

A NEW LOPHOPID GENUS IN THE BIOGEOGRAPHIC MOZAIC OF THE FAMILY (HEMIPTERA: FULGORMORPHA: LOPHOPIDAE)

ADELINE SOULIER-PERKINS¹ and ADAM STROIŃSKI²

¹*Muséum national d'Histoire naturelle, Mécanismes adaptatifs et évolution, MECADEV-UMR 7179 MNHN-CNRS, Sorbonne Universités, 57 rue Cuvier, CP 50, F-75005 Paris, France; e-mail: soulier@mnhn.fr*

²*Museum and Institute of Zoology, Polish Academy of Sciences, 64 Wilcza Street, PL00-679 Warsaw, Poland; e-mail: adam@miiz.waw.pl*

Abstract.— A new genus and species *Panegu linnavuorii* **gen. et sp. nov.** are described and illustrated. The species is described from a single male specimen. The genus is placed as *incertae sedis* in the Lophopidae.



Key words.— Papua New Guinea, new species

INTRODUCTION

The Rossel Island, called as well Yela, is a small island in the Pacific Ocean not longer than 37 km and 16 km wide. It belongs to the Louisiade archipelago (Papua New Guinea) and stretches out to 370 km southeast from the New Guinea's coastline. Actually, 45 genera are described for the Lophopidae, 5 of which are fossils (Bourgoin 2016). Eight genera are present on the New Guinea island: *Lophops* Spinola, 1839, which is a cosmopolitan genus and *Kasserota* Distant, 1906, *Megacarna* Baker, 1925, *Zophiuma* Fennah, 1955, *Maana* Soulier-Perkins, 1998, *Jugoda* Melichar, 1915, *Acarina* Stål, 1863 and *Onycta* Fennah, 1955 that are restricted to New Guinea and to several small closely located islands. Phylogenetic analyses showed that four main lineages can be recognized, Carriona⁺ group with its only representative *Carriona* Muir, 1931, Makota⁺, Sarebasa⁺ and Bisma⁺ (Soulier-Perkins 2001). According to Emeljanov (2013), the genus should be placed within the Menoscinae. However, the placement of the new genus, described here, is given at minima only to family level as we expect it should be a monophyletic lineage for the reason advocated in

Wang *et al.* (2016a). In order to place the new genus described here correctly, a new phylogeny of the family should be undertaken but for now, from many Asian countries and Austral-Asian islands, many genera and species of the family have to be described first, as shown for China in Wang *et al.* (2016b).

MATERIAL AND METHODS

Preparation and observation

The abdomen of the specimen examined was cut off and cleared for 10 minutes in warm (50°C) 10% KOH. Dissections and cleaning of genital structures were performed in distilled water. Final observations were made in glycerin using Olympus stereomicroscope (SZH10). The photos of the habitus were taken using a stereomicroscope Leica MZ 16 with IC3D digital camera; final images were produced using Helicon Focus 5.0 software. The SEM photographs of uncoated specimen were taken in the Laboratory of Scanning Microscopy, MIZ PAS (Warsaw), using a scanning microscope HITACHI S-3400N under Low Vacuum conditions.

Measurements and abbreviations

The following proportions of measurements were made and abbreviations used in this study:

Total length – measured (in dorsal view) from the apex of head protrusion to the apex of tegmina,

A/B – width of vertex measured at posterior margin/length of vertex measured at midline,

C/E – width of frons in upper margin/length of frons at midline,

D/E – maximum width of frons/length of frons at midline,

F/B – length of pronotum at midline/length of vertex at midline,

G/F – length of mesonotum/length of pronotum at midline,

G/B+F – length of mesonotum/cumulative length of vertex and pronotum at midline,

G/H – length of mesonotum at midline/width of mesonotum between lateral angles,

I/J – length of tegmen measured from the base to the apical margin in median portion/width of tegmen measured from the apex of clavus to the anterior margin.

Terminology follows Bourgoïn (1988) and Bourgoïn and Huang (1990) for male genitalia and Bourgoïn *et al.* (2015) for the forewing venation.

TAXONOMY

Order Hemiptera Linnaeus, 1758

Suborder Fulgoromorpha Evans, 1946

Superfamily Fulgoroidea Latreille, 1807

Family Lophopidae Stål, 1866

Panegu gen. nov.

(Figs 1–57)

Type species. *Panegu linnavuorii* sp. nov., here designated.

Etymology. The generic name was formed with the first two letters of each word of Papua New Guinea. Since the termination of the name is in “u”, this genus is neutral.

Diagnosis. The presence of protuberance just below the upper margin of frons can be observed only in genera *Bisma* Distant, 1906, *Zelega* Melichar, 1915 and *Panegu* gen. nov., but out of these three genera only *Panegu* possesses discontinuous lateral margins of the frons (Figs 5–6, 15–17). It differs from all other lophopids with clypeus bearing median carina bifurcate just below frontoclypeal suture (Figs 5–7,

18–19) dorso-posterior angle of pygofer with 2 processes and gonostylus bearing one spine and one process (Figs 46–48, 50–52).

Description. **Head.** Head width with compound eyes narrower than prothorax (Figs 1, 4, 9, 11). Vertex (Figs 1, 4, 11–14) extremely elongate, slightly narrowing apicad, apex rounded; all margins carinated, lateral margins strongly elevated; disc of vertex without median carina. Frons (Figs 5–6, 15–17) higher than wide, upper part distinctly narrower than lower one with widest part distinctly below the antennae, upper margin carinated, lateral margins carinated but partly incomplete in the lower part. Disc of frons tricarinated, carinae fused below upper margin forming protuberance; carinae obsolete and partly swollen, reaching to $\frac{3}{4}$ of frontal height.

Disc of vertex (with lateral margins elevated) in lateral view about the same level as surface of pro- and metathorax (Fig. 33); compound eyes elongate, medially ventral margin cut out and with small postero-ventral callus; ocelli absent, foramen of antenna reaching compound eyes, ocellar and genal carina present. Frontoclypeal suture arched and distinct. Clypeus below frontoclypeal suture depressed, without lateral carinae; median carina present and bifurcate just below the frontoclypeal suture; carinae of bifurcated branches partly obsolete, sensory area between branches present. Pedicel of antenna longer than wide; sensory plate organs of “folded flattened” type, surrounded by strong denticles, present on the whole pedicel and not organized in line; trichoboid sensilla of type 1 present on whole surface, of type 2 present only on ventral side (Figs 21–26). Rostrum with apex not reaching the level of meta-trochanter, apical segment distinctly shorter than subapical one (Figs 7, 36).

Thorax. Pronotum distinctly shorter than vertex and mesonotum at midline; disc of pronotum not produced anteriorly, with two dimples and slightly elevated lateral carinae connected anteriorly and nearly reaching posterior margin. Postocular carinae starting from the edge of posterior margin and diminish behind compound eyes. Mesonotum and scutellum shorter than wide, longer than vertex at midline and shorter than cumulative length of vertex and pronotum at midline; disc of mesonotum with a pair of parallel median carinae (weakly visible), area between median carinae concave; lateral carinae connected anteriorly and nearly reaching posterior margin of mesonotum. Legs: pro- and metathoracic legs flattened but not foliaceous (Figs 7, 36); both femora and tibiae about the same length; femora elongate, widened apicad; tibiae much more flattened and rounded than femora; prothoracic leg more flattened than mesothoracic one. Metathoracic leg with tibia longer than femur, bearing 2 lateral spines on its lower half and row of strong apical teeth (Figs 8, 37–38). First tarsal segment bearing about 10

apical spines organized in triangular area, first segment distinctly longer than cumulative length of the second and third segment. Second tarsal segment reduced to small lobe without any teeth (Figs 8, 37–38).

Male terminalia (Figs 39–57). Anal tube (Figs 39–42, 49) elongate with pair of apical lobes covering dorsal margin of gonostyli. Pygofer (Figs 39–48, 50–52) with dorsal margin prolonged posteriorly by two processes, rounded at apex; posterior margin almost straight, except upper part curved in; ventral margin straight and little longer than dorsal one. Gonostylus (Figs 46–48, 50–52) longer than wide with apex incised apically, upper lobe slightly folded inside and bearing medially short well-sclerotized spine oriented posteriorly; dorsal margin basally with hook-shaped process with well sclerotized apex and membranous part bearing setae. Periandrium (Figs 53–55) with dorsal part prolonged by a pair of well sclerotized processes with sharp apex laterally pointing dorsad; median lobe membranous, rectangle-shaped in dorsal view, bearing a pair of short, well-sclerotized processes nearly as long as the median lobe. Ventral part of periandrium regularly rounded ventrally with accentuation of the curve in the middle and finishing apically with a pair of elongated membranous lobes with sharp, sclerotized apex; membranous part with micro-sculpture. Ventral periandrium with pair of dorsally elongated processes large in $\frac{1}{3}$ lower part and thin and spatula-shaped at apex. Ventral periandrium bearing ventrally the second pair of sclerotized sharp processes oriented posteriorly, similar to auroch horns in ventral view.

Distribution. Rossel Island (Papua New Guinea).

Panegu linnavuorii sp. nov.
(Figs 1–57)

Etymology. Named after Rauno Linnavuori to whom it is dedicated.

Diagnosis. The unique character in this species is the shape of the ventral processes (anterior and posterior) of aedeagus (Figs 56–57): the anterior process is ovoid at base with a narrow and sharp posterior part, its ventral margin is denticulate; the posterior process is partly flattened with apex finishing with three teeth.

Description. **Head.** Vertex: proportion A/B = 3.1. Frons: proportion C/E = 0.2, proportion D/E = 0.65.

Thorax. Pronotum: proportion F/B = 0.42. Mesonotum G/F = 2.77, G/H = 0.72. Tegmen: proportion I/J = 3.14.

Male genitalia. Aedeagus with apex multilobed (Figs 56–57). Aedeagus, in lateral view, bearing a pair of antero-ventral processes oriented posteriorly; each process with ventral margin denticulate, ovoid base and narrowing sharply apical part. Postero-ventral processes of aedeagus partly flattened oriented dorsad with apex finishing in three teeth.

Coloration (Figs 1–6). Tegmina brownish with translucent triangular area along the second half part. Vertex brown, pronotum light brown with a lateral and median reddish patches, mesonotum light brown, frons yellowish with a median longitudinal red stripe prolonged on the median carina of clypeus. Lateral parts of head bearing a brown stripe joining the compound eye and apex of vertex, reddish patch between the ocellar carina and the longitudinal frontal carina. Pro- and mesothoracic legs reddish with tibia dark brown to black toward the apex. Metathoracic legs yellowish bearing brown spines with dark apex. Abdomen yellow, terminalia brown, posterior-dorsal process of pygofer dark brown to black.

Type material. Holotype, ♂: [PNG: NEW GUINEA: SE: Louisiade Archipelago: Yela I: Mt Rossel, 300–710 m, 16–17.III.1979], [Calophyllum], [W.C. Gagné, Coll. BISHOP Museum]. Specimen deposited in Bishop Museum.

Distribution. Rossel Island (Papua New Guinea).

DISCUSSION

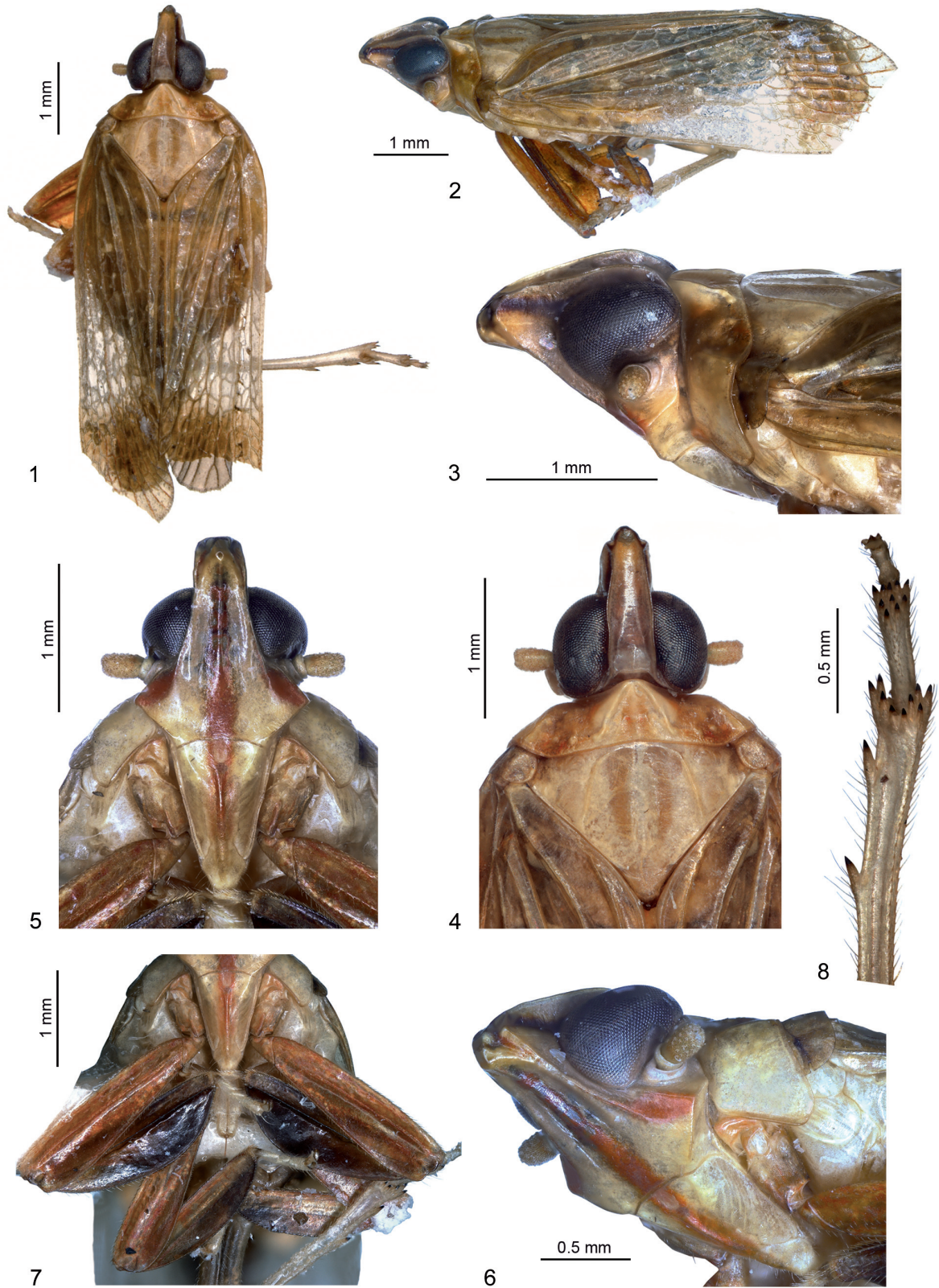
This species was collected from the genus plant *Calophyllum* Linné, 1753 that belongs to the family Calophyllaceae and order Malpighiales (Based on APG III). However, this information does not allow us to conclude for sure on the state of host plant for this plant, even if the specimen was collected on it, it is not mentioned clearly that the specimen was observed feeding on it. The Lophopidae are generally found on Arecales or Poales. If this genus is truly feeding on this Eudicot taxa, the switch of host plant would be very important. As this insect is living on a small island where the resources are limited and we cannot exclude such a switch, this adaptation may have undergone throughout a comparable process of diet relaxation as shown for the Tropiciduchidae *Montrouzierana* Signoret, 1861 (Wang *et al.* 2014). According to the actual characters (unique set) observed for this species and genus, it is placed in the Lophopidae and its placement within one of the actual clades is not consistent for now and a cladistics analysis is required in order to find its sister group. Specimens of Lophopidae are hard to be collected but the representatives of this family seem to be very diverse throughout the Sundaland and up to the islands as far into the Pacific as the Samoa islands. Coming just after the description of two other genera *Venisiella* Stroiński et Soulier-Perkins, 2015 and *Binaluana* Soulier-Perkins et Stroiński, 2015 (Stroiński and Soulier-Perkins 2015; Soulier-Perkins and Stroiński 2015) respectively from the Fiji and Palawan islands, this third new genus illustrates how few we still know about the diversity of planthoppers and particularly the Lophopidae.

REFERENCES

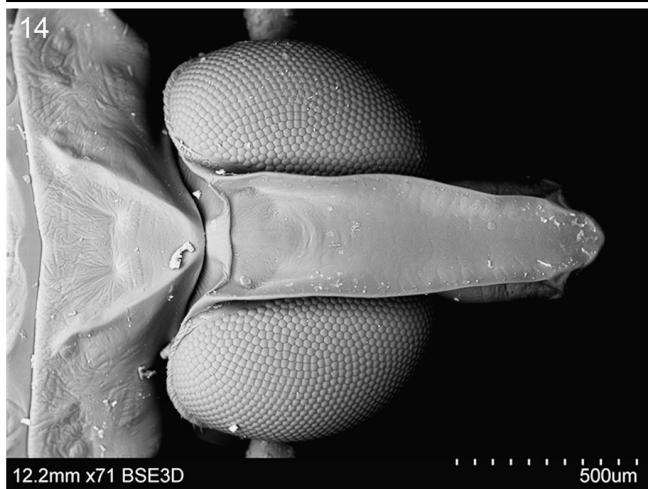
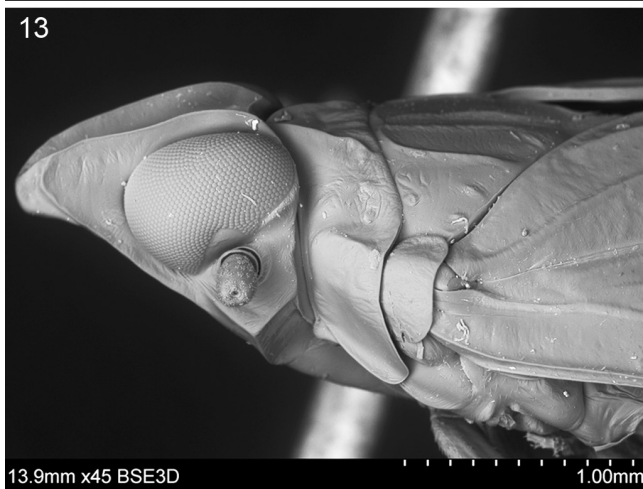
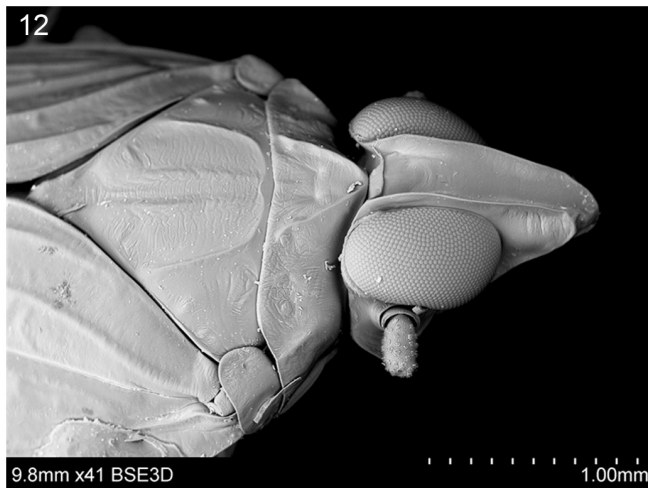
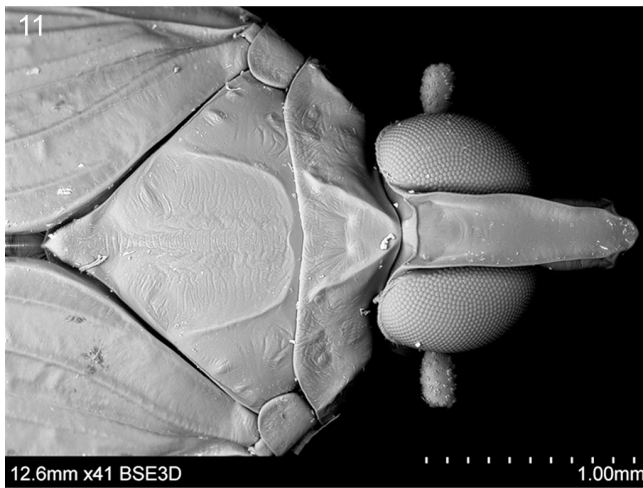
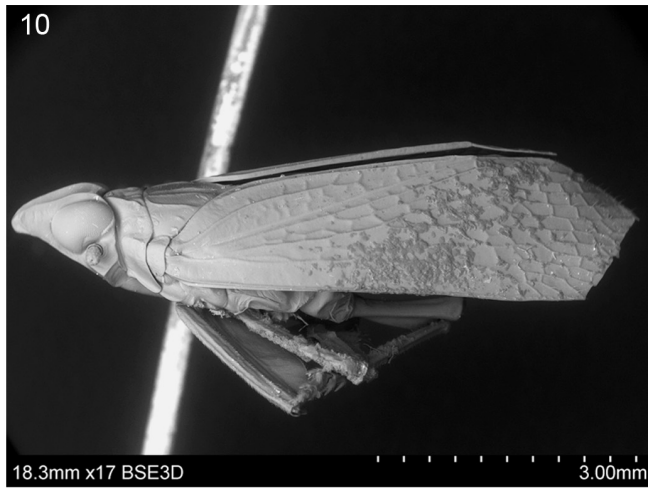
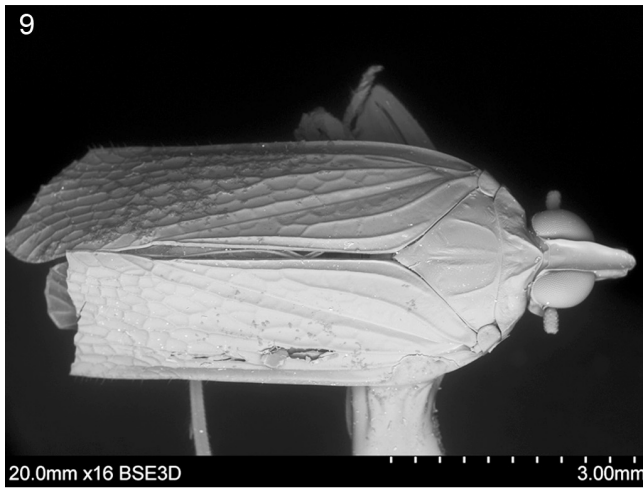
- Baker, C. F. 1925. Some Lophopidae (Fulgoroidea) of the Indo-Malayan and Papuan regions. *Treubia*, 6: 271–296.
- Bourgoin, T. 1988. A new interpretation of the homologies of the Hemiptera male genitalia, illustrated by the Tettigometridae (Hemiptera: Fulgoromorpha). *In*: Vidana C. & Arzone A. (eds): Proc. 6th International Auchenorrhyncha Congress, Turin, Italy, 7–11 Sept. 1987. CNR-IPRA, Turin: 113–120 pp.
- Bourgoin, T. and J. Huang, 1990. Morphologie comparee des genitalia males des Trypetimorphini et remarques phylogenetiques (Hemiptera: Fulgoromorpha: Tropiduchidae). *Annales de la Société Entomologique de France*, 26(4): 555–564.
- Bourgoin, T., Wang R.-R., Asche, M., Hoch, H., Soulier-Perkins, A., Stroiński, A., Yap, S. and J. Szvedo. 2015. From micropterism to hyperpterism: recognition strategy and standardized homology-driven terminology of the forewing venation patterns in plant hoppers (Hemiptera: Fulgoromorpha). *Zoomorphology*, 134: 63–77.
- Bourgoin, T. 2016. FLOW (Fulgoromorpha Lists on The Web): a world knowledge base dedicated to Fulgoromorpha. Version 8 [19/05/2016]. <http://www.hemiptera-databases.org/flow/>
- Distant, W. L. 1906. The fauna of British India, including Ceylon and Burma. Rhynchota. Vol. III (Heteroptera-Homoptera). Lt.-Col. C. T. Bingham (Ed.): 503 pp.
- Distant, W. L. 1906. Rhynchotal notes. XI. *Annals and Magazine of Natural History (Ser. 7)*, 18: 349–356.
- Emeljanov, A. F. 2013. On the Subdivision of the Family Lophopidae (Homoptera, Auchenorrhyncha: Fulgoroidea) on the Subfamilies and Tribes with Description of Two New Tribes. *Entomological Review*, 94(2): 208–210.
- Fennah, R. G. 1955. New and little-known Lophopidae and Issidae from Australasia (Homoptera : Fulgoroidea). *Proceedings of the Royal Entomological Society of London (B)*, 24: 165–173
- Melichar, L. 1915. Monographie der Lophopinen. *Annales Historico-Naturales Musei Nationalis Hungarici*, 13: 337–385.
- Muir, F. A. G. 1931. New and little-known Fulgoroidea from South America. *Proceedings of the Hawaiian Entomological Society*, 7: 469–480.
- Soulier-Perkins, A. 1998. The Lophopidae (Hemiptera : Fulgoromorpha): Description of three new genera and key to the genera of the family. *European journal of entomology*, 95: 599–618.
- Soulier-Perkins, A. 2001. The phylogeny of the Lophopidae (Hemiptera, Fulgoromorpha) and the impact of sexual selection and coevolutionary sexual conflict. *Cladistics*, 17: 1–24.
- Soulier-Perkins, A. and A. Stroiński. 2015. A new lophopid genus as another piece in the biogeographical history puzzle of the family in the Sunda Shelf (Hemiptera: Fulgoromorpha: Lophopidae). *Zootaxa*, 4006(3): 586–600. <http://dx.doi.org/10.11646/zootaxa.4006.3.10>
- Spinola, M. 1839. Essai sur les Fulgorelles, sous-tribu de la tribu des Cicadaïes, ordre des Rhyngotes. (Suite). *Annales de la Société Entomologique de France*, 8: 339–454.
- Stål, C. 1863. Hemipterorum exoticorum generum et specierum nonnullarum novarum descriptiones. *Transactions of the Entomological Society of London (Ser. 3)*, 10: 571–603.
- Stroiński, A. and A. Soulier-Perkins. 2015. A new lophopid genus (Hemiptera: Fulgoromorpha) corroborates the family phylogeny and historical biogeography. *Annales Zoologici*, 65(2): 269–285. doi: 10.3161/00034541ANZ 2015.65.2.009
- Wang, M. L., Wang, Y. L. and A. Soulier-Perkins. 2016a. Neither Menoscinae nor Lophopinae, a new genus that challenges the current classification of the Lophopidae Stål, 1866 (Hemiptera: Fulgoromorpha). *European Journal of Entomology*, 113: 233–239. doi: 10.14411/eje.2016.028
- Wang, M. L., Soulier-Perkins, A., Wang, Y. L. and T. Bourgoin. 2016b. Taxonomic updates and descriptions of four new Lophopini planthopper species (Hemiptera, Fulgoroidea, Lophopidae) from Yunnan province, South China. *European Journal of Taxonomy*, 185: 1–25. <http://dx.doi.org/10.5852/ejt.2016.185>
- Wang, R.-R., Stroiński, A., Szvedo, J., Bourgoin, T. and A. L. Liang. 2014. Recent dispersal and diet relaxation might explain the monotypic and endemic genus *Montrouzierana* Signoret, 1861 in new Caledonia (Hemiptera: Fulgoromorpha: Tropiduchidae). *Annales Zoologici*, 64(4): 693–708. doi: 10.3161/000345414X685974

Received: May 5, 2016

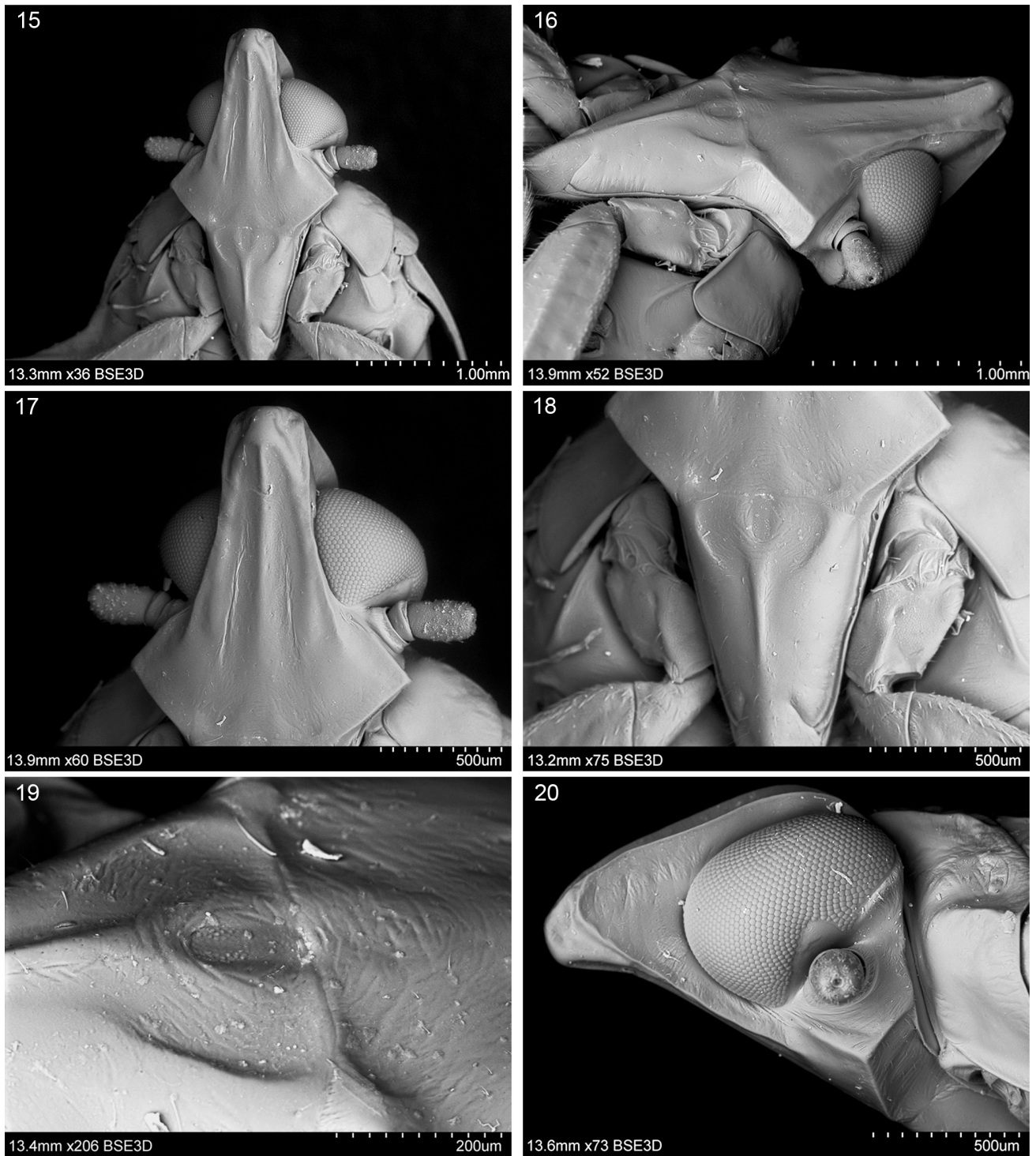
Accepted: June 1, 2016



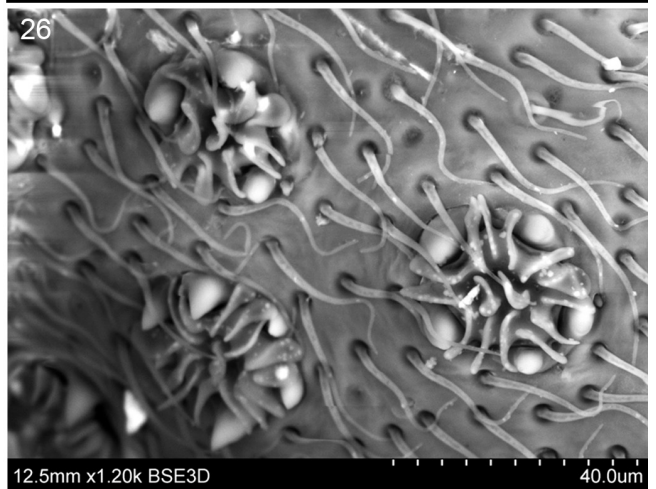
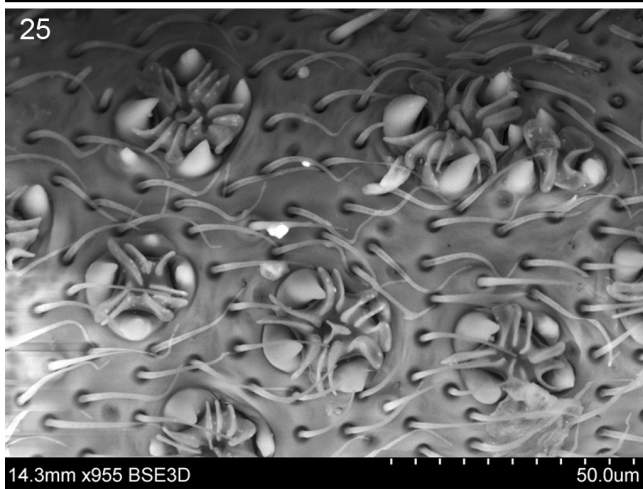
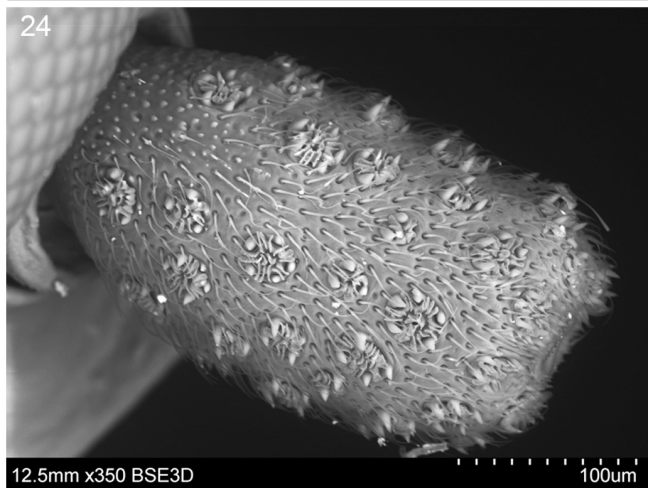
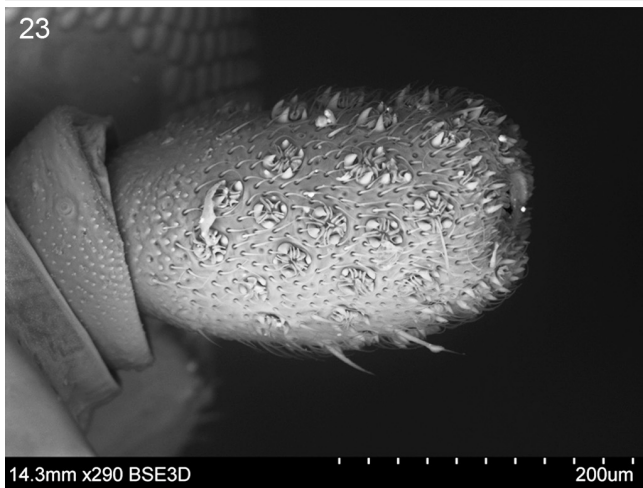
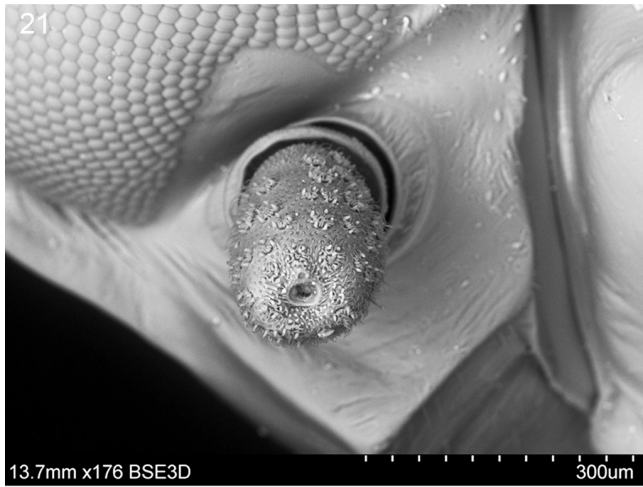
Figures 1–8. *Panegu linnavuorii* gen. et sp. nov. (1–2) Habitus: (1) dorsal view, (2) dorso-lateral view; (3–4) anterior part of body: (3) lateral view, (4) dorsal view; (5–6) head: (5) frontal view, (6) fronto-lateral view; (7) clypeus, rostrum and legs, ventral view; (8) hind leg, ventral view.



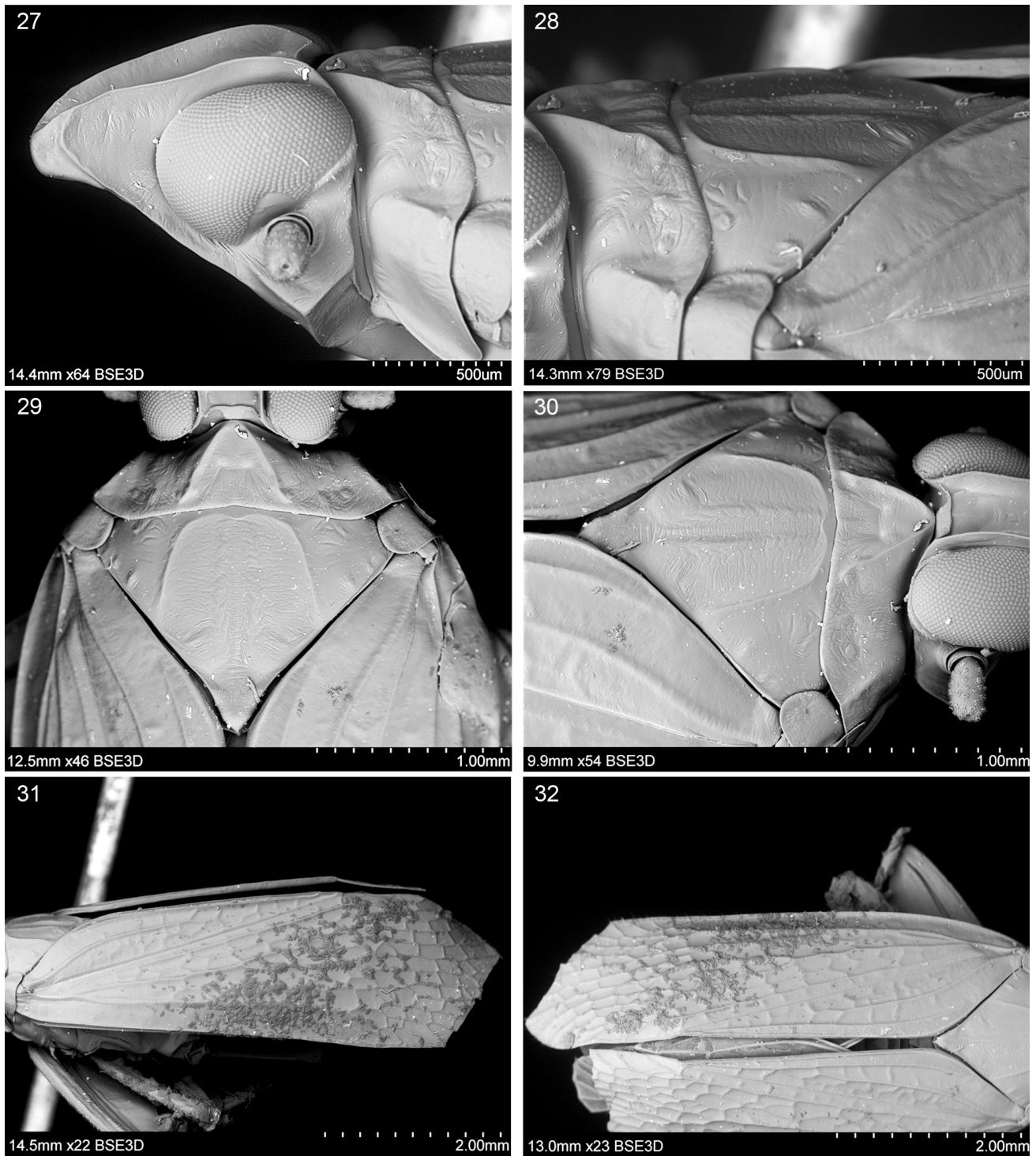
Figures 9–14. *Panegu linnavuorii* gen. et sp. nov., SEM photographs. (9–10) Habitus: (9) dorsal view, (10) lateral view; (11–13) anterior part of body: (11) dorsal view, (12) dorso-lateral view, (13) lateral view; (14) head and pronotum, dorsal view.



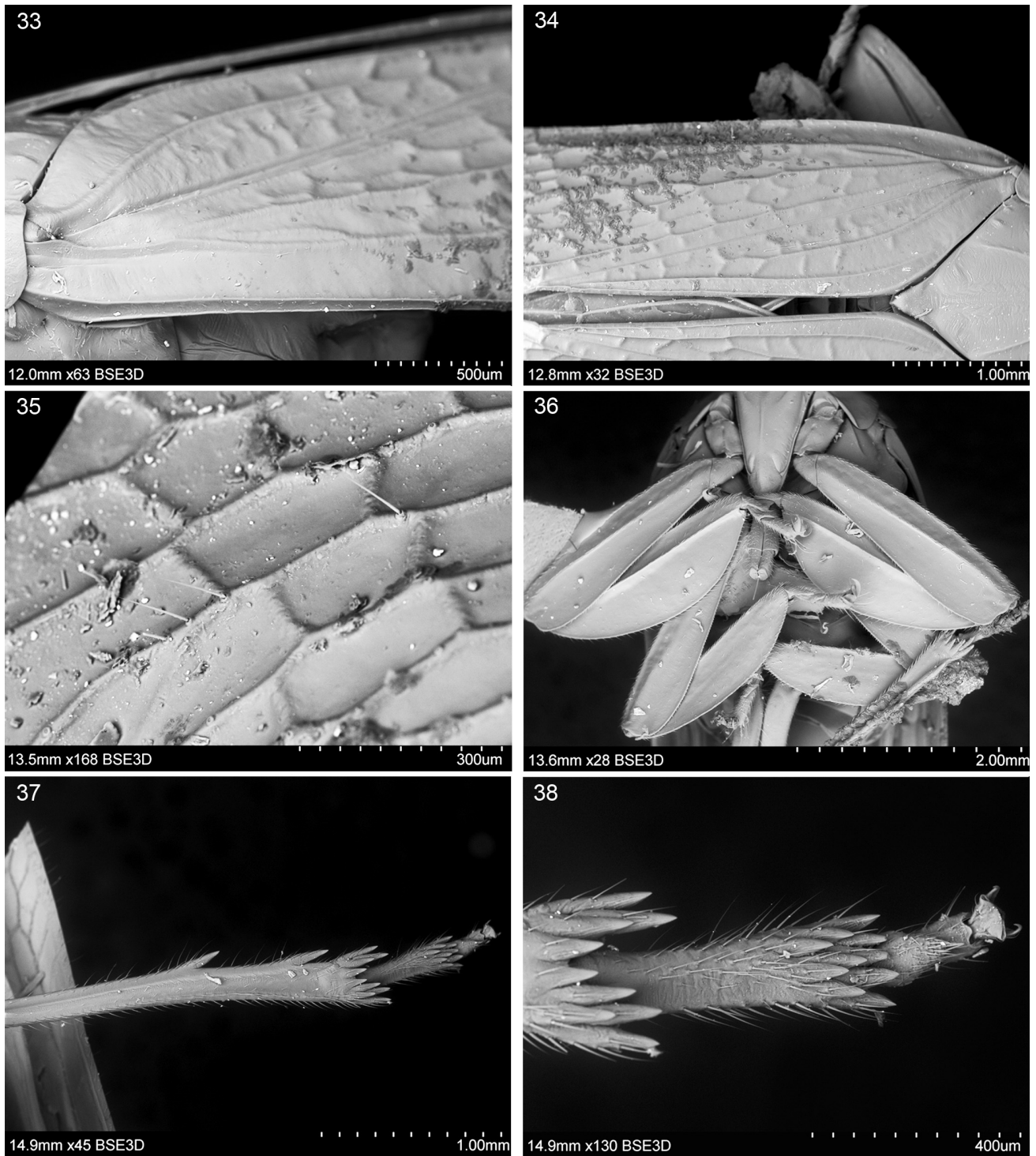
Figures 15–20. *Panegu linnavuorii* gen. et sp. nov., SEM photographs. (15–16) Head: (15) frontal view, (16) fronto-lateral view; (17) frons, frontal view; (18–19) clypeus: (18) frontal view, (19) upper part, fronto-lateral view; (20) head, lateral view.



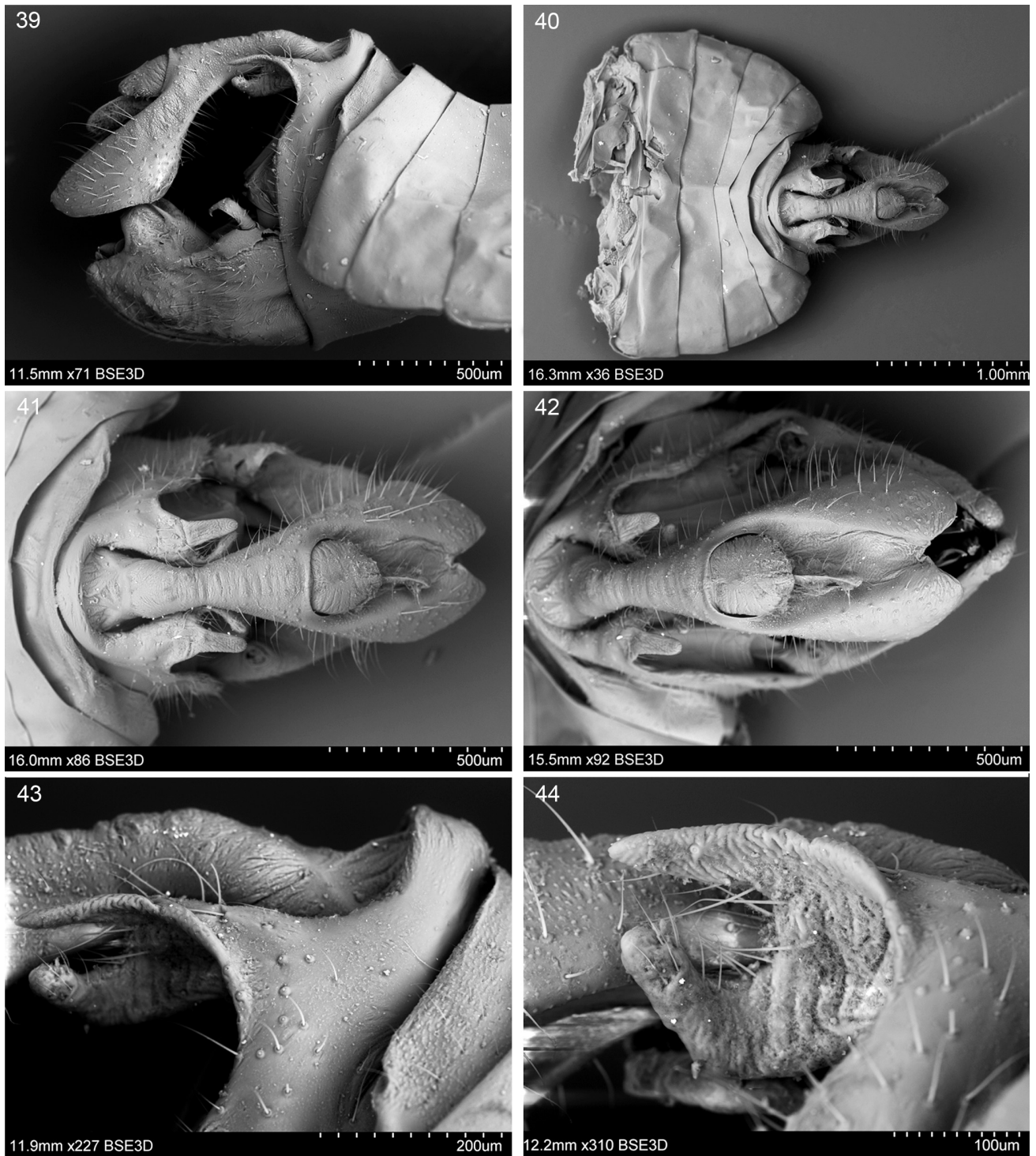
Figures 21–26. *Panegu linnavuorii* gen. et sp. nov., SEM photographs. (21–24) Pedicel: (21) lateral view, (22) apical part, lateral view, (23–24) lateral view; (25–26) antennal plate organs on pedicel.



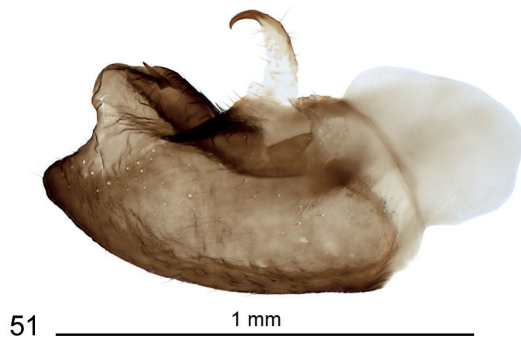
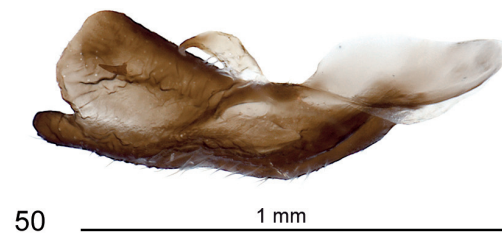
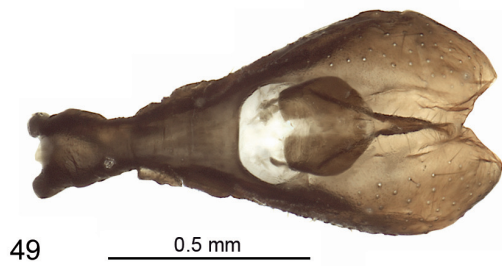
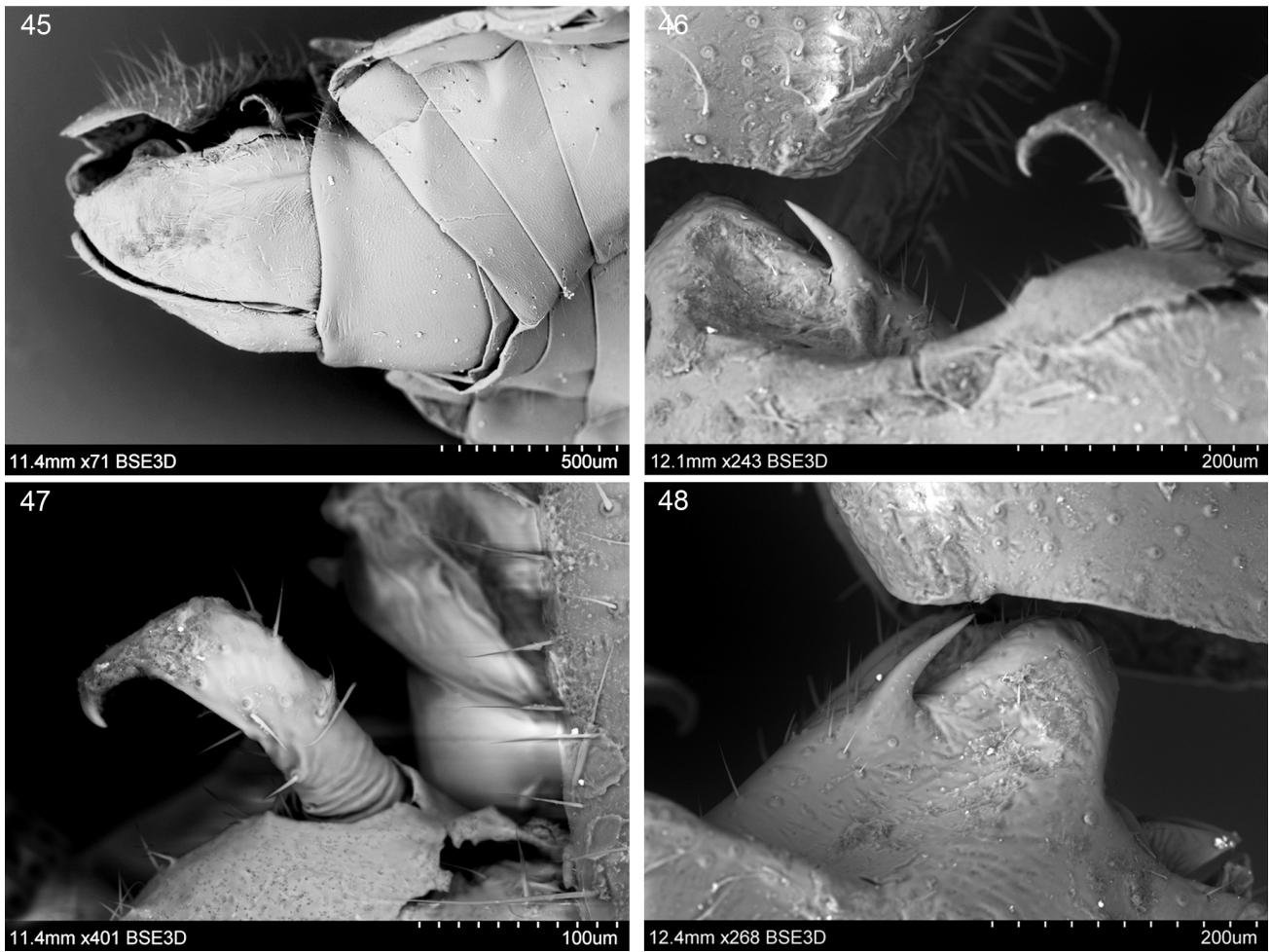
Figures 27–32. *Panegu linnavuorii* gen. et sp. nov., SEM photographs. (27) Head and pronotum, lateral view; (28–30) pronotum and mesonotum: (28) lateral view, (29) dorsal view, (30) dorso-lateral view; (31–32) left tegmen: (31) lateral view, (32) dorsal view.



Figures 33–38. *Panegu linnavuorii* gen. et sp. nov., SEM photographs. (33–34) basal part of tegmen, (33) lateral view, (34) dorsal view; (35) tegmen, setae on veins; (36) rostrum and legs, ventral view; (37) hind leg, ventral view; (38) distal part of hind tibia and tarsomere, ventral view.



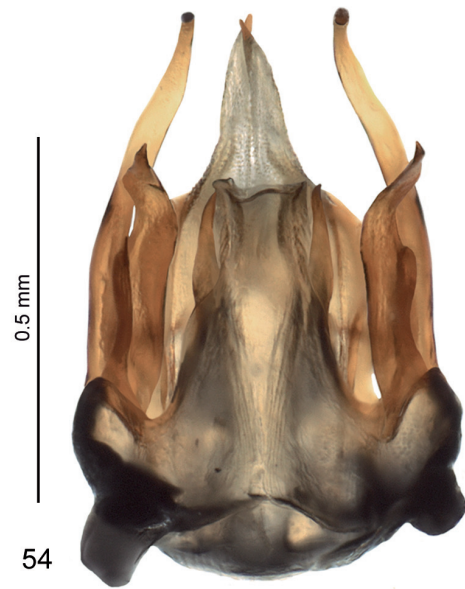
Figures 39–44. *Panegu linnavuorii* gen. et sp. nov., SEM photographs, male terminalia. (39) Terminalia, lateral view; (40) abdomen and terminalia, dorsal view; (41–42) anal tube and upper periandrium, dorsal view; (43–44) upper periandrium, lateral view.



Figures 45–52. *Panegu linnavuorii* gen. et sp. nov., male terminalia. (45) Terminalia, ventro-lateral view; (46–48) Gonostyli spine and process on upper margin: (46) both, lateral view, (47) process, (48) spine; anal; (49) anal tube, dorsal view; (50–52) gonostyli: (50) dorsal view, (51) dorso-lateral view, (52) lateral view.



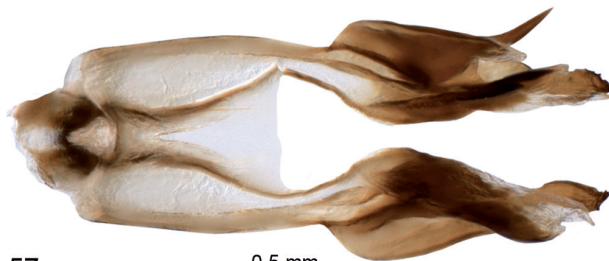
53 0.5 mm



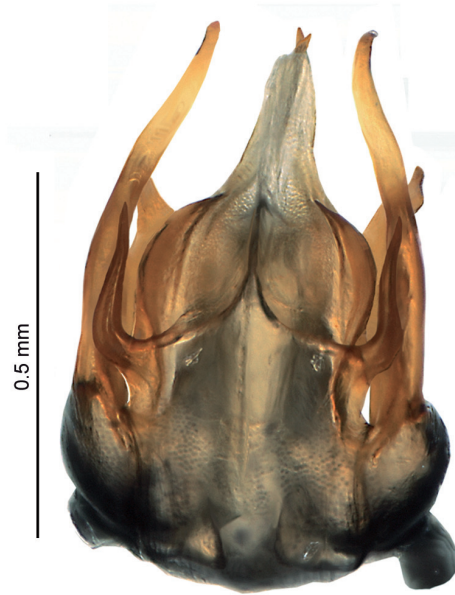
54 0.5 mm



56 0.5 mm 1 mm



57 0.5 mm



55 0.5 mm

Figures 53–57. *Panegu linnavuorii* gen. et sp. nov., male. (53–55) perianthium: (53) lateral view, (54) dorsal view, (55) ventral view; (56–57) aedeagus: (56) lateral view, (57) dorsal view.