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Research Article

A catalogue and redescription of type specimens of fireflies (Coleoptera, Lampyridae, Luciolinae) deposited in Naturalis Biodiversity Center, Leiden

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Abstract

Type specimens of flashing fireflies (Coleoptera, Lampyridae, Luciolinae) in the Naturalis Biodiversity Center, Leiden (RMNH) collection were documented. Specimens explicitly marked or indicated as types belonging to the lucioline fireflies were investigated with each specimen and its accompanying labels photographed, and its morphological characters analysed and compared with the original species description. The genitalia dissections of selected types enabled redescription and clarification of the taxonomic status of seven name-bearing type specimens. This study provides the first redescriptions of holotypes, designation of lectotypes for five species, and confirmation that two of these belong in the genus *Luciola* s. str. A lectotype and paralectotype were designated for two specimens of *Luciola cerea* Gorham, 1882 which is confirmed to belong to the genus *Curtos* Motschulsky, 1845. *Atyphella testaceolineata* Pic, 1939 was redescribed and figured based on the holotype (an incomplete specimen). We assigned *Luciola laticollis* Gorham, 1883 and *Luciola nicollieri* Bugnion, 1922 to *Luciola* sensu stricto and *Luciola picea* Gorham, 1882 to *species inquirenda*. The identity of *Pteroptyx decolor* Olivier, 1911 is finally confirmed as a close Indonesian relative of *Pteroptyx valida* Olivier,1909 and a lectotype is designated. In addition, we take the first opportunity to present pictures of the original holotype of *Pygoluciola stylifer* Wittmer, 1939. We also discuss the challenges taxonomists face in identifying specimens and how detailed dissections allow us to present descriptions of certain male features not previously addressed.

Key Words

Atyphella, *Curtos*, Indonesia, *Luciola* sensu stricto, name-bearing type, Philippines, *Pteroptyx decolor*, Southeast Asia, Sri Lanka

Introduction

Firefly beetles, or Lampyridae, are diverse insects with more than 2,200 species (Lewis et al. 2024). Within Lampyridae, the subfamily Luciolinae Lacordaire, 1857, is among the largest, consisting of more than 400 described species. Most lucioline species are found in Southeast Asia and the Australopacific regions (Ballantyne et al. 2019; Jusoh et al. 2021).

Identifying species in the Luciolinae taxonomy is a difficult task for taxonomists due to inadequate descriptions and difficulties in locating types (Ballantyne et al. 2022). Firefly specimens are soft-bodied and prone to distortion, adding to the challenge (Ballantyne 2008). Type specimens are mostly found in European museums, which makes it even more challenging for taxonomists in these regions (Ballantyne et al. 2019).

In late 2019, one of us (WFAJ) had the opportunity to visit the Naturalis Biodiversity Center in Leiden, the Netherlands and search collections to locate and digitally catalogue type specimens of Lampyridae. Naturalis Biodiversity Center (RMNH), is one of the world's

largest and most important natural history collections. It contains approximately 37 million specimens from the collections of the National Museum of Natural History (Rijksmuseum voor Natuurlijke Historie), the former Zoological Museum Amsterdam (ZMA), and the former National Museum of Geology and Mineralogy (Rijksmuseum voor Geologie en Mineralogie) (Creuwels 2017). The most extensive collection in RMNH is Entomology, which contains about 18 million specimens (Naturalis Biodiversity Center: https://www.naturalis.nl/en/deelcollecties).

In this study, we examined Luciolinae specimens explicitly marked or indicated as type material, collected from major islands in Indonesia (including parts of Borneo), Sri Lanka, and the Philippines, currently housed in RMNH. This illustrated catalogue aims to enhance the accessibility to Lampyridae type material knowledge, particularly for researchers in South and Southeast Asia and the Pacific islands.

To ensure consistency, we compared the external morphology of the type specimen with the original descriptions. Each specimen and its labels was photographed using a high-resolution imaging system, and a museum barcode catalogue number was assigned. We also clarified the taxonomic status of each named species and designated lectotypes for selected species.

Methods

Digital imaging

Images were captured using digital imaging systems. RMNH supplied habitus images and labels of specimens (Hans Huijbregts and Yvonne van Dam). Specific angles highlighting diagnostic characters of Luciolinae were photographed using the Dun Inc. Passport II Photomicrography imaging system (with 65 mm MPE Canon Lens), and image processing followed the procedure outlined in Jusoh et al. (2021). For capturing genitalia features, Leica Microsystem's microscope camera (Model DMC5400) was employed.

Taxonomy and interpretation of labels

Species are addressed in alphabetical order under a generic heading with full generic synonymic tables as given in Ballantyne et al. (2019). Descriptions of morphological characters and information about genera follow Ballantyne et al. (2022) with abbreviations repeated below. Text is transcribed verbatim as it appears on the respective labels. The labels are listed and numbered in the order found on the specimen, commencing with the uppermost. A slash (/) separates texts on different lines, and a semi-colon (;) separates different labels. If the text on labels cannot be appropriately identified, the line is marked by "[?]".

Interpretation of localities

Type localities are cited in their original spelling with current interpretation of cited locations in Table 1.

Table 1. Interpretation by the authors, of the verbatim used to describe locality.

Verbatim location	Interpretation of locality (Country)
"Buru"	Buru is one of the islands within Maluku Islands (Indonesia)
"L. Petak"	Long Petak in northern Kalimantan on island of Borneo (Indonesia)
"SW Celebes" / "Paloppo" / "Todjamboe"	Southwest West Sulawesi / Palopo / Tojambu. Tojambu is a locality in Palopo in the province of South Sulawesi (Indonesia)
"Ceylan" / "Talgaswella"	Sri Lanka / Talgaswella (Sri Lanka)
"Bodjonegoro"	Bojonegoro is in East Java (Indonesia)
"Koetoer"	Kutur (?) in Sumatra (Indonesia)
"Rawas"	Rawas could possibly refer to Rawas area of the upper Musi River on the island of Sumatra (Indonesia)
"Lebong"	Lebong in Bengkulu Province, Indonesia, on the island of Sumatra (Indonesia)
"Palembang bovenland"	Palembang Highlands is referring to Palembang in South Sumatra (Indonesia)
"Atjeh"	Aceh or Aceh Province on the northwest tip of Sumatra Island (Indonesia)
"Borneo" / "occ" / "Sambas"	Borneo / occidental(?) / Sambas. Sambas is one of the regencies of West Kalimantan province (Indonesia)
"H. pg"	It could be interpreted as an abbreviation of "Highlands of Palembang" based on Gorham's original description of *Luciola picea* (Indonesia)
"Alahan pandjang"	Alahan Panjang is in West Sumatra (Indonesia)
"Nueva Vizcaya" / "Imugan"	Imugan is in the municipality of Santa Fe, province of Nueva Vizcaya (Philippines)

Abbreviations for taxonomic characters

Abbreviations follow Ballantyne et al. (2015, 2019, 2022) and are repeated for convenience:

ASD distance between antennal sockets;
BP basal piece;
FS antennal flagellar segments;
GHW greatest head width (across eyes, measured parallel to ASD);
L length;
LL lateral lobes;
LO light organ;
ML median lobe;
MN mesonotal plates;
MPP median posterior projection ventrite 7 male only;
MS mesoscutellum;
W width;
V abdominal ventrites referred to by actual number e.g., V2, V6;
T abdominal tergites.

Elytral interstitial lines are numbered from 1, nearest the suture, to 4, nearest the lateral margin. Condition of the specimens precluded any attempt to investigate further features of the mouthparts including the nature of the apical labial palpomere. All figures have anterior end to top of page unless otherwise indicated.

Results

We examined 15 specimens of lucioline fireflies in RMNH collection, of which 13 are confirmed below as type material:

An incomplete specimen of *Atyphella testaceolineata* Pic, 1939 (abdomen only) was redescribed and figured; no dissections were made.

Two specimens of *Luciola cerea* Gorham, 1882 were designated as lectotype and paralectotype and redescribed, and this species confirmed as a species of *Curtos* Motschulsky, 1845; a further two specimens labelled *L. cerea* were not considered to be types.

Luciola laticollis Gorham, 1883 was redescribed from a male lectotype and female paralectotype designation and confirmed to belong to the genus *Luciola* sensu stricto. *Luciola nicollieri* Bugnion, 1922 was redescribed from a lectotype (intact male) and paralectotype (male without head and prothorax) designation and confirmed to belong to the genus *Luciola* sensu stricto.

A single male of *Pteroptyx decolor* Olivier, 1911 from the type locality was designated a lectotype and redescribed. Coloured pictures of the holotype male and labels of *Pygoluciola stylifer* Wittmer, 1939, were provided to supplement previous depictions of only line figures and to correct label data.

The taxonomic status *Luciola picea* Gorham, 1882 was discussed. Existing taxonomic categories are not suitable for accommodating *Luciola picea*, which is considered a *species inquirenda*. A lectotype male and two paralectotype males, along with a female paralectotype were designated.

The species addressed here are listed with current, and original combinations (Table 2):

Atyphella Olliff, 1890

Atyphella Olliff 1890: 64 5. Lea 1909: 110. Olivier 1909b: lxxxii (Partim); 1910: 40; 1911b: 171; 1913a: 417 (Partim). Ballantyne 1987b: 172, 175–77, 181, 183–5. Calder 1998: 176 (Partim). Ballantyne and Lambkin 2000: 22, figs 1–18, 36 a, b, c (Partim); 2006 (Partim): 30; 2009: 34 (figs 9–11, 35, 78, 79, 83–85, 118–179). Ballantyne et al. 2019:58 (figs 5–8, 57, 58, 68, 69, 180–205).

Luciola (*Luciola*) Laporte. Sensu McDermott 1964: 45; 1966: 99.

Luciola (*Atyphella*) (Olliff). Ballantyne 1968: 108. Ballantyne and McLean 1970: 23.

Type species. *Atyphella lychnus* Olliff, 1890.

Table 2. Nomenclature of species addressed in this study in two forms: currently accepted and original names.

Current nomenclature	Original name
Atyphella testaceolineata Pic, 1939	*Atyphella testaceolineata* Pic, 1939
Curtos cerea (Gorham, 1882)	*Luciola cerea* Gorham, 1882
Luciola laticollis Gorham, 1883	*Luciola laticollis* Gorham, 1883
Luciola nicollieri Bugnion, 1922	*Luciola nicollieri* Bugnion, 1922
Pteroptyx decolor Olivier, 1911a	*Pteroptyx decolor* Olivier, 1911a
Pygoluciola stylifer Wittmer, 1939	*Pygoluciola stylifer* Wittmer, 1939
Luciola picea Gorham, 1882 ***species inquirenda***	*Luciola picea* Gorham, 1882

Key to species. Ballantyne et al. (2019: 58) keyed 28 species of *Atyphella* from males only. *A. testaceolineata* Pic was distinguished in that key by light organs in V7 entire, elytra striped, with three interstitial lines.

Atyphella testaceolineata Pic, 1939

Fig. 1A–C

Atyphella testaceolineata Pic, 1939: 370. Wittmer 1939: 127. Ballantyne and Lambkin 2009: 53, figs 153, 158, 164–165; Ballantyne et al. 2019: 57.

Luciola (*Luciola*) *testaceolineata* (Pic). McDermott 1966: 114.

Holotype. 1 ♂ (incomplete, abdomen only; by original description and determined by authors in this study).

Type locality. "Buru".

Material examined (1♂ specimen). *Holotype*: INDONESIA ● ♂; (1) "L.J.TOXOPEUS / Buru,Station 7 / alt.Sept. 1921"; (2) "TYPE / Atyphella / testaceolineata / 1928 Pic"; (3) "?astyphella / testaceolineata / n. sp."; (4) "Atyphella / testaceolineata / Pic 1939 / ZMAN type / COLE.0930.1"; (5) "RMNH.INS / 968356" (Fig. 1A).

Diagnosis. Pronotum with median dark marking (from original description); elytra brown with suture, lateral margin and three longitudinal pale stripes corresponding to interstitial lines 1–3 (Fig. 1B). The head and prothorax are missing, and characters of these areas could not be confirmed.

Redescription of incomplete holotype. *Colour* (Fig. 1B, C). MS, MN light brown; elytra brown, slightly darker across base including humeral angles, lateral areas appearing semi-transparent; suture, lateral margin (extent defined by underlying epipleuron) including apex, 3 interstitial lines (lines 1–3) very pale light brown, pale lateral area just inside visible inner margin of epipleuron extending most of elytral length (Fig. 1B); interstitial lines 1, 2, 3 margined laterally by single line of punctures, line 3 effaced at front and behind (Fig. 1B), elytral lateral margin semi-transparent, paler colour extending onto dorsal surface narrowly in preapical 1/3; in basal half, lateral area of elytron just inside lateral margin brown; ventral surface of meso-, metathorax brown, legs 2, 3 dirty light brown, tibiae, tarsi darker brown; basal abdominal ventrites very dark brown, paler median markings on V4, 5; V6, 7 yellow; abdominal tergites dark brown except for pale T8.

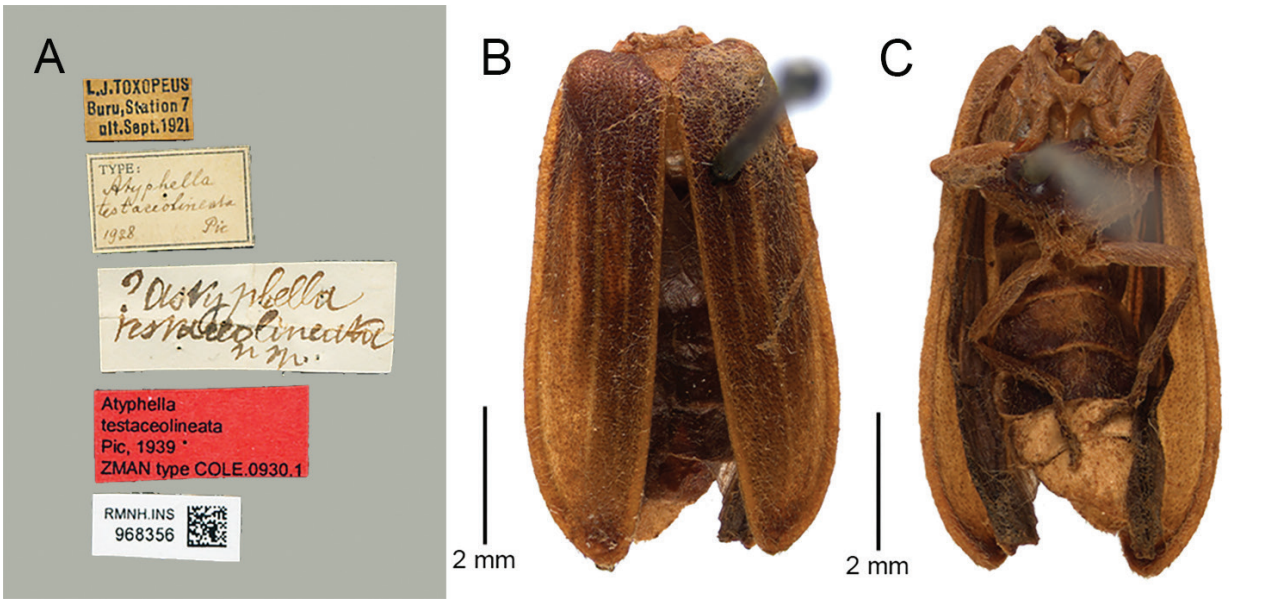

Figure 1. *Atyphella testaceolineata* Pic holotype male. **A.** Specimen labels; **B.** Dorsal habitus; **C.** Ventral habitus. All images are to scale, except specimen labels.

Elytra (Fig. 1B). Elytra slightly convex sided; interstitial line development not clear, possible extent outlined above.

Abdomen (Fig. 1C). LO occupy V 6 completely, probably retracted along posterior margin V7; MPP of V 7 well defined and apically rounded. Not dissected.

Notes. We consider this specimen a holotype because it corresponds with the original description outlined in Pic's publication from 1939, especially in terms of its size and type locality. We can confirm features of colouration of the hind body as described by Pic (1939) but not of the prothorax and head, which are missing. Ballantyne and Lambkin (2009: 53) recorded the incomplete specimen they examined from Buru Island (listed above) as a holotype. Ballantyne and Lambkin (2009: 53) assigned tentatively specimens from Morobe Province New Guinea to *A. testaceolineata* which conformed in features of elytral colour pattern and abdominal colouration to the incomplete type specimen. They described features of the head and male genitalia which we cannot confirm.

Curtos Motschulsky, 1845

Curtos Motschulsky 1845: 36; 1853: 51. Lacordaire 1857: 337. Olivier 1907: 55; 1910: 47. McDermott 1964: 47; 1966: 118. Chûjô and Sâtô 1970: 59. Jeng et al. 1998: 331. Fu et al. 2012: 17. Fu 2014: 86. Yiu 2012: 90; 2017: 90. Ballantyne et al. 2019:76 (fig. 14).

Type species. *Curtos mongolicus* Motschulsky by original designation.

Key to species. Jeng et al. (1998) keyed Taiwanese species only.

Curtos cerea (Gorham, 1882)

Fig. 2A–V

Luciola cerea Gorham, 1882: 103–104; 1887: 70. Olivier 1902: 76. McDermott 1966:101.

Lectotype and paralectotype. 2 ♂ (herein designated).

Type locality. "Koetoer".

Material examined (2♂ specimens). Lectotype (herein designated): INDONESIA ● ♂; (1) "cerea"; (2) "*Sum. Exp.* / *Koetoer* / *6/78*"; (3) "*Koetoer* / *6.78*"; (4) "RMNH Leiden / ex Indo-Austr. / collection"; (5) "RMNH.INS / 968351" (Fig. 2A). Paralectotype: ♂; (1) "Luciola / cerea"; (2) "*Sum. Exp.* / *Lebong* / *5/78*"; (3) *Lebong* / *5/78*"; (4) "[?]"; (5) "RMNH Leiden / ex Indo-Austr. / collection"; (6) "RMNH.INS / 968360" (Fig. 2B).

Additional material examined (2 ♂ non types). INDONESIA ● possibly ♂, abdomen missing; (1) "Rawas / 5.78"; (2) RMNH Leiden / ex Indo-Austr. / Collection"; (3) "RMNH.INS / 968352" (Fig. 2C). ♂; (1) "Cerea"; "Sum. Exp. / Alahan / pandjang / 4/9.77"; (2) A. pg. / 4/9.77"; (3) "[?]"; (4) "RMNH Leiden / ex Indo-Austr. / collection"; (5) "RMNH.INS / 968361" (Fig. 2D).

Diagnosis. The lectotype male, RMNH.INS 968351 (herein designated) and paralectotype, RMNH.INS 968360 differ in dorsal colouration but are here regarded as the same species. Dorsal surface orange yellow with somewhat diffuse median darker brown markings on pronotum (very faintly in specimen RMNH. INS 968360); elytra with apical brown area occupying approximately half the elytral length. The only other *Curtos* sp. described from the island of Sumatra *Curtos rouyeri* Pic has a reddish head. Not possible to distinguish this species from several other species having

yellowish dorsum and black tipped elytra and these are discussed below.

Redescription of lectotype and paralectotype male. ***Body length*****.** 6.0 mm long. L/W 2.6.

Colour**.** Specimen with the accession number RMNH. INS 968351 ("Koetoer"; Fig. 2E): pronotum orange yellow, with median dark brown area not well defined, narrow in anterior 1/3, not reaching to anterior margin, expanding in posterior 2/3, not reaching to posterior margin; MN and base of MS appear dark brown; Specimen with the accession number RMNH.INS 968360 ("Lebong"; Fig. 2F) pronotum with very diffuse median dark area; elytra semi-transparent, slightly paler yellowish than pronotum, with mid-brown apical marking extending to suture, posterior margin, and apical 1/5 of length of lateral margin; dark marking extends obliquely across elytra including humeral carina to anterior 1/3 such that inner margin of elytra and suture along basal 2/3 its length are pale, with carina pale in basal 3/5; head between eyes dark brown, antennae and palpi brown; venter of thorax mid brown, base of legs light brown, tibiae and tarsi darker brown; anterior margin femora of legs 2, 3 mid brown; basal abdominal ventrites very dark almost black, LO in V6, 7 creamy white, fills V7 to posterior margin (Fig. 2G); T7, 8 pale semi-transparent yellow, remainder of tergites dark brown; dorsally reflexed tergal margins of T6, 7 white, of remainder dark brown.

Pronotum (Fig. 2H). Width less than humeral width.

Elytra (Fig. 2I). Punctation semitransparent when viewed from beneath.

Head (Fig. 2J). Antennal sockets close but not contiguous; mouthparts well developed; antennae longer than head width but less than twice head width; all flagellar segments elongate slender.

Abdomen (Fig. 2G). Posterior margin of V7 entire, broadly rounded, no MPP developed (Fig. 2K). T8 (Fig. 2L) ventral surface flat, no ridges or flanges developed; paired anterior sections short, apically narrowed; median posterior margin shallowly emarginated; dorsal surface covered with elongate setae; median triangular area (wider at anterior end) densely covered with very short setae, area narrowing anterior to posterior emargination.

Aedeagal sheath (Fig. 2M–R). Slightly asymmetrical; area of sternite anterior to tergite articulations broad, apically rounded (Fig. 2M, P); posterior area of sternite smoothly emarginated along both sides, more deeply on right; posterior half of sternite membranous, apically rounded, densely hairy (Fig. 2P); tergite much wider than posterior half of sternite (Fig. 2M, P), appearing from below as two heavily sclerotised subparallel sided arms which connect with a similarly sclerotised transverse posterior margin at approximately 90°; anterior sclerotised portion of tergite very short; posterior area (Fig. 2M, N, P, Q, R) probably represented by paired separated hooked, apically acute, asymmetrical lobes visible to the sides of the sheath sternite when viewed from above (hooks arrowed; left lobe visible at left of sternite, right lobe to right (Fig. 2M), right lobe visible to left of sternite (Fig. 2P); lobes expand irregularly into pointed, hooked pieces which probably function for muscle attachment (Fig. 2N, O, Q, R; pointed apices of both lobes visible).

Aedeagus (Fig. 2S–V). ML slightly longer than LL; left LL slightly shorter than right (Fig. 2S, U); apices of LL expand, irregularly truncate (longer on outer margin) with apex of left lobe longer on inner margin (Fig. 2U); LL separate along median dorsal line and divergent towards their apices (Fig. 2S); inner preapical margin of both LL with short pointed hook, visible only on R apex in 2V (Fig. 2S, V); anterior basal margin of LL widely produced (Fig. 2S, T); BP subdivided into two elongate oval sections which are separated anteriorly (Fig. 2S, U, V). Attachment of ML to LL (Fig. 2S, T): lateral margins of postero dorsal area of anterior ML thickened, darkened, extend obliquely dorsally to converge (Fig. 2T arrow indicates area of convergence), and separate slightly just before they connect with the inner basal margin of the LL, well behind acute anterior margin of LL (Fig. 2S, T; arrow in 2S shows area of connection to inner margin of LL); nature of connection between these two areas not determined; inner margins of LL narrowly sclerotised, expanding slightly at base level with the point of attachment of the ML (Fig. 2S), with the sclerotization extending anteriorly almost to anterior margin of LL base; entire median dorsal sclerotization considered to be reinforcing.

Notes. After discovering that the specimens we subsequently assigned to lectotype and paralectotype status had been mixed in with other specimens, we took extra care to verify whether the additional specimens we examined were part of the type material or not. We meticulously examined each specimen to ensure we accurately identified the type-material, and our results were reliable. Our thorough examination allowed us to confidently identify the actual type specimens and exclude any specimens not part of the type material. However, because it is not possible to confidently identify so many similarly coloured *Curtos* species (see further below) we retained a list above of two further non type specimens which may aid in any future revision.

There is no recent revision of *Curtos* apart from Jeng et al. (1998) who addressed nine species from Taiwan and Japan. Ballantyne et al. (2009, 2013, 2015, 2016) scored characters for two *Curtos* species (*Curtos costipennis* (Gorham, 1880) and *Curtos okinawanus* Matsumura, 1918) and Fu et al. (2012) for two species. Ballantyne et al. (2019: table 15) listed 19 species and a further seven which were recommended for transfer from *Luciola*. *Curtos* is one of the few Luciolinae genera which can be immediately distinguished by external features only, including the well-defined elytral carina and the large evenly spaced elytral punctation, which occurs on both males and females.

In Gorham's description of *Luciola cerea*, he noted the specimens he examined were all males (5–6 millimetres). He also listed six locations (see type localities) where the specimens were collected, which he referred to as "(Sum. Exp.)" for Sumatra Expedition. In the RMNH collection,

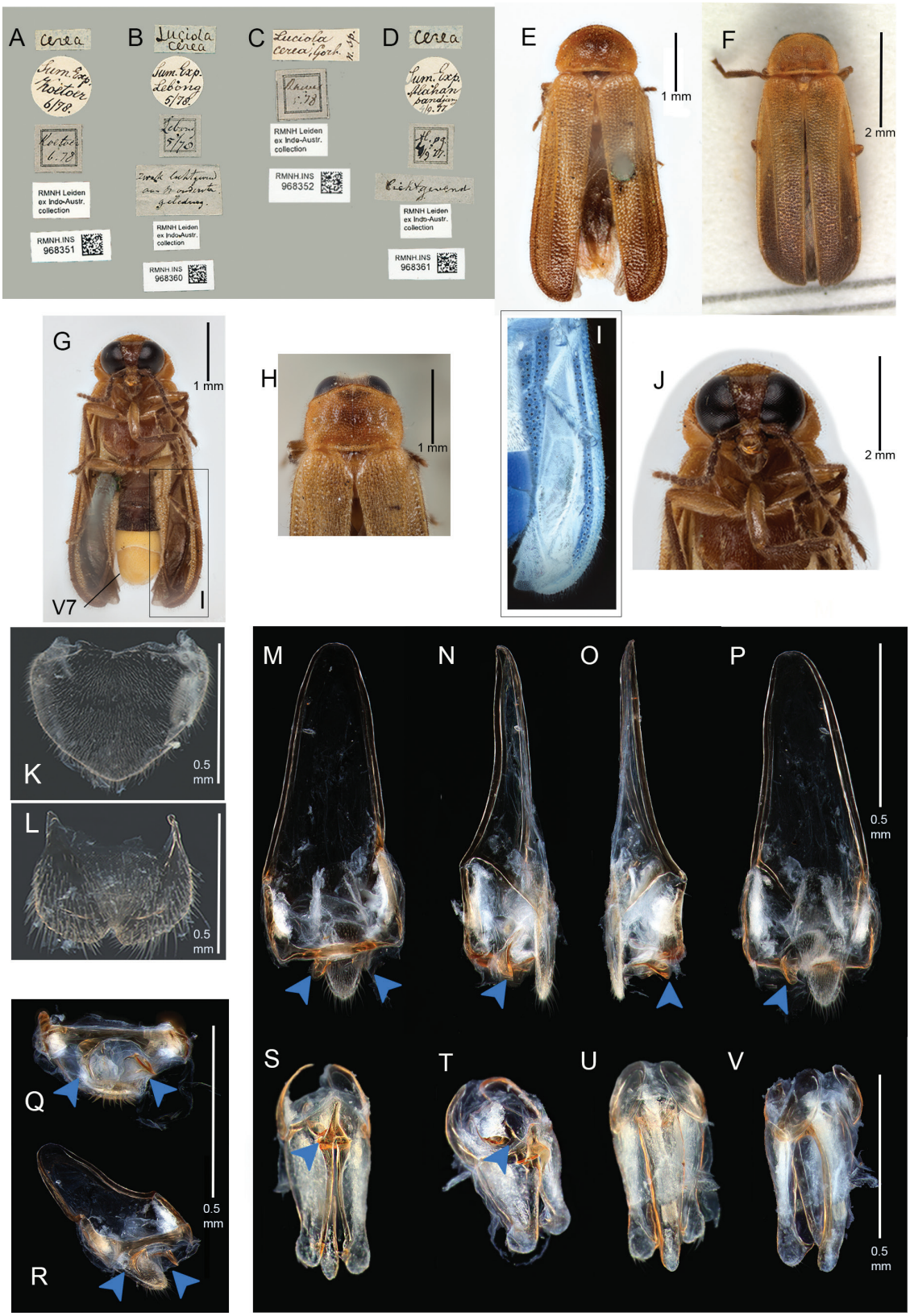

Figure 2. *Luciola cerea* Gorham lectotype male (**A, E, G–V.** RMNH.INS 968351), paralectotype male (**B, F.** RMNH.INS 968360), and non-type males (**C.** RMNH.INS.968352; **D.** RMNH.INS 968361); **A–D.** Specimen labels; **E, F.** Dorsal habitus; **G.** Ventral habitus; **H.** Dorsal pronotum; **I.** Elytral punctation from beneath; **J.** Anterior head; **K.** V7 ventral; **L.** T8 dorsal; **M–R.** Aedeagal sheath (arrows indicate hooks arising from posterior margin of sheath tergite; see text for further explanation): **M.** Dorsal view; **N.** Oblique right lateral view; **O.** Left lateral view; **P.** Ventral view; **Q.** Posterior, tergite uppermost view; **R.** Oblique dorso-lateral view, anterior end to upper left; **S–V.** Aedeagus (arrow on S and T indicates area of attachment of ML to inner area of LL base; see text for further explanation): **S.** Dorsal view; **T.** oblique left dorso-lateral view; **U.** Ventral view; **V.** Right ventrolateral view. All images are to scale, except specimen labels.

we noticed four specimens with the species name marked on a label written in Gorham's handwriting as "cerea" or "*Luciola cerea*, Gorh. n.sp." or "*Luciola cerea*". However, one specimen with the accession number RMNH.INS 968352 has "Rawas" as a locality label, which was not mentioned in the original description, but in Gorham (1887, in Ritsema). Therefore, we believe that it should not be considered part of type series. In addition to the four specimens, we also noted seven others in the collection (not pictured here): six from "Koetoer" and one from "Kloempang". These specimens do not bear Gorham's handwritten labels, but the locality labels are identical to the syntypes, i.e., from "Sum. Exped". Because we believe that these were part of Gorham's revision in 1887, they are not considered syntypes.

Ballantyne et al. (2019) listed the following species having pale yellow dorsum (including pale pronotum) and black elytral apices: *Curtos atripennis* Pic, 1934, *C. cerea*, *C. costipennis*, *Curtos flaviceps* Pic, 1927. Of these only *C. cerea* and *Curtos rouyeri* Pic, 1927 are from Indonesia. Of the other *Luciola* species recommended for transfer to *Curtos* the following all have the same basic dorsal colour pattern of pale-yellow dorsum with black elytral apices: (i) *Luciola complanata* Gorham, 1895; (ii) *Luciola delauneyi* Bourgeois, 1890; (iii) *Luciola deplanata* Pic, 1929; (iv) *Luciola extricans* Walker, 1858; (v) *Luciola multicostulata* Pic, 1927 and (vi) *Luciola nigripes* Gorham, 1903. Most were described with some proportion (¼, ⅓, ½) of the elytral apex black.

A specimen with the accession number RMNH.INS 968352 has no abdomen for confirmation. Specimen with the accession number RMNH.INS 968361 ("Alahan pandjang") is not consistent with the other two syntypes in being more slender and elongated (L/W 3.3) and there are no dark markings on the elytra.

Other remarks. Little detailed work has been done thus far on species of *Curtos* and examination of these Leiden types allowed WFAJ not only to dissect them but to expose various new features of their morphology especially in the male genitalia. Clearly, comparisons with other species are not presently possible, and it is very probable that many of these species are synonyms. The hooked posterior lobes attributed here to the sheath tergite have not been seen elsewhere in the Luciolinae. Species of *Sclerotia* Ballantyne have irregularly shaped sclerites in a band of muscle which surrounds the aedeagal sheath in life. Both may have the same function, that of extra surface area for muscle attachment, but their origins appear to be different.

Luciola Laporte, 1833 *sensu stricto*

Luciola Laporte s. str. (*sensu* Ballantyne and Lambkin 2013: 64).

Luciola Laporte 1833: 146. Lacordaire 1857: 335. Motschulsky 1853: 52. Gorham 1880: 99. Olivier 1902: 69; 1907: 50. Lea 1909: 106. Ballantyne and Lambkin 2013: 64. Yiu 2012: 92; 2017: 92. Fu 2014: 23.

Type species. to be determined (see Bouchard et al. 2024).

Luciola (*Luciola*) Laporte. McDermott 1966: 103 (Partim). Nec Calder 1998: 178.

Bourgeoisia Olivier. Olivier 1908: 17; 1911c: 102. McDermott 1966: 117. Deheyn and Ballantyne 2009: 47. Ballantyne and Lambkin 2013: 64.

Type species: *Luciola antipodum* Bourgeois designated by McDermott 1966.

See Ballantyne et al. (2022: 42) and Bouchard et al. (2024: 302–303) for explanation and definition of this category. McDermott (1966: 98) incorrectly listed *Luciola pedemontana* Motschulsky designated by Motschulsky (1853). Ballantyne, Jusoh and others are undertaking a review of the correct type species for this genus (Keller and Ballantyne 2023; Bouchard et al. 2024). Key to species of *Luciola* s. str: The key to both males and females in Ballantyne et al. (2019: 87) did not accommodate species having pale marginal elytral markings, and *Luciola laticollis* was listed there under *Luciola* sensu lato.

Luciola laticollis Gorham, 1883

Fig. 3A–R

Luciola laticollis Gorham, 1883: 4. Olivier 1902: 82; 1911a: 18; 1912:88. McDermott 1966: 108. Ballantyne et al. 2019: 103.

Type locality. "Java: Bodjonegoro".

Lectotype and paralectotype. 1♂, 1♀ (herein designated).

Material examined (1♂, 1♀ specimens). ***Lectotype*** (herein designated): INDONESIA ● ♂; (1) "♂"; (2) "type"; (3) "Luciola / laticollis / Gorham"; (4) "Piepers / Bodjonegoro / Java"; (5) "RMNH Leiden / ex Indo-Austr. / Collection"; (6) "RMNH.INS / 968349" (Fig. 3A). Paralectotype: ♀; (1) "♀"; (2) "type"; (3) "Luciola / laticollis / Gorham"; (4) "Piepers / Bodjonegoro / Java."; (5) "RMNH Leiden / ex Indo-Austr. / collection"; (6) "RMNH.INS / 968350" (Fig. 3B).

Diagnosis. Male with dark brown elytra having narrowly paler (appearing orange) lateral margins, apex and suture, light brown pronotum with a wide median dark brown marking (Fig. 3C, D). Most similar to *Luciola tiomana* Ballantyne, 2019 from which it can be distinguished by its locality (*L. tiomana* is from the tip of the Malay peninsula), pronotal colour (that of *L. tiomana* is completely black); ventral surface dark brown almost black except for light brown legs and creamy white light organs in V6, 7; female coloured as for male (Fig. 3E, F), with full length elytra and shortened hind wings, not considered capable of flight.

Redescription of lectotype male. ***Body length*****.** 5.5–6.0 mm long (Fig. 3C, D). The size range of this specimen is applied to indicate that its measurement may vary slightly from its actual length as it appears to have a slightly drooped body, which is a result of how it has died or been preserved in the past.

Colour (Fig. 3C, D, G, H). Colour probably reflects age of specimen and description attempts to account for

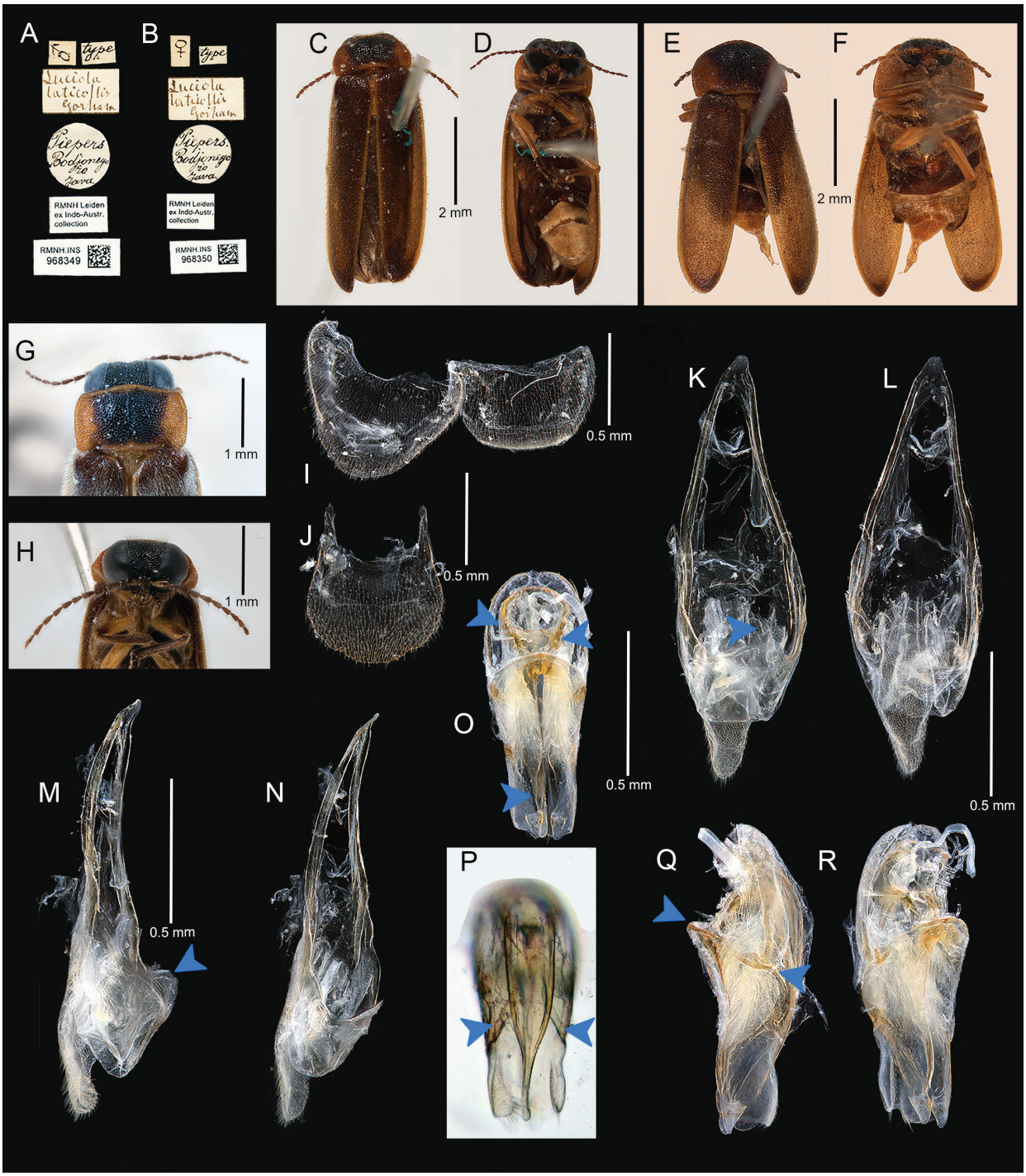

Figure 3. *Luciola laticollis* Gorham, 1883 lectotype male (**C, D, G–R**) and paralectotype female (**E, F**). **A, B.** Specimen labels; **C, D.** Male dorsal (C), and ventral habitus (D); **E, F.** Female dorsal (E) and ventral habitus (F); **G, H.** Head, prothorax and anterior part of mesothorax, dorsal (G) and ventral (H); **I.** V7 (left) and V6 dorsal aspects; **J.** T8 dorsal; **K–N.** Aedeagal sheath: **K.** Dorsal view (arrow indicates midanterior margin sheath tergite); **L.** Dorsal view; **M.** Left lateral view (arrow indicates midanterior margin sheath tergite); **N.** Slightly oblique left lateral view; **O–R.** Aedeagus: **O.** Dorsal view (anterior left arrow indicates thickened lateral margin of base of ML; anterior right arrow indicates posterior extension of ML towards inner base of LL; posterior single left arrow indicates divergence of inner dorsal margins of LL); **P.** Ventral view (leafy lobes on inner margins LL arrowed); **Q.** Right lateral view (left arrow indicates base of LL in area of attachment of the ML; lower right arrow indicates posterior margin of BP); **R.** Slightly oblique left dorsolateral. All images are to scale, except specimen labels.

that; pronotum lateral margins orange, wide median dark brown marking extending across 6/10 width, reaching neither anterior nor posterior margin, both margins narrowly orange; median dark area with somewhat irregular lateral margins; MS, MN paler colour like that of base of suture; elytra dark brown, very narrow brownish orange lateral, apical and sutural margins; head between eyes dark brown, antennae, palpi brown; venter of thorax

almost black; legs 1 basal segments yellowish brown, apical ¼ femora and all of tibiae, tarsi dark brown; legs 2 basal segments yellowish brown with tibiae, tarsi dark brown; legs 3 all of legs yellowish brown except for dark brown apical 2/3 tibiae, and all of tarsi; basal abdominal ventrites very dark brown, creamy pale LO in V6, 7.

Pronotum (Fig. 3G). Pronotum width subequal to humeral width; subparallel-sided.

Elytra (Fig. 3C). Parallel-sided; interstitial lines not defined.

Head. Not able to be retracted into prothoracic cavity; head width subequal to width across cavity; mouthparts well developed; antennal sockets not contiguous; antennal segments elongate slender, length antenna/GHW 1.5.

Abdomen (Fig. 3D, I, J). LO in V7 retracted from posterior and part of lateral margins; posterior margin of V7 broadly rounded, no MPP defined (Fig. 3D); T8 with entire rounded posterior margin; anterolateral projections narrow, 0.3 as long as entire tergite (Fig. 3J); posterior margin of T7 entire, not emarginated (Fig. 3I).

Aedeagal sheath (Fig. 3K–N). Slightly asymmetrical (asymmetry may be due to age of specimen); sheath sternite apex entire, densely hairy, projecting beyond tip of tergite (Fig. 3K–N); median anterior dorsal margin of tergite of sheath broadly produced with narrow acute median apex (Fig. 3K, N arrowed).

Aedeagus (Fig. 3O–R). 2.5 × as long as wide; basal piece defined in two distinct halves Fig. 3O); extending for approximately half aedeagal length along sides of LL (Fig. 3Q, R; arrow in Q indicates posterior extent); dorsal anterior base of LL broadly rounded and evenly produced (Fig. 3O); LL lateral margins subparallel when viewed from beneath (Fig. 3P); LL expanded at apices partly enfolding ML from beneath; LL very close in basal half along middorsal line, becoming almost contiguous before diverging in next 0.4 (area of divergence arrowed in Fig. 3O), converging at their apices (Fig. 3O); LL with elongated slender apically acute lobes arising from their outer ventral surfaces, converging anteriorly behind ML (Fig. 3P arrowed); ML, LL subequal in length; ML narrowed in apical 0.3 with apex rounded in dorsal aspect (Fig. 3P, Q). Dorsal attachment of ML to LL (Fig. 3O, Q, R): lateral margins of anterior dorsal ML thickened, darkened (Fig. 3O left and right arrows to top of figure), extending and converging obliquely dorsally connecting with thickened, darkened paired lobes arising from inner basal margin of LL just behind anterior margin; from side the mid anterior margin inclines dorsally such that the dorsal margins of the LL appear concave (Fig. 3Q upper left arrow); connection between the two areas probably muscle as attachment appears to permit some independent movement of the ML.

Redescription of paralectotype female. ***Body length*** (Fig. 3E, F). 6.0 mm long.

Colour (Fig. 3E, F). Colour as for male except for dark brown basal abdominal ventrites, LO ill-defined in semi-transparent orange yellow V6; V7, 8 coloured as for 6; dorsal abdomen dark brown except for pale cream T8.

Pronotum (Fig. 3E). Wider than humeral width; anterolateral corners broadly rounded.

Elytra (Fig. 3E, F). Interstitial lines not defined; elytra may be full length but difficult to assess (elytral length 4 × median pronotal length), extending beyond apex of abdomen but this could be a consequence of dehydration; lateral margins subparallel-sided and appear to be contiguous along most of their sutural margins when closed. Hind wings: shortened, 0.66 as long as elytra and female may be flightless.

Head (Fig. 3F). Mouthparts well developed, and female could feed; antennae incomplete but segments elongate slender, visible length is greater than head width.

Abdomen (Fig. 3F). Posterior margin of V7 broadly and shallowly emarginated. No further dissections were attempted.

Notes. Gorham (1883) referred to the broad pronotum (it is subequal in width to the width across the elytral humeri in the male, but wider in the female). He described the elytra as black with narrow pale margins (the elytral colour here is dark brown and the paler margins are very narrow and not obvious). Olivier (1911a) indicated the median dark pronotal marking was reduced in a Sumatran female, while the median dark pronotal marking occupied the entire disc ("disque entire") in the type. Yiu (2017) addressed a small population of males and females from Lantau in Hong Kong as "near *laticollis*", and in his Table 1 attempted to reconcile features of the original descriptions of three *Luciola* species with his specimen identification. His *Luciola* nr. *laticollis* (page 55) is not inconsistent with what we describe here. Ballantyne et al. (2019) listed *L. laticollis* under *Luciola* s. lato and type not located, as they felt the distinctive colour pattern would allow subsequent association of specimens.

This species is assigned to *Luciola* s. str. because of the distinctive features of the male aedeagus.

Luciola nicollieri Bugnion, 1922

Fig. 4A–Q

Luciola nicollieri Bugnion, 1922: 1–14. Ballantyne et al. 2019:103. De Silva et al. 2023: 331.

Luciola nicolleri. McDermott 1966: 110 (misspelling).

Lectotype and paralectotype. 2♂ (herein designated).

Type locality. "Ceylan, Talgaswella, district d'Elpitiya".

Material examined (2♂ specimens). ***Lectotype*** (herein designated): SRI LANKA ● ♂: (1) "E.BUGNION / Hiver 1906–7 / Ceylan / Talgaswella"; (2) "don.E. BUGNION'22"; (3) "COTYPE: Luciola / Nicollieri / Bugnion / ♂"; (4) "Luciola. / nicollieri / Bugnion, 1922 / ZMAN type COLE.0929.1"; (5) "RMNH.INS / 968348" (Fig. 4A); Paralectotype: SRI LANKA ● ♂ (missing head and prothorax): (1) "E.BUGNION / Hiver 1906–7 / Ceylan / Talgaswella"; (2) "don.E.BUGNION'22"; (3) "COTYPE: / Luciola / Nicollieri / Bugnion / ♂"; (4) "Luciola / nicollieri / Bugnion, 1922 / ZMAN type / COLE.0929.2"; (5) "RMNH.INS / 968347" (Fig. 4B)

Diagnosis. Male with orange pronotum, black elytra with narrow pale orange lateral and sutural margins, elytral apex

appearing more widely pale due in part to an accumulation of fat body. Venter black except for yellowish creamy LO in V6, 7. The only *Luciola* s. str. so far recorded with pale coloured pronotum without darker markings, and dark brown to black elytra with all margins pale except at the base.

Redescription of lectotype male. ***Body length*** (Fig. 4D). 6.5 mm long (intact specimen only).

Colour (Fig. 4C–G). Pronotum orange with faint thin black line visible from above along lateral margin and around anterolateral corners (not visible in figures); MS, MN very light brown; elytra very dark brown with epipleural ridge (from above) appearing narrowly paler brown; apical paler fat body extending narrowly anteriorly for 0.9 elytral length along lateral margin, scooped in median area, extending anteriorly 1/10 elytral length along suture; remainder of suture indistinctly slightly paler than rest of elytron; head between black eyes black; antennae and palpi dark brown; venter of thorax and basal abdominal ventrites

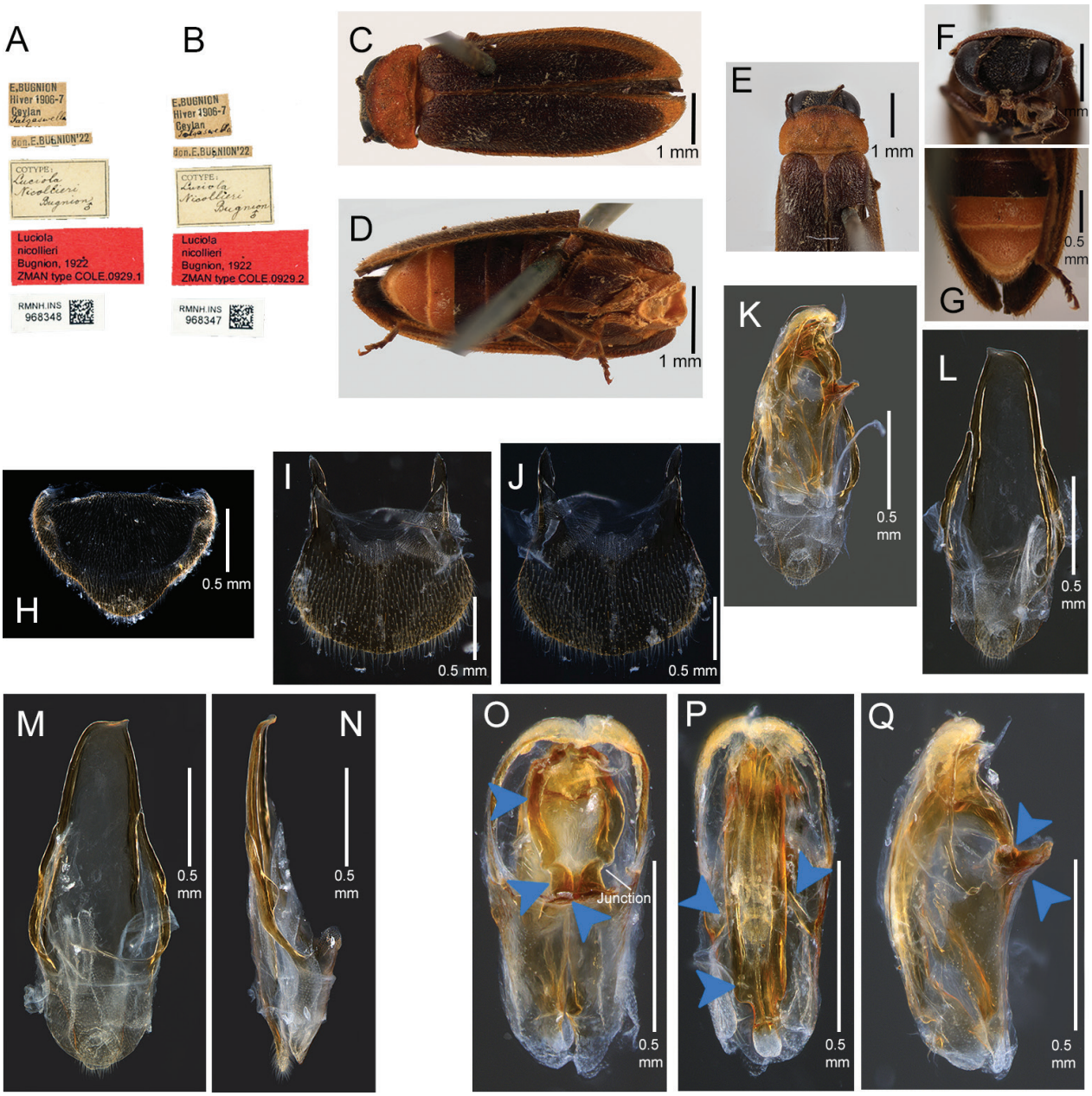

Figure 4. *Luciola nicollieri* Bugnion, 1922 lectotype male (**A**, **C, E, F, H–Q**) and paralectotype male (**B, D, G.** Without head and prothorax). **A, B.** Specimen labels; **C.** Ventral mesothorax – end of abdomen; **D.** Dorsal habitus; **E.** Dorsal head prothorax and anterior area of mesothorax; **F.** Anterior head; **G.** Ventral, V5–7 and elytral apices; **H.** V7 ventral; **I, J.** Tergite 8 – T8 dorsal view (I) and ventral view (J); **K–N.** Aedeagal sheath: **K.** Dorsal with aedeagus ventral surface to right; **L.** Ventral view; **M.** Dorsal view; **N.** Left lateral; **O–Q.** Aedeagus: **O.** Dorsal view (arrow top left indicates thickened left margin of ML, lower arrow thickened lobe from inner margin of LL, lower arrow right side indicates area of attachment to inner surface of base of LL); **P.** Ventral view (upper oblique arrows left and right indicate leafy lobes from inner margins of LL, lower left arrow lateral expansion of ML margins); **Q.** Left lateral (upper arrow indicates junction between lobes from ML to left and lobes from LL to right; lower right arrow indicates area of attachment to inner base of LL). All images are to scale, except specimen labels.

black; legs 1, 2 with coxae, trochanters light brown, remainder very dark brown; legs 3 entirely very dark brown except for small light brown area where inner margins of coxae are contiguous; LO in V6, 7 orange with posterior margin of both yellowish; T6–8 yellow semi–transparent with underlying fat bodies visible; T3–5 dark brown; laterally reflexed margins of V3–5 dark brown, of 6, 7 yellow.

Pronotum (Fig. 4E). Width slightly exceeds humeral width.

Elytra (Fig. 4D). Interstitial lines not obvious.

Head (Fig. 4F). Antennal sockets contiguous; head wider than width of prothoracic cavity; mouthparts well developed, and specimen could feed as adult. Antennae longer than, but less than twice GHW, all flagellar segments elongate slender.

Abdomen (Fig. 4C, G–J). LO completely occupies V6, and possibly also V7 (Fig. 4C); posterior margin of V7 broadly rounded; posterior margin of T7 entire (Fig. 4G, H), not emarginated, with corners rounded; posterior margin of T8 entire, not emarginated, lateral margins slightly divergent posteriorly, anterolateral prolongations narrow, apically acute and 0.4 as long as entire tergite; ventral surface smooth without ridges or flanges (Fig. 4I, J).

Aedeagal sheath (Fig. 4K–N). Slightly asymmetrical as right margin of sternite is narrowly emarginated (Fig. 4L); anterior margin sternite slightly produced on right side (Fig. 4L, M, N); posterior margin entire, rounded, hairy, extending only a little beyond the rounded hairy tergite apex (Fig. 4N); sheath tergite in two sections (Fig. 4 K, L, N); anterior margin of tergite irregularly produced (Fig. 4 L, M, N).

Aedeagus (Fig. 4O–Q). L/W 2.5; BP narrow extending along sides of LL for slightly less than half aedeagal length, extent somewhat confused by underlying tissue (Fig. 4O, P, Q); anterior dorsal margin of LL neither emarginated nor produced (Fig. 4O); LL contiguous along basal 1/3 of their dorsal length, then with a slight separation before apices approach in median line (Fig. 4O); inner preapical area of right LL hooked (unclear if this is also on the other lobe), apices LL expanded, membranous, wrap around on ventral surface beside ML apex, not covering apex (Fig. 4P); elongate slender, apically acute leaf like lobes present along outer ventral margins, extending behind ML (Fig. 4P upper arrows); when viewed from beneath ML subparallel-sided along basal 4/5 then abruptly narrowed (Fig. 4 P); sides of ML just before narrowed area narrowly expanded laterally on ventral surface, incline slightly below; (these narrowed lateral expansions partly contribute to the narrowed appearance) (Fig. 4 P, Q; lower single arrow on left indicates the lateral expansion on the right side only); ML only slightly expanded at its rounded tip; ML when viewed from the side same width along most of length until the area above the lateral expansions of its ventral surface, when it expands to its apex (Fig. 4 Q). Attachment of ML to LL (Fig. 4 O, Q): lateral margins of anterior dorsal ML thickened, darkened, extend obliquely dorsally (Fig. 4O upper left arrow) to connect (upper arrow Fig. 4Q shows area of attachment between the two sets of lobes), with similar thickened, darkened paired lobes arising from inner basal margin of LL (Fig. 4O lower left arrow), immediately behind anterior margin of LL (right arrow Fig. 4O) (Fig. 4O, Q); mid anterior margin of LL heavily sclerotised and darkened, inclining dorsally so in lateral view the dorsal anterior LL margin appears concave (Fig. 4Q lower left arrow); connection between the two areas probably muscle as attachment appears to permit some independent movement of the ML.

Notes. Bugnion (1922) described two "côtes", but interstitial lines were not clearly visible on this specimen. He considered *nicollieri* most closely resembled *Luciola horni* and attempted to distinguish the two species (see Bugnion 1922: 2). Yiu (2017) identified as near *nicollieri*, a population of males, brachelytral females, and larvae with laterally explanate tergal margins from Hong Kong. The specimens Yiu illustrated are inconsistent with what we describe here, as the ML of the aedeagus narrows to its apex. Ballantyne et al. (2019) listed *L. nicollieri* under *Luciola* s. lato and type not located, as they felt the distinctive colour pattern would allow subsequent association of specimens. De Silva et al. (2023) described a specimen from Sri Lanka basing their identification on Ballantyne's comparison with these dissections. It is difficult to reconcile their figure 3 d-f with what we illustrate here. They also associated a brachelytral and possibly flightless female with the male.

Pteroptyx Olivier, 1902

Pteroptyx Olivier 1902: 72; 1907: 55; 1909a: 319; 1909b: lxxxii; 1910: 47; 1911a: 102; 1913b: 58. Olivier and Pic 1909: 139. McDermott 1959: 10 (partim); 1964: 46 (partim); 1966: 117 (partim). Ballantyne and McLean 1970: 223 (partim). Ballantyne 1987a: 117; 1987b: 171; 2001: 51. Ballantyne et al. 2011: 8 (partim). Ballantyne et al. 2015: 35. Yiu 2017: 103. Jusoh et al. 2018: 1. Nec Ballantyne in Calder 1998: 180. Nec Ballantyne and Lambkin 2000: 68.

Type species. *Luciola testacea* Motschulsky designated by Lucas 1918. (ZMMU). See discussion in Ballantyne et al. 2015.

Poluninius Ballantyne, 2013: 100. Jusoh et al. (2018) synonymy.

Type species: *Poluninius selangoriensis* Ballantyne 2013: 101.

Key to species. Jusoh et al. (2018) keyed males of *Pteroptyx* but misidentified *Pteroptyx decolor* which was keyed from specimens from Sarawak having black tipped elytral apices.

Pteroptyx decolor Olivier, 1911a

Fig. 5A–N

Pteroptyx decolor Olivier, 1911a: 17. Olivier 1913: 55. McDermott 1966: 117. Ballantyne and McLean 1970: 248. Ballantyne 2001: 63. Jusoh et al. 2018: 29, figs 57–66.

Lectotype. 1♂ (herein designated).

Type locality. "Atjeh".

Material examined (1♂ specimen). ***Lectotype*** (herein designated): INDONESIA ● ♂: (1) "Atjeh"; (2) "Coll. Veth"; (3) "Pteroptyx / decolor / Ern. Oliv."; (4) "RMNH Leiden / ex Indo-Austr. / collection"; (5) "RMNH.INS / 968355" (Fig. 5A).

Diagnosis. Very pale yellowish brown dorsal colouration, with elytra semi-transparent and globules of fat body showing beneath pronotal cuticle; ventral surface very pale brown, with globular fat bodies visible beneath abdominal ventrites, LO in V6, 7 cream; labrum (partly obscured) antennae, palpi and tarsi dark brown, head between eyes yellowish brown. *P. decolor* belongs to that group of *Pteroptyx* which do not have paired lobes to either side of T8 emargination, the deflexed elytral apices are elongated and not dimpled on the posterior margin, the posterolateral corners of V7 are rounded and scarcely produced, and the MPP of V7 has a flat dorsal surface with a short posterior prolongation. Most similar to *P. valida* from which it is distinguished by the paler colour (*P. valida* has black elytral apices) and its occurrence in Indonesia.

Redescription of lectotype male. ***Body length*** (Fig. 5B). 7 mm long.

Colour (Fig. 5B–D). Dorsally light brownish yellow with all areas slightly semi-transparent except V6, 7; pronotum slightly more orange yellow than elytra (Fig. 5B); MS, MN concolourous with elytra; head between eyes pale yellow; eyes black, antennae (except for brownish orange basal ¾ of scape) and palpi dark brown; labrum (partly obscured) pale yellow with basal half brown (Fig. 5C); venter of thorax pale yellowish brown, metathorax appearing slightly mid-brown because of dehydrated, underlying muscles visible through semi-transparent cuticle; legs yellowish, legs 1 with dark brown tarsi; legs 2 incomplete; legs 3 with coxae coloured as for ventral metathorax, basal 2 tarsomeres yellow, apical 3 dark brown; deflexed elytral apices yellowish; abdomen yellowish with underlying fat bodies in V3–5 visible; LO in V6, 7 yellowish dirty cream (Fig. 5D).

***Pronotum*.** With lateral margins subparallel-sided, posterior angles almost 90°, anterolateral corners rounded obtuse.

Elytra (Fig. 5B, D, see arrows). Elytral deflexed apex wide, long, apically truncated; Fig. 5D shows longitudinal groove on both deflexed areas similar to that seen in *P. valida* (Ballantyne 2001: fig. 51 stippled area; Ballantyne and Menayah 2002: fig. 7; Jusoh et al. 2018: fig. 202).

Abdomen (Fig. 5D–I). LO in V7 bipartite, inner margins incline medially. MPP of V7 as described for *P. valida* (Jusoh et al. 2018: figs 205–209) with a slightly wider and shorter bifurcated projection from dorsal surface (Fig. 5E–G; arrowed in Fig. 5E, G). T8 median posterior margin emarginated, areas beside emargination slightly sinuous; posterolateral corners rounded; anterior paired prolongations wide, semi parallel-sided, with rounded apices; ventral surface with wide median groove margined by ridges running slightly obliquely from posterior margin for ⅓ length of tergite; margins elongated at anteromedial area into flanges with rounded apices (Fig. 5H, I; area of flanges arrowed in Fig. 5I not clearly visible).

Aedeagal sheath (Fig. 5J, K): elongate slender symmetrical; sheath sternite expands to its widest point where it articulates laterally with the tergite arms, then diminishes in width towards its rounded apex (Fig. 5K paired oblique upper arrows indicate widest margin of sternite); sheath tergite in two sections, posterior section narrows and is apically rounded; anterior section with anterior margin deeply and evenly emarginated, extending at the sides into bulbous pieces ('paraprocts' oblique arrows in Fig. 5J) (Fig. 5J, K).

Aedeagus (Fig. 5L–N). LL 0.7 length of ML (distances measured along dorsal surface only from base of lateral lobes); LL separated along their dorsal length for approximately half their length. Attachment of ML to LL: base of ML wide, inner dorsal margin abuts the inner dorsal area of LL well behind their anterior margin (Fig. 5M, N; upper arrow Fig. 5M, N anterior dorsal margin LL; lower arrow area of attachment of ML to inner surface LL).

Notes. In Olivier's original description, he described *Pteroptyx decolor* based on a male from "Atjeh" and a female from "Borneo" (Olivier 1911a: 17). He did not name a depository or designate a holotype but mentioned that the specimens were in his collection ("Ma coll."). Until now, and without any type material, the identification of specimens as *Pteroptyx decolor* has been based primarily on their locality (Borneo) and their pale dorsal colouration.

Ballantyne and McLean (1970: figs 8a–i) addressed a female paratype, and 15 males and 25 females from Sarawak. They did not recognise the significance of the "Atjeh" label on Olivier's male specimens and indicated the species was restricted to Borneo. The pale dorsal colouration included a pale head (between the eyes) with dark brown labrum, and dark markings at the extreme elytral apex which were not always visible from above. Ballantyne (2001) examined a further 4 males and a female collected in Saratok by Polunin, which were otherwise consistent with those described in Ballantyne and McLean (1970).

Jusoh et al. (2018) discussed the uncertainty around the identification of this species and inadvertently permitted the conclusions we present here by the characters used in their key to males.

In Jusoh et al. (2018) four species were characterised with well-defined lobes alongside the median posterior emargination of tergite 8 viz. *Pteroptyx asymmetria* Ballantyne, 2001, *Pteroptyx bearni* Olivier, 1909, *P. decolor* and *Pteroptyx tener* Olivier, 1907. Only *P. asymmetria* has a strongly asymmetrical posterior margin to tergite 8 (Jusoh et al. 2018: figs 17, 20). Of the three remaining *P. tener* does not have the posterior margin of T7 emarginated (it is slightly sinuous) and the posterolateral corners of V7 are angulate and scarcely produced (Jusoh et al. 2018: figs 162–165). The two remaining species "*P. decolor*" and *P. bearni* differ most obviously in colour ("*decolor*" was described as very pale dorsally, while *bearni* has dark elytra and pinkish orange pronotum). The outlines of V7 and T7 and 8 are similar,

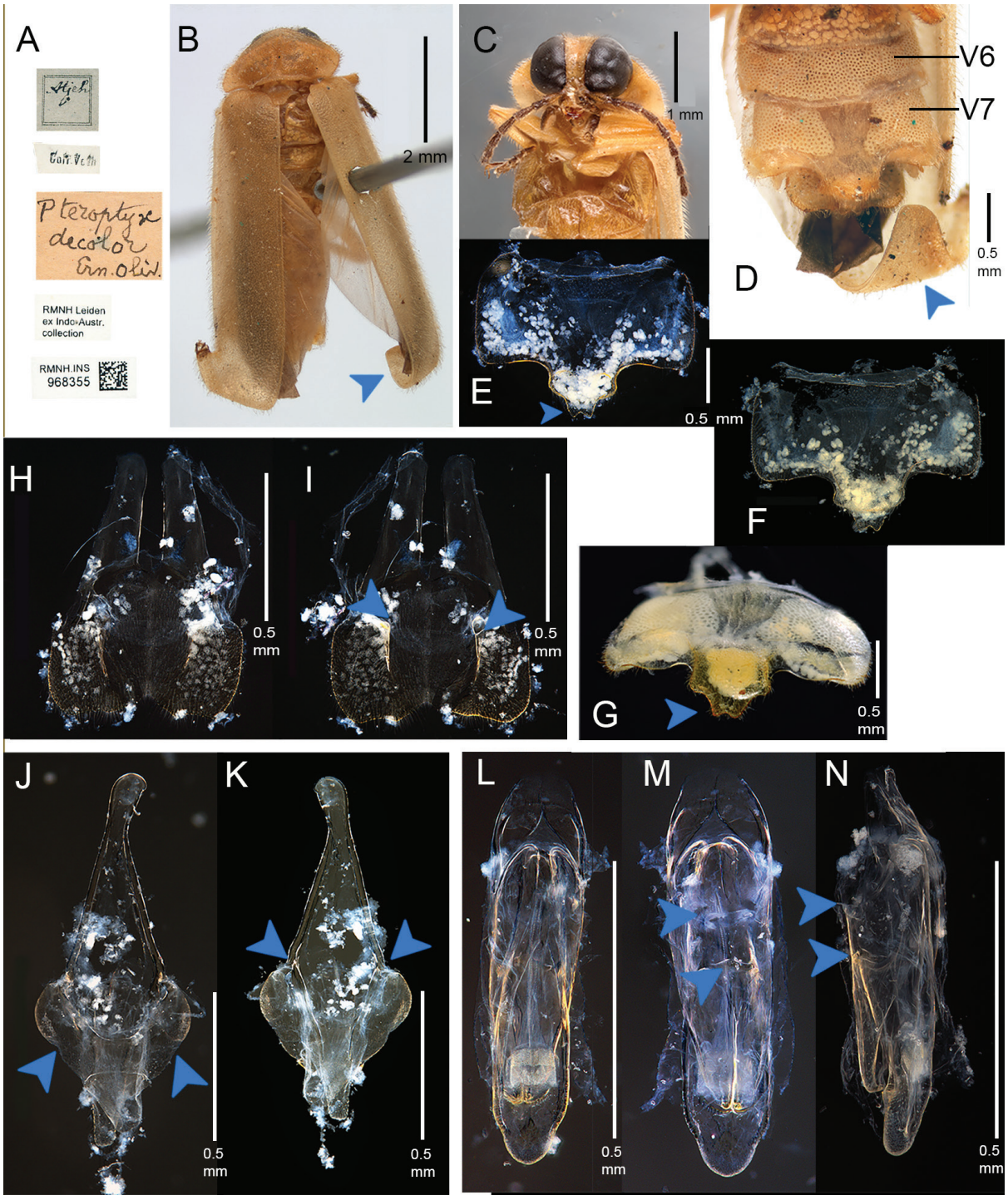

Figure 5. *Pteroptyx decolor* Olivier, 1911 lectotype male. **A.** Specimen labels; **B.** Dorsal habitus; **C.** Ventral anterior body including head; **D.** Ventral abdominal apex and apex left elytron; **E–G.** V7 ventral view (**E**), dorsal view (**F**), and **G** posterior with ventral surface uppermost (projection of tip of MPP of V7 arrowed in **E, G**). **H–I.** T8 dorsal and ventral (oblique arrows in **I** indicate position of flanges); **J–K.** Aedeagal sheath: **J**. Ventral view; **K.** Dorsal view (paraprocts arrowed in **J**; widest margin of sternite arrowed in **K**); **L–N.** Aedeagus: **L.** Ventral view; **M.** Dorsal view; **N.** Right lateral (upper arrows **M, N** anterior dorsal margin of LL; lower arrows **M, N** attachment of ML to inner surface of LL). All images are to scale, except specimen labels.

but "*decolor*" has the projections to each side of the T8 emargination broadly rounded, while in *bearni* they are narrow and acute (Jusoh et al. 2018: figs 39–40, 44, 45, 57–59, 64–65).

It is very probable that the following references to *P. decolor* are a presently undescribed species: Ballantyne and McLean (1970) reference to 15 males and 25 females from Sarawak; Ballantyne (2001) reference to 4 males, female taken in Saratok. The species may be restricted to the island of Borneo and appears close to *P. bearni* differing in the broadly rounded paired projections beside the T8 emargination.

We herein designated a lectotype for *Pteroptyx decolor* to reduce the potential for confusion, especially considering previous misidentifications.

Pygoluciola Wittmer, 1939

Pygoluciola Wittmer 1939: 21. Ballantyne 2008: 1. Ballantyne and Lambkin 2006: 21; 2009: 107; 2013: 108. Ballantyne Lambkin Boontop et al. 2015: 8. Ballantyne Lambkin Luan et al. 2016: 204. Fu and Ballantyne 2008: 1. Fu Ballantyne and Lambkin 2010: 2; 2012: 6. Wattanachaiyingcharoen and Nak-Eiam 2012: 24. Yiu 2017: 105. Ballantyne et al. 2019:120 (figs 38, 41–43, 50, 51, 364–462).

Luciola subgenus *Pygoluciola* (Wittmer). McDermott 1966: 115; Ballantyne 1968: 119; Ballantyne and Lambkin 2000: 82; 2001: 361; Ballantyne and McLean 1970: 233.

Type species. *Pygoluciola stylifer* Wittmer 1939, by monotypy (RMNH).

Key to species. Ballantyne et al. (2019) listed 19 species which they keyed from males.

Pygoluciola stylifer Wittmer, 1939

Fig. 6A–D

Pygoluciola stylifer Wittmer, 1939: 21–32. Ballantyne 2008: 2. Ballantyne and Lambkin 2006:33.

Luciola (*Pygoluciola*) *stylifer*. Ballantyne 1968:119. McDermott 1966:115.

Holotype. 1 ♂ (by original description, as indicated by Wittmer's original type label and determined by authors in this study).

Type locality. "Long Petah" (from page 3, "Fundort: "M.O.-Borneo Expedition, Long Petah, 450 in, IX–X.1925 (leg. H C. Siebers)").

Material examined (1♂ specimen). *Holotype*: INDONESIA ● ♂; (1) "Holotype"; (2) "H. C. Siebers / M.O. Borneo Exp. / 1200 M. bij L. Petak / 15–20 X. 1925 VIII–IX"; (3) *Pygoluciola* / *stylifer* / Wittm. / det. W. Wittmer"; (4) "*T.Y.P.US.*" (Fig. 6A).

Diagnosis. *P. stylifer* belongs to that group of *Pygoluciola* where males have the posterior margin of V7 and T8 narrowly prolonged and curving (Fig. 6B, C). It and *P. guigliae* are the only species of this genus to have curved tibiae, and it is distinguished from *guigliae* by the median emargination of the apex of the prolonged posterior margin of V7 (visible in Fig. 6B).

Notes. McDermott (1966) submerged *Pygoluciola* under *Luciola* as a subgenus, and Ballantyne (1968) briefly addressed *Luciola stylifer* with line figures of the terminal abdomen and aedeagus. Ballantyne and Lambkin (2006) returned *Pygoluciola* to generic status and gave a more extensive description of the male holotype with line figures of pronotum, aedeagus and terminal abdominal segments.

Here, we have the first opportunity to present coloured pictures of the type male and verify the original labels that come with the specimen. Wittmer (1939), in the original description of *P. stylifer*, made it clear that the type is "in coll. Rijksmuseum Leiden" (now RMNH). However, upon comparing Wittmer's original species description with the original labels attached to the type specimen in RMNH, we find that the information he provided was not consistent: (1) He wrote "450 m", but it was "1200 M" on the label; (2) He spelt the locality name "Long Petah", but it should be "L. Petak" or "Long Petak"; (3) The months of 1925 from his description were "IX–X", but then it was written "VIII–IX" on the label.

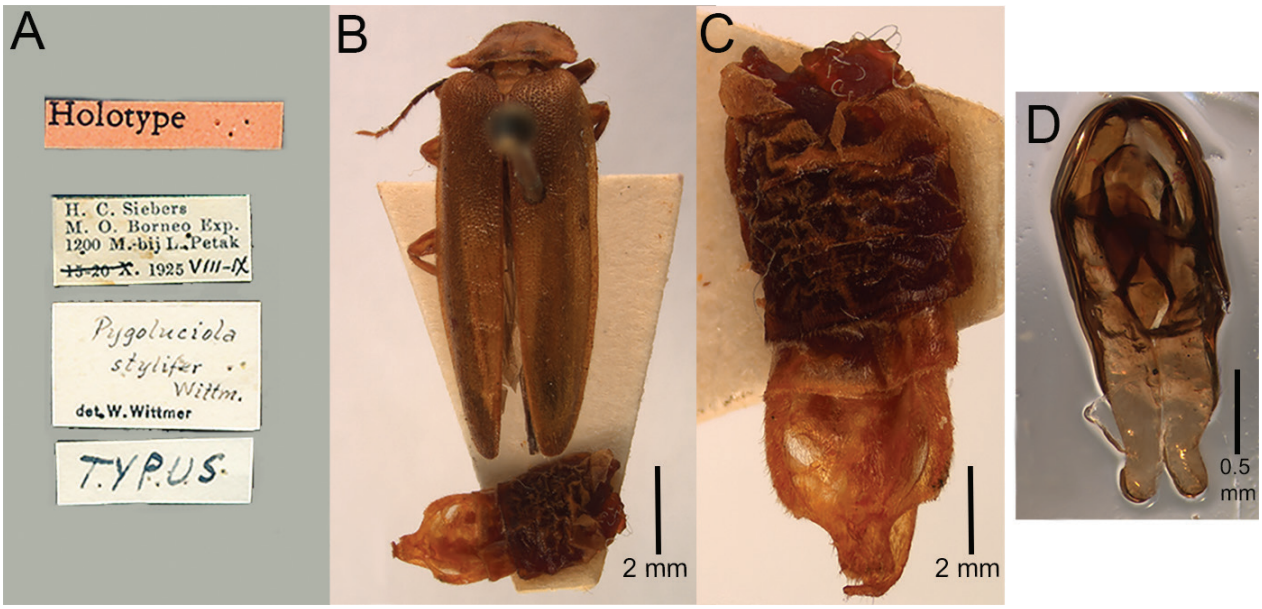

Figure 6. *Pygoluciola stylifer* Wittmer, 1939 holotype male**. A.** Specimen labels; **B.** Dorsal habitus and dissected abdomen; **C.** Abdomen ventral; **D.** Aedeagus ventral. All images are to scale, except specimen labels.

Species inquirenda

Luciola picea Gorham, 1882

Fig. 7A–D

Luciola picea Gorham, 1882: 104–105; 1887: 71. Olivier 1900: 236; 1902: 84. Ballantyne et al. 2019: 104. McDermott 1966:111.

Lectotype and paralectotypes. 4 ♂ (herein designated).

Type locality. "Palembang bovenland".

Material examined (4♂ specimens). ***Lectotype*** (herein designated): INDONESIA ● ♂; (1) "Luciola / picea, Gorh:"; (2) "*Sum. Exp.* / *Palembang* / *bovenland* / *5 of 6.78*"; (5) "RMNH.INS / 968354" (Fig. 7A. Paralectotypes: ♂; (1) "Luciola / picea, Gorh:"; (2) "*Sum. Exp.* / *Lebong* / *5/78*"; (3) "*Lebong / 5/78*"; (4) "RMNH / Leiden / ex Indo-Austr. / collection"; (5) "RMNH.INS / 968353" (Fig. 7B). ♂; (1) "Luciola / picea, Gorh:"; (2) "*Sum. Exp.* / *Palembang bovenland* / *5 of 6.78*"; (3) "*Palemb.* / *Bovenl.* / *5 of 6/78*"; (4) "RMNH Leiden / ex Indo-Austr. / collection"; (5) "RMNH.INS. / 968358" (Fig. 7C). ♀; (1) "Luciola / picea, Gorh: / [n.sp]"; (2) "*H.pg* / *9.79*"; (3) "RMNH / Leiden / ex Indo-Austr. / collection"; (4) RMNH.INS / 968359" (Fig. 7D).

Taxonomic remarks

We can confirm only that this species does not conform to *Luciola* s. str. in features of the aedeagus (see Fig. 7C; LL without leaf like lobes on their inner ventral margin and expanded apices; ML not elongate curved with preapical ventral point). There is no described genus which will accommodate this species and we follow the indication by Yiu (2017) who designated a category *species inquirenda* for specimens with similar aedeagal morphology (Ballantyne et al. 2019). The present taxonomic categories in Ballantyne et al. (2019) do not accommodate these specimens. Further investigation is necessary, including the collection and analysis of specimens from various geographic locations and the use of phylogenetic analysis to better understand the classification of this species. We believe that these additional steps will provide us with a more comprehensive understanding of the species' identity and its place within the broader taxonomic framework of Luciolinae.

Notes

In Gorham's original description, he mentioned the specimens are all males from four localities, suggesting that there could be at least another male syntype (Gorham 1882). In 1887, he cited 24 specimens – all males – from four localities with the majority of these specimens collected from "Highlands of Palembang" or "Palembangsche Bovenladen". However, it is unclear whether these were the same specimens used in the original description or if they were additional specimens collected during the Sumatra Expedition. We herein designated a lectotype for *Luciola picea* and listed paralectotypes to reduce the potential for confusion in future revision of this species.

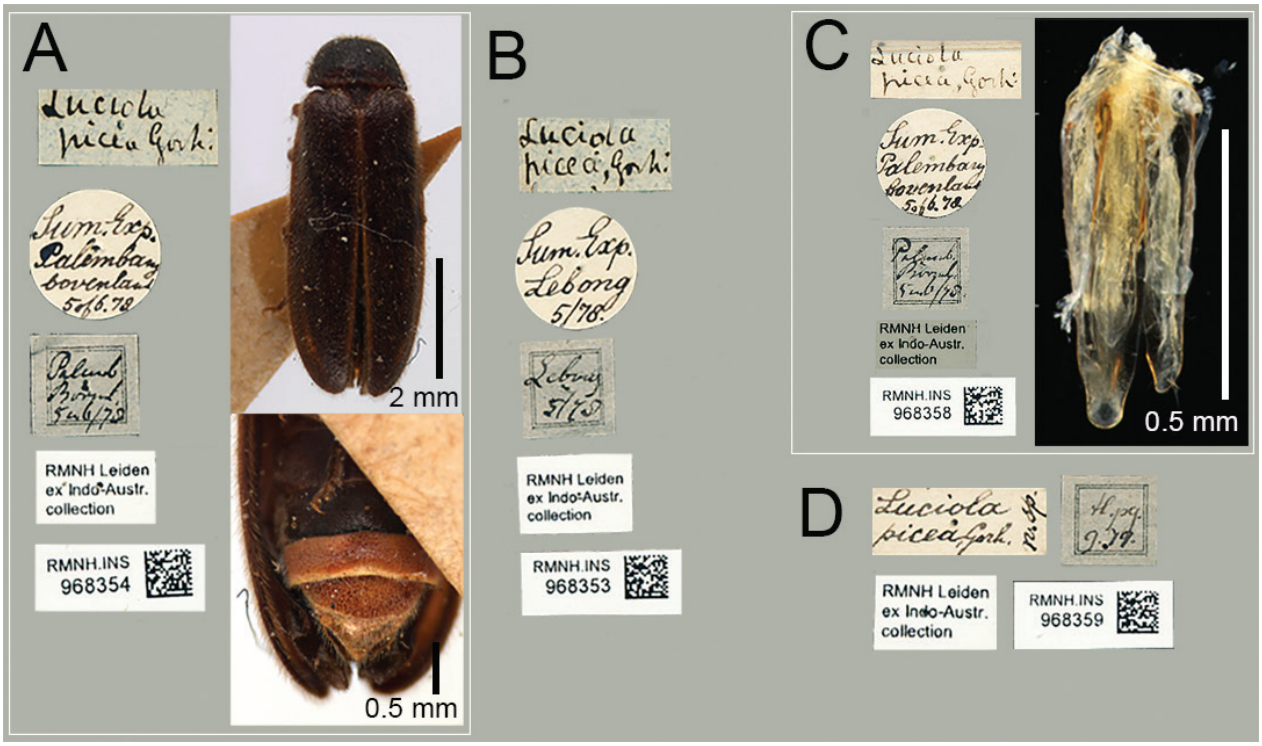

Figure 7. *Luciola picea* Gorham, 1882 lectotype male (**A**) and paralectotypes (**B–D**). **A–D.** Specimen labels, with **A.** Dorsal habitus above, and ventral abdominal apex below; **C.** With ventral aedeagus to right. All images are to scale, except specimen labels.

Discussion

Ballantyne et al. (2022) indicated the many uncertainties that taxonomists often face in attempting identification of their specimens. In this study, we can overcome some of these with the first redescriptions of holotypes, designation of lectotypes for five species, and confirm that two belong in the genus *Luciola* s. str.

While the unique holotype remains the pinnacle for species identification, locating it can be a daunting task. Additionally, while museums may indicate they possess a holotype, further investigation often reveals that this supposed unique specimen is part of a syntype series. We have been able to establish the status of the specimens standing in this collection by detailed examination of the specimen labels, and corroboration by similar examination of how the literature was worded when the specimen was first described.

The holotype itself may be so old and discoloured that it conveys little. Fortunately, all but one of these specimens have retained all sections and only display the inevitable loss of some colour over the original description. Luciolinae taxonomy has come to rely more and more on features of the male genitalia, including that of the last abdominal segments, which are retracted within the abdomen (the aedeagal sheath of Ballantyne et al. (2019). The first author undertook the delicate dissections of males to reveal previously unknown and useful taxonomic features here.

Here, we have had the good fortune to address seven name-bearing type specimens which fulfil most of the conditions we outlined above. They are either identified as types (though they may be syntypes), are from the original locality specified in the description and conform to the original description. The museum was generous in its practices and not only loaned but permitted dissection.

Additionally, the detailed dissections allow us to present descriptions of certain features of the male not previously addressed. The *Curtos* species are shown to have the posterior area of their narrow aedeagal sheath tergite with paired asymmetrical hooks. The means of attachment of the dorsal surface of the aedeagal median lobe to the inner surface of the lateral lobes is investigated and certain generic distinctions are described.

Overall, this study demonstrates that despite the numerous challenges taxonomists face in identifying specimens, a detailed examination of the specimen labels and literature, along with delicate dissections of male specimens, can help overcome some of these challenges and shed light on previously unknown taxonomic features.

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