



Research Article

Parasitoids of butterflies: reassignment of *Dolichogenidea hasorae* (Wilkinson, 1928) as a new combination along with new host-parasitoid linkages and notes on host specificity from Kerala, India

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ABSTRACT: Butterflies are flagship species for biodiversity conservation and thus the knowledge of their associated natural enemies is important. In this study, rearing data on parasitism of seven butterfly species in six genera belonging to three Lepidoptera families (Hesperiidae, Lycaenidae and Papilionidae) are presented for the first time from Kerala, India. Four species of parasitic wasps along with two possibly unnamed species, collectively from three Hymenoptera families (Braconidae, Chalcididae and Ichneumonidae), were discovered. *Dolichogenidea hasorae* (Wilkinson, 1928) **n. comb.** (Hymenoptera: Braconidae) is reassigned from the traditionally defined genus *Apanteles*. The following host associations are recorded: *Brachymeria lasus* (Walker) (Chalcididae) from pupa of *Hasora chromus* (Cramer) (Hesperiidae); *Casinaria ajanta* Maheshwary & Gupta (Ichneumonidae) from caterpillars of two hesperiid species – *Ampittia dioscorides* (Fabricius) (Hesperiidae) and *Parnara* sp. (Hesperiidae); *Dolichogenidea hasorae* (Wilkinson) **n. comb.** from caterpillar of *Hasora taminatus* (Hübner); *Glyptapanteles aristolochiae* (Wilkinson) from caterpillar of *Troides minos* (Cramer) (Papilionidae); *Apanteles* sp. (Braconidae) from caterpillar of *Telicota bambusae* (Moore) (Hesperiidae); and *Cotesia* sp. from caterpillar of *Udara akasa* (Horsfield) (Lycaenidae). The majority of these records are the first reports except *C. ajanta* from *Parnara* sp. Host range extension and varied host association of parasitoids are discussed based on newly acquired and previously published data. Brief diagnosis of wasps and illustrations of wasps along with their respective hosts are provided.

KEY WORDS: Butterflies, parasitic wasps, Kerala, India

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INTRODUCTION

Usually for any geographical region, the fauna of butterflies is well known owing to their magnificent appearance and aesthetic value contrary to the scanty documentation of the associated parasitoids. As butterflies are important in biodiversity conservation so do their parasitoids, whether to maintain equilibrium in the nature or to reveal their threats if at all strategies are to be taken to conserve them. In India, many successful attempts have been initiated in the recent past to unveil the diversity of parasitic wasps associated with butterfly species (Gupta and Kalesh, 2012; Gupta *et al.*, 2013; Gupta *et al.*, 2014; Gupta *et al.*, 2015). However sighting a parasitized caterpillar is still rare. In continuation to the studies on the documentation of parasitic wasps associated with butterflies, recent surveys conducted in 2013–2014 yielded six species of parasitoids from various life stages of butterflies. Seven species of butterflies were

found to be parasitized: *Ampittia dioscorides* (Fabricius) (Hesperiidae), *Hasora chromus* (Cramer) (Hesperiidae), *Hasora taminatus* (Hübner) (Hesperiidae), *Parnara* sp. (Hesperiidae), *Telicota bambusae* (Moore) (Hesperiidae), *Troides minos* (Cramer) (Papilionidae), and *Udara akasa* (Horsfield) (Lycaenidae). Our study reports new host-parasitoid interactions/associations along with host range extension of parasitic wasps.

MATERIALS AND METHODS

The collections were made from Kakkur, Kakkavayal, Kakkayam and Kottayam in Kerala district by SK and PM. Parasitoids were reared from the wild-caught caterpillars. The caterpillars were kept in cages awaiting parasitoid emergence. Taxonomic studies were done by AG. Alcohol preserved specimens were processed using Hexamethyldisilazane and later point-mounted. Photographs of the wasps

were taken using Leica M 205 A stereozoom microscope with Leica DC 420 inbuilt camera using Automontage software (version 3.8). Macro images of the various life stages of hosts were taken using either of the cameras- Canon 40D, Canon 7D, lens Sigma 180mm macro; Nikon 5200, lens Sigma 105mm macro and Nikon SB600 Flash. Wasp specimens were identified consulting Gupta & Maheshwary (1977), Joseph *et al.* (1973), Narendran (1989), Nixon (1967), and Wilkinson (1928). Specimens are deposited in the collections of the ICAR-National Bureau of Agricultural Insect Resources (NBAIR), Bangalore, India.

RESULTS AND DISCUSSION

Seven species of butterflies in three families of Lepidoptera (Hesperiidae, Lycaenidae and Papilionidae) were found to be parasitized by six species of wasps belonging to three families of Hymenoptera (Braconidae, Chalcididae and Ichneumonidae) during various stages of their respective life cycles. The rearing details are summarized in Table 1. for butterfly host species (arranged in alphabetical order), associated parasitic wasp species, stage of parasitism and solitary/gregarious nature of cocoon in Kerala, India. The details of various species of parasitoids are arranged in the alphabetical order of the butterfly host species as given in Table 1.

Order Hymenoptera Linnaeus, 1758

Family Ichneumonidae Latreille, 1802

Casinaría ajanta Maheshwary & Gupta

Host: Caterpillar of *Ampittia dioscorides* (Fabricius) (Lepidoptera: Hesperiidae) (Fig. 1B) and caterpillar of *Parnara* sp. (Lepidoptera: Hesperiidae) (Fig. 1D).

Locality: Kerala, Kozhikode, Kakkur (11.23°N, 75.49°E), India.

Voucher material: One female (from caterpillar of *A. dioscorides*), 09.vii.2013, coll. Saji, K., NBAIR Code: 9713AD. One male (from caterpillar of *Parnara* sp.), 09.vii.2013, coll. Saji, K., NBAIR Code: 9713P.

Scape and pedicel yellowish brown. Fore leg (except coxa) yellowish brown. Anterior region of mesopleuron (anterior to speculum) distinctly striate. Propodeum flattened, abruptly narrowing apically. Median propodeal carinae indistinct. Female similar to male except face rugose-punctate, smooth along orbital margins; mesopleuron a little closely rugose; apical transverse carina of propodeum weakly present on sides; metasoma brownish-black.

Distribution

India, Indonesia and Malaysia.

Remarks

This parasitoid *C. ajanta* was reared from caterpillars of two different hesperiid species— *Ampittia dioscorides* (Fabricius) (Lepidoptera: Hesperiidae) (Fig. 1B) and *Parnara* sp. (Lepidoptera: Hesperiidae) (Fig. 1D) from the same locality at the same time. In this case, the parasitoid chose two different host species depending on the availability of the hosts in the vicinity. Hence *C. ajanta* does not seem to be a host specific parasitoid.

Table 1. List of reared butterfly species, associated parasitic wasp species, stage of parasitism of the host and solitary/gregarious nature of the wasp species from Kerala, India during the year 2013-2014

S. No	Butterfly host species	Parasitic wasp species	Host stage parasitism	Solitary/gregarious
1	<i>Ampittia dioscorides</i> (Fabricius) (Lepidoptera: Hesperiidae)	<i>Casinaría ajanta</i> Maheshwary & Gupta (Hymenoptera: Ichneumonidae)	Larva	Solitary
2	<i>Hasora chromus</i> (Cramer) (Lepidoptera: Hesperiidae)	<i>Brachymeria lasus</i> (Walker) (Hymenoptera: Chalcididae)	Pupa	Solitary
3	<i>Hasora taminatus</i> (Hübner) (Lepidoptera: Hesperiidae)	<i>Dolichogenidea hasorae</i> (Wilkinson) n. comb. (Hymenoptera: Braconidae)	Larva	Solitary
4	<i>Parnara</i> sp. (Lepidoptera: Hesperiidae)	<i>Casinaría ajanta</i> Maheshwary & Gupta (Hymenoptera: Ichneumonidae)	Larva	Solitary
5	<i>Telicota bambusae</i> (Moore) (Lepidoptera: Hesperiidae)	<i>Apanteles</i> sp. (Hymenoptera: Braconidae)	Larva	Solitary
6	<i>Troides minos</i> (Cramer) (Lepidoptera: Papilionidae)	<i>Glyptapanteles aristolochiae</i> (Wilkinson) (Hymenoptera: Braconidae)	Larva	Gregarious
7	<i>Udara akasa</i> (Horsfield) (Lepidoptera: Lycaenidae)	<i>Cotesia</i> sp. (Hymenoptera: Braconidae)	Larva	Solitary

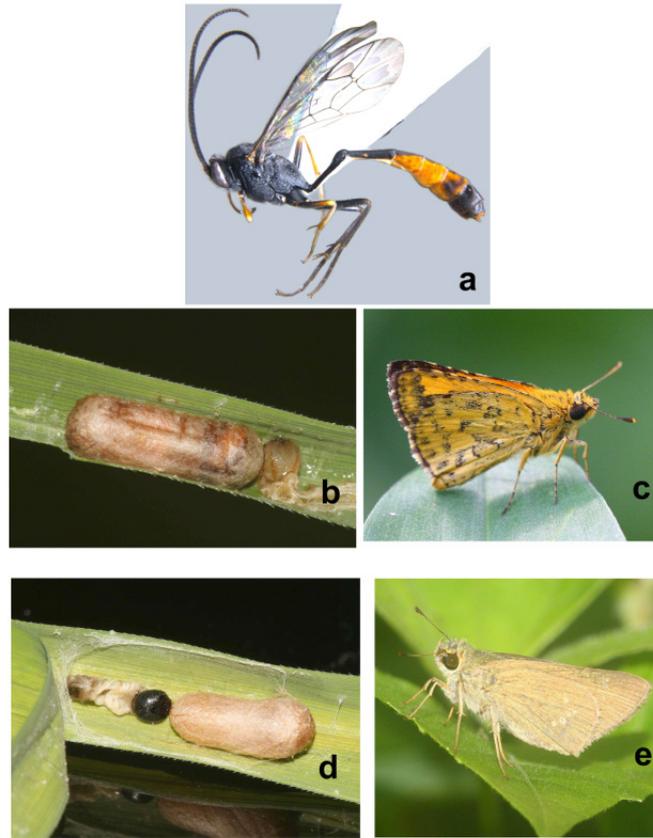


Fig. 1. *Casinaria ajanta* Maheshwary & Gupta (Hymenoptera: Ichneumonidae) (A) and its hosts (B–E). A, profile view, female; B, parasitized host caterpillar *Ampittia dioscorides* (Fabricius) along with the cocoon; C, Adult of *A. dioscorides*; D, parasitized host caterpillar *Parnara* sp. along with the cocoon; E, Adult of *Parnara* sp.

Family Chalcididae Latreille, 1817

***Brachymeria lasus* (Walker)**

Host: Pupa of *Hasora chromus* (Cramer) (Lepidoptera: Hesperiiidae) (Fig. 2C) on the host plant *Millettia pinata* (L.).

Locality: Kerala, Kavanattinkara, Kumarakom, Kottayam (9.58°N, 76.52°E), India.

Voucher material: One female, 14.x.2013, coll. Manoj P., NBAIR Code: 141013.

Black; tegulae pale yellow, basal part reddish-brown; coxae and trochanters black; femora shiny black with apical part clear yellow; fore and mid tibiae clear yellow with median black patch on ventral side; hind tibiae creamy yellow with base wholly black. First tergite smooth. Second tergite distinctly punctate. Lateral ridges of scrobe produced in

front of the antennal toruli; area below scrobe with a median portion. Scape not exceeding front ocellus. Detailed diagnosis in Joseph *et al.* (1973).

Distribution

Cosmopolitan.

Remarks

Primary hosts are majorly from Lepidoptera. Amongst Hesperiiidae hosts, it is recorded as a pupal parasitoid of *Caltoris* sp. (Gupta and Kalesh, 2012), *Cephrenes* sp., *Daimio Tethys* (Ménétriés), *Tethys* sp., *Erionota thrax* (Linnaeus), *Padraona chrysozona*?, *Parnara guttata* (Bremer & Grey), *Parnara pellucida* Matsumura and *Suastus gremius* (Fabricius) (Noyes, 2015). *Hasora chromus* is a new host record for *B. lasus*.

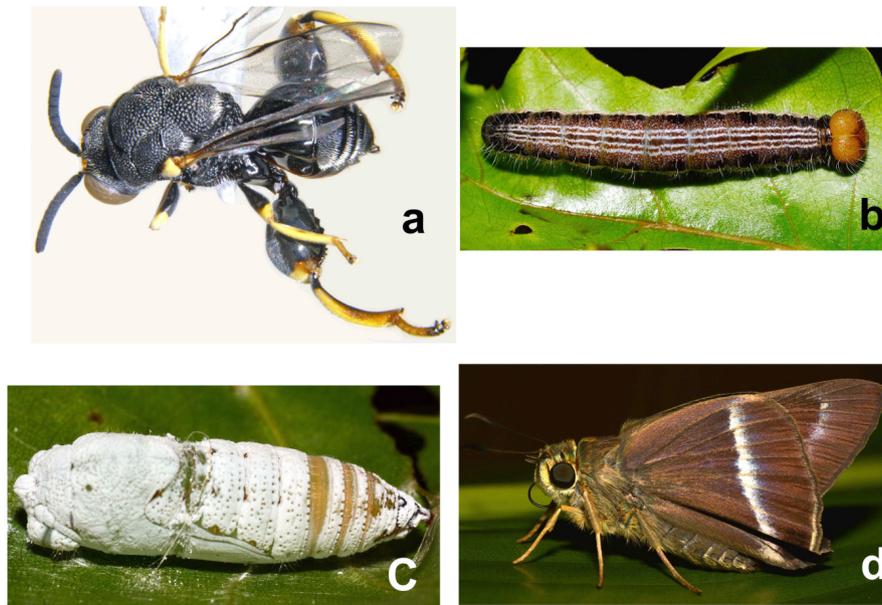


Fig. 2. *Brachymeria lasus* (Walker) (A) and its host (C–D). A, profile view, female; B, host caterpillar *Hasora chromus* (Cramer); C, pupa of *H. chromus*; D, adult of *H. chromus*.

Family Braconidae Nees, 1811

***Dolichogenidea hasorae* (Wilkinson) n. comb.**

Apanteles hasorae Wikinson: 1928, 133–134.

Host: Caterpillar of *Hasora taminatus* (Hübner) (Lepidoptera: Hesperidae).

Locality: Kerala, Kozhikode, Kakkayam (11.25°N, 75.83°E), India.

Voucher material: One female, 19.xii.2013, coll. Saji K., NBAIR Code: 191213.

Mesoscutum typically shining with coarse, distinctly separated punctures. Scutellum shiny and impunctate. Propodeum with a more or less well-defined areola (along with traces of costulae). Fore wing with areolet open (r–m absent). Hind wing with vannal lobe margin uniformly convex and hairy. First tergite longer than wide, parallel-sided, smooth and shiny. Second tergite wider than long, unsculptured, usually shorter than third tergite. Hypopygium moderately large. Ovipositor sheath long, hairy throughout. A detailed description is given in Wikinson (1928).

Distribution

India (new distributional record) and Java.

Remarks

This species was initially described under the genus *Apanteles* (Wilkinson, 1928: 133) from the host *Hasora mixta* (Mabille) on *Derris* sp. with Java as the type locality. Later it was also included in the Indo-Australian species of the *ultor*-group of *Apanteles* (Nixon, 1967). The following generic characters justifies its placement in the genus *Dolichogenidea*: mesoscutum typically shining with coarse, distinctly separated punctures (Fig. 3A); hind wing with vannal lobe margin uniformly convex and hairy (Fig. 3B); first tergite longer than wide, parallel-sided (Fig. 3A); ovipositor sheath long and hairy throughout.

This parasitoid was reared from the caterpillar of *Hasora taminatus* (Hübner) (Lepidoptera: Hesperidae), a new host record. As *H. taminatus* is known to occur in Java too, there is a possibility of this parasitic wasp extending its host range from *H. mixta* to *H. taminatus*. This is the first distri-

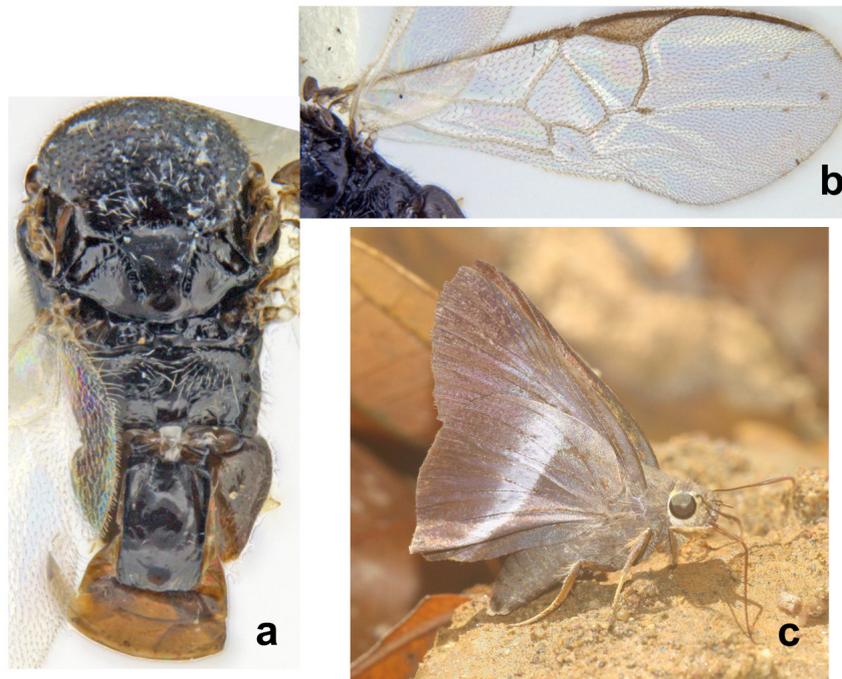


Fig. 3. *Dolichogenidea hasorae* (Wilkinson) n. comb. (A–B) and its host (C). A, mesosoma, dorsal view; B, fore wing; C, host adult butterfly *Hasora taminatus* (Hübner).

bution record of *D. hasorae* n. comb. from India and also a new record of its host.

***Apanteles* sp.**

Host: Caterpillar of *Telicota bambusae* (Moore) (Lepidoptera: Hesperidae).

Locality: Kerala, Kozhikode, Kakkur (11.23°N, 75.49°E), India.

Voucher material: Two males, 19.xii.2013, coll. Saji K., NBAIR Code: 191213TB.

Male: Dark brownish black hind tibia, pale testaceous on basal third. Face dull and punctate. Fore wing with pterostigma pale surrounded with brown border. Propodeum strongly areolate; basal half rugose, in contrast to shining smooth posterior fields. Hind coxa minutely punctate. First tergite narrowing apically.

Distribution

The genus is cosmopolitan.

Remarks

Species level identification of *Apanteles* group requires female as keys are mainly based on comparative

characters: hind tibia/hind femur/hind basitarsus to ovipositor sheath length. Since both the specimens reared were males the identity is retained as *Apanteles* sp.

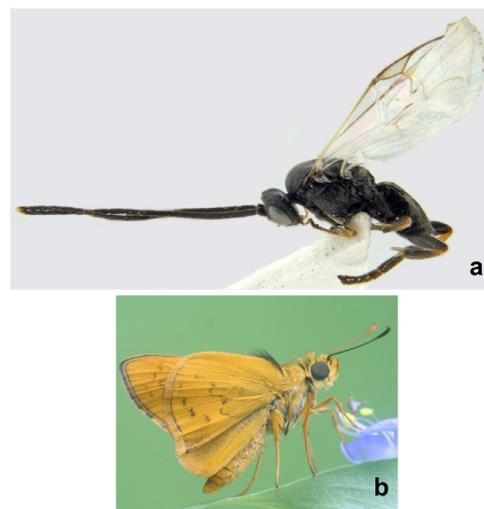


Fig. 4. *Apanteles* sp. (A) and its host (B). A, profile view, male; B, host adult butterfly *Telicota bambusae* (Moore).

***Glyptapanteles aristolochiae* (Wilkinson)**

Host: Caterpillar of *Troides minos* (Cramer) (Lepidoptera: Papilionidae) (Fig. 5C)

Locality: Kerala, Kozhikode, Kakkavayal (11.49°N, 75.97°E), India.

Voucher material: Six females, 07.vii.2013, coll. Saji K., NBAIR Code: 7713.

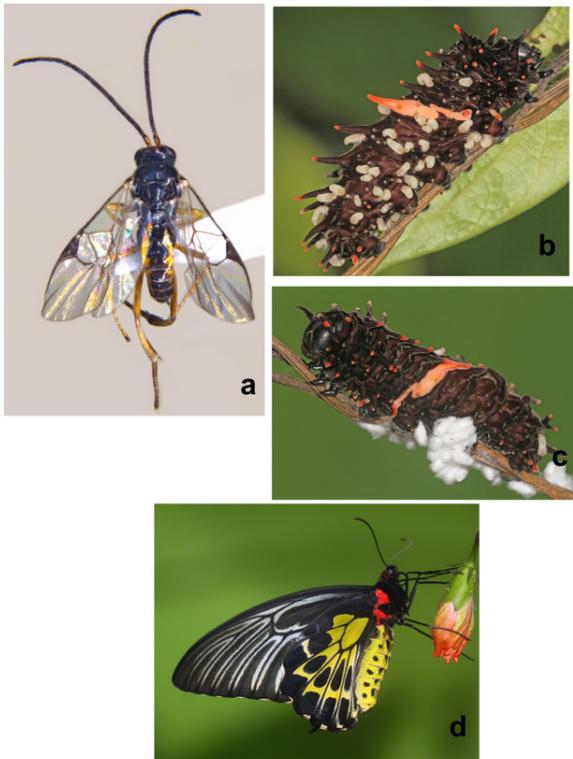


Fig. 5. *Glyptapanteles aristolochiae* (Wilkinson) (A) and its host (B–D). A, dorsal view, female; B, host caterpillar *Troides minos* (Cramer) with emerging parasitoids; C, host caterpillar *T. minos* with cocoons; D, host adult butterfly *T. minos*.

Black; scape, tegulae, mouth parts and lateral margins of first three basal tergites of metasoma yellow-red testaceous; pterostigma brown; legs yellow testaceous except hind tarsi and apices of hind tibiae; hind coxa punctuate and basally dark red in color. Ovipositor sheath equal to length of hind tibial spur. Head, mesoscutum and scutellum finely and evenly punctuate. The lateral sulci of the second tergite of metasoma slightly curved and not closely placed basally.

Distribution

India: Kerala and Karnataka; Sri Lanka.

Remarks

Troides minos is a new host record for *G. aristolochiae*. Earlier this wasp species was recorded as a gregarious parasitoid of the Crimson rose butterfly- *Pachliopta hector* (Linnaeus) (Lepidoptera: Papilionidae) (Gupta *et al.*, 2011) and *Pachliopta aristolochiae* (Fabricius) (Yu, 2012). The pattern of host association indicates that *G. aristolochiae* parasitizes members of the family Papilionidae.

Cotesia sp.

Host: Caterpillar of *Udara akasa* (Horsfield) (Lepidoptera: Lycaenidae) (Fig. 6B).

Locality: Kerala, Kozhikode, Kakkayam (11.25°N, 75.83°E), India.

Voucher material: Two females, 22.ii.2014, coll. Saji K., NBAIR Code: 22214.

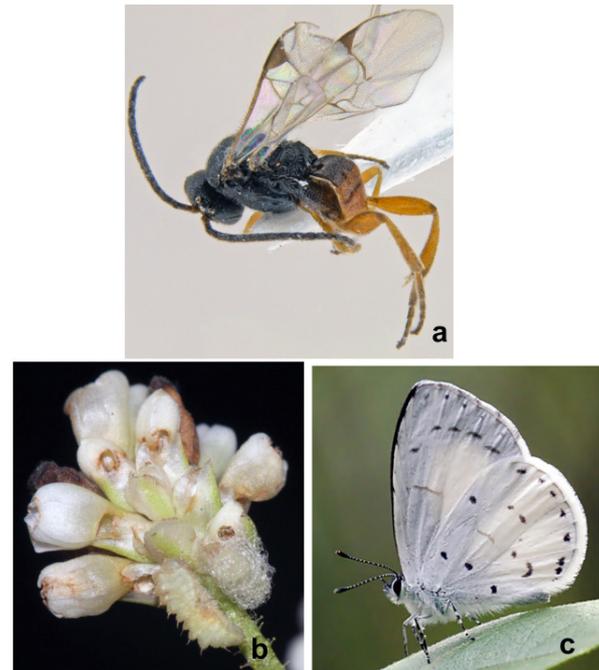


Fig. 6. *Cotesia* sp. (A) and its host (B & C). A, profile view, female; B, parasitized host caterpillar *Udara akasa* (Horsfield) along with solitary cocoon; C, host adult butterfly *U. akasa*.

Head, mesosoma and first tergite metasoma black (median tergites along with lateral margins yellowish). Fore and mid leg yellowish brown. Hind coxa dorsally black laterally dark brown. Hind femur (except extreme apex) yellowish brown, hind tibia yellowish brown, hind tarsi dark brown except basal half of basitarsus. Mesoscutum strongly punctate. Scutellum sparsely and shallowly punctate. Propodeum strongly rugose with weak median carina and strong transverse basal carina. Metasoma with first tergite rugose-punctate. Second tergite punctate and indefinitely sculptures, lateral sulci absent. Third tergite sparsely and shallowly punctate. Hind coxa coarsely and closely punctate.

Distribution

The genus is cosmopolitan.

Remarks

In the review of Indo-Australian species of *Apanteles* (Wilkinson 1928: 100) this species corresponds well with *Apanteles taprobanae* Cameron (now *Cotesia taprobanae*), also the description matches with the same. Possibility is there that this could be *C. taprobanae*, but as the cocoons described in Wilkinson (1928: 101) –“white and are heaped indiscriminately together” differ from the ones in this case –“cream coloured and solitary”, the species identity here is not confirmed due to disparity in cocoon laying pattern. The microgastrines are known to have fixed species specific cocoon laying pattern (except rare examples) hence species identity is kept in abeyance until further rearings yield sufficient data.

DISCUSSION

This study has indicated host range extension within the same genus for the parasitic wasp *D. hasorae* **n. comb.** and within the same family but targeting another genus for two species of parasitoids: *G. aristolochiae* and *C. ajanta*. This behavior could be attributed to the dominance of the butterfly species in their respective region supported with the co-occurrence of the respective wasp species. All the three species- *D. hasorae* **n. comb.**, *G. aristolochiae* and *C. ajanta* still maintain restricted host range whether within a genus or within a family unlike *B. lasus* which being cosmopolitan in habitat is known to parasitize various hosts across Lepidoptera and is not at all restricted to one particular family or region.

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