



<https://doi.org/10.11646/zootaxa.4415.1.6>

<http://zoobank.org/urn:lsid:zoobank.org:pub:FE0C98F6-E952-4FE9-82DE-37F13BD1C703>

New species for *Virgilia* Stål, 1870 (Hemiptera, Lophopidae), genus review and key to species

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Abstract

Two new species of the lophopid genus *Virgilia* Stål 1866, are described and illustrated, *V. cocovora* Soulier-Perkins **sp. nov.** and *V. imuganensis* Soulier-Perkins **sp. nov.** A key to the species of the genus is provided. Photos for the four *Virgilia* species are presented and the male terminalia illustrations are given. A comment on the potential pest status of one of the described species, *V. cocovora*, is given.

Key words: Fulgoromorpha, Mindanao, Philippines, agricultural pest, Arecaceae, coconut

Introduction

The lophopid genus *Virgilia* Stål, 1870 belongs to the Virgiliini Emeljanov, 2013, a monophyletic lineage, as shown by Soulier-Perkins (2001) and tested later by Stroński & Soulier-Perkins (2015). The Virgiliini contains 6 genera: *Virgilia*, *Makota* Distant, 1909, *Painella* Muir, 1931 *Clonaspe* Fennah, 1955, *Venisiella* Stroński & Soulier-Perkins, 2015 and *Buxtoniella* Muir, 1927 (Bourgoin 2018), respectively distributed from the Philippines to the Fiji Islands along the South and Southeast Pacific island arcs. The distribution of the genera is the result of a series of vicariant events throughout geological time (Soulier-Perkins 2000). *Virgilia luzonensis* Baker, 1925 and *Virgilia nigropicta* Stål, 1870 are both found in the Philippines and until this study were the only known *Virgilia* species.

Within the Lophopidae, *Painella simmondsi* Muir, 1931 and *V. luzonensis* are listed by Wilson (1988) as species breeding on palms and suspected to be involved on transmitting diseases on coconuts, but only two other species are clearly known as being involved in spreading plant diseases or conditions. *Zophiuma butawengi* (Heller, 1966) is responsible for the “Finschhaffen disorder” on some Arecaceae in Papua New Guinea (Smith 1980, Gitau *et al.* 2011) and *Pyrilla perpusilla* (Walker, 1851) involved in the yellowing of sugarcane (Poaceae) in Afghanistan, Bangladesh, India, Nepal, Pakistan and Sri Lanka (Kumarasinghe & Wratten 1996). Nymphs and adults of *Pyrilla* suck phloem sap from the plant leading to yellowing and excrete honeydew on the leaves onto which sooty moulds may develop, diminishing the photosynthetic activity of the plant. This insect causes direct and indirect damages affecting the quality of sugarcane and its yield. In addition, *P. simmondsi* can also be considered as pest in Solomon Islands since that yellowing on coconut palms, similar to Finschhaffen disorder might be associated with the presence of this insect (Stapley 1976, 1978). In the Philippines, in South-eastern Luzon, a survey in 1979 found *V. luzonensis* to be significantly more common on healthy than on cadang-cadang infected palms (Zelazny & Pacumbaba 1982).

An unknown species of Lophopidae was recently discovered on coconut trees on the southern island of Mindanao, Philippines. It appears to belong to the genus *Virgilia*. Material identified as *Virgilia* was borrowed from

various collections and examined. Another new species, collected on the island of Luzon, in the southern part of Cagayan Valley, was then identified. These two species are described here.

Material and methods

The abdomen of each specimen examined was cut off and cleared for 20 minutes in warm (80°C) 10% KOH. Dissections and cleaning of genital structures were performed in distilled water. If needed, a few drops of blue paragon, that replaces the chlorazol black since its prohibition, is used in order to stain the ectodermic genital ducts were added for a few minutes. Final observations were made in glycerine using a camera lucida attached to Leica microscopes (MZ16). The photos of the habitus were taken using a stereomicroscope Leica MZ 16 with IC3D digital camera; final images were produced using Helicon 5.0 software.

Terminology follows Bourgoïn (1988) and Soulier-Perkins (1998, 2001) for male and female genitalia and Bourgoïn et al. (2015) for the forewing venation.

Abbreviations:

FSCA	Florida State Collection of Arthropods, Gainesville, Florida, USA
MNHN	Muséum national d'Histoire naturelle, Paris, France
MNH-UPLB	Museum of Natural History, University of the Philippines Los Baños, Philippines
BPBM	Bernice Pauahi Bishop Museum, Oahu, Hawaii, USA
ZMA	The Zoological Museum Amsterdam now merged into the Naturalis Biodiversity Center, Leiden, Netherlands

Taxonomy

Class Hexapoda Blainville, 1816

Order Hemiptera Linnaeus, 1758

Suborder Fulgoromorpha Evans, 1946

Superfamily Fulgoroidea Latreille, 1807

Family Lophopidae Stål, 1866

Tribe Virgiliini Emeljanov, 2013

Genus *Virgilia* Stål, 1870

Virgilia Stål, 1870: 752 (description)

Type species: *Virgilia nigropicta* Stål, 1870, by original description.

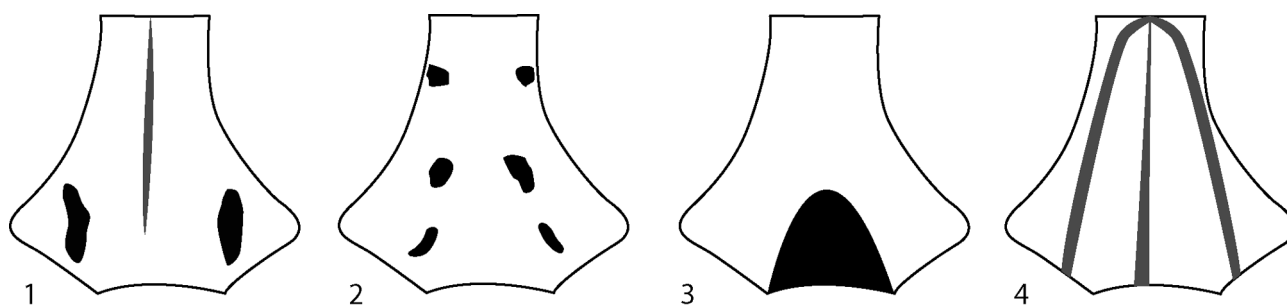
Melichar 1915: 373 (key); Baker 1925: 281 (key to species)

Key to the species of *Virgilia* Stål

1. Colouration on the frons following the median and sub-lateral carinae only, no other kind of patches (Fig. 4) *V. imuganensis* Soulier-Perkins **sp. nov.**
- Patches of colouration on the frons but none following the sub-lateral carinae 2
2. Clypeus nearly black, the half-moon patch on the frons can stretch toward the vertex margin (Fig. 3) *V. nigropicta* Stål
- Clypeus cream in colour that can get sometimes brownish toward the tip 2
2. Frons with median carina underlined with brown, and two vertical dark brown patches within the lateral enlarged areas of the

frons (Fig. 1) *V. luzonensis* Baker

- Frons bearing six small brown patches, one pair in each vertical third division of the frons (Fig. 2)
 *V. cocovora* Soulier-Perkins sp. nov.



FIGURES 1–3. Schematic patterns on *Virgilia* frons. 1 *V. luzonensis*. 2 *V. cocovora*. 3 *V. nigropicta*. 4 *V. imuganensis*.

***Virgilia cocovora* Soulier-Perkins sp. nov.**

(Figs 5–34)

Type material. Male holotype: Philippines: Mindanao, Compostela Valley, New Bataan, Camanlangan, on coconut, 3.2.2016, M.V. Navasero & G.A.S. Burgonio rec & leg, MNHN(EH)23546 (MNHN).

Paratypes: 1♂?, 4♀?. Philippines, Mindanao, Compostela Valley, New Bataan, Camanlangan, on coconut, 3.2.2016, M.V. Navasero & G.A.S. Burgonio rec. & leg., 3♀? MNHN(EH) 23545, 23547 and 23548 (MNHN) 1♂? & 1♀? (MNH-UPLB).

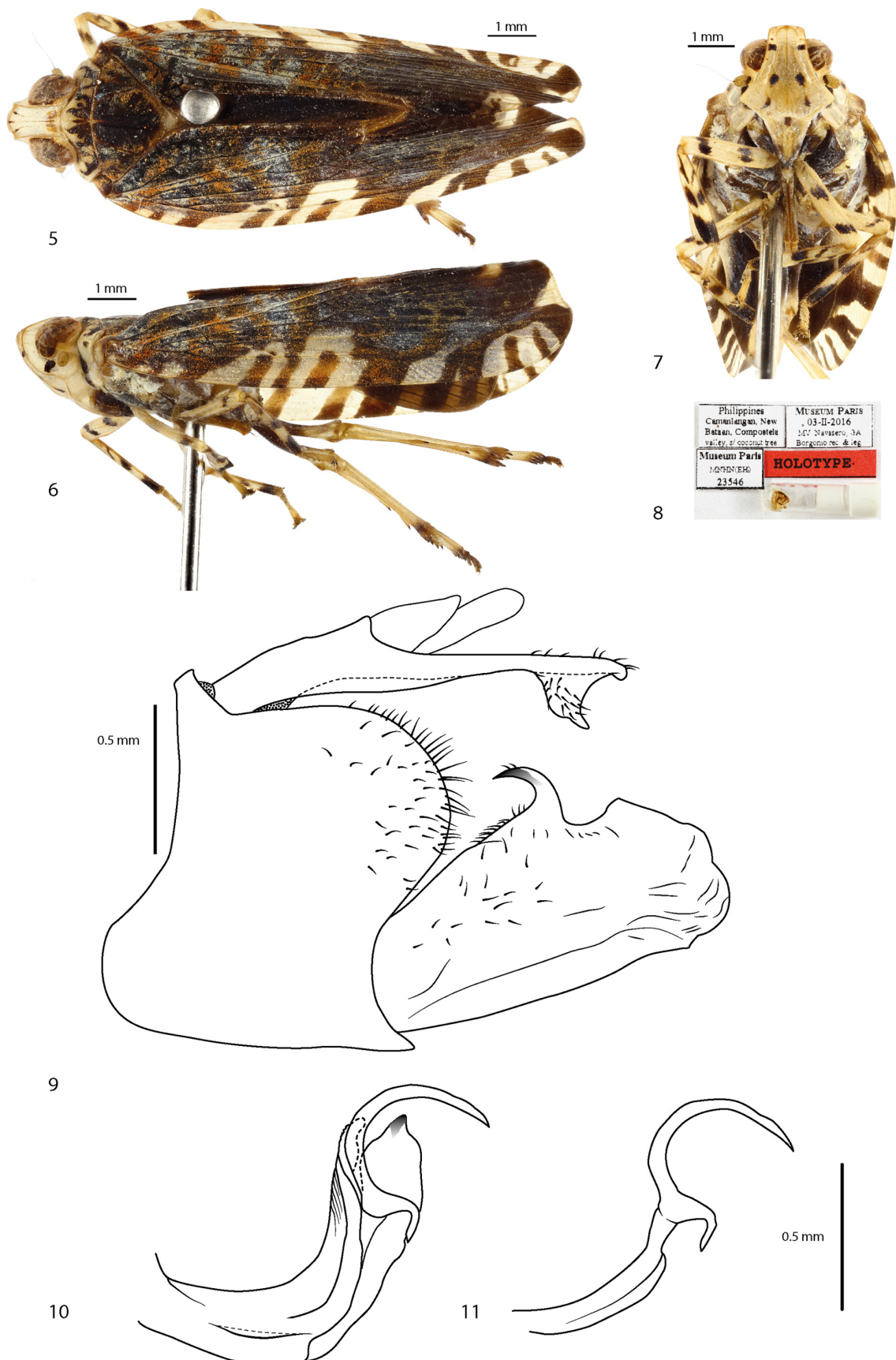
Distribution. Philippines, Mindanao Island (Fig. 65)

Diagnosis. Easy to recognise from the other three *Virgilia* by the coloration of its frons, it bears six brown spots (Fig. 2) where the *V. luzonensis* presents two patches and a stripe (Fig. 2), *V. imuganensis* colouration along the media and sub-lateral carinae (Fig. 4) and *V. nigropicta* a single large patch, half-moon shaped, touching the fronto-clypeal margin (Fig. 3).

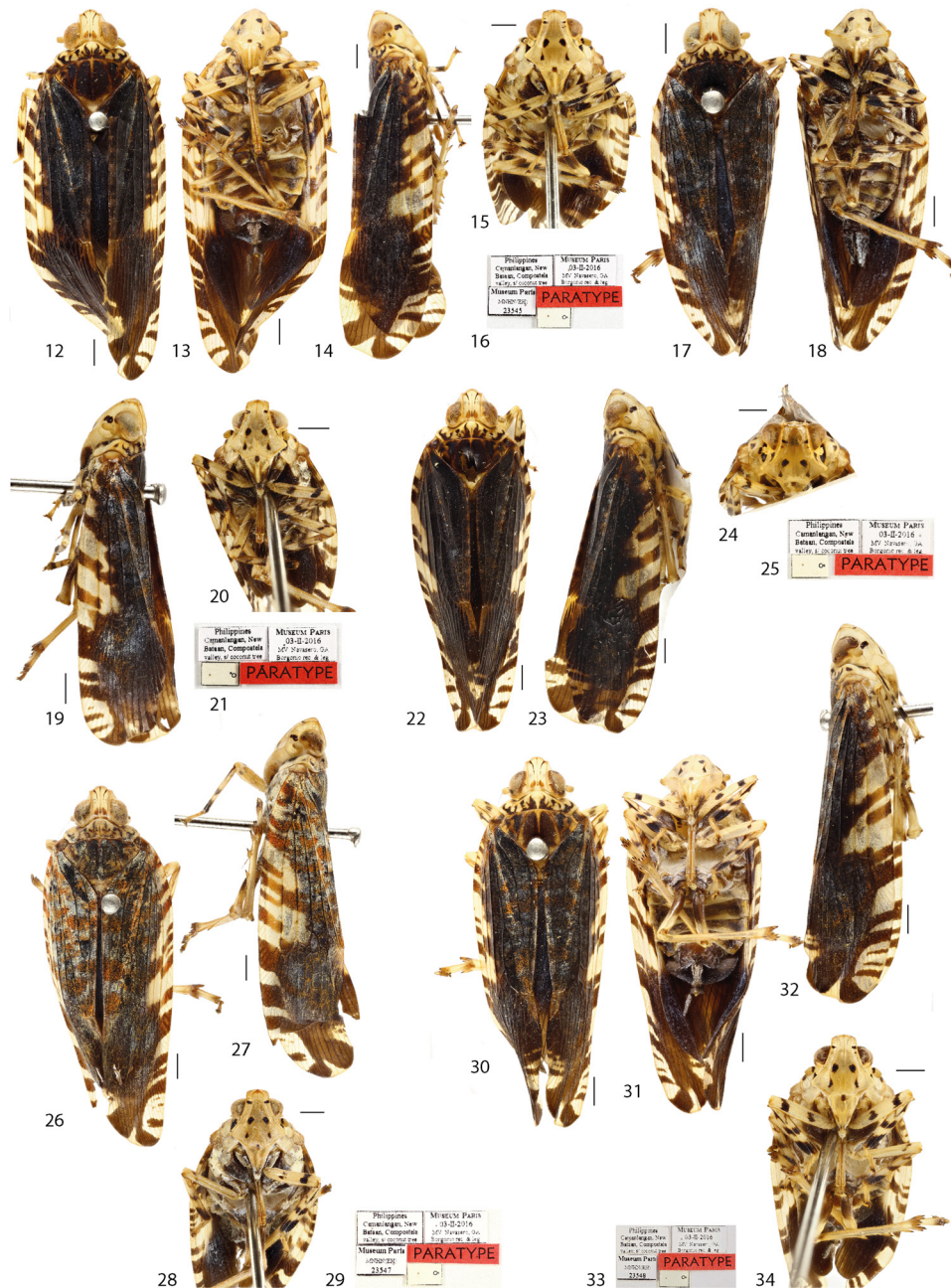
Description. Total length of male holotype: 1.17 cm (tegmina included), male paratype: 1.17 cm, female paratypes between 1.31 and 1.49 cm.

Head. In dorsal view, head 1.78 times wider across eyes than long in midline. Vertex 1.74 longer than wide, posterior margin almost straight, anterior margin V shaped, lateral margins posterior two-third parallel and last anterior third diverging slightly. In frontal view, frons 1.04 wider across the widest part at gena level than long in midline, fronto-vertex and fronto-clypeal margins slightly rounded and respectively convex and concave, lateral margins regular and underlining the pear-shaped frons, the widest area is sharply curved, sub-lateral and median carinae present but not reaching the fronto-clypeal suture. In lateral view, ocellus present located below compound eye and anteriorly to antennae, ocellar carinae absent, genal carinae present. Prothorax larger than head and 4.15 times wider than long in midline, longest length being in midline. Mesothorax 1.45 times wider than long in midline. Tegmina 3.12 longer than wide at midline, ScP+R(+MA) forking first, then CuA and finally MP, all forking before the end of clavus and respectively around 1/5, 1/3 and 1/2 of the total tegmina's length. Metatibiae bearing 3 lateral and 7 stout apical spines, first metatarsal segment bearing a series of apical spines organised in a triangular area, longer than cumulative length of second and third metatarsal segment, second segment reduced to a lobe without any spine.

Male terminalia. In lateral view, anal tube elongated posteriorly, 5.25 times longer than its biggest thickness measured just before the epiproct insertion, ventral margin developed just before the apex into an irregular tooth shaped extension pointing postero-ventrally. Pygofer with dorso-posterior margin largely and regularly rounded, posterior margin clearly inverted S shaped, posterior and ventral margin meeting in a sharp acute angle. Gonostylus with dorsal margin developing on its 2/3 posterior length a regular dorso-anterior oriented hook shaped extension, just posterior to the hook, the dorsal margin is curved ventrally, ventral margin roughly straight and posterior margin generally convex and irregularly curved. Periandrium with dorsal margin starting horizontally and bending up to its half at 90° and finishing in a rounded lobe, ventral margin curving as well and finishing dorsally in a hillock. Aedeagus bearing a ventral posterior process sickle-shaped and a short ventral anterior process strongly bent and pointing ventrally.



FIGURES 5–11. *Virgilia cocovora* n. sp., holotype. **5** Habitus, dorsal view. **6** Habitus, lateral view. **7** Frons and clypeus, anterior view. **8** Labels. **9** Anal tube, pygopher and gonostylus, lateral view. **10** Aedeagus s.l., lateral view. **11** Aedeagus s.s., lateral view.



FIGURES 12–34. *Virgilia cocovora* n. sp., paratypes. 12–16 female MNHN(EH)23545 12 Habitus, dorsal view. 13 Habitus, ventral view 14 Habitus, lateral view 15 Frons and clypeus, anterior view 16 Labels. 17–21 male 17 Habitus, dorsal view. 18 Habitus, ventral view 19 Habitus, lateral view 20 Frons and clypeus, anterior view 21 Labels. 22–25 female 22 Habitus, dorsal view 23 Habitus, lateral view 24 Frons and clypeus, anterior view 25 Labels. 26–29 female MNHN(EH)235457 26 Habitus, dorsal view 27 Habitus, lateral view 28 Frons and clypeus, anterior view 29 Labels. 30–34 female MNHN(EH)23548 30 Habitus, dorsal view. 31 Habitus, ventral view 32 Habitus, lateral view 33 Labels 34 Frons and clypeus, anterior view.

Colour. Generally brownish and cream with ochre powdery colour on tegmina that tend to disappear on specimens preserved in the collections. Head cream coloured with: on the vertex, a median discrete carina underlined in brown, two brown lines comma shaped close to the anterior margin and two yellowish-brown patches closes to the posterior margin; on the frons, 3 brown-black dots on each side along the sub-lateral carinae; on the clypeus that tend to get darker toward its apex, a brown patch in the middle, just below the fronto-clypeal suture; on each gena, a circular brown patch around the ocellus. Prothorax mixed with cream and brown with the cream more abundant along the anterior margin and the brown along the posterior margin, mesothorax brown and apex of metathorax cream. Tegmina dominantly dark brown with a series of 7-8 cream lunula shaped areas along the costal and radial margin that can be very small or larger and containing up to two dark stripes starting from the margin of

the tegmina, one lunula on the apical margin in the medial area and one ultimate lunula on the margin on the anterior cubital area. Profemur with two dark brown transversal stripes.

Etymology. The species name is built using the first four letters of coconut “coco”, plant on which the specimens were collected and found feeding and the Latin word “vorare” meaning to devour.

***Virgilia imuganensis* Soulier-Perkins sp. nov.**

(Figs 35–43)

Type material. Male holotype: Philippines: Luzon, Imugan MNHN(EH)23937 (MNHN).

Paratype: 1♂?. [Imugan Luzon], [coll. Dr D. Mac Gillavry], [Zoology Museum collection Amsterdam], 1♂? (ZMA).

Distribution. Philippines, Luzon Island (Fig. 65)

Diagnosis. Easy to recognise from the other three *Virgilia* by the coloration of its frons, it bears line of brown colour only along the median and the sub-lateral carinae (Fig. 4), the three running stripes meet at the edge of the fronto-vertex margin, when *V. cocovora* bears six brown spots (Fig. 2), *V. luzonensis* has two patches and a stripe (Fig. 2) and *V. nigropicta* a single large patch, half-moon shaped, touching the fronto-clypeal margin (Fig. 3).

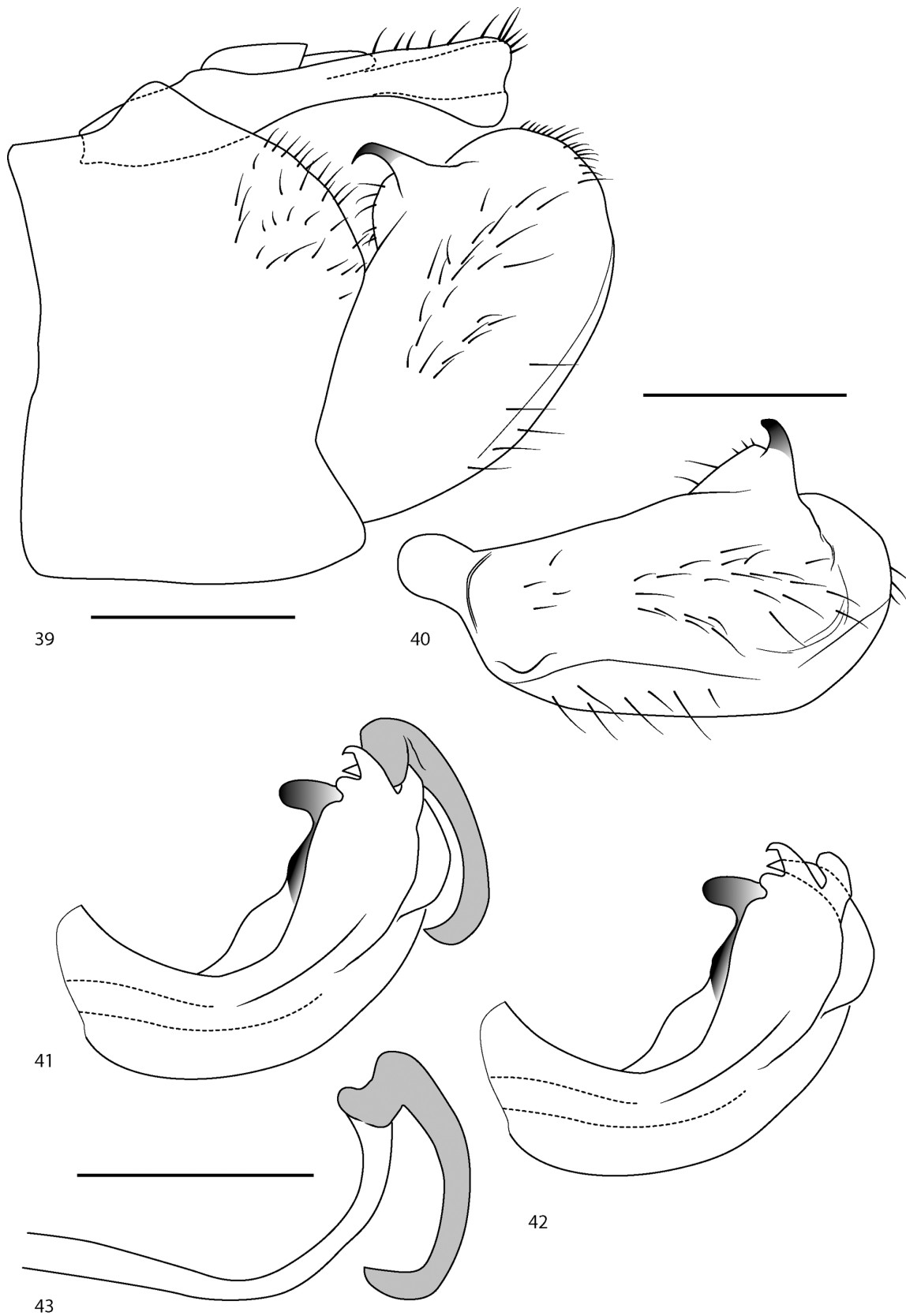
Description. Total length of male holotype: 1.08 cm (tegmina included)



FIGURES 35–38. *Virgilia imuganensis* n. sp., holotype. **35** Habitus, dorsal view. **36** Habitus, lateral view. **37** Frons and clypeus, anterior view. **38** Labels.

Head. In dorsal view, head 1.7 times wider across eyes than long in midline. Vertex 1.68 longer than wide, posterior margin concave, anterior margin V shaped, lateral margins posterior curving slightly at the eyes level and lateral margins elevated (Fig. 35). In frontal view, frons 1.02 wider across the widest part at gena level than long in midline, fronto-vertex margin slightly concave, fronto-clypeal margin almost straight, lateral margins regular and underlining the pear-shaped frons, the widest area is sharply curved, sub-lateral and median carinae present but not reaching the fronto-clypeal suture (Fig. 37). In lateral view, ocellus present located below compound eye and anteriorly to antennae, ocellar carinae absent, genal carinae present (Fig. 36). Prothorax larger than head and 4.41 times wider than long in midline. Mesothorax 1.55 times wider than long in midline. Tegmina 2.7 longer than wide at midline, ScP+R(+MA) forking first, then CuA and finally MP, all forking before the end of clavus and

respectively around 1/6, 1/3 and 2/5 of the total tegmina's length. Metatibiae bearing 3 lateral and 9 stout apical spines, first metatarsal segment bearing a series of apical spines organised in a triangular area, longer than cumulative length of second and third metatarsal segment, second segment reduced to a lobe without any spine.



FIGURES 39–43. *Virgilia imuganensis* n. sp., holotype, lateral view **39** Anal tube, pygopher and gonostylus. **40** gonostylus. **41** Aedeagus s.l. **42** Periandrium. **43** Aedeagus s.s.

Male terminalia. In lateral view, anal tube elongated posteriorly, 5.14 times longer than its biggest thickness measured just before the epiproct insertion, narrowing at epiproct and paraproct level, ventral margin developed before the apex into a regular rounded extension pointing ventrally (Fig. 39). Pygofer with dorsal margin elevated medially, hiding the anterior part of anal tube then truncated posteriorly, posterior margin indented anteriorly in its third lowest portion, posterior and ventral margin meeting in a rounded angle, anterior margin almost straight (Fig. 39). Gonostylus with dorsal margin developing on its 3/4 posterior length a dorsal extension rounded anteriorly and hook shaped, posterior to the hook, the dorsal and posterior margin rounded regularly, ventral margin gently rounded (Figs 39–40). Perianthrium with dorsal margin curving up and finishing in its median part apically by a thumb shaped extension oriented anteriorly and on both sides by two extensions, the first, hook shaped and oriented median anteriorly and the second rounded and hidden by the aedeagus ventral process, ventral margin very regularly curved and finishing apically by a pair of sharp processes oriented dorso-anteriorly (Figs 41–42). Aedeagus bearing a ventral anterior process curving down and with its apex pointing anteriorly, ventral posterior process absent (Fig. 43).

Colour. Generally brownish and cream. Head cream with: on the vertex, median carina underlined in brown on its 1.3 anterior part and two brown patches on the half posterior area (Fig. 35); on the frons, 3 brown-black stripes underlining the median and sub-lateral carinae; clypeus cream bearing medially a brown longitudinal stripe (Fig. 37); on each gena, a large brown patch stretches from below the compound eye down to the frontal suture, symmetrically a brown patch stretches from above the compound eye to the vertex carina (Fig. 36). Prothorax cream with only the posterior margin slightly underlined in brown, meso- and metathorax browns. Tegmina with basal 2/3 dominantly dark brown with 2 cream lunula shaped areas along the costal margin, posterior margin of this area cut toward the start of the radial margin; last third of the tegmina dominantly cream with a large brown band crossing from the areola postica to the radial margin plus a series of 4 brown patches of stripes starting on the margin and reaching or not this band. Profemur with 1 dark brown transversal stripe, mesofemur cream, pro- and mesotibias brown along the external margins and apically, metafemur brownish and metatibia cream except for the tips of spines.

Etymology. The species is named after the place where it was found: Imugan located South-East in the Cagayan Valley region on Luzon.

***Virgilia luzonensis* Baker, 1925**

(Figs 44–56)

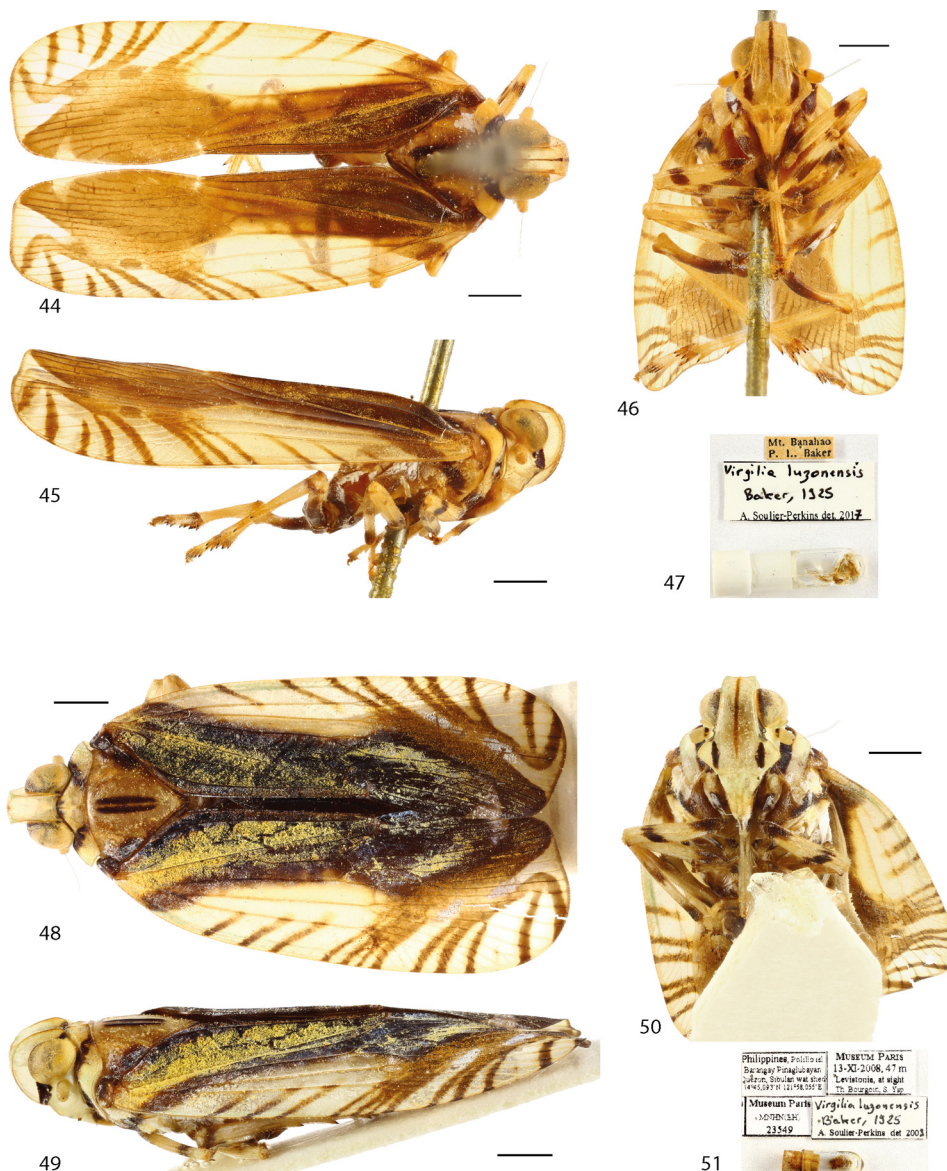
Virgilia luzonensis Baker, 1925: 282, pl. IV, fig. 11 (description)

We provide here for the first time, an illustrated description of male terminalia (Figs 52–55) and female terminalia (Fig. 56) for *V. luzonensis*. The illustrated specimen belongs to Baker's collection and type series, collected on Mount Banahao in Laguna Province on Luzon (Figs 44–47). Pictures of the habitus are provided as well for a specimen collected more recently, in 2008 (Figs 48–51), on which the colourations are less faded.

Type material. Syntypes: 24♂?, 23♀?, 1?. [Mt. Banahao, P. I. Baker], red label hand written: [*Virgilia luzonensis* Baker] 1♀? (FSCA). [Mt. Banahao, P. I. Baker] 22♀?, 24♂? & 1? (FSCA).

Other examined material. Specimens: 15♂?, 5♀?, 1?. [Philippines, Polillo Isl, Barangay Pinaglubayan, Quezon, Sibulan Water Shed, 14°45,093' N, 121°58,05' E], [Museum Paris, 12.XI.2008, 47m, *Levistonina*, *Pandanus*, at sight, A. Soulier-Perkins & S. Yap rec.], 4♂? MNHN(EH) 23813-23816; [Museum Paris, 13.XI.2008, 47m, *Levistonina*, at sight, A. Soulier-Perkins & S. Yap rec.] 3♂? MNHN(EH) 23817-23819 & 1? MNHN(EH) 23820; [Museum Paris, 12.XI.2008, 47m, *Levistonina*, *Pandanus*, at sight, T. Bourgoïn & S. Yap rec.], 6♂? MNHN(EH) 23821-23826 & 2♀? MNHN(EH) 23828-23829; [Museum Paris, 13.XI.2008, 47m, *Levistonina* at sight, T. Bourgoïn & S. Yap rec.], 1♂? MNHN(EH) 23549; [Philippines, Polillo Isl, Barangay Pinaglubayan, Quezon, Sibulan Water Shed, 14°44,420' N, 121°57,529' E], [Museum Paris, 10.XI.2008, 55m, rainforest beating at sight, T. Bourgoïn & S. Yap rec.], 1♂? MNHN(EH) 23827; [Philippines, Polillo Isl, Barangay Pinaglubayan, Quezon, Sibulan Water Shed, 14°44,590' N, 121°57,38' E], [Museum Paris, 10.XI.2008, 70 m, rainforest beating at sight, T. Bourgoïn & S. Yap rec.], 1♀? MNHN(EH) 23830; [Philippines, Luzon UP Land Grant, Barangay Saray, Pakil, Laguna, N14°24'07", E 121°32'42"], [Museum Paris, forêt, 373 m, 12.XI.2010], 1♀? MNHN(EH) 23831 (MNHN). [Philippine Is., Mt Makiling, 2-7.III.1960], [T.C. Maa collector Bishop], 1♀? (BPBM)

Distribution. Philippines, Luzon and Polillo Islands (Fig. 65).



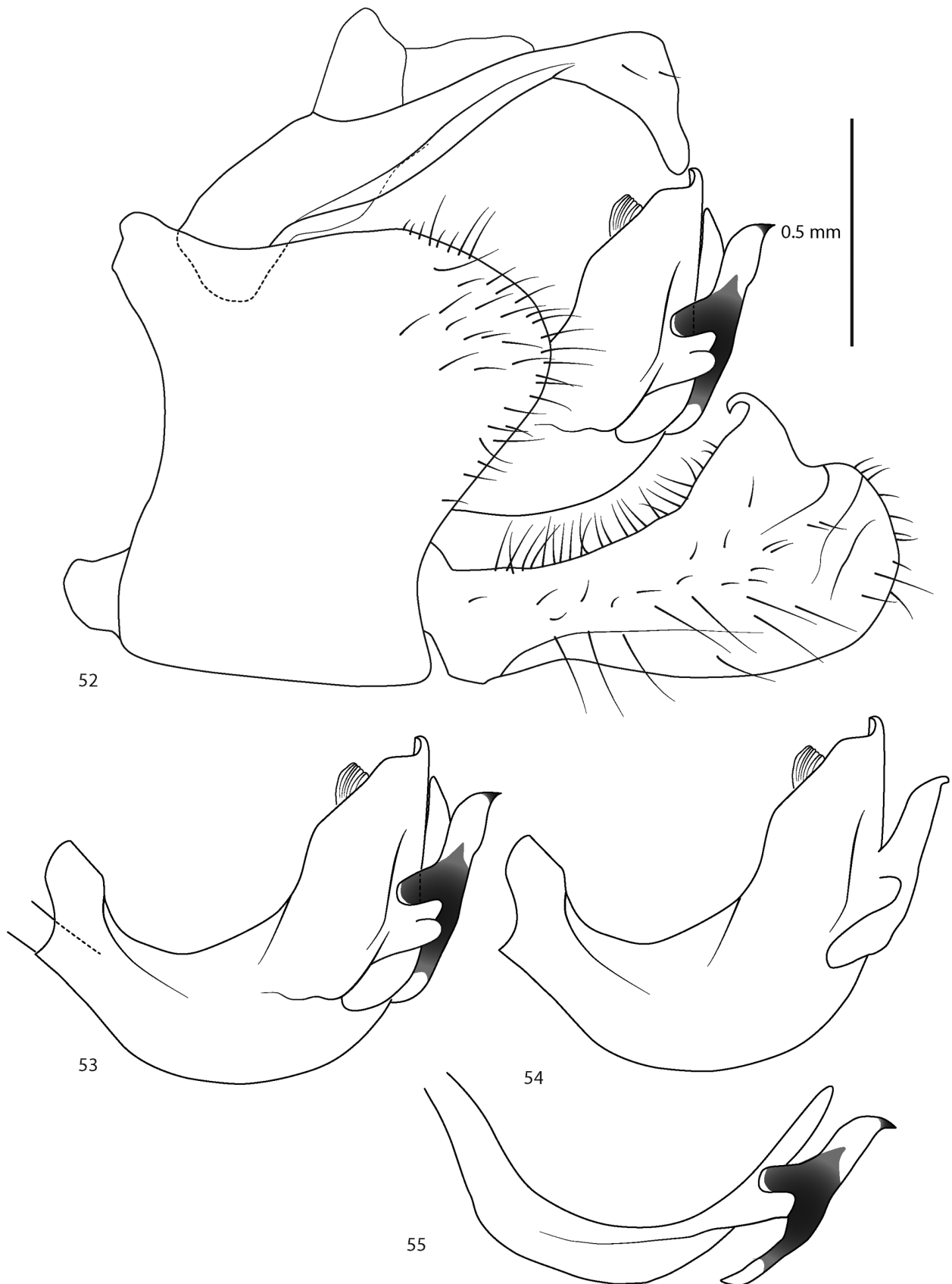
FIGURES 44–51. *Virgilia luzonensis*. 44–47 male from Baker’s type series collection 44 Habitus, dorsal view 45 Habitus, lateral view 46 Frons and clypeus, anterior view 47 Labels. 48–51 male MNHN(EH)23549 48 Habitus, dorsal view 49 Habitus, lateral view 50 Frons and clypeus, anterior view 51 Labels.

***Virgilia nigropicta* Stål, 1870**
(Figs 57–64)

Virgilia nigropicta Stål, 1870: 753, Tab. IX, fig. 29 (description); Melichar 1915: 378 (additional description); Baker 1925: 282, Pl. IV, fig. 10 (additional description and illustrations)

In 1870, when Stål described *V. nigropicta* from Semper’s collection, he provided a drawing of the habitus. The type was supposed to be a male but was not dissected. However, from the habitus drawing, since the wings are spread and the body visible, we can clearly identify the specimen as being a female by the shape of the anal tube, typical of the genus as figured for the female terminalia of *V. luzonensis* (Fig. 56), specimen selected from Baker’s collection. According to Stål’s description, Baker identified a specimen as *V. nigropicta* from Surigao, which he assumed to be near the type locality. The specimen is a female. We found male specimens in the BPBM collections fitting with both Stål and Baker descriptions and coming from Esperanza, which is south to Surigao on the Mindanao Island. We illustrate here one specimen (Figs 57–61) and provide illustrations for the male terminalia

(Figs 62–64). Some additional material examined come from a region further west on the island, near the lake Lanao.



FIGURES 52–55. *Virgilia luzonensis*, lateral view. **52** Male terminalia **53** Aedeagus s.l. **54** Periandrium **55** Aedeagus s.s.

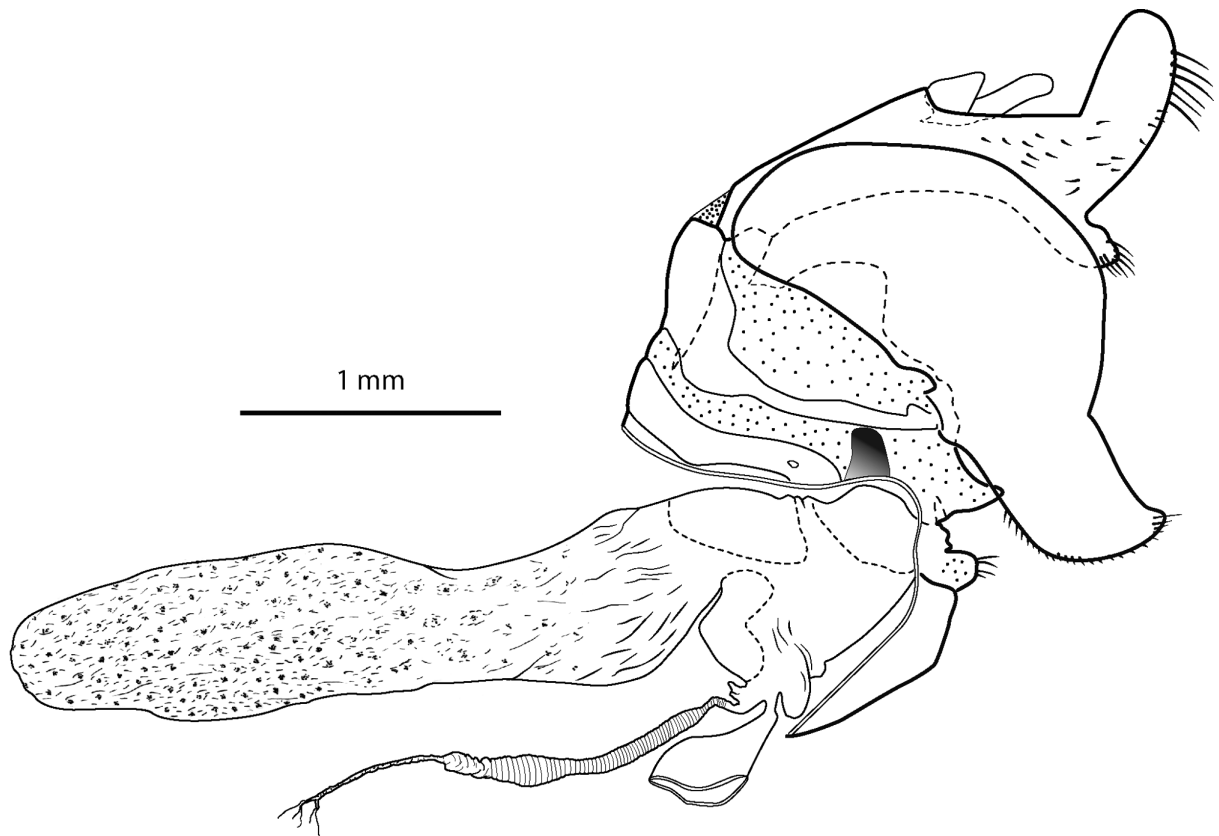
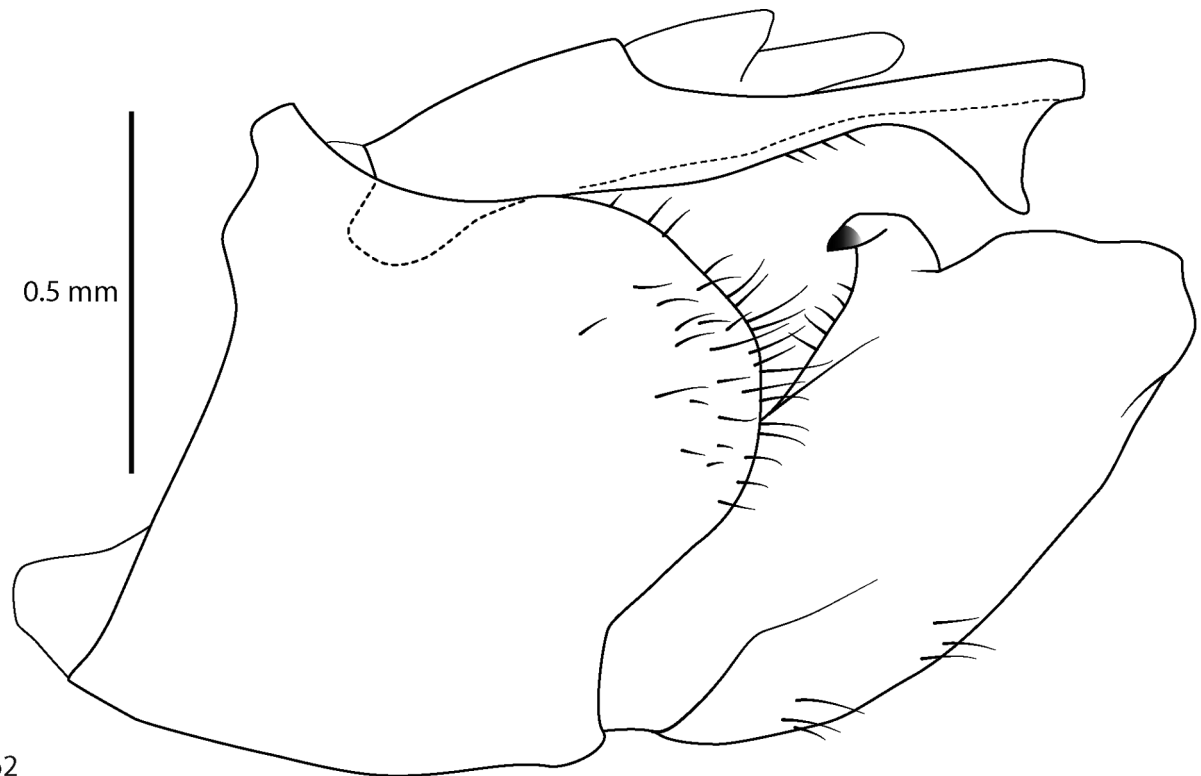


FIGURE 56. *Virgilia luzonensis*. Specimen from Baker's type series collection, female terminalia, lateral view.



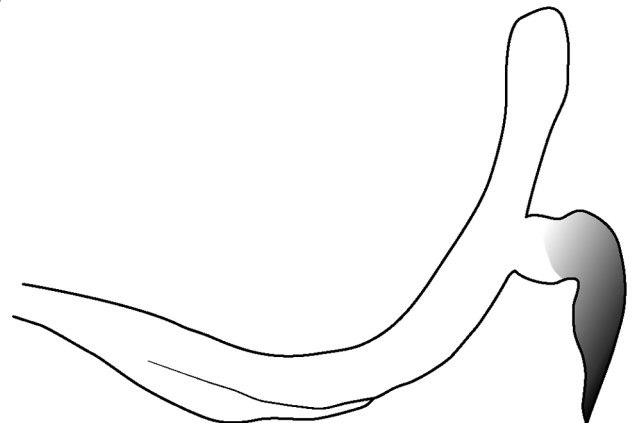
FIGURES 57–61. *Virgilia nigropicta*. male from Baker's type series collection 57 Habitus, dorsal view 58 Habitus, ventral view 59 Habitus, lateral view 60 Frons and clypeus, anterior view 61 Labels.



62



63



64

FIGURES 62–64. *Virgilia nigropicta*, on lateral view. **62** Male Anal tube, pygopher and gonostylus **63** Aedeagus s.l. **64** Aedeagus s.s.

Examined material. Specimens: 5♂?, 5♀?. [Surigao, Mindanao, Baker], [*Virgilia nigropicta* Stal], 1♀? (FSCA). [Philippines: Mindanao I: Agusan: Esperanza: Bagugan: Matibog Creek, 300m 7.XI.1959], [C.M. Yoshimoto collector] 3♂? (BPBM). [P.I., Mindanao, Agusan, Los Arcos, 19-23.XI.1959], [C.M. Yoshimoto collector, Bishop Museum] 1♀? (BPBM). [P.I., Mindanao, Lanao, Gurain Mts., 1380m, 16.VI.1958], [H.E. Milliron collector], 1♀? (BPBM). [P.I., Mindanao, Lanao, Gurain Mts., 1380m, 16.VI.1958], [H.E. Milliron collector], 1♀? MNHN(EH) 23832 & 1♂? MNHN(EH) 23833 (MNHN). [Surigao, Mindanao], [*Virgilia nigropicta* det. M.R. Wilson, 1992], 1♂? MNHN(EH) 23938 & 1♀? MNHN(EH) 23939 (MNHN).

Distribution. Philippines, Mindanao Island (Fig. 65).

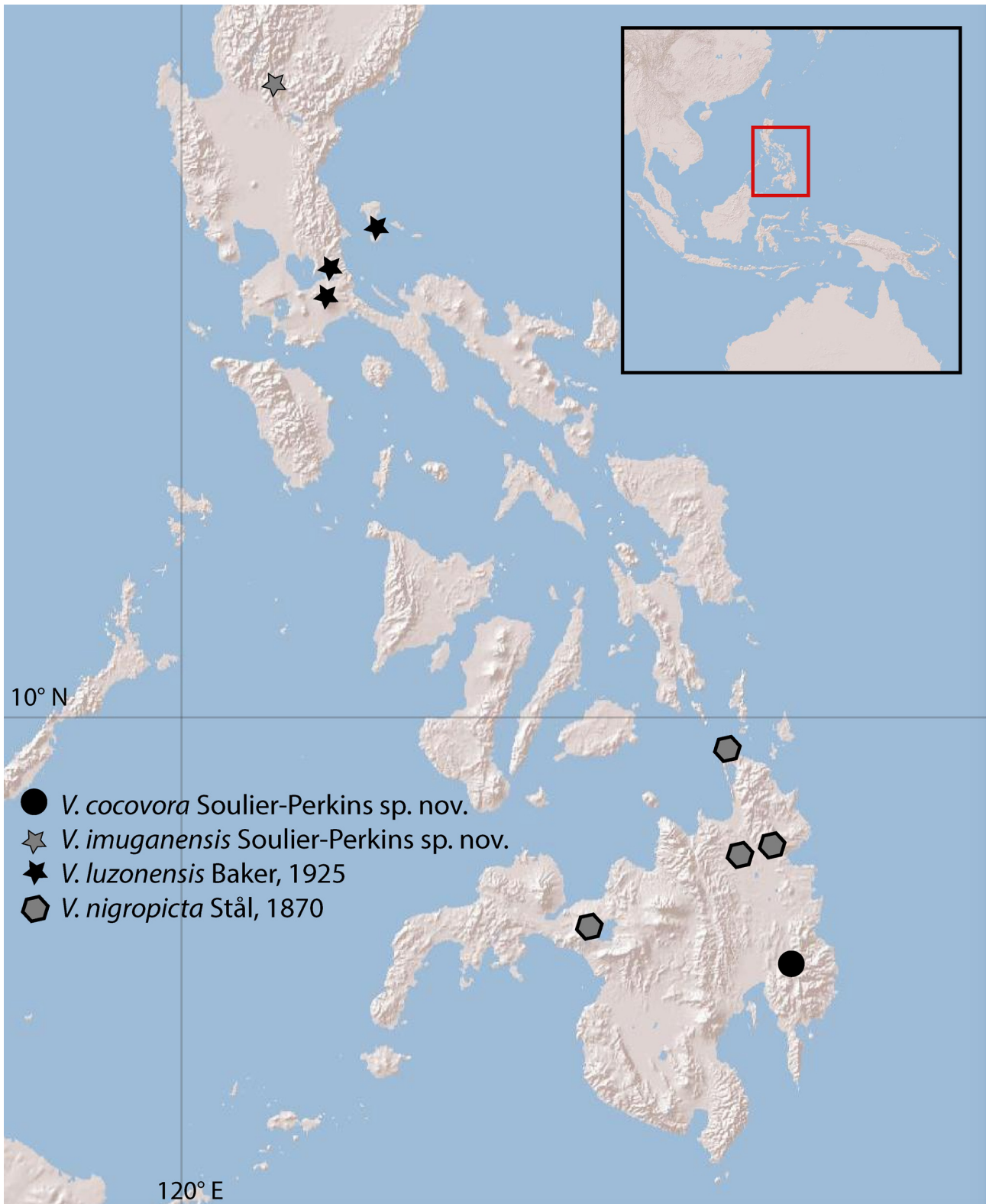


FIGURE 65. Distribution map.

Discussion

The two Lophopidae species known for causing damage on palms do not appear to transmit diseases but are involved because of their feeding action. *Z. butawengi*, is feeding on the palm fronds and prefers to feed in the tough tissue of the petiole, mid-veins and leaf veins rather than in the lamina (Howard *et al* 2001). The plant tissues

are destroyed due to the mechanic action of the stylets and possibly the injection of some toxin contained in its saliva (Gitau et al. 2011). It is responsible for the yellow-bronzing of fronds with the chlorotic symptoms appearing at the tips and progressing toward the petiole. The advanced symptoms lead to the death of the frond. Another reported species that is important on palms is *P. simmondsi*, which is associated with a condition similar to Finschhafen disorder in the Solomon Islands (Stapley 1976, 1978; Wilson 1988). On sugarcane, the problem is slightly different with *P. perpusilla*. The nymphs and the adults suck the phloem of the plant as well and excrete some honeydew onto which fungi grow, leading to a reduction of plant photosynthesis affecting its sugar quality.

In February 2016, an unknown species of Lophopidae was reported and found in large number on coconut trees. According to Navasero *et al.* (2016), the symptoms observed were characterized by yellowing from tip to near base of leaflets on affected fronds (Fig. 66). Leaves with more advanced symptoms appeared brownish to brown in colour. The yellowing of the leaflets was followed by lateral necrosis, the leaves gradually turning brown then drying up (Fig. 68). Damaged fronds had presence of profuse growth of sooty moulds (Fig. 67), and severely damaged trees showed reduced nut production. These symptoms exhibited by the coconut trees when infested with *V. cocovora* **sp. nov.** look similar to those of palm trees infested with *Z. butawengi*. Also, maybe due to the excretion of the honeydew, sooty moulds have grown on the fronds. Due to its feeding behaviour, *V. cocovora* **sp. nov.** appears therefore to damage the plant tissue, making it vulnerable to drying and lowering of the plant vigour.



FIGURES 66–68. Damages on coconut tree. **66** Yellowing of the affected fronds **67** Development of sooty moulds **68** leaves turning brown and drying up.

Acknowledgments

Thanks to Mr Laurent Fauvre (MNHN, Paris) who took the pictures to illustrate the four species of the genus.

References

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