

## Research article

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# First record of the lanternfly genus *Limois* Stål, 1863 in Vietnam with a new species, *L. sonlaensis* sp. nov. (Hemiptera: Fulgoromorpha: Fulgoridae)

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**Abstract.** The lanternfly genus *Limois* Stål, 1863 is recorded from Vietnam for the first time based on a new species, *L. sonlaensis* sp. nov. from Son La Province in North Vietnam. The new species is described and illustrations of the holotype and male genitalia and a distribution map, are provided. An updated identification key to the nine species of *Limois* is given.

**Key words.** Fulgoroidea, planthopper, Auchenorrhyncha, Tonkin, Indochina, China.

## INTRODUCTION

The family Fulgoridae Latreille, 1807 contains about 774 species in 142 genera according to the FLOW database (Fulgoromorpha Lists On the Web – Bourgoïn 2021), representing slightly less than 6 % of the species of Fulgoromorpha Evans, 1946 globally. In Vietnam, the family includes 37 species and the country is currently the most diverse in terms of lanternfly species as compared to other Indochinese countries such as Cambodia (17 species – Constant et al. 2016; Constant & Bartlett 2019), Laos (6 species – Bourgoïn 2021), Thailand (16 species – Bourgoïn 2021), and even China (32 species – Bourgoïn 2021).

The genus *Limois* Stål, 1863 contains eight extant species and is distributed in the Oriental Region and the southeastern and far eastern parts of the Palaearctic Region: China (northeast China, Shanxi, Shaanxi, Hebei, Beijing, Gansu, Ningxia, Xizang, Hunan, Sichuan, Guangxi, Fujian), Taiwan, Japan, Korea, Far Eastern Russia, Bangladesh, northern India and Myanmar (Wang et al. 2020). It also contains two extinct species from China, and is the type-genus of the tribe Limoisini Lallemant, 1963 in the subfamily Aphaeninae Blanchard, 1847 (Wang et al. 2020; Bourgoïn 2021).

The recent publication of a revision of the genus *Limois* by Wang and co-authors (Wang et al. 2020) attracted the

attention of the second author to a specimen in the collection of the Vietnam National Museum of Nature, which was recognised as both an additional lanternfly genus for the fauna of Vietnam and a species new to science.

The aim of this paper is to describe the new species of *Limois*, *L. sonlaensis* sp. nov. as an addition to the biodiversity of Vietnam and to provide an updated identification key for the nine extant species of *Limois*.

## MATERIALS AND METHODS

The male genitalia were extracted after boiling the distal portion of the abdomen several minutes in a 10% solution of potassium hydroxide (KOH) at about 100°C. The pygofer was separated from the remains of the abdomen and the aedeagus dissected with a needle blade for examination. The organs were then placed in glycerine for preservation in a tube attached to the pin of the specimen. The external morphological terminology follows O'Brien & Wilson (1985), the wing venation terminology follows Bourgoïn et al. (2015) and for the male genitalia, Bourgoïn & Huang (1990). The metatibiotarsal formula gives the number of spines on (side of metatibia) apex of metatibia/apex of first metatarsomere/apex of second metatarsomere.



5. Thorax densely covered with numerous minute dark spots, disc of mesonotum without black marking (Fig. 1B; Wang et al. 2020: fig. 2D); tegmina submedially without strongly contrasting broad irregular band (Fig. 1A; Wang et al. 2020: fig. 2A)..... 6
- Thorax with minute dark spots sparse or absent, disc of mesonotum with black markings (Wang et al., 2020: figs 3A, 8B, 9B); tegmina submedially with contrasting broad irregular band (Wang et al. 2020: figs 3D, 8A, C, E, 9A, G) ..... 7
6. Minute black spots density equal on disc of pro- and mesonotum (Wang et al., 2020: fig. 2D); postclypeus pale yellowish with minute darker spots (Wang et al., 2020: fig. 2E); dorsal angle of gonostyli rounded in lateral view (Wang et al. 2020: fig. 2G–H) ..... *L. guangxiensis* Chou & Wang, 1985
- Minute black spots covering on disc of pronotum distinctly less dense than that on disc of mesonotum (Fig. 1B); postclypeus dark brown with irregular pale yellowish markings (Fig. 1C); dorsal angle of gonostyli forming a right angle in lateral view (Fig. 2A) ..... *L. sonlaensis* sp. nov.
7. Pronotum with 2 dark spots anteriorly, without one longitudinal broken black band on each side of median carina (Wang et al. 2020: fig. 3A) ..... *L. hunanensis* Chou & Wang, 1985
- Pronotum without dark spots anteriorly, with one longitudinal broken black band on each side of median carina (Wang et al. 2020: figs 8B, 9B) ..... 8
8. Tegmina with an oblique narrow fascia from apex to disc (Wang et al. 2020: fig. 13) ..... *L. bifasciatus* Ollenbach, 1928
- Tegmina without an oblique narrow fascia from apex to disc (Wang et al. 2020: figs 8A, C, E, 9A, G) ..... *L. westwoodii* (Hope, 1843)
3. Postclypeus dark brown with irregular pale yellowish markings (Fig. 1C).
4. Tegmina with red suffusion on basal half of corium, the reddish area not reaching base and not extending to costal cell (Fig. 1A, D).
5. Posterior wings with broad dark brown band along posterior margin and broad dark brown band separating basal orange-red area from transparent distal third (Fig. 1A, D).
6. Gonostyli with dorsal angle forming a right angle (Fig. 2A).

### Differential diagnosis

The most similar species is *L. guangxiensis* Chou & Wang, 1985 from which *L. sonlaensis* sp. nov. can be separated, for example by the minute spots on disc of pronotum less densely distributed than on disc of mesonotum (spotting density similar on disc of pro- and mesonotum in *L. guangxiensis*) and by the pale yellowish ground colour of the postclypeus (postclypeus dark brown with irregular pale yellowish markings in *L. sonlaensis*).

*Limois sonlaensis* sp. nov. can be separated from the remaining other species of the genus by the absence of dark brown or black markings on the disc of the pro- and mesonotum. The remaining other species, except *L. westwoodii*, also lack the dark brown band separating the orange-red basal area from the transparent distal area of the posterior wings.

### Etymology

The species epithet refers to Son La Province in North Vietnam, where the type specimen was collected.

### Description

**Measurements and ratios.** LT: ♂ (n = 1): 20.6 mm. LTg/BTg = 2.6; LV/BV = 0.5; LF/BF = 1.03.

**Head.** Vertex excavate, with all margins carinate; about two times broader than long; weakly transversely wrinkled; with a broadly U-shaped carina along median  $\frac{3}{4}$  of posterior margin; pale yellow with irregular brown markings in middle and at posterolateral angles (Fig. 1B, E). Posterior face of head pale yellowish with two longitudinal brown markings near middle (Fig. 1B, E). Frons about as broad basally as long in mid-line (excluding cephalic process); slightly convex in lateral view; broadest with margins rounded near fronto-clypeal suture, then moderately tapering dorsad with lateral margins broadly incurved; portion above fronto-clypeal suture slightly excavate, then median portion of disc elevated; elevation tapering dorsad and gradually turning into two side-by-side carinae extending nearly to apex of cephalic process; frons mostly dark brown mottled with pale yellow and rather densely covered in minute black points (Fig. 1B–C, H). Cephalic process directed posterodorsally, tapering towards apex; in lateral view, anterior margin rounded and posterior margin straight,

### *Limois sonlaensis* sp. nov.

urn:lsid:zoobank.org:act:B2AE4EF3-DA99-4E9A-9A79-25741F7C60EF (Figs 1–4)

### Material examined

#### Holotype

♂ (Figs 1–3). Vietnam, Son La Province; Thuận Châu District, Co Mạ, alt. 1,400 m; 21°21'11.5" N, 103°32'35.5" E; 7 Oct 2008; leg. Hoang Vu Tru; light trap; VNMN.

### Diagnosis

The species can be separated from the other *Limois* species by the combination of the following characters:

1. Frons with two longitudinal carinae (Fig. 1C).
2. Pro- and mesonotum without large dark making on disc, only with minute black spots; spots distinctly less dense on pronotum than on mesonotum (Fig. 1B).

oblique; anterior face with lateral margins foliate laterally near base and two parallel median carinae stopping before a small lamina; small lamina followed by excavate apex of process; posterior face of process flattened, elongate with sides parallel and lateral margins carinate, and dorsal margin angularly pointed dorsad; pale yellowish slightly variagated with brown and with irregular minute reddish brown points, and with carinae of anterior face dark brown (Fig. 1B–C, E–F, H). Genae pale yellowish with few brown markings (Fig. 1E, H). Eyes large, about half as wide as vertex in dorsal view, strongly rounded and protruding laterally (Fig. 1B–C). Ocelli well-developed, under compound eyes (Fig. 1H). Antennae rather short, subcylindrical, black-brown (Fig. 1E, H). Clypeus convex, elongate, subtriangular, carinate medially with carina stronger on anteclypeus; lateral margins carinate on basal  $\frac{2}{3}$  of postclypeus; base narrower than frons; brown with anteclypeus darker and transverse irregular pale yellowish markings; some minute black points on postclypeus along lateral and median carinae (Fig. 1C–D). Labium brown, very elongate and narrow, surpassing apex of abdomen, with last segment much shorter than penultimate (Fig. 1D).

**Thorax.** Pronotum wider than long with lateral angles acutely pointed lateroventrally in dorsal view; anterior margin strongly bisinuate, roundly emarginated behind eyes, slightly emarginate behind vertex; posterior margin more or less straight, abruptly oblique near lateral angle; weak median carina on anterior half of disc with a deep impressed point at each side; disc transversely wrinkled posterior to impressed points; anterolateral margin strongly carinate; paranotal lobes with strong carina parallel to anterolateral margin on dorsal  $\frac{1}{3}$  and ventral margin carinate; ventral  $\frac{2}{3}$  of paranotal lobes coarsely punctured; pale yellowish dorsally with some minute dark brown dots and one bigger black point behind eye; paranotal lobes with area between carinae dark brown with large pale yellowish markings dorsally; ventral  $\frac{2}{3}$  of paranotal lobes dark brown variegated with yellowish (Fig. 1B–C, E–F, H). Mesonotum subtriangular with very weakly marked median and peridiscal carinae; median carina stopped before scutellum; peridiscal carinae incurved on anterior  $\frac{1}{4}$ ; scutellum slightly elevated, following a shallow depression; ground colour pale yellowish; disc densely covered in irregular small black dots; lateral fields beyond peridiscal carinae smooth with some black-brown markings including a curved marking anteriorly (Fig. 1B, E, H). Tegulae pale yellowish with irregular minute black points on ventral  $\frac{2}{3}$  (Fig. 1B, E, H).

**Tegmina.** (Fig. 1A, D, G) Elongate, slightly more than  $2.5 \times$  as long as broad, with a small round lobe posterior to clavus (damaged on right wing of holotype); apical angle rounded; apical margin strongly oblique; costal cell pale yellowish brown with irregular rather large black-brown markings; clavus pale yellowish with irregular dark brown markings, markings larger on distal

$\frac{2}{3}$ ; basal  $\frac{1}{2}$  of corium opaque, pale yellowish with large black-brown markings and a large reddish zone on disc, not reaching base and more visible ventrally (Fig. 1D); distal half transparent with large markings and veins, dark brown (Fig. 1A, D, G). Venation dense and reticulate, with numerous secondary veins and cross-veinlets; Pc+CP extending slightly beyond nodal line; ScP+R(+MA) very short; RP(+MA) merged with MP at basal  $\frac{2}{5}$  of clavus; PCu and A1 fused at about  $\frac{3}{4}$  of clavus length (Fig. 1A).

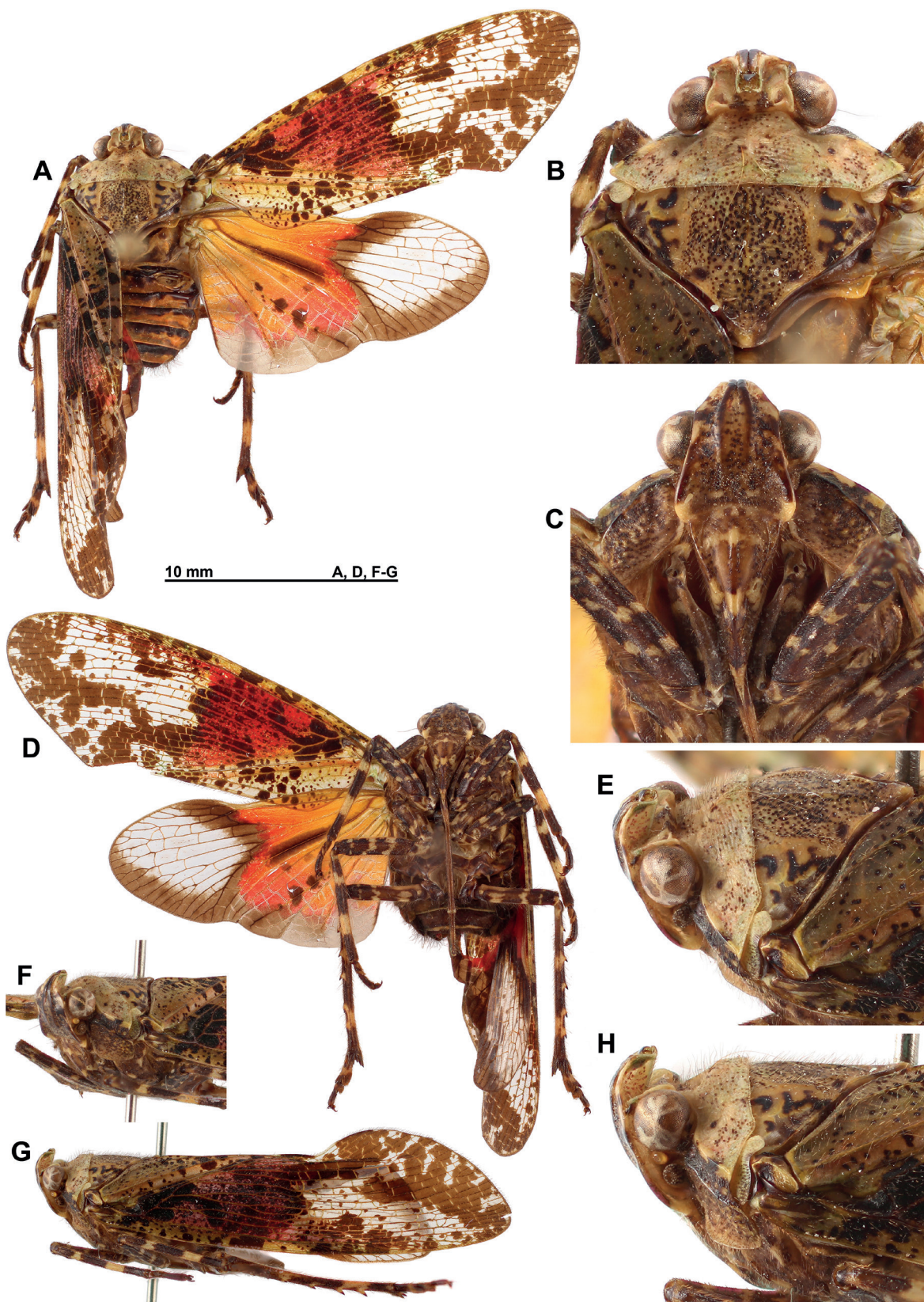
**Hind wings.** (Fig. 1A, D) Elongate, roundly pointed apically, with posterior margin roundly indentate at claval fold. Basal half bright orange turning to bright red distally; distal half transparent with broad dark brown, C-shaped band between bright red and transparent areas; broad dark brown band along posterior margin; vein CuA dark brown marked by an elongate dark brown marking progressively widening towards the posterior and abruptly stopped at first fork of CuA; three dark brown markings along vein A1 in orange area.

**Legs.** (Fig. 1A, D) Elongate and slender. Dark brown; femora with irregular pale yellow markings more or less arranged in rings; tibiae with 2 well-defined pale yellowish rings, the more distal one broader. Metatibiotarsal formula: (5–6) 7 / 8–9 / 6.

**Abdomen.** Tergites orange with broad dark brown band along basal margin (Fig. 1A, D); ventral face black-brown (Fig. 1D).

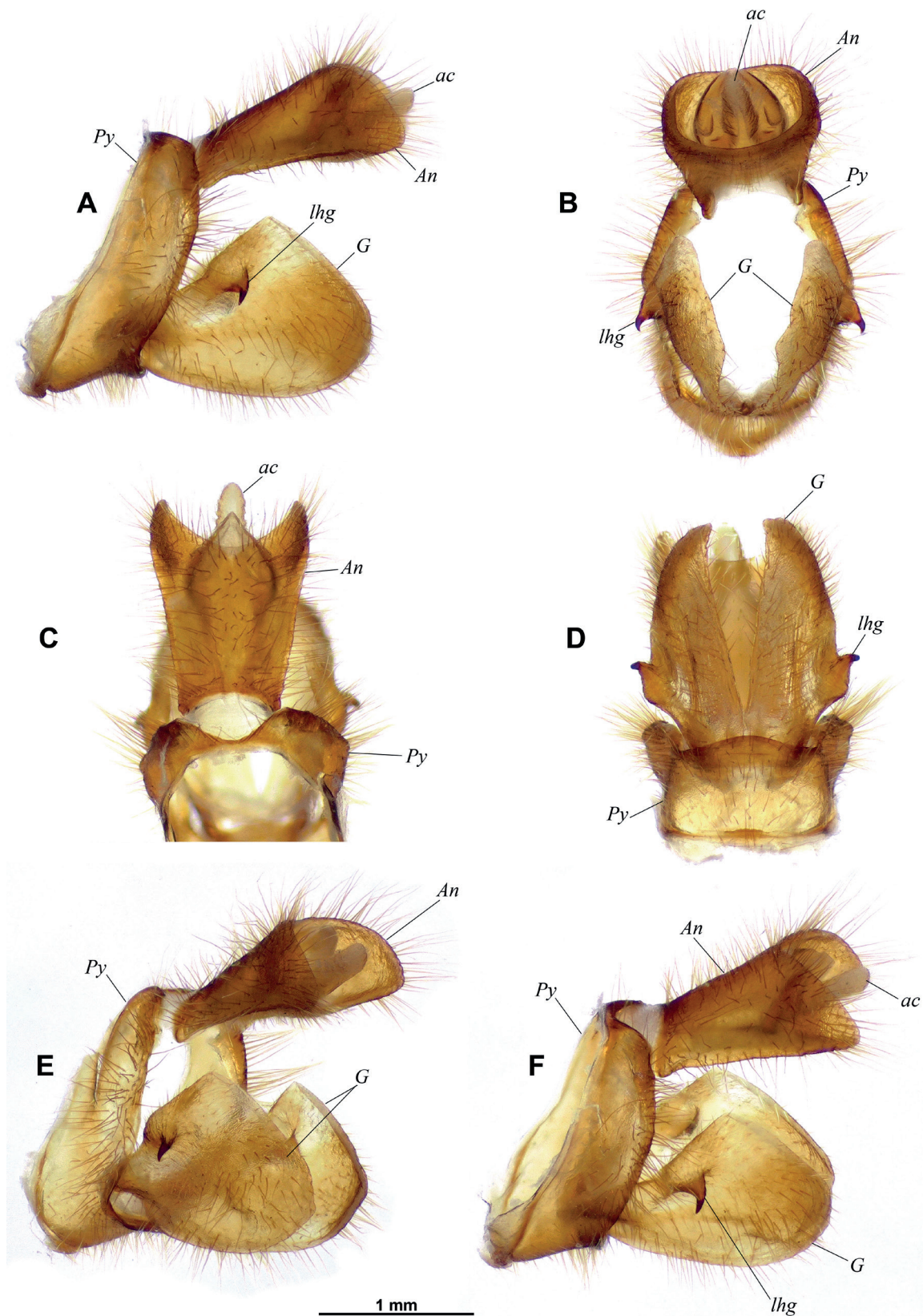
**Terminalia. Male.** Pygofer (Py) with ventral margin sinuate in lateral view; posterior margin in lateral view slightly convex, emarginate on ventral  $\frac{1}{6}$  (Fig. 2A); in dorsal view deeply, roundly emarginate posteriorly (Fig. 2C, F); posterior margin slightly roundly projecting posterad in ventral view (Fig. 2D). Gonostyli (G) subtriangular in lateral view, with dorsal angle right and posterior margin rounded (Fig. 2A), in ventral view gonostyli connected basally (Fig. 2D), lateral hook (lhg) slender, directed posteroventrally, then curved ventrally towards apex (Fig. 2A–B, D). Phallobase sclerotized in basal  $\frac{1}{6}$ , sheath cylindrical, phallobasal conjunctival processes sclerotized over entire length, about five times as long as sheath, apical  $\frac{1}{4}$  curved dorsad and terminally membranous and inflated, phallus with a dorsal and a ventral pair of elongate membranous processes (Fig. 3A–B, D–G). Connective rod-like (Fig. 3A). Tectiductus rather large, in lateral view elongate, in dorsal view broad, subsquarish, distinctly concave ventrally (Fig. 3A–E, G). Anal tube (An) massive, in lateral view reaching level of apex of gonostyli, ventral margin nearly straight, apical margin obliquely, roundly truncate (Fig. 2A), in dorsal view, widening from base to apex,  $1.09 \times$  broader near apex than long in median line,  $1.34 \times$  longer in maximum length than wide at maximum width, apical margin roundly emarginate in dorsal view (Fig. 2C); anal column (ac) elongate, surpassing posterior margin of anal tube (Fig. 2A, C).



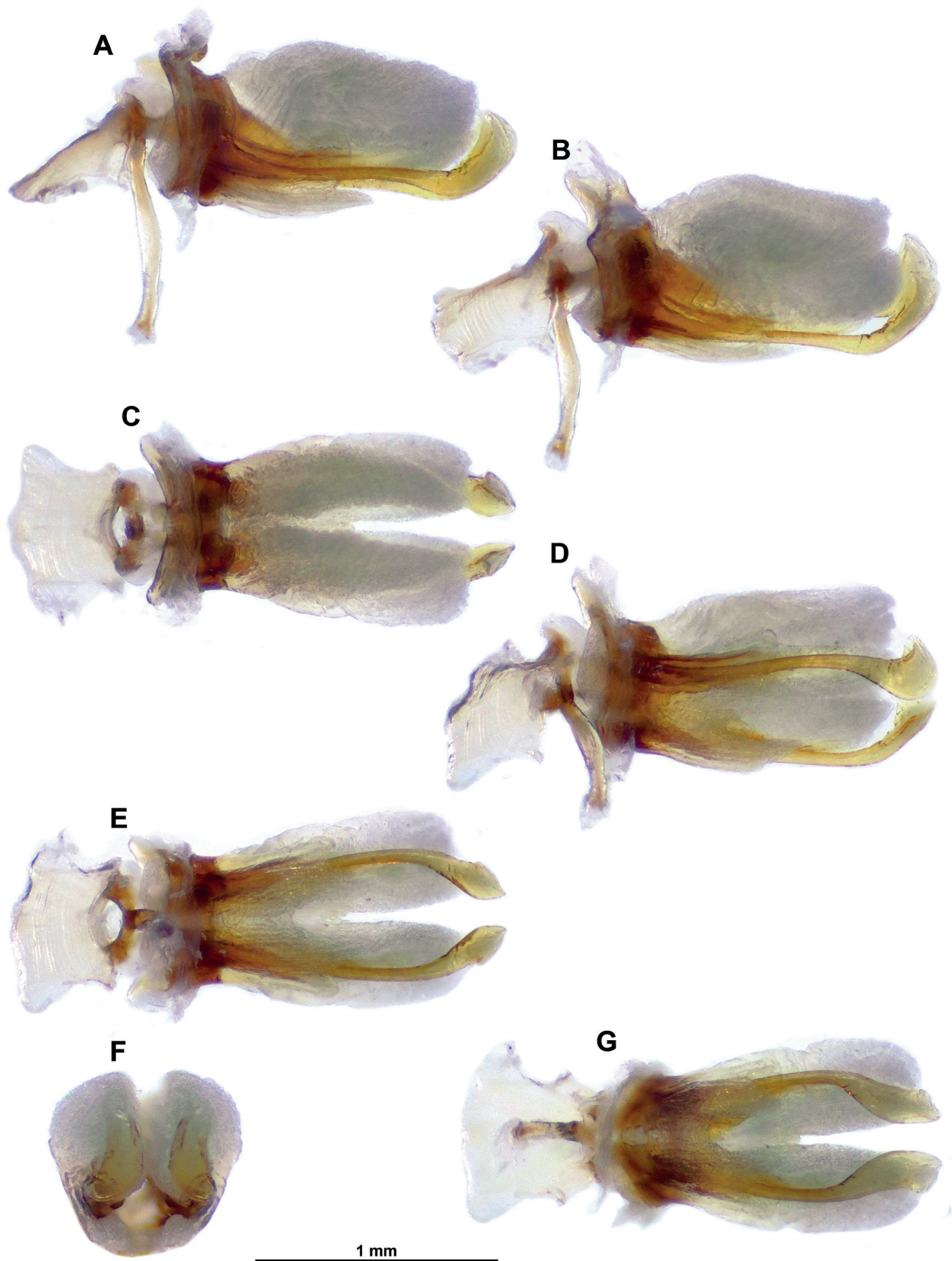


**Fig. 1.** *Limois sonlaensis* sp. nov., ♂, holotype (VNMN). **A.** Habitus, dorsal view. **B.** Head and thorax, dorsal view. **C.** Head and thorax, perpendicular view of frons. **D.** Habitus, ventral view. **E.** Head and thorax, laterodorsal view. **F.** Head and thorax, antero-lateral view. **G.** Habitus, lateral view. **H.** Head and thorax, lateral view.





**Fig. 2.** *Limois sonlaensis* sp. nov., ♂, holotype (VNMN), terminalia: anal tube, pygofer and gonostyli. **A.** Left lateral view. **B.** Caudal view. **C.** Dorsal view. **D.** Ventral view. **E.** Posterolateral view. **F.** Laterodorsal view. Abbreviations: *ac* = anal column; *An* = anal tube; *G* = gonostylus; *lhg* = lateral hook of gonostylus; *Py* = pygofer.



**Fig. 3.** *Limois sonlaensis* sp. nov., ♂, holotype (VNMN), terminalia: aedeagus and connective. **A.** Lateral view. **B.** Laterodorsal view. **C.** Dorsal view. **D.** Lateroventral view. **E.** Ventral view. **F.** Caudal view. **G.** Posteroventral view.



### Note

*Limois sonlaensis* sp. nov. is the only species of the genus in which RP(+MA) is merging with MP on tegmina. Both tegmina of the specimen show this character. However, as only one male is available, this character needs to be confirmed from additional material in the future, and might represent a good diagnostic character to recognize this species.

### Biology

The specimen was collected at a light trap in secondary mountain tropical evergreen forest, at 1,400 m in altitude (Fig. 4).

### Distribution

Vietnam, Son La Province (Fig. 4).

## DISCUSSION

The genus *Limois* now contains nine species, seven of which being present in China. The genus is also found in

northern India, Myanmar, Bangladesh, Far Eastern Russia and South Korea (Wang et al. 2020), and it is here recorded from Vietnam for the first time. Despite the recent collecting effort, especially in China, very little is known about the natural history of these species, and host plants remain completely undocumented so far. Specimens are quite scarce in the collections, even if it happens that they get collected from light traps. The fact that they seem to prefer mountainous habitats leads to the hypothesis that probably more species exist which will be discovered in the future.

**Acknowledgments.** We thank Miss Mado Berthet (RBINS) for improving the plates of habitus and genitalia; Dr Patrick Grootaert, Dr Frederik Hendrickx, Dr Marie-Lucie Susini Ondafe and Dr Luc Janssens de Bisthoven (RBINS) for supporting our Global Taxonomy Initiative project in Vietnam. This paper is a result of the GTI project “A step further in the Entomodiversity of Vietnam” supported through a grant issued by the capacity building Programme of the Belgian Global Taxonomy Initiative National Focal Point that runs under the CEBioS programme with financial support from the Belgian Directorate-General for Development Cooperation (DGD). The present study was also



**Fig. 4.** *Limois sonlaensis* sp. nov., distribution map.



supported by the Vietnam National Foundation for Science and Technology Development (NAFOSTED) for the second author.

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Autor(en)/Author(s): Constant Jerome, Pham Hong-Thai

Artikel/Article: [First record of the lanternfly genus Limois Stål, 1863 in Vietnam with a new species, \*L. sonlaensis\* sp. nov. \(Hemiptera: Fulgoromorpha: Fulgoridae\) 9-17](#)