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First larval description of the genus *Risiophlebia* Cowley, 1934 (Odonata: Libellulidae), based on *R. dohrni* (Krüger, 1902), with notes on taxonomic placement and comparison with related Southeast Asian libellulid larvae

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Abstract. The final instar larva of *Risiophlebia dohrni* (Krüger, 1902) (Odonata: Libellulidae) is described for the first time based on specimens collected from lowland freshwater swamp forests in Singapore. The larva is characterised by elongate antennae exceeding head length, small compound eyes, and well-developed middorsal and posterolateral abdominal spines. Comparative examination with related Southeast Asian libellulid larvae indicates that *Risiophlebia* possesses a distinctive combination of characters not observed in other described genera. These findings provide useful diagnostic features for larval identification and contribute to improving comparative larval taxonomy of Southeast Asian Libellulidae. The species inhabits shallow stagnant pools in swamp forest habitats, highlighting the importance of conserving these localised wetland environments.

Key words. *Risiophlebia dohrni*, larval description, morphology, swamp forest, conservation, Southeast Asia

INTRODUCTION

Risiophlebia Cowley, 1934 is a small genus, currently comprising two species: *R. dohrni* (Krüger, 1902) and *R. guentheri* Kosterin, 2015 (listed in Paulson et al., 2026). Both species inhabit swampy forests across much of Southeast Asia. Although the genus is geographically widespread—from Eastern Indochina (*R. guentheri*) to southern Thailand and much of Sundaland, excluding Java and Palawan (*R. dohrni*) —populations are highly localised, and both species appear to be uncommon in collections and field surveys (Phan et al., 2022).

The current classification of subfamilies within the family Libellulidae remains unresolved. However, studies of larval morphology may help clarify these taxonomic uncertainties (Fleck et al., 2008). The genus *Risiophlebia* was placed within the traditional subfamily Tetrathemistinae based on Steinmann (1997); however, Dijkstra (2025) proposed a new classification assigning it to the subfamily Pantalinae. Although it is a distinctive member of the subfamily, the larval morphology of *Risiophlebia* has remained unknown, creating a substantial gap in larval comparative studies.

In this study we provide a first description of the larva of *Risiophlebia* based on *R. dohrni* and discuss its implications for the phylogenetic placement together with its relevance to conservation assessments.

MATERIAL AND METHODS

Final instar larvae were collected from lowland habitats in swamp forests of Singapore using D-frame nets, then manually sorted. Specimens were transported to the laboratory and reared in plastic containers under controlled conditions until emergence, following procedures outlined by Keetapithchayakul et al. (2025). Specimens (larva/exuvia) were carefully cleaned to remove accumulated debris. The cleaning procedure involved gently brushing the specimens with a small soft-tipped paintbrush while they were immersed in a soap solution and then placing them inside a sonicator (ultrasonic cleaner). Voucher specimens were deposited in Lee Kong Chian Natural History Museum, Singapore and the Zoological Collection of Duy Tan University (ZCDTU), Da Nang, Vietnam.

Adult identification was based on Ngiam & Ng (2022). Morphological measurements and photographs were taken using a ZEISS Stemi 508 stereomicroscope equipped with an

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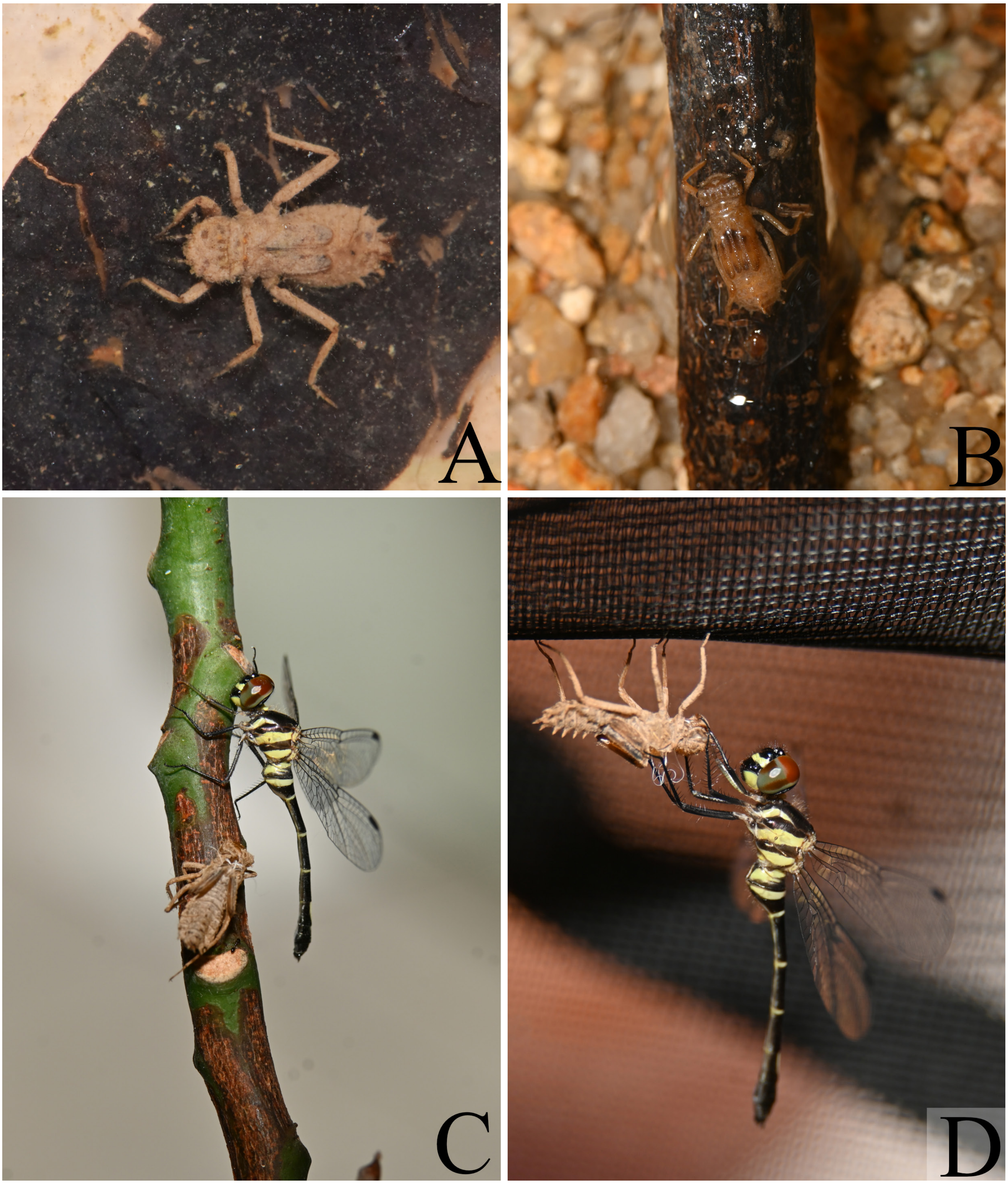

Fig. 1. Habitus and emerging of *Risiophlebia dohrni.* A, F0 larva, in nature, Central Catchment Nature Reserve, Singapore (13 August 2025); B, F0 larva, in laboratory; C, D, Adult emerging from larva in laboratory.

OPTIKA C-P6 digital camera. Final plates were assembled using Affinity Photo 2.

Occurrence data presented in this study were obtained from the iNaturalist online database (www.inaturalist.org) and GBIF (Global Biodiversity Information Facility: www.gbif.org) and published literature (Dow, 2020; Dow, 2021; Dow et al., 2024; GBIF, 2026). The method of dataset retrieval followed Phan et al. (2025). The resulting coordination datasets were plotted and visualised via QGIS 3.44.3. The derived datasets of this study were deposited in the GBIF database (GBIF, 2026).

The description of the mandibular formula, generic characteristics, and distinctive surface features of the larvae follow Watson (1956), Novelo-Gutiérrez & Sites (2024), and Nguyen et al. (2026), respectively.

Abbreviations used are S1–10: abdominal segments 1–10; A1–7: antennomeres 1–7; SS: simple setae; SPS: spiniform setae.

RESULTS

Larval description of *Risiophlebia dohrni* (Krüger, 1902)

Material examined. 3 F0 larvae (1 male, 2 female), 13 Aug 2025: Central Catchment Nature Reserve, Singapore. coll. R.W.J. Ngiam & T.S. Keetapithchayakul; 1 female (as last stadium larvae, reared), same location and date, coll. Z.S.H. Soh.

Description of larva. A very small, compact, and robust larva, with habitus typical of libelluloid larvae (Fig. 2). Body pale yellowish-ochre colour, generally smooth, with fine scattered setae on most surfaces. S8–9 with lateral blunt elongate spines.

Head. – about 1.86 times as wide as long (Fig. 3B). Labrum (Fig. 3E) broad and ventrally flattened, with the ventral margin slightly concave, bearing scattered long SS on the anterior half and dense SS from the medial to distal regions. Clypeus (Fig. 3B) broad and ventrally flattened, with ventral margin shallowly concave, mostly glabrous, with a few scattered fine pits bearing small SS near lateral edges. Antefrons slightly convex, with ventral surface flattened, pale to yellowish brown with broad dark median patch extending dorsally toward postfrons. Postfrons appears as narrow transverse band immediately below ocellar area in dorsal view, finely pitted with scattered small SS and long SS becoming denser toward midline. Vertex broad and slightly convex, extending laterally to inner margins of compound eyes, with anterior margin gently curved and merging indistinctly with postfrons; vertex with suture defining clear ocellar area and posterolateral sections. Ocellar area on upper and lower postfrons; three ocelli in weakly curved transverse row, median ocellus anterior to lateral ocelli. Posterolateral regions moderately convex, gently sloping, posterior to compound eyes, gradually merging with compound eyes without distinct boundary. Antennae seven segmented (Fig. 3A, D); relative length ratios of antennomeres A1–A7: 0.10: 0.10: 0.19: 0.11: 0.13: 0.18: 0.19 (total antennal length = 2.16 mm), with A1 and A2 short, the latter barrel shaped, A3 and A7 the longest, elongate and slender, A7 gradually tapering distally; A1–A3 with scattered SS, A4–A7 with scattered longer SS. Compound eyes (Fig. 3B, D, E) very small, maximum width 0.08 maximum head width, hemispherical and projecting laterally. Remainder of eye pigmentation extending from anterior side of compound eye in narrow curved subtriangular pigmented patches that each extend for about ⅖ of total head width, the space between them being about ⅕ head width. Occiput (Fig. 3B) broad and moderately convex, densely pitted with scattered distinct SPS; anterolateral margins strongly rounded behind posterior margins of compound eyes. Postocular lobe (Fig. 3B) poorly developed, forming slightly curved lateral margin with scattered long PS, long SS, and stout SPS, and slightly broad and gently convex posterior margin bearing scattered small SPS with seven distinct patches (three lateral smooth sub-oval and one median subtriangular). Genae (Fig. 3C, E) smooth and slightly convex, extending below compound eyes, with sparse pitts bearing SPS and a row of distinct SPS along lateral margin near maxillary base bearing dense SPS and long SS ventrolaterally. Labium (Figs. 3C, 4) spoon-shaped, with ventral surface covered by scattered SPS; prementum–postmentum articulation reaches posterior procoxae. Prementum (Fig. 4A–E) subpentagonal, with latero-basal margins concave (Fig. 4A). SPS present basally at base of the palp articulation, its ventral surface covered with small SPS, intermingled with scattered distinct SS; premental setae (Fig. 4C) consist of seven long and six short setae (7+6) on each side of the midline; median lobe (Fig. 4D, E) well developed, slightly crenate, with a dense row of small SPS along the apical margin and distinct SPS (eight on each side and two apical) along medial apical margin. Postmentum elongate and rectangular, with ventral surface gently convex laterally and with distinct median longitudinal groove extending from the basal half to anterior margin, making distal margin appear deeply concave (Fig. 4B, D). Labial palps (Fig. 4A, B, F–I) covering the anterior part of head as a mask (Figs. 2D, 3D), with apical margins slightly undulate and forming nine lobes; distal end with 2–3 raptorial setae on each lobe, dorsal margin of each palp fringed with dense rows of long SS along entire margin. The ventral surface covered with small SPS, with six long palpal setae, and movable hook very slender, sharply pointed, and smooth. Mandibles (Fig. 5A–D) asymmetrical and robust, with the formula L 1234 0 ab / R 1234 y abd, bearing well-developed teeth; the outer margin smoothly angulate without obvious spines, with long antero-lateral SS and scatted SS. Maxilla (Fig. 5E–G) with galeolacinia, with seven teeth: two of approximately equal size, one small dorsal tooth, the apical tooth being largest, and three small ventral teeth consisting of one small apical tooth, the second tooth long, bending outward, and one smallest tooth basally.

Thorax.– Prothorax (Fig. 3B, D) narrower than head and densely covered with minute small SS; pronotum almost square, with anterior ridge bearing row of long SS medially, a shallow median depression extending longitudinally along the midline, and posterior margin broadly concave and slightly raised in lateral view, moderately developed lateral lobes extending dorsolaterally, each bearing several long SS near margins. Pterothorax (Fig. 2) broader than pronotum, with dorsal area of mesopleura shield-like, bearing a row of long SS along the lateral ridge and a pair of large transverse spiracles. Thoracic sternites (Figs 2B, 6A) narrower than head capsule; prosternum forming a socket supporting the labium; mesosternum broadest and most conspicuous sternite, with truncated anterolateral lobes projecting obliquely outward to form rounded prominences on either side, bearing dense long SS on anterior part. Metasternum broad, with median

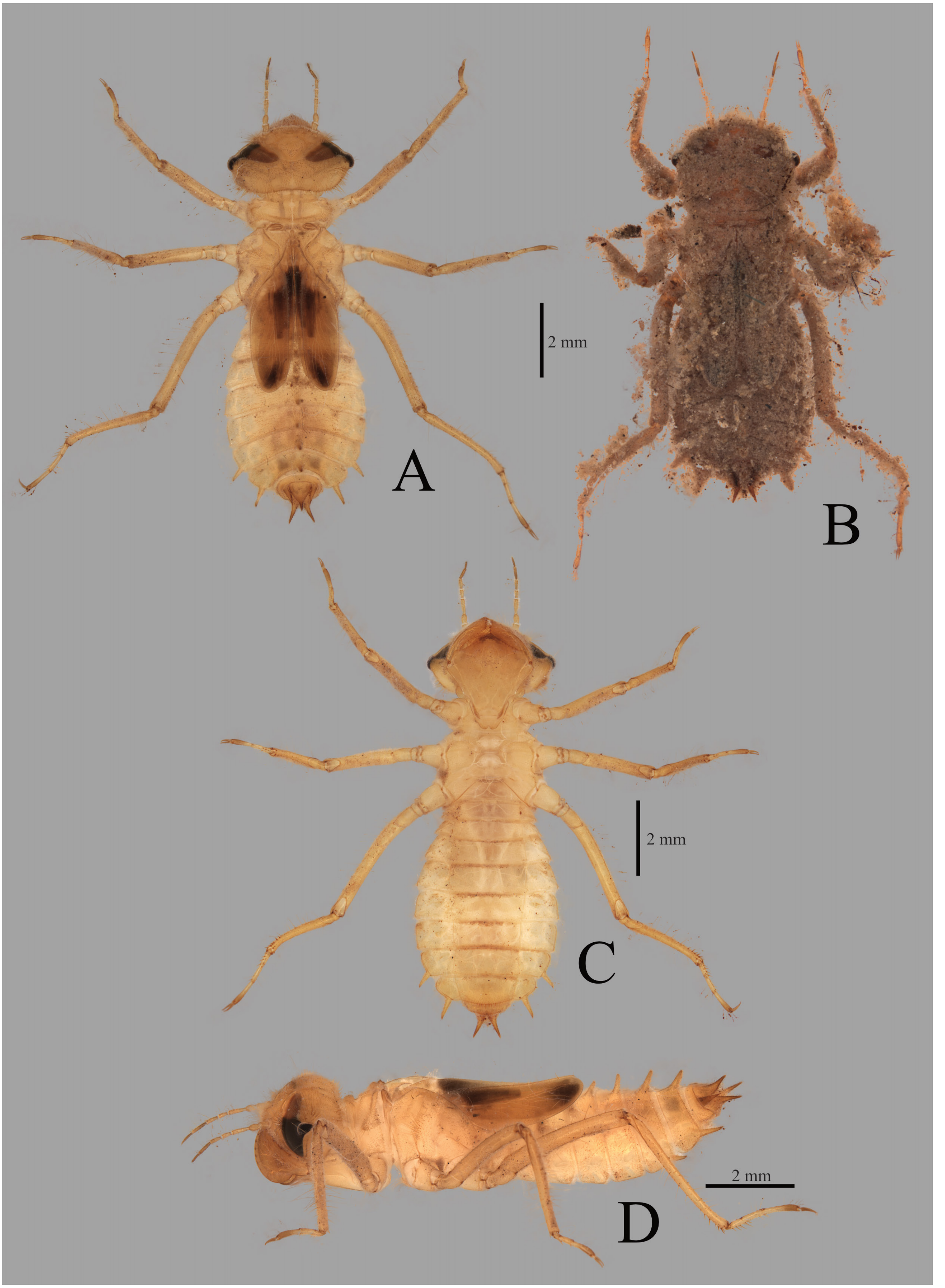

Fig. 2. Habitus of *Risiophlebia dohrni* larva. A, dorsal view; B, dorsal view, with sediment before cleaning; C, ventral view; D, lateral view.

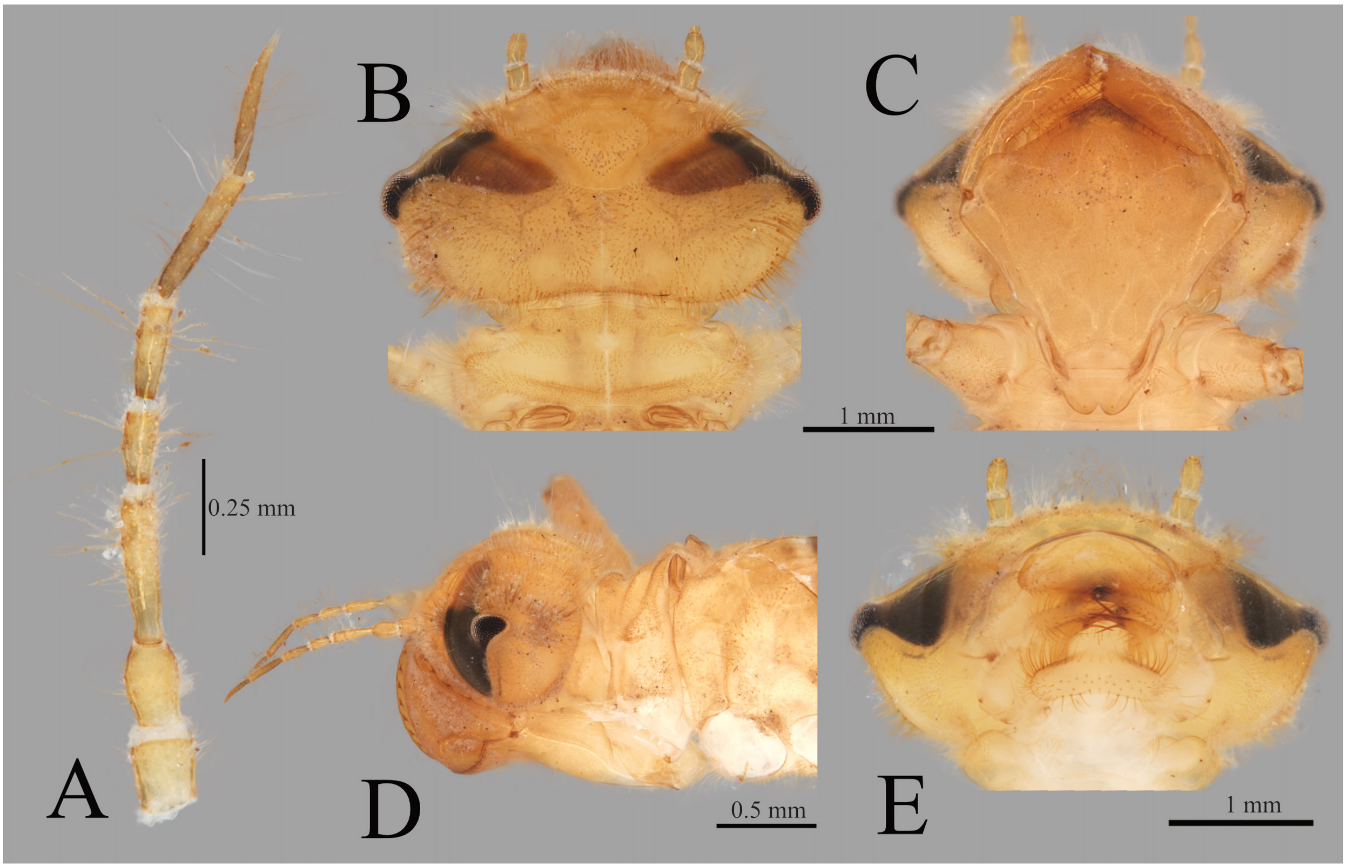

Fig. 3. Head and antenna of *Risiophlebia dohrni* larva. A, enlarged left antenna; B, head, dorsal view; C, head, ventral view; D, head, lateral view; E, head, ventral view, dissected labium.

area slightly concave and bounded by pair of weakly raised oblique ridges; lateral portion forms convex lobe projecting obliquely outward and downward, bearing sparse short setae near anterolateral margin, and middle area to posterior margin a transverse subtrapezoid. Wing sheaths parallel, with the anterior and posterior wing sheaths reaching posterior of S6 and anterior of S7, respectively. Legs (Fig. 6) with robust coxae densely bearing SS; femora thick and elongate, with sparse long SS and SPS, metafemur reaching anterior margin of S7; tibiae subequal to or slightly shorter than femora, slender and nearly straight, bearing scattered long SPS, short SS. Tibial comb (Fig. 6B–D) with scattered long SS and distal end bearing scattered distinct SPS; metatibia with long SS and distal end with distinct row of SPS. The tarsal formula 3–3–3, with each segment bearing two scattered rows of fine, robust SPS on ventral surface; metatarsi longest, and pretarsal claw simple with a developed empodium.

Abdomen.– (Figs. 2, 7) ovate, widest at S6–7 and abruptly rounded posteriorly. Terga S1–4 bear scattered SPS on mid and lateral parts, S5–10 have sparse small SPS on each segment, and middorsal protuberances on S4–9 with tufts of SPS, blunt elongate rearwardly directed spine on S4–5, slightly uprise on S6–9. Posterolateral spines distinct, blunt elongate spine and diverging on S8–9, with those on S8 shorter than on S9 (Fig. 7A, B), and the spines on S9 reaching the middle of cerci. S10 shorter than S9, but extending posteriorly beyond the posterior margin of S9. The sternum creamy-pale (Fig. 7B), with posterior margins of sterna 1–6 smooth and sterna 7–9 bearing a row of distinct SPS, largest on S9. Antepleurites present and rather well developed on S3–5 and S9. Anal pyramid (Fig. 7C–E) distinct and sharply pointed; epiproct stout and triangular, 1.30× longer than wide, yellowish-brown, with the basal two-thirds slightly upward, bearing scattered long SS; paraprocts yellowish-brown, bending outward laterally and pyramidal, 1.67× longer than cerci, with tip slightly acute and bearing rows of SS and long SS along dorsal and ventral margins; cerci bending inward, slender in dorsal view, 1.49× shorter than epiproct, straight tips.

Distribution. *Risiophlebia dohrni* exhibits a broad distribution across Southern Thailand (the Kra Isthmus) downward to Sundaland excluding Java and Palawan (Steinmann, 1997; Kosterin, 2015; Dow, 2020; Dow, 2021; Dow et al., 2024; GBIF, 2026), while its congener *R. guentheri* is known from Cambodia and Vietnam (Fig. 8) (Kosterin, 2015; Phan et al., 2022).

Habitat and biology. The larvae of *Risiophlebia dohrni* inhabit pools in lowland freshwater swamp forest and at the edges of peat swamp forest, sometimes also occurring in disturbed semi-open wetlands with light peat or tannin-stained freshwaters (Fig. 9A, B). Microhabitats are typically shallow stagnant water (10–40 cm depth) with freshwater swamp plants and leaf litter in the shaded areas of the habitat. The larvae were found together with *Podolestes orientalis* Selys, 1862, *Amphicnemis gracilis* Krüger, 1898,

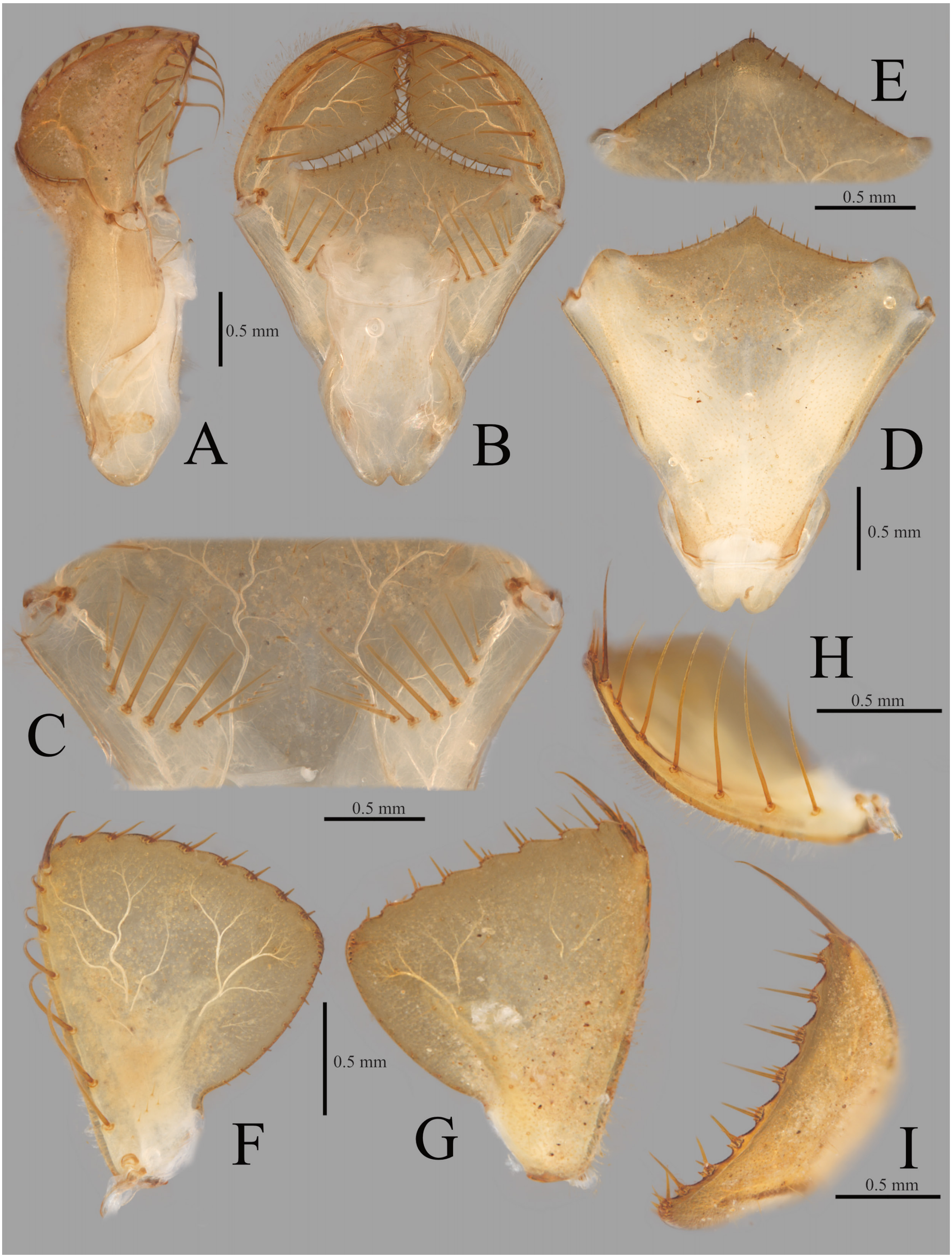

Fig. 4. Labium of *Risiophlebia dohrni* larva. A, prementum, lateral view; B, prementum, dorsal view; C, enlarged prementum, dorsal view; D, prementum, ventral view; E, enlarged median lobe of prementrum, dorsal view; F, left labial palp, dorsal view; G, left labial palp, ventral view; H, enlarged left labial palp, oblique-dorsal view; I, enlarged left right labial palp, top view.

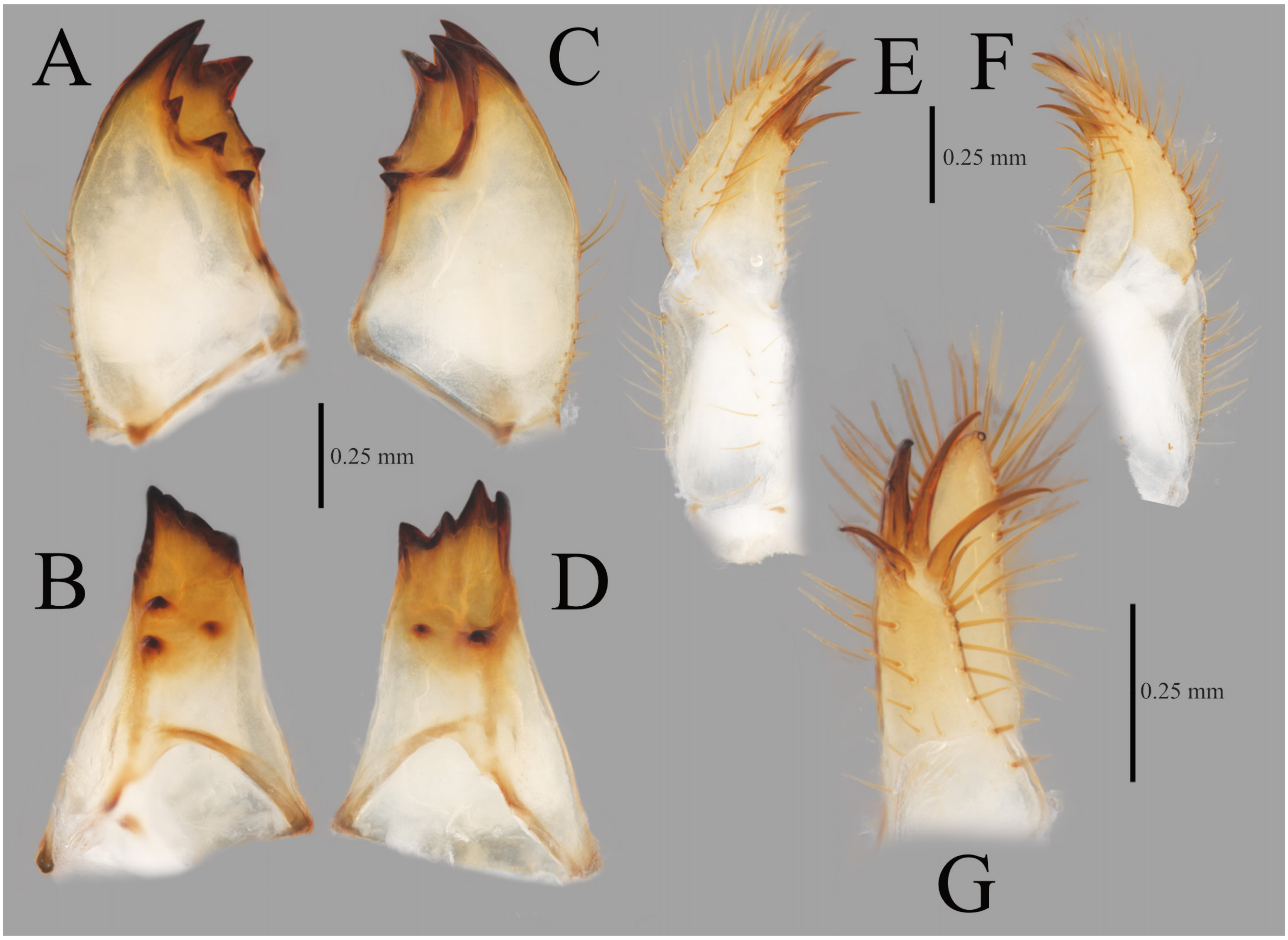

Fig. 5. Mouth parts of *Risiophlebia dohrni* larva. A, right mandible, ventro-internal view; B, right mandible, internal view; C, left mandible, ventro-internal view; D, left mandible, internal view; E, right maxilla, ventral view; F, right maxilla, dorsal view; G, enlarged right maxilla, internal view.

and *Orchithemis pulcherrima* Brauer, 1878. Adults, which are usually found perching on low branches of trees (Fig. 9C, D), were also observed mating and laying eggs near the larval habitats. Males guard a small territory in the habitat and actively chase other males or females which approach. Females are usually seen singly further away from water, and approach stagnant pools to lay eggs. During oviposition the female repeatedly dips the tip of her abdomen into water at the edge of the pool, releasing clumps of small round eggs. The male continues to guard the female and hovers beside her throughout the egg laying process.

DISCUSSION

The identification and delimitation of subfamilies within Libellulidae remains problematic, as larval and adult morphological characters and available molecular data have not yet been fully integrated across the family. Although the monophyly of Libellulidae is well supported, relationships among its subfamilies remain weakly resolved, reflecting both limited taxon sampling and the frequent occurrence of homoplasy in morphological traits (Carle et al., 2015; Bybee et al., 2021). Recent integrative studies combining adult and larval morphology with large-scale molecular datasets highlight the importance of total-evidence approaches for improving phylogenetic resolution within Libelluloidea (Goodman et al., 2025). However, progress is constrained by incomplete larval knowledge across many genera, as the larvae of numerous taxa remain undescribed and sometimes are unknown. Even well-known, described larvae are often insufficiently characterised to support robust phylogenetic comparisons. This limitation is particularly evident in Southeast Asia, where larval identification at the genus level remains incomplete across several odonate groups, particularly Anisoptera in Thailand, especially within Libellulidae (Novelo-Gutiérrez & Sites, 2024), as well as Calopterygoidea in tropical Asia (Orr, 2024) and Platycnemididae across Asia (Keetapithchayakul et al., 2022; Keetapithchayakul & Phan, 2024).

The genus *Risiophlebia* was previously assigned to the traditional subfamily Tetrathemistinae, a group historically recognised as comprising 17 genera (Steinmann, 1997). However, recent taxonomic revision by Dijkstra (2025) has substantially redefined the composition of this subfamily, restricting it to only three genera (*Calophlebia* Selys, 1896; *Notiothemis* Ris, 1919; and *Tetrathemis* Brauer, 1868a), while some of the former members, including *Risiophlebia*, were transferred to the subfamily Pantalinae as part of the

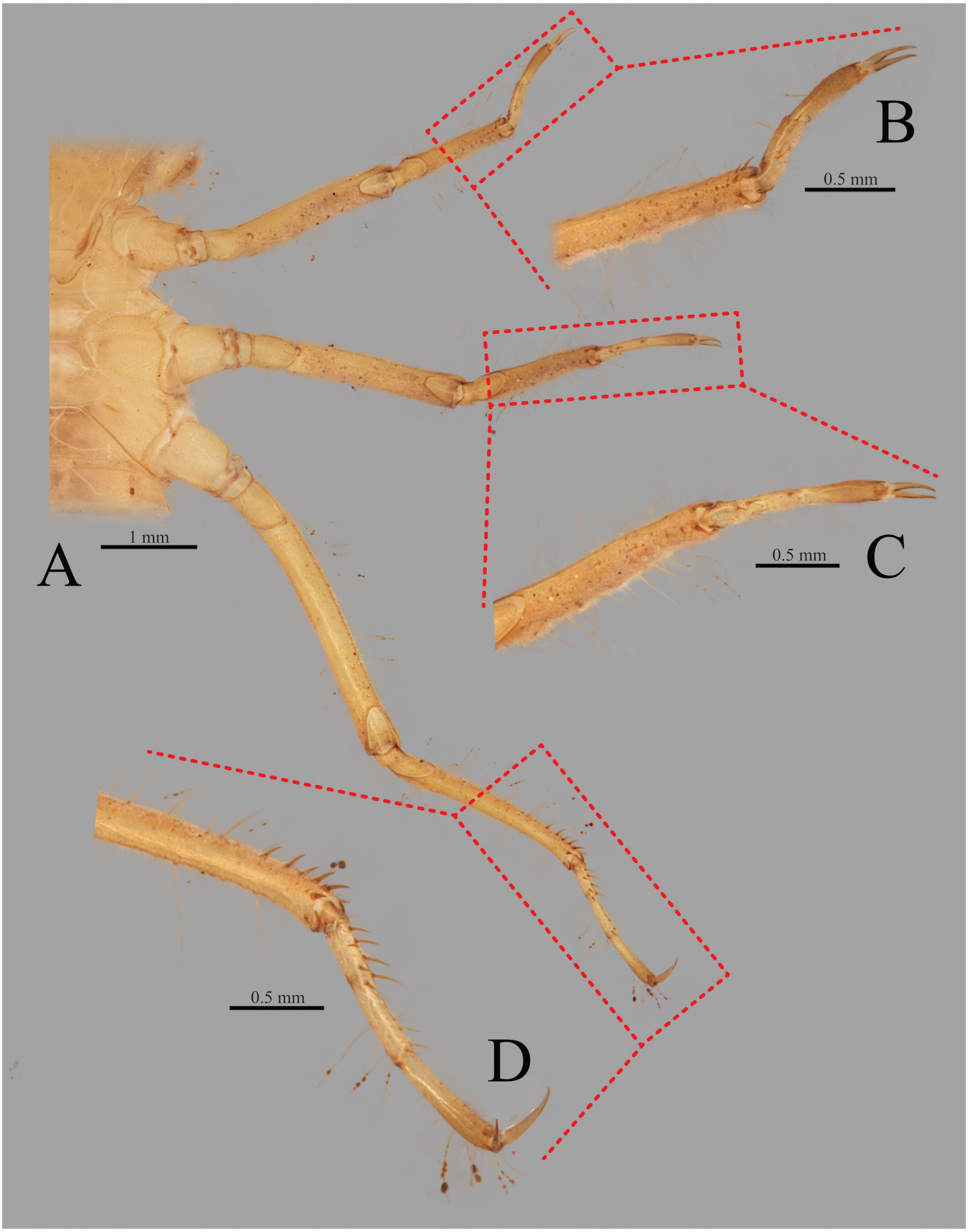

Fig. 6. Pterothorax and legs of *Risiophlebia dohrni* larva. A, pterothorax, ventral view; B, distal end of foreleg, ventral view; C, distal end of midleg, ventral view; D, distal end of hindleg, ventral view.

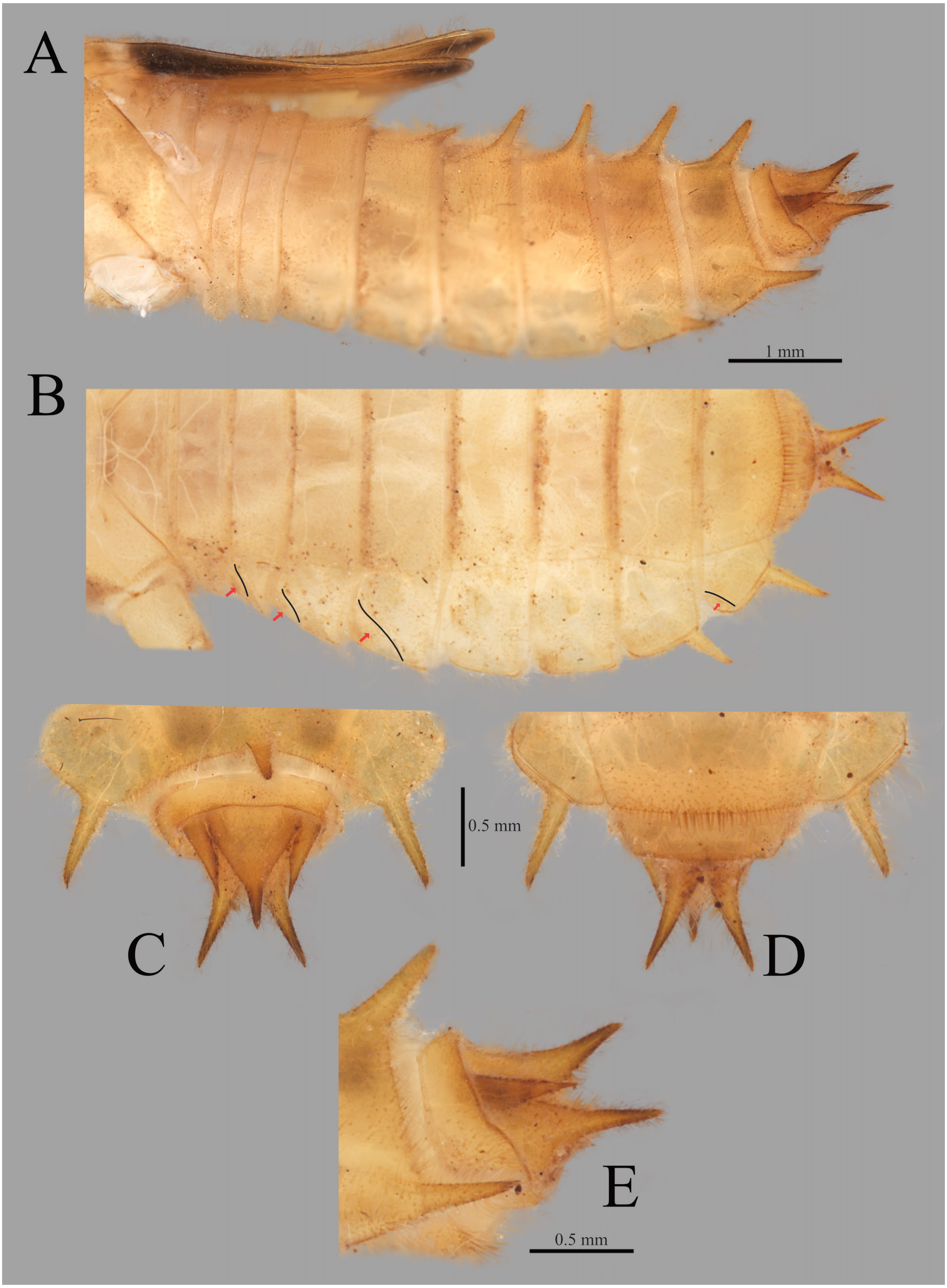

Fig. 7. Abdomens of *Risiophlebia dohrni* larva. A, abdomen, lateral view; B, abdomen, ventral view; C, caudal appendages, dorsal view; D, caudal appendages, ventral view; E, caudal appendages, lateral view.

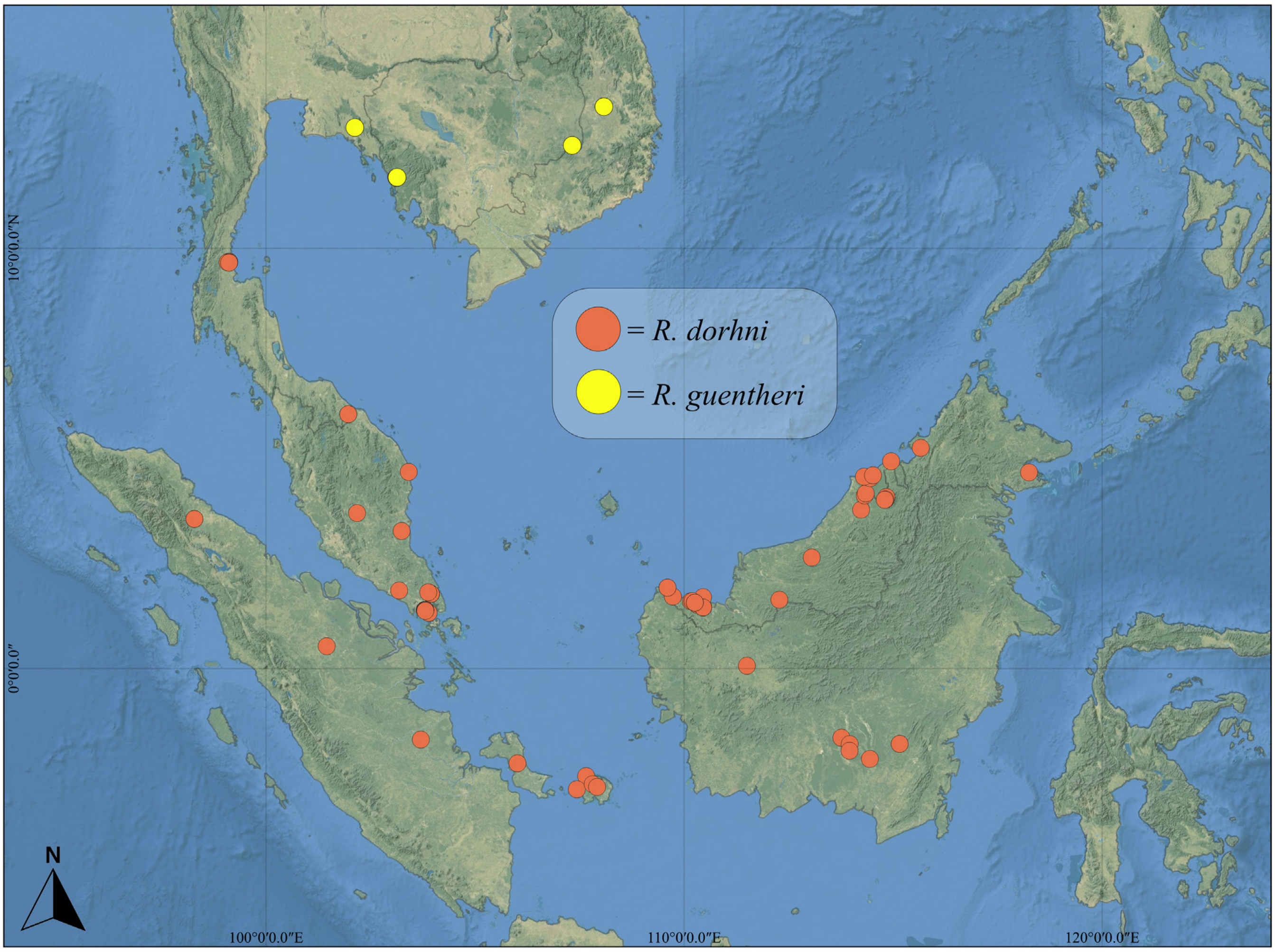

Fig. 8. Geographic distribution of the genus *Risiophlebia* spp. in Southeast Asia.

"remaining genera" group. Despite this reassignment, the taxonomic placement of *Risiophlebia* remains uncertain. Members of Pantalinae (remaining genera) are primarily distributed across subtropical and tropical regions, particularly within Southeast Asia, including Sundaland, Wallacea, New Guinea, and Australia, and currently comprise six genera according to Dijkstra (2025), namely *Celebophlebia* Lieftinck, 1936, *Celebothemis* Ris, 1909, *Huonia* Förster, 1903, *Nannophlebia* Selys, 1878, *Onychothemis* Brauer, 1868b, and *Risiophlebia*.

The larval stage of *R. dohrni* described here provides important new comparative data for considering the taxonomic placement of the genus which remains uncertain; therefore, the present study focuses pragmatically on comparisons with Southeast Asian larvae of relatively small-sized libellulid genera with which it might be confused (*Acisoma* Rambur, 1842; *Aethriamanta* Kirby, 1889; *Brachydiplax* Brauer, 1868a; *Brachygonia* Kirby, 1889; *Nannophya* Rambur, 1842; *Nannophyopsis* Lieftinck, 1935; *Neurothemis* Brauer, 1867; and *Orchithemis* Brauer, 1878) as well as genera within the subfamily Pantalinae whose adult habitus suggests possible close relationships (*Huonia*; *Nannophlebia*; *Onychothemis*; *Pantala* Hagen, 1861; *Trithemis* Brauer, 1868a; and *Zygonyx* Hagen, 1867) and the traditional subfamily Tetrathemistinae (*Hylaeothemis* Ris, 1919 and *Tetrathemis*) (Steinmann, 1997; Dijkstra, 2025).

Overall, the larva exhibits a unique combination of characters that does not closely correspond to any described small-sized libellulid genus from Southeast Asia, including all known Asian genera of Pantalinae and Tetrathemistinae (Table 1). Furthermore, *Risiophlebia* can be readily distinguished from other genera with described larvae in these subfamilies by the following combination of morphological characters:

1. Ratio between maximum compound eyes width and maximum head width less than 0.10× (small compound eyes) [more than 0.10× but less than 0.20× (moderate)—*Tetrathemis*; more than 0.20× (large)—*Huonia*, *Nannophlebia*, *Onychothemis*, *Pantala*, *Trithemis*, and *Zygonyx*];
2. Ratio between antenna length and head length more than 1.10× (antenna longer than head) [more than 0.9 but less than 1.10× (equal)— *Hylaeothemis*; less than 0.9× (shorter) —*Huonia*, *Onychothemis*, *Pantala*, *Tetrathemis*, *Trithemis*, and *Zygonyx*; unknown— *Nannophlebia*];
3. Postocular lobe poor developed [moderately developed—*Huonia*; well developed— *Onychothemis*];
4. Glabrous areas on postocular lobe with 7 patches [5 patches— *Onychothemis*, *Tetrathemis*, and *Zygonyx*; 9 patches— *Hylaeothemis*];

Table 1. Comparison of larval characters of *Risiophlebia dohrni* and selected small-sized Southeast Asian libellulid genera.

Characters	***Risiophlebia dohrni***	***Acisoma panorpoides***	***Aethriamanta brevipennis***	***Brachydiplax chalybea* and *B. farinosa***	***Brachygonia oculata***	***Nannophyopsis clara* and *N. chalcosoma***	***Nannophya pygmaea***	***Neurothemis* sp.**	***Orchithemis pulcherrima***
Subfamily	Pantalinae	Palpopleurinae	Urothemistinae	Brachydiplectinae	Brachydiplectinae	Sympetrinae	Palpopleurinae	Palpopleurinae	Libellulinae
1. Ratio between antenna length and head length	longer > 1.0×	shorter < 1.0×	shorter < 1.0×	longer > 1.0×	shorter < 1.0×	longer > 1.0×	shorter < 1.0×	shorter < 1.0×	shorter < 1.0×
2. Ratio between max. compound eyes width and max. head width	small <0.1×	large > 0.2×	very large > 0.4×	large > 0.2×	medium >0.1× and < 0.2×	large > 0.2×	large > 0.2×	large > 0.2×	medium >0.1× and < 0.2×
3. Postocular lobe	poorly developed	poorly developed	moderately developed	poorly developed	moderately developed	well developed	poorly developed	poorly developed	poorly developed
4. Glabrous areas on postocular lobe	present, 7 patches	present, 7 patches	present, 5 patches	absent	absent	present, 5 patches	present, 3 patches	present, 2 patches	present, 5 patches
5. Palpal setae	6	6–7	7	9–12	8	9	5–6	9–11	6
6. Premental setae	13	11–14	12	11–15	10	12–13	9	12	absent (15 stout setae)
7. Palpal crenations	9 very weak crenations	very shallow crenations	7 weak crenations	6–9 very weak crenations	6 weak crenations	6 strong crenations	9 very weak crenations	13 very weak crenations	7 weak crenations
8. Middorsal protuberances / spines	blunt elongate spine on S4-9	absent	low profile, rounded curves, sharply pointed on S5–8	low profile, straight, sharply pointed on S4–8, S3–8	low profile, straight, sharply pointed on S2–8	low profile, rounded curves, sharply pointed on S4–9	Low, obtuse, middorsal protuberances on S2–8	absent	low profile, straight, sharply pointed on S4–8
9. Posterolateral spines on abdominal segment	blunt elongate spine, divergent on S8–9	absent	sharply pointed, incurved on S8–9	sharply pointed spine, straight on S8–9	sharply pointed spine, straight on S8–9	Small hook-like spines on S7–9	Small hook-like spines on S8–9	Small hook-like spines on S8–9	Small incurved spines on S8–9
10. Antepleurites present	S3-5, S9	unknown	S3–5	S3–5, S8–9	unknown	S3–5	S3–5	S3–5	unknown
11. S10 sunken into S9	absent	present	absent	present	present	present	present	present	absent
References	this study	Novelo-Gutiérrez & Sites, 2024	Chandran et al., 2025	Butler, 2012; Novelo-Gutiérrez & Sites, 2024	Ngiam et al., 2021	Yeh & Lien, 1995; Fleck & Orr, 2006	Nguyen et al., 2026	Novelo-Gutiérrez & Sites, 2024	Butler, 2013

Fig. 9. Habitats site and adults of *Risiophlebia dohrni*. A, freshwater swamp; B, freshwater swamp, Central Catchment Nature Reserve, Singapore; C, a mature male; D, a pair in tandem. Photos C and D by Zick Soh Shun Hua (16 June 2023 and 14 April 2023, respectively).

5. Palpal setae less than 10 [more than 10— *Onychothemis* and *Pantala*; absent— *Hylaeothemis*];
6. Premental setae more than 10 [less than 10— *Huonia*, *Nannophlebia*, *Tetrathemis*, *Trithemis*, and *Zygonyx*; absent— *Hylaeothemis*];
7. Palpal crenations with weak crenation [very weak (almost smooth)— *Onychothemis* and *Zygonyx*; moderate— *Trithemis*; strong— *Huonia*, *Nannophlebia*, *Pantala*, and *Tetrathemis*];
8. Middorsal protuberances / spines on S4–9 [S2–9— *Nannophlebia*; S3–9— *Trithemis* and *Tetrathemis*; S5–9— *Huonia*; S2–8— *Onychothemis*; absent— *Hylaeothemis*];
9. Blunt, elongate posterolateral spines on S8–9 [small incurved— *Huonia* and *Trithemis*; large incurved on S5–9— *Onychothemis*; long incurved— *Pantala* and *Zygonyx*; small hook— *Nannophlebia* and *Tetrathemis*; absent— *Hylaeothemis*];
10. Antepleurites present on S3–5, S9 [S3–4— *Onychothemis* and *Pantala*; S3–5— *Tetrathemis*, *Trithemis*, and *Zygonyx*; unknown— *Huonia*, *Nannophlebia* and *Hylaeothemis*];
11. S10 set off from S9 [S10 sunken into from S9— *Onychothemis*, *Pantala*, *Tetrathemis*, and *Trithemis*] (Lieftinck, 1953; Hawking, 1993; Theischinger, 2007; Sasamoto & Kawashima, 2009; Theischinger & Endersby, 2009; Novelo-Gutiérrez & Sites, 2024; and this study).

The larva of *Risiophlebia dohrni* is particularly distinguished by its elongate antennae (longer than head length), small compound eyes (<0.1× head width), and distinctive middorsal and posterolateral abdominal spines. Among pantalinid genera, *Nannophlebia* is for the most interesting comparison, particularly because adult morphology, especially the characteristic arched abdomen suggests a possible relationship between the two genera. However, larval knowledge of *Nannophlebia* remains limited to a few Australian species despite the genus comprising 26 described species (Theischinger, 2007; Theischinger & Endersby, 2014; Theischinger et al., 2021; Paulson et al., 2026). Moreover, most are known to inhabit lotic habitats that may be reflected in their larval morphology. The absence of larval descriptions from Wallacea and Papua also limits meaningful comparison and highlights the need for additional data to determine whether observed similarities reflect phylogenetic affinity or convergent morphology.

Elongate posterolateral spines on abdominal segments S8–9, similar to those of *Risiophlebia*, are also present in several pantaline genera, including *Zygonyx*, *Pantala*, and *Onychothemis*. Among these, *Zygonyx* shows the closest resemblance in general proportion and orientation, although the spines in *Risiophlebia* are blunt and divergent, whereas those of the other genera are typically long, incurved, and apically pointed, perhaps adaptations to their different habitats and greater size. *Zygonyx* and *Onychothemis* are associated with swift flowing-water habitats and *Pantala* occupies a wide range of aquatic environments, whereas *Risiophlebia* is a specialist inhabitant of shallow stagnant swamp pools with accumulated leaf litter (Morse et al., 1994; Novelo-Gutiérrez & Sites, 2024; Keetapithchayakul et al., 2026).

The establishment of these diagnostic larval characters is essential for accurate field identification, which is a prerequisite for understanding the distribution and habitat requirements of *Risiophlebia*. As our understanding of species boundaries continues to evolve, it is becoming increasingly apparent that many taxa may have far more restricted distributions than previously believed, both in terms of species and their specific habitats (Kalkman & Orr, 2016; Nguyen et al., 2026). These species may be confined to very specific ecological niches or limited geographic areas, such as isolated wetlands or particular forest types (Dow, 2021; Phan et al., 2022). This highlights the need for a thorough reassessment of conservation priorities, especially considering the rapid degradation of lowland wetland ecosystems across Southeast Asia. Freshwater and peat swamp forests, which are the primary habitats for *Risiophlebia*, are increasingly threatened and rapidly declining. In Singapore, such habitats are highly restricted, with only one remaining swamp forest. Hence, *Risiophelebia*'s national conservation status has been listed as Endangered in the latest edition of the Singapore Red Data Book (Davison et al., 2024). Habitat loss poses a potential threat to these species, particularly during their larval stages, emphasising the importance of conserving swamp forest habitats. At the global scale, however, *Risiophlebia dohrni* is currently assessed as Least Concern (LC), whereas *R. guentheri* is classified as Data Deficient (DD) on the IUCN Red List due to limited available data on its distribution and population status (Kosterin, 2018; Dow, 2020). These assessments highlight the need for continued monitoring and habitat protection, particularly for species associated with localised swamp environments. Despite these differing conservation statuses, the strong dependence of both species on swamp forest habitats indicates that localised habitat degradation could pose significant long-term risks to their populations. Effective conservation should therefore focus on the protection and management of swamp forest ecosystems, including the preservation of microhabitats, prevention of habitat conversion, and the promotion of targeted field surveys to improve knowledge of species distribution and population trends.

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