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Taxonomic notes on the genus *Heliogomphus* Laidlaw, 1922 (Odonata: Gomphidae), with a redescription of *H. kalarensis* Fraser, 1934 from southern India

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All relevant data are within the paper.

Abstract. The taxonomy and distribution of dragonflies of the genus *Heliogomphus* from the Western Ghats of southern India are discussed. A morphological study of fresh male specimens from the field, as well as holotypes and lectotypes from repositories was undertaken. Contradicting statements in scientific literature, we found that the markings on the occiput and thorax are not dependable features in distinguishing sympatric *Heliogomphus promelas* (Selys, 1873) and *H. kalarensis* Fraser, 1934. The structure of the epiprocts and the male genitalia were key features for differentiating them. *Heliogomphus pruinans,* Fraser, 1922 is removed from the synonymy of *H. promelas* and is synonymized with *H. kalarensis* instead based on the analysis of the structure of its epiproct. In accordance with the provisions of ICZN Article 23.9.1.2, in suppression of the unused senior synonym, the taxon name *H. kalarensis* is retained as a nomen protectum. *Heliogomphus unifasciatus* is treated as nomen nudum. Taxonomic notes and updated distribution summaries of the two species from the Western Ghats with an identification key to the males are provided. *Heliogomphus kalarensis* is redescribed from fresh field-collected specimens, including details of the male genitalia and anal appendages. Fieldwork in the Western Ghats revealed that *H. kalarensis* is the most common of the two *Heliogomphus* species in Kerala state. The published records of *H. promelas* and *H. kalarensis* from this region need to be revisited in light of the facts presented here.

Key words. *Heliogomphus,* Kerala, misidentification, taxonomic notes, Western Ghats

Introduction

The odonates of the genus *Heliogomphus* Laidlaw, 1922 are medium-sized, marked in black and greenish yellow, and characterized by the lyrate cerci of males (Fraser, 1934). They are true jungle insects that breed in small tributaries of montane streams or their adjoining seepages (Fraser, 1942). This genus contains 21 extant species distributed throughout the wetter parts of India, Sri Lanka, mainland Southeast Asia south to Borneo and the Philippines (Fraser, 1942; Paulson et al., 2022).

Of the four species known from India, two valid taxa, *H. promelas* (Selys, 1873) and *H. kalarensis* Fraser, 1934 (Fraser, 1942; Kimmins, 1966; Nair et al., 2021), have been reported from the Western Ghats. *Heliogomphus promelas* was recorded from Coorg, Mettupalayam, and the Kotagiri Ghats in the Nilgiri Hills, Cochin, 'Annaimallai' (Anamalai Hills), and Travancore Hills (Fraser, 1934, 1942), while *H. kalarensis* was until now known only from a single specimen collected from 'Kalar' (Kallar) Mettupalayam, Kotagiri Ghat, Nilgiri Hills in Tamil Nadu. Both species of *Heliogomphus* are found in the Western Ghats including Kerala state (Nair et al., 2021). *Heliogomphus promelas* is endemic to India (Kalkman et al., 2020, Nair et al., 2021) and red-listed as 'Near Threatened' (IUCN, 2022; Subramanian et al., 2018). *Heliogomphus kalarensis* is considered a Western Ghat endemic (Kalkman et al., 2020; Nair et al., 2021), and its IUCN Red List status is 'Data Deficient'. Another taxon, *H. pruinans,* was described by Fraser in 1922 from Kalar (Kallar), Nilgiris, but was later synonymized with *H. promelas* by Fraser (1934).

During our fieldwork in the Western Ghats of Kerala state (Fig. 1) we came across two morphologically distinct taxa of *Heliogomphus.* One of the morphotypes was keyed to *H. promelas* without any difference from what information was already provided by Fraser (1934). The placement of the other morphotype as per the keys by Fraser (1934, 1942) was more problematic, since the primary description of the male of *H. kalarensis* was inadequate and based on a single male (Fraser, 1934) without any detailed description of its anal appendages. This called for a more detailed examination of the holotypes and lectotypes in the BMNH in comparison to our fresh specimens from the field. Hence, we here provide a redescription, taxonomic notes, and an updated distribution overview of the two species of *Heliogomphus* from the Western Ghats of peninsular India with a revised field identification key for the males. The validity of the taxon *Heliogomphus pruinans*, Fraser, 1922 is discussed as per the provisions of the ICZN (1999).

Materials and methods

Abbreviations used

Ax	Antenodal cross-veins
BMNH	British Natural History Museum, London, UK.
FW	Forewing
HFL	Hind Femoral Length
HW	Hindwing
IUCN	International Union for the Conservation of Nature
NP	National Park
Px	Postnodal cross-veins
TNHS	Travancore Nature History Society, Trivandrum, Kerala, India
TORG	TNHS Odonate Research Group
TR	Tiger Reserve
WLS	Wildlife Sanctuary

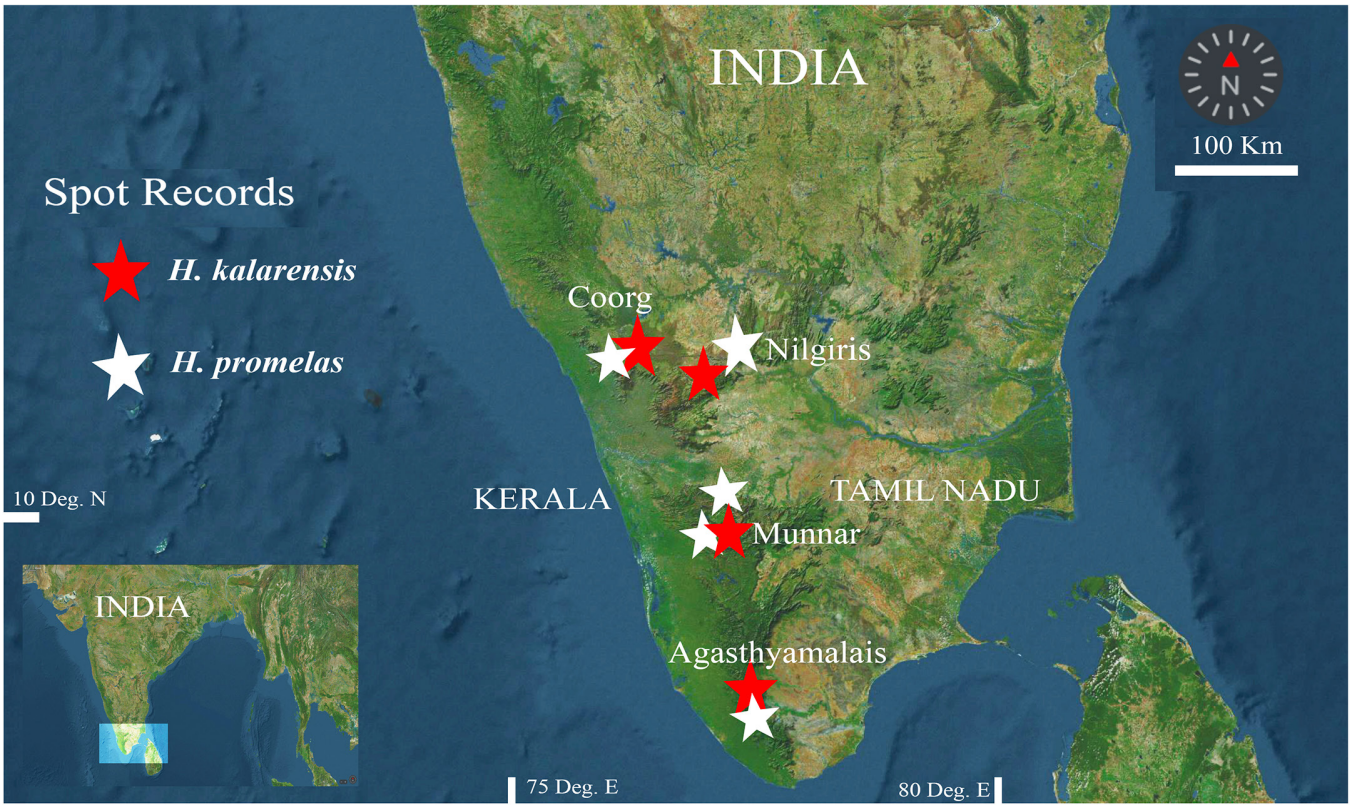

Figure 1. Map of southern India, showing landscapes with spot records of *Heliogomphus kalarensis* and *H. promelas.*

The insects collected were preserved in absolute alcohol and compared to specimens of known species of *Heliogomphus* from the Western Ghats in the BMNH and TORG collections. Examination of type specimens in museum collections and on the basis of digital material by the first author was facilitated by the kind cooperation of curators of British Museums. The nomenclature used here follows Paulson et al. (2022) and Nair et al. (2021). Morphological terms follow Chao (1990) and Garrison et al. (2006). The known distribution of the species follows Subramanian et al. (2018) and Nair et al. (2021). Measurements and morphological details of all species mentioned in the text are based on specimens in the voucher collection of the TORG. Photographs of the specimens were taken with a Canon EOS 70D DSLR (Canon Inc., Japan) fitted with a 180-mm macro lens. The currently known distribution of *Heliogomphus* spp. from India is based on the current authors' personal records made during more than two decades of extensive fieldwork in the Western Ghats and Nair et al. (2021, in press). Genitalia and anal appendages were dissected and studied by KS under a stereo zoom microscope (HEADZ Model HD81) and later preserved in glycerol. Illustrations were hand-drawn and digitalized by KS.

Results

Systematics

Superfamily Gomphoidea Rambur, 1842
Family Gomphidae Rambur, 1842
Genus *Heliogomphus* Laidlaw, 1922

Heliogomphus Laidlaw, 1922, Rec. Ind. Mus. vol. xxiv, pp. 378, 379

Type species: *Heliogomphus selysi* Fraser (as *Leptogomphus nietneri* Selys).

Species from the Western Ghats. *Heliogomphus promelas* (Selys, 1873) and *H. kalarensis* Fraser, 1934.

Diagnosis

Males with moderately long hind femora, not armed with long spines; apex of the distal segment of vesica spermalis disk-like, without a flagellum; anterior hamulus not bifurcate; cerci lyrate, tip curled and with one or more less robust spine near the base. (Fraser, 1942; Chao, 1990).

Key to Heliogomphus Laidlaw, 1922 of the Western Ghats, peninsular India, based on males

1. Lateral horns of the epiproct angulated dorsally at its middle, its posterior half tapering and directed dorsolaterally, tip bulbous; in dorsal view, the cerci are directed posterolaterally, the lateral profile of the cerci a straighter, short, lateral spine is directed posterolaterally in its basal third, its tip curled in on itself then laterally; secondary genitalia with the middle segment of the vesica spermalis with a triangular extension posteriorly in lateral view; auricle on S2 semicircular in outline ..... *H. promelas*
2. Lateral horns of the epiproct straight, directed posterolaterally, tip finely tapered; in dorsal view, the male cerci are directed laterally, in lateral profile, the cerci are sinuous, with a short lateral spine in its basal third directed straight laterally, its extreme tip curved laterally then in on itself; secondary genitalia with the middle segment of the vesica spermalis with a rectangular extension posteriorly in lateral view; auricle on S2 elliptical in outline ..... *H. kalarensis*

***Heliogomphus promelas* (Selys, 1873)**
(Figs 2A, 2B, 3, 5A, 5C, 5E, 5G, 7 A–C)

1873 *Gomphus promelas* Selys: Selys, *Bull. Acad. Belg., 36* (2), 498.
1890 *Aeshna promelas*: Kirby, *Cat. Odon.,* 68.
1907 *Gomphus? promelas*: Williamson, *Proc. U.S. Natl. Mus*., *33*, 305.
1922 *Gomphus promelas* Selys: Laidlaw, *Rec. Ind. Mus., 24,* 371, 398.
1923b *Gomphus promelas* Selys: Fraser, *J. Bom. Nat. Hist. Soc*., *29,* 330.
1925 *Heliogomphus promelas* Selys: Fraser, *J. Bom. Nat. Hist. Soc*., *30,* 848, 849, fig. 1, pl. i, fig. 6.
1930 *Heliogomphus promelas* Selys: Laidlaw, *Trans. Ent. Soc. Lond., 78,* 182.
1931 *Heliogomphus promelas* Selys: Fraser, *Rec. Ind. Mus*., *33,* 444, 447.
1932 *Heliogomphus promelas* Selys: Needham, *Rec. Ind. Mus*., *34,* 220.
1934 *Heliogomphus promelas* Selys: Fraser, *Fauna Brit. India, Odon*., Vol II., 323, 324, 326–329. figs 99, 101a.
1942 *Heliogomphus promelas* Selys: Fraser, *Trans. R. Ent. Soc. Lond.*, *92*(2), 334, 335, 337, 338. 339, 340, figs 1(1) female, 1(5) male, figs 3 (4), 3 (17), plate 1 (2).
1995 *Heliogomphus promelas* Selys: Prasad & Varshney, *Oriental Insects*, *29*(1), 400.

2000 *Heliogomphus promelas* Selys: Tsuda, *A Distributional List of World Odonata*.
2005 *Heliogomphus promelas* Selys: Subramanian, *Dragonflies and damselflies of Peninsular India,* 114.
2009 *Heliogomphus promelas* Selys: Sharma, Ramamurthy & Kumar, *Biological Forum – An International Journal, 1*(2), 108.
2009 *Heliogomphus promelas* Selys: Subramanian, *A checklist of Odonata (Insecta) of India*, 14.
2011 *Heliogomphus promelas* Selys: Kiran & Raju, *Malabar Trogon, 9*(3), 32.
2013 *Heliogomphus promelas* Selys: Kiran & Raju, *Dragonflies and Damselflies of Kerala,* 153.
2013 *Heliogomphus promelas* Selys: Babu, Subramanian & Nandy, *Rec. Zool. Surv. India, 347*, 5, 25.
2014 *Heliogomphus promelas* Selys: Emiliyamma, *Rec. Zool. Surv. India*, *114*(1), 59, 64.
2017 *Heliogomphus promelas* Selys: Subramanian & Babu, *A checklist of Odonata (Insecta) of India, ver. 3.0,* 9, 29.
2018 *Heliogomphus promelas* Selys: Subramanian, Emiliyamma, Babu, Radhakrishnan & Talmale, *Atlas of Odonata (Insecta) of Western Ghats, India,* 26, 224, 225.
2020 *Heliogomphus promelas* Selys: Kalkman, Babu, Bedjanic, Coniff, Gyeltshen, Khan, Subramanian, Zia & Orr, *Zootaxa, 4849*(1), 34.
2021 *Heliogomphus promelas* Selys: Nair, Samuel, Palot & Sadasivan, *Entomon, 46*(3), 192, 214 fig. 2C, 228, 233.
2022 *Heliogomphus promelas* Selys: Sadasivan, Nair & Samuel, *J. Threat. Taxa, 14*(6), 21214, 21225.
2022 *Heliogomphus promelas* Selys: Nair, Samuel, Palot & Sadasivan, *Entomon* (in press).

Diagnosis

Antehumeral stripe separated from the mesothoracic collar; sides of thorax with two black stripes; external spine of cerci of moderate size; antehumeral stripe straight; lateral spine of cerci followed posteriorly at the most by a very shallow concavity; superior humeral spot absent; female with vesicle projecting posteriorly with two long, outwardly curved horns (Fraser, 1942).

Specimens examined *(n = 5 males)*

NHMUK **#**014666648, male, Burliyar, Nilgiris, Tamil Nadu; Col. Fraser FC; NHMUK **#**014666649, male, Mudis Hills, Tamil Nadu, 04.v.1929 Col. Fraser FC; TORG #1015, male, Pandipathu, Peppara WLS, Trivandrum, Kerala, 24.iii.2022, Col. Kalesh Sadasivan; TORG #1016, male, Edamalakudi, Munnar, Kerala, 02.v.2022, Col. Kalesh Sadasivan; TORG #1017, male, Kanichar, Kannur, Kerala, 12.vi.2022, Col. Vinayan P Nair.

Other specimens studied in the field (not collected). (n = 7 males). 3 males Pandipathu, Peppara WLS, Trivandrum, Kerala, May 2022, Kalesh Sadasivan; 2 males, Edamalakudi, Munnar, Kerala, May 2022, Kalesh Sadasivan; 2 males, Kanichar, Kannur, Kerala, June 2022, Vinayan P Nair.

Measurements (in mm) (n = 3). Total length (including appendages). 47–48, abdominal length 34–35, forewing length 30–32, hindwing length 30–31, HFL 6. Nodal Range. FW: 15–17 & Px 13–15; HW: Ax 11–12 & Px 11–13.

Morphological variation

We have not found any ambiguity in the description and diagnosis of, or the keys to, *H. promelas* from that which has already been provided by Fraser (1934, 1942), so that no redescription is required here. Nevertheless, some aspects regarding the melanotic variant, structure of secondary genitalia, and the epiprocts are discussed below.

Melanotic variant (Figs 7B, 7C). Fraser (1942) mentioned a melanotic variant of *H. promelas* in which the large greenish yellow stripe on the metepisternum is highly reduced, appearing as a streak or spot occupying its dorsal half. In some individuals, this reduced streak is split up into two yellow spots. This heavily marked variant is thus easily recognized (Fig. 7B). In cases of doubt, examination of the epiprocts and/or vesica spermalis will provide clarity.

Secondary genitalia (Figs 3B, 3C, 5C). Colour dark amber-brown to blackish brown. Anterior hamule shorter than the posterior hamule in lateral view, distal half tapering and curved into a hook with its tip directed posterolaterally; body of posterior hamule broader than anterior hamule, tapering and curved gradually towards its tip; the tip of the posterior hamule is relatively pointed, occasionally notched, and is directed anteromedially. Sheath of the vesica spermalis (ligula) broad, higher than the posterior hamule, directed posteriorly, covering the distal portion of Segment 2 and Segment 3 of the vesica spermalis. The structure of the vesica spermalis and the posterior hamule is illustrated in Figs 3B–C. The middle segment of the vesica spermalis in lateral view has a rectangular extension directed posteriorly (Figs 3C, 5C). Auricle semicircular in outline in ventral view, with a series of small, medially-directed spines on its posterior and medial portions.

Anal Appendages (Figs 2B, 3D–F, 5E, 5G) The epiprocts were not explicitly described by Fraser (1934). In dorsal view, the male cerci are directed posterolaterally, profile of the cerci much straighter; its tip curled in on itself laterally (Fig. 5G). Lateral horns of the epiproct angulated dorsally at its middle, posterior half tapering, and directed posterolaterally (Fig. 5G); tip of the epiprocts bulbous, bearing a small rudimentary spine directed dorsally.

Distribution

Kerala: Coorg landscape—Malabar, Kanichar in Kannur; Munnar landscape—Edamalakudi, High Range subunit; Agasthyamalai landscape—Ponmudi Hills Ponmudi Hills in Kulathupuzha Reserve and Peppara WLS, (Travancore) (Nair et al., in press). Tamil Nadu: Anamalai and Mudis Hills; Nilgiri Hills—Burliyar, Mettupalayam, and Kotagiri Ghats (Fraser, 1922, 1925, 1931, 1934, 1942). Karnataka: Coorg—Mercara, Mangalore Ghat, Sampaji River. Goa: Dudhsagar Falls, Cotigao WLS, Derode (Rangnekar et al., 2010). Odisha: (Subramanian et al., 2018).

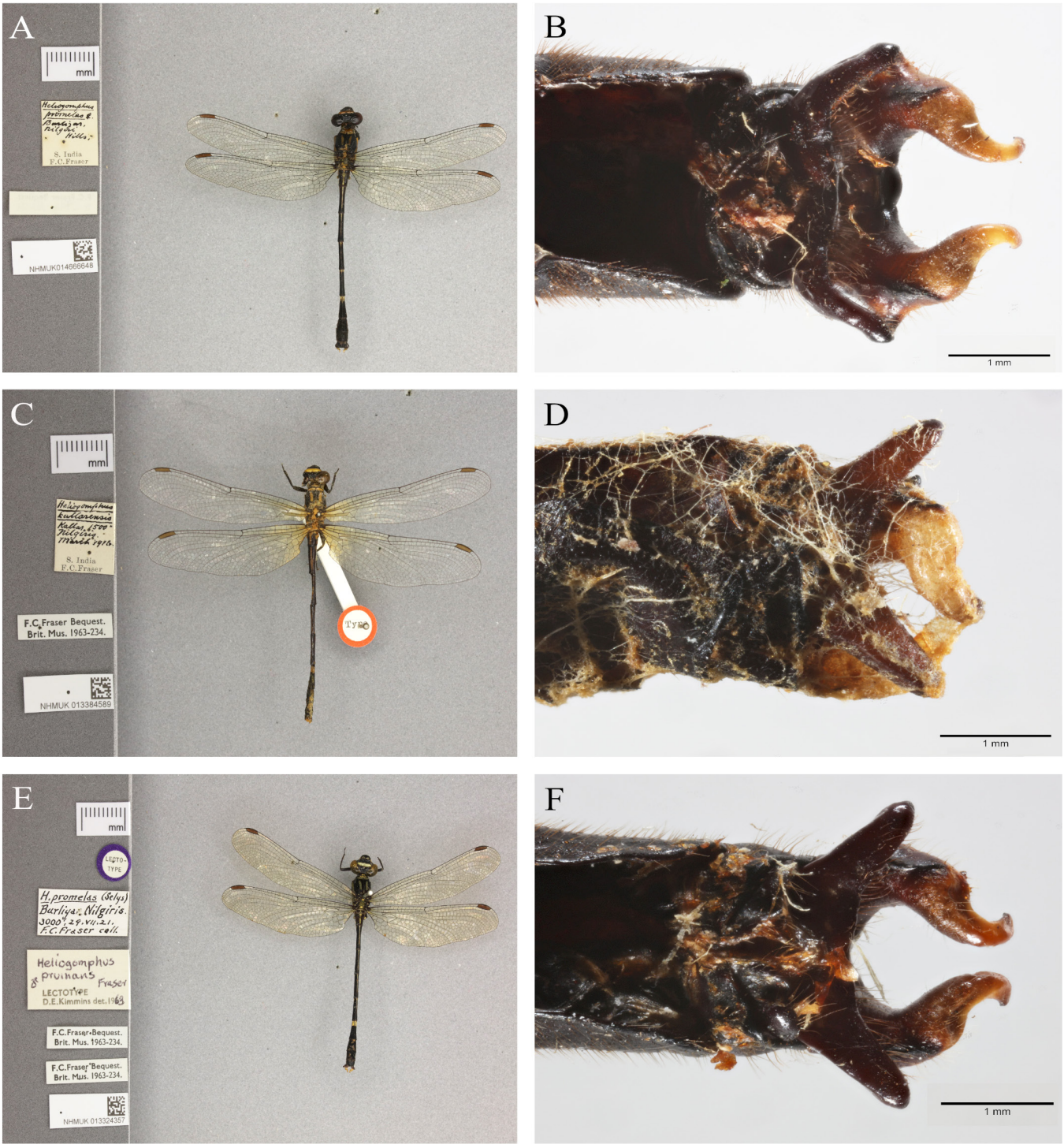

Figure 2. Specimens of *Heliogomphus* from the BMNH, London: (A) Dorsal habitus of *H. promelas* NHMUK #014666648, male, Burliyar, Nilgiris, Tamil Nadu; (B) close-up in ventral view of epiprocts of *H. promelas*, NHMUK #014666649; (C) dorsal habitus of *H. kalarensis* holotype, male, NHMUK #013384589, Kallar, Nilgiris, Tamil Nadu; (D) close-up in ventral view of epiprocts of *H. kalarensis*, holotype male, NHMUK #013384589; (E) dorsal habitus of *H. pruinans* NHMUK #013324357, male, Buruliyar, Nilgiris, Tamil Nadu; (F) close-up in ventral view of epiprocts of *H. pruinans*, NHMUK #013324357. Photos courtesy of BMNH, London.

Annotations

In addition to the diagnostic features provided by Fraser (1942) and mentioned above, examination of *H. promelas* specimens in the BNHM (NHMUK #014666648), fresh specimens from Western Ghats (12 males, not collected), and voucher specimens in the TORG collection revealed that none of these specimens had antehumeral or occipital spots in agreement to Fraser (1934, 1942) and that the spots on the prothorax were variable. The epiproct of this species is divergent, flat, and curved posterodorsally, with its extreme tip hooked and recurved (Figs 2B, 3E, 5E, 5G). This character is constant and reliable for species identification, even when the structure of the cerci is inconclusive, and differentiates it from *H. kalarensis*. When a specimen labelled '*H. unifasciatus* Fras.' was found in the BMNH collection (NHMUK #014666649, male, Mudis Hills, Tamil Nadu, 04.v.1929 Col. Fraser FC) and carefully studied it was revealed that the morphological features, notably the epiproct, are those of *H. promelas.* This taxon name was untraceable in Fraser (1934, 1942) and Paulson et al. (2022), and we found no literature citing this species, hence it must be treated as a *nomen nudum*.

***Heliogomphus kalarensis* Fraser, 1934**
(Figs 1, 2C–F, 4, 5B, 5D, 5F, 5H, 6, 7D, 7E)

1922 *Heliogomphus pruinans* Fraser: Fraser, [new synonymy], *Rec. Ind. Mus., 24*, 416, 417, pl. xi, fig. 3.

1923a *Heliogomphus pruinans* Fraser, *J. Bom. Nat. Hist. Soc., 29*, 63.

1924 *Heliogomphus pruinans* Fraser: Fraser, *Rec. Ind. Mus., 26*, 427, 473.

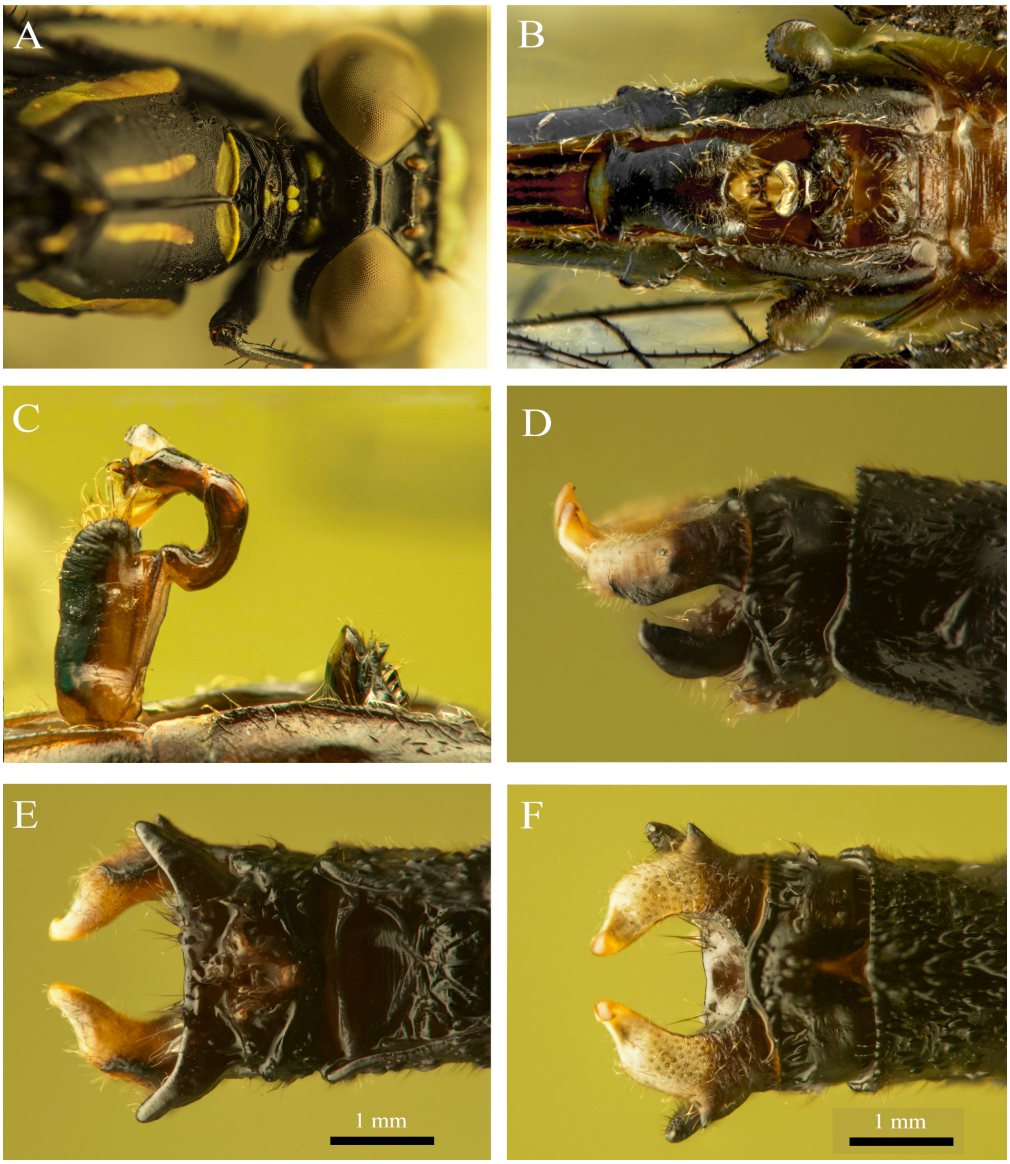

Figure 3. Specimen of *H. promelas*, TORG #1015, male, Pandipathu, Peppara WLS, Trivandrum, Kerala: (A) Dorsal view of synthorax; (B) ventral view of genital fossa; (C) right lateral view of vesica spermalis extruded in ventral exposure; (D) right lateral view of anal appendages; (E) ventral view of anal appendages showing dorsally curved epiprocts; (F) dorsal view of anal appendages showing cerci.

1925 *Heliogomphus pruinans* Fraser: Laidlaw, *Philip. J. Sci., 28*, 560.

1933 *Heliogomphus kalarensis* Fraser: Fraser, *Ceylon J. Sci., B, 18*, 29, fig. 4. [nom. nud.]

1934 *Heliogomphus kalarensis* Fraser: Fraser, *Fauna Brit. India, Odonata, 2*, 325, 329, 330, fig. 101b.

1942 *Heliogomphus kalarensis* Fraser: Fraser, *Trans. R. Ent. Soc. Lond.*, *92*(2), 335, 336, 339, 340, fig 3 (7), plate 1 (3).

1966 *Heliogomphus kalarensis* Fraser: Kimmins, *Bull. Br. Mus. nat. Hist. (Ent.), 18*(6), 173–227.

1985 *Heliogomphus kalarensis* Fraser: Allen, Davies & Tobin, *Soc. Int. Odonatol. Rapid Comm. (Suppl.), 5*, 31.

1989 *Heliogomphus kalarensis* Fraser: Lahiri. *Proc. Ninth Intl. Symp. Odonat.*, *4*, 53–56.

1995 *Heliogomphus kalarensis* Fraser: Prasad & Varshney, *Oriental Insects*, *29*(1), 400.

1997 *Heliogomphus kalarensis* Fraser: Steinmann H 2, 123.

1995 *Heliogomphus kalarensis* Fraser: Tyagi B.K. *Zoos Print Journal*, *12*(10), 8.

2000 *Heliogomphus kalarensis* Fraser: Tsuda *A Distributional List of World Odonata*.

2005 *Heliogomphus kalarensis* Fraser: Subramanian, *Dragonflies and damselflies of Peninsular India,* 114.

2007 *Heliogomphus kalarensis* Fraser: Subramanian, *Odonata—Biology of Dragonflies,* 264.

2009 *Heliogomphus kalarensis* Fraser: Subramanian, *A checklist of Odonata (Insecta) of India,* 14.

2011 *Heliogomphus kalarensis* Fraser: Kiran & Raju, *Malabar Trogon, 9*(3), 32.

2013 *Heliogomphus kalarensis* Fraser: Kiran & Raju, *Dragonflies and Damselflies of Kerala,* 153.

2013 *Heliogomphus kalarensis* Fraser: Babu, Subramanian & Nandy, *Rec. Zool. Surv. India, 347*, 5, 25.

2014 *Heliogomphus kalarensis* Fraser: Emiliyamma, *Rec. Zool. Surv. India, 114*(1), 59, 64.

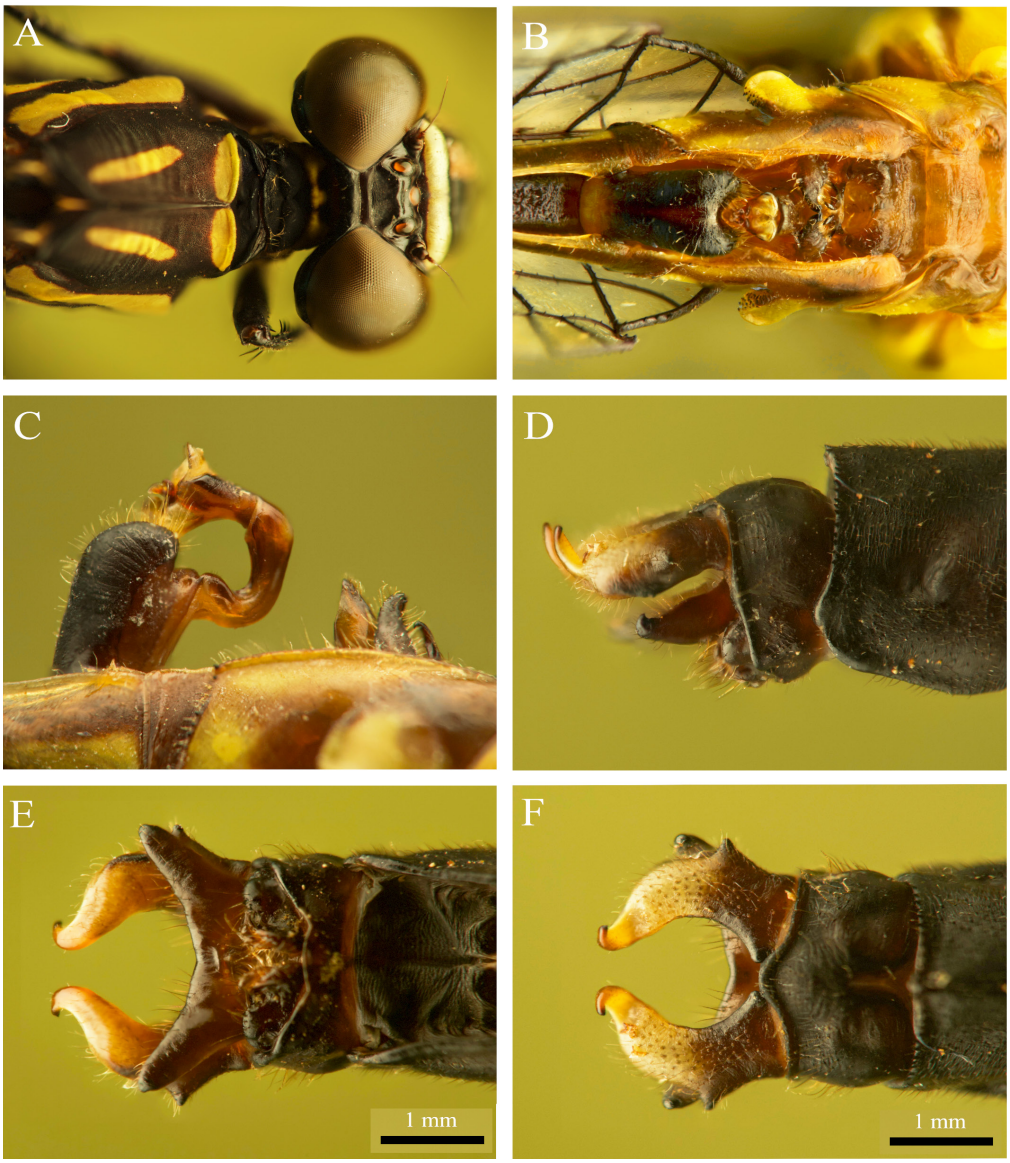

Figure 4. Specimen of *H. kalarensis*, TORG #1018, male, Pandimotta, Shendurney, Kerala: (A) Dorsal view of synthorax; (B) ventral view of genital fossa; (C) right lateral view of vesica spermalis extruded in ventral exposure; (D) right lateral view of anal appendages; (E) ventral view of anal appendages showing straight epiprocts; (F) dorsal view of anal appendages showing cerci.

2017 *Heliogomphus kalarensis* Fraser: Subramanian & Babu, *A checklist of Odonata (Insecta) of India, ver. 3.0,* 26.

2018 *Heliogomphus kalarensis* Fraser: Subramanian, Emiliyamma, Babu, Radhakrishnan & Talmale, *Atlas of Odonata (Insecta) of Western Ghats, India,* pp. 223.

2020 *Heliogomphus kalarensis* Fraser: Kalkman, Babu, Bedjanic, Coniff, Gyeltshen, Khan, Subramanian, Zia & Orr, *Zootaxa, 4849*(1), 34.

2020 *Heliogomphus kalarensis* Fraser: Subramanian, Babu & Emiliyamma, *Faunal Diversity of Biogeographic Zones of India, Western Ghats,* 234.

2021 *Heliogomphus kalarensis* Fraser: Paulson, Schorr & Deliry, *World Odonata List.*

2021 *Heliogomphus kalarensis* Fraser: Nair, Samuel, Palot, & Sadasivan, *Entomon, 46*(3), 192, 228.

2022 *Heliogomphus kalarensis* Fraser: Nair, Samuel, Palot & Sadasivan, *Malabar Trogon, 20*(1), 21.

2022 *Heliogomphus kalarensis* Fraser: Gopalan, Sherif & Chandran, *J. Threat. Taxa*, *14*(2), 20655.

2022 *Heliogomphus kalarensis* Fraser: Nair, Sadasivan, Vijayakumaran, Nayakkan, Palot, & Samuel, *Entomon* (in press).

2022 *Heliogomphus kalarensis* Fraser: Sadasivan, Samuel, Nair & Murukesh, *Entomon* (in press).

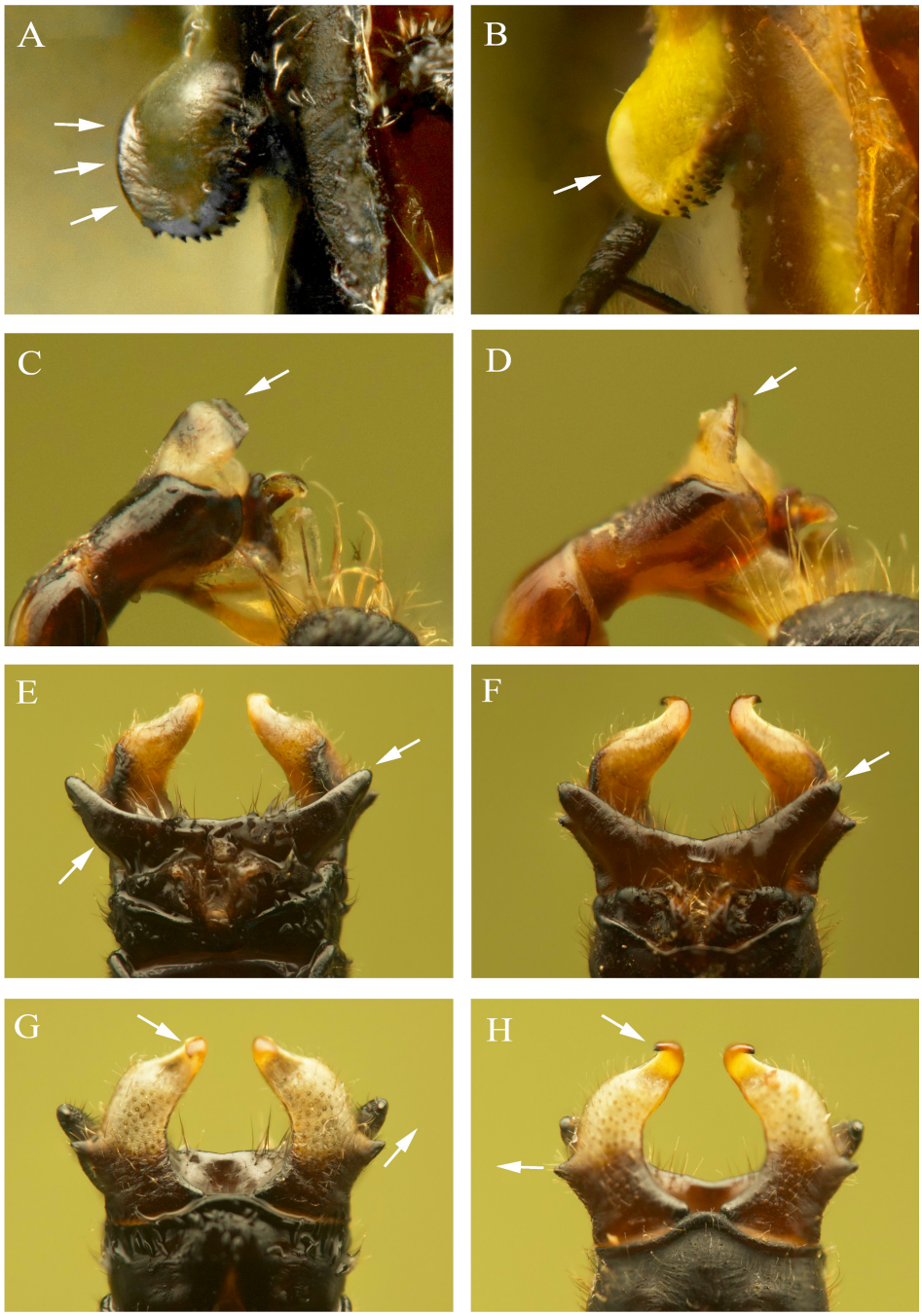

Figure 5. Comparison of *H. promelas* and *H. kalarensis* males: (A) Ventral view of right auricle of *H. promelas*; (B) ventral view of right auricle of *H. kalarensis*; (C) expansion on the middle segment of the vesica spermalis of *H. promelas*; (D) expansion on the middle segment of the vesica spermalis of *H. kalarensis*; (E) ventral view of the epiprocts of *H. promelas*; (F) ventral view of the epiprocts of *H. kalarensis*; (G) dorsal view of the cerci of *H. promelas*; (H) dorsal view of the cerci of *H. kalarensis*.

Diagnosis

Antehumeral stripe separated from the mesothoracic collar; sides of thorax with two black stripes; antehumeral stripe straight; superior humeral spot present; external spine of cerci of moderate size; lateral spine of cerci followed posteriorly at the most by a very shallow concavity; cerci broadening towards the apex and with the outer margin strongly angulated; outer margin of cerci bent at less than a right angle; female vesicle simple (Fraser, 1942).

Specimens examined *(n = 6 males)*
Holotype

NHMUK #013384589, male, Kallar, Nilgiris, Tamil Nadu, March 1916, Col. Fraser FC; NHMUK #013324357, male, Buruliyar, Nilgiris, Tamil Nadu, 29.vii.1921, Col. Fraser FC; TORG #1018, male, Pandimotta, Shendurney, Kerala, 01.v.2022, Col. Kalesh Sadasivan; TORG #1019, male, Ponmudi, Trivandrum, Kerala, 02.v.2022, Col. Kalesh Sadasivan; TORG #1020, male, Ponmudi, Trivandrum, Kerala, 01.vi.2022, Col. Kalesh Sadasivan; TORG #1021,

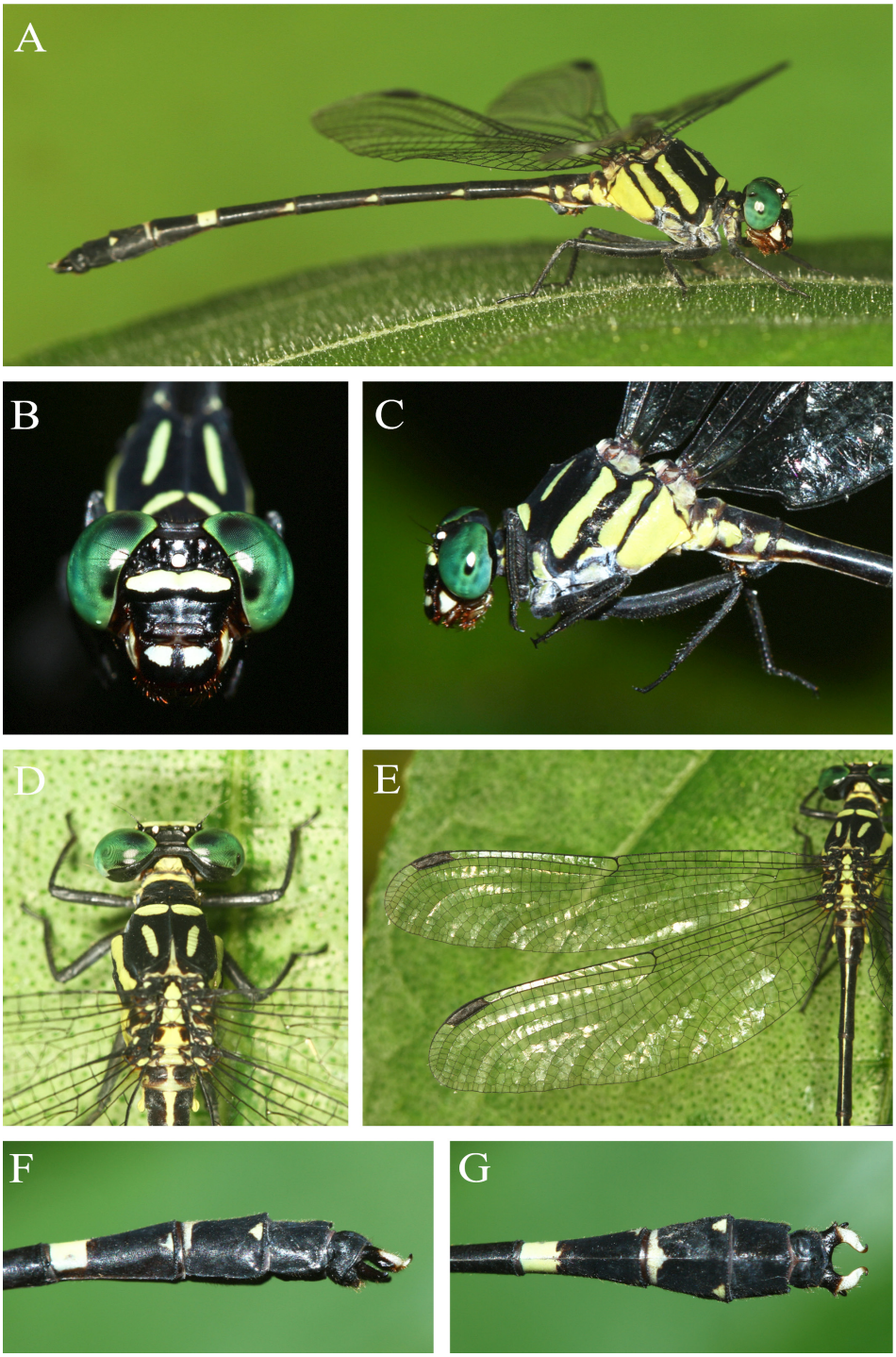

Figure 6. *Heliogomphus kalarensis* in life: (A) Lateral view of the whole insect; (B) close-up of the head; (C) lateral view of head and synthorax; (D) dorsal view of the head, prothorax, and synthorax; (E) venation; (F) lateral view of S7–10 and appendages; (G) dorsal view of S7–10 and appendages.

male, Kanichar, Kannur, Kerala, 12.vi.2022, Col. Vinayan P. Nair.

Other specimens studied in field (not collected) (n = 12 males). 5 males, Pandipathu, Peppara WLS, Trivandrum, Kerala, May 2022, Kalesh Sadasivan; 4 males, Edamalakudi, Munnar, Kerala, May 2022, Kalesh Sadasivan; 3 males, Kanichar, Kannur, Kerala, June 2022, Vinayan P. Nair.

Measurements (in mm) (n = 4). Total length (including appendages) 48–50, abdominal length 34–36, forewing length 32–33, hindwing length 32–32, HFL 5–6.

Description of male
(Figs 1, 2C–F, 4, 5B, 5D, 5F, 5H, 6, 7D, 7E)

Head (Figs 4A, 6B–D). Eyes anteriorly pale green, anterodorsally darker, and inferolaterally greenish white. Genae brownish black. Mandible black in the middle, marked by a large triangular yellowish white patch. Labium translucent yellowish brown posteriorly, and anteriorly black at the tooth. Labrum black, bearing two large triangular yellowish white patches on each half, its entire free edge bordered thickly with black. Anteclypeus dark blackish brown. Postclypeus shiny black. Antefrons and postfrons black, the latter bearing a large transverse yellowish white band. Vertex shiny black. Occipital bar matte black, and postocular lobe shiny black. Ocelli waxy white. Antennal segments black. Long pale amber-brown setae along the inferior border of the anteclypeus and on the labium.

Prothorax (Fig. 4A). Ground colour black, marked with pale lemon-yellow spots. In dorsal view, anterior lobe with a transverse yellow band, which occasionally bears two semicircular, black, paradorsal spots; middle lobe black, occasionally with a pair of small, yellow, paradorsal spots; posterior lobe entirely black, rarely with a mid-dorsal yellow spot. In lateral view, the lateral portion of the middle lobe with a yellow spot. Proepisternum yellow and proepimeron black. Forelegs generally black, but the anterior sectors of the coxae and trochanter yellow. Spines and claws black.

Synthorax (Figs 4A, 6A, 6C, 6D, 7D, 7E). Ground colour black, marked with pale lemon-yellow. In dorsal view, mid-dorsal carina black, the yellow mesothoracic collar narrowly bisected by it; antehumeral stripes well developed, almost reaching the antealar sinus dorsally; upper humeral spot variable, absent in three out of the six specimens examined. In lateral view, the mesepisternum black, bearing the yellow mesothoracic collar and the antehumeral stripes that taper dorsally, short of extending to the antealar sinus. Mesepimeron black, bearing a large central yellow dorsal stripe that almost reaches the wing base. Mesinfraepisternum dorsally

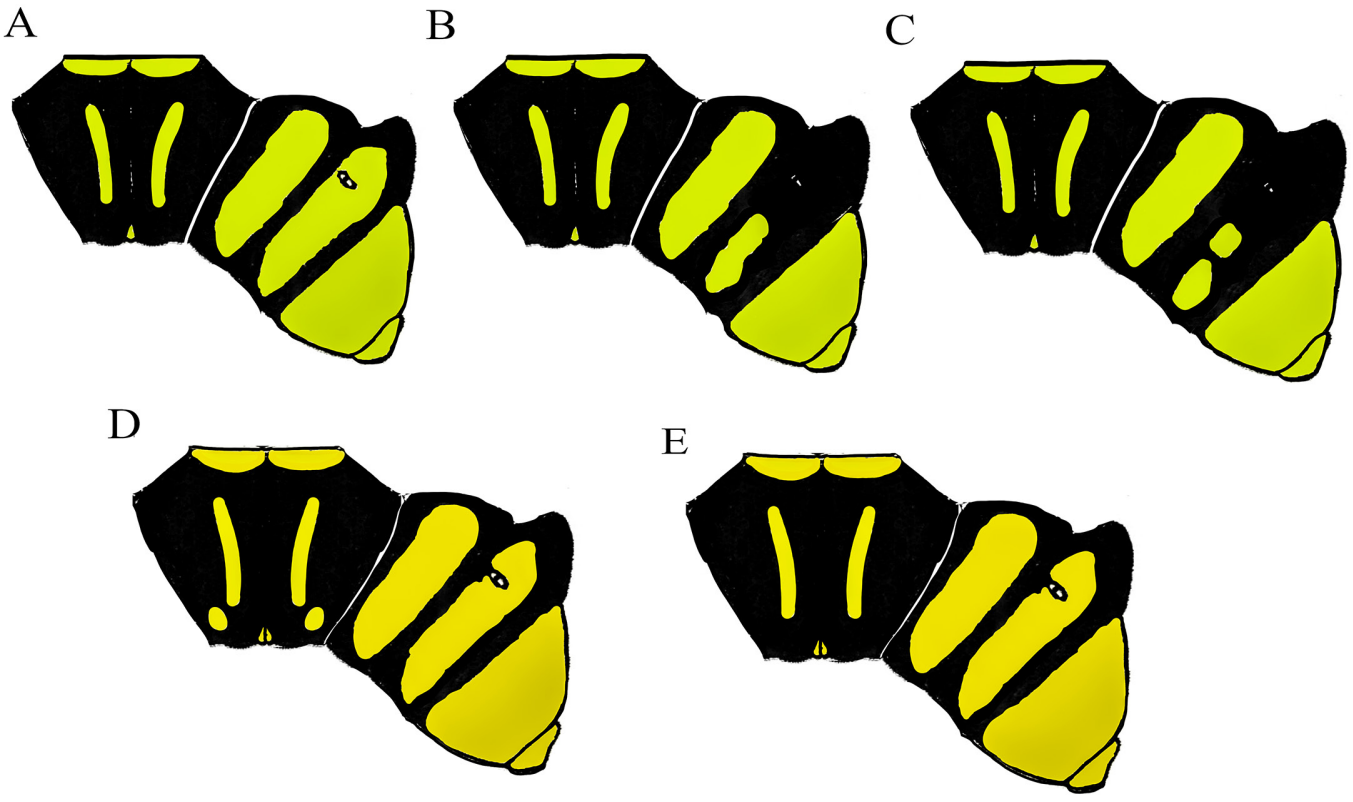

Figure 7. Schematic overview of the variation in the markings on the synthoraces of *H. promelas* and *H. keralensis:* (A) *H. promelas*; (B) *H. promelas* melanotic variant; (C) *H. promelas* melanotic variant; (D) *H. kalarensis* with upper humeral spots; (E) *H. kalarensis* without upper humeral spots.

black and inferiorly marked with yellow. Metepisternum black and marked with a large yellow stripe that almost fills it. Metepimeron wholly yellowish. The interpleural suture bordered with black. Metinfraepisternum mostly yellow, borders black. Metathoracic spiracle brown bordered with black. The mid- and hindleg coxae, trochanter, femur, and tibia are all black. The hind femur long, reaching the junction of abdominal sternites S1 and S2.

Wings (Figs 2C, 2E, 6E). Hyaline; Pt of both wings black, parallelogram-shaped, occupying almost five cells; borders slanting laterally; inferior border curvilinear. Pt length three times its breadth at its middle. Nodal range in FW: Ax 11–17 & Px 13–15; HW: Ax 10–12 & Px 11–13.

Abdomen (Figs 2C, 2E, 6A, 6F, 6G). Ground colour shiny black and marked with pale lemon-yellow as follows: S1 inferolaterally and laterally pale yellowish white, smudged with brown dorsolaterally; S2 auricle and adjoining region With a small spot near its posterior edge; S3–6 marked with very small, triangular, basolateral streaks, the ventral parts of which extending posteriorly by not more than an anterior fifth of the segments; S7 marked with a ventrally incomplete annulus, this broad dorsal patch extends laterally, but is interrupted ventrally; a small triangular spot on the posterior border of S7; S8 with a thick incomplete annulus, ending mid-laterally, the posterior edge with a small triangular spot. S9–10 black and unmarked. Auricle on S2, in ventral view, elliptical in outline, with a series of small, medially directed spines on its posteromedial and medial portion. In dorsal view, a mid-dorsal yellow line extends from S1 almost to the caudal border of S5; dorsal streak reduced in S6, reaching only its anteriormost fifth; the basal dorsal patch in S7 has a short bifid paradorsal extension posteriorly; S8 and 9 have a small triangular dorsal extension posteriorly.

Anal appendages (Figs 2D, 2F, 4D, 4E, 4F, 5F, 5H). Ground colour of cerci and epiprocts black; the part of the cerci distal to the lateral spine is white dorsally, brown ventrally, and its extreme tip is smudged with brown and ends in a black hook. Length of cerci equals that of S10 in dorsal view. Lateral horns of the epiproct straight, directed posterolaterally, tip finely hooked. In dorsal view, the male cerci are directed laterally, lateral profile of the cerci sinuous, short spine directed straight laterally in its basal third, its extreme tip curved laterally in on itself.

Secondary genitalia (Figs 4B, 4C, 5D). Colour amber-brown to dark brown. Anterior hamule (AH) shorter than the posterior hamule (PH) in lateral view, distal half tapering and curved into a hook with its tip directed posterolaterally; Body of PH broader than AH, tapering and curved gradually towards its tip; tip of PH truncated, flat, shallowly notched, and directed anteriorly, lying along its counterpart in the midline. Ligula broad, higher than the PH, directed posteriorly, covering the distal section of the stem and the middle segment of the vesica spermalis. The structure of the VS and PH is illustrated in Fig. 4C. The middle segment of the vesica spermalis, in lateral view, has a triangular extension directed ventro-posteriorly (Fig. 5D).

Distribution

Kerala: Nilgiri–Silent Valley landscape—Silent Valley NP (Nair et al., 2021); Coorg landscape—Kanichar and Kottiyoor WLS, Kannur; Munnar landscape—Mangulam and Edamalakudi of High Range subunit; Agasthyamalai landscape—Chinnapullu in Trivandrum Territorial Division, Ponmudi Hills in Kulathupuzha Reserve, and Peppara WLS (Nair et al., in press). Tamil Nadu: Kallar, Mettupalayam, Kotagiri Ghat in Nilgiris (Fraser, 1934, 1942) and Kotagiri Ghat Kotagiri Ghat in Nilgiris (Kimmins, 1966).

Annotations

In addition to the diagnostic features mentioned above, examination of the holotype in the BNHM (NHMUK #013384589 *Heliogomphus kalarensis* Fraser, 1934), fresh specimens from the Western Ghats (12 males, not collected), and voucher specimens in the TORG collection (4 males) revealed that the inferior appendage of this species is divergent, robust and straight, with its extreme tip hooked and recurved (Figs 2D, 2F, 4D–F, 5F, 5H). Coloration is variable in this species: the sides of the thorax sport three yellow stripes of which the middle one is variable in thickness, making differentiation from *H. promelas* difficult using images alone. Although the presence of an upper humeral spot is diagnostic of *H. kalarensis*, this marking is variable, too, absent in three out of the six specimens examined. The yellow occiput is said to be a unique character to distinguish *H. kalarensis* from *H. promelas,* but we found this feature to be variable as well and absent in five out of six specimens of *H. kalarensis*. The robustness of the outer spine on the cerci and the curvature of the tip was found variable in *H. kalarensis* and hence does not represent a solid character to distinguish this species from *H. promelas*. The spots on the prothorax were individually variable.

Furthermore, we examined the lectotype of *Heliogomphus pruinans* Fraser, 1922 (NHMUK #013324357) and found that the epiprocts conform to those of *H. kalarensis* and not of *H. promelas* (Fig. 2F). As a consequence, this taxon name is removed from the synonymy of *H. promelas* and is placed as a senior synonym in that of *H. kalarensis.* According to the International Code of Zoological Nomenclature (ICZN, 2000), the prevailing name should be retained as a nomen protectum, if a senior synonym or homonym has not

been used as a valid name after 1899 (Article 23.9.1.1) and the junior synonym or homonym has been used as valid by at least ten authors in 25 scientific works published in the immediately preceding 50 years and encompassing not less than ten years (Article 23.9.1.2). Since these criteria are met by the name *H. kalarensis* Fraser, 1934, which was used in 27 scientific works, the name *Heliogomphus pruinans,* Fraser, 1922 is synonymized with *H. kalarensis* Fraser, 1934, a nomen protectum in accordance with ICZN Article 23.9.1.2, suppressing its lesser used senior synonym.

Discussion

The taxonomic confusions prevailing in the genus *Heliogomphus* of the Western Ghats are resolved. *Heliogomphus kalarensis* is redescribed based on fresh specimens. The taxonomic status of *H. pruinans*, Fraser, 1922, is evaluated and is synonymized here with *H. kalarensis. H. unifasciatus* is treated as a nomen nudum.

Examination of the epiprocts and male genitalia appears to be key to differentiating the males of the two *Heliogomphus* spp. of the Western Ghats. Contradicting previous statements in scientific literature, we found that the markings on the occiput and thorax were not dependable features in separating *H. promelas* and *H. kalarensis*, but the structure of the epiproct and the male genitalia are. We observed that the colour pattern is variable in *H. promelas*, with extreme melanotic forms existing in which the yellow stripes are less distinct and the middle stripe is reduced to a superior streak or spots. The upper humeral spot is absent in all forms, but this character is not dependable to differentiate *H. promelas* from *H. kalarensis.* The broad basal ring in S7 was believed to be a distinguishing character after it was stated to be absent in the key to the Indian species of *Heliogomphus* provided by Fraser (1934). A detailed examination of specimens revealed, however, that this character is present in both species. Thus, images taken in the field alone do not allow to differentiate *Heliogomphus* spp. in the Western Ghats, rendering it mandatory to examine the epiprocts. With respect to the anal appendages, the male *H. kalarensis* has a straight epiproct, directed posterolaterally with its tip hooked in ventral view. In *H. promelas,* the epiproct is angulated at its middle, with the posterior half tapering and directed dorsolaterally in ventral view. This difference in the structure of the male epiproct is reliable for easily telling apart the two species in the field. The morphological characters of the cerci are not appreciable without comparison with specimens of the other species, so that the usability of this feature is greatly compromised in the field. The structure of the epiprocts was constant throughout all colour morphs across landscapes, thereby providing a strong morphological character to identify the two species. The structure of the hamulus did not provide any convincing pointers for differentiating them. The shape of the extensions on the middle segment of the vesica spermalis in lateral view affords a clue as to the species' identity, being rectangular in *H. promelas* and triangular in *H. kalarensis.* The identification of species with confidence from field images may be possible to some extent when examining the thoracic markings, but in the end can be confirmed only based on evaluating the lateral and ventral aspects of the epiprocts. Considering the above, examination of the epiprocts is the only dependable approach to distinguishing the two sympatric species.

In Kerala state, *H. promelas* is found in Coorg—Brahmagiris landscape (Palot & Kiran, 2016), Wayanad (Palot & Emiliyamma, 2015); Nelliampathies—Anamalais (Fraser, 1934; Adarsh et al., 2015); Nilgiri—Silent Valley, Lower Periyar Valley, Cardamom Hills, Pandalam Hills and Agasthyamalai landscapes (Nair et al., 2021). *Heliogomphus kalarensis* was previously reported only in the Nilgiri—Silent Valley landscape (Nair et al., 2021), but subsequent fieldwork undertaken by the authors (Nair et al., in press) has found that both species are much more widely distributed than previously reported. The two taxa are sympatric throughout their range in the Western Ghats from Coorg to Agasthyamalais. Moreover, *H. kalarensis* seems to be the most common species of the two *Heliogomphus* in Kerala state. This is in contradiction to the statements in some recent literature like Gopalan et al. (2022), which had excluded this species despite its being mentioned in Kerala state checklists (Kiran & Raju, 2013; Nair et al., 2021). In this context, we would like to reiterate that the unscientific trend and practice of species record exclusion without taxonomic justification seen in certain recent publications from the region can mislead conservationists, odonatologists, and policymakers, by overlooking critical odonate species. This can have a deleterious effect on the conservation of extremely rare and endemic taxa such as *H. kalarensis, Asiagomphus nilgiricus* Laidlaw, 1922, and *Idionyx periyashola* Fraser, 1939, all of which are confirmed to occur in Kerala state (Nair et al., 2021) and even outside legally protected areas (Nair et al., in press).

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References

Adarsh, C. K., Arunraj, R., & Nameer, P.O. (2015). Odonata (Insecta) diversity of Chinnar Wildlife Sanctuary, The Southern Western Ghats, India. *Journal of Threatened Taxa 7*(2): 6910–6919. http://dx.doi.org/10.11609/JoTT.o3771.6010-19

Allen, D., Davies, L. & Tobin, P. (1985). The dragonflies of the world: A systematic list of the extant species of Odonata. Vol. 2. Anisoptera. *Societas Internationalis Odonatologica Rapid Communications (Supplements)* 5: i-xi 1–151.

Babu, R., Subramanian, K. A. & Nandy, S. (2013). Endemic odonates of India. *Records of Zoological Survey of India, Occasional Paper* No. 347, 1–60 (Published by the Director, ZSI, Kolkata).

Chao, H. F. (1990). *The gomphid dragonflies of China (Odonata: Gomphidae).* [In Chinese with keys in English]. Fuzhou: Science and Technology Publishing House, 1–486.

Emiliyamma, K. G. (2014). Systematic studies on Odonata (Insecta) of Southern Western Ghats. *Records of the Zoological Survey of India, 114*(1): 57–87.

Fraser, F. C. (1922). Appendix to F. F. Laidlaw's paper, a list of the dragonflies from the Indian Empire with special reference to the collection of the Indian Museum, Part V. *Records of the Indian Museum, 24*, 415–426.

Fraser, F. C. (1923a). Dragonfly collecting in India. Part II. *Journal of the Bombay Natural History Society, 29*(1), 48–69.

Fraser, F. C. (1923b). Indian dragonflies. Part XVI. *Journal of the Bombay Natural History Society, 29*(2), 324–333.

Fraser, F. C (1924). A survey of the Odonate (dragonfly) fauna of Western India with special remarks on the genera *Macromia* and *Idionyx* and descriptions of thirty new species. *Records of the Indian Museum, 26*, 423–522 + 3 plates.

Fraser. F. C. (1925). Indian dragonflies. Part XXII. *Journal of the Bombay Natural History Society, 30*(4), 846–857.

Fraser, F. C. (1931). Additions to the survey of the odonate (dragonfly) fauna of Western India, with descriptions of nine new species. *Records of the Indian Museum, 33,* 443–474.

Fraser, F. C. (1933). The Gomphines of Ceylon (Order Odonata). *Ceylon Journal of Science: Biological Sciences, 18,* 19–36.

Fraser, F. C. (1934). *Fauna of British India, including Ceylon and Burma, Odonata*, Vol II. London: Taylor & Francis Group.

Fraser, F. C. (1942). Notes on the genus *Heliogomphus* Laidlaw, with descriptions of two new species (Odonata). *The Transactions of the Royal Entomological Society of London, 92*, 333–341. https://doi.org/10.1111/j.1365-2311.1942.tb01209.x

Garrison, R. W., von Ellenreider, N. & Louton, J. A. (2006). *Dragonfly genera of the New World: an illustrated and annotated key to the Anisoptera.* Baltimore, Maryland, USA: The Johns Hopkins University Press.

Gopalan, S. V., Sherif, M. & Chandran, A. V. (2022). A checklist of dragonflies & damselflies (Insecta: Odonata) of Kerala, India. *Journal of Threatened Taxa, 14*(2), 20654–20665. https://doi.org/10.11609/jott.7504.14.2.20654-20665

ICZN (1999). *International Code of Zoological Nomenclature. Fourth edition.* London, UK: The International Trust for Zoological Nomenclature. Accessed on August, 05, 2022, from https://www.iczn.org.

IUCN (2022). *The IUCN Red List of Threatened Species. Version 2021-3.* Downloaded on 03 June 2022, from https://www.iucnredlist.org.

Kalkman, V. J., Babu, R., Bedjanic, M., Coniff, K., Gyeltshen, T., Khan, M. K., Subramanian, K. A., Zia, A. & Orr, A. G. (2020). Checklist of the dragonflies and damselflies (Insecta: Odonata) of Bangladesh, Bhutan, India, Nepal, Pakistan, and Srilanka. *Zootaxa, 4849*(1), 1–84. https://doi.org/10.11646/zootaxa.4849.1.1.

Kimmins, D. E. (1966). A list of the Odonata types described by F.C.Fraser, now in the British Museum (Natural History). *Bulletin of the British Museum (Natural History) Entomology, 18*(6), 173–227.

Kiran, C. G. & Raju, D. V. (2011). Checklist of Odonata of Kerala with their Malayalam names. *Malabar Trogon, 9*(3), 31–35.

Kiran, C. G. & Raju, D. V. (2013). *Dragonflies and Damselflies of Kerala. A bilingual photographic field guide.* Kottayam, Kerala: Tropical Institute of Ecological Sciences.

Kirby, W. F. (1890). *A synonymic catalogue of Neuroptera Odonata, on Dragonflies, with an appendix of fossil species.* London: Gurney and Jackson.

Lahiri, A. R. (1989). On the status of rare Indian odonate species. Advances in odonatology, *Proceedings of the Ninth International Symposium on Odonatology*, Madurai, 1988, *4,* 53–56.

Laidlaw, F. F. (1922). A list of the dragonflies recorded from the Indian Empire with special reference to the collection of the Indian Museum, Part V. The subfamily Gomphinae with appendix by F. C. Fraser. *Records of the Indian Museum*, *24,* 367–426.

Laidlaw, F. F. (1925). Two new species of Dragonflies (Odonata) from the Philippine Islands, with remarks on the genus *Heliogomphus*. *The Philippine Journal of Science, 28*(1), 559–565.

Laidlaw, F. F. (1930). A synonymic list of dragonflies of the family Gomphidae (Odonata: Anisoptera) found in the Oriental region. *Transactions of the Entomological Society of London, 78,* 171–197.

Nair, V. P., Sadasivan, K., Vijayakumaran, V., Nayakkan, A., Palot, M. J. & Samuel K. A. (2022). Further notes and updates to dragonflies and damselflies of Kerala—Status and distribution, Part 1. *Entomon,* in press.

Nair, V. P., Samuel, K. A., Palot, M. J. & Sadasivan, K. (2021). The dragonflies and damselflies (Odonata) of Kerala—Status and distribution. *Entomon, 46*(3), 185–238. https://doi.org/ 10.33307/entomon.v46i3.609

Needham, J. G. (1932). A key to the dragonflies of India. *Records of the Indian Museum, 34,* 195–228.

Palot, M. J. & Emiliyamma, K. G. (2015). A checklist of odonates of Thusharagiri falls, Kozhikode district, Kerala. *Malabar Trogon, 13* (1): 24–28.

Palot, M. J. & Kiran, C. G. (2016). Dragonfly survey of Aralam Wildlife Sanctuary, Kannur district, Kerala—A report. *Malabar Trogon, 14* (1–3), 44–46.

Paulson, D., Schorr, M. & Deliry, C. (2022). *World Odonata List*. Accessed June, 02, 2022, from https://www2.pugetsound.edu/academics/academic-resources/slater-museum/biodiversity-resources/dragonflies/world-odonata-list2

Prasad, M. & Varshney, R. K. (1995). A checklist of the Odonata of India including data on larval studies. *Oriental Insects*, *29*(1), 385–428. https://doi.org/10.1080/00305316.1995.10433748

Rangnekar, P., Borkar, M. & Dharwadkar, O. (2010). Additions to the Odonata (Insecta) of Goa. *Journal of Threatened Taxa, 2*(4), 805–814.

Sadasivan, K., Nair, V. P. & Samuel, K. A. (2022). The dragonflies and damselflies (Insecta: Odonata) of Shendurney Wildlife Sanctuary, southern Western Ghats, India. *Journal of Threatened Taxa, 14*(6), 21213–21226.

Sadasivan, K., Samuel, K. A., Nair, V. P. & Murukesh, M. D. (2022). Dragonflies and damselflies (Odonata) of Silent Valley National Park, and its Environs. *Entomon,* in press.

Selys, L. (1873). Appendices aux troisièmes additions et liste des Gomphines, décrites dans le synopsis et ses trois additions. *Bulletins de l'Académie royale des sciences, des lettres et des beaux-arts de Belgique, 36*(2), 492–531.

Sharma, G., Ramamurthy, V. V. & Kumar, R. (2009). Collection of damselflies and dragonflies (Odonata: Insecta) in National Pusa collection. Division of Entomology, Indian Agricultural Research Institute, New Delhi, India. *Biological Forum—An International Journal, 1*(2), 106–109.

Steinmann, H. (1997). *World catalogue of Odonata. Volume II*. Anisoptera. Tierreich. Teilband. Berlin.

Subramanian, K. A. (2005). *Dragonflies and damselflies of Peninsular India—A field guide.* e-Book of Project Lifescape. Bangalore, India: Centre for Ecological Sciences, Indian Institute of Science and Indian Academy of Sciences.

Subramanian, K. A. (2007). Endemic odonates of Western Ghats: Habitat, distribution, and conservation. In: *Odonata—Biology of Dragonflies*; Ed. B. K. Tyagi. Jodhpur, India: Scientific Publishers, 257–271.

Subramanian, K. A. (2009) *A checklist of Odonata (Insecta) of India.* Zoological Survey of India. www.zsi.gov.in

Subramanian, K .A. & Babu, R. (2017). *A checklist of Odonata (Insecta) of India, Version 3.0*. www.zsi.gov.in

Subramanian, K. A., Babu, R. & Emiliyamma, K. G. (2020). Insecta: Odonata. In *Faunal Diversity of Biogeographic Zones of India: Western Ghats*. pp. 227–242. Kolkata: Director, Zoological Survey of India.

Subramanian, K. A., Emiliyamma, K. G., Babu, R., Radhakrishnan, C. & Talmale, S. S. (2018). *Atlas of Odonata (Insecta) of Western Ghats, India.* Kolkata: Director, Zoological Survey of India.

Tsuda, S. (2000). *A Distributional List of World Odonata*. Privately published, Osaka.

Tyagi, B. K. (1997). Dragonfly wealth of India—Extant species. A preliminary systematic list. *Zoos Print Journal*, *12*(10), 3–10.

Williamson, E. B. (1907). The Dragonflies (Odonata) of Burma and Lower Siam II a—Subfamilies Cordulegasterinae, Chlorogomphinae, and Gomphinae. *Proceedings of the United States National Museum, 33*(1571), 267–317.