

Research article[urn:lsid:zoobank.org:pub:C4E72122-207A-4ED4-B71E-8BF6E35DC753](https://zoobank.org/pub:C4E72122-207A-4ED4-B71E-8BF6E35DC753)**First record of the lanternfly genus *Limois* Stål, 1863 in Vietnam with a new species, *L. sonlaensis* sp. nov. (Hemiptera: Fulgoromorpha: Fulgoridae)****Jérôme Constant^{1,*} & Thai Hong Pham²**¹Royal Belgian Institute of Natural Sciences, O.D. Phylogeny and Taxonomy, Entomology, Vautier street 29, B-1000 Brussels, Belgium.²Mienrung Institute for Scientific Research, Vietnam Academy of Science and Technology, 321 Huynh Thuc Khang, Hue, Vietnam²Vietnam National Museum of Nature & Graduate School of Science and Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Hanoi, Vietnam*Corresponding author: Email: jerome.constant@naturalsciences.be¹[urn:lsid:zoobank.org:author:6E6072A1-9415-4C8D-8E60-2504444DB290](https://zoobank.org/author:6E6072A1-9415-4C8D-8E60-2504444DB290)²[urn:lsid:zoobank.org:author:E34CB863-7E3B-4E8F-8738-B41C07D9F5F9](https://zoobank.org/author:E34CB863-7E3B-4E8F-8738-B41C07D9F5F9)

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.

Abbreviations for measurements

The measurements were taken as in Constant (2004).

BF	=	maximum breadth of the frons
BTg	=	maximum breadth of the tegmen
BV	=	maximum breadth of the vertex
LF	=	length of the frons at median line
LTg	=	maximum length of the tegmen
LT	=	total length (apex of head to apex of tegmina)
LV	=	length of the vertex at median line

The photographs of the collection specimens were taken with a Canon 700D camera equipped with a Sigma 50 mm Macro lens; those of the terminalia, with a Leica EZ4W stereomicroscope with integrated camera, and in both cases, stacked with CombineZ software and optimized with Adobe Photoshop CS3. The distribution map was produced with SimpleMappr (Shorthouse 2010).

Institutional abbreviations

VNMN	=	Vietnam National Museum of Nature, Hanoi, Vietnam.
GTI	=	Global Taxonomy Initiative.

RESULTS

Order Hemiptera Linnaeus, 1758
 Suborder Auchenorrhyncha Duméril, 1806
 Infraorder Fulgoromorpha Evans, 1946
 Superfamily Fulgoroidea Latreille, 1807
 Family Fulgoridae Latreille, 1807
 Subfamily Aphaeninae Blanchard, 1847
 Tribe Limoisini Lallemand, 1963

Genus *Limois* Stål, 1863

Limois Stål, 1863: 230.

Type species: *L. westwoodii* (Hope, 1843).

Limois – Metcalf 1947: 170. — Lallemand 1963: 54. — Chou & Lu 1981: 221. — Chou et al. 1985a: 30. — Chou et al. 1985b: 108. — Nagai & Porion 1996: 22. — Wang et al. 2020: 36.

Species included [distribution]

Limois bifasciatus Ollenbach, 1928 [India, Uttarakhand State (Ollenbach, 1928)]

Limois chagyabensis Chou & Lu, 1981 [China: Xizang, Shaanxi, Sichuan (Wang et al., 2020)]

Limois emelianovi Oshanin, 1908 [China: Gansu, Dongbei (Wang et al. 2020); Russia (Oshanin 1908; Anu-

friev 2009); Korea (Doi 1932a, 1932b; Kwon & Huh 2001)].

Limois guangxiensis Chou & Wang, 1985 [China: Guangxi, Fujian (Wang et al. 2020)]

Limois hunanensis Chou & Wang, 1985 [China: Hunan (Wang et al. 2020)]

Limois kikuchii Kato, 1932 [China: northern China (Kato 1932, 1933), Shaanxi, Beijing (Liang 2005), Korea (Kato 1933; Metcalf 1947)]

Limois sonlaensis sp. nov. [Vietnam: Son La Province]

Limois sordida Wang, Xu, Constant & Qin, 2020 [China: Shanxi; Hebei, Beijing (Wang et al. 2020)]

Limois westwoodii (Hope, 1843) [Bangladesh (Hope 1843); China: Xizang; Myanmar (Wang et al. 2020)]

Identification key to the species of *Limois* Stål, 1863

1. Frons with three longitudinal carinae (Wang et al. 2020: figs 1E–F, 4C, 6E, 11D) 2
 - Frons with two longitudinal carinae (Wang et al. 2020: figs 2E, 3B, 8D, 9D–F) 5
2. Pronotum with one dark irregular patch along the posterior margin on each lateral area (Wang et al., 2020: fig. 11B); base of hindwings yellow in male and red in female (Wang et al. 2020: fig. 11A, C) ...
 - *L. emelianovi* Oshanin, 1908
 - Pronotum without one dark irregular patch along the posterior margin on each lateral area (Wang et al., 2020: figs 1D, 4B, 6D); base of hindwings concolorous in both sexes (Wang et al., 2020: figs 1A–B, 4A, D, 6A–B) 3
3. Pronotum brown (Wang et al., 2020: fig. 4B); genital styles distinctly elongate, subtriangular in lateral view (Wang et al., 2020: fig. 5A–B)
 - *L. kikuchii* Kato, 1932
 - Pronotum purplish red or dark brown (Wang et al. 2020: figs 1D, 6D); genital styles short, almost equilateral in lateral view (Wang et al. 2020: figs 1H, 7A, C) 4
4. Pronotum purplish red (Wang et al. 2020: fig. 1D); thorax sparsely covered with few dark spots (Wang et al., 2020: fig. 1D); irregular stripe in tegmina short and straight, not extending to anal angle (Wang et al., 2020: fig. 1A–C); apical half of endosomal processes exposed (Wang et al. 2020: figs 1K–L, 14C–D)
 - *L. chagyabensis* Chou & Lu, 1981
 - Pronotum dark brown (Wang et al. 2020: fig. 6D); thorax densely covered with numerous dark spots (Wang et al., 2020: fig. 6D); irregular stripe in tegmina long, sinuately extending to anal angle (Wang et al., 2020: fig. 6A–C); apical 1/3 of endosomal processes exposed (Wang et al. 2020: figs 7D–E, 15C–D)
 - *L. sordida* Wang, Xu, Constant & Qin, 2020

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 2/4 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 variegated 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).

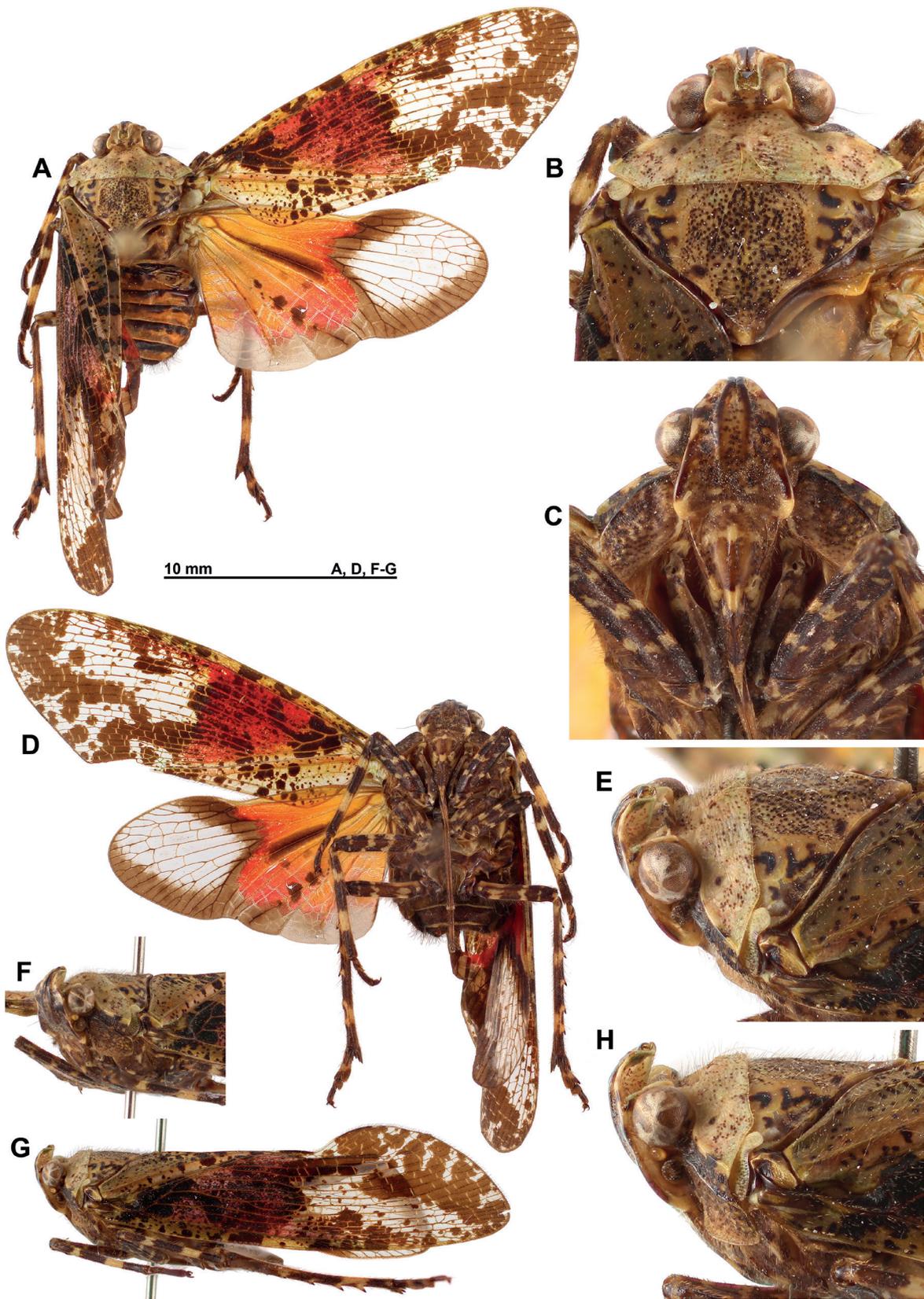


Fig. 1. *Limois sonlaensis* sp. nov., ♂, holotype (VNMN). **A.** Habitus, dorsal view. **B.** Head and thorax, dorsal view. **C.** Head and thorax, perpendicular view of frons. **D.** Habitus, ventral view. **E.** Head and thorax, laterodorsal view. **F.** Head and thorax, anterolateral view. **G.**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

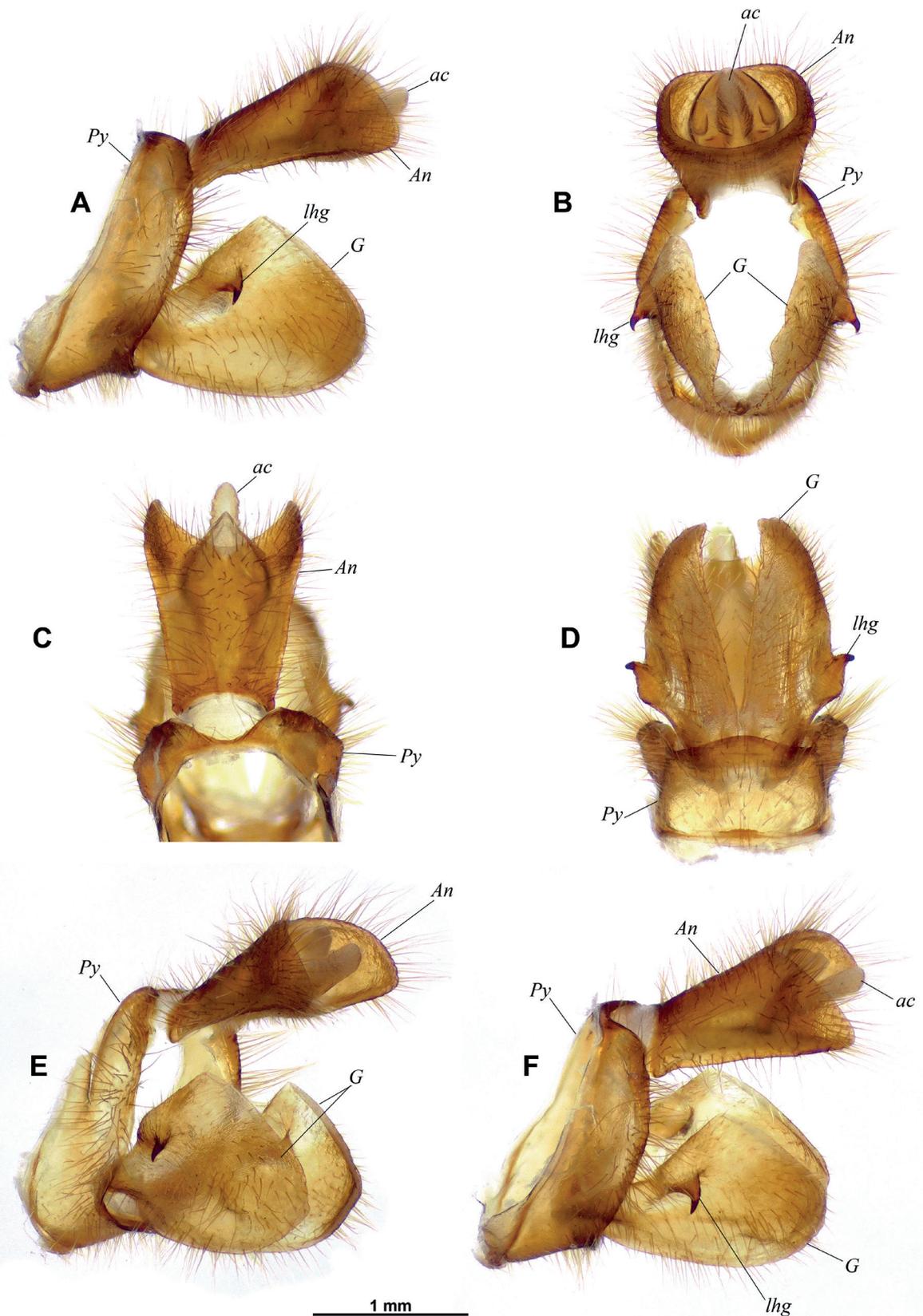


Fig. 2. *Limois sonlaensis* sp. nov., ♂, holotype (VNMN), terminalia: anal tube, pygofer and gonostyli. **A.** Left lateral view. **B.** Caudal view. **C.** Dorsal view. **D.** Ventral view. **E.** Posterolateral view. **F.** Laterodorsal view. Abbreviations: *ac* = anal column; *An* = anal tube; *G*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

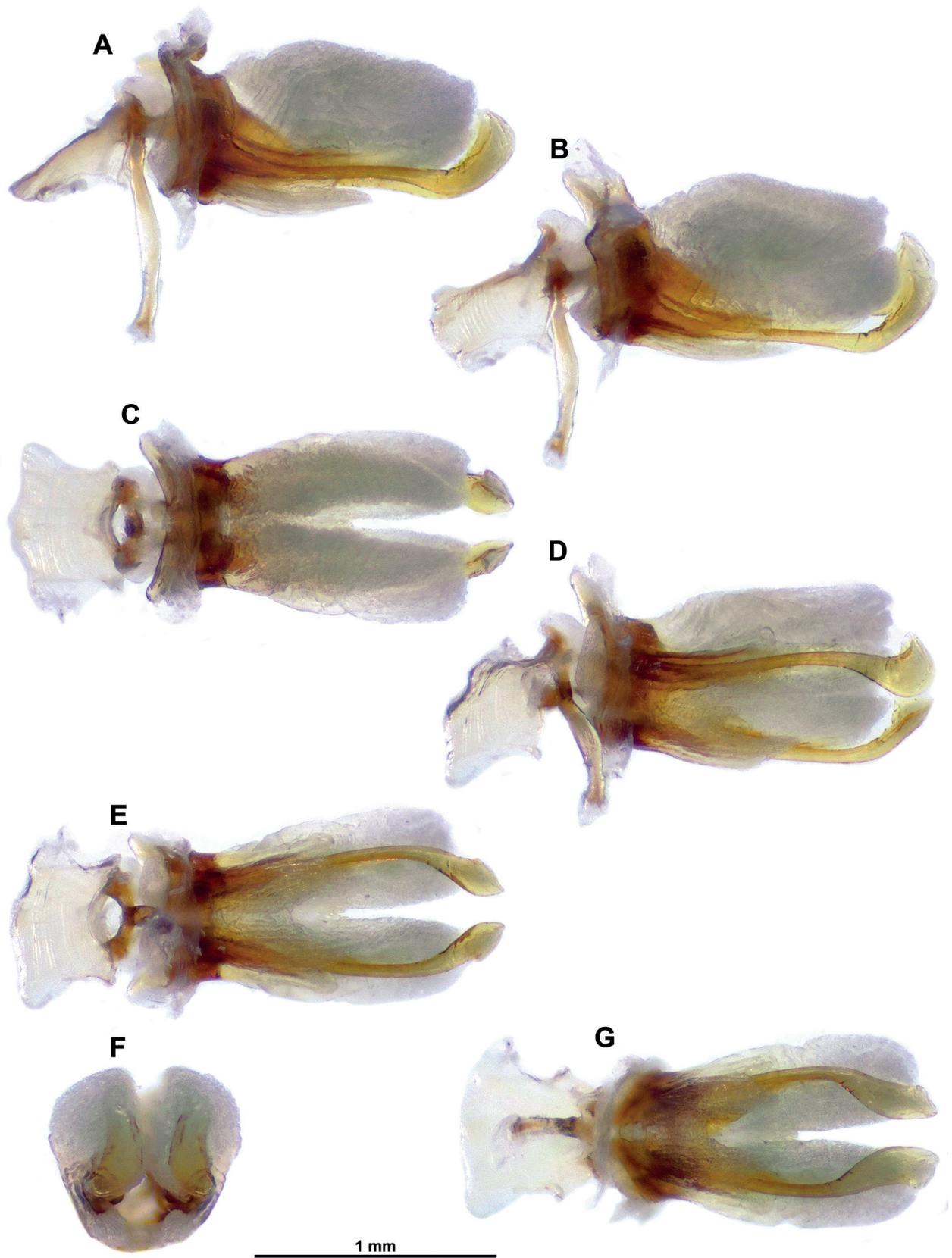


Fig. 3. *Limois sonlaensis* sp. nov., ♂, holotype (VNMN), terminalia: aedeagus and connective. **A.** Lateral view. **B.** Laterodorsal view. **C.** Dorsal view. **D.** Lateroventral view. **E.** Ventral view. **F.** Caudal view. **G.** Posteroventral view.

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.

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

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