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A New Species and New Records of the Dobsonfly Genus *Protohermes* van der Weele, 1907 (Megaloptera: Corydalidae: Corydalinae) from Thailand

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ABSTRACT.– The dobsonfly genus *Protohermes* van der Weele, 1907 is the most diverse genus within the family Corydalidae of the order Megaloptera. In the present study, we describe a new species of *Protohermes*, namely *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov., and report three additional species newly recorded from Thailand: *P. cangyuanensis* Yang & Yang, 1988, *P. impunctatus* Liu, Hayashi & Yang, 2008, and *P. striatulus* Navás, 1926. These findings are based on an integrative approach that combines both morphological and molecular data. A key to the males of Thai *Protohermes* species is provided.

KEYWORDS: Neuropterida, aquatic insects, freshwater ecosystems, molecular identification, COI

INTRODUCTION

The order Megaloptera Latreille, 1802 is traditionally recognized as one of the earliest lineages of holometabolous aquatic insects (Grimaldi and Engel, 2005). All species in the order have aquatic larvae, whereas their eggs, pupae, and adults are terrestrial. Although megalopterans represent a relatively small group of aquatic insects, they serve as important predators within freshwater ecosystems (McCafferty, 1981). The genus *Protohermes* van der Weele, 1907 is the most species-rich genus of the family Corydalidae Leach, 1815 in Megaloptera, with 90 extant species worldwide (Martins et al., 2022; Liu et al., 2024). As noted by Liu et al. (2024), the genus *Protohermes* accounts for about 22.3% of known megalopteran diversity, comprising 404 extant species to date. Adults of *Protohermes* are medium to large in size (20 to 60 mm), exhibiting coloration that ranges from yellowish to blackish (Yang and Liu, 2010). The wings typically bear yellowish or whitish markings, and the forewing veins A1 and A2 are basally fused, creating the appearance of a three-branched A1 vein (Yang and Liu, 2010). Based on previous studies, the Megaloptera fauna of Thailand consisted of five unidentified *Protohermes* species and three described species: *P. furcatus* (Chiang Mai Province), *P. stigmosus* (Nan Province) and *P. triangulatus* (Chiang Rai, Chiang Mai, and Nan Provinces) (Liu et al., 2008, 2009; Piraonapicha et al., 2021, 2023). Liu et al. (2024) revised the classification of *Neurhermes sumatrensis* (van der Weele, 1909) and *Neurhermes tonkinensis* (van der Weele, 1909), formerly belonging to *Neurhermes*, transferring them to the *Protohermes tonkinensis* species group. Additionally, *P. triangulatus* has been treated as a junior synonym of *P. weelei* (Liu et al., 2024).

This present paper reports 10 species of *Protohermes* from Thailand, including a new species from Thailand and the People's Democratic Republic (Lao PDR). In addition, three *Protohermes* species are newly recorded from Thailand. Standard DNA barcodes (partial nucleotide sequences of the cytochrome c oxidase subunit I (COI) gene) are provided for the molecular identification of the Thai species of *Protohermes*.

MATERIALS AND METHODS

Sources of Materials and Terminology

Adults *Protohermes* were collected near streams in Nan Province using mercury vapor light traps operated overnight. Specimens were stored in 95% ethanol prior to being pinned. Type specimens of the new species are deposited in the Entomological Museum of Queen Sirikit Botanic Garden, The Botanical Garden Organization, Chiang Mai, Thailand (QSBG), the Natural History Museum of the National Science Museum, Thailand (THNHM), and the Entomological Museum of China Agricultural University (CAU), Beijing, China. For morphological study, the apex of the

TABLE 1. Species and specimen information used in the DNA barcoding analysis.

Species	Locality	Sex	Voucher	Accession number	Source
P. cangyuanensis	Loei, Thailand	male	PCML36	PV450176	This study
	Nan, Thailand	male	PCM1N37	PV450177	This study
	Nan, Thailand	female	PCF1N38	PV450178	This study
	Nan, Thailand	male	PCM1N39	PV450179	This study
P. furcatus	Chiang Mai, Thailand	male	THNHM-I-24145	OQ024829	Piraonapicha et al., 2023
P.impunctatus	Chiang Mai, Thailand	female	PIMFC69	PV469860	This study
	Chiang Mai, Thailand	female	PIMFC73	PV469861	This study
	Chiang Mai, Thailand	female	PIMFC74	PV469862	This study
	Chiang Mai, Thailand	male	PIMMC68	PV469863	This study
	Chiang Mai, Thailand	male	PIMMC71	PV469864	This study
	Chiang Mai, Thailand	male	PIMMC72	PV469865	This study
P. sirindhornae sp. nov.	Nan, Thailand	male	PSIM1	PV454577	This study
	Nan, Thailand	female	PSIF2	PV454578	This study
	Nan, Thailand	female	PSIF3	PV454579	This study
	Lao PDR	male	PSILF	PV454580	This study
P. stigmosus	Nan, Thailand	male	THNHM-I-24146	OQ024823	Piraonapicha et al., 2023
	Nan, Thailand	female	THNHM-I-24147	OQ024824	Piraonapicha et al., 2023
P. striatulus	Nan, Thailand	female	PSTRFN64	PV469866	This study
	Nan, Thailand	female	PSTRFN65	PV469867	This study
	Nan, Thailand	male	PSTRMN63	PV469868	This study
	Nan, Thailand	male	PSTRMN66	PV469869	This study
	Nan, Thailand	male	PSTRMN67	PV469870	This study
P. sumatrensis	Nakhon Si Thammarat, Thailand	male	NSM19	PV454564	This study
	Nakhon Si Thammarat, Thailand	male	NSM20	PV454565	This study
	Nakhon Si Thammarat, Thailand	male	NSM21	PV454566	This study
	Nakhon Si Thammarat, Thailand	female	NSF22	PV454567	This study
	Nakhon Si Thammarat, Thailand	female	NSF23	PV454568	This study
	Nakhon Si Thammarat, Thailand	female	NSF24	PV454569	This study
P. tonkinensis	Nakhon Ratchasima, Thailand	male	NTMKY1	PV454570	This study
	Nakhon Ratchasima, Thailand	male	NTMKY2	PV454571	This study
	Nakhon Ratchasima, Thailand	male	NTMKY3	PV454572	This study
	Nakhon Ratchasima, Thailand	female	NTFKY4	PV454573	This study
	Nakhon Ratchasima, Thailand	female	NTFKY5	PV454574	This study
	Chiang Mai, Thailand	female	NTFC17	PV454575	This study
	Chiang Mai, Thailand	female	NTFC16	PV454576	This study
P. weelei	Chiang Mai, Thailand	male	PTMC54	PV469871	This study
	Chiang Mai, Thailand	male	PTMC55	PV469872	This study
	Nan, Thailand	male	PTMN56	PV469873	This study
	Nan, Thailand	male	PTMN59	PV469874	This study
	Nan, Thailand	male	PTMN56-THNHM	OQ024825	Piraonapicha et al., 2023
	Nan, Thailand	male	PTMN57-THNHM	OQ024826	Piraonapicha et al., 2023
	Nan, Thailand	female	PTFN58-THNHM	OQ024827	Piraonapicha et al., 2023
	Loei, Thailand	female	PTFL53-THNHM	OQ024828	Piraonapicha et al., 2023
Indosialis bannaensis	Buri Ram, Thailand	male	KKUM004	MK578524	Piraonapicha et al., 2020

abdomen was cleared with 10% KOH for 8–12 h, then removed and placed in fresh glycerine for further dissection. The terminology of wing venation mainly follows that of Liu et al. (2016, 2024). In addition, adult megalopteran specimens were borrowed from the Natural History Museum of the National Science Museum, Thailand (THNHM), for identification.

DNA Extraction and PCR Amplification

Tissue samples from all right legs of adult males and females were preserved in 95% ethanol. Total DNA was extracted following the DNeasy Blood & Tissue Kit (Qiagen) protocol, and the extracted DNA was stored at -20 °C. The PCR reaction mix had a total volume of 50 µl, comprising 20 µl ultrapure water, 3 µl of the DNA template, 1 µl of each primer (10 µM), and 25 µl of master mix. Thermal cycling started with incubation at 94 °C for one min, followed by 40 cycles at 94 °C for 30 s, annealing at 48, 50 °C for 50 s and extension at 72 °C for one min, with a final extension step at 72 °C for five min. All PCR products were visualized on 1.5% agarose gels using Omnipur Agarose (United States of America). A 592 bp fragment of the COI gene was amplified using universal primers LCO1490 and HCO2198, as described by Folmer et al. (1994).

DNA Sequencing and Analyses

Purified PCR products underwent bidirectional Sanger sequencing on the ABI PRISM 3130x.1 Genetic Analyzer (Applied Biosystems, Foster City, USA) Sequencing was performed by Macrogen Inc. Sequencing (Seoul, Korea). The COI sequences are available on GenBank (https://www.ncbi.nlm.nih.gov/genbank) under accession numbers specified in Table 1.

Molecular Phylogenetic Analysis

The *Protohermes* COI sequences were aligned using the ClustalW algorithm (Thompson et al. 1994) with default settings in MEGA 11 (Tamura et al., 2021). ModelFinder was then applied to evaluate 88 potential substitution models across 11 schemes using a likelihood-based approach. The Bayesian Information Criterion (BIC) was used to select the best-fitting model (Schwarz G. 1978), balancing model complexity and data fit, which identified TIM2+F+G4 as the optimal choice. Phylogenetic relationships were reconstructed using the Maximum Likelihood (ML) method in IQ-TREE 2.2.0 (Minh et al., 2020), accessed via the IQ-TREE web server (Trifinopoulos et al. 2016). To assess clade support, two complementary methods were employed: the SH-aLRT branch test (Guindon et al., 2010) and ultrafast bootstrap (UFBoot) analysis (Hoang et al., 2018), ensuring robust evaluation of evolutionary relationships.

Species Delimitation

Species delimitation was performed using two distance-based approaches: the Automatic Barcode Gap Discovery (ABGD) (Puillandre et al., 2012) and Assemble Species by Automatic Partitioning (ASAP) (Puillandre et al., 2021). Both methods were implemented through their respective web-based platforms, applying the Kimura 2-parameter (K2P) model (Kimura 1980) under default parameter settings to ensure consistency and reproducibility in partitioning genetic clusters. These analyses provided complementary insights into lineage boundaries within the dataset.

RESULTS

Taxonomy

Order Megaloptera Latreille, 1802
Family Corydalidae Leach, 1815

Genus *Protohermes* van der Weele, 1907

Protohermes van der Weele, 1907: 243. Type species: *Hermes costalis* Walker, 1853, subsequent designation by Martins et al., 2022: 23.

Hermes Gray in Cuvier, 1832: 332. Type species: *Chauliodes maculipennis* Gray in Cuvier, 1832, original designation.

Neurhermes Navás, 1915: 391. Type species: *Chauliodes maculipennis* Gray in Cuvier, 1832, by monotypy [of *Hermes* Gray in Cuvier, 1832].

Allohermes Lestage, 1927: 100. Type species: *Protohermes davidi* van der Weele, 1909, original designation.

New species of *Protohermes* from Thailand and Lao PDR.

The *Protohermes differentialis* species group

Diagnosis.– Revised from Liu and Yang (2006). Male genitalia: Tergum 9 subtrapezoidal, with lateral portions more sclerotised and strongly produced posteriorly, and with small arcuate anterior incision and rather wide V-shaped posterior incision. Sternite 9 broad, strongly sclerotised; anterior margin with median portionslightly produced; posterior incision V-shaped, dividing pair of broad mammilliform processes. Gonostylus 9 long, unguiform, arcuately curved inward and dorsad. Ectoprocts claviform, sometimes distally incised. Cercus suboval, located posteriorly on inner margin of ninth tergum. Gonostyli 10 narrow, arched; dorsomedial process fused with ventral portion of tergite 9; lobes distinctly short and stout, medially approximate, ventrally curved.

Distribution: China, Myanma, Thailand (new record), Vietnam.

Protohermes sirindhornae Piraonapicha, Chomphuphuang & Liu, sp. nov.

http://zoobank.org/urn:lsid:zoobank.org:act: D7BF7D64-CADD-4A6E-A08E-7B7399E4B43A

(Figs 1–6)

Holotype.– **THAILAND.** Male, Bo Kluea District, Nan Province, 19º11'13.35"N, 101º10'5.91"E, 1,006 m a.s.l., 21.IV.2021, K. Piraonapicha leg. (THNHM, THNHM-I-22785).

Paratypes.– 2 males, same locality and collector as holotype, IV.2024, (QSBG); 1 female, same date, locality and collector as holotype (THNHM, THNHM-I-26251). 1 male, Lao PDR., Xieng Khouang Province, Ban Muang, 1417 m, 26.v.2013, H. Yoshitomi leg.

Diagnosis.– Pronotum entirely brown, with a pair of interrupted yellow markings, running on anterior margin to posterior margin, located near lateral margins; in ventral view, gonostylus 9 long and sharp,

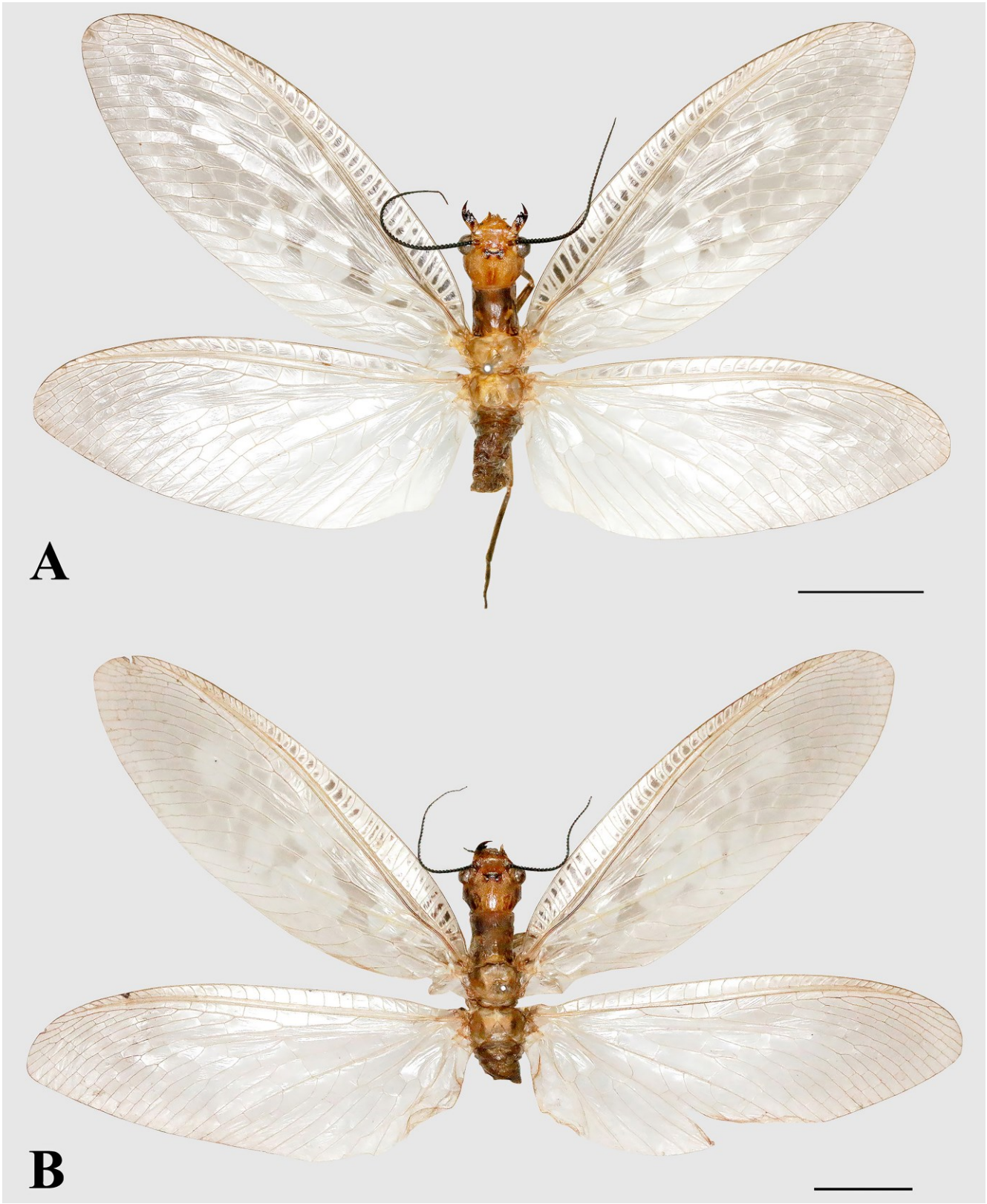

FIGURE 1. Habitus photo of *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov. **A.** Male (Holotype); **B.** Female (Paratype). Scale bar = 1 cm.

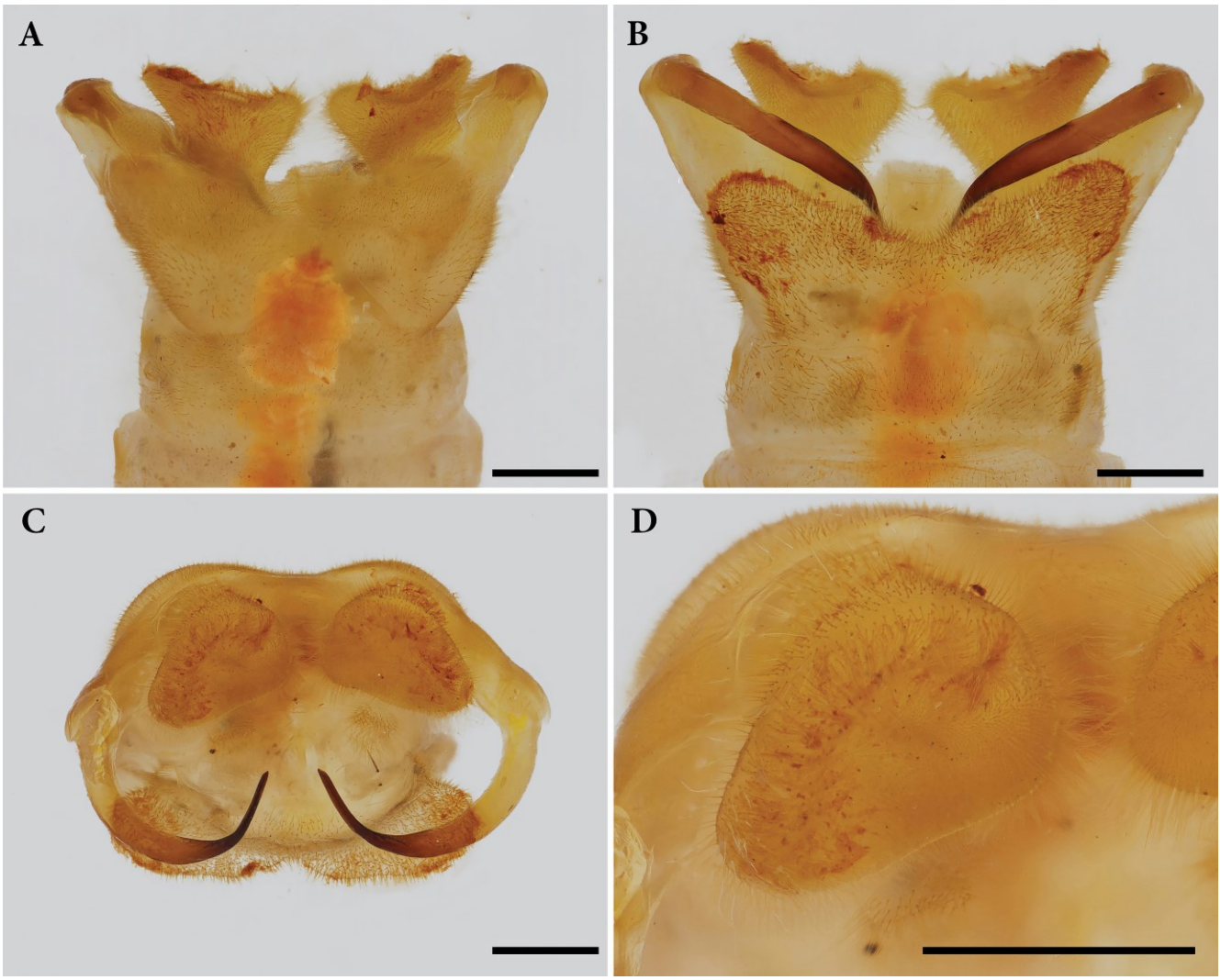

FIGURE 2. Male genitalia of *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov. (Holotype from Thailand). **A.** Dorsal view; **B.** Ventral view; **C.** Caudal view; **D.** Ectoproct in caudal view. Scale bar = 1 mm.

unguiform, and curved inward; in ventral view, gonostylus 10 connected to fused gonocoxites 10 at dorsolateral corners, subrectangular, clearly longer than broad; tip of gonocoxite 10 curved inward.

Description.– **Male** (Fig. 1A). Measurements. Male (n = 3). Total body length 21.06–37.3 mm (including mouthparts); head width 4.19–5.2 mm, head length 4.32–4.4 mm (excluding labrum and mandibles); prothorax length 3.01–4.5 mm; prothorax width 3.12–3.7 mm; right forewing length 25.4–36.6 mm; right forewing width 11.26–13.5 mm; right hindwing length 27.43–31.6 mm; right hindwing width 11.86–13.16 mm; wing spans 58.41–73.39 mm.

Head yellowish brown, obtuse post-ocular spine; dorsum of head with dense irregular pale brown markings on posterior half (a pair of pale brown vittae at middle portion, and pale brown markings near posterolateral corners); compound eyes dark, located anterior to mid-length of head; ocelli located between compound eyes, close to antennal socket, inner margin pale brown; antennae subserrate, scapes yellowish brown, pedicel reddish brown, scapes almost twice as long as pedicel, flagellum dark; labrum yellowish brown, subtriangular, shorter than broad; mandibles yellowish brown to brown (anterior half brown; posterior half yellow yellowish brown, with brown marks at median portion in dorsal view), with long and sharp apical tooth, followed by broad and subtriangular preapical tooth, and subtriangular basal tooth (teeth reddish brown); labial palpus brown; occiput subtriangular, yellow, posterior margin roundly convex in dorsal view.

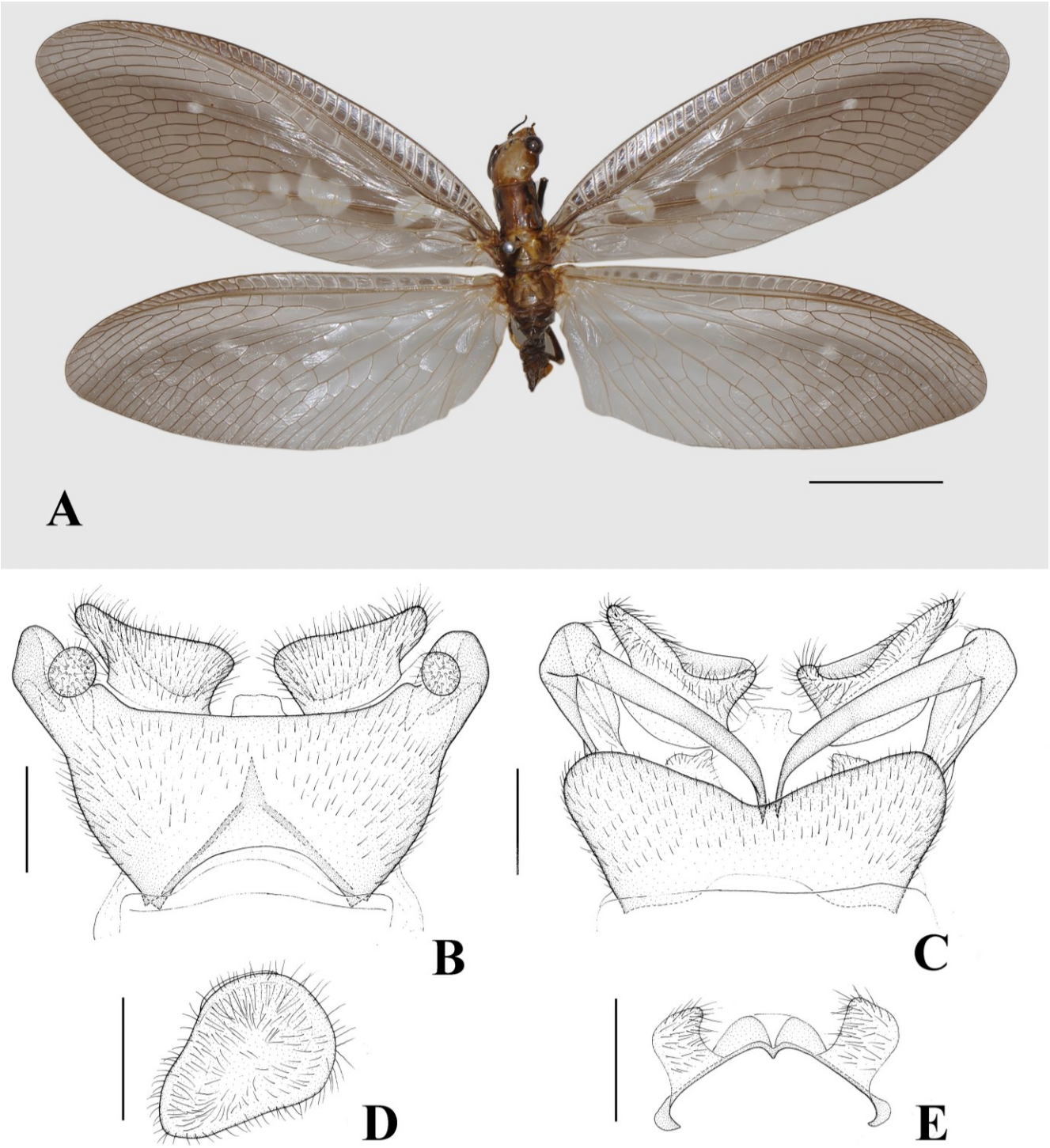

FIGURE 3. *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov. (Paratype from Lao PDR), male. **A.** Habitus; **B.** Male genitalia, dorsal view; **C.** Same, ventral view; **D.** Same, caudal view; **E.** Gonocoxites + gonostyli 10, ventral view. Scale bar = 1 cm (A), 0.5 mm (B–E).

Pronotum, subquadrate, entire brown, with a pair of interrupted yellow markings, running on anterior margin to posterior margin, located near lateral margins; mesonotum and metanotum subrectangular, yellowish brown, both clearly broader than long; legs covered with short dense setae; femora yellowish brown; tibiae and tarsi brown; tarsal claws reddish brown; forewing pale smoky brown, basal half with a large 4–5 creamy with marking, and large round yellow marking on apical 1/3; costal cells with distinct brown stripes; hindwing much paler than forewings, respectively with a round pale marking on apical 1/3;

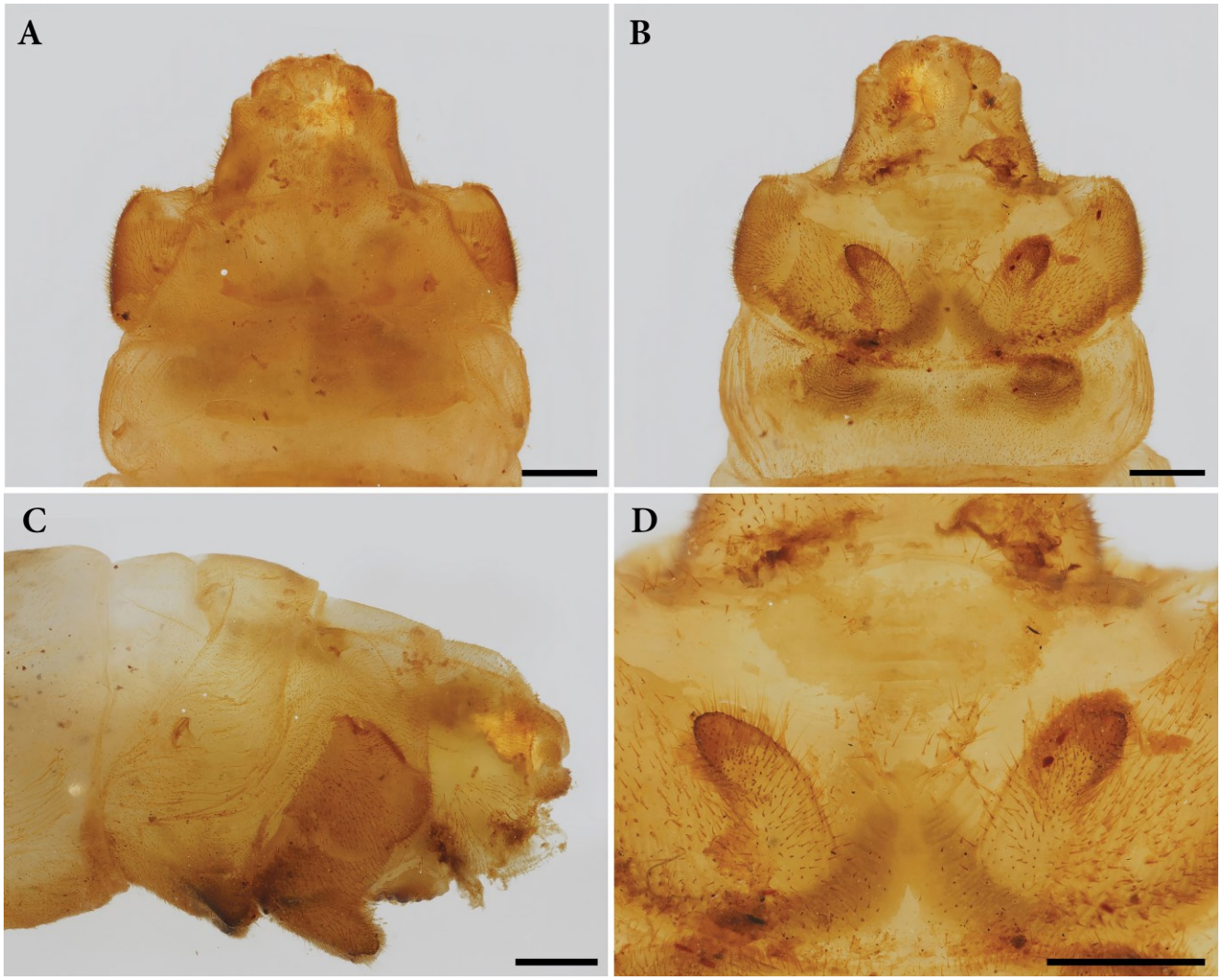

FIGURE 4. Female genitalia of *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov. **A.** Dorsal view; **B.** Ventral view; **C.** Lateral view; **D.** Posteromedian portion of fused gonocoxites 8, ventral view. Scale bar = 1 mm.

veins dark except veins in creamy areas with marking yellow; RA 10-branched, with 9 crossveins between RA and RP, MP_{1+2} 5-branched, MP_{3+4} 2-branched. Abdomen brown.

Genitalia.– Tergum 9 subrectangular, clearly broader than long, with oblique lateral margins, arcuately incised anteriorly (V-shaped), posterior margin concave; in ventral view, sternum 9 subrectangular, clearly broader than long, posterior margin concave to form subtriangular posterolateral corners; in ventral view, gonostylus 9 long and sharp, unguiform, and curved inward; in lateral view, gonostylus 9 curved backward into anterodorsally; in ventral view ectoproct subcylindrical, short; tip of ectoproct slightly incised and covered with dense short setae; in caudal view, tip of ectoproct subtriangular; in dorsal view, callus cerci suboval, connected to posterolateral corners of tergum 9; fused gonocoxites 10 arched, medial portion anteriorly convex; posterior margin concave (as V-shaped) medially; in ventral view, gonostylus 10 connected to fused gonocoxites 10 at dorsolateral corners, subrectangular, clearly longer than broad; tip of gonostylus 10 a short digitiform processes, which is pointed inward (Figs 2, 3B–E).

Female (Fig. 1B).– Measurements (n = 1). Total body length 43.1 mm (including mouthparts); head width 6.0 mm, head length 5.4 mm (excluding labrum and mandibles); prothorax length 5.0 mm; prothorax width 4.7 mm; right forewing length 44.7 mm; right forewing width 15.9 mm; right hindwing length 40.60 mm; right hindwing width 16.0 mm.

Similar to male in structure, sculpture, color, wing venation and pilosity, with the following condition that should be noted: 1) fused gonocoxites 8 in lateral view subtriangular; 2) fused gonocoxites 8 in ventral view subrectangular, median portion of posterior margin

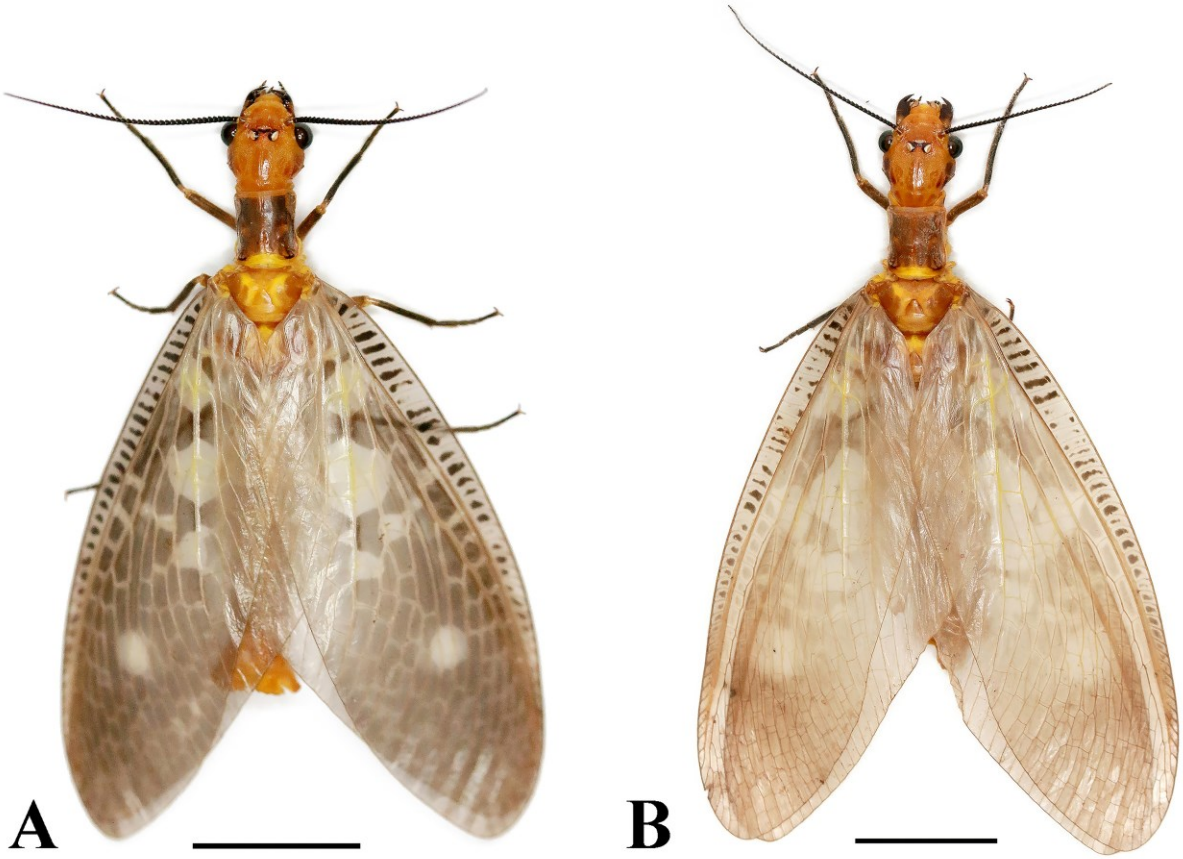

FIGURE 5. *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov. living specimens, dorsal view. **A.** Male; **B.** Female. Scale bars = 1 cm.

with a pair of short digitiform processes; 3) in lateral view, gonocoxites 9 broadly subtriangular, slightly incised near tip, with a rather small lobe at tip; 4) in lateral view, upper part of ectoproct subtriangular, and lower part suboval; 5) in lateral view, callus cerci large and suboval connected to ectoproct (Fig. 4).

Distribution.– Thailand (Nan Province); Lao PDR. (Fig. 8).

Etymology.– The species epithet honors Her Royal Highness Princess Maha Chakri Sirindhorn in commemoration of her 70th birthday anniversary.

Remarks.–This species can be distinguished from its congeners by having 1) head yellowish brown (entirely shiny black in the other members of the *Protohermes differentialis* species group); 2) wings pale smoky brown (blackish brown in the other group members); 3) in dorsal view posterior margin of tergum 9 concave, without incision medially (V-shaped in the other group members); 4) large gonostylus 10, and with short digitiform processes pointed inward at apex and 5) in dorsal view, the ectoproct is broader than long (longer than broad in the other group members).

Species of *Protohermes* newly recorded from Thailand

The *Protohermes costalis* species group

Diagnosis.– Revised from Liu et al. (2007a). Male genitalia: Gonostylus 9 always enveloped by Tergum 9 and invisible in dorsal view. Tergum 9 short and subcylindrical, ventrally usually produced into a tubercle bearing a small tuft; tip usually slightly incised and densely setose. Gonocoxites 10 arched, basally more or less elevated at middle, apical margin usually incised medially.

Distribution: China, India, Japan, Laos, Myanmar, Nepal, Pakistan, Thailand, Vietnam.

***Protohermes striatulus* Navás, 1926 new record**
(Fig. 6A, B)

Protohermes striatulus Navás, 1926: 58; Liu et al., 2009: 31, fig. 16.
Protohermes basiflavus Yang, 2004: 265, fig. 10; Liu et al., 2007a: 18, figs 8, 38–44 Yang and Liu, 2010: 156, fig. 67 (synonymy by Liu et al., 2009).

Non-type material examined.– 4 males, Bo Kluea District, Nan Province, 19º11'13.35"N, 101º10'5.91"E, 1,006 m a.s.l., 29.VII.2019, L. Khaton leg. (THNHM, THNHM-I-24476 to THNHM-I-24479, in alcohol); 1 male, 1 female, same locality and collector, 12.V.2020 (THNHM, THNHM-I-24053, THNHM-I-24480, pinned); 3 males, same locality and collector, 29.V.2019 (THNHM, THNHM-I-24481, THNHM-I-24483 to THNHM-I-24484, in alcohol).

Diagnosis.– Head yellowish brown, without dark markings; pronotum with two pairs of large black vittae on each side; male sternum 9 with rather shallow trapezoidal posterior incision.

Distribution.– China (Guangxi, Yunnan); Myanmar (Dawna); Vietnam (Bac Kan, Lao Cai, Tuyen Quang) (Liu et al., 2009; Yang and Liu, 2010); Thailand (Nan Province).

The *Protohermes fruhstorferi* species group

Diagnosis.– Revised from Liu et al. (2007c). Male genitalia: Tergum 9 subquadrate, about 2.0 times as wide as long. Sternum 9 broad, overlapping entire ninth tergum; posterior incision deep, arched or subtrapezoidal. Gonostyli 9 slender, unguiform. Ectoprocts ventrally directed, inner portion with a longitudinal incision. Gonocoxites 10 narrow, arched; dorsomedial process present; lateral lobes short with distal portions strongly inflated and trapezoidal.

Distribution.–China, Thailand, Vietnam.

Protohermes cangyuanensis Yang & Yang, 1988
(Fig. 6C, D)

Protohermes cangyuanensis Yang & Yang, 1988: 50, fig. 6; Liu et al., 2007c: 308, figs 1, 4–6; Yang & Liu, 2010: 202, fig. 91.

Non-type material examined.– **Thailand.** 21 males, Bo Kluea District, Nan Province, 19°11'13.35"N, 101° 10'5.91"E, 1,006 m a.s.l., 12.V.2020, L. Khaton leg. (THNHM, THNHM-I-24102 to THNHM-I-24117, pinned; THNHM-I-24118 to THNHM-I-24122, in alcohol); 11 females, same locality, date and collector (THNHM, THNHM-I-24123 to THNHM-I-24131, pinned; THNHM-I-24132 to THNHM-I-24133, in alcohol); 1 male, same locality and collector, 4.IV.2020 (THNHM, THNHM-I-24134, pinned); 4 males, same locality and collector, 29.VII.2019 (THNHM, THN HM-I-24141, pinned; THNHM-I-24135 to THNHM-I-24137, in alcohol); 2 females, same locality, date and collector (THNHM, THNHM-I-24138 to THNHM-I-24139, in alcohol); 1 male, Song Khon waterfall, Phu Ruea District, Loei Province, 17°21'12.8"N, 101°24' 23.1"E, 706 m a.s.l., 3.V.2020, K. Piraonapicha leg. (THNHM, THNHM-I-24140, pinned); 1 female, Huay leng Royal project, Wieng Kaen District, Chiang Rai Province 20°00’37.9” N 100°25’45.8” E, 913 m a.s.l., 5 vii 2014, W. Srisuka et al. leg (QSBG, QSBG-2014-199-28).

Diagnosis.– Pronotum with a pair or two pairs of lateral black vittae; forewing medially with one creamy white transverse band; the male sternum 9 not inflated medially, with trapezoidal posterior incision.

Distribution.– China (Yunnan) (Liu et al., 2007c; Yang and Liu, 2010), Thailand (Loei and Nan Provinces).

The *Protohermes guangxiensis* species group

Diagnosis.– Revised from Liu et al. (2008a). Male genitalia: The posterolateral portions of the tergum 9 are more or less laterally produced and the anterior margin is shallowly to deeply V-shaped. Sternum 9 is usually short, with a posterior, subtrapezoidal incision. Gonostylus 9 is well developed, slender, elongate, and unguiform. The male cercus is flattened. In all members of the group, Ectoprocts is subcylindrical with the distal portion produced into a medially directed ventral process. Gonocoxites 10 is arched and the dorsomedial process is mostly well developed. The ventromedial process of the male Gonocoxites 10 is sometimes present but feebly developed, while the lateral lobe is digitiform, sometimes with bifurcate tip.

Distribution.– China, Myanmar, Thailand, Vietnam.

Protohermes impunctatus Liu, Hayashi & Yang, 2008
(Fig. 6E, F)

Protohermes impunctatus Liu, Hayashi & Yang, 2008: 36, figs 3, 20–24.

Non-type material examined.– 4 males, Chom Thong District, Chiang Mai Province, 18º32'19.3"N, 98º33' 00.1"E, 6.IX.2020, K. Piraonapicha leg. (THNHM, THNHM-I-24444 to THNHM-I-24446, pinned; THN

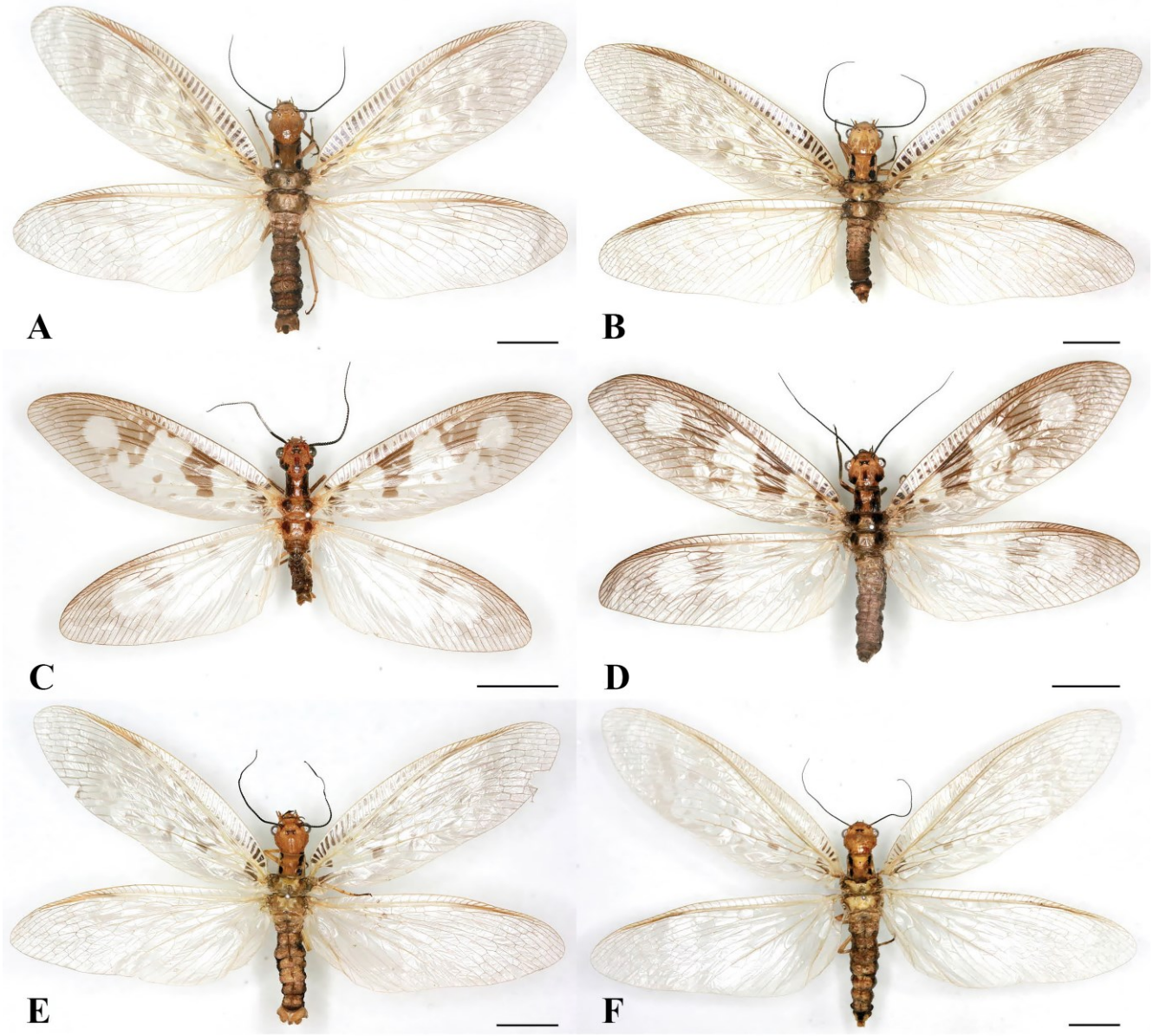

FIGURE 6. Habitus photos of species of *Protohermes* newly recorded from Thailand. *Protohermes striatulus*, **A.** Male and **B.** Female. *Protohermes cangyuanensis*, **C.** Male and **D.** Female. *Protohermes impunctatus*, **E.** Male and **F.** Female. Scale bar = 1 cm.

HM-I-24440, in alcohol); 4 females, same locality, date and collector (THNHM, THNHM-I-24447 to THN HM-I-24450, pinned); 1 male, same locality and collector, 17.IX.2019 (THNHM, THNHM-I-24442, in alcohol); 1 female, same locality, date and collector (THNHM, THNHM-I-24443, in alcohol).

Diagnosis.– Head yellow and without dark markings. Additionally, it has two pairs of prothoracic marks, the anterior pair being slightly longer than the posterior one. The male ectoproct is nearly rounded in caudal view, with a short, blunt ventral process.

Distribution.– Myanmar (Karan) (Liu et al., 2008); Thailand (Chiang Mai Province).

Checklist of *Protohermes* from Thailand (Fig. 8)

The *Protohermes assamensis* species group

1. *Protohermes tenellus* Liu, Hayashi & Yang, 2007
Distribution.–Thailand.

The *Protohermes costalis* species group

2. *Protohermes stigmosus* Liu, Hayashi & Yang, 2007
Distribution.– China, Thailand.

3. *Protohermes striatulus* Navás, 1926
Distribution.–China, Myanmar, Thailand, Vietnam.

4. *Protohermes weelei* Navás, 1925
Distribution.– China, Laos, Thailand, Vietnam.

The *Protohermes differentialis* species group

5. *Protohermes sirindhornae* Piraonapicha, Chomphuphuang & Liu, sp. nov.
Distribution.– Lao PDR., Thailand.

The *Protohermes fruhstorferi* species group

6. *Protohermes cangyuanensis* Yang & Yang, 1988
Distribution.– China, Thailand.

The *Protohermes guangxiensis* species group

7. *Protohermes furcatus* Liu, Hayashi & Yang, 2008
Distribution.– Thailand.

8. *Protohermes impunctatus* Liu, Hayashi & Yang, 2008
Distribution.– Myanmar, Thailand.

The *Protohermes tonkinensis* species group

9. *Protohermes sumatrensis* (van der Weele, 1909)
Distribution.– Indonesia, Malaysia, Thailand.

10. *Protohermes tonkinensis* (van der Weele, 1909)
Distribution.– China, Lao PDR., Thailand, Vietnam.

Molecular Analysis

Phylogenetic analyses and species delimitation

The phylogenetic relationships of *Protohermes* species in Thailand were reconstructed using the Maximum Likelihood (ML) method, with clade support assessed via SH-aLRT branch tests and ultrafast bootstrap (UFBoot) analysis (Fig. 7). The resulting phylogenetic tree revealed well-supported clades corresponding to distinct species, with consistently high bootstrap values and SH-aLRT support across most nodes, indicating robust evolutionary relationships. Nine major clades were identified, representing distinct *Protohermes* species: *P. furcatus*, *P. cangyuanensis*, *P. stigmosus*, *P. striatulus*, *P. weelei*, *P. sirindhornae* sp. nov., *P. impunctatus*, *P. sumatrensis*, and *P. tonkinensis*. Each clade exhibited strong statistical support, often exceeding 99%, underscoring the reliability of these groupings. Among these, the newly described species, *P. sirindhornae* sp. nov., formed a distinct clade with full statistical support (100/100), highlighting its clear genetic divergence from other species. Similarly, *P. impunctatus* maintained a well-supported clade (99.6/100) and was identified as the sister clade to the combined grouping of *P. sumatrensis* and *P. tonkinensis*. The clade for *P. sumatrensis* displayed high support values (96.4/99), while the clade for *P. tonkinensis* showed slightly lower support values (56.3/94), potentially reflecting more recent divergence or incomplete lineage sorting.

Species delimitation analyses using ABGD and ASAP methods corroborated the phylogenetic findings by identifying clear barcode gaps among genetic sequences, confirming the genetic distinctiveness of most clades observed in the phylogenetic tree. These analyses validated the separation of species such as *P. furcatus*, *P. cangyuanensis*, *P. stigmosus*, *P. striatulus*, *P. weelei*, and *P. sirindhornae* sp. nov., as well as *P. impunctatus*. However, both ABGD and ASAP grouped *P. sumatrensis* and *P. tonkinensis* together as a single species, suggesting a closer genetic relationship between these taxa and highlighting the need for further investigation into their evolutionary relationship. Overall, this phylogenetic reconstruction and species delimitation analysis revealed clear genetic differentiation among species, indicating limited gene flow between populations and potential speciation driven by geographic and ecological factors within Thailand and surrounding regions. These findings provide valuable insights into the evolutionary history of *Protohermes* in Thailand, supporting the recognition of the new species (*P. sirindhornae* sp. nov.) and offering a framework for future taxonomic and conservation studies.

Key to the Thai Species of the Dobsonfly Genus *Protohermes* Based on Male

1 In dorsal view, head black ……. 2
– In dorsal view, head yellow to brown. ...…… 3

2. Posterolateral corners of sternum 9 nearly right angle; posterior projection on ninth sternum shorter than sternum 9 (see fig. 18 in Piraonapicha et al., 2021) ……..……..…… *P. sumatrensis*
– Posterolateral corners of sternum 9 produced as triangle; posterior projection sternum 9 longer than sternum 9 (see fig. 20 in Piraonapicha et al., 2021) ……..……..……. *P. tonkinensis*

3. Pronotum entire brown (Fig. 5) …..…….…… ……...…… *P. sirindhornae* sp. nov.
– Pronotum yellow to yellowish brown ……..…. 4

4. Prothorax marked with small black spots, distance of middle area between dark spots longer than black spot length (see figs 3, 18 in Liu et al., 2007b) …… ……...…….. *P. tenellus*

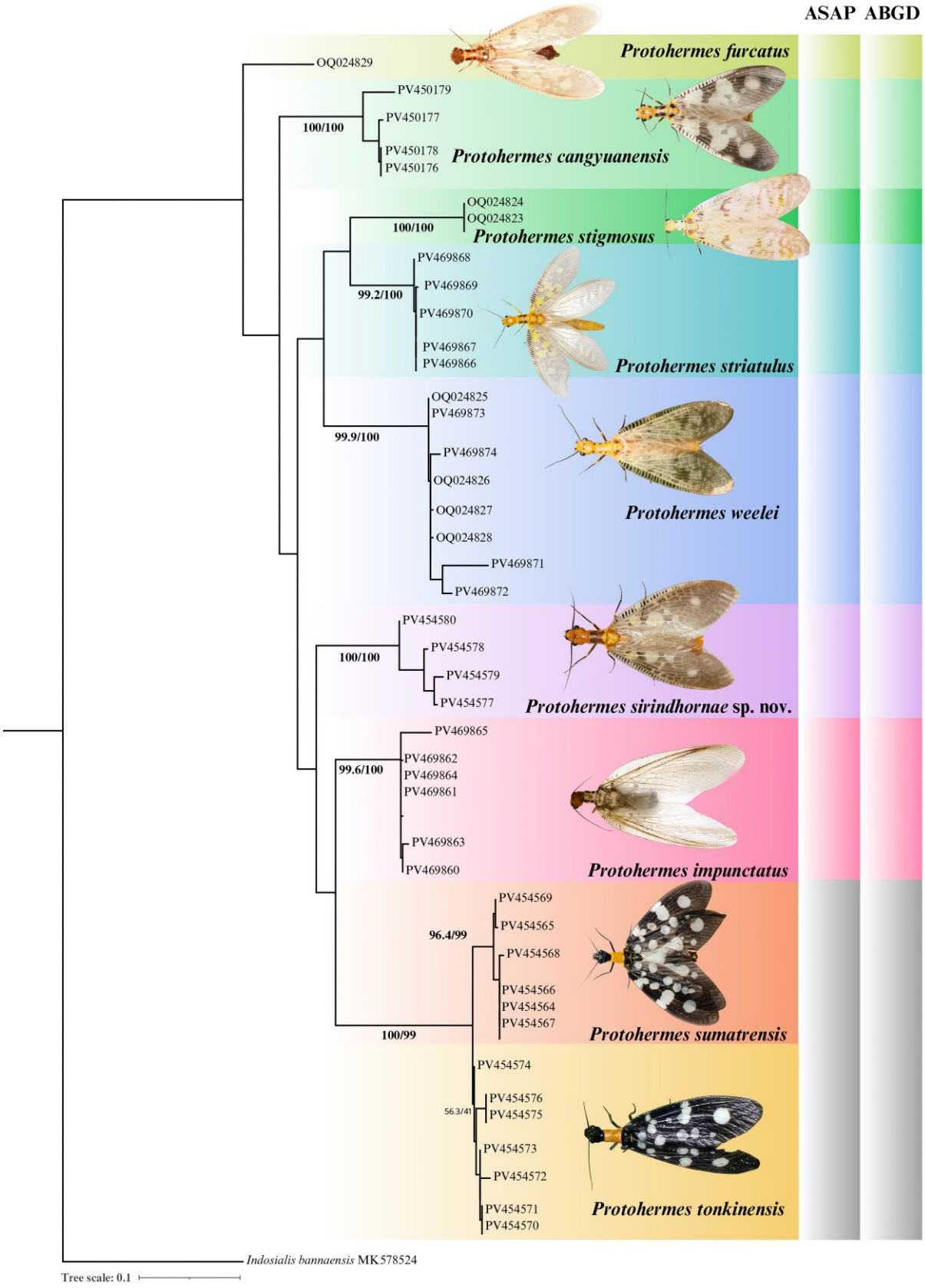

FIGURE 7. Molecular species delimitation of Thai *Protohermes* using maximum likelihood using partial COI sequences. Tree was inferred from 621 base pair of 9 species of *Protohermes* and a species of *Indosialis* as the outgroup. Nodal support values are bootstrap values (percentage of 1000 replicate). Node numbers represent two values support, including bootstrap support from SH-aLRT branch tests and ultrafast bootstrap (UFBoot) analysis. The bars illustrate molecular delimitation methods, encompassing genetic distances (ABGD, ASAP). Scale bar indicates 0.1 nucleotide substitutions.

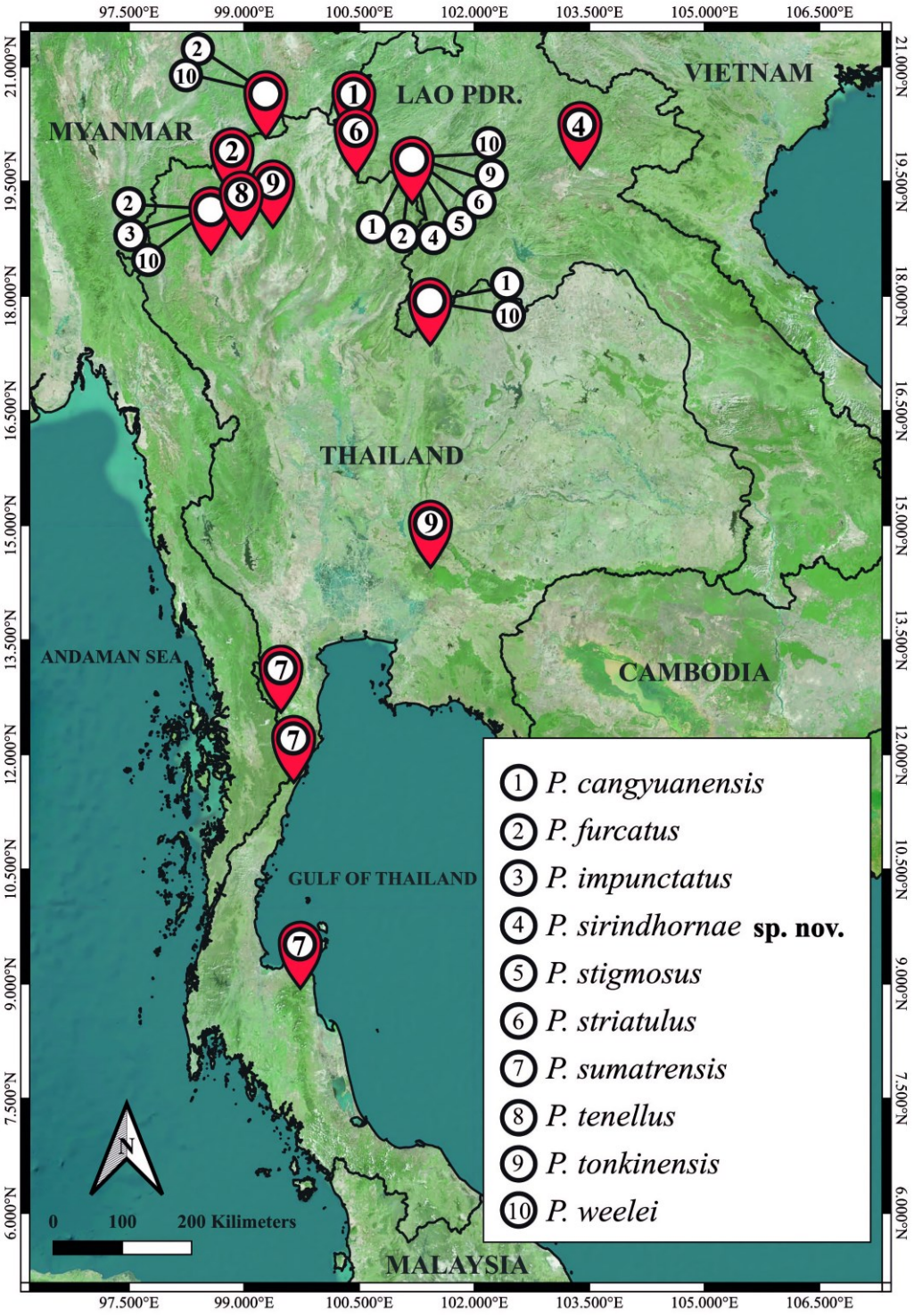

FIGURE 8. Geographical distribution map of *Protohermes* spp. in Thailand.

– Prothorax marked with small black spots, distance of middle area between dark spots as long as or less than black spot length …… 5

5. Posterolateral lobes of gonostylus 10 bifurcate (see fig. 26B in Piraonapicha et al., 2021) … *P. furcatus*
– Posterolateral lobes of gonostylus 10 digitiform or subtriangular ……..…….….. 6

6. Wings brown to dark brown (Fig. 6C, D) ……... ……..……...…..... *P. cangyuanensis*
– Wings pale grayish brown …….…… 7

7. Tergum 9 subtrapezoidal, with oblique lateral margins (see figs 21, 22 in Liu et al. 2008) ……. ……...…….…… *P. impunctatus*

– Tergum 9subrectangular, with almost parallel lateral margins ……..…..… 8

8. Ectoproct shorter than sternum 9 ……...……..…. 9
– Ectoproct longer than sternum 9 ……...…….. 10

9. Anterolateral corners of occiput with black markings (see fig. 128 in Liu et al., 2007a, identified as *P. triangulatus*) ….…….…… *P. weelei*
– Anterolateral corners of occiput without black markings …….…..… 10

10. Pronotum with 10 black markings (see fig. 123 in Liu et al., 2007a) ….……..…..… *P. stigmosus*
– Pronotum with 6 black markings (Fig. 6A, B). ……..…….. *P. striatulus*

DISCUSSION

Ten species of *Protohermes* have been recorded in Thailand, accounting for approximately 10% of the known species in the genus. Previously, most species were classified into 16 species groups, primarily based on characteristics of the male genitalia: The *P. assamensis* species group (Liu et al., 2007a), the *P. changninganus* species group (Liu et al., 2013a), the *P. costalis* species group (Liu et al., 2007b), the *P. davidi* species group (Liu et al., 2010), the *P. dichrous* species group (Liu et al., 2013b), the *P. differentialis* species group (Liu & Yang, 2006a), the *P. fruhstorferi* species group (Liu et al., 2007c), the *P. guangxiensis* species group (Liu et al., 2008a), the *Protohermes infectus* species group (Liu et al., 2024), the *P. latus* species group (Liu et al., 2013c), the *P. parcus* species group (Liu et al., 2009a), the *P. sabahensis* species group (Liu et al., 2008b), the *Protohermes sinuolatus* species group (Liu et al., 2024), the *Protohermes tonkinensis* species group (Liu et al., 2024), the *P. xanthodes* species group (Liu et al., 2006), and the *P. xingshanensis* species group (Yang & Liu, 2010). Six species groups are currently recognized from Thailand (see checklist of *Protohermes* from Thailand). Among these species, only *P. furcatus* and *P. tenellus* are endemic to Thailand. *Protohermes sirindhornae* sp. nov. was placed as a member of the *P. differentialis* species group in Tu et al. (2025), in which this species was not formally described but named as an unidentified species. This new species appears to be confined in distribution to northern Thailand and northern Lao PDR. *Protohermes impunctatus* was previously considered endemic to Myanmar, particularly near the region adjacent to Tak Province, West of Thailand (Liu et al., 2008). In general, the *Protohermes* species in Thailand are primarily distributed in the northern region. Aside from these species, *P. striatulus* and *P. tonkinensis*, which are widely distributed in Indochina, may exhibit affinities with a distinct faunal element largely confined to eastern Indochinese countries such as Lao PDR., Thailand, and Vietnam (Liu and Dvorak, 2017). Currently, 22 species of Megaloptera are recorded from Thailand, and *Protohermes* consists of about half of the entire known megalopteran fauna of the country. This is not surprising as northern Thailand is borders to Myanmar and Yunnan Province, China, where the megalopteran diversity is particularly rich. Further field surveys in northern Thailand may contribute more species new to Thailand.

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