

## On the taxonomic position of *Vindilis fornicata* Stål, 1870 (Hemiptera: Auchenorrhyncha: Fulgoroidea: Issidae)

## О таксономическом положении *Vindilis fornicata* Stål, 1870 (Hemiptera: Auchenorrhyncha: Fulgoroidea: Issidae)

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The genus *Vindilis* Stål, 1870 is placed in the tribe Parahiraciini Cheng et Yang, 1991 based on the examination of photographs of the type specimen of its type species, *Vindilis fornicata* Stål, 1870. According to the hind wing structure and venation, *V. fornicata* is closely related to *Nisoprincessa palawana* Gnezdilov, 2017; both genera and species are known from the Philippines only.

Род *Vindilis* Stål, 1870 помещен в трибу Parahiraciini Cheng et Yang, 1991 на основе изучения фотографий типового экземпляра *Vindilis fornicata* Stål, 1870. В соответствии со строением и жилкованием заднего крыла *V. fornicata* близок к *Nisoprincessa palawana* Gnezdilov, 2017; оба рода и вида известны только с Филиппин.

**Key words:** planthoppers, systematics, morphology, Oriental Region, Parahiraciini, *Vindilis*

**Ключевые слова:** фулгоровидные цикадовые, систематика, морфология, Ориентальная область, Parahiraciini, *Vindilis*

### INTRODUCTION

The systematic position of the monotypical genus *Vindilis* Stål, 1870 remained unclear since it was described in the subfamily Issinae of the family Fulgoridae by C. Stål (1870) based on a single female specimen collected from the Philippines by C.G. Semper (1832–1893), a German zoologist who traveled to the Philippines and Palau islands between 1858 and 1865 (Smith, 2018). Five years ago, Gnezdilov (2013) formally placed this genus into the tribe Issini Spinola, 1939, however, the examination of photographs of the type specimen of *Vindilis fornicata* Stål, 1870 revealed that this species has the 3-lobed hind wings with the wide remigial and remigio-vannal lobes, the narrow anal lobe and the deep cubital cleft, as well as the cuspidal apex of the forewing clavus (Figs 1, 3, 8); all of which

are the apomorphies of the tribe Parahiraciini Cheng et Yang, 1991 (Gnezdilov & Wilson, 2007; Gnezdilov, 2015). The metope of *V. fornicata* is also protruding similar to many other representatives of Parahiraciini, e.g. *Bardunia* Stål, 1863, *Fortunia* Distant, 1909, *Mincopius* Distant, 1909, *Nisoprincessa* Gnezdilov, 2017 and *Scantinius* Stål, 1866. The tribe Parahiraciini is placed in the subfamily Hemisphaeriinae according to Wang et al. (2016).

### MATERIAL AND METHODS

The morphological terminology follows Gnezdilov (2003) and Gnezdilov et al. (2014), but the wing venation terminology follows Gnezdilov & Bartlett (2018). *R*, *M*, *CuA*, *CuP*, *Pcu*, *A* are abbreviations for main veins (stocks); *R* corresponds to *ScP+R(+MA)*, *RA* and *RP* of Bourgoin et al.

(2014); *M* corresponds to *MP* of these authors. Branches of main veins and crossveins between them are indicated as follows: *CuA* 2 – cubitus anterior with 2 branches; *A*<sub>1</sub> – first anal vein; *A*<sub>1,2</sub> – second branch of first anal vein; *cup-pcu* – vein between *CuP* and *Pcu*; *icua* – intermediate (*i*) vein between branches of *CuA*; etc.

The examined type specimen is deposited in the Naturhistoriska Riksmuseet (Stockholm, Sweden). The label information is quoted with “/” indicating a new line and “//” indicating the next label. The photos were taken using a Canon EOS 5D Mark II camera with a 65 mm macro lens (MPE-65 mm f/2.8 1-5X) and the software packages Canon EOS Utility, Digital Photo Professional, and Zerene Stacker. The drawings were made using a Leica MZ95 light microscope with a camera lucida attachment. The figure plates were produced with Adobe Photoshop.

## SYSTEMATICS

Family **Issidae** Spinola, 1839

Subfamily **Hemisphaeriinae** Melichar, 1906

Tribe **Parahiraciini** Cheng et Yang, 1991

Genus ***Vindilis*** Stål, 1870

*Vindilis* Stål, 1870: 759.

Type species *Vindilis fornicata* Stål, 1870.

**Diagnosis.** Metope protruding, with two pairs of strong keels joined anteriorly (Figs 2, 4, 5). Fore wings hemispherical (Figs 1, 2). Hind wings having remigial and remigio-vannal lobes equally wide, deep cubital cleft between them, anal lobe narrow, *CuA* and *CuP* closely connected or fused apically, and *Pcu* fused with *A*<sub>1,1</sub> medially, *A*<sub>2</sub> 1 (Figs 1, 3, 8).

**Supplementary description.** Metope wide, protruding in lateral view (Fig. 2), with one row of pustules along each lateral margin and two pairs of strong keels joined anteriorly (Figs 4, 5). Upper part of metope above keels with relief transverse folds (Fig. 4). Coryphe transverse, twice as

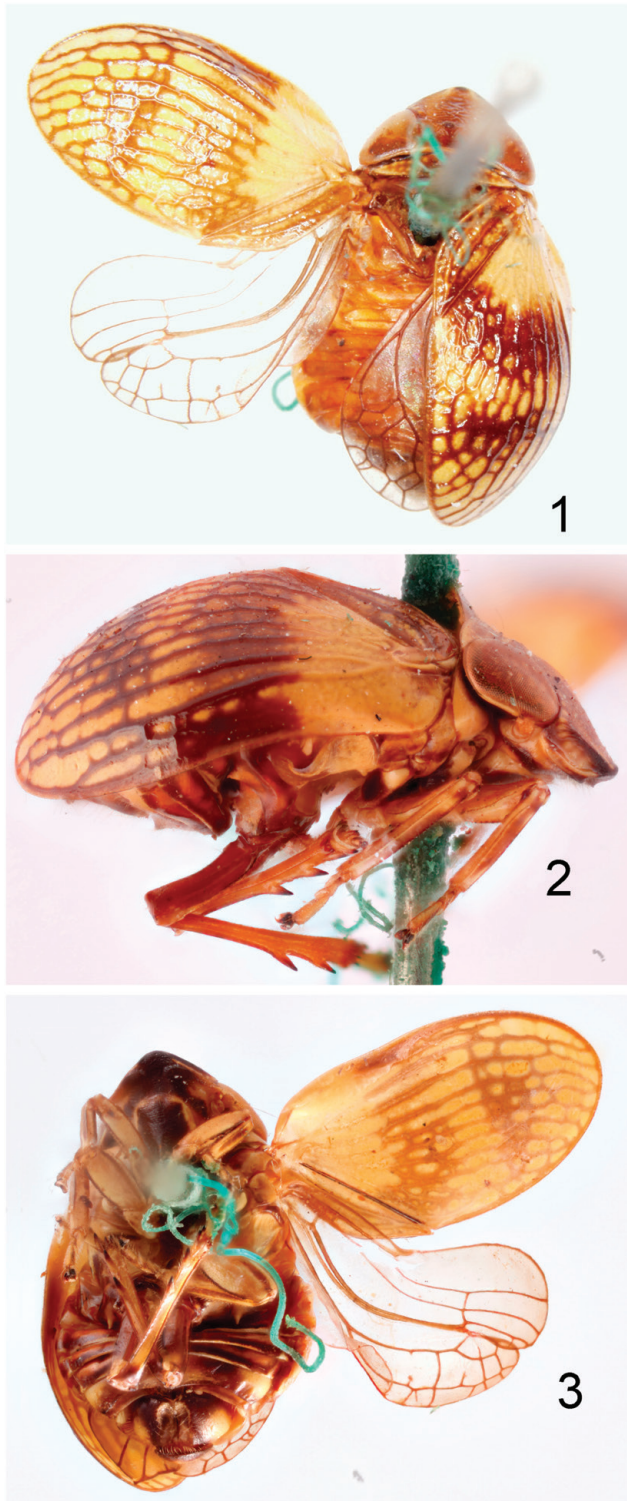
wide as long medially, with median groove and with anterior and posterior margins slightly concave (Fig. 4). Postclypeus large. Rostrum with second and third segments of equal length; third segment slightly conically tapering towards apex (Fig. 5). Pedicel large, ball-shaped. Pronotum with very narrow paradiscal fields and wide paranotal lobes (Figs 1, 2). Tegulae small. Fore wings hemispherical; veins in relief, with rich crossvenation; hypocostal plate wide (Figs 1–3). Clavus open (*Pcu*+*A*<sub>1</sub> ending at apex of clavus), 0.3 times as long as entire wing; *Pcu* fused with *A*<sub>1</sub> near apex of clavus. Basal cell large, oval. Fore wing veins sequence: *R* 2, furcated closely to basal cell; *M* 2, furcated on basal cell; *CuA* 5, with first furcation at short distance from basal cell and second furcation just before claval apex (Figs 1–3). Hind wing as long as fore wing, 3-lobed, with deeply concave costal margin and with coupling lobe (Figs 1, 3, 8). Remigial and remigio-vannal lobes equally wide, with deep cubital cleft in between; anal lobe narrow (Fig. 8). Hind wing veins sequence: *R* 2 (furcated near to coupling lobe at wing middle); *r-m* 1; *M* 1; *m-cua* 1; *CuA* 2 (furcated in apical third of wing); *CuP* 1; *Pcu* 2 (furcated apically); *pcu-a*, 3; *A*<sub>1</sub> 2; *A*<sub>2</sub> 1 (Figs 3, 8). *CuA* and *CuP* are closely connected along most of their length or even fused apically. *Pcu* fused with *A*<sub>1,1</sub> medially. Fore and middle femora slightly flattened (Fig. 5). Hind tibia with two large lateral spines in distal half (Fig. 2). Gonoplags rounded (Fig. 6). Anal tube wide, widely rounded apically.

***Vindilis fornicata*** Stål, 1870  
(Figs 1–8)

*Vindilis fornicata* Stål, 1870: 761.

**Material examined after photographs.** Female (holotype), **Philippines**, “Ins. Philipp.”// “Semper.”// “Type.”// “Typus”// “*Vindilis / fornicata* / Stål. [hand-written]”// “NHRS-HEMI / 000000097”.

**Supplementary description.** General coloration light yellow (Figs 1–3). Forewings shiny, light yellow, each with two wide dark



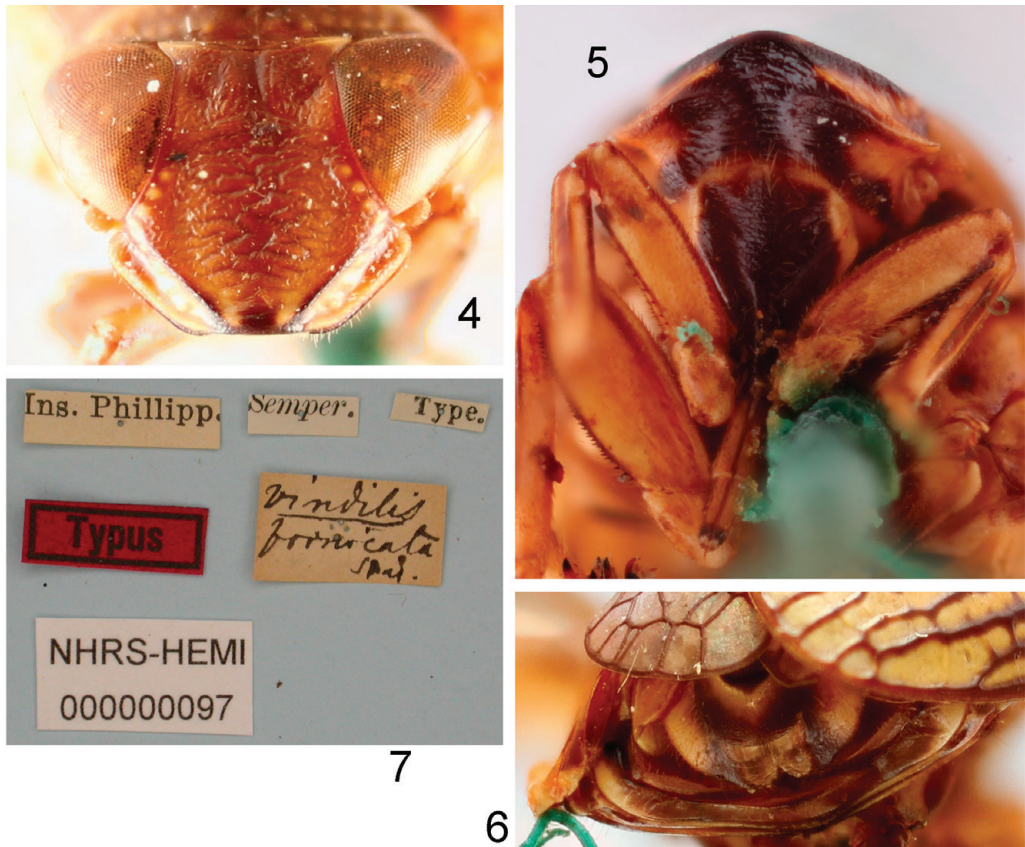
**Figs 1–3.** *Vindilis fornicata* Stål, holotype: 1, dorsal view; 2, lateral view; 3, ventral view. Total length 5 mm.

brown bands (Fig. 2). Keels of metope when jointed, lower part of metope (except for metopoclypeal suture), postclypeus frontally and anteclypeus dark brown (Figs 4, 5). Hind wings opaque, with dark brown veins (Fig. 6). Apex of rostrum and apices of leg spines black. Anal tube brown marginally.

## DISCUSSION

The tribe Parahiraciini Cheng et Yang, 1991 currently comprises 24 genera (one fossil and 23 extant) and 78 species including one genus with one species transferred into the tribe in this paper (Gnezdilov, 2013, 2015, 2017; Gnezdilov & Bourgoïn, 2016; Bourgoïn, 2018). The tribe is subendemic in the Oriental Region (Gnezdilov, 2013). Besides *Vindilis fornicata* Stål, two more genera and two species are known from the Philippines: *Nisoprincessa palawana* Gnezdilov, 2017 and *Bardunia philippina* Constant, 2018 (Gnezdilov, 2017; Constant, 2018).

Based on the structure of the hind wing, which has the anal lobe of the vannus well developed, *V. fornicata* is close to *N. palawana* (Fig. 9) and to the members of the genus *Scantinius* Stål, 1866 (Fig. 10) known from the Malay Peninsula, Sumatra, Dinding Islands and Borneo (Gnezdilov & Wilson, 2007). The species of the genus *Bardunia* Stål, 1863 have the bilobed hind wing with the remigio-vannal lobe much wider than the remigial lobe (Constant, 2018, fig. 2E). The hind wings venation suggests close relationship of *V. fornicata* and *N. pala-*

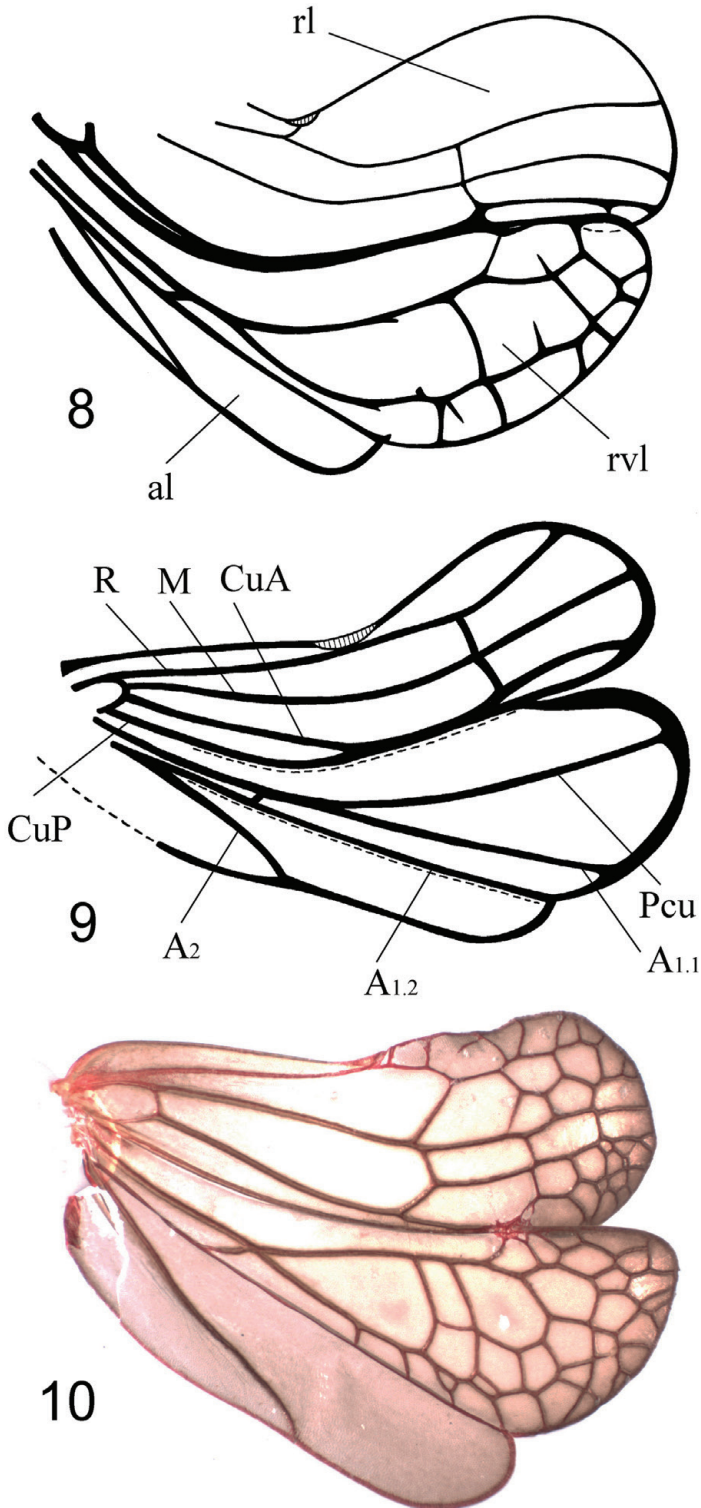


**Figs 4–7.** *Vindilis fornicata* Stål, holotype: 4, head, dorsal view; 5, head, ventral view; 6, ovipositor, posterior view; 7, labels.

*wana*. Both taxa are characterized by  $CuA$  and  $CuP$  veins closely connected or fused along the most of their length, as well as by  $Pcu$  and  $A_{1,1}$  veins fused medially (Figs 1, 8, 9). On the other hand, *V. fornicata* is well distinguished from *N. palawana* by the rich cross-venation of the remigio-vannal lobe of the hind wing, and from the all other genera of Parahiraciini by its peculiar (almost hemispherical) forewings and two pairs of strong keels on the metope (Figs 2, 4, 5).

Within the tribe Parahiraciini at least three groups of genera are distinguished. The first group includes *Nisoprincessa* Gnezdilov, 2017, *Scantinius* Stål, 1866 and *Vindilis* Stål, 1870 which are characterized by the trilobed hind wing with the anal lobe of vannus well developed, and with  $A_2$  1. The second group is monotypical with only *Folife-*

*murum* Che, Zhang et Wang, 2013 included. It has the rudimentary one-lobed hind wing (Che et al., 2013, fig. 5). The rest of the genera, including the type genus of the tribe, belong to the third group and characterized by the bilobed hind wing with the remigio and remigio-vannal lobes well developed and wide, with the remigio lobe always narrower than the remigio-vannal lobe and with the anal lobe of vannus reduced or rudimentary. It is important to notice, that the last group of genera is polymorphic according to the shape of the hind wing. The genus *Rhombisus* Gnezdilov et Hayashi, 2016 has the anal lobe reduced (Gnezdilov & Hayashi, 2016, fig. 8), but the genera *Tetricodes* Fennah, 1956 and *Pseudochoutagus* Che, Zhang et Wang, 2011 have a small anal lobe with the second anal vein present (Gnezdilov & Con-



**Fig. 8–10.** Parahirciini, hind wing; 8, *Vindilis fornicata* Stål, holotype, modified from photograph; 9, *Nisoprincessa palawana* Gnezdilov, holotype (after Gnezdilov, 2017, modified); 10, *Scantinius bruchoides* (Walker, 1858) (after Gnezdilov, 2012). Abbreviations: rl – remigial lobe; rvl – remigio-vannal lobe; al – anal lobe.

stant, 2012, fig. 5; Chang et al., 2017, figs 11, 26), and finally, the genera *Macrodarumoides* Che, Zhang & Wang 2012 and *Thabenula* Gnezdilov, Soulier-Perkins et Bourgoïn, 2011 have the narrow remigial and remigiovannal lobes as well as lack any visible anal lobe (Gnezdilov et al., 2011, fig. 18C). The remaining genera of this group should be checked carefully for the presence/reduction of the anal lobe. Further study based on all available morphological characters, including the wings and male and female genitalia, is needed to establish a subtribal system of the group.

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