. Legs with coxae, trochanters and basal femora yellowish brown, distal femora, all tibiae and all tarsi medium brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.45, width 0.55; width of eye/interocular space, 0.10/0.35. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length:width, 0.30 : 0.80. Metanotum length 0.22. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.10 : 0.09 : 0.07 : 0.07 : 0.07 : 0.25.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, slender, erect black setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of all tibiae, posterior margin of middle femur; fore femur ventral margin straight, unmodified, bearing numerous short, stiff pale setae along entire length, intermixed with evenly spaced comb of 10 long, erect, pilose black setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur unmodified.

Abdominal venter set with short appressed gold setae, and scattered longer erect golden brown setae; abdominal ventrite II forming a small tumescence centrally bearing erect golden setae, this tumescence contiguous with a low carina continuing posteriorly on midline of ventrites III–VI, areas immediately lateral to this carina slightly depressed to form a pair (1+1) of shallow longitudinal sulci, ventrite VII strongly depressed along longitudinal midline, forming a V-shaped sulcus with apex directed anteriorly, lateral sections of ventrites V–VII to either side of sulcus/carina modifications bearing incipient tufts of moderately long, posteriorly-slanting golden setae. Proctiger produced anteriorly into a short, blunt process with a very small angle near the apex (fig. 66). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.40 : 0.32 : 0.42 : 0.45.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.60 : 0.62 : 0.25 : 0.0; of middle leg, 0.70 : 0.75 : 0.10 : 0.25; of hind leg, 0.85 : 1.05 : 0.12 : 0.30.

Micropterous female: Similar to micropterous male in general structure, but with following exceptions: overall coloration darker, dorsal head, thorax and abdominal tergites suffused with medium brown,

metanotum and abdominal tergites II and III with patches of silvery setae laterally, abdominal tergite IV lacking silvery setae, abdominal tergite V bearing silvery setae on posterior half, abdominal tergite VII hidden beneath infolded connexiva, abdominal tergite VIII with scattered silvery setae centrally, this tergite plus proctiger lying in nearly vertical orientation; connexiva strongly and suddenly convergent posteriorly, meeting over and covering posterior portion of abdominal tergite VI, all of tergite VII, base of tergite VIII, connexival segments VII with a few moderately short erect black setae along dorsal margins plus an acuminate tuft of stiff black setae arising on the inner margins and projecting upward between the appressed dorsal margins of these segments, posterolateral connexival angle of segment VII sharply angulate, not produced (fig. 47); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments (fig. 47), set with scattered moderately short erect black setae, extreme lateral margins adjoining connexival bases broadly black, overlain with silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter, fore femur, and hind femur unmodified.

Macropterous female: Similar to micropterous female in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, orange brown, set with fine dark punctations, apex rounded, humeri weakly tumescent; wings complete, matte dark brown, extending past tip of abdomen, forewing bearing 4 closed cells, both basal cells with white streaks at basal angles, 2 distal cells lacking pale markings, costal margin bearing numerous long, stiff, erect black setae.

Macropterous male: Unknown.

Etymology

The name ‘misima’ is a noun in apposition and refers to the island of Misima, to which this species is endemic.

Distribution

Louisiade Archipelago (fig. 75).

Comparative notes

Neusterensifer misima is an orange-brown species that is superficially similar to *N. yela* from Rossel Island. It differs from that species in having a much differently shaped process on the male proctiger (compare figs. 65, 66), and by the structure of the female connexiva, which meet posteriorly to cover only portions of abdominal tergites VI–VIII, rather than covering tergites V–VII as in *N. yela*, and have only a single acuminate setal tuft in lateral view, rather than two (compare figs. 47, 48). The absence of silvery setae on abdominal tergite IV in both sexes is also a useful di-

Figs. 71-73.

Neusterensifer species, process arising from male proctiger. – 71a, b, *N. dentrecasteaux*: a, lateral view, b, ventral view; 72, *N. kula*, ventral view; 73, *N. tufi*, ventral view.

agnostic spot character. Females of *N. misima* do share with *N. yela* and *N. sulcata* the presence of an acuminate tuft of black setae arising from the inner margins of the VII connexival segments and projecting posteriorly between the dorsal margins of the infolded VII connexival segments (figs. 46-48), a putative synapomorphy indicating that all three of these orange-brown species endemic to separate islands in the Louisiades form a closely related group.

Biological notes

This species was taken from standing pools amid boulders and metamorphic bedrock exposures adjacent to cascades along the midreach of Guwana Creek, a small, clear, steeply-dropping stream descending from the mountains of western Misima. Further habitat notes on this locality may be found in the discussion under *Rheovelina anomala*.

Neusterensifer muyuw sp. n. (figs. 37, 41, 49, 69, 70, 83)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., Woodlark Island, Suloga Peninsula, stream entering W. side of Suloga Harbor, 0-180 m. [0-590 ft.], 9°12'21.6"S, 152°42'29.2"E, water temp. 27-28 °C., 23-24 January 2003, CL 7217, D. A. and J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov.: 3 macropterous males, 4 macropterous females, 71 micropterous males, 80 micropterous females, same data as holotype, D. A. and J. T. Polhemus (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length 2.15-2.20 mm ($\bar{x}$ = 2.17, n = 3); width 0.90-1.00 mm ($\bar{x}$ = 0.93, n = 3). Micropterous female, length 2.40-2.50 mm ($\bar{x}$ = 2.45, n = 3); width 0.90-1.00 mm, ($\bar{x}$ = 0.93, n = 3).

Macropterous male, length 2.50 ($n = 1$); width 1.10 mm ($n = 1$). Macropterous female, length 2.50–2.70 mm ($\bar{x} = 2.57$, $n = 3$); width 1.10–1.20 mm, ($\bar{x} = 1.15$, $n = 3$).

Colour. – Micropterous male: Ground colour light orange brown, sparingly marked with darker brown on dorsal thorax and abdomen, legs yellowish brown; small patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II–VII, and along anterior margin of pronotum, and on sides of thorax and abdomen. Head orange brown, darker along midline; eyes dark red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, darker anteromedially and at punctations on posterior lobe, bearing a pair (1+1) of elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, lateral and extreme posterior margins of metanotum and all abdominal tergites narrowly dark brown to blackish, posterior portion of tergite VII plus all of tergite VIII medium to dark brown, laterotergites below connexiva narrowly black along sutures and adjoining spiracles; connexiva entirely light orange brown. Antennae medium brown. Legs generally yellowish brown with tibiae and tarsi darker.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.50, width 0.55; width of eye/interocular space, 0.12/0.20. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.35/0.85. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.15 : 0.15 : 0.10 : 0.10 : 0.10 : 0.22.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, slender, erect brown setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of all tibiae, posterior margin of middle femur, distal $\frac{1}{3}$ of posterior margin of hind femur; fore femur ventral margin sinuate, weakly biconcave, bearing numerous short, stiff black setae along entire length, intermixed with evenly spaced comb of about 10 long, erect, pilose black setae; middle tibia bearing a row of evenly spaced, long pilose black setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur with a tumescence centrally on posterior margin (fig. 37), this tumescence thickly set with very short, stiff black setae.

Abdominal venter set with short appressed gold setae, and scattered much longer erect gold setae; abdominal ventrite II forming a small tumescence cen-

trally, ventrite VI depressed along longitudinal midline to form a small sulcus, ventrite VII strongly depressed centrally, forming a deep, V-shaped sulcus with apex directed anterad and contiguous with narrow medial sulcus on posterior section of ventrite VI, lateral sections of ventrite VII to either side of sulcus bearing a pair (1+1) of thick, ovate tufts of short, stiff black setae (fig. 41). Proctiger produced anteriorly into a moderately long, acuminate, blade-like process with a sharply angulate apex (fig. 69). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.40 : 0.30 : 0.42 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.60 : 0.55 : 0.28 : 0.0; of middle leg, 0.75 : 0.75 : 0.08 : 0.25; of hind leg, 0.95 : 0.98 : 0.10 : 0.20.

Micropterous female: Similar to micropterous male in general structure and coloration, but with following exceptions: metanotum and abdominal tergites II and III with patches of silvery setae laterally, abdominal tergite IV with small patches of silvery setae laterally and along longitudinal midline, abdominal tergites V and VI bearing silvery setae on posterior halves, abdominal tergite VII produced into posteriorly-directed, finger-like medial process, apex of this process projecting under and beyond posterior angles of connexival segment VII and over base of tergite VIII, apex bearing an acuminate tuft of stiff black setae (fig. 49), abdominal tergites VIII and IX with a few scattered silvery setae, these tergites lying in nearly vertical orientation; connexiva strongly and suddenly convergent posteriorly, meeting over and covering abdominal tergite VII and base of tergite VIII, connexival segments II–VII with very sparse, moderately long erect black setae along dorsal margins, posterolateral connexival angle of segment VII sharply angulate, bearing an acuminate, posteriorly-directed tuft of stiff black setae (fig. 49); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases broadly black, overlain with a few silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter and fore femur unmodified, and hind femur slightly incrassate, incipiently swollen on central section of posterior margin.

Macropterous male: Similar to micropterous male in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, orange brown, set with fine dark punctations, apex rounded, humeri weakly tumescent; wings complete, matte dark brown, extending past tip of abdomen, forewing bearing 4 closed cells, inner basal cell with white streak at basal angle, remaining 3 cells lacking pale markings, costal margin bearing numerous long, stiff, erect black setae.

Macropterous female: Similar to macropterous male in general structure and colour, but with pale streak in inner basal cell obscure; abdominal tergite VII not forming a setiferous posterior projection as in micropterous form.

Etymology

The name 'muyuw' refers to the traditional Papuan name for Woodlark Island.

Distribution

Woodlark Island (fig. 70).

Comparative notes

Neusterensifer muyuw is most similar morphologically to *N. sulcata* from Tagula Island, with both species having deep sulci on male abdominal ventrite VII (compare figs. 40, 41) and acuminate processes on the male proctiger (Figs. 68, 69). In *N. muyuw*, however, the central sulcus on ventrite VII is shaped like a posteriorly-opening V when viewed from below, and the flanking tufts of black setae angle inward toward each other anteriorly (fig. 41), while in *N. sulcata* the central sulcus on ventrite VII follows the longitudinal midline, and the flanking black setal tufts are parallel (fig. 40). The shapes of the processes on the male proctiger, though similar, also differ between the two species (compare Figs. 68, 69).

Females of *N. muyuw* have abdominal tergite VII prolonged into a posteriorly-directed, finger-like process with a long tuft of black setae at the apex (fig. 49), a character state once again similar that seen in *N. sulcata* (fig. 46). Females of *N. muyuw* may be separated from those of *N. sulcata* by their lighter overall coloration, the presence of a small patch of silvery setae centrally as well as laterally on abdominal tergite IV, and a band of silvery setae running transversely across the posterior margin of abdominal tergite V.

Biological notes

The type locality was a clear, rocky, heavily shaded stream descending from the forested hills of the Sulo-ga Peninsula on southwestern Woodlark Island (fig. 83). *Neusterensifer muyuw* was abundant at this site, occurring in small, sheltered pockets of water along the stream margins.

Neusterensifer dentrecasteaux sp. n.
(figs. 43, 58, 71, 75, 86)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., D'Entrecasteaux Islands, Fergusson Island, east coast, Awae-towa River, lower midreach, E. of Basima, 15 m. [50 ft.], 9°27'34.0"S, 150°49'37.5"E, water temp. 23 °C., 25 August 2002, 09:45–11:15 hrs., CL 7183, D. A. &

J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., D'Entrecasteaux Islands: 1 macropterous male, 7 micropterous males, 27 micropterous females, Fergusson Island, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM); 5 macropterous males, 2 macropterous females, 42 micropterous males, 61 micropterous females, same data as holotype except 26 January 2003, D. A. & J. T. Polhemus (USNM); 1 micropterous male, Fergusson Island, east coast, Yaya River, N. of Mebulibuli Point, 0–60 m. [0–200 ft.], 9°30'34.3"S, 150°52'51.1"E, water temp. 25.8 °C., 23 August 2002, 10:00–16:30 hrs., CL 7178, D. A. & J. T. Polhemus (USNM); 3 micropterous males, 1 micropterous female, Fergusson Island, east coast, Mebulibuli Creek and rocky tributary, 1.3 km. upstream of mouth, S. of Basima, 15–75 m. [50–250 ft.], 9°30'54.4"S, 150°52'04.2"E, water temp. 24 °C., 24 August 2002, 09:00–13:00 hrs., CL 7180, D. A. & J. T. Polhemus (USNM); 2 micropterous males, Goodenough Island, Tuabeda River at Kalauna village, 335 m. [1100 ft.], 9°23'01.5"S, 150°19'32.0"E, water temp. 22.5 °C., 26 August 2002, 10:00–12:00 hrs., CL 7184, D. A. & J. T. Polhemus (USNM); 3 micropterous males, Gumini River at road bridge, SW of Alotau, 15 m. [50 ft.], 10°19'08.0" S, 150°14'06.8" E, water temp. 28 °C. (shaded side pools), 21 January 2004, 10:30–14:00 hrs., CL 7174, D. A. & J. T. Polhemus (USNM). PAPUA NEW GUINEA, Oro Prov.: 45 micropterous males, 33 micropterous females, Kofure River, W. of Tufi, 0–45 m. [0–150 ft.], 9°04'58.2"S, 149°16'38.7"E, water temp. 28 °C., 25 January 2004, 09:30–14:00 hrs., CL 7304, D. A. & J. T. Polhemus (USNM, JTPC).

Description

Size. – Micropterous male, length 2.15–2.30 mm ($\bar{x}$ = 2.23, n = 7); width 0.85–1.00 mm ($\bar{x}$ = 0.95, n = 7). Micropterous female, length 2.50–2.85 mm ($\bar{x}$ = 2.74, n = 6); width 1.00–1.10 mm ($\bar{x}$ = 1.04, n = 6). Macropterous male, length 2.50–2.70 mm ($\bar{x}$ = 2.57, n = 4); width 1.15–1.20 mm ($\bar{x}$ = 1.19, n = 4). Macropterous female, length 2.90 (n = 1); width 1.25 mm, (n = 1).

Colour. – Micropterous male: Ground colour dark brown, marked with orange brown on connexiva, yellowish brown on basal legs; patches of short, shining, silvery pubescence present along anterior margin of pronotum, on sides of thorax and abdomen, laterally on metanotum and abdominal tergites II–VII. Head dark brown; rostrum yellowish brown, fuscous medially, piceous distally. Pronotum dark brown, becoming lighter reddish brown anterolaterally, bearing a pair (1+1) of elongate transverse yellowish brown spots to either side of midline behind anterior margin. Metanotum and abdomen dark brown dorsally, extreme lateral and posterior margins of metanotum and

abdominal tergites blackish, connexiva orange brown on outer halves, laterotergites below connexiva blackish. Antennae dark brown. Legs generally medium brown, with coxae, trochanters, and basal femora pale yellowish brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.37, width 0.62; width of eye/interocular space, 0.12/0.35. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.45/0.92. Metanotum length 0.25. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.15 : 0.12 : 0.10 : 0.12 : 0.10 : 0.30.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, erect brown setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of all tibiae, posterior margins of middle and hind femora; fore femur with ventral margin nearly straight, bearing a few short, stiff, semi-erect black setae basally plus short pale along entire length, these latter setae intermixed with evenly spaced comb of about 10 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose golden setae of progressively decreasing length along posterior margin, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur simple and unmodified, lacking setal tufts.

Abdominal venter set with numerous erect, moderately long gold setae; central sections of ventrites V and VI narrowly depressed medially to form a continuous, shallow longitudinal sulcus, both ventrites with a pair (1+1) of dense tufts of short, black setae bordering sulcus to either side, ventrite VII broadly depressed centrally, forming concavity on underside of terminal abdomen (fig. 43). Proctiger produced anteriorly into a moderately long, broad, blade-like process with an sharply angulate apex when viewed dorsally, this apex multi-pronged when viewed ventrolaterally (figs. 71a, b). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.42 : 0.30 : 0.47 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.60 : 0.35 : 0.0; of middle leg, 0.90 : 0.80 : 0.17 : 0.25; of hind leg, 1.00 : 1.10 : 0.17 : 0.30.

Micropterous female: Similar to micropterous male in general structure and colour, with following exceptions: connexiva more broadly marked with orange brown; metanotum and abdominal tergites II–IV with small patches of silvery setae laterally, abdominal tergites V and VI entirely covered with silvery setae, abdominal tergite VII with a very few silvery setae along

longitudinal midline, abdominal tergite VIII with numerous diffusely scattered silvery setae, this tergite plus proctiger lying in nearly vertical orientation; connexiva open and not touching for their entire length, gradually convergent posteriorly, posterolateral angles simple, gently curving, not produced (fig. 58), margin of connexival segment VII narrowly flattened posteriorly to form a small, pad-like structure, all connexival segments bearing short, dark, erect setae, these setae becoming longer and denser on inner faces of segments V–VII; lateral sections of abdominal ventrites black, curving upward into vertical orientation at connexival bases, margins adjoining connexival bases black with broad patches of silvery setae; abdominal venter and legs unmodified.

Macropterous male: Similar to micropterous male in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, dark blackish brown, set with fine dark punctations, apex rounded, humeri weakly tumescent; wings complete, matte black, extending past tip of abdomen, forewing bearing 4 closed cells, both basal cells with white streaks at basal angles, 2 distal cells with small, faint, elongate white spots near posterior apices, costal margin bearing long, stiff, erect black setae.

Macropterous female: Similar to macropterous male in general structure and colour.

Etymology

The name ‘dentrecasteaux’ is a noun in apposition, and refers to the D’Entrecasteaux Islands, to which this species is endemic.

Distribution

Goodenough and Fergusson Islands, and the eastern Papuan Peninsula (fig. 75).

Comparative notes

Neusterensifer dentrecasteaux is a dark colored taxon that is easily separated from the other *Neusterensifer* species occurring in far eastern New Guinea by the complete covering of silvery setae on abdominal tergites V and VI in females; by the widely separated female connexiva that leave all abdominal tergites visible; by the dense fringe of black setae along the inner faces of female connexival segments V–VII; by the male abdominal venter that is only shallowly sulcate medially but bears dense paired tufts of black setae on both ventrites V and VI (fig. 43); and by the distinctively multifurcate apex of the process arising from the male proctiger (figs. 71a, b).

Biological notes

Neusterensifer dentrecasteaux is found along the margins of lowland streams and rivers, often next to shaded banks along slowly flowing or sheltered side pools.

Fig. 74. Distribution of *Neusterensifer* species in the far eastern New Guinea region.

The type locality was a swift, clear river in a mostly unshaded bed of water-rounded rocks and cobbles, surrounded by gardens and disturbed lowland rain forest (fig. 86). The insects were found in sheltered side pools and water pockets amid cobbles along the stream margins.

Neusterensifer kula sp. n.
(figs. 45, 64, 72)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Milne Bay Prov., D'Entrecasteaux Islands, Fergusson Island, east coast, Yaya River, N. of Mebulbuli Point, 0-60 m. [0-200 ft.], 9°30'34.3"S, 150°52'51.1"E, water temp. 26 °C., 23 August 2002, 10:00-16:30 hrs., CL 7178, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Milne Bay Prov., D'Entrecasteaux Islands: 2 macropterous females, 20 micropterous males, 28 micropterous females, Fergusson Island, same data as holotype, D. A. & J. T. Polhemus (USNM, JTPC, BPBM); 2 micropterous males, 1 micropterous female, Fergusson Island, east coast, Mebulbuli Creek and rocky tributary, 1.3 km. upstream of mouth, S. of Basima, 15-75 m. [50-250 ft.], 9°30'54.4"S, 150°52'

04.2"E, water temp. 24 °C., 24 August 2002, 09:00-13:00 hrs., CL 7180, D. A. & J. T. Polhemus (USNM); 2 macropterous females, 3 micropterous males, 1 micropterous female, Fergusson Island, east coast, upper Awaetowa River and rocky tribs., W. of Basima, 575-650 m. [1885-2130 ft.], 9°30'34.3"S, 150°48'17.3"E, water temp. 22 °C., 27 January 2003, 10:00-14:00 hrs., CL 7225, D. A. Polhemus (USNM); 8 micropterous males, 7 micropterous females, Goodenough Island, Waidala Creek, 3 km. W. of Bolubolu on road to Vivigani, 15 m. [50 ft.], 9°22'04.9"S, 150°21'14.3"E, water temp. 25 °C., 27 August 2002, 08:30-10:00 hrs., CL 7188, D. A. & J. T. Polhemus (USNM); 1 micropterous male, Goodenough Island, Kuliana Creek at Ewaoiana, near Kalauna village, 290 m. [950 ft.], 9°22'53.8"S, 150°19'29.6"E, water temp. 24.5 °C., 26 August 2002, 10:00-12:00 hrs., CL 7185, D. A. & J. T. Polhemus (USNM).

Description

Size. – Micropterous male, length 2.25-2.35 mm ($\bar{x}$ = 2.30, n = 6); width 0.90-1.05 mm ($\bar{x}$ = 0.98, n = 6). Micropterous female, length 2.75-2.80 mm ($\bar{x}$ = 2.79, n = 5); width 1.00-1.05 mm, ($\bar{x}$ = 1.04, n = 5). Macropterous female, length 2.75-2.80 mm ($\bar{x}$ =

2.78, $n = 2$); width 1.20 mm, ($\bar{x} = 1.20$, $n = 2$).

Colour. – Micropterous male: Ground colour orange brown, marked with darker brown on dorsal thorax and abdomen, legs yellowish brown; small patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II–VII, along anterior margin of pronotum, on lateral thorax and abdomen. Head orange brown, darker along midline; eyes dark red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, darker centrally and at punctations on posterior lobe, bearing a pair (1+1) of faintly indicated elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, lateral and extreme posterior margins of metanotum and abdominal tergites II–VII darker, laterotergites below connexiva narrowly black along sutures and adjoining spiracles; connexiva entirely orange brown. Antennae dark brown. Legs with coxae, trochanters and femora except at apices yellowish brown, apical femora, tibiae and tarsi medium brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.50, width 0.60; width of eye/interocular space, 0.12/0.40. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.40/0.92. Metanotum length 0.23. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.10 : 0.10 : 0.07 : 0.07 : 0.10 : 0.35.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, slender, erect golden brown setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of all tibiae, posterior margin of middle femur; fore femur ventral margin weakly sinuate and biconcave, bearing a small patch of stiff black setae basally plus numerous short, stiff, pale setae on distal $\frac{3}{4}$, intermixed with evenly spaced comb of 10 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose golden setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur slightly incrassate, posterior margin bearing numerous very short, stiff gold setae centrally.

Abdominal venter set with short appressed gold setae, and scattered much longer erect golden brown setae; abdominal ventrite II forming a small tumescence centrally, this tumescence contiguous with a low carina continuing posteriorly on midline of ventrite III, ventrites IV–VII depressed along longitudinal midline, forming a narrow sulcus that becomes progressively deeper posteriorly, ventrites II–VI with numerous long, inwardly- to posteriorly-directed setae, these se-

tae gold in colour on ventrite II but becoming progressively darker and eventually blackish on ventrites III–VI, lateral sections of ventrites IV–VI to either side of medial sulcus bearing numerous moderately long, inwardly-directed gold setae, lateral portions of ventrite VII to either side of sulcus not strongly tumescent, but bearing a pair (1+1) of thick, roughly circular tufts of short, stiff, inwardly-directed dark brown to black setae. Proctiger produced anteriorly into a moderately long blade-like process with an expanded apex bearing a small terminal point (fig. 72). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.40 : 0.30 : 0.42 : 0.60.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.65 : 0.55 : 0.30 : 0.0; of middle leg, 0.85 : 0.90 : 0.12 : 0.30; of hind leg, 1.00 : 1.10 : 0.17 : 0.30.

Micropterous female: Similar to micropterous male in general structure, but with following exceptions: overall coloration darker orange brown to rusty brown, metanotum and abdominal tergites II–IV with patches of silvery setae laterally, abdominal tergites V and VI bearing silvery setae on posterior $\frac{2}{3}$, abdominal tergite VII produced into posteriorly-directed, finger-like medial process, apex of this process projecting under and beyond posterior angles of connexival segment VII and over base of tergite VIII and bearing a long, acuminate tuft of stiff black setae (fig. 45), abdominal tergite VIII with a few scattered silvery setae, this tergite plus proctiger lying in nearly vertical orientation; connexiva strongly and suddenly convergent posteriorly, meeting over and covering base of abdominal tergite VI plus all of tergite VII, connexival segment V with a few moderately long erect black setae along dorsal margin, acuminate tufts of stiff black setae arising on the inner margins of connexival segments VII and projecting upward between the appressed dorsal margins of these segments (fig. 45), posterolateral connexival angles of segment VII obtusely angulate, not produced; lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases narrowly black, overlain with a few silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter, fore femur and hind femur unmodified.

Macropterous female: Similar to micropterous female in general structure and colour, with following exceptions: posterior lobe of pronotum highly expanded, brown, set with fine dark punctations, apex rounded, humeri weakly tumescent; wings complete, matte dark brown, extending past tip of abdomen, forewing bearing 4 closed cells, both basal cells with white streaks at basal angles, 2 distal cells lacking pale mark-

Fig. 75. Distribution of *Neusterensifer* species in the far eastern New Guinea region.

ings, costal margin bearing long, stiff, erect black setae basally; abdominal tergite VII not forming a setiferous posterior projection as in micropterous form.

Macropterous male: Unknown.

Etymology

The name 'kula' refers to the ancient kula trading ring that links the offshore islands of eastern New Guinea.

Distribution

D'Entrecasteaux Islands (fig. 64).

Comparative notes

Neusterensifer kula is an orange-brown species from Fergusson and Goodenough islands in the D'Entrecasteaux group that is the apparent sister species to *N. tufi* from the Cape Nelson peninsula of mainland New Guinea (see comparative notes under that species), and is also very similar in many respects to *N. sulcata* from Tagula Island in the Louisiades. As in *N. sulcata*, females have a setiferous posteromedial projection on abdominal tergite VII that projects backward below the apices of the infolded connexiva (fig. 45), and a secondary acuminate tuft arising from the inner

faces of connexiva VII and projecting between the dorsal margins of the infolded connexiva themselves (fig. 45). Females of *N. kula* may be distinguished from those of *N. sulcata* by the degree of posterior infolding on the connexiva, which cover only the extreme posterior portion of abdominal tergite VI plus all of tergite VII, rather than the entirety of tergites VI and VII as in *N. sulcata*, and by the absence of a small, diffuse tuft of upright black setae at the posterior angle of connexival segment V (compare figs. 45, 46). Females of *N. kula* may also be distinguished from those of *N. tufi* by possessing two separate upright, acuminate tufts of stiff black setae arising from the abdomen in lateral view, rather than a single tuft arising from the posterior prolongation of tergite VII, as in *N. tufi* (compare figs. 45, 49). All three of these species under discussion also share with *N. muyuu*, *N. bowutu*, and *N. microrivula* the common synapomorphy of a posteriorly prolonged, finger-like projection on the posterior margin of abdominal tergite VII, indicating that they are all members of a single clade distributed on various sectors of the EPCT.

Males of *N. kula* may be distinguished from those of *N. sulcata* in having a longitudinal sulcus medially on abdominal ventrites IV-VII, rather than on ven-

trites VI and VII; in having the pair of dark setae tufts on abdominal ventrite VII roughly circular rather than elongate-ovate; and in having the apex of the process on the proctiger expanded to form a “bird head” shape (fig. 72), rather than being tapering and acuminate. The shape of the male proctiger process is instead very similar to the state seen in *N. tufti*, but has a shorter apical prolongation beyond the expanded distal head, and lacks small angulations on posterior margin of the head (compare figs. 72, 73).

In addition, the male fore femur of *N. kula* is weakly sinuate along its posterior margin and bears a patch of stiff, slightly darkened setae basally. Abdominal ventrites II–V also possess a medial patch of long hairs that runs from the tumescent basal segments down into the anterior end of the medial sulcus; these hairs become darker as they enter the sulcus on the central portions of ventrites IV and V. The male hind femur and tibia are not modified. In contrast to males of *N. sulcata* and *N. femoralis*, which have a similar general orange-brown appearance, the male hind femur in *N. kula* is not tumescent or otherwise modified.

Biological notes

The type series was taken from small pools along the margins of rocky creeks draining the hilly eastern shore of Fergusson Island. For a further description of the Yaya River type locality see the discussion under *Rhevelia robiniae*.

Zoogeographic notes

As currently understood, *N. kula* is confined to Goodenough and Fergusson islands in the D'Entrecasteaux group; these islands were formed by a group of metamorphic core complexes that emerged along the axis of the Woodlark Rift during the last 5 Myr (Abers et al. 2002). To date, *N. kula* has not been collected on Normanby Island, the third major island in the D'Entrecasteaux group; instead, this latter island harbors taxa such as *N. hunteri* and *N. femoralis* that are also found at the eastern end of the adjacent Papuan Peninsula. This pattern of distribution implies that Normanby Island has had a separate faunal history from the remainder of the D'Entrecasteaux group, and may have had an independent geological origin.

Neusterensifer tufti sp. n.
(figs. 38, 39, 50, 73, 74)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Oro Prov., Kofure River and cascading tribs., W. of Tufi, 0–45 m. [0–150 ft.], 9°04'58.2"S, 149°16'38.7"E, water temp. 28 °C., 25 January 2004, 09:30–14:00 hrs., CL 7304, D. A. & J. T. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Oro Prov.: 19 micropterous males, 18 micro-

pterous females, same data as holotype (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length 2.30–2.35 mm ($\bar{x}$ = 2.33, n = 5); width 0.90–1.10 mm ($\bar{x}$ = 1.01, n = 5). Micropterous female, length 2.50–2.60 mm ($\bar{x}$ = 2.55, n = 5); width 0.90–1.10 mm, ($\bar{x}$ = 1.02, n = 5).

Colour. – Micropterous male: Ground colour orange brown, marked with darker brown on dorsal thorax and abdomen, legs yellowish brown; small patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II–VII, along anterior margin of pronotum, on lateral thorax and abdomen. Head orange brown, darker along midline; eyes dark red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, darker centrally and at punctations on posterior lobe, bearing a pair (1+1) of faintly indicated elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, lateral and extreme posterior margins of metanotum and abdominal tergites II–VII darker, laterotergites below connexiva narrowly black along sutures and adjoining spiracles; connexiva entirely orange brown. Antennae dark brown. Legs with coxae, trochanters and femora except at apices yellowish brown, apical femora, tibiae and tarsi medium brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.50, width 0.62; width of eye/interocular space, 0.12/0.37. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.40/0.90. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.17 : 0.12 : 0.10 : 0.10 : 0.10 : 0.40.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, slender, erect dark brown setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of all tibiae, posterior margins of middle and hind femora; fore femur ventral margin weakly sinuate and biconcave, bearing a small, dense patch of stiff black setae basally plus numerous shorter, stiff, paler setae on distal $\frac{3}{4}$, intermixed with evenly spaced comb of 10 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose golden setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur very slightly incrassate (fig. 38), posterior margin bearing numerous very short, stiff gold setae centrally.

Abdominal venter set with short appressed gold se-

Figs. 76-77.

Neusterensifer species, process arising from male proctiger. — 76 a-c, *N. goilala*: a, left lateral view, b, ventral view, c, right lateral view. 77 a, b, *N. bowutic*: a, ventral view, b, right lateral view.

tae; abdominal ventrite II forming a prominent domed tumescence centrally, this tumescence contiguous with a well developed setiferous carina continuing posteriorly on midline of ventrites III-VI (fig. 39), lateral portions of ventrites V and VI flanking this tumescence slightly depressed, forming a pair (1+1) of shallow longitudinal sulci flanking the carina; ventrite VII strongly depressed along longitudinal midline, forming a narrow sulcus that becomes progressively deeper posteriorly, lateral portions of ventrite VII to either side of sulcus not strongly tumescent, but bearing a pair (1+1) of dense, roughly circular tufts of short, stiff, posteriorly-directed dark brown to black setae. Proctiger produced anteriorly into a moderately long blade-like process with an expanded apex bearing an extended terminal point (fig. 73). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.38 : 0.27 : 0.40 : 0.52.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.62 : 0.60 : 0.28 : 0.0; of middle leg, 0.80 : 0.80 : 0.15 : 0.30; of hind leg, 0.90 : 1.10 : 0.15 : 0.30.

Micropterous female: Similar to micropterous male in general structure, but with following exceptions: overall coloration darker orange brown to rusty brown, metanotum and abdominal tergites II-IV with patches of silvery setae laterally, abdominal tergite V with silvery setae on posterior half, abdominal tergite VI bearing silvery setae on posterior $\frac{2}{3}$, abdominal tergite VII mostly hidden beneath infolded connexival apices, posterior margin produced medially into a posteriorly-directed, finger-like medial process bearing an acuminate tuft of long black setae at its tip (fig. 50), apex of this process projecting under and beyond posterior angles of connexival segment VII and over base of tergite VIII; abdominal tergite VIII with covered with numerous silvery setae except at extreme base,

this tergite plus proctiger lying in nearly vertical orientation; connexiva strongly convergent posteriorly, meeting over and covering much of abdominal tergite VII, connexival segments V-VII with a few moderately long erect black setae along outer margins but lacking specialized hair tufts, posterolateral connexival angles of segment VII obtusely angulate, not produced; lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases narrowly black, overlain with silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter, fore femur and hind femur unmodified.

Macropterous form: Unknown.

Etymology

The name 'tufi' is a noun an apposition and refers to the town of Tufi near the type locality.

Distribution

Eastern New Guinea (fig. 74).

Comparative notes

Neusterensifer tufi is similar in many respects to *N. kula*, from which it can be distinguished by the more highly developed and setiferous medial tumescence on male abdominal ventrites II-VI (fig. 39), and the somewhat different shape of the process on the male proctiger (compare figs. 72, 73). In both species the proctiger process has an expanded apex of similar overall shape, but in *N. tufi* the extreme tip is more elongate, and posterodorsal margin of the expanded section is multidentate (Fig. 73). The female differs from that of *N. kula* in having the connexival margins not as closely appressed posteriorly, covering only the posterior half of abdominal tergite VII when viewed from above, rather than the posterior half of tergite VI and all of tergite VII as in *N. kula*. The connexiva of *N. tufi* also lack tufts of stiff black setae on the inner faces of the seventh connexival segments that project upward between the appressed margins of the segments (fig. 50); such tufts are present in *N. kula* (fig. 45). By contrast, both *N. tufi* and *N. kula* do possess a posterior elongation of abdominal tergite VII into a finger-like structure with a tuft of long black setae at its apex that projects posteriorly beneath the infolded posterolateral angles of the connexiva and beyond tergite VIII (figs. 45, 50); this character state allies *N. tufi* with other members of the '*kula* group' of *Neusterensifer* distributed throughout the EPCT.

Zoogeographic notes

The apparent sister species relationship of *N. kula* from Goodenough and Fergusson islands in the D'Entrecasteaux group and *N. tufi* from the Cape

Nelson peninsula, indicated by similarities in the male proctiger process and ventral abdominal structures, is of zoogeographic interest, because the presence of these closely related species along the western extension of the Woodlark Rift supports the current geological hypothesis that the D'Entrecasteaux Islands and the Tufi area have shared a common geological history linked by this structure (Abers et al. 2002).

Biological notes

The type series was taken from a standing pool in bedrock next to a cascade in a narrow, rock walled gorge.

Neusterensifer bowutu sp. n.

(figs. 51, 77a, 77b, 78)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Morobe Prov., 'Kerosine Creek' and rocky trib., middle Aleater [= Alewiri] River basin, W. of Lababia village, 30 m. [100 ft.], 7°18'46.2"S, 147°06'30.1"E, water temp. 25 °C., 5 May 2003, 10:30-12:30 hrs., CL 7245, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Morobe Prov.: 14 micropterous males, 8 micropterous females, same data as holotype, D. A. Polhemus (USNM, JTPC, BPBM); 5 micropterous males, 6 micropterous females, rocky hill stream behind Kamiali guesthouse, S. of Lababia village, nr. Cape Dinga, 30 m. [100 ft.], 7°18'02.0"S, 147°08'01.4"E, CL 7243, water temp. 25.5 °C., 4 May 2003, 14:00-15:00 hrs., D. A. Polhemus (USNM); 3 micropterous females, trib. to lower Aleater [= Alewiri] River, 5 m. [15 ft.], 7°19'14.7"S, 147°07'34.9"E, 27 °C., 3 May 2003, 13:00-15:00 hrs., CL 7241 D. A. Polhemus (USNM).

Description

Size. – Micropterous male, length 1.80-2.10 mm ($\bar{x}$ = 1.93, n = 3); width 0.75-0.80 mm ($\bar{x}$ = 0.78, n = 3). Micropterous female, length 2.20-2.25 mm ($\bar{x}$ = 2.23, n = 2); width 0.80-0.85 mm ($\bar{x}$ = 0.83, n = 2).

Colour. – Micropterous male: Ground colour dark orange brown, marked with yellowish brown on anterior pronotum and basal legs; patches of short, shining, silvery pubescence present laterally on metanotum, abdominal tergites II, III, and V-VII, along anterior margin of pronotum, and on sides of thorax and abdomen. Head dark orange brown; eyes silvery red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, slightly darker anteromedially, bearing a pair (1+1) of elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen brown dorsally, laterotergites below connexiva black along sutures and adjoining spiracles; connexiva light orange brown. Antennae dark brown, becoming

Fig. 78. Distribution of *Neusterensifer* species in the far eastern New Guinea region.

blackish distally. Legs generally medium brown with tarsi darker, coxae, trochanters, basal femora and all ventral surfaces pale yellowish white.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.40, width 0.60; width of eye/interocular space, 0.15/0.30. Pronotum moderately long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.27/0.80. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.15 : 0.12 : 0.08 : 0.10 : 0.08 : 0.27.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, fine, slender, erect dark setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I–III, anterior margins of all tibiae, posterior margins of middle and hind femora; fore femur with ventral margin flattened and weakly concave on basal half, this area bearing numerous short, stiff gold setae, posterior margin also with evenly spaced comb of 6–8 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose golden setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur very slightly incrassate, lacking tumescences or specialized setal patches.

Abdominal venter set with short appressed gold setae, and scattered longer erect golden setae; abdominal ventrite II forming a small tumescence centrally, ventrites III–V forming a prominent median carina along

longitudinal midline, this carina declining in height in posterior direction, flanked to either side by deep, narrow parallel sulci, these parallel sulci merging to form a single deep sulcus on central sections of ventrites VI and VII, these two ventrites each with a pair (1+1) of dense tufts of short, stiff black setae lying to either side of the medial sulcus. Proctiger produced anteriorly into a moderately long, tapering blade-like projection with an acuminate apex (figs. 77a, b). Parameres vestigial or absent.

Antennal formula I : II : III : IV : 0.30 : 0.25 : 0.35 : 0.50.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.55 : 0.50 : 0.27 : 0.0; of middle leg, 0.75 : 0.70 : 0.09 : 0.25; of hind leg, 0.75 : 0.95 : 0.12 : 0.25.

Micropterous female: Similar to micropterous male in general structure, with following exceptions: overall coloration somewhat darker, rusty orange brown, strongly contrasting with pale orange brown connexiva; metanotum and abdominal tergites II and III with small patches of silvery setae laterally, abdominal tergites IV and V bearing silvery setae across entire widths on posterior $\frac{2}{3}$, abdominal tergite VI hidden beneath infolded connexival margins, abdominal tergite VII produced posteromedially to form a small, acuminate process extending beneath and slightly beyond the infolded posterior margins of the connexiva, apex of this process bearing a posteriorly directed tuft of long, stiff, black setae (fig. 51); abdominal tergite VIII with numerous silvery setae across entire width, this tergite and proctiger lying in nearly vertical orientation; connexiva strongly and suddenly convergent

posteriorly, meeting over and covering abdominal tergite VI and most of VII except for tip of posteromedial projection, all connexival segments with a few moderately long erect black setae along dorsal margins, inner margins of connexival segments VII with acuminate tuft of stiff black setae that projects upward and between the infolded connexival margins, posterolateral connexival apices of segment VII forming small obtuse angles; lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases diffusely blackish, overlain with patches of silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter, fore femur, and hind femur unmodified.

Macropterous form: Unknown.

Etymology

The name 'bowutu' is a noun in apposition and refers to the Bowutu Mountains, from which this species was collected.

Distribution

Eastern New Guinea (fig. 78).

Comparative notes

Neusterensifer bowutu is a small, rusty brown species occurring in the Bowutu Mountains of the northern Papuan Peninsula (fig. 78). Females share with those of *N. yela* from Rossel Island, *N. hunteri* from the Milne Bay area, and *N. microrivula* from the Lakekamu Basin a tuft of stiff black setae on the inner margin of female connexival segment VII that projects upward between the infolded connexival margins. Females of *N. bowutu* also possess the posteromedial prolongation of abdominal tergite VII seen in these and several other species, with this tergite forming a small, setiferous posterior tumescence that extends slightly beyond the posterior apices of the infolded connexiva (fig. 51). The males are similar to those of *N. yela* and *N. sulcata* from the Louisiades and *N. microrivula* in having a deep, V-shaped sulcus along the midline of the ventral abdomen, but may be easily separated by the shape of the process on the proctiger (figs. 77a, b). As with *N. microrivula*, these character states indicate that *N. bowutu* is yet another member of a monophyletic *Neusterensifer* lineage scattered across the various sectors of the East Papua Composite Terrane.

Biological notes

The type locality was a small, high gradient stream descending out hills covered by dense primary rain forest, with a bed profile consisting of alternating rocky riffles, small shallow pools, and small cascades over dark volcanic bedrock. Individuals of *N. bowutu*

were found along the margins of the small pools, but were not abundant. Another series was taken from a similar small, shaded, high gradient stream draining directly to the sea near Lababia, while a few additional individuals were captured along the shaded, undercut margins of a swift but much lower gradient lowland stream entering the terminal reach of the Aleater River at the point where it exited the mountains near its mouth at Sachsen Bay.

Neusterensifer goilala sp. n. (figs. 36, 44, 56, 76a-c, 82)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Central Prov., Owen Stanley Range, small hill streamlet, 1.3 km. SSE of Woitape, 1600 m. [5250 ft.], 8°32'59.8"S, 147°15'34.3"E, water temp. 17.5 °C., 2 October 2003, 08:30-09:15 hrs., CL 7248, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Central Prov.: 1 micropterous male, 7 micropterous females, same data as holotype (BPBM); 1 micropterous male, Owen Stanley Range, Om Creek, trib. to upper Udabe River, 1.85 km. SSE of Woitape, 1585 m. [5200 ft.], 8°33'27.7"S, 147°15'21.8"E, water temp. 19 °C., 2 October 2003, 12:00-12:30 hrs., CL 7251, D. A. Polhemus (USNM); 4 micropterous males, Owen Stanley Range, tributary streamlet to Hane River, 1.0 km. SSE of Fane, 1310-1370 m. [4300-4500 ft.], 8°33'32.7"S, 147°05'23.7"E, water temp. 20 °C., 4 October 2003, 11:00-12:30 hrs., CL 7256, D. A. Polhemus (USNM); 1 macropterous female, 8 micropterous males, 9 micropterous females, Owen Stanley Range, trib. to Mas River, 1.9 km. SW of Fane, 1220-1250 m. [4000-4100 ft.], 8°33'33.0"S, 147°04'12.2"E, water temp. 20.5 °C., 5 October 2003, 10:45-12:30 hrs., CL 7258, D. A. Polhemus (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length 2.85-3.00 mm ($\bar{x}$ = 2.92, n = 6); width 1.00-1.20 mm ($\bar{x}$ = 1.08, n = 6). Micropterous female, length 3.10-3.25 mm ($\bar{x}$ = 3.18, n = 6); width 1.10-1.20 mm, ($\bar{x}$ = 1.15, n = 6). Macropterous female, length 3.25 (n = 1), maximum width (across humeral angles of pronotum) 2.35 mm (n = 1).

Colour. – Micropterous male: Ground colour dark orange brown, marked with lighter orange brown on anterior pronotum and connexiva; patches of short, shining, silvery pubescence present laterally on metanotum, abdominal tergites II, III, VI and VII, along anterior margin of pronotum, and on sides of thorax and abdomen. Head dark orange brown; eyes silvery red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, slightly darker medially, bearing a pair (1+1) of elongate transverse yel-

Figs. 79-81.

Neusterensifer species, process arising from male proctiger. – 79, *N. lubu* Polhemus & Polhemus, ventral view; 80, *N. microrivula*, ventral view; 81, *N. aviavi*, ventral view.

lowish spots to either side of midline behind anterior margin. Metanotum and abdomen brown dorsally, laterotergites below connexiva black along sutures and adjoining spiracles; connexiva medium orange brown. Antennae dark orange brown, paler ventrally. Legs generally pale brown with tarsi darker; coxae, trochanters, basal femora and all ventral surfaces pale yellowish; metasternum matte black, ventral head and abdomen predominantly orange brown.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.37, width 0.67; width of eye/interocular space, 0.15/0.45. Pronotum moderately long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.50/1.00. Metanotum length 0.30. Abdominal tergites dull, without shining areas; lengths of tergites II-

VII, respectively: 0.22: 0.20 : 0.15 : 0.15 : 0.15 : 0.47.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with scattered medium length, semi-erect golden setae; legs and antennae thickly clothed with short gold setae, scattered long erect golden setae present along anterior margins of antennal segments I-III, anterior margins of all tibiae, posterior margins of middle and hind femora; fore femur with ventral margin weakly concave centrally, this area bearing numerous short, stiff dark golden setae, posterior margin also with evenly spaced comb of 6-8 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose golden setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur tumescent on central portion of posterior margin, this tumescence bear-

ing numerous short, stiff, dark setae (fig. 36).

Venter with metasternum broadly angulate on posterior margin; abdominal venter set with short appressed gold setae, and scattered longer erect golden setae; abdominal ventrite II forming a small tumescence centrally with small tuft of erect, posteriorly directed gold setae at apex, ventrites III-V forming a prominent median carina along longitudinal midline (fig. 44), this carina descending from tumescence on ventrite II and declining in height in posterior direction, flanked to either side by deep, narrow parallel sulci, these parallel sulci merging to form a single deep, nearly hair-free sulcus on central sections of ventrites VI and VII, ventrite VII bearing a pair (1+1) of large, strongly raised tumescences lying on either side of the medial sulcus, these tumescences bearing dense tufts of short, stiff black setae. Proctiger produced anteriorly into a moderately long, projection with a blunt, hooked tip (figs. 76a-c). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.50 : 0.30 : 0.45 : 0.55.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.75 : 0.70 : 0.35 : 0.0; of middle leg, 1.10 : 1.00 : 0.20 : 0.30; of hind leg, 1.25 : 1.40 : 0.20 : 0.30.

Micropterous female: Similar to micropterous male in general structure and coloration, with following exceptions: metanotum and abdominal tergites II and III with small patches of silvery setae laterally, abdominal tergite IV with narrow band of silvery setae across entire widths on posterior margin, abdominal tergite V forming an elongate triangle set between strongly converging connexiva, abdominal tergites VIII hidden beneath appressed connexival margins, proctiger lying in nearly vertical orientation, thickly covered with short silvery setae; connexiva strongly and suddenly convergent posteriorly, meeting over and covering abdominal tergites VI-VIII, connexival segment VII bearing a fringe of stiff, black, posteriorly-directed setae along posterior margin when viewed laterally (fig. 56), posterolateral connexival apices of segments VI and VII forming a broad, keel-like obtuse angle when viewed laterally (fig. 56); lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, predominantly black, overlain with extensive patches of silvery setae; abdominal venter, fore femur, and hind femur unmodified.

Macropterous female: Similar to micropterous form in general structure and coloration but with pronotum enlarged, length/width = 1.10/1.30, humeral angles well developed, prominent, posterior lobe well produced, almost entirely covering scutellum, apex forming a rounded angle; wings fully developed, bearing 6 closed cells, consisting of two long, narrow cells basally between the Sc and An veins and separated by the combined R+M+Cu vein (terminology follows Polhe-

mus & Polhemus, 1988, fig. 9), followed by two more larger and elongate cells in filling most of the central portion of the wing lying laterally to the Cu vein, then two very small cells distal to the outermost of the two middle cells; wing coloration dull black, with elongate, creamy white streak in outer basal cell and very small creamy white patches centrally in each of the two middle cells.

Macropterous male: Unknown.

Etymology

The name 'goilala' is a noun an apposition and refers to the highland people who inhabit the region surrounding the type locality.

Distribution

Eastern New Guinea (fig. 82).

Comparative notes

Neusterensifer goilala is one of the largest known species in the genus, with body lengths in both males and females exceeding 2.90 mm, and occurs at elevations above 1200 m in the Owen Stanley Range of the Papuan Peninsula (fig. 82). Females may be recognized by the strongly convergent and appressed connexival margins, which cover part or all of tergites VI-VIII, forming a keel-like structure with a broadly obtuse posterior angle when viewed laterally with its apex at the suture between segments VI and VII (fig. 56). Males may be easily recognized by the structure of the process on the proctiger, with its blunt, hooked tip (figs. 76a-c); the pair of convergent sulci on abdominal ventrites III-V that merge into a single deep sulcus on ventrites VI and VII, flanked by prominent setiferous tumescences on the lateral sections of ventrite VII (fig. 44); by the slightly rising medial carina on abdominal ventrite VI with a small patch of dark setae at the apex, which extends anteriorly so as to nearly bisect ventrites III-V (fig. 44); and by the broad ventral tumescence on the central section of the hind femur (fig. 36).

The ventral abdominal modifications of the male of *N. goilala* are similar in many respects to those seen in *N. bowutu* from the northern coast of the Papuan Peninsula, except that in the latter species there are setiferous tumescences flanking the central longitudinal sulcus on both ventrites VI and VII, rather than only on VII as seen in *N. goilala* (fig. 44), and there is no anteriorly produced medial carina on ventrite VI. *Neusterensifer bowutu* also lacks the tumescent male hind femur found in *N. goilala* (fig. 36); this tumescent state is instead similar to that seen in other species found further east in the Papuan Peninsula and on adjacent archipelagos, including *N. femoralis* (fig. 35), *N. sulcata*, and *N. muyuw* (fig. 37).

Biological notes

This species was taken on small, shallow, first order spring-fed streamlets shaded by primary montane rain forest at elevations above 1200 m. in the central Owen Stanley Range. The orange-brown coloration of the insects closely matches the laterite substrate of these clear streamlets, rendering the insects cryptic on the water surface.

Neusterensifer microrivula sp. n. (figs. 52, 80, 82)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Gulf Prov., rocky tributary to Sapoi River, upstream of Ivimka Research Station, 120-150 m. [395-490 ft.], 7°43'36"S, 146°29'59"E, water temp. 24.5 °C., 16 January 2001, 07:00-13:00 hrs., CL 7148, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA: 9 micropterous males, 12 micropterous females, Gulf Prov., same data as holotype, D. A. Polhemus (USNM, JTPC, BPBM); 1 micropterous male, 2 micropterous females, Central Prov., small tributary streamlet to Yaniwe River at Tekadu, 300 m. [985 ft.], 7°40'36"S, 146°33'05"E, water temp. 24 °C., 21 January 2001, 12:00-16:30 hrs., CL 7157, D. A. Polhemus (USNM, BPBM).

Description

Size. – Micropterous male, length 1.95-2.05 mm ($\bar{x}$ = 2.02, n = 6); width 0.75-0.85 mm ($\bar{x}$ = 0.82, n = 6). Micropterous female, length 2.35-2.40 mm ($\bar{x}$ = 2.41, n = 5); width 0.90-0.95 mm, ($\bar{x}$ = 0.92, n = 5).

Colour. – Micropterous male: Ground colour orange brown, marked with yellowish brown on anterior pronotum and basal legs; patches of short, shining, silvery pubescence present laterally on metanotum, abdominal tergites II, III, and V-VII, along anterior margin of pronotum, and on sides of thorax and abdomen. Head orange brown; eyes dark red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum orange brown, slightly darker anteromedially, bearing a pair (1+1) of elongate transverse yellowish spots to either side of midline behind anterior margin. Metanotum and abdomen orange brown dorsally, lateral and extreme posterior margins of metanotum and all abdominal tergites narrowly dark brown to blackish, laterotergites below connexiva black along sutures and adjoining spiracles; connexiva entirely light orange brown. Antennae medium brown. Legs generally medium brown with tarsi darker, coxae, trochanters, basal femora and all ventral surfaces pale yellowish white.

Structural characters. – Micropterous male: head of moderate length, declivant anteriorly, with weak impressed median line; length 0.40, width 0.57; width of eye/interocular space, 0.16/0.35. Pronotum

long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.30/0.80. Metanotum length 0.20. Abdominal tergites dull, without shining areas; lengths of tergites II-VII, respectively: 0.10 : 0.10 : 0.08 : 0.08 : 0.07 : 0.25.

Entire dorsum and laterotergites covered with fine appressed golden pubescence, intermixed with numerous long, fine, slender, erect golden setae; legs and antennae thickly clothed with short gold setae, scattered long erect black setae present along anterior margins of antennal segments I-III, anterior margins of all tibiae, posterior margins of middle and hind femora; fore femur ventral margin very weakly sinuate and biconcave, bearing a small patch of short, stiff black setae near base, posterior margin also with evenly spaced comb of 6-8 long, erect, pilose golden setae; middle tibia bearing a row of evenly spaced, long pilose golden setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur unmodified, lacking tumescences or specialized setal patches.

Abdominal venter set with short appressed gold setae, and scattered longer erect golden setae; abdominal ventrite II forming a small conical tumescence centrally, ventrite III with a low median carina along longitudinal midline flanked to either side by shallow parallel sulci, central sections of ventrites IV-VII strongly depressed, forming a deep longitudinal sulcus on underside of abdomen; ventrites VI and VII each with a pair (1+1) of dense tufts of short, stiff black setae to either side of medial sulcus. Proctiger produced anteriorly into a moderately short, stout, tapering blade-like projection with a weakly bifurcate apex (fig. 80). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.40 : 0.25 : 0.42 : 0.49.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.60 : 0.50 : 0.30 : 0.0; of middle leg, 0.70 : 0.70 : 0.12 : 0.25; of hind leg, 0.90 : 1.00 : 0.13 : 0.25.

Micropterous female: Similar to micropterous male in general structure, with following exceptions: overall coloration somewhat darker, rusty orange brown, strongly contrasting with pale orange brown connexiva; metanotum and abdominal tergites II-IV with small patches of silvery setae laterally, abdominal tergite V bearing silvery setae across entire width on posterior $\frac{2}{3}$, abdominal tergite VII produced medially into a small, thumb-like projection bearing a tuft of elongate, stiff black setae that projects posteriorly below the infolded margins of connexival segment VII (fig. 52), abdominal tergite VIII with numerous scattered silvery setae across entire width, tergite VIII and proctiger lying in nearly vertical orientation; connexiva strongly and suddenly convergent posteriorly, meeting over and covering abdominal tergites VI-VII plus basal portion

of VIII, all connexival segments with a few moderately long erect black setae along dorsal margins, a brushy tuft of stiff black setae arising on the inner margins of connexival segments VII and projecting upward between the appressed dorsal margins of the segments, posterolateral connexival apices of segment VII forming small right angles; lateral sections of abdominal ventrites curving upward and inward to bases of connexival segments, set with scattered moderately long erect black setae, extreme lateral margins adjoining connexival bases diffusely blackish, overlain with patches of silvery setae, black coloration also narrowly present along all abdominal sutures; abdominal venter, fore femur, and hind femur unmodified.

Macropterous form: Unknown.

Etymology

The name 'microrivula' comes from the Latin 'micros', or very small, and 'rivulo', or small stream, referring to this species' preference for small headwater streams in the New Guinea mountains.

Distribution

Eastern New Guinea (fig. 82).

Comparative notes

Neusterensifer microrivula is a small, orange-brown species occurring along the southern flanks of the far western Owen Stanley Range, in the upper Lakekamu River basin. Females are similar to those of *N. yela* from Rossel Island and *N. kula* from the D'Entrecasteaux Islands in possessing a tuft of stiff black setae on the inner connexival margins of segment VII that projects posteriorly between the infolded margins of the segment (fig. 52), although in the case of *N. microrivula* this tuft is brushy rather than acuminate. It is also similar to the foregoing species in having a posteromedial prolongation of female abdominal tergite VII (fig. 52), but in *N. microrivula* this projection is incipient and shorter than that seen in other similarly modified *Neusterensifer* species. Males are similar to those of *N. yela* and *N. sulcata*, the latter from Tagula Island, in having the male ventral abdomen deeply sulcate along the longitudinal midline, but may be easily separated by the shape of the process on the male proctiger (fig. 80). On the basis of these character states, *N. microrivula* is hypothesized to be a member of the same clade of orange-brown species that is widely spread across the various fragments of the East Papua Composite Terrane.

Biological notes

The type locality was a small, swift, rocky tributary to the Aviavi River, flowing through a bed of rocks and cobbles in a catchment shaded by primary premontane rain forest. This insects were found on a

small, shallow pool adjacent to the main channel, and were otherwise uncommon along the remainder of the stream. Another series was taken from a small headwater streamlet at Tekadu, nearly 300 m. higher in elevation in the same Aviavi River catchment. At the latter locality, the insects occurred along pool margins in a small, shaded channel draining hill slopes covered with lightly disturbed premontane rain forest.

Neusterensifer aviavi sp. n. (figs. 59, 78, 81)

Material examined. – Holotype, micropterous male: PAPUA NEW GUINEA, Gulf Prov., rocky tributary to Sapoi River, upstream of Ivimka Research Station, 120–150 m. [395–490 ft.], 7°43'36"S, 146°29'59"E, water temp. 24.5 °C., 16 January 2001, 07:00–13:00 hrs., CL 7148, D. A. Polhemus (USNM). – Paratypes: PAPUA NEW GUINEA, Gulf Prov.: 5 micropterous males, 2 micropterous females, same data as holotype, D. A. Polhemus (USNM, JTPC, BPBM).

Description

Size. – Micropterous male, length 2.15–2.30 mm ($\bar{x}$ = 2.22, n = 5); width 0.85–0.90 mm ($\bar{x}$ = 0.86, n = 5). Micropterous female, length 2.30–2.50 mm ($\bar{x}$ = 2.40, n = 3); width 1.00–1.05 mm, ($\bar{x}$ = 1.03, n = 3).

Colour. – Micropterous male: Ground colour dark brown, marked with orange brown on anterior pronotum and connexiva; patches of short, shining, silvery pubescence present laterally on metanotum and abdominal tergites II–IV and VII, on posterior halves of tergites V and VI, broadly across central portion of tergite VIII, along anterior margin of pronotum, and on sides of thorax and abdomen. Head dark brown; eyes blackish red; rostrum pale whitish yellow, fuscous medially, piceous distally. Pronotum dark brown, becoming orange brown anterolaterally, bearing a pair (1+1) of elongate transverse orange brown spots to either side of midline behind anterior margin. Metanotum and abdominal tergites dark brown, laterotergites broadly blackish below connexiva, connexiva orange brown on outer halves and ventrally. Antennae medium brown. Legs generally medium brown, with coxae, trochanters, basal femora and all ventral surfaces pale yellowish to yellowish brown.

Structural characters. – Micropterous male: head of moderate length, declinant anteriorly, with weak impressed median line; length 0.40, width 0.60; width of eye/interocular space, 0.15/0.37. Pronotum long, covering mesonotum, thickly set with obscure foveae, humeri depressed; length/width, 0.40/0.85. Metanotum length 0.17. Abdominal tergites dull, without shining areas; lengths of tergites II–VII, respectively: 0.12 : 0.10 : 0.10 : 0.10 : 0.08 : 0.30.

Entire dorsum and laterotergites covered with fine

Fig. 82. Distribution of *Neusterensifer* species in the far eastern New Guinea region.

appressed golden pubescence, intermixed with numerous short, erect golden setae; legs and antennae thickly clothed with short pale setae, scattered long erect black setae present along anterior margins of antennal segments I-III, anterior margins of all tibiae, posterior margins of middle and hind femora; fore femur ventral margin straight, not modified, bearing numerous short, erect pale setae along entire length, intermixed with evenly spaced comb of 6-8 long, erect, pilose pale setae; middle tibia bearing a row of evenly spaced, long pilose pale setae of progressively decreasing length, longest and most basal of these setae with length approximately equal to $\frac{1}{3}$ that of tibia; hind femur with numerous short, erect pale setae along posterior margin, lacking tumescences or specialized setal tufts.

Abdominal venter set with short appressed gold setae, and scattered longer pale setae; abdominal ventrites I-IV unmodified; ventrite V shallowly sulcate centrally along longitudinal midline; ventrite VI sharply raised posteromedially to form a pair (1+1) of angulate tumescences slightly separated by a shallow sulcus along longitudinal midline, apices of these tumescences black, bearing sparse tufts of moderately long, fine, gold setae; ventrite VII broadly and transversely flattened across central section, bearing a pair (1+1) of low longitudinal tumescences separated by a shallow sulcus along longitudinal midline, these tumescences contiguous with bases of paired angulate tumescences on ventrite VI. Proctiger produced anteriorly into a moderately long, acuminate process (fig. 81). Parameres vestigial or absent.

Antennal formula I : II : III : IV; 0.37 : 0.25 : 0.42 : 0.56.

Proportions of legs as follows: Femur, tibia, tarsal 1, tarsal 2 of fore leg, 0.60 : 0.52 : 0.22 : 0.0; of middle leg, 0.75 : 0.75 : 0.17 : 0.27; of hind leg, 0.90 : 1.07 : 0.20 : 0.30.

Micropterous female: Similar to micropterous male in general structure and colour, with following exceptions: metanotum and abdominal tergites II and III with small patches of silvery setae laterally, tergite IV covered with silvery setae for its entire width on posterior half, tergites V and VI almost entirely covered with silvery setae across their entire widths, tergite VII lacking silvery setae, abdominal tergite VIII bearing a few scattered silvery setae centrally, this tergite plus proctiger lying 45° from vertical when viewed laterally; connexiva broadly separated, bowing outward, margins gradually convergent posteriorly, posterolateral angles of segments VII produced into stout, angulate projections (fig. 59) with apices angling inward over lateral sections of abdominal tergite VII, margins of all connexival segments bearing scattered long, erect, black setae but lacking specialized setal tufts; lateral sections of abdominal ventrites curving upward to bases of connexival segments, set with numerous long erect black setae, lateral margins adjoining connexival bases broadly blackish overlain with silvery setae; abdominal venter, fore femur, hind femur unmodified.

Macropterous form: Unknown.

Etymology

The name 'aviavi' is a noun in apposition and refers to the Aviavi River, to which the Sapoi River at the type locality is a tributary.

Distribution

Eastern New Guinea (fig. 78).

Comparative notes

Neusterensifer aviavi may be recognized by its generally dark coloration, the presence of paired angulate processes centrally on male abdominal ventrite VI, the moderately long, slender and acuminate process on the male proctiger (fig. 81), and the angulate, infolded projections of the female connexival apices (fig. 59).

Biological notes

This species occurred on small pockets of water amid cobbles bordering a rocky stream in the hills surrounding the Lakekamu Basin. For further description of this locality see the discussion under *N. microrivula*.

Neusterensifer lubu D. Polhemus & J. Polhemus (figs. 60, 79, 82)

Neusterensifer lubu D. Polhemus & J. Polhemus 2000a: 115.

Material examined. – PAPUA NEW GUINEA, Gulf Prov.: 1 micropterous male, 2 micropterous females, pools along Sapoi River, upstream of Ivimka Research Station, 120–150 m. [395–490 ft.], 7°43'36"S, 146°29'59"E, water temp. 24.5 °C., 16 January 2001, 07:00–13:00 hrs., CL 7148, D. A. Polhemus (USNM).

Distributional notes

This species was originally described from the Lubu River at Omo, in the premontane foreland of the Kikori River basin. The new records from the Lakekamu River basin extend the species range considerably to the east along the southern flanks of the New Guinea central mountains, and indicate that *N. lubu* will also be found in the Purari River catchment as well. This same distribution pattern is shared by the trepobatine gerrid *Stygiobates mubi* J. Polhemus & D. Polhemus (Polhemus & Polhemus 2002).

Biological notes

The Lakekamu series was taken from shaded, partially vegetated vertical banks bordering a long, quiet side pool 1.0–1.5 m. deep along the midreach of the Aviavi River, a large, very swift, rocky stream in an open, mostly unshaded channel draining the south flanks of the western Owen Stanley Range. This locality was very near the small, more heavily shaded tributary stream from which the type series of *N. aviavi* and *N. microrivula* were taken, but the three species appeared to adopt a strict habitat segregation, with the former two only occurring along the tributary hill stream, and *N. lubu* occurring only along the main river channel.

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Figs. 83-86. Habitats of Microveliinae in eastern New Guinea and nearby islands. – 83, Woodlark Island, rocky stream draining to Suloga Harbor; type locality for *Neusterensifer myuw*. 84, Basilaki Island, waterfall on a tributary to the Guiagoila River. Wet faces next to the falls are habitat for *Rheovelina basilaki*, while pool margins support *Neusterensifer hunteri*; 85, Seeps and small cascades on a small tributary to the Hane River, near Fane, Owen Stanley Range; type locality for *Aegilipsicola auga* and paratype locality for *Rheovelina truncata*. 86, Midreach of Awaetowa River near Basima, Fergusson Island, D'Entrecasteaux group; sheltered pocket water along the river margins is habitat for *Neusterensifer dentrecasteaux*.

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