

## Research article

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# Review of the genus *Superciliaris* Meng, Qin & Wang, 2020 (Hemiptera, Fulgoroidea, Issidae): from island endemic to wide Oriental distribution

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[urn:lsid:zoobank.org/author:85C736EC-1219-4F74-8848-3A168CF20152](https://zoobank.org/author:85C736EC-1219-4F74-8848-3A168CF20152)

**Abstract.** Three new species of the genus *Superciliaris* Meng, Qin & Wang, 2020 are described from southern Vietnam, Malaysia (northern Borneo), and Indonesia (northern Sulawesi). The genus is recorded for the first time from mainland Asia and Sunda Archipelago. A key to species of *Superciliaris* is given. The relationships of the species are discussed.

**Keywords.** Genetic connections, Hemisphaeriini, Issinae, morphology, new species, soil trap, southeastern Asia.

Gnezdilov V.M. 2022. Review of the genus *Superciliaris* Meng, Qin & Wang, 2020 (Hemiptera, Fulgoroidea, Issidae): from island endemic to wide Oriental distribution. *European Journal of Taxonomy* 826: 80–93. <https://doi.org/10.5852/ejt.2022.826.1837>

## Introduction

The genus *Superciliaris* Meng, Qin & Wang, 2020 (in Zhang *et al.* 2020) belongs to the planthopper family Issidae Spinola, 1839, which is widely distributed and species-rich in the Oriental region (Gnezdilov 2013; Bourgoin 2022). Originally, *Superciliaris* was included in the monotypic issid subfamily Superciliarinae Meng, Qin & Wang, 2020 (in Zhang *et al.* 2020), subsequently placed in synonymy under the tribe Hemisphaeriini Melichar, 1906 of the subfamily Issinae Spinola, 1839 sensu Gnezdilov *et al.* (2020) (Gnezdilov 2022). This genus was erected for two species, *Superciliaris reticulatus* Meng, Qin & Wang, 2020 (type species) and *S. diaoluoshanis* Meng, Qin & Wang, 2020, both described from Hainan Island (China) (Zhang *et al.* 2020). During my study of the material on Issidae from Vietnam and the Sunda Archipelago deposited in the Zoological Institute of the Russian Academy of Sciences in Saint Petersburg (Russia) and in the Natural History Museum in London (UK), three new species of *Superciliaris* were discovered and they are described below. These new findings significantly expand the distribution of the genus in the Oriental Region from Hainan Island to Vietnam, Borneo and Sulawesi.

## Material and methods

The terminology of the head and body follows Anufriev & Emeljanov (1988) and that of the male genitalia follows Gnezdilov *et al.* (2014). The taxonomy of the family Issidae follows Gnezdilov *et al.* (2020). Photographs were taken using a Canon EOS 5D Mark IV camera with a lens Canon-MP-E-65mm f/2,8 1–5× Macro and a flash Canon Macro Twin-Lite MT-26EX-RT. Images were produced using Helicon Focus ver. 7.6.4 and Adobe Photoshop ver. CC 2019 software. The genital segments were macerated in 10% KOH and figured in glycerine jelly (Brunel Micro Ltd, UK) using a Leica MZ9.5 stereo microscope with a camera lucida.

The type specimens of the species described are deposited in the Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia (ZIN) and in the Natural History Museum, London, UK (BMNH).

Label information for the specimens from BMNH is quoted, with ‘/’ indicating a new line and ‘//’ indicating the next label.

## Results

### *Taxonomy*

Class Insecta Linnaeus, 1758  
 Order Hemiptera Linnaeus, 1758  
 Suborder Auchenorrhyncha Duméril, 1806  
 Superfamily Fulgoroidea Latreille, 1807  
 Family Issidae Spinola, 1839  
 Subfamily Issinae Spinola, 1839  
 Tribe Hemisphaeriini Melichar, 1906

*Superciliaris* Meng, Qin & Wang, 2020

*Superciliaris* Meng, Qin & Wang (in Zhang *et al.* 2020): 296.

### **Type species**

*Superciliaris reticulatus* Meng, Qin & Wang, 2020.

### **Diagnosis**

Head, pronotum, mesonotum, and forewings finely shagreened by punctation. Metope (frons) wide, with lateral margins nearly straight or slightly converging above eyes and foliated below eyes hanging over the pedicels (Fig 4B, D, F). Metopoclypeal suture nearly straight, deep. Pedicel globular. Rostrum distinctly protruding beyond hind coxae; 3<sup>rd</sup> segment long, nearly as long as 2<sup>nd</sup> one, narrowing apically. Eyes 0.5 × as wide as coryphe (vertex) (in dorsal view) (Figs 1A, 2A, 3A). Paradiscal fields of pronotum very narrow behind eyes. Paranotal lobes of pronotum triangular-shaped, with strongly producing lower angle (Fig. 4A). Scutellum depressed basally. Tegulae narrow, with elongate depression (Fig. 4E, G). Forewings wide, with reticulate venation, without hypocostal plate, claval suture invisible. Forewing costal margin strongly protruding below eyes (in lateral view) (Fig. 4C, E, G). Hind wings rudimentary. Male anal tube with long and narrow column. Male pygofer elongate vertically. Apical aedeagal process long and narrow, pointed, well visible above upper phallobase margins as two filaments (Figs 5B, 6B, 7A). Aedeagus with pair of ventral hooks directed basally, nearly straight or strongly curved. Gonopore apical.

## Distribution

Five species known from China (Hainan), Vietnam, Malaysia (Borneo), and Indonesia (Sulawesi).

## Key to the species of *Superciliaris* Meng, Qin & Wang, 2020

1. Metope and coryphe joined at acute angle (in lateral view) (Fig. 1B). Metope with distinct median comb or carina in its upper half (Figs 1C, 4B). Aedeagus with short ventral hooks ( $\frac{1}{3}$  of aedeagus length) arise nearly medially ..... 2
  - Metope and coryphe joined at nearly right angle (in lateral view) (Figs 2B, 3B). Metope flat, without comb or with weak carina (Figs 2C, 3C, 4D, 4F). Aedeagus with long ventral hooks ( $\frac{4}{5}$  of aedeagus length) arise subapically ..... 4
2. Generally brown yellowish. Phallobase elongate (in lateral view), with almost straight ventral hooks (Fig. 5B). Vietnam ..... *S. anichkini* sp. nov.
  - Generally dark brown. Phallobase wide (in lateral view), with strongly curved ventral hooks (Zhang *et al.* 2020: figs 116g, 117g) ..... 3
3. Male anal tube with angularly convex posterior margin (in dorsal view) (Zhang *et al.* 2020: fig. 116f). China (Hainan Province) ..... *S. reticulatus* Meng, Qin & Wang, 2020
  - Male anal tube with weakly convex posterior margin (in dorsal view) (Zhang *et al.* 2020: fig. 117f). China (Hainan Province) ..... *S. diaoluoshanis* Meng, Qin & Wang, 2020
4. Coryphe nearly  $2.5 \times$  as wide as long at midline (Fig. 3A). Head, pro- and mesonotum dark brown. Style with nearly straight hind margin (Fig. 7E). Male anal tube distinctly enlarged from its base to its apex (in dorsal view) (Fig. 7C). Malaysia (Sabah) ..... *S. tawaiensis* sp. nov.
  - Coryphe twice as wide as long at midline (Fig. 2A). Head, pro- and mesonotum light yellow, with dense black dots. Style with deeply concave hind margin (Fig. 6D). Male anal tube equally wide (in dorsal view) (Fig. 6F). Indonesia (Sulawesi) ..... *S. celebensis* sp. nov.

### *Superciliaris anichkini* sp. nov.

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Figs 1, 4A–C, 5

## Diagnosis

Generally brown yellowish. Metope and coryphe joined at acute angle. Metope with distinct median and sublateral carinae. Phallobase convex ventrally, without horn-shaped processes apically. Aedeagus with short nearly straight ventral hooks ( $\frac{1}{3}$  of aedeagus length) arise nearly medially on aedeagus.

## Etymology

The species is named after the collector, Dr Alexandr E. Anichkin (Yoshkar-Ola, Russia), soil biologist, who spent many years studying invertebrates of Vietnam.

## Type material

### Holotype

VIETNAM • ♂; Lâm Đông Province, Bidoup Mt.; 1450–1530 m a.s.l.; 24 Apr. 2009; soil trap; A.E. Anichkin leg.; ZIN.

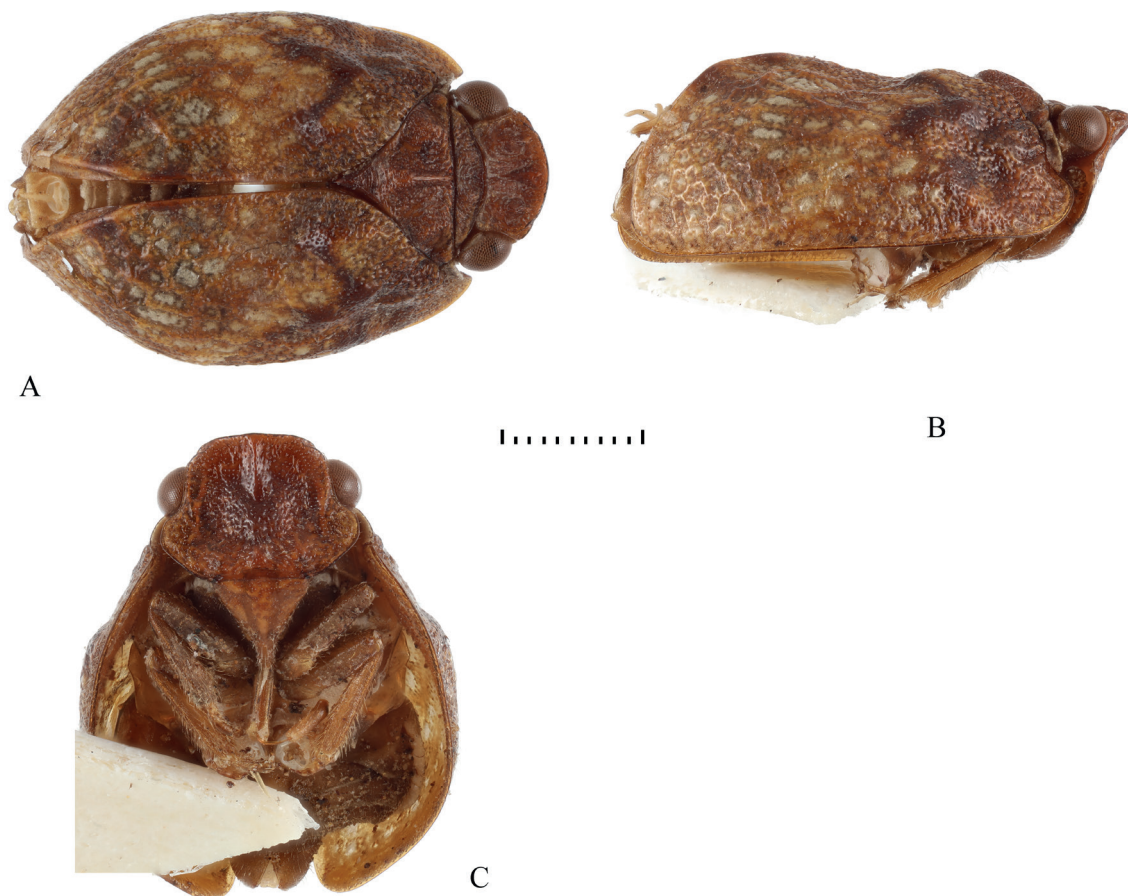
**Description**

**Male**

MEASUREMENTS. Total length: 3.6 mm.

STRUCTURE. Metope with two large depressions besides of midline above postclypeus and with strong median carina running from upper margin to middle and with weaker sublateral carinae joined to metopial upper margin, but not fused to median carina, and running slightly beyond eyes (Figs 1C, 4B). Postclypeus not large, weakly swollen, smooth, without carinae. Metope and coryphe joined at acute angle in shape of short process (in lateral view) (Fig. 1B). Coryphe wide, transverse, shagreened, with three large bulges (triangular medial one and two rounded lateral ones); anterior margin strongly convex; posterior margin widely concave; lateral margins and posterior margin keel-shaped (Fig. 1A). Pronotum short,  $0.5 \times$  as long as coryphe at midline, without carinae but with pair of small bulges besides of midline; anterior margin widely convex; posterior margin straight. Mesonotum  $3 \times$  as long as pronotum, with strong median carina and with pair of large bulges laterally. Each forewing with large bulge in claval basement (Fig. 1B). Fore and middle femora not flattened. Hind legs missed.

COLORATION (Fig. 1). General coloration brown yellowish to dark brown. Eyes dark brown. Forewings with yellowish areas and whitish spots in cells except in basal third. Abdominal sternites, pygofer and styles dark brown. Anal tube light brown.



**Fig. 1.** *Superciliaris anichkini* sp. nov., ♂, holotype (ZIN), external view. **A.** Dorsal view. **B.** Lateral view. **C.** Frontal view. Scale bar = 1 mm.

MALE TERMINALIA (Fig. 5). Pygofer vertically elongate, with convex hind margins (Fig. 5A). Anal tube wide and short, enlarged and truncate apically, with nearly straight posterior margin (in dorsal view) (Fig. 5G). Anal column long surpassing posterior margin of anal tube. Phallobase tubular-shaped, elongate, curved (in lateral view), apical part inflated in water after boiling (Fig. 5C). Ventral phallobase lobe long and wide, slightly narrowing apically (Fig. 5D). Ventral aedeagal hooks nearly straight, directed basally, slightly enlarged subapically, with pointed apices (Fig. 5B, D). Connective relatively large, with long handle. Style vertically elongate, with straight hind margin and weak comb behind neck (in lateral view) (Fig. 5E). Capitulum of style on distinct neck, with wide lateral tooth. Capitulum narrowing apically (in dorsal view) (Fig. 5F).

#### Female

Unknown.

#### Remark

The species was collected in a soil trap in mixed forest with dominating of *Pinus dalatensis* Ferré (Pinaceae) on a soil surface with a well-developed moss cover (Dr Alexandr E. Anichkin pers. com.).

#### *Superciliaris celebensis* sp. nov.

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Figs 2, 4D–E, 6

#### Diagnosis

Generally dark brown. Metope and coryphe joined at nearly right angle (in lateral view). Metope without median carina but with weak sublateral carinae. Phallobase with median groove ventrally; each dorso-lateral phallobase lobe with short horn-shaped process apically. Aedeagus with pair of long ventral hooks ( $\frac{4}{5}$  of aedeagus length) arising subapically. Style with deeply concave hind margin. Male anal tube equally wide (in dorsal view).

#### Etymology

The species is named after the type locality.

#### Type material

##### Holotype

INDONESIA • ♂; “Sulawesi Utara / G. Mogogonipa / summit, 1008 m.” // “Dumoga-Bone N.P. / 20 May 1985.” // “R. Ent. Soc. Lond. / PROJECT WALLACE / B.M. 1985-10”; BMNH.

#### Description

##### Male

MEASUREMENTS. Total length: 3.5 mm.

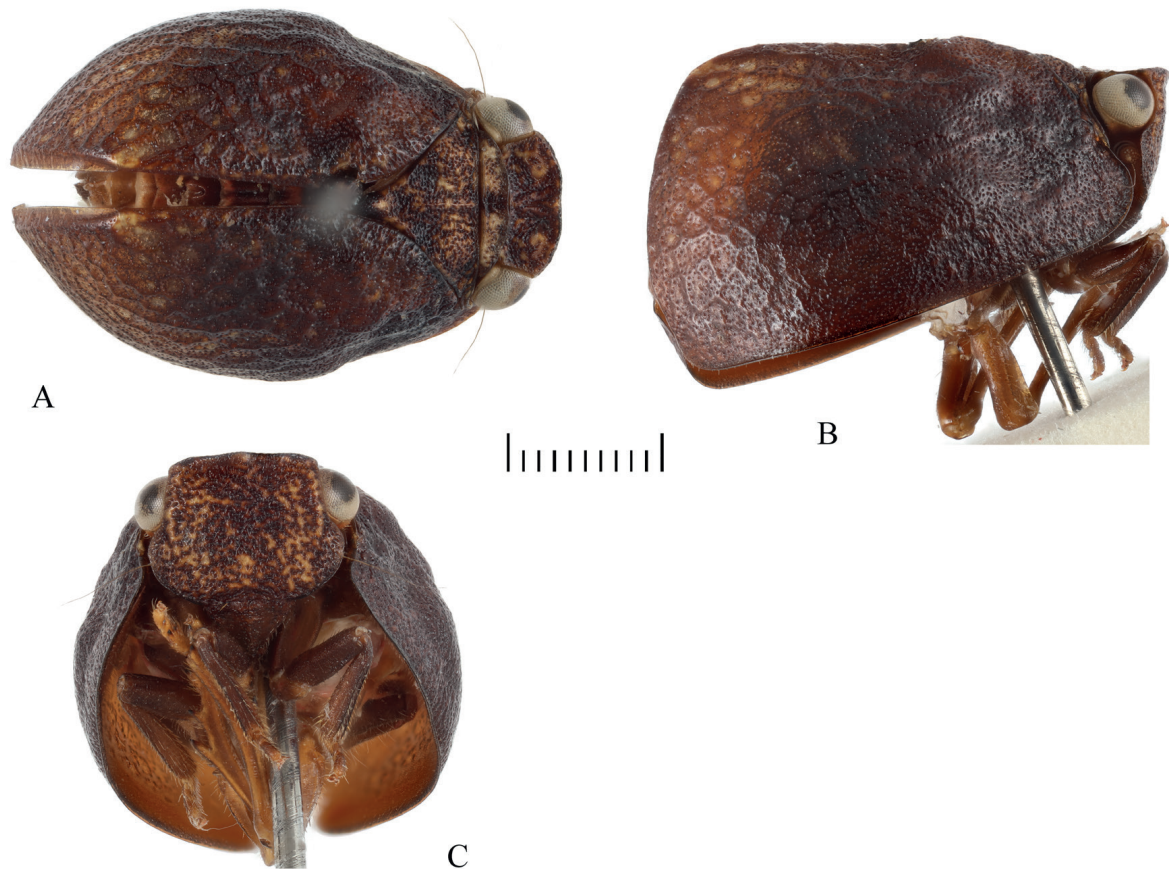
STRUCTURE. Metope slightly depressed below upper margin medially, without median carina but with weak sublateral carinae running from upper margin to slightly beyond eyes and not reaching metopoclypeal suture (Figs 2C, 4D). Postclypeus flattened dorso-ventrally, with distinct median carina. Metope and coryphe joined at nearly right angle (in lateral view). Coryphe twice as wide as long at midline, with pair of weak lateral bulges and with three folds medially; anterior margin convex, with weak median notch; posterior margin weakly concave (Fig. 2A). Pronotum  $0.5 \times$  as long as coryphe, depressed medially. Mesonotum more than  $3 \times$  as long as pronotum, with fine median carina and pair of lateral bulges. Each forewing clavus with bulge basally. Femora and tibiae not flattened. Hind tibia with two lateral spines above middle and with five apical spines. First metatarsomere slightly longer than



second one, but distinctly wider, with long setae ventrally, with two latero-apical and five intermediate spines. Second metatarsomere with two latero-apical spines only. Arolium of pretarsus nearly reaching claw apices (in dorsal view).

**COLORATION** (Fig. 2). Eyes light, except dark brown to black in middle. Metope, coryphe, pro- and mesonotum dark brown, with dense light yellow dots. Clypeus, genae, scapus, rostrum, fore and middle legs dark brown. Pedicel dark brown, with light yellow sensory organs. Paranotal lobes of pronotum light brown yellowish, with dark brown margins. Forewings dark brown to black basally, each with light yellow spot at claval apex. Hind legs brown. Apices of leg spines black. Abdominal segments brown to dark brown, except light yellow hind margins of sternites IV–VII. Anal tube, pygofer and styles dark brown.

**MALE TERMINALIA** (Fig. 6). Pygofer vertically elongate, with convex hind margins (Fig. 6A). Anal tube nearly  $1.5 \times$  as long as wide, equally wide, slightly narrowing apically, with weakly convex posterior margin (in dorsal view) (Fig. 6F). Anal column long and narrow, not surpassing posterior margin of anal tube (in dorsal view). Phallobase vertically elongate, narrow, curved (in lateral view), with median groove ventrally; each dorso-lateral phallobase lobe truncate apically, with short horn-shaped process (Fig. 6B–C). Ventral phallobase lobe short and wide, widely and deeply concave apically (Fig. 6C). Aedeagus with pair of long and narrow, pointed ventral hooks ( $\frac{4}{5}$  of aedeagus length), with several notches apically. Hooks arising subapically and directed downwards. Connective with large cup and



**Fig. 2.** *Superciliaris celebensis* sp. nov., ♂, holotype (BMNH), external view. **A.** Dorsal view. **B.** Lateral view. **C.** Frontal view. Scale bar = 1 mm.

long handle. Style with deeply concave hind margin. Capitulum on short neck, with wide lateral tooth (in lateral view) (Fig. 6D), not narrowing apically (in dorsal view) (Fig. 6E).

#### **Female**

Unknown.

#### **Remark**

Currently Dumoga-Bone National Park is called Bogani Nani Wartabone National Park located in northern Sulawesi.

#### ***Superciliaris tawaiensis* sp. nov.**

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Figs 3, 4F–G, 7

#### **Diagnosis**

Generally dark brown. Metope and coryphe joined at nearly right angle (in lateral view). Metope with very weak and short median carina and weak sublateral carinae. Phallobase with median groove ventrally; each dorso-lateral phallobase lobe with short horn-shaped process apically. Aedeagus with pair of long ventral hooks ( $\frac{4}{5}$  of aedeagus length) arise subapically. Style with nearly straight hind margin. Male anal tube distinctly enlarged from base to apex (in dorsal view).

#### **Etymology**

The species is named after the type locality.

#### **Type material**

##### **Holotype**

MALAYSIA • ♂; “Sabah: Tawai / Plat. 1300 ft, / 8 km S. Telupid / 8.IX.1977” // “M.E. Bacchus / B.M. 1978-48”; BMNH.

#### **Description**

##### **Male**

MEASUREMENTS. Total length (forewing apices curved): 2.8 mm.

STRUCTURE. Metope slightly depressed below upper margin, with very weak and short median carina and weak sublateral carinae running from upper margin to slightly beyond eyes, but not reaching metopoclypeal suture (Figs 3C, 4F). Metope and coryphe joined at nearly right angle (in lateral view) (Fig. 3B). Coryphe transverse, nearly  $2.5 \times$  as wide as long at midline; anterior margin nearly straight; posterior margin concave (Fig. 3A). Coryphe longitudinally striated medially, with pair of weak bulges laterally. Postclypeus with smooth median carina. Pronotum  $0.5 \times$  as long as coryphe at midline, without bulges or carinae. Mesonotum  $4 \times$  as long as pronotum, with fine median carina and pair of lateral bulges. Forewings without bulges. Hind tibia with two lateral spines above middle and with five apical spines. First metatarsomere slightly longer than second one, but distinctly wider, with long setae ventrally and with two latero-apical and five intermediate spines. Second metatarsomere with two latero-apical spines only.

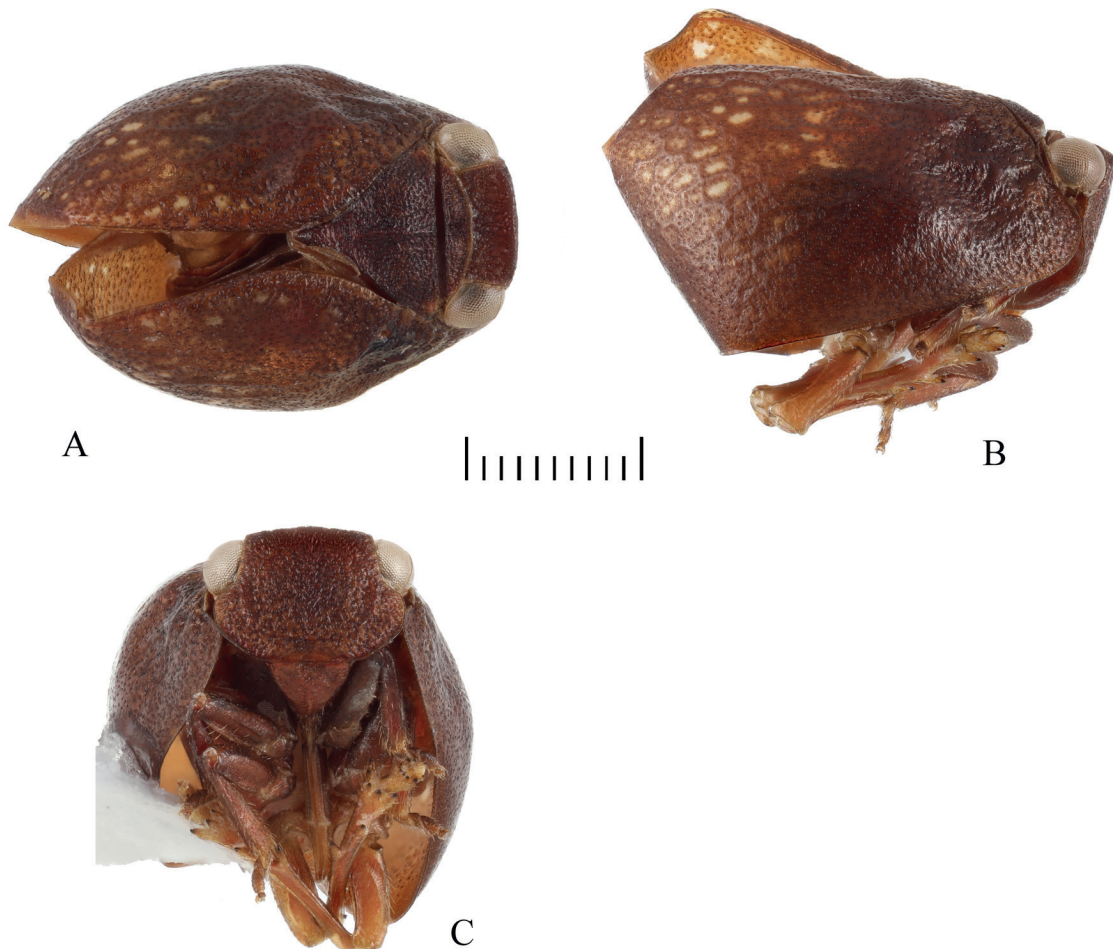
COLORATION (Fig. 3). General coloration dark brown, with black punctuation. Eyes light. 3<sup>rd</sup> segment of rostrum light brown outside and dark brown behind. Forewings with light yellow spots in cells of apical part of clavus and ventro-apical half of corium. Forewing appendix (hardly visible on left wing

on Fig. 3A) light brown yellowish from apex of clavus to dorso-lateral angle. Hind femora and tibiae brown. Apices of leg spines black.

**MALE TERMINALIA** (Fig. 7). Pygofer vertically elongate, with convex hind margins. Anal tube nearly twice as long as wide medially, distinctly enlarged from base to apex (in dorsal view) (Fig. 7C). Anal column long and narrow, not surpassing posterior margin of anal tube (Fig. 7C–D). Phallobase vertically elongate, narrow, curved (in lateral view), with median groove ventrally; each dorso-lateral phallobase lobe truncate apically, with short horn-shaped process (Fig. 7A–B). Ventral phallobase lobe short and wide, widely and deeply concave apically (Fig. 7C). Aedeagus with pair of long ventral hooks ( $\frac{4}{5}$  of aedeagus length) arising subapically and with several notches apically. Style with nearly straight hind margin (in lateral view) (Fig. 7E). Capitulum on distinct neck, with wide lateral tooth, not narrowing apically (in dorsal view) (Fig. 7F).

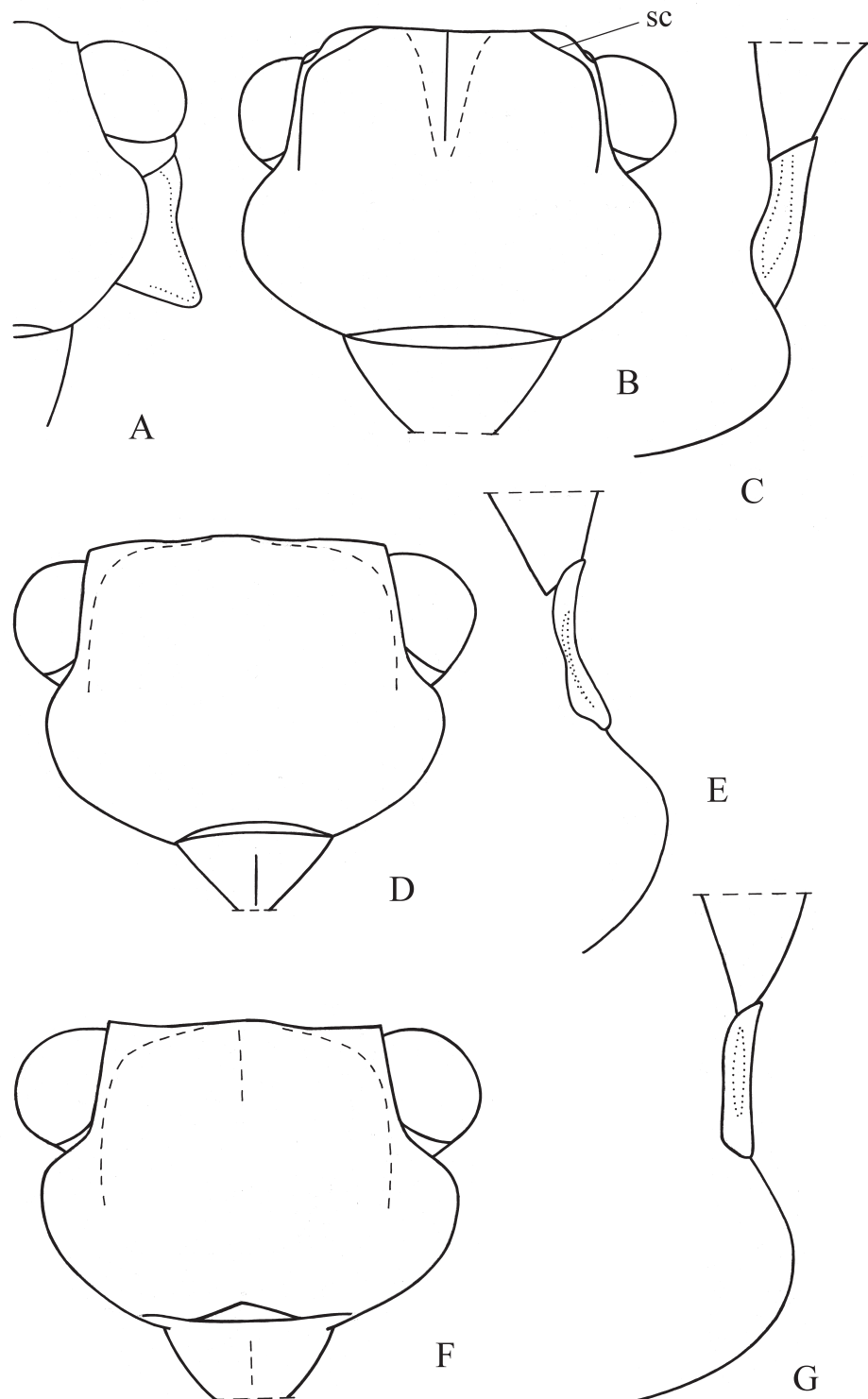
**Female**

Unknown.

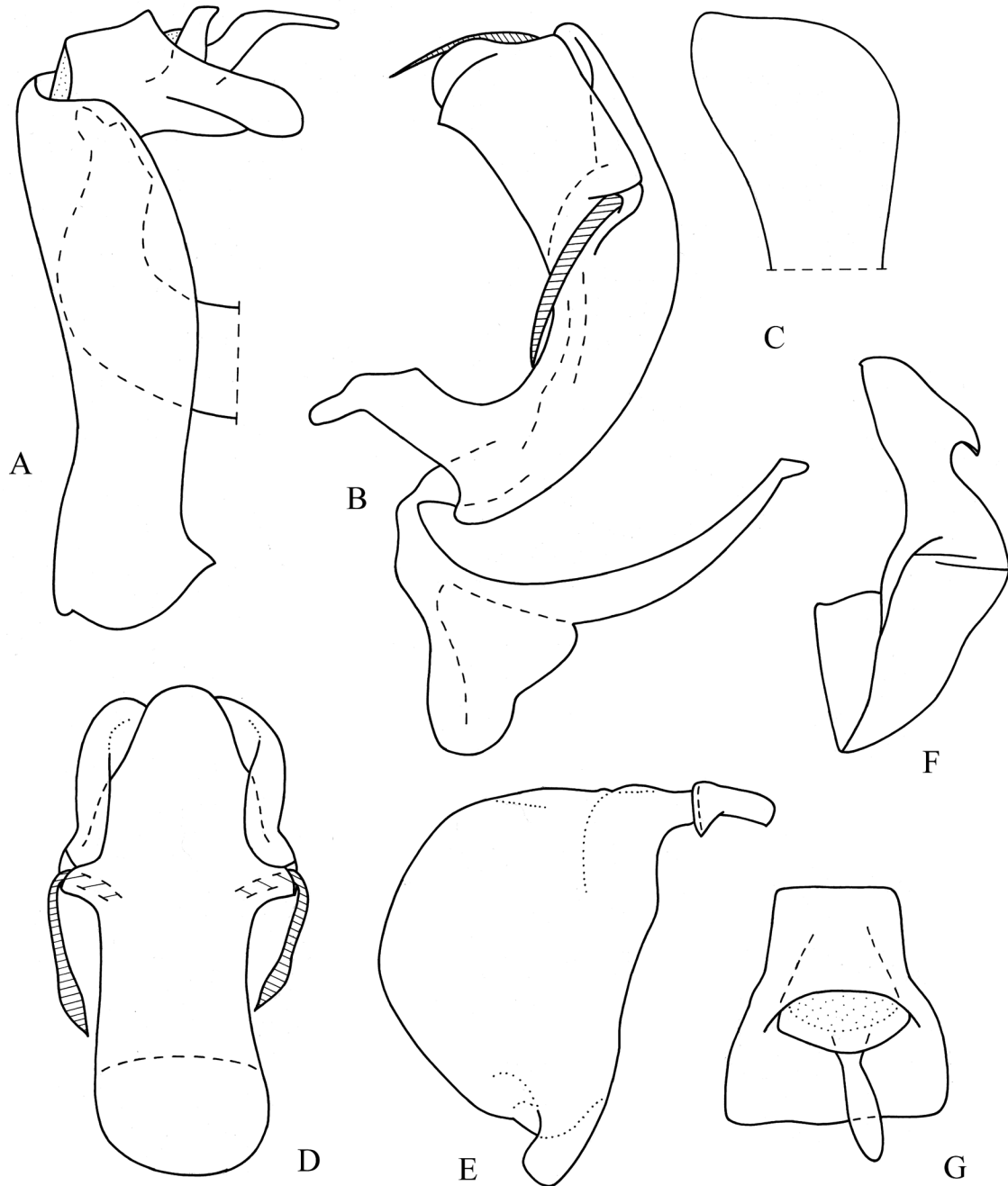


**Fig. 3.** *Superciliaris tawaiensis* sp. nov., ♂, holotype (BMNH), external view. **A.** Dorsal view. **B.** Lateral view. **C.** Frontal view. Scale bar = 1 mm.





**Fig. 4.** *Superciliaris* spp., external view (weak carinae and margins are indicated by dotted lines). **A–C.** *S. anichkini* sp. nov., ♂, holotype (ZIN). **A.** Half of face and left paranotal lobe, frontal view. **B.** Face, frontal view. **C.** Tegula and basal part of forewing, lateral view. **D–E.** *S. celebensis* sp. nov., ♂, holotype (BMNH). **D.** Face, frontal view. **E.** Tegula and basal part of forewing, lateral view. **F–G.** *S. tawaiensis* sp. nov., ♂, holotype (BMNH). **F.** Face, frontal view. **G.** Tegula and basal part of forewing, lateral view. Abbreviation: sc = sublateral carinae of metope. No to scale.

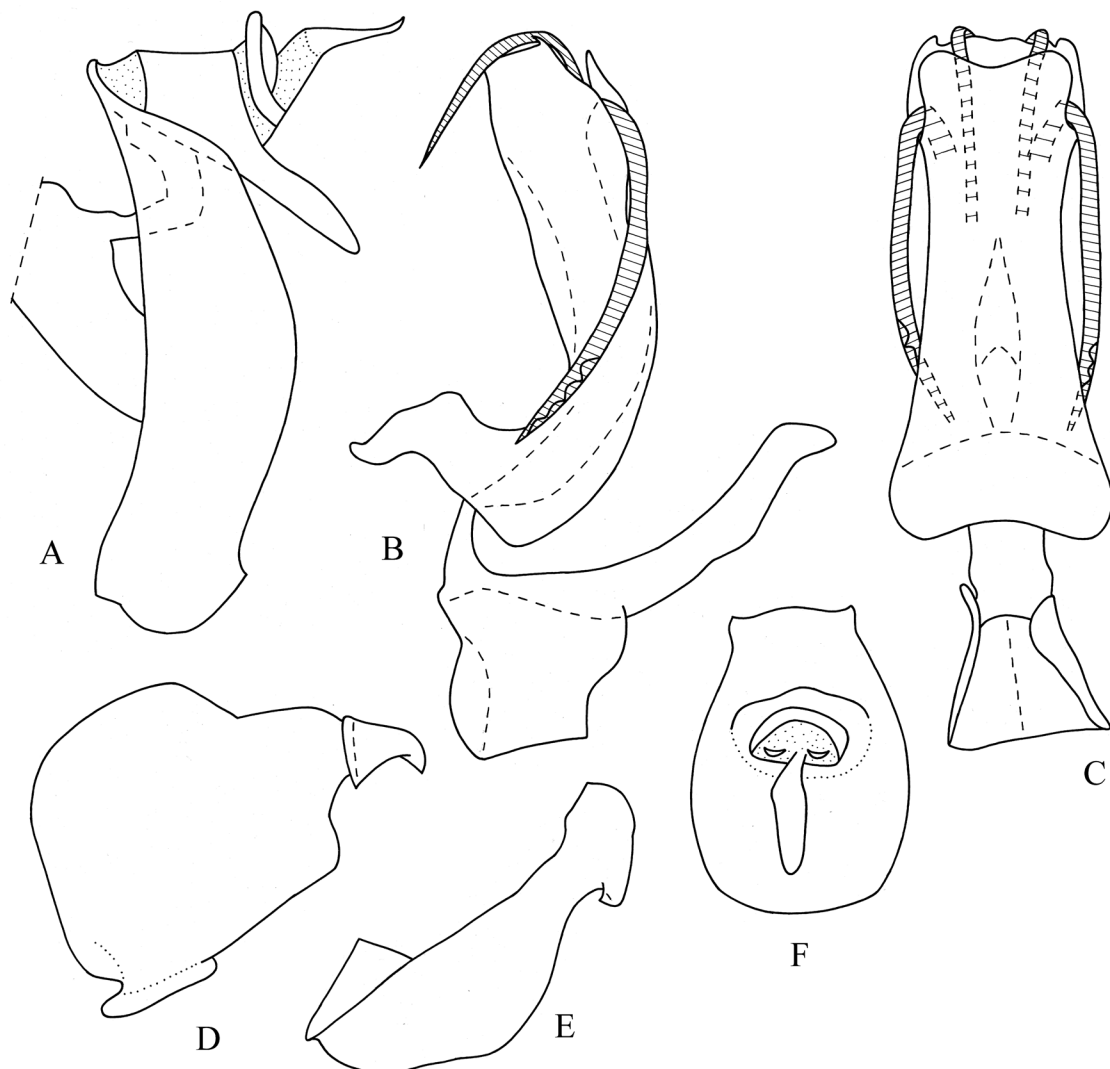


**Fig. 5.** *Superciliaris anichkini* sp. nov., ♂, holotype (ZIN), genitalia. **A.** Pygofer and anal tube, lateral view (basal part of penis showed by dotted line). **B.** Penis (aedeagus shaded) and connective, lateral view. **C.** Apical part of phallobase inflated in water. **D.** Penis, ventral view. **E.** Style, lateral view. **F.** Style, dorsal view. **G.** Anal tube, dorsal view. No to scale.

## Discussion

According to the data on the type locality and the method of collecting (soil trap) of *Superciliaris anichkini* sp. nov., this group of planthoppers probably lives in leaf litter or moss cover. Some of them, *S. reticulatus*, *S. diaoluoshanis*, and *S. anichkini* sp. nov. are even superficially similar to members of the bug family Peloridiidae (Heteroptera) in having spread forewings (in dorsal view) which may be explained by living in similar habitats with moss. However, no ecological data on species of *Superciliaris* is yet available.

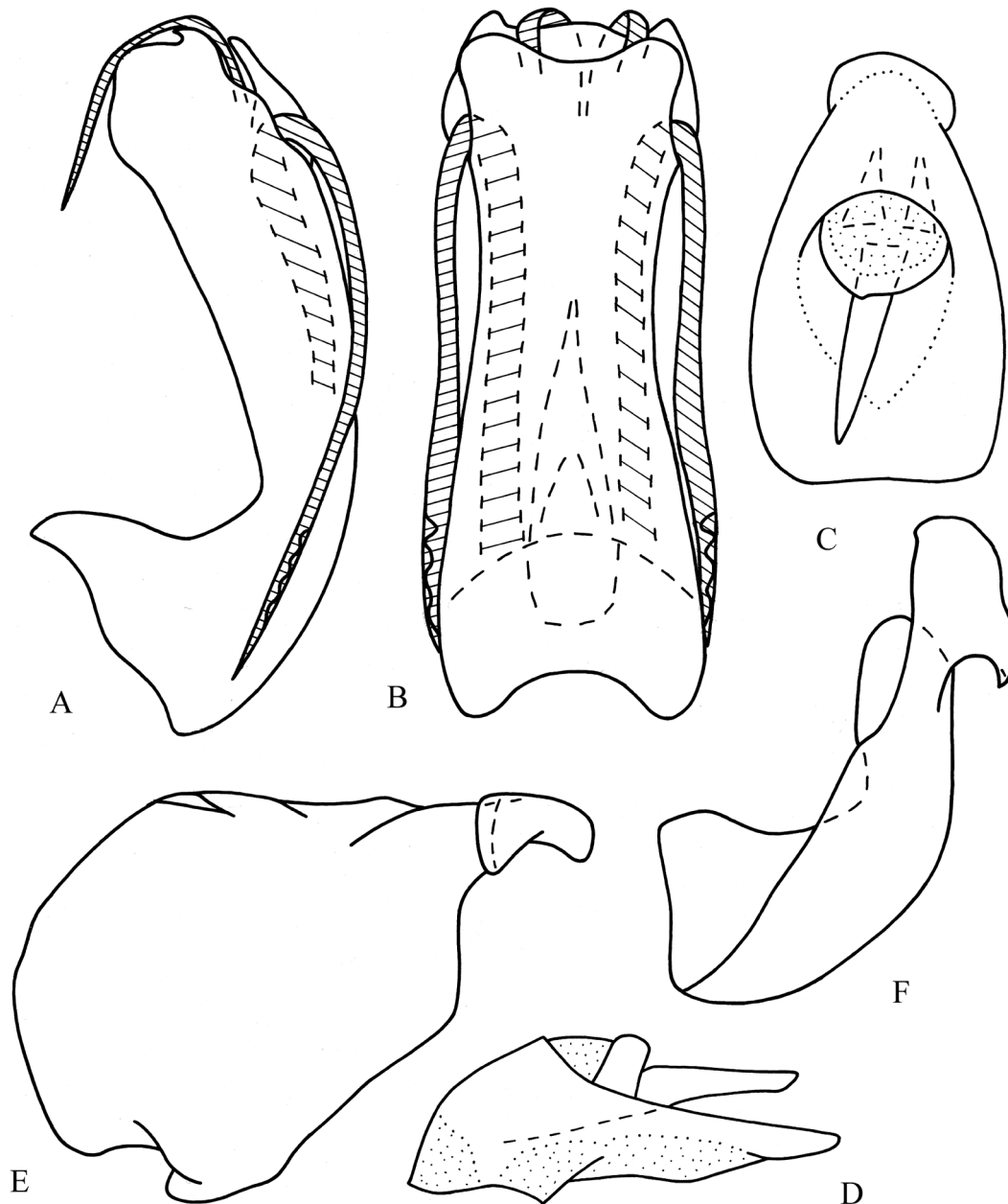
As many other Issidae with coleopterous and subbrachypterous forewings and rudimentary or reduced hind wings, species of *Superciliaris* could disperse between the islands and the mainland of southeastern Asia apparently only via the land bridges formed during volcanic activity or decline and rise in sea level in different periods of the Cenozoic (Hantoro *et al.* 1995; Hall 1996) or via current human activity with



**Fig. 6.** *Superciliaris celebensis* sp. nov., ♂, holotype (BMNH), genitalia. **A.** Pygofer, anal tube, and basal part of penis, lateral view. **B.** Penis and connective, lateral view. **C.** Penis and connective, ventral view. **D.** Style, lateral view. **E.** Style, dorsal view. **F.** Anal tube, dorsal view. No to scale.

any plant cargo which is postulated for several issid species that became adventive in the New and Old World (Gnezdilov & O'Brien 2006; Gnezdilov 2013; Chan *et al.* 2013; Gnezdilov & Bartlett 2022).

Within *Superciliaris*, there are two groups of species (see the key above). One group uniting *S. reticulatus*, *S. diaoluoshanis*, and *S. anichkini* sp. nov. from Hainan Island and southern Vietnam and another group uniting *S. celebensis* sp. nov. and *S. tawaiensis* sp. nov. from Borneo and Sulawesi. In the Indochinese group of species, *S. anichkini* sp. nov. from Vietnam is very distinct in having an elongate phallobase and



**Fig. 7.** *Superciliaris tawaiensis* sp. nov., ♂, holotype (BMNH), genitalia. **A.** Penis, lateral view. **B.** Penis, ventral view. **C.** Anal tube, dorsal view. **D.** Anal tube, lateral view. **E.** Style, lateral view. **F.** Style, dorsal view. No to scale.



almost straight ventral aedeagal hooks while *S. reticulatus* and *S. diaoluoshanis* from Hainan are closely related and differ from each other mainly by the shape of the male anal tube. *Superciliaris celebensis* sp. nov. and *S. tawaiensis* sp. nov. from Sunda are closely related and differ mainly in the shape of the style and the male anal tube while both clearly differ from the Indochinese species in head structure and length and attachment of the ventral aedeagal hooks. Thus, apparently the age difference between the species from mainland Indochina and the species from Hainan, Borneo, and Sulawesi is much greater than it is between the two Hainan species or the two species of Sunda. In particular, the species from the Sunda Archipelago may only have separated from each other after the last glacial period during the rise in sea level between the islands.

## Acknowledgments

I am glad to thank Dr Vladimir V. Neimorovets (Saint Petersburg, Russia) for taking photos of the species described and Dr Alexandr E. Anichkin (Yoshkar-Ola, Russia) for collecting and providing the type specimen of *Superciliaris anichkini* sp. nov. as well as for his friendly support during my field trip to Vietnam and to Mr Michael D. Webb (London, UK) for the opportunity to study the specimens from the collection of the Natural History Museum in London and his kind help during my stay in London. I also thank the anonymous reviewers for their useful comments on the manuscript. My research stay at the Natural History Museum was sponsored by the Royal Society of London. The study is performed in the frameworks of the Russian State Research project N 1021051302540-6.

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*Manuscript received: 5 Jan. 2022*

*Manuscript accepted: 27 May 2022*

*Published on: 27 June 2022*

*Topic editor: Tony Robillard*

*Section editor: Christopher H. Dietrich*

*Desk editor: Eva-Maria Levermann*

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