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Taxonomic Insight on *Indophanes barbara* (Walker, 1853) (Neuroptera: Myrmeleontidae) Recorded from Kerala, India

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ABSTRACT

The antlion genus *Indophanes* Banks, 1940 is newly recorded from Kerala (new faunistic record) with species, *Indophanes barbara* (Walker, 1853). Taxon is redescribed and the genitalia features of male and female are illustrated for the first time based on freshly collected specimens. Moreover, the distribution and flight period of *Indophanes* species from India are plotted.

Keywords: Antlion, taxonomy, *Indophanes*, Kerala, India.

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INTRODUCTION

Indophanes Banks, 1940 (Myrmeleontidae: Nemoleontinae) was established by Banks (1940) based on the type species *Indophanes barbara* (Walker, 1853) from Sri Lanka (Machado et al., 2019; Zheng & Liu, 2023). This genus is mainly distributed in China, India, Nepal, Pakistan and Sri Lanka (Zheng & Liu, 2023; Oswald, 2024). Currently *Indophanes* comprises eight species worldwide, of which three species, *I. audax* (Walker, 1853), *I. barbara* (Walker, 1853) and *I. infestus* (Walker, 1853) are reported from India (Chandra & Sharma, 2009; Suryanarayanan & Bijoy, 2024a; Oswald, 2024). *Indophanes audax* was reported from West Bengal, Meghalaya, Mizoram, Tripura, Maharashtra and Andaman & Nicobar Islands, while *I. barbara* was reported from Maharashtra, Madhya Pradesh and *I. infestus* from Gujarat, Maharashtra, West Bengal and Bihar (Needham, 1909; Ghosh, 1980; Ghosh, 1984; Ghosh, 1998; Ghosh, 2000; Chandra et al., 2011; Chandra & Sharma, 2012). All the three species were recently redescribed by Zheng & Liu (2023) based on the type specimens, but the genitalia features of both male and female are not added because of the unavailability of specimens of these rare species.

As part of the study on antlions of the Kerala part of Western Ghats, we are redescribing and illustrating the genitalia features of *I. barbara* (Walker, 1853) based on the freshly collected specimens from Kerala. Also, the distribution of three species of *Indophanes* in India and the flight period is updated and figured. Moreover, *Indophanes* is reported for the first time from the state of Kerala based on this study.

MATERIAL AND METHODS

Adult specimens were collected mainly by using a sweep net and light trap (Mercury vapour bulb-160W). The collected specimens were transferred into a killing jar filled with ethyl acetate. After that, specimens were pinned, stretched, dried, labeled, and preserved as per standard procedures. The specimens were examined through Labomed® Luxeo 6Z Stereomicroscope. Specimens were identified up-to species level after Zheng & Liu (2023). The photos were prepared with Canon© 7D Mark II digital camera with a 100 mm F/2.8L macro lens. For the preparation of male genitalia, the last 3-4 abdominal segments were removed and put in 10% KOH overnight. These were then washed in distilled water and kept in 80% ethyl alcohol with a drop of glycerol for observation. The photography was done under Leica© M205 Stereomicroscope with LAS V3.7© software. After photography, the genital organs of each specimen were transferred to a glass vial with 60-70% glycerine. The terminology for male and female genitalia follows Aspöck et al., 1980; Aspöck & Aspöck, 2008 and Badano et al., 2017. The voucher specimens were deposited in the Shadpada Entomology Research Lab (SERL) at Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala, India.

Abbreviations. C - Costa, Sc - Subcosta, R - Radius, Sc + R - Subcosta + Radius, Rs_1 + Ma - Radial vein 1 + Media anterior, Mp - Media posterior, Mp_1 - Media posterior 1, Mp_2 - Media posterior 2, Cua - Cubitus anterior, Cua_1 - Cubitus anterior 1, Cua_2 - Cubitus anterior 2, Av - Ambient vein, Cup - Cubitus posterior, Cup+A_1 - Cubitus posterior + Anal vein 1, A_1, A_2 and A_3 - Anal veins 1, 2 and 3, ps - pterostigma, r - reghma area, gx- gonocoxites, T8 and T9 - Tergite 8, and 9, S8 and S9 - Sternite 8, and 9, ect - Ectoproct,

gx - Gonocoxites, gx9 and gx11 - gonarcus-parameres complex in male, gx8 - Posterior gonapophysis, gx9 - Lateral gonapophysis in female.

RESULTS

Family Myrmeleontidae Latreille, 1802

Subfamily Myrmeleontinae Latreille, 1802

Tribe Nemoleontini Banks, 1911

Genus *Indophanes* Banks, 1940

Diagnosis. Antennae longer than thorax; pronotum somewhat longer than wide; CuA fork arising before Rs in forewing; A_2 and A_3 unite in short term then diverge, A_2 forked, A_3 simple in forewing; hindwing with one or two cross-veins in front of origin of Rs; legs slender and long; tibial spurs as long as tarsal segments 1-2 combined; claws as long as length of last tarsal segment; Male gonocoxite 9 with posterior part as a pair of nearly rhomboid plate in ventral view. Female gonocoxite 8 slender, digitiform, projecting distally; gonapophysis 8 narrow, ribbon-shaped; gonocoxite 9 with stout digging setae posteriorly; ectoprocts with stout digging setae on ventral side.

Indophanes barbara (Walker, 1853)

Myrmeleon barbara Walker, 1853: 358. Type locality: Sri Lanka.

Material examined. 3♂, 6♀ India: Kerala State: Palakkad District, Pudunagaram, elev. 136 m, (coordinates: 10°40′58.73″N, 76°41′01.62″E), Bijoy. C., 08.IX.2019, 16.IX.2019, 18.IX.2020, 27.IX.2020, 18.XI.2020, 10.I.2021, 01.X.2021, 13.II.2023, 26.II.2023, SERLNR020, SERLNR021, SERLNR089, SERLNR090, SERLNR113, SERLNR119, SERLNR180, SERLNR343, SERLNR346. 1♂, 1♀ India: Kerala State: Palakkad District, Chittur, elev. 140 m, (coordinates: 10°40′38.06″N, 76°42′58.81″E), Sreelakshmi. S., 13.VIII.2021, 07.XII.2021, SERLNR170, SERLNR247. 1♀ India: Kerala state: Palakkad district, Kulikkiliyad, elev. 90 m, (coordinates: 10°57′56.01″N, 76°24′20.47″E), Kavya. G. Pillai., 17.III.2023, SERLNR365. 2♀ India: Kerala state: Thrissur district, Irinjalakuda, elev. 40 m, (coordinates: 10°21′14.87″N, 76°12′48.90″E), Aswathi. P. G., Sudhin. P. P., 14.II.2020, 30.I.2022, SERLNR037, SERLNR260. 2♀ India: Kerala state: Thrissur district, Manakkody, elev. 30 m, (coordinates: 10°29′08.57″N, 76°10′10.84″E), Subin. K. S., 14.I.2022, 22.I.2023, SERLNR258, SERLNR342. 1♀ India: Kerala state: Kozhikode district, Chaliyam, elev. 36 m, (coordinates: 11°09′21.56″N, 75°48′40.56″E), Kamila. A. P., 12.VI.2020, SERLNR114. 1♀ India: Kerala state: Kozhikode district, Devagiri, elev. 78 m, (coordinates: 11°15′50.38″N, 75°50′09.69″E), Reshma. T. T., 28.X.2021, SERLNR218. 2♂ India: Kerala state: Malappuram district, Aroor, elev. 53m, (coordinates: 11°11′59.07″N, 75°55′41.27″E), Reshma. T. T., 22.VIII.2021, 06.IX.2021, SERLNR172, SERLNR179. 1♀ India: Kerala State: Kannur District, Kuthuparamba, elev. 69 m, (coordinates: 11°49′54.78″N, 75°33′55.85″E), Mohammed Anas. P. P., 30.I.2022, SERLNR259. 1♀ India: Kerala State: Thiruvananthapuram District, Ponmudi, elev. 633 m, (coordinates: 08°44′39.99″N, 77°07′36.99″E), Suryanarayanan. T. B., 12.IV.2023, SERLNR387.

Diagnosis. Adult: Vertex yellow with two longitudinal dark-brown stripes on lateral sides, which joins medially with dark-brown transverse band, sparsely covered with short black setae. Frons yellow with sparse white hairs. Pronotum light-yellow, somewhat longer than wide, with a pair of longitudinal dark-brown stripes dorsally.

Forewing with slightly dark-brown shading on radial veins at terminal bifurcation before reaching Av and rhegma. Cubital area with an indistinct dark brown oblique band. 8-9 presectoral crossveins present. Hindwing rhegma indistinct; dark-brown shading on both sides of gradate veins in postcostal and radial area, and at ends of bifurcated radial veins in apical area (Figs. 1a-b).

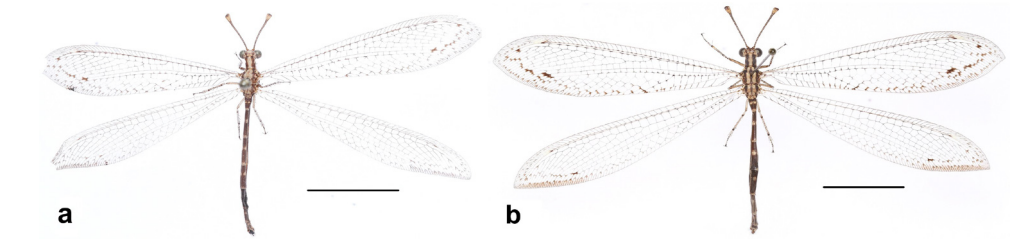


Figure 1. *Indophanes barbara* (Walker, 1853). a) Male habitus; b) Female habitus.

Redescription

Measurements. Male (n=6): Length of body: 20-21 mm. Forewing, length 23-24 mm, width 6 mm; hindwing, length 24-25 mm, width 5 mm. Female (n=16): Length of body: 21-22 mm. Forewing, length 26-27 mm, width 7 mm; hindwing, length 27-28 mm, width 6 mm.

Head (Figs. 2a-b). Vertex yellow with two longitudinal dark-brown stripes in lateral sides, which joins medially with dark-brown transverse band, sparsely covered with short black setae. Frons, inter-antennal marking and anterior tentorial pits yellow. Clypeus yellow, sparsely covered with long black setae; labrum, maxilla, labial palps and gena yellow; base of mandible yellow, hairless, and with dark-brown apices at inner side. Compound eyes large, blackish-grey, wider than half of head width. Antenna longer than length of head and prothorax combined; scape and pedicel generally yellow with dark-brown annulations; flagellomeres annulated with brown and whitish rings. Club thicker at apex than at base, last segment dark-brown.

Thorax (Fig. 2b). Pronotum light-yellow, somewhat longer than wide, with a pair of longitudinal dark-brown stripes dorsally, covered with black setae except on median portion; mesonotum yellow, with slender median dark-brown stripe, lateral margins with dark-brown markings; metanotum yellow with small median dark-brown stripe, covered with long white setae.

Wings (Fig. 2c). Forewing slightly shorter than hindwing. Wing tips acute and straight below, wing tapering basally, anal area obtuse, venation dense, cells higher than wide basally in costal and radial area. Venation covered with short sparse white setae. Costa yellow with short white setae. Costal area with single rows of cells, cells longer than wide, membrane transparent. Cross-veins simple but bifurcated in front of pterostigma. Pterostigma with 6-7 veins, veins bifurcated basally and simple distally, dominantly faint yellow. Sc and R pale-yellow alternating dark brown at cross-veins. 11 branches in radial sector, 8-9 cross-veins in front of origin of Rs. Mp, Mp_1 and Mp_2 pale yellow, Cua, Cua_1 also pale-yellow alternating dark brown at cross-veins.

Cubital fork ca. 30°, acute enough. Meeting point Cua_2 and $Cup+A_1$ has dark-brown on membrane. Posterior Banksian line visible. A_1, A_2 and A_3 yellow, between A_2 and A_3 with 2 cells, A_1, A_3 simple, A_2 bifurcated distally. Membrane almost completely transparent but with dark-brown shading at rhegma, and both side of gradate veins in postcostal and radial areas. Also, slightly brown shading on radial veins at terminal bifurcation before reaching Av.

In hindwing, C yellow with short white setae. 4-5 cross-veins bifurcated in front of pterostigma otherwise simple, brownish at both ends. Pterostigma with 2-3 bifurcated veins, dominantly faint yellow. Sc and R pale yellow with alternate dark brown at cross-veins. 10 branches in radial sector, 1 cross-vein in front of origin of Rs. Mp_1, Mp_2 and Cua dominantly pale yellow but small dark brown section at meeting points with cross-veins. Membrane almost completely transparent but with light brown shading on both sides of gradate veins in postcostal and radial area, and at ends of bifurcated radial veins in apical area.

Legs (Figs. 2d-e). Short. Yellow with dark brown marks, hairy; coxa light-brown densely covered with small yellow setae and long black setae; trochanter yellowish-brown; middle and hind femora yellow with light brown longitudinal markings on dorsal side, covered with long black setae; tibiae yellow with brown spots and half rings anteriorly and half ring on distal ends, covered with long and small black setae; hind tibia yellowish white, with disperse black dots at setal bases, covered with black setae, tibial spurs reddish-brown, as long as tarsomeres 1-2 together; tarsi yellow covered with black setae only at distal end of last segments with brown markings on distal ends; tarsal claws reddish-brown, 3/4 as long as distal tarsomere.

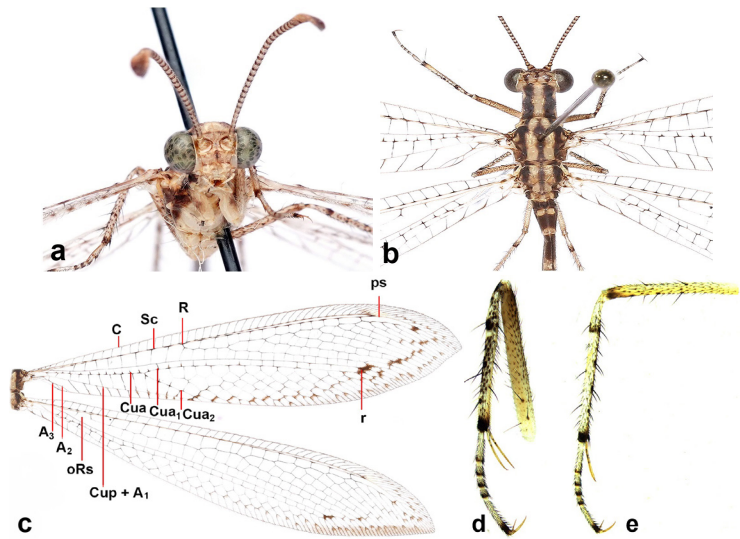


Figure 2. *Indophanes barbara* (Walker, 1853). a) Head in frontal view; b) Head and thorax in dorsal view; c) Male wing venation; d) Foreleg; e) Hindleg in lateral view.

Abdomen. Slim, brownish-yellow, with alternate light-yellow band at distal end of each segment dorsally and laterally in middle portion of each segment, covered with short black and white setae; posterior margin of each abdominal tergum with dark-brown stripe medially. Sternites yellow, with long black and a few white setae.

Male terminalia and genitalia (Figs. 3a-c). Tergum 9 quadrate; sternum 9 nearly quadrate in lateral view and covered with long black and a few short white setae; ectoproct ovoid plate, covered with black setae becoming much longer ventrally, white setae along lateral margins. Shape of inner genitalia complex (gonocoxite 9 and gonocoxite 11 = gonarcus-parameres complex) as in Fig. 3c in dorsal view.

Female terminalia (Figs. 3d-e). Tergum 8 quadrate in lateral view; gonocoxite 8 short, club-shaped, covered with long black setae; tergum 9 nearly triangular shape; gonocoxite 9 rod-shaped, posteriorly covered with some stout setae; ectoprocts ovoid, covered with black stout setae.

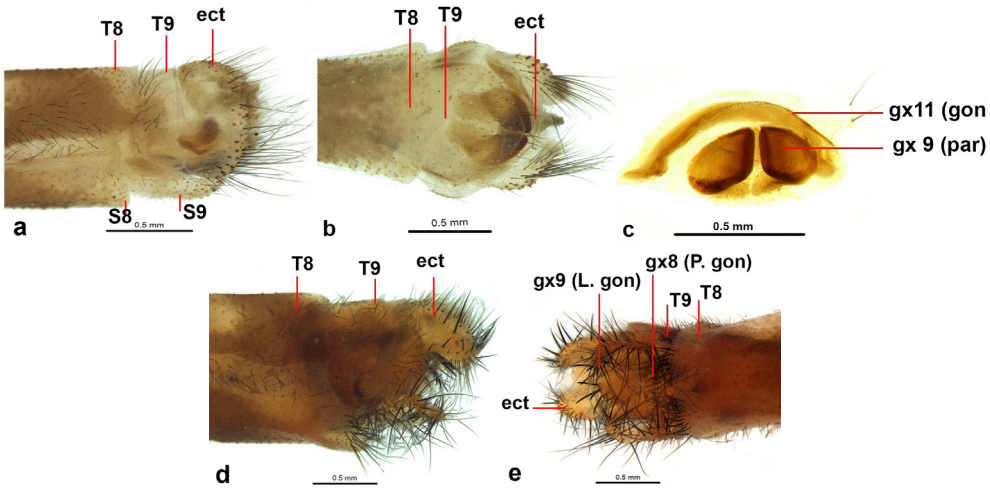


Figure 3. *Indophanes barbara* (Walker, 1853). **a)** Male terminalia, in lateral view; **b)** The same, in ventral view; **c)** Male inner genitalia, in ventral view (in sense Aspöck, et al., 1980; Aspöck & Aspöck, 2008; Badano, et al., 2017); **d)** Female terminalia, in lateral view; **e)** The same, in ventral view.

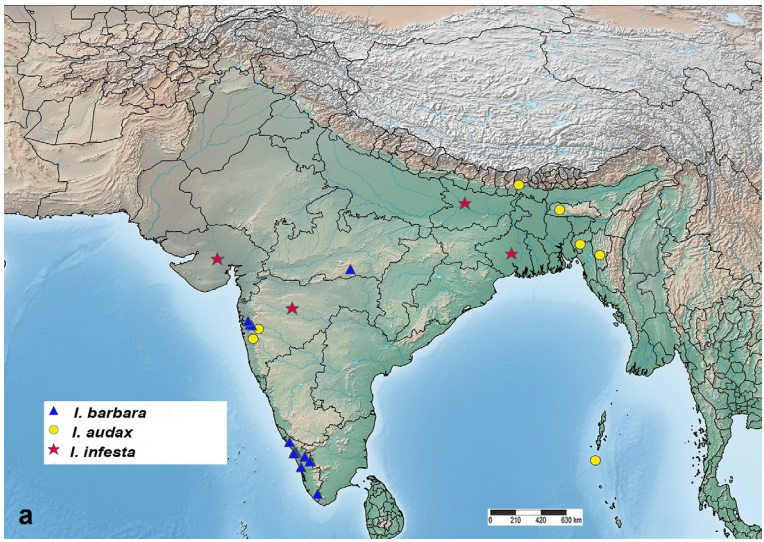
Distribution in India (Fig. 5a). Maharashtra (Raigad Dist.: Matheran hill station, Matheran echo point; Satara Dist.: Khandala hill station), Pune Dist.: Bhaja Cave), Madhya Pradesh (Chhindwara Dist.: Chota Mahadev), Kerala (Thrissur Dist.: Irinjalakuda, Manakkody; Palakkad Dist.: Pudunagaram, Chittur, Kulikkiliyad, Kozhikode Dist.: Chaliyam, Devagiri, Kannur Dist.: Kuthuparamba, Malappuram Dist.: Aroor, Thiruvananthapuram Dist.: Ponmudi).

Biology. Adults are drawn to artificial light and active at night. In daytime, it rest on dry vines of the climbers which will allow them to camouflage from the surrounding environment (Figs. 4a-b). The habitat is near to household ecosystems surrounded by dense vegetation in laterite soil (sand soil structure). Like other *Indophanes* species, the larva of this species is not pit-building. The adult flight period and seasonality of

I. barbara (Walker, 1853) is mainly observed in the all months except in May and July based on the five year field collection in Kerala (Fig. 5b). Although this result suggests that they are active in almost whole year, but they are not a common species in Kerala. They adjust their flight pattern based on slight changes in the environment like rainfall pattern. Almost same pattern of flight period of this genus was observed from Kerala by Suryanarayanan & Bijoy (2023). In Ghosh (1980) and Chandra et al. (2011) adult flight period and seasonality noted in the months October and November only. The adult flight period and seasonality of *I. audax* (Walker, 1853) is mainly observed in the months of March and April (Fig. 5b) based on Ghosh (2000). *I. infestus* (Walker, 1853) collections months are absent in literatures and need to be analysed in future based on freshly collected specimens.

Figure 4. *Indophanes barbara* (Walker, 1853). a) Adult male in natural habitat; b) Habitat of species in Chittur, Kerala (photo: Sreelakshmi S).

Comments. *Indophanes barbara* (Walker, 1853) is only reported from Sri Lanka and India (Oswald, 2024). *I. vartianorum* Hölzel, 1972 described from Pakistan is also expected in India from mountainous northern states in future.



Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
I. audax												
I. barbara												

b

Figure 5. a) Distribution of three *Indophanes* species from India; b) Flight period of *Indophanes audax* (Walker, 1853) and *Indophanes barbara* (Walker, 1853) from India.

DISCUSSION

After the research period of Ghosh (1977-2000), there is a significant gap in the taxonomic studies on the order Neuroptera and its families in India. Only 60 species under 33 genera of Order Neuroptera are reported from Western Ghats (Singh et al., 2020). Recently, there has been notable taxonomic revisions and distributional records in Neuroptera by Kaur et al. (2019a, 2019b); Winterton & Gupta (2020); Winterton et al. (2021); Suryanarayanan & Bijoy (2021a, 2021b, 2021c, 2021d, 2022, 2023, 2024b); Suryanarayanan et al. (2022, 2023a, 2023b, 2024a, 2024b, 2024c) based on intensive faunal surveys carried in Western Ghats as well as other regions of India. In this study, rare antlion species *Indophanes barbara* (Walker, 1853) was redescribed and illustrated based on the freshly collected specimens from Kerala, India.

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