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Three new species of gall-forming psyllids (Hemiptera: Psylloidea) from Papua New Guinea, with new records and notes on related species

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ABSTRACT

Three new species of gall-forming psyllids (Hemiptera: Psylloidea) in the families Triozidae and Phacopteronidae are described from Papua New Guinea: *Trioza incrustata* Percy, sp. nov. makes enclosed leaf margin galls on *Celtis philippensis* (Cannabaceae), *Trioza grallata* Percy, sp. nov. makes enclosed leaf surface galls on *Elaeocarpus schlechterianus* (Elaeocarpaceae), and *Cornegenapsylla allophyli* Malenovský and Percy, sp. nov. makes enclosed leaf margin galls on *Allophylus cobbe* (Sapindaceae). Descriptions of the adult and immature morphology for these new species are provided, and differences in adult and immature morphology between *Cornegenapsylla allophyli* and *Cornegenapsylla sinica* Yang and Li, 1982 (the type species of *Cornegenapsylla*) are illustrated. We report new records for Papua New Guinea of *Pseudophacopteron tuberculatum* (Crawford, 1912) on *Alstonia* sp. (Apocynaceae), *Pauropsylla triozoptera* Crawford, 1913 on *Ficus trachypison* (Moraceae) and *Pauropsylla udei* Rübsaamen, 1899 on *Ficus variegata*, with descriptions of the variation found in the latter two widespread Asian species. *Pauropsylla reticulata* Mathur, 1975 is synonymized with *P. udei*. Mitochondrial DNA barcodes for the new species, as well as for *P. triozoptera* and *P. udei* are provided.

Introduction

The diversity, distribution and taxonomic placement of gall-inducing taxa among psyllid families has been reviewed by Hodkinson (1984, 2009), Burckhardt (2005), Yang et al. (2006), and Yang and Raman (2007). There is no well-established estimate of the number of galling psyllid species worldwide, although a higher percentage of galling species is known to occur in particular psyllid families, e.g. Triozidae, Phacopteronidae and Calophyidae (Burckhardt 2005; Malenovský et al. 2007; Yang and Raman 2007), and in geographic distribution, e.g. higher rates of galling in the tropics, and particularly in South East Asia and the Pacific (Hodkinson 1983;

Burckhardt 2005). Numbers of galling psyllids may be equally as high in Afrotropical and Neotropical regions but these faunas are poorly known (D. Burckhardt pers. comm.). Confounding factors affecting attempts to estimate the number of galling species include poorly resolved taxonomies, large numbers of species still needing to be described particularly from the tropics, and uncertain associations between gall types and particular psyllid taxa, e.g. those listed as 'undertermined psyllid galls' in Hodkinson (1983). In other cases, general leaf distortion through feeding has been considered a gall by some but not others; while some psyllid taxa make one type of gall, such as a pit gall, as an early instar and another type of gall, such as a leaf roll or enclosed leaf gall, as a later instar. Furthermore, although some taxa have been established as root gallers, little is known about the extent of this type of galling habit (Lauterer and Baudyš 1968; Bird and Hodkinson 1999). The majority of psyllid gall types, however, are produced on the leaves of plants, e.g. ~75% of galling species in Taiwan (Yang et al. 2006).

In other regional faunas where the native psyllid fauna has been relatively well studied, galling species may make up less than 15% (e.g. UK) of the total psyllid fauna in temperate zones, and more than 50% (e.g. Hawaiian Islands) in the tropics (Zimmerman 1948; Hodkinson 2009). In Taiwan, ~100 species of gallers represent ~60% of the described psyllid fauna (Yang and Raman 2007), and in Japan ~45 species of gallers represents ~50% of the described fauna (Yukawa and Masuda 1996). Notably, both of these oriental galling faunas are dominated by taxa in the family Triozidae (Yukawa and Masuda 1996; Yang and Raman 2007; Yang et al. 2013).

The psyllid fauna of Papua New Guinea (PNG) is poorly known, with only 15 species recorded (Ouvrard 2015), but it may be reasonable to expect a ratio of galling to non-galling taxa similar to that found in other oriental faunas, as well as a similar dominance of Triozidae among the gallers. The species treated here were mostly collected by P.T.B. during ecological surveys of galling insects from lowland and montane rainforests in Madang and Morobe Provinces, PNG, in association with the New Guinea Binatang Research Centre (http://www.entu.cas.cz/png/parataxoweb. htm). Three new species are described, two in the family Triozidae and one in Phacopteronidae, and the taxonomy of *Cornegenapsylla sinica* Yang and Li, 1982 (Phacopteronidae) is reviewed. *Cornegenapsylla* was a previously monotypic genus containing the longan psyllid (*Cornegenapsylla sinica*), which is widespread in Asia, including China, Malaysia and Thailand (Yang and Li 1982; Hodkinson 1986; Martin and Lau 2011), and new records from Singapore are reported here. We also report new records for PNG of *Pauropsylla triozoptera* Crawford, 1913 on *Ficus trachypison* (Moraceae) and of *Pauropsylla udei* Rübsaamen, 1899 on *Ficus variegata* with description of the variation found in the PNG specimens and galls relative to specimens from elsewhere (Hong Kong, Bangladesh, Philippines) for these widespread Asian species; we synonymize *Pauropsylla reticulata* Mathur, 1975 with *P. udei*; and we report new records for PNG of *Pseudophacopteron tuberculatum* (Crawford, 1912) on *Alstonia* sp. (Apocynaceae). We include mitochondrial DNA barcodes for the new species, as well as for *P. triozoptera* and *P. udei* to provide an estimation of mitochondrial genetic distances between these taxa.

Material and methods

Lowland field collections were made in the period August 2010 to March 2011 (with a few samples dating back to 1995 and 1996) near the villages of Baitabag, Mis and Ohu, Madang Province, PNG, which are each surrounded by approximately 200 ha of mixed secondary and primary rainforest. Further collections were made in montane rainforest in the period August 2010 to November 2012 near Yawan village in the Finisterre Range of mountains, Morobe Province. Adults were reared from galls placed in clear plastic bags and pegged to washing lines in open-sided barns, and immatures were dissected from galls in the field on an *ad hoc* basis. Adults and immatures were preserved in 95% ethanol.

Ethanol-preserved material was macerated and cleared in 10% potassium hydroxide and clove oil and slide mounted in Canada balsam as described in Hodkinson and White (1979). Morphological terminology follows Hodkinson and White (1979), Hollis (1984), White and Hodkinson (1985), Percy (2003) and Malenovský and Burckhardt (2009). The DNA barcodes provided here were sequenced from two mitochondrial gene regions, cytochrome c oxidase subunit I (COI), and cytochrome B (cytB). DNA was obtained from material preserved in ethanol, and protocols for DNA extraction, polymerase chain reaction and sequencing follow those described in Percy (2003); polymerase chain reaction primers for COI and cytB, respectively, are given in Simon et al. (1994) and Timmermans et al. (2010). Genetic distances reported here were obtained using neighbour-joining analyses with uncorrected (*p*) distances in PAUP* (Swofford 2003). The DNA sequences are deposited in GenBank.

Type material is deposited in: Natural History Museum, London, UK (BMNH); National Agricultural Research Institute of PNG, Lae, PNG (NARI); Institut Royal des Sciences Naturelles, Bruxelles, Belgium (IRNB); Moravské zemské muzeum [Moravian Museum], Brno, Czech Republic (MMBC); and Naturhistorisches Museum, Basel, Switzerland (NHMB). Other institutional abbreviations cited: Muséum d'histoire naturelle, Geneva, Switzerland (MHNG); National Museum of Natural History, Smithsonian Institution, collections deposited in the Systematic Entomology Laboratory, United States Department of Agriculture, Beltsville, MD, USA (USNM); Zoological Institute, Russian Academy of Sciences, St Petersburg, Russia (ZISP).

Abbreviations used in the descriptions are as follows (all measurements are recorded in mm): Adults: WL, forewing length; HW, head width; AL, antennal length; GP, genal process length; PB, distal proboscis segment length; HVW, ratio head width : vertex width; ALHW, ratio antennal length : head width; VLGP, ratio vertex length : genal process length; VLW, ratio vertex length : width; WLW, ratio forewing length : width; CUR, ratio forewing cell cu_1 width : height; MR, ratio forewing cell m_2 width : height; TLFL, ratio hind leg tibia length : femur length. Adult male terminalia: MP, proctiger length; PL, paramere length; AEL, distal aedeagus segment length; MSLH, ratio subgenital plate length : height; AHS, ratio distal aedeagus segment length : aedeagus hook length; PLSH, ratio paramere length : subgenital plate height. Adult female terminalia: FP, proctiger length; FSP, subgenital plate length; RL, circumanal ring length; OV, ovipositor valvulae dorsalis length; FPRL, ratio female proctiger : circumanal ring length; FPHW, ratio female proctiger : head width; FPFSP: ratio female proctiger : subgenital plate length. Immatures: BL, body length; BW, body width; WL, forewing pad length;

CPL, caudal plate length; CPW, caudal plate width; RW, circumanal ring width; HW, head width; AL, antennal length.

Taxonomy

<div align="center">

Family **TRIOZIDAE** Löw, 1879
Trioza incrustata Percy, sp. nov.
(Figures 1A–L; 2A–F; 3A)

</div>

### *Adult colour (ethanol material)*

Forewing without pattern, but membrane generally fuscous, veins light brown. Body generally mid to light brown, antennal segments 3–10 darker brown.

Adult structure

Forewings (Figure 1A) long and narrow with acutely pointed apex, cell cu_1 distinctly larger than cell m_2, vein Rs short, curving to the wing margin; a group of marginal radular spines present in cells cu_1, m_1 and m_2; surface spinules sparsely scattered in all cells; wing margins and veins sparsely covered with short to minute setae. Head not strongly deflexed with genal processes short, divergent and conical, more or less symmetrical and broadly rounded at apex (Figure 1C). Vertex more or less flat dorsally, with lateral ocelli lying on small tubercles, medial epicranial suture distinct. Antennae (Figure 1B) long and slender, 3rd antennal segment $0.6 \times$ head width, 10-segmented with rhinaria apically on segments 4, 6, 8 and 9, terminal segment with one apical seta medium long (~0.05 mm), paired with a short blunt tube-like seta (less than half the length, ~0.02 mm). Clypeus (Figure 1D) triangular in lateral view, bearing two medium long setae apically. Distal segment of proboscis medium long. Dorsum of thorax with scattered short setae. Hind leg (Figure 1G) with meracanthus well developed and straight; metatibia with a single large genual spine basally and 1+3 (typically) or 1+2 shortly stalked sclerotized apical spurs; metabasitarsus constricted medially and longer than apical tarsus. Male terminalia (Figure 1H) with proctiger lobed basally; paramere (Figure 1I) expanded basally into a distinct internal bulge and then tapering evenly to a darkly sclerotized apex; apical aedeagus segment (Figure 1J) short, hooked and with an extended, sharply pointed beak. Female terminalia (Figure 1K) short, proctiger curving downwards and slightly longer than the bluntly terminating subgenital plate, circumanal ring relatively large, $0.36 \times$ length of proctiger, and composed of a double row of cells; ovipositor valvulae dorsales (Figure 1L) in profile with medial bulge dorsally.

Adult measurements (mm) and ratios (1♂, 1♀)

WL: 3.12–3.55; HW: 0.68–0.73; AL: 1.85–2.06; GP: 0.12; PB: 0.14–0.15; HVW: 1.85–1.96; ALHW: 2.71-2.83; VLGP: 2.00–2.38; VLW: 0.62–0.83; WLW: 2.85–2.86; CUR: 1.37–1.60; MR:
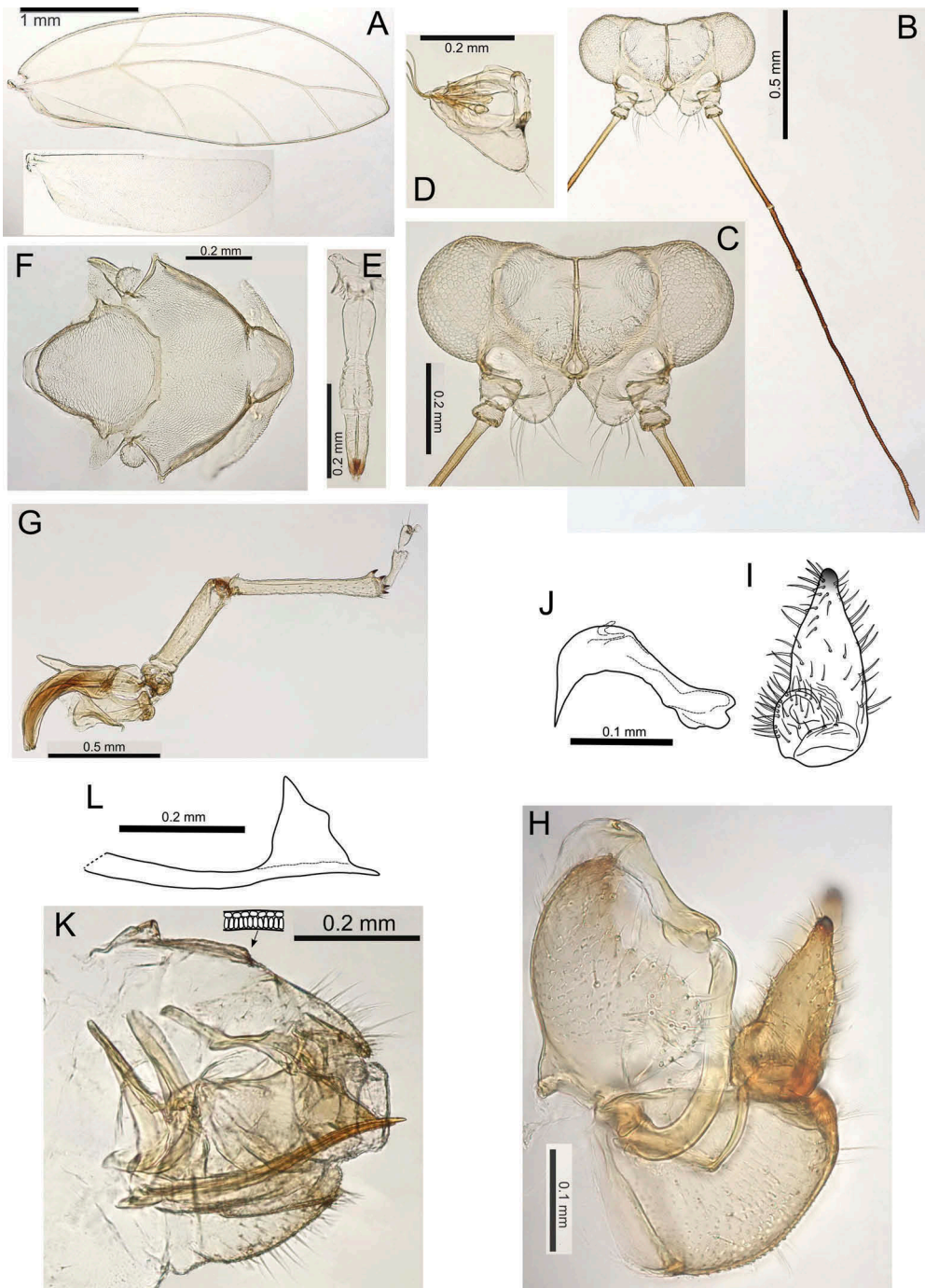
Figure 1. Adult *Trioza incrustata* Percy, sp. nov. (A) Forewing and hindwing (inset); (B, C) head and antenna; (D) clypeus; (E) proboscis; (F) thorax dorsum; (G) hind leg; (H) male terminalia; (I) paramere (inner surface); (J) distal aedeagus segment; (K) female terminalia; (L) ovipositor.

0.65–0.73; TLFL: 1.37–1.47. ♂: MP: 0.22; PL: 0.22; AEL: 0.18; MSLH: 1.00; AHS: 1.83; PLSH: 1.00. ♀: FP: 0.49; FSP: 0.32; RL: 0.18; OV: 0,12; FPRL: 2.77; FPHW: 0.67; FPFSP: 1.53.

Immature structure

Body outline elongate ovoid and more or less uninterrupted (Figure 2A, E, F). Forewing buds with pronounced humeral lobe. Antennae of 5th instar (Figure 2C) with seven or eight segments bearing four rhinaria, one each apically on segments 3 and 5 and two on the terminal segment; 4th instar antennae 3- or 4-segmented bearing one rhinarium on 3rd segment, and two rhinaria on terminal 4th segment; 3rd instar antennae 3-segmented bearing one rhinarium on 2nd segment and one on terminal 3rd segment; 2nd instar antennae 1-segmented bearing one rhinarium. Tarsi with well-developed claws and crescent arolia (Figure 2C). Distinct 'thoracic lobes' visible in 5th instar (see inset Figure 2A). Anus situated ventrally; circumanal ring broad and shallowly V-shaped, with a single row of elongate cells.

Immature chaetotaxy

The 2nd–5th instars with stalked, fan-shaped setae around the margin (Figure 2B, F), 3rd–5th instars with dorsal surface covered in distinct pattern created by the arrangement of simple setae on round tubercle-like annuli (Figure 2A, B; absent in the 2nd instars with the pattern becoming progressively more intricate in older instars).

Immature measurements (mm), 5th instar (n = 2)

BL: 2.09–2.15; BW: 1.39–1.42; WL: 1.24–1.27; CPL: 0.76–0.79; CPW: 1.24–1.27; RW: 0.26–0.27; HW: 0.62–0.67; AL: 0.28.

Host plant

Celtis philippensis (Cannabaceae)

Distribution

PNG, Madang Province.

Biology

The gall is a leaf fold at the margin of the leaf and consists of the upper adaxial surface folding down to make the gall on the lower abaxial leaf surface (Figure 3A). The fold becomes sealed and appears to contain a single immature. There is sometimes a single fold, but more often several discrete chambers, in this case, it is not clear whether each chamber is completely sealed from the others. When mature, the gall seal opens along the intersection between adaxial and abaxial leaf surfaces. The density of galls and immatures is high with ~70 immatures collected from three sample sites. Rearing from galls produced five adult psyllids from two of these sites. Other insect associates found in the galls include cecidomyid larvae, and chalcid pupae and larvae (Encyrtidae and Eulophidae).

Etymology

The specific epithet refers to the distinct pattern on the dorsum of older immatures appearing as an encrustation formed by the tubercle-like annuli at the base of the setae.
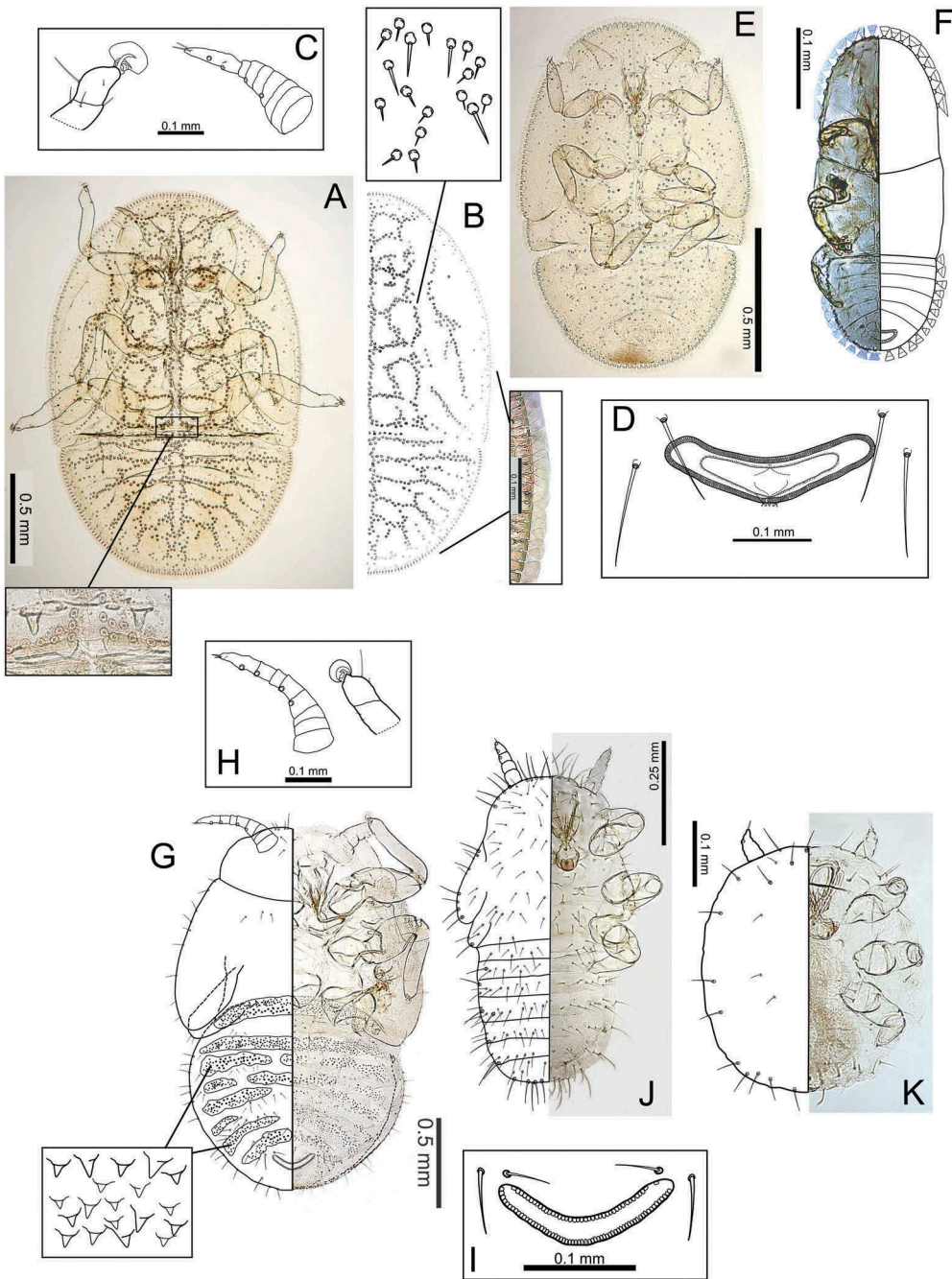
Figure 2. Immatures, *Trioza incrustata* Percy, sp. nov. (A–F), and *Trioza grallata* Percy, sp. nov. (G–K). (A–D) 5th instar; (B) outline illustrating distinct pattern on dorsal surface; (C) antenna and tarsi; (D) circumanal ring; (E) 4th instar; (F) 2nd instar; (G–I) 5th instar; (H) antenna and tarsi; (I) circumanal ring; (J) 3rd instar; (K) 1st instar.
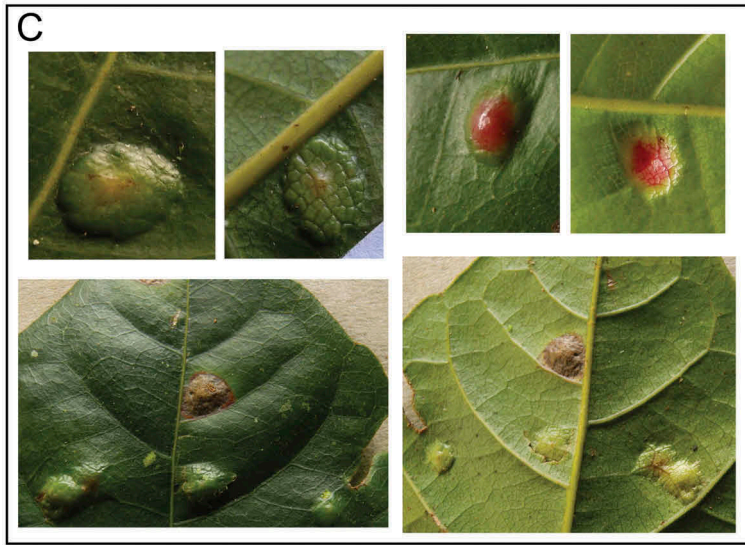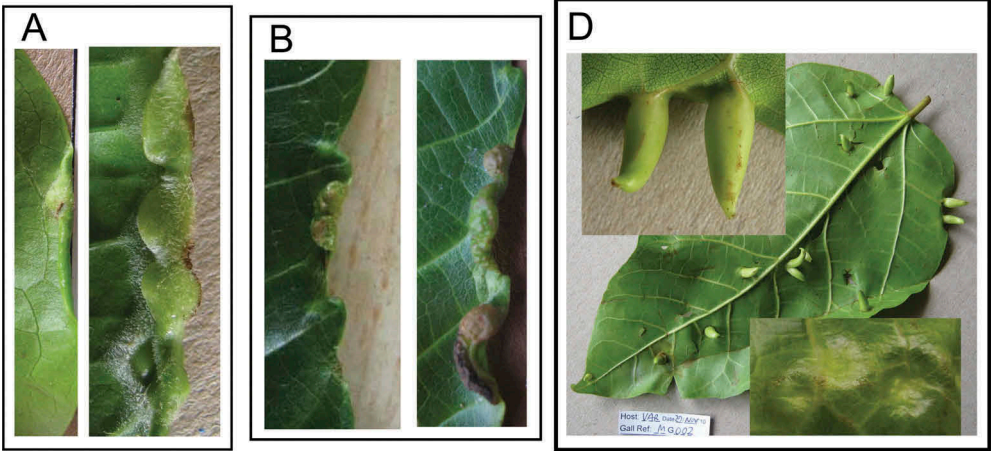
Perfect passive participle derived from the Latin verb *incrustare*, to have an ornamental cover.

Comments

The host plant is a common lowland rainforest tree in New Guinea and much of South East Asia (George Weiblen, pers. comm.). Six additional triozid taxa are known from the plant genus *Celtis*. Yang (1984) described two of these species from Taiwan, *Trioza celtisae* Yang, 1984 and *Trioza lineata* Yang, 1984 on *Celtis tetrandra* and *Celtis sinensis*, respectively. Li (2011) described an additional species from *Celtis sinensis*, *Trioza longigenitus* (Li 2011), and the immatures and biology for *Trioza bifasciaticeltis* Li and Yang, 1991, which has free-living immatures on the lower abaxial surface of leaves. Although no biology is mentioned for the immatures of *T. celtisae*, this species is related to *T. lineata*, which is also described as having free-living immatures on the lower abaxial surface of leaves (Yang 1984). Li (2011) placed the above species in a new genus, *Metatriozidus*, but this was considered artificial and synonymized with *Trioza* by Yang et al. (2013). A fifth Asian species, *Trioza brevifrons* Kuwayama, 1910, is recorded from Korea, Japan and Taiwan. The host-plant in Korea and Japan is *Celtis sinensis* var. *japonica* (Kwon 1983), but the host association of the type material from Taiwan is unknown, and these specimens appear to differ from those in Korea and Japan (Kwon 1983; Yang et al. 2013). Lastly, a South American species, *Leuronota fuscata* (Laing, 1923) develops on *Celtis iguanaea* (Burckhardt and Queiroz 2012, and D. Burckhardt pers. comm.). None of these *Celtis*-feeding triozid species appears related to *Trioza incrustata* sp. nov., and no clear affiliations are apparent within the Triozidae; we therefore place this taxon within the artificially large (polyphyletic) genus *Trioza* Foerster, 1848. *Trioza incrustata* is the first species of *Trioza* known to produce leaf margin galls on *Celtis*.

Type material

Holotype, ♂ (slide mounted), Mis village, Madang Province, PNG (5°11′S, 145°47′E, 50 m), 21 March 2011, ex *Celtis philippensis*, (HE06) P. Butterill leg. (BMNH). Paratypes, 1 ♀ (HE07), immatures: 2 5th, 3 4th, 1 3rd, 2 2nd (GALL015) as for holotype (BMNH). *Other material*: immatures and galls, Baitabag village (5°8′S, 145°46′E, 100 m), and Ohu village

Figure 3. Galls Papua New Guinea (A–D), Singapore (E), Taiwan (F). (A) *Trioza incrustata* Percy, sp. nov.: leaf margin galls on *Celtis philippensis* (Cannabaceae) (early and later gall development viewed from lower leaf surface); (B) *Cornegenapsylla allophyli* Malenovský and Percy, sp. nov.: leaf margin galls on *Allophylus cobbe* (Sapindaceae) (early and later gall development viewed from upper leaf surface); (C) *Trioza grallata* Percy, sp. nov.: leaf surface galls on *Elaeocarpus schlechterianus* (Elaeocarpaceae) (adaxial and abaxial leaf surfaces); (D) *Pauropsylla udei* Rübsaamen: conical leaf surface galls on *Ficus variegata* (Moraceae) produced on the abaxial leaf surface (inset above: gall detail on lower leaf surface; inset below: gall viewed from upper leaf surface); (E) *Pauropsylla udei* Rübsaamen: globular leaf surface galls on *Ficus variegata* (Moraceae) produced on the adaxial leaf surface, images on right show a dissected gall chamber and presence of the eclosed adult within; (F) *Pauropsylla triozoptera* Crawford: conical leaf surface galls produced on the adaxial leaf surface of *Ficus* cf. *ampelas* (Moraceae).

(5°13′S, 145°40′E, 200 m), near Madang, Madang Province, PNG, March 2011, ex *Celtis philippensis*, P. Butterill leg. (NARI).

Gene sequences
GenBank: KT588301 (COI), KT588307 (cytB) (PNGHE06–11).

Trioza grallata Percy, sp. nov.
(Figures 2G–K; 4A–R; 3C)

Adult colour (ethanol material)
Forewings without pattern but membrane fuscous, veins brown. Body generally mid to dark brown, with distinct pale longitudinal band on the dorsum of the thorax (Figure 4E) and sometimes extending forward through the vertex. Ventral part of the abdomen, particularly in females, may also be paler. Antennal segments 3–10 dark brown to black. Legs paler except apices of tibiae and tarsi, which are dark brown to black.

Adult structure
Forewings (Figure 4A) distinctly broader in the apical half with a bluntly acute apex; height of cells cu_1 and m_2 subequal; vein Rs short, curving evenly to the wing margin; a group of marginal radular spines present in cells cu_1, m_1 and m_2; surface spinules either absent or very sparsely distributed; wing margins and veins with short to minute setae. Head (Figure 4G) with genal processes short, widely divergent, asymmetrical, and terminating in slightly swollen, blunt apices with two or three long stout setae; distinct swellings also present below the genae (Figure 4H). Vertex more or less flat dorsally, with lateral ocelli lying on small tubercles, medial epicranial suture distinct. Antennae (Figure 4G) long and slender, 3rd antennal segment 0.75–0.81 × head width, 10-segmented with rhinaria apically on segments 4, 6, 8 and 9, terminal segment with one long apical seta (0.09–0.12 mm), paired with a short stout tube-like seta (less than half the length, ~0.02 mm). Clypeus (Figure 4I) well rounded and ventrally scaly, rough surfaced, and covered in short setae plus two long setae. Distal segment of proboscis medium long. Dorsum of thorax covered in short, stout setae. Hind leg (Figure 4F) with meracanthus well developed and straight; metatibia slender and elongate (almost twice the length of the metafemur), with one, but more usually a pair of genual spines basally and 1+3 (occasionally 1+4) large, distinctly stalked and sclerotized apical spurs; metabasitarsus constricted basally and subequal in length to apical tarsus. Sternites with numerous stout setae (Figure 4J). Male terminalia (Figure 4K) with proctiger strongly lobed medially and constricted to a narrow tube dorsally. Paramere (Figure 4L, M) expanded into a lobe in the basal half and then more or less parallel sided and slightly arched backwards, the posterior margin with a comb of long stout setae, and terminating in a small posteriorly directed sclerotized hook. Apical aedeagus segment (Figure 4O) short, base swollen, strongly curved basally and then angled apically, with a rounded and slightly inflated apex. Female terminalia (Figure 4P) with proctiger more or less straight dorsally, ventral margins lobed medially; apex acute, darker, and covered in short stout setae; proctiger markedly longer than (> 1.5 ×) the bluntly terminating subgenital plate, apex of subgenital plate notched and terminating in several long setae; circumanal ring
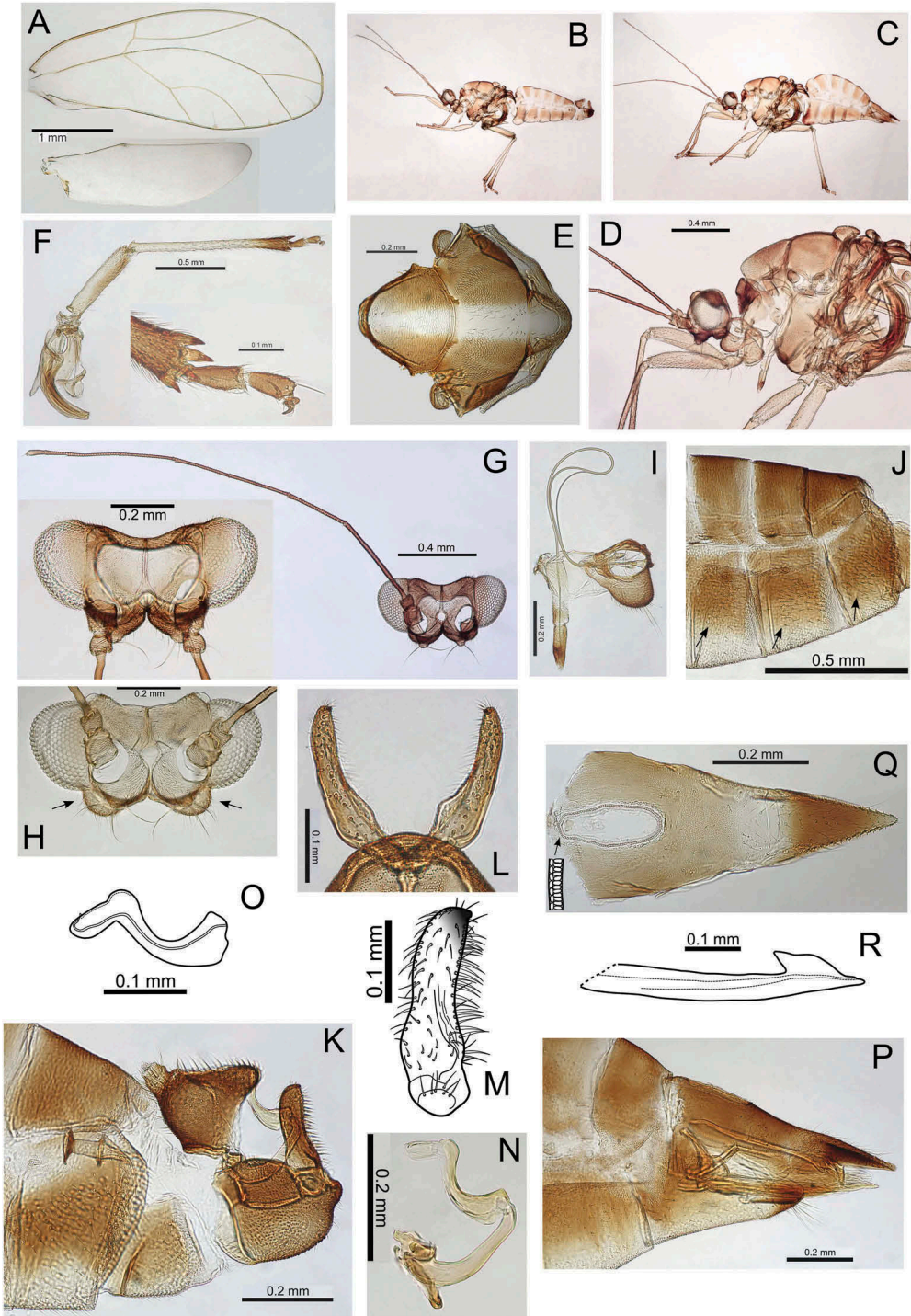
(Figure 4Q) is long and narrow, 0.3 × the length of proctiger, and composed of a double row of cells; inner ovipositor valve (Figure 4R) small and in profile slightly bulging dorsally.

Adult measurements (mm) and ratios (4 ♂ 3 ♀)

WL: 3.30–3.58; HW: 0.67–0.71; AL: 2.27–2.51; GP: 0.14–0.17; PB: 0.15–0.18; HVW: 1.92–1.96; ALHW: 3.41-3.61; VLGP: 1.2–1.67; VLW: 0.50–0.63; WLW: 2.38–2.45; CUR: 1.19–1.33; MR: 0.68–0.74; TLFL: 1.77–1.86. ♂: MP: 0.19–0.20; PL: 0.24–0.25; AEL: 0.18–0.20; MSLH: 1.17–1.29; AHS: 2.23–2.50; PLSH: 0.95–1.11. ♀: FP: 0.72–0.74; FSP: 0.44–0.49; RL: 0.22; OV: 0.14–0.15; FPRL: 3.21–3.37; FPHW: 1.02–1.06; FPFSP: 1.51–1.65.

Immature structure

Body outline of older instars elongate ovoid with protruding wing bud margins, but lacking an obvious humeral lobe (Figure 2G, J). Antennae of 5th instar (Figure 2H) 7- or 8-segmented, bearing four rhinaria apically on segments 4, 5, 7 and 8; 3rd instar antennae 4-segmented bearing three rhinaria, one on 3rd and two on 4th segment; 2nd instar antennae 3-segmented bearing two rhinaria on 2nd and 3rd segments; 1st instar antenna with a single segment bearing a single rhinarium. Tarsi with weakly developed claws and crescent arolia (Figure 2H). Small 'thoracic lobes' visible in 5th instars. Anus situated ventrally; circumanal ring composed of single, sometimes interrupted, row of rounded to elongate cells (Figure 2I).

Immature chaetotaxy

The 1st–5th instars have scattered medium to long simple setae on margins and surfaces of head, thorax, and abdomen; in addition, the 5th instar also has irregular patches of short, stout, thorn-like cuticular projections on the dorsal surface of the abdomen (Figure 2G).

Immature measurements (mm), 5th instar (n = 2)

BL: 1.39–1.73; BW: 1.00–1.21; WL: 0.64–0.79; CPL: 0.73; CPW: 0.82; RW: 0.16; HW: 0.52–0.54; AL: 0.33.

Host plants

Elaeocarpus schlechterianus (Elaeocarpaceae).

Distribution

PNG, Morobe Province.

Figure 4. Adult *Trioza grallata* Percy, sp. nov. (A) Forewing and hindwing (inset); (B) male whole; (C) female whole; (D) head and thorax; (E) thorax dorsum; (F) hind leg; (G) head and antenna; (H) head tilted back to show sub-genal swellings; (I) clypeus and proboscis; (J) abdominal segments showing setae on ventral sclerites; (K) male terminalia; (L) parameres (posterior); (M) paramere (inner surface); (N) aedeagus; (O) distal aedeagus segment; (P) female terminalia; (Q) female proctiger dorsum; (R) ovipositor.

Biology

This species produces small, round to ovoid, enclosed blister-like galls on the leaf blade (Figure 3C), which are exited mostly on the upper adaxial leaf surface. In all galls dissected (*n* = 13), there was a single unilocular gall chamber, and when present, a single immature psyllid. Incubating galls for rearing produced ~90 adult psyllids. Associated insects included cecidomyid and sciarid midges, and chalcid parasitoids.

Etymology

The specific epithet refers to the long, slender tibiae, hence from the Latin *gralla*, a stilt, *grallata* = bearing stilts (adjective).

Comments

The host plant is a New Guinea endemic known from rather few collections, at elevations of 850–1850 m, from Jayapura (Papua) through the highlands to Morobe Province. (George Weiblen pers. comm., with reference to Coode 1981). Five species of *Trioza* are known from the plant genus *Elaeocarpus*. Matsumoto (1999) treated three of these, together with two additional species that may also be *Elaeocarpus*-feeders, as the 'Trioza maculata group'. The *maculata* group is found in Japan, Taiwan, Vietnam and Malaysia (Sabah). *Trioza grallata* sp. nov., on *Elaeocarpus schlechterianus*, does not appear to be related to this group. Neither does it appear to be related to either of the two remaining species known from *Elaeocarpus* that both produce small galls on the leaves. One of these species, from Taiwan, *Trioza elaeocarpi* Yang, 1984, produces small round galls on leaves of *Elaeocarpus sylvestris* (Yang 1984), and the other, *Trioza indigena* Tuthill, 1951, from the Caroline Islands forms small leaf galls on *Elaeocarpus kusanoi*, which is endemic to the island of Pohnpei, Senyavin Islands (Tuthill 1951). Li (2011) transferred *Trioza maculata* and *Trioza elaeocarpi* to *Triozopsis* Li, 2005, but Yang et al. (2013) subsequently synonymized *Triozopsis* with *Trioza*; as with *Trioza incrustata* sp. nov., no clear affiliations are apparent within Triozidae.

Type material

Holotype, ♂ (slide mounted), close to Yawan village, Morobe Province, PNG (06°08′S, 146°52′E, 1700 m), 7 February 2011, (HE08) P. Butterill leg. (BMNH). Paratypes, 5 ♂, 5 ♀, (HE08, HE09), immatures: 1 5th, 3 4th, 2 3rd, 1 2nd instar (GALL363 ex *Elaeocarpus schlechterianus*) as for holotype (BMNH). **Other material**: immatures, 1st–5th instars (HEY1, HEY3, GALL359, GALL360 ex *Elaeocarpus schlechterianus*) as for holotype, P. Butterill leg. (NARI).

Gene sequences

GenBank: KT588302 (COI), KT588308 (cytB) (PNGHE08–11).

Pauropsylla triozoptera Crawford, 1913
(Figures 3F, 5G–H)

Pauropsylla triozoptera Crawford, 1913: 296; Yang et al. (2013): 46.
Sympauropsylla triozoptera (Crawford), Enderlein (1921): 116.
Neotrioza triozoptera (Crawford), Li (2011): 1315.

Material examined

9 ♂, 4 ♀, 2 5th instars, Ohu village, Madang Province, PNG, 11 April 1995, (hand collecting/beating) hatched from leaf galls ex *Ficus trachypison*, Y. Basset leg. (MMBC); 4 5th instars (+ 4 larvae of Lepidoptera 'commensal'), same data as previous but 11 January 1995, from galls on mature leaves; 4 ♂, 2 ♀, Baitabag village, Madang Province, PNG, March 1996, ex *Ficus trachypison* (TRA 3), V. Novotný leg. (MMBC). 2 ♂, 1 ♀, Laguna College, Laguna, Philippines, 10 June 1976, leaf galls ex *Ficus ulmifolia*, R. Braza leg. (BMNH); 2 ♂, 3 ♀, Davao Experiment Station, Philippines, March 1964, traps air level, M. Gavarra leg. (BMNH); 2 ♂, 4 ♀, same data as previous but January 1964 (BMNH); 1 ♂, 4 ♀, same data as previous but traps ground level, October–December 1961 (BMNH). 1 5th instar, 5 1st–2nd instars, Taiwan (22.0499°N, 120.8576°E, 150 m), 30 January 2010, dissected from galls ex *Ficus* cf. *ampelas*, D. Percy leg. (BMNH).

Comments

This species is widespread in eastern Asia. We report the first records for PNG, Madang Province, on *Ficus trachypison* (Moraceae). All known *Pauropsylla* are gall inducing. This species shares with *Pauropsylla udei* a galling habit on *Ficus* in PNG, but there are notable morphological differences between the two species, including the male terminalia illustrated in Figure 5(G, I); the head structure (illustrated by Uichanco 1921); antennae with three rhinaria on segment 3 and a single rhinarium on segments 4, 6, 8 and 9 (the latter associated with a very long seta as long as segment 10) in *P. triozoptera*, versus only four on segments 4, 6, 8 and 9 (associated with a short seta) in *P. udei*; metatibia with three apical spurs in *P. triozoptera* versus four (2 + 2) in *P. udei*, and the female terminalia. The immatures can also be differentiated primarily by the large distinctly shaped circumanal pore area in *P. triozoptera* (Figure 6H, and illustrated by Yang 1984) versus much reduced anus lacking circumanal pore area in *P. udei*. Genetic divergence between the two species is high (mitochondrial DNA divergence > 20%).

Host plants

Ficus tinctoria (= *F. gibbosa*), *F. ulmifolia* and possibly *F. ampelas* in Taiwan (Yang 1984; Hodkinson 1986; Yang et al. 2013), *F. trachypison* (new record) in PNG.

Biology

Dissected galls from PNG (on *F. trachypison*) and from Taiwan (on *F.* cf. *ampelas*) contained a single immature per gall. As described below for *P. udei*, some noticeable variation in gall phenotype within this species was found. All galls produced by *P. triozoptera* are enclosed galls on the leaf blade, but in PNG the gall exterior is covered in spine-like trichomes, whereas in Taiwan the galls are smooth, without trichomes (Figure 3F). Furthermore, the shape of the galls in Taiwan is narrowly conical, and in PNG it is globular or broadly conical (bell-shaped), produced on the upper adaxial leaf surface; on some leaves from PNG, mature galls appear to fuse, forming an irregular bumpy mass in which individual galls are difficult to distinguish. In PNG, the galls on *F. trachypison* may be parasitized by a species of Braconidae (an adult braconid was present in the sample together with the gall). Parasitization of gall-inducing psyllids by Braconidae has been reported for *Pauropsylla braconae* Li, 2000 in Li et al., 2000 on *Ficus*
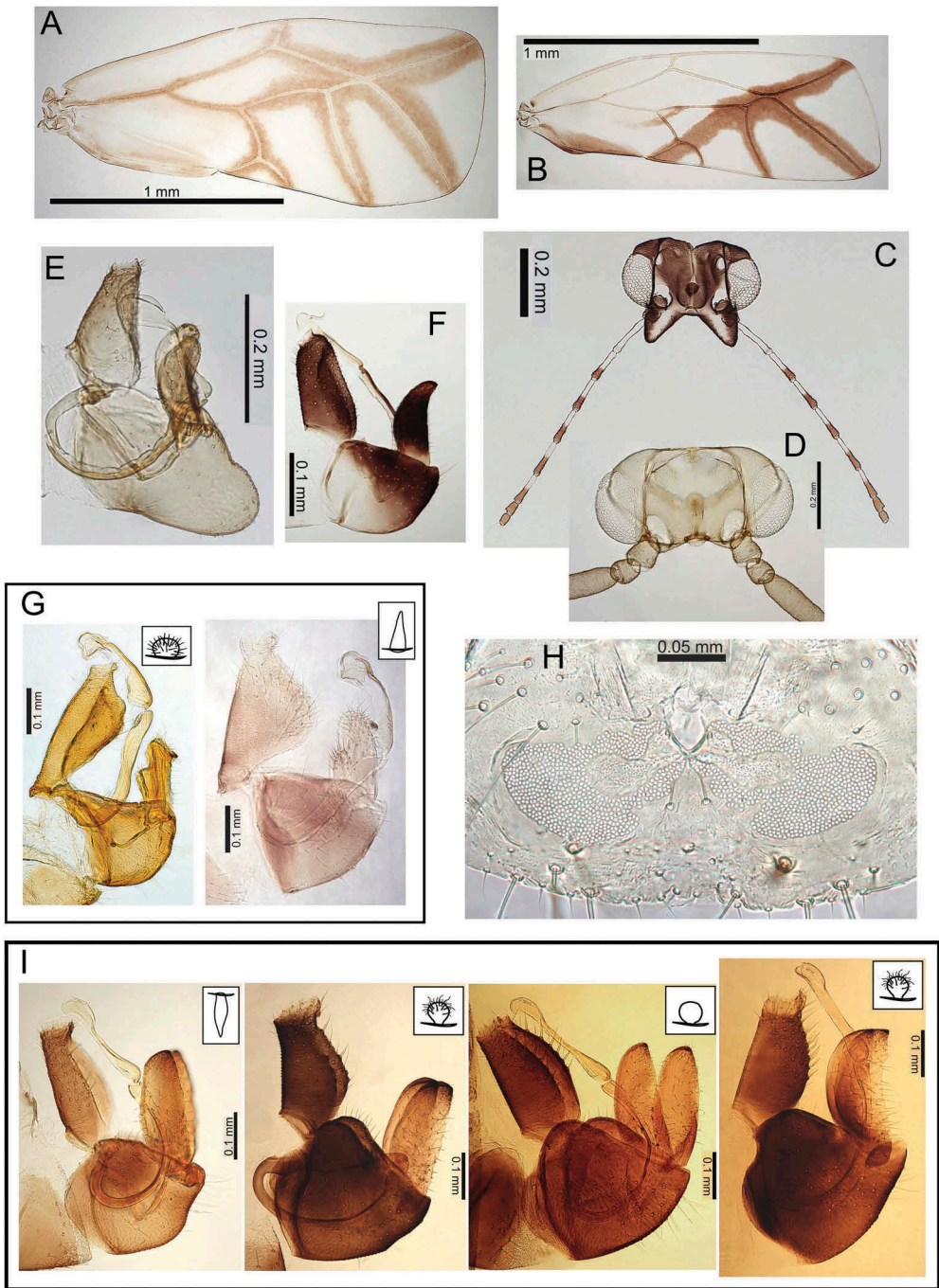
Figure 5. Adult comparison of *Cornegenapsylla allophyli* Malenovský and Percy, sp. nov. (A, D, E) and *Cornegenapsylla sinica* Yang and Li (B, C, F). (A, B) Forewings: (A) *C. allophyli*, (B) *C. sinica*; (C, D) heads: (C) *C. sinica*, (D) *C. allophyli*; (E, F) male terminalia: (E) *C. allophyli*, (F) *C. sinica*. Comparison of adult male terminalia in specimens of *Pauropsylla triozoptera* Crawford (G, left to right): from Papua New Guinea, Philippines, with inset schematic of gall phenotypes; (H) 5th instar circumanal pore area of *P. triozoptera* from Taiwan. Comparison of adult male terminalia in specimens *Pauropsylla udei* Rübsaamen (I, left to right): from Papua New Guinea, Hong Kong, Bangladesh, Philippines, with inset schematic of gall phenotypes.
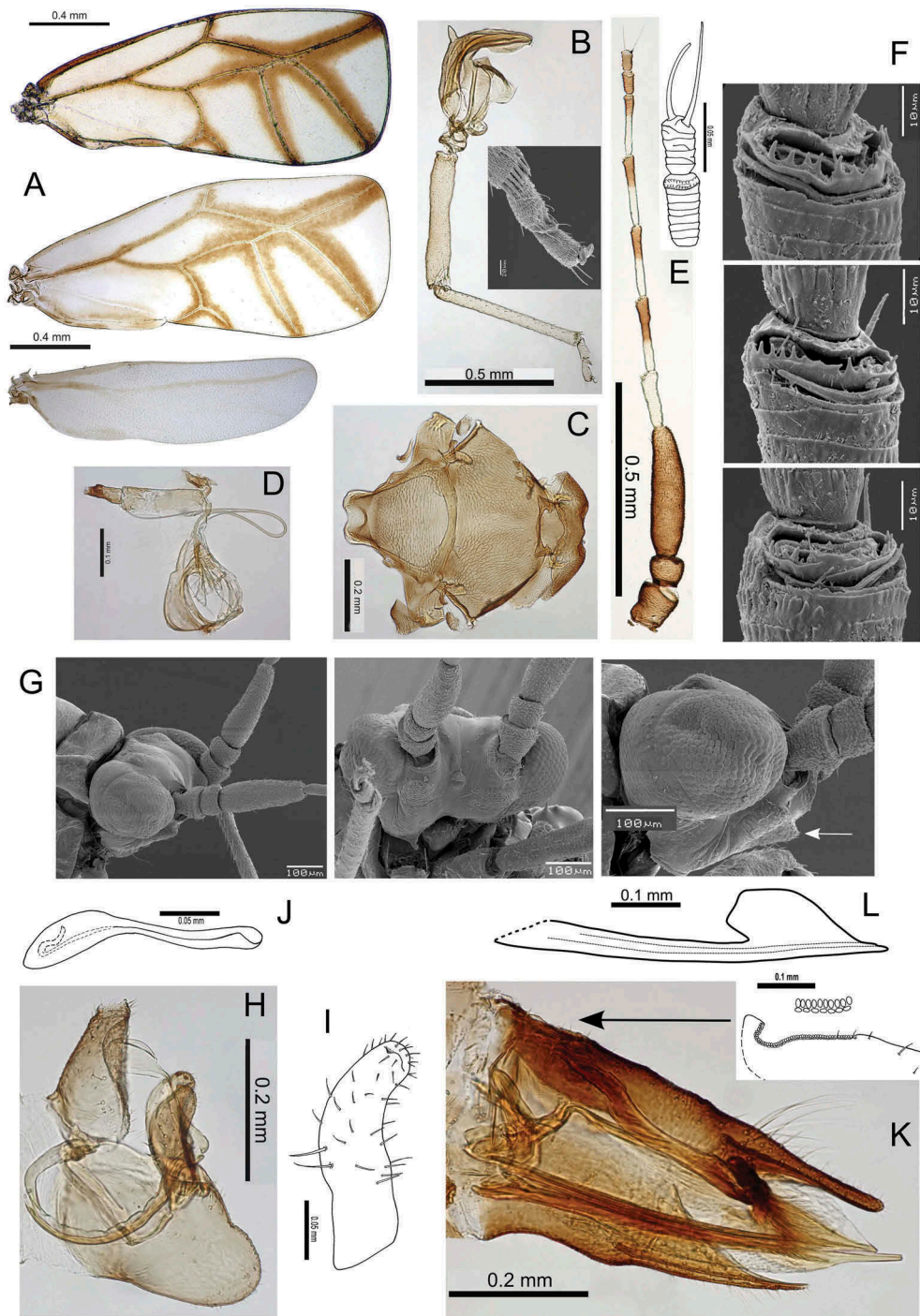
Figure 6. Adult *Cornegenapsylla allophyli* Malenovský and Percy, sp. nov. (A) Forewings and hindwing, upper forewing imaged with reflected light and lower with transmitted light; (B) hind leg; (C) thorax dorsum; (D) clypeus and proboscis; (E) antenna, terminal two segments (inset); (F) antennal rhinaria on 4th (lower), 5th (middle) and 6th (upper) segments; (G) head, lateral (left), ventral (middle) and lateral showing reduced but distinct genal tubercles (right); (H) male terminalia; (I) paramere (inner surface); (J) distal aedeagus segment; (K) female terminalia, circumanal ring (inset); (L) ovipositor.

hainanensis in China (Yunnan) (Li et al. 2000). In Taiwan, a 5th instar was found parasitized by *Psyllaephagus* sp. (Encyrtidae, det. J. Noyes, BMNH).

Distribution
Taiwan (Yang 1984; Li 2011; Yang et al. 2013), Japan: mainland, Ryukyu Islands (Hodkinson 1983, 1986), Indonesia: Java (Hodkinson 1986), Philippines (Crawford 1913; Hodkinson 1983, 1986), PNG (new record), Fiji (Hodkinson 1983, 1986).

Gene sequences
GenBank: KT588303 (COI), KT588309 (cytB) (TAI83–10).

Pauropsylla udei Rübsaamen, 1899
(Figures 3D,E; 5I)

Pauropsylla udei Rübsaamen, 1899: 264.
Pauropsylla montana Uichanco, 1919: 546, nomen nudum; Uichanco (1921): 265.
Pauropsylla bakeri Crawford, 1915: 258; Crawford (1919): 145.
Pauropsylla reticulata Mathur, 1975: 102 syn. nov.

Material examined
2 ♂, 11 2nd–5th instars, Mis village (5°11′S, 145°47′E, 50 m) and Ohu village (5°13′S, 145°40′E, 200 m), Madang Province, PNG, September–November 2010 and February–March 2011, reared from conical galls ex *Ficus variegata*, P. Butterill leg. (BMNH); 1 ♀, dissected from conical galls in alcohol, Baitabag village, Madang Province, PNG, January 1996, ex *Ficus variegata*, V. Novotný leg. (MMBC); 1 ♂, 2 ♀, numerous circular galls and immatures, Singapore (1.353°N, 103.778°E, 75 m), 6 November 2012, ex *Ficus variegata*, D. Percy leg. (BMNH); 9 ♂, Sylhet, Bangladesh, 1 November 1930, ex circular galls, M. Bose leg. (BMNH), same as type series of *Pauropsylla reticulata* Mathur, 1975 syn. nov.; 2 ♂, 1 ♀, Pokfulam, Hong Kong, 14 March 1973, ex *Ficus variegata* (BMNH); 1 ♂, 3 ♀, Ha Kwai Chung Tsuen, Hong Kong, 7 November 2005, C. Lau leg. (BMNH); 12 4th–5th instars, Hang Mei Village, Tai O, Lantau Island, Hong Kong, 12 April 2010, ex *Ficus variegata* circular galls, J. Martin leg. (BMNH); 1 ♀, 4 4th–5th instars, Gunung Mulu National Park, Borneo, Sarawak, Malaysia, 27 June 1978, ex *Ficus*, V. Eastop leg. (BMNH); 2 ♂, 2 ♀, Laguna College, Laguna, Philippines, 30 December 1975, ex *Ficus variegata* leaf galls, R. Braza leg. (BMNH).

Comments
This species is widespread in Asia. We report new records for PNG, Madang Province, on *Ficus variegata* (Moraceae), and illustrate some of the variation found in the structure of the male terminalia from different parts of the Oriental Region (Figure 5I). The PNG specimens have a narrower male paramere and proctiger, and the female terminalia are shorter, but otherwise specimens are similar to those examined from Hong Kong and Bangladesh; specimens from the Philippines show the most structural difference in male terminalia and further investigation of regional patterns of intra-specific variation is needed to assess whether there is sufficient divergence to warrant recognizing separate species. The 2nd and 5th instar immatures from PNG are covered in medium to long

simple setae as illustrated in Rübsaamen (1899). Immatures examined from Sarawak and Hong Kong did not reveal noticeable differences. Genetic divergence between PNG and Singapore specimens supports the need for further intra-specific investigation (mitochondrial DNA divergence was relatively high, ~10%), as does the striking gall type differences between PNG and other areas.

Comments on synonymization

Nine adult specimens of *P. reticulata* Mathur, 1975 collected together with the type series at the type locality, together with two dried galls, were sent to BMNH in 1931 (Mathur 1975). The suspected synonymy of this material was noted by Hollis (1984, p. 28), and after examining this material, DMP concurs with his assessment and the synonymy is formalized here. The two galls are spherical and globular, and appear similar to those found on *Ficus variegata* (Moraceae) from Singapore (Figure 5E) and the Philippines (illustrated by Uichanco 1919), but they appear to lack exterior trichomes. In addition, there is some uncertainty regarding the host-plant range, as the holotype and paratype series (including BMNH material) was collected 'ex galls on unknown plant', but Mathur (1975) also cites other material collected from West Bengal, India (13 July 1935) ex galls on leaves of *Breonia chinensis* (= *Anthocephalus indicus*; Rubiaceae) in his description of *P. reticulata*. Furthermore, the type series of *P. udei* was originally described with the host as an unknown species of Rubiaceae in Sumatra, which was subsequently considered a host record error by Uichanco (1921), and certainly the original illustration and description of the galls by Rübsaamen (1899) for *P. udei* resemble closely those illustrated here on *Ficus variegata* leaves (Figure 5E).

Host plant

Various *Ficus* (Moraceae) species, including *F. fulva* (=*F. chlorocarpa*) and *F. variegata* (Uichanco 1919; Hodkinson 1983, 1986). In PNG it was collected on *F. variegata*.

Biology

As noted for *P. triozoptera* above, we report notable variation in the gall phenotype. In all cases, the galls of *P. udei* are enclosed and produced on the leaf blade. In PNG the galls are conical and smooth, without trichomes, and produced on the lower, abaxial leaf surface (Figure 3D). Those found in the Philippines, Singapore and Hong Kong are spherical or oval, usually produced on the upper, adaxial leaf surface, and the outer surface of each gall is covered in trichomes that are cream to red; gall coverage can be dense on younger leaves (Figure 3E).

Distribution

Bangladesh (Assam in Hodkinson 1983, 1986); China (Hong Kong; Hodkinson 1983, 1986; Martin and Lau 2011); Indonesia (Hodkinson 1983, 1986); Malaysia (Hodkinson 1983); PNG (new record); Philippines (Uichanco 1919; Hodkinson 1983, 1986); Singapore (Hodkinson 1983). Possibly India (Mathur 1975, as *P. reticulata*; see comments on synonymization above).

Gene sequences

GenBank: KT588305 (COI), KT588311 (cytB) (PNGHE05-10); and KT588304 (COI), KT588310 (cytB) (SING01–12).

Family **PHACOPTERONIDAE** Heslop-Harrison, 1958
Cornegenapsylla allophyli Malenovský and Percy, sp. nov.
(Figures 3B; 5A,D,E; 6A–L; 7A–D)

Adult colour (ethanol material)

Forewing membrane (Figure 6A) clear except for brown infuscations along the veins; veins brown in basal wing half, light ochreous in apical half. Hindwing membrane infuscate basally (Figure 6A). Body almost uniformly brown, legs paler. Antenna (Figure 6E) with segments 1–3 brown, segment 4 uniformly off-white, segments 5–8 off-white basally and dark brown to black apically, segments 9–10 entirely dark brown to black.

Adult structure

Forewing (Figure 6A) with apex broadly truncate; cell cu_1 small; membrane lacking surface spinules, but with small patches of radular spines close to veins at the margin. Head distinctly wider than thorax. Vertex (Figure 6G) almost flat dorsally, with lateral ocelli lying on small tubercles, rounded down to frons; medial epicranial suture distinct anteriorly and posteriorly, but indistinct medially. Genae very small, weakly swollen, with a small tubercle below insertion of antennae (Figure 6G). Antenna (Figure 6E) relatively long; the 3rd segment strikingly enlarged, approximately as long as segments 4 and 5 together; segments 4–10 slender; segments 4–9 each with widely elliptic rhinarium largely bordered with wreath of small, acute cuticular spines, segments 4–8 each with an additional sensilla lying in a transverse groove closely adjacent to rhinarium (Figure 6F); terminal setae subequal, slightly shorter than segments 9 and 10 together (Figure 6E). Clypeus (Figure 6D) somewhat flattened, rounded at apex, lacking long setae. Apical segment of proboscis short. Metatibia with a small genual spine basally, and 13–15 evenly sized unsclerotized spurs apically; metabasitarsus slightly longer than apical tarsal segment and bearing two sclerotized lateral spurs (Figure 6B). Male subgenital plate elongate, strongly produced into a posterior hump (Figure 6H). Male proctiger (Figure 6H) narrowly conical. Paramere (Figure 6I) curved posteriorly, with apex broadly rounded; inner side covered with fine setae. Distal segment of aedeagus (Figure 6J) with a rounded, unhooked apex. Female terminalia (Figure 6K) long; proctiger with dorsal margin nearly straight; circumanal ring relatively small, 0.2 × length of proctiger, and composed of a double row of cells; subgenital plate gradually narrowing to a pointed apex; inner ovipositor valve dorsally broadly triangular in profile (Figure 4L).

Adult measurements (mm) and ratios (3 ♂, 2 ♀)

WL: 1.72–2.16; HW: 0.51–0.61; AL: 1.13–1.30; GP: 0.03–0.06; PB: 0.09; HVW: 1.82–20; ALHW: 2.05–2.17; VLGP: 3.50–70; VLW: 0.64–0.70; WLW: 2.20–2.29; CUR: 2.83–30; MR: 0.55–0.63; TLFL: 1.11–1.18. ♂: MP: 0.16–0.21; PL: 0.16–0.18; AEL: 0.19–0.21; MSLH: 1.58–

1.77; AHS: 2.36–2.40; PLSH: 0.91–0.92. ♀: FP: 0.62–0.74; FSP: 0.47–0.54; RL: 0.14; OV: 0.19; FPRL: 4.53; FPHW: 1.02–1.25; FPFSP: 1.31.

Immature structure

Body outline elongate, with protruding wing buds lacking humeral lobes (Figure 7A, D). Antennae of 5th instar (Figure 7B) with 8 or 9 segments bearing four rhinaria, one each apically on segments 6–9; 3rd instar antennae 5- to 6-segmented bearing three rhinaria, one each on terminal 3 segments. Tarsi with well-developed claws, arolia very small (Figure 7B). Anus situated terminally, circumanal pore area with large and irregular lateral fields of multiple pores extending to both ventral and dorsal surfaces; circumanal ring medially narrow with a single row of elongate cells (Figure 7C).

Immature chaetotaxy

Immatures with sparse coverage of short simple setae on body dorsal surface and margins. Dorsal surface of caudal plate/abdominal tergites with small groups of pointed lanceolate setae close to the body margin (Figure 7A, D).

Immature measurements (mm), 5th instar (n = 2)

BL: 2.09–2.24; BW: 1.21–1.30; WL: 0.67; CPL: 1.06–1.24; CPW: 0.94–0.97; RW: 0.32–0.37; HW: 0.62–0.63; AL: 0.42–0.46.

Egg

Stout laterally positioned pedicel at base, apical tail present (Figure 7B: dissected from 5th instar immatures).

Host plant

Allophylus cobbe (= Pometia pinnata) (Sapindaceae).

Distribution

PNG, Madang Province.

Biology

The gall is a leaf fold on the margin of the leaf and consists of the lower abaxial surface folding up over the upper adaxial surface to make the gall on the upper leaf surface (Figure 3B).

Etymology

A noun in the genitive case, named in reference to the host plant genus Allophylus.

Comments

This species is placed in the hitherto monotypic genus, Cornegenapsylla Yang and Li, 1982. It shares with the type species, C. sinica, the forewing pattern with bands of dark pigmentation around the veins, the forewing shape (the forewing being elongate with an almost rectangular apex), and the head shape, though it lacks the well-developed genal processes of C. sinica (comparison of forewing, head and male terminalia are provided in Figure 5A–F). It differs most distinctly from C. sinica in the larger body size,
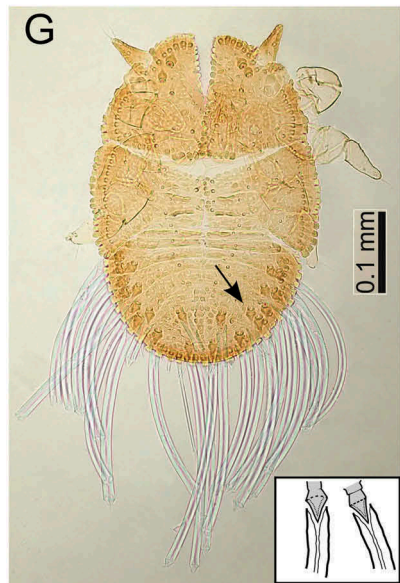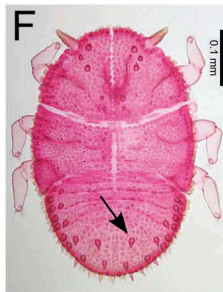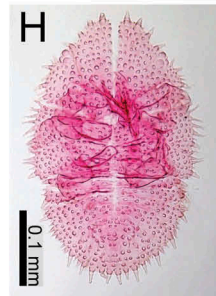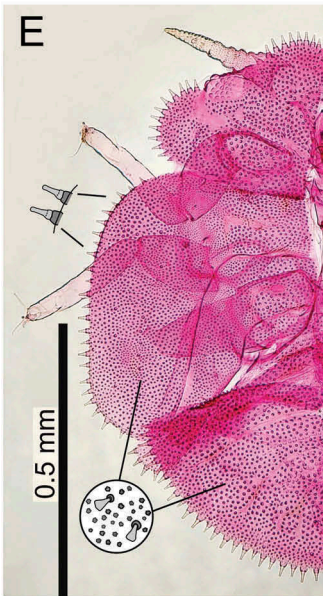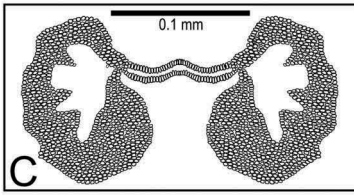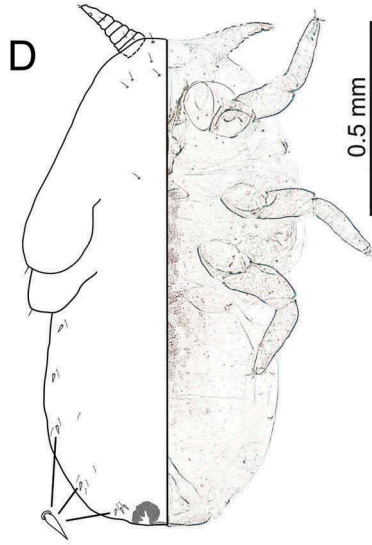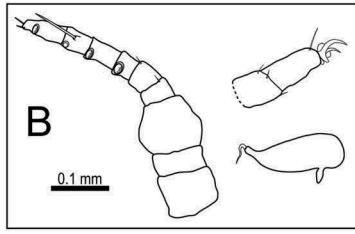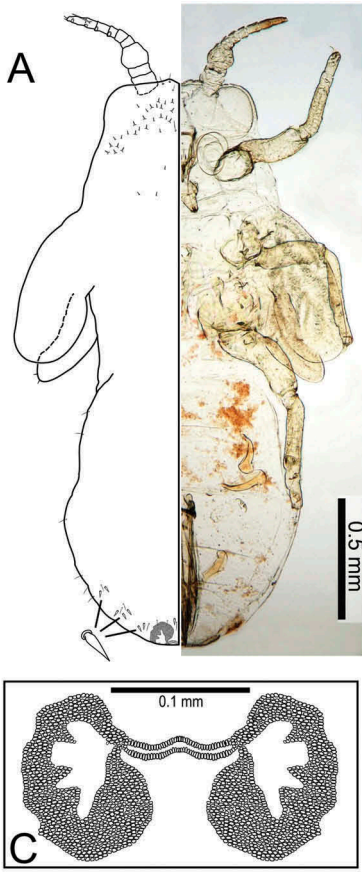
the very short genal processes, the swollen 3rd antennal segment, the male subgenital plate produced into a posterior bulge, the elongate shape of the female terminalia, the immature morphology, and the host plant species and galling biology. Both species produce galls on host plants in the family Sapindaceae, but *C. sinica* immatures produce deep pit galls on young leaves of *Dimocarpus longan* (Yang 1984), whereas *C. allophyli* immatures produce enclosed galls on the leaf margins of mostly mature leaves of *Allophylus cobbe*. These different biologies are reflected in the different immature structure and chaetotaxy, with *C. sinica* immatures showing the ventro-dorsally flattened body form, and marginal placement of setae typical of pit gall formers; whereas *C. allophyli* immatures have irregularly dispersed simple setae and non-flattened, broadly inflated body form typical of enclosed gall formers.

Ongoing work by I.M. suggests that *Cornegenapsylla* is affiliated with the Neotropical genus *Phacosemoides* Lima and Guitton, 1962, as well as a number of species from the Afrotropical *Pseudophacopteron caffrariense*-group as defined in Malenovský and Burckhardt (2009).

Type material

Holotype, ♂ (slide mounted), Mis village near Madang, Madang Province, PNG (5°11′S, 145°47′E, 50 m), 13 October 2011, (HE01) P. Butterill leg. (BMNH). Paratypes, 1 ♂, 1 ♀ (HE02, HE03), immatures: 1 5th, 1 3rd (GALL087 ex *Allophylus cobbe*), as for holotype (BMNH); 2 ♂ 3 ♀, Baiteta, Madang Province, PNG, 16 May 1995 (AR 16), 27 June 1995, canopy fogging, *Sloanea forbesii* (Elaeocarpaceae) (AR 19), 28 May 1996 (at light, AR 53), 24 June 1996 (at light, T2), O. Missa leg. (IRNB, MMBC, NHMB, dry and slide mounted and preserved in ethanol).

Gene sequences

GenBank: KT588306 (cytB) (PNGHE02-11).

<div align="center">

Cornegenapsylla sinica Yang and Li, 1982
(Figures 5B,C,F; 7E–H)

</div>

Cornegenapsylla sinica Yang and Li, 1982: 124; Burckhardt and Ouvrard (2012): 17.
Neophacopteron euphoriae Yang, 1984: 165; Li (2011): 1223.
Phacopteron sinicum (Yang and Li), Li (2011): 1223.

Material examined

3 ♂, 2 ♀, 2nd–5th instars, Singapore Botanic Gardens, Singapore, 2 January 1997, ex *Dimocarpus longan*, J. Martin leg. (BMNH); 4 ♂, 1 ♀, 2nd–4th instars, Bangkok, Thailand,

Figure 7. Immatures, *Cornegenapsylla allophyli* Malenovský and Percy, sp. nov. (A–D), and *Cornegenapsylla sinica* Yang and Li (E–H). (A–C) 5th instar; (B) antenna, tarsi, and egg; (C) circumanal pore area and ring; (D) 3rd instar; (E) 5th instar (stained); (F, G) 3rd instars (F stained), with (G) showing production of long waxy filaments from large pointed setae; (H) 2nd instar (stained).

1961, ex *Dimocarpus longan*, A. Manjikul leg. (BMNH); 1 ♂, 3 ♀, Johor, Malaysia, 13 April 1970, ex *Nephelium malaiense*, Dept. Agric. leg. (BMNH).

Comments

With the synonymization of *Neophacopteron euphoriae* and *Cornegenapsylla sinica* by Li (2011), it is confirmed that there is a single species on longan that is widely distributed in South East Asia. Burckhardt and Ouvrard (2012) mistakenly mention the combination *Cornegenapsylla euphoriae* (Yang, 1984) when reinstating *Cornegenapsylla* as a valid genus. *Cornegenapsylla sinica* remains unusual within the Phacopteronidae for the long genal processes and the male terminalia covered with stout lanceolate setae, as well as a characteristic near vertical feeding posture (Yang et al. 2009). Without an explanation, but probably based on the relatively well-developed genae in the type species of *Phacopteron* Buckton, 1896, Li (2011) placed *C. sinica* in *Phacopteron*, which was subsequently reversed by Burckhardt and Ouvrard (2012). The type species of *Phacopteron, Phacopteron lentiginosum* Buckton, 1896 is a widespread species from Pakistan to South East Asia. The inclusion of the only other species in *Phacopteron, Phacopteron gabrieli* Navasero and Calilung, 2000, from the Philippines is considered doubtful. *Phacopteron lentiginosum* produces a completely enclosed round gall on the leaves of *Garuga* spp. (Burseraceae) (Hodkinson 1986; Li 2011), which dehisces after adult eclosion inside the gall (Raman 1987). A similar biology with emergence of the adult from a sac-like gall is illustrated here for *Pauropsylla udei* (Singapore specimens) on *Ficus variegata* (Figure 3E).

The 1st–5th instar immatures of *C. sinica* were described and illustrated by Yang (1984). The 5th instar body margin is bordered with bluntly pointed setae situated on cuticular tubercles and the dorsum of 5th instars has sparsely distributed minute club-shaped setae (Figure 7E). Here we provide illustrations of 2nd, 3rd and 5th instars (Singapore specimens, Figure 7E, F, H), and a 3rd instar immature (Thailand specimens) showing the production of waxy filaments from the large pointed dorsal setae (Figure 7G). In contrast to *C. allophyli* sp. nov., the antenna of 5th instar immatures of *C. sinica* is 6- to 7-segmented, bearing only two rhinaria on the apical segments, and the anus is situated ventrally, surrounded by a small transverse circumanal ring composed of a single row of cells.

Host plant

Dimocarpus longan (Sapindaceae).

Distribution

China: Fujian, Hainan, Guangdong, Guangxi, Hong Kong (Yang and Li 1982; Martin and Lau 2011; Li 2011; and BMNH data); Malaysia (Hodkinson 1986); Taiwan (Yang 1984; Yang et al. 2009); Thailand (Hodkinson 1986), and Singapore (new record, BMNH data).

Biology

The immatures produce deep pit galls on young leaves (Yang 1984). *Cornegenapsylla sinica* is a pest of longan, an important fruit crop in South East Asia. It causes economic damage by direct effects of feeding, and possibly as well by the transmission of a

'filamentous virus' (a suspected phytoplasma, cf. Nguyen et al. 2012) that is the agent of longan witches' broom disease (Chen et al. 1992, 2001; Xu et al. 2001; Yen et al. 2005).

Pseudophacopteron tuberculatum (Crawford, 1912)

Pauropsylla tuberculata Crawford, 1912: 430.
Pseudophacopteron tuberculatum (Crawford), Enderlein (1921).

Material examined (only specimens from PNG listed)
1 ♂, 1 ♀, Varirata National Park, Central Province, 13–15 October 1987, (ex *Alstonia*) D. Hollis leg. (BMNH); 2 ♂, 8 ♀, Baiteta, Madang Province, 30 June 1995, (canopy fogging *Ficus* sp., AR 22) O. Missa leg. (IRNB, MMBC).

Comments
Both the host plant and the psyllid are widespread in Asia. We report new records on *Alstonia* sp. (probably *Alstonia scholaris* or *A. brassii*) for mainland PNG, Central and Madang Provinces, while psyllid galls on *Alstonia scholaris* probably induced by this species have been recorded from Ralum, Bismarck Archipelago by Rübsaamen (1905). The host is used in agroforestry for timber as well as other uses and is also planted as an ornamental (Orwa et al. 2009). *Pseudophacopteron tuberculatum* is considered a serious pest of plantations of *Alstonia scholaris* in the Philippines (Braza and Calilung 1981). Its taxonomy, however, is in need of revision because there are likely to be undescribed species on the same host in the Oriental and Australasian Regions (BMNH data) and *Pseudophacopteron alstonium* Yang and Li, 1983, which is similar to *Pseudophacopteron tuberculatum*, was described from *Alstonia scholaris* in China (Li 2011). The specimens cited above from PNG correspond well in their morphology with the original description (Crawford 1912) and type specimens of *Pauropsylla tuberculata* in USNM examined by I.M.

Host plant
Alstonia scholaris (Apocynaceae) (Crawford 1912; Mathur 1935, 1975).

Distribution
Bangladesh (BMNH data), Myanmar (Mathur 1975), India (Assam, Bihar, Bombay, Tamil Nadu, West Bengal; Mani 1948; Mathur 1975; ZISP data), Indonesia (Java, Salajar, Sebesi, Sulawesi, Sumatra, Tanimbar; Docters van Leeuwen-Reijnvaan and Docters van Leeuwen-Reijnvaan 1910, 1916; Hodkinson 1983, 1986), Laos (MMBC data), Malaysia (Mathur 1975), PNG (mainland; new record, and Bismarck Archipelago; Rübsaamen 1905), Philippines (Luzon and Mindanao; Uichanco 1919; 1921; Braza and Calilung 1981; BMNH data), Thailand (Hodkinson 1983; 1986; MHNG data) and Vietnam (MHNG data).

Biology
This species makes enclosed conical or barrel-shaped galls usually on the leaf blade, and often along the mid-vein. Mathur (1935) noted about 20 scattered galls on a single leaf. More rarely galls can be found on young fruits or branches (Houard 1923; Mani 1948,

1964). The galls have been described and illustrated by several authors (e.g. Rübsaamen 1905; Docters van Leeuwen-Reijnvaan and Docters van Leeuwen-Reijnvaan 1910, 1916; Uichanco 1919; Houard 1923; Mani 1964; Yang and Li 1983).

Discussion

Many more psyllid species undoubtedly remain to be discovered and described from PNG and adjacent regions. Determining the taxonomic affinities of the *Trioza* species described here is partly hindered by the current poor knowledge of the regional fauna and the fluctuating state of revisionary systematics in the family Triozidae. It is unlikely that either of the *Trioza* species described here will be of economic importance.

In contrast, the fruit of *Allophylus cobbe* is edible and locally popular, sometimes known commonly as the 'Fijian Longan', and therefore *Cornegenapsylla allophyli* has the potential to have an economic impact, but, despite the widespread distribution of the host-plant from India, China, Thailand, out to Pacific Islands such as Fiji and Samoa (Orwa et al. 2009), the psyllid may not be sufficiently abundant or widespread to be considered a potential pest. Several other phacopteronid species are known as pests of economically important fruit or timber trees, especially in South East Asia, including the congeneric *Cornegenapsylla sinica*, which injures shoots and leaves of longan (*Dimocarpus longan*) and may be a viral or phytoplasma vector. In addition, *Pseudophacopteron album* (Yang and Tsay 1980) (= *P. canarium* Yang and Li, 1983) is a serious pest of Chinese olive (*Canarium album*) in South China, necessitating control measures (Lu and Liu 2001; Li 2011); heavy infestations of *Pseudophacopteron calilungae* Navasero, 1998 damage the inflorescences of pili nut (*Canarium ovatum*) in the Philippines (Navasero 1998); and *Pseudophacopteron tuberculatum* (Crawford 1912) causes economic loss in plantations of white cheese-wood (*Alstonia scholaris*) in the Philippines (Braza and Calilung 1981).

The intraspecific variation, and seeming interspecific convergence, in gall types produced by *P. triozoptera* and *P. udei* from different regions is striking and needs to be investigated further. Gall phenotypes are usually conserved within species (e.g. *Lonchocarpus*-feeding psyllids from Central America; Hollis and Martin 1997), but the gall variation reported here does not correlate well with adult morphological variation or host variation. Together, genetic divergence and the different gall types suggest that there are grounds to more closely examine morphological divergence. The presence of multiple species would not be surprising over such large geographic distributions, but it remains surprising that there is not more morphological divergence evident. Only more comprehensive sampling from across the Oriental Region for both species is likely to yield a better understanding of these patterns of variation.

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Geolocation information

Trioza incrustata (point): 5°11′S, 145°47′E; 5°8′S, 145°46′E; 5°13′S, 145°40′E.
Trioza grallata (point): 06°08′S, 146°52′E.
Pauropsylla triozoptera (point): 22.0499°N, 120.8576°E.
Pauropsylla udei (point): 5°11′S, 145°47′E; 5°13′S, 145°40′E; 1.353°N, 103.778°E.
Cornegenapsylla allophyli (point): 5°11′S, 145°47′E.

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