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A peculiar case of parasitisation with two new species of wasps parasitizing the rice leaf-roller *Pelopidas mathias* (Fabricius, 1798) (Lepidoptera: Hesperiidae) from southern India

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Abstract Paddy, *Oryza sativa* L. (Poales: Poaecea) is infested by a series of lepidopteran, coleopteran, hemipteran, and acarine pests in India. Of the long list, the species Rice Leaf-Roller *Pelopidas mathias* (Fabricius, 1798) (Lepidoptera: Hesperiidae) is one of most encountered defoliators on paddy. Here we record and describe with illustrations, a new parasitic complex comprising of two new species of parasitic wasps, *viz. Brachymeria eastwoodi* Binoy, **sp. nov.** and *Sympiesis eastwoodi* James & Santhosh, **sp. nov.** on the pupae of *P. mathias* from southern India. The parasitoid complexes on *P. mathias* are also augmented.

Keywords *Pelopidas mathias* · Parasitism · *Brachymeria* · *Sympiesis* · New species · India

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Introduction

Rice is the main staple food for more than 3 billion people on earth (Nguyen & Ferrero, 2006) and India ranks second in the production as well as consumption of the same (Kirar et al., 2018). Income from rice cultivation is the source of mammoth's share in any tropical country's net economy and the production of same is an equal task. Maximum net productivity, the goal sought is constrained by a number of factors of which insect pests are quite important causing more than 30% in losses. More than 100 species of insects are known to attack the rice, out of which 20 are of major economic significance estimating a yield loss to about 25% (Dhaliwal et al., 2015). Lepidopteron insect-pests are the main class of pests causing significant damage to crop yield in rice of which *Pelopidas mathias* (Fab.) is a predominant defoliator and one of the major pests, affecting all the rice ecosystems.

Rice Leaf-Roller also known as Rice sipper (*P. mathias* (Lepidoptera: Hesperiidae) is a major pest of paddy in almost all rice growing areas. *P. mathias* is widely distributed in Asia, the Middle East and Africa. Its extensive distribution is probably associated with its wide host range and ability to migrate during unfavourable seasons, either winter in temperate regions or a dry season in the tropics (Litsinger et al., 1994). Biology and bionomics of the leaf roller and of its parasitoids are thus making an important and imperative focal point in the case of sustainable agricultural practices in rice cultivation.

Brachymeria Westwood is the most diverse and abundant chalcid genus in the world. With 315 species described from the world, 121 from the Oriental region and 76 species from India (Noyes, 2019), *Brachymeria* is experimented in controlling a variety of pests across the world (Bouček, 1988). Most *Brachymeria* species are primary parasitoids attacking the immobile pupal form or the larval-pupal interphase with cases of hyperparasitism accounted through Hymenoptera, Diptera and Lepidoptera (Joseph et al., 1973; Narendran & van Achterberg, 2016).

The genus *Sympiesis* Förster is found across the Nearctic, Palaearctic, and Oriental regions, as well as Australia, New Zealand and Pacific islands. (Bouček, 1988). Worldwide, *Sympiesis* includes 137 described species; 21 from the Oriental region, 15 from India (Noyes, 2019). Narendran (2011) provided a key to the species of the Indian subcontinent, in which 13 species were included. The majority of *Sympiesis* species are solitary or gregarious primary parasitoids on lepidopterous larvae mining leaves of various plants with few others associated with species of Coleoptera, Diptera, Hemiptera and Hymenoptera. Some species have also been recorded as hyperparasitoids through Hymenoptera (Heyerdahl & Dutcher, 1985) and Diptera (Thompson, 1955; Herting, 1977).

Here we report a unique incidence of parasitism on rice leaf-roller *Pelopidas mathias* (Fab.) (Lepidoptera: Hesperiidae) by two new chalcidoid species *Brachymeria eastwoodi* Binoy, **sp. nov.**, and *Sympiesis eastwoodi* James & Santhosh, **sp. nov.** The new species are described and illustrated with diagnoses from its congeners. The parasitoid complex of the herbivore, *P. mathias* is also augmented here.

Materials and Methods

Pupae of the rice leaf-folder were collected by means of handpicking from rice field in Vellanikkara near Kerala Agricultural University (10°32′45.7″N & 76°16′31.7″E, 22m above mean sea level) in Thrissur district of Kerala, India. Fresh and infested immature of the leaf-folder were sorted out based on the activity profile and brought into lab conditions and placed in separate clear containers for emergence. Emerged moths were fed with honey, later killed and dry mounted.

Emerging parasitoids were aspirated out, killed and stored in 70% ethyl alcohol and later card mounted for identification. The *Sympiesis* specimens were treated using the standard HMDS treatment technique (Heraty & Hawks, 1998). The specimens were studied under Leica M205A stereo zoom microscope and images were captured using the attached Leica DFC 2900 digital camera. Images at varying focal planes were stacked and final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® CS5 (Version 6.1).

Terms and measurements: The terms used are from the Hymenoptera Anatomy Consortium (2022). The general abbreviations of the terms are as follows: **AOL=** Distance between anterior ocellus and posterior ocellus; **CC=** Coast cell; **fu$_x$=** funicular segments, x being the funicle number; **MLM=** Midlobe of mesoscutum; ***mv*=** Marginal vein; **OD=** Diameter of median ocellus; **LOL=** Diameter of lateral ocellus; **OOL=** Minimum distance between posterior ocelli and compound eye; ***pmv*=** Postmarginal vein; **POL=** Distance between two posterior ocelli; ***smv*=** Sub-marginal vein; ***stv*=** Stigmal vein; **Gt$_x$=** gastral terga, x being the tergum number; **WIOS=** Width of interocular space, measured at mid-length of the face in frontal view. Type specimens were deposited at the National Zoological Collections of the Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK).

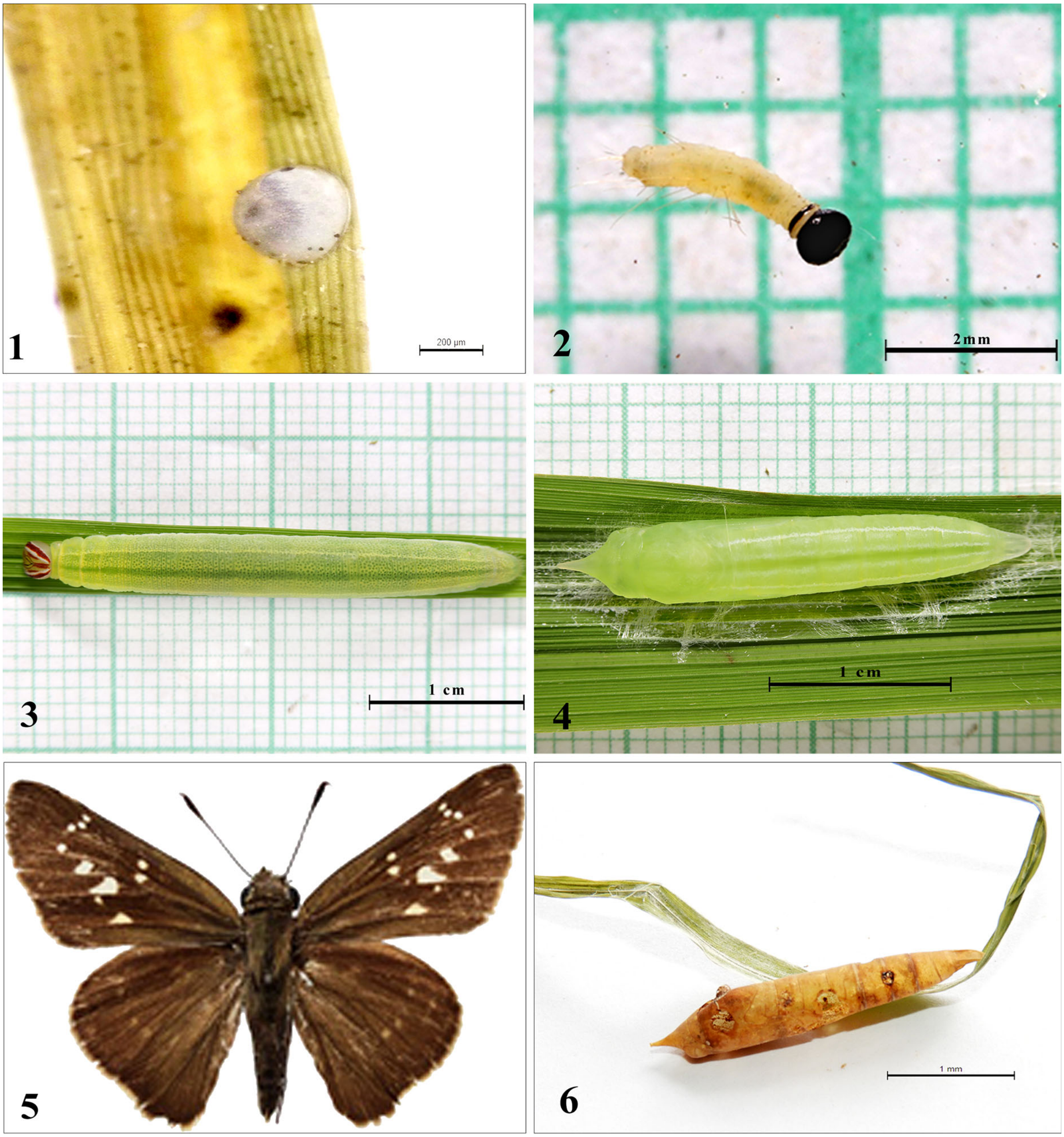
Results

Systematic treatment

Type-host:*Pelopidas mathias* (Fab.) (Lepidoptera: Hesperiidae); common names Rice Leaf-Roller, Rice sipper. (Figs 1–6).
Type-locality: India: Kerala, Thrissur district, Vellanikkara near Kerala Agricultural University (10°32’45.7“N & 76°16’31.7”E) all coll. C. Binoy.
Etymology: The specific name for both species in masculine gender is derived from patronym Eastwood dedicated by CB in admiration towards the legendary American actor, film director, producer, and composer Clint Eastwood.

Brachymeria Westwood, 1829

Brachymeria Westwood in Stephens, 1829: 36. Type species: *Chalcis minuta* Fabricius; designated by Westwood (1839).



Figures 1–6 Life stages of *Pelopidas mathias* (Fab.). 1, egg; 2, first instar larva; 3, final instar larva; 4, fresh unparasitized pupa; 5, female adult moth; 6, parasitized pupa with emergence hole.

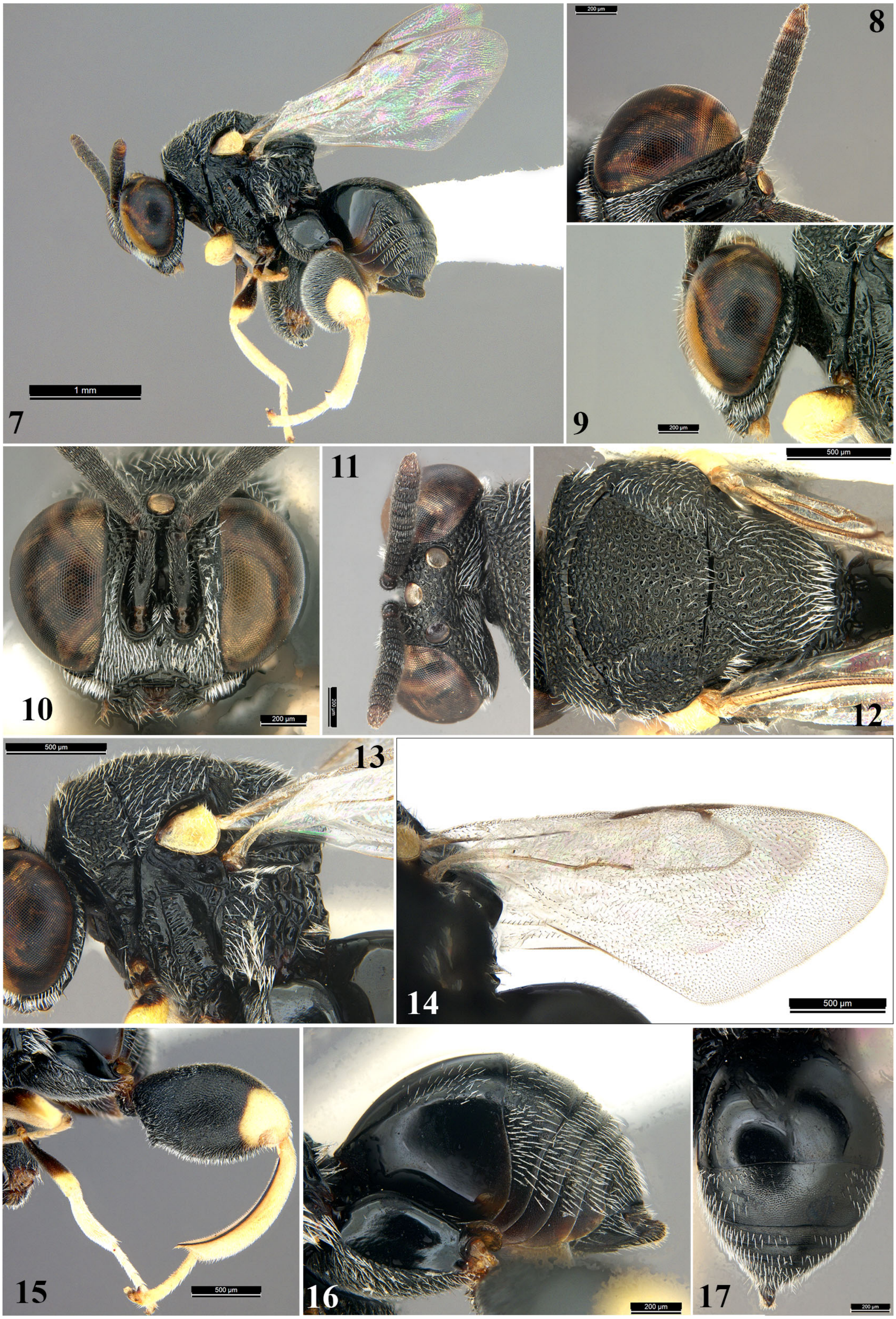
Narendran & van Achterberg (2016): 28–29 may be referred for the complete list of synonymy.

Brachymeria eastwoodi Binoy, sp. nov.

Type-material: Holotype ♀. Paratype ♀ all from same host species and locality; date of emergence: 16.i.2021.

Depositories: Holotype ♀ [ZSIK] ZSIK Regd. No. ZSI/WGRC/IR/INV.21698, Paratype ♀ [ZSIK] ZSIK Regd. No. ZSI/WGRC/IR/ INV.21699.

Diagnosis. The new species keys out to *Brachymeria olethria* (Waterston) in the key to Oriental species to *Brachymeria* (Narendran, 1989). Comparing with the original description and illustration of the species and


7
1 mm
8
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9
200 µm
10
200 µm
11
200 µm
12
500 µm
13
500 µm
14
500 µm
15
500 µm
16
200 µm
17
200 µm

◀**Figures 7–17** *Brachymeria eastwoodi* Binoy, **sp. nov.** Holotype ♀. 7, habitus, lateral view; 8, antenna; 9, head, lateral view; 10, head, frontal view; 11, head, dorsal view; 12, mesosoma, dorsal view; 13, mesosoma, lateral view; 14, wings; 15, hind leg; 16. metasoma, lateral view; 17, metasoma, dorsal view.

subsequent synonyms (as *Chalcis olethrius* Waterston (Waterston, 1914); as *Brachymeria raoi* Joseph, Narendran and Joy (Joseph et al., 1972)), the new species resembles *B. olethria* in having head with prominent postorbital carina reaching genal margin; preorbital carina present; apex of scrobe reaching median ocellus; hind femur without inner basal tooth; hind coxa without ventro-mesal tooth. However, *B. eastwoodi* **sp. nov.** differs from *B. olethria* in having hind tibia yellow with ventral margin black (*vs.* hind tibia black with apical yellow spot); hind femur black with apical third entirely yellow (*vs.* hind femur black with apical reddish yellow spot); preorbital carina obsolete at malar sulcus (*vs.* preorbital carina clearly indicated at malar sulcus); postorbital carina straight (*vs.* postorbital carina wavy). *Brachymeria eastwoodi* **sp. nov.** closely resembles *B. marmonti* (Girault) in having hind tibia entirely yellow with ventral margin back; head with pre- and postorbital carina indicated. However, the new species differs from *B. marmonti* in having the overall colour of antenna, legs (with yellow marking) and metasoma black (*vs.* antenna, legs (with yellow marking) and metasoma (venter) rufous); head with irregular rugulae (*vs.* head conspicuously pitted); POL at least 12.0 × OOL (*vs.* POL 6.6 × OOL); propodeum narrowed medially, 9.0 × as wide as median length, posterior margin deeply emarginated inwards (propodeum rectangular, 5.38 × as wide as median length); scutellum punctate with interspaces distinctly reticulate, apex moderately explanate (*vs.* scutellum punctate with interspaces slightly raised, carinate, apex rounded); hind femur with 13–14 ventral teeth, basal one larges, remainder short (*vs.* hind femur with 10–11 teeth, teeth equal in size); Gt_1 smooth, shiny (*vs.* Gt_1 shiny, shagreened) hypopygium weakly explanate (*vs.* hypopygium distinctly explanate).

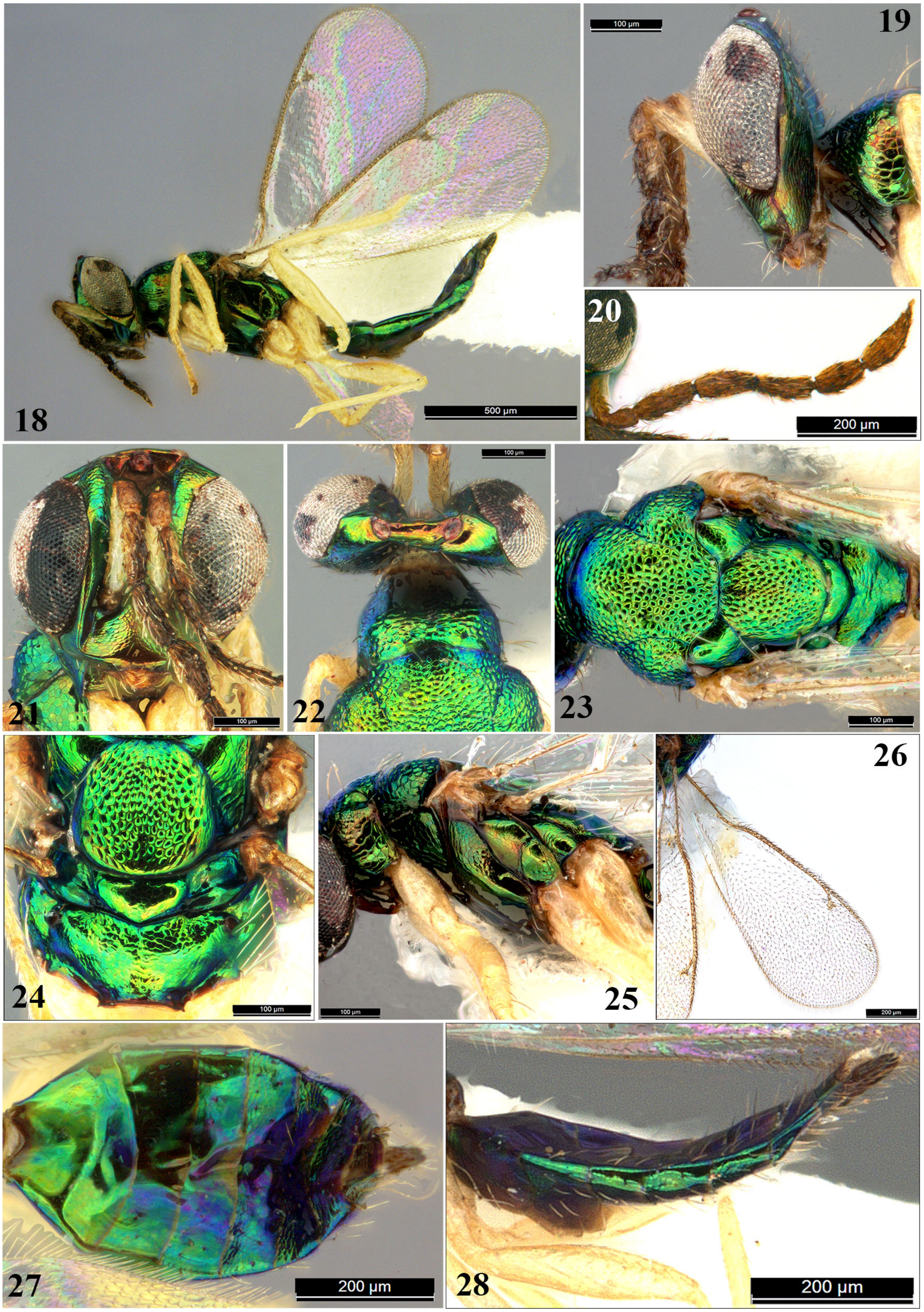
Description. Holotype, ♀. Body length 3. 12 mm; length of fore wing 2.37 mm.

Colour. Body black with the following parts as follows: scape, pedicel and flagella brown-black with clava ventro-apically brown; tegula immaculate yellow; wing hyaline with veins deep brown; fore and mid coxae black, fore femur mostly immaculate yellow with dorsobasal third brown, mid femur brown-black with distal yellow patch; all tibia and tarsi immaculate yellow; hind coxa shiny black; hind femur black with large apical immaculate yellow patch; hind tibia yellow with brown-black ventral margin; metasoma and ovipositor sheath black.

Head. head in frontal view 1.52× as wide as high with lower face having dense white pubescence; scrobe smooth 1.45 × as long as wide, almost reaching the anterior ocellus; interantennal projection 0.32 × as long as scrobe (Fig. 10); antenna with scape not reaching anterior ocellus, as longer than fu_2 to fu_5 combined; club more than twice as long as preceding funicular segment, apex spatulate (Fig. 8); clypeus 5.5× as long as high; in dorsal view 1.01 × as wide as long, shallowly punctate, POL 12.0 × OOL, median ocellus slightly larger than lateral ocellus (Fig. 11); eyes glabrous, occupying the entire length of face in lateral view, 1.59× as long as wide; temple almost lacking; preorbital carina represented, obsolete at malar sulcus; postorbital carinae distinct, reaching genotemporal margin; gena limited to posterior margin alone (Fig. 9); relative measurements of antennal segments in the ratio 37:7:8:8:8:8:9:7:7:18.

Mesosoma. Dorsally with close umbilicate pits with moderate white pubescence; pronotum raising onto high mesoscutum and scutellum and posteriorly sharply declining onto propodeum; mesoscutum coarsely punctate, medially with sparse white pubescence, interstice narrow, less than half the diameter of punctae, coarsely reticulate; scutellum moderately high, as wide as long, with close umbilicate pits and narrow reticulate interspace; apical margin of scutellum explanate, with dense white setae (Fig. 12); mesopleura with large umbilicate punctures, metapleura rugose punctate with moderately dense pubescence (Fig. 13); wings hyaline, with sparse small setae on lamina; *mv* 2.5 × as long as *pmv* and 5.54 × as long as *stv* (Fig. 14); hind coxa smooth dorsally, with setigerous punctures ventrally; hind femur 1.73 × as long as wide, surface colliculate, inner surface rugose 13-14 irregular black teeth on ventral side, basal tooth largest (Fig. 15), no inner basal tooth; propodeum declining steeply onto metasoma (Fig. 13).

Metasoma. Metasoma 0.97 × as long as mesosoma in profile, subglobose, pointed apically with pubescence ventro-laterally along Gt_2 to Gt_6; Gt_1 as long as half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200 μm

◀**Figures 18–28** *Sympiesis eastwoodi* James & Santhosh, **sp. nov.** Holotype ♀. 18, habitus, lateral view; 19, head, lateral view; 20, antenna; 21, head, frontal view; 22, head and pronotum, dorsal view; 23, mesosoma, dorsal view; 24, scutellum and propodeum, dorsal view; 25, mesosoma, lateral view; 26, fore wing; 27, metasoma, dorsal view; 28, metasoma, lateral view.

the total length of gaster including epipygium, smooth and shiny; Gt_2 microsculptured, with moderately dense pubescence; Gt_6 rugose punctate with five rows of setigerous pits and white setae; hypopygium weakly explanate; ovipositor sheath distinctly visible dorsally (Figs 16 & 17).
Male. Unknown.

Sympiesis Förster, 1856

Sympiesis Förster, 1856: 74. Type species: *Eulophus sericeicornis* Nees, by original designation.

Narendran (2011): 361–362 may be referred for the complete list of synonymy.

Sympiesis eastwoodi James & Santhosh, sp. nov.

Type-material: Holotype ♀, Paratype ♀, all from same host species and locality; date of emergence: 18.i.2021.
Depositories: Holotype ♀ [ZSIK] ZSIK Regd. No. ZSI/WGRC/IR/INV.21700, Paratype ♀ [ZSIK] ZSIK Regd. No. ZSI/WGRC/IR/ INV.21701 (dissected and pasted on card).
Diagnosis. Body bright metallic green and legs yellow, with strong engraved reticulation on mesoscutum and scutellum, notauli complete, MLM with 4 pairs of setae, propodeum without median carina and plica, propodeal spiracle separated from metanotum by a distance subequal to its diameter, POL 1.6 × OOL, clypeus truncate, slightly emarginated apically, CC 10.5 × as long as wide, *pmv* 2.2 × *stv*, *mv* 3.0 × *pmv*. *Sympiesis eastwoodi* **sp. nov.** keys out to *S. hyplosis* Narendran in the key to the species of *Sympiesis* of Indian subcontinent (Narendran, 2011) in having notauli complete; median carina and plicae absent on propodeum; malar space 0.25 × height of eye in profile; eye length in profile 0.63 × its height. However, it differs from *S. hyplosis* in having: metasoma 1.5× as long as wide (*vs*. 2.2 × as long as wide); CC 9.85 × as long as wide (*vs*. CC 7.0 × as long as wide); MLM with four pairs of setae (*vs*. MLM with six pairs of setae); metasoma fully metallic green (*vs*. Gt_1 only metallic green, Gt_2 pale yellow and remaining segments black); POL 1.5 × OOL (*vs*. POL 2.0 × OOL). *Sympiesis eastwoodi* **sp. nov** resembles *S. thyrsisae* Gupta, Gawas and Bhambure in having notauli complete, similar sculptures on mesoscutum and scutellum and MLM with four pairs of setae but it differs from the same in having propodeum without median carina (*vs*. propodeum with median carina); CC 9.9 × as long as wide (*vs*. CC 8.5 × as long as wide); legs including coxae pale yellow (vs. legs pale yellow except mid coxa and hind coxa brownish-black); fu_2 1.1× fu_1 (*vs*. fu_2 as long as fu_1); propodeal spiracle separated from metanotum by a distance subequal to its diameter (vs. propodeal spiracle separated from metanotum by a distance shorter than diameter of spiracle). *Sympiesis eastwoodi* **sp. nov** also resembles *S. abalisis* Narendran in having complete notauli, propodeum without median carina and metasoma 0.8× combined length of head and mesosoma but it differs from the same in having MLM with four pairs of setae (*vs*. MLM with numerous scattered short setae); metasoma entirely bright metallic green (*vs*. metasoma black with only Gt_1 metallic green); malar space 0.3 × height of eye in profile (vs. malar space 0.4× height of eye in profile); POL 1.5 × OOL (*vs*. POL 2.0 × OOL); propodeal spiracle separated from metanotum by a distance subequal to its diameter (vs. propodeal spiracle separated from metanotum by a distance shorter than diameter of spiracle); eye length in profile 0.6× of its height (*vs*. eye length in profile 0.7× of its height).
Description. Holotype ♀ (Figs. 18–28). Body length 1.3–1.5 mm; length of fore wing 1.2 mm.
Colour. Body bright metallic green with orange-red lusture in the area between and around ocelli, clypeus and lateral sides of mesosoma and blue tinge on sides of occiput, pronotum, anterior margin of mesoscutum, dorsal part of metasoma and every edge, yellow tinge on mesosoma and Gt_1 dorsally; pronotum darker in anterior half, bright metallic green posteriorly; eyes reflective silvery grey, ocelli red-brown, antenna brown with scape pale yellow, clypeal margin red-brown, tegula yellow; legs including coxae pale yellow, claws brown; wings hyaline with veins and setae pale brown.

Table 1 Chalcidoidean parasitoid complex associated with *Pelopidas mathias* (Fab.)

Family	Genus	Species	Remarks	Reference
Chalcididae	*Brachymeria*	*albotibialis* Ashmead	Primary	Narendran (1986)
	" "	*eastwoodi* Binoy, **sp. nov.**	" "	Present report
	" "	*excarinata* Gahan	" "	Narendran (1986)
	" "	*jayaraji* Joseph, Narendran & Joy	" "	Joseph et al. (1972) and Narendran (1986)
Eulophidae	*Elasmus*	*claripennis* Cameron	Primary	Verma & Hayat (1986)
	Euplectrus	*nyctemerae* Crawford	" "	Husain & Khan (1986)
	Pediobius	*foveolatus* Crawford	" "	Gupta & Kalesh (2012)
	" "	*mitsukurii* Ashmead	" "	Matsumura (1992)
	Stenomesius	*elegantulus* Risbec	" "	Bouček (1977)
	Sympiesis	*eastwoodi* James & Santhosh, **sp. nov.**	Hyperparasitic	Present report
Eurytomidae	*Eurytoma*	*manilensis* Ashmead	Primary	Gupta & Kalesh (2012)
	Eurytoma	Unidentified species	" "	Kandalkar et al. (1998a, b)
Pteromalidae	*Dibrachys*	Unidentified species	" "	Disthaporn & Jeerapong (2001)
	Trichomalopsis	*apanteloctena* Crawford	Primary and Hyperparasitic	Kamijo & Grissell (1982), Farooqi & Subba Rao (1986), and Sureshan & Narendran (2001)
Trichogrammatidae	*Trichogramma*	*chilonis* Ishii	Primary	Hayat & Viggani (1984); Hayat & Subba Rao (1986)
	" "	*chilotraeae* Nagaraja & Nagarkatti	" "	Nagaraja (2008)
	" "	*hesperidis* Nagaraja	" "	Nagaraja (2008)
	" "	*japonicum* Ashmead	" "	Nagaraja (2008)
	Trichogrammatoidea	*bactrae* Nagaraja	" "	Nagaraja (1978); Hayat & Viggani (1984); Hayat & Subba Rao (1986)

Head. Head in dorsal view transverse, collapsing, with fine reticulations, 3.5 × as broad as long; POL 1.6 × OOL; OOL as long as LOL, WIOS 3.1 × POL (Fig. 22); in frontal view, collapsing, 1.3 × as broad as long, with moderately strong reticulations; eyes with sparse, short setae; antennae inserted a little above the ventral margin of eyes; scape not reaching the level of vertex, 0.7 × as long as eye length; clypeus truncate, margin slightly emarginate (Fig. 21); malar sulcus distinct; malar space 0.3 × of eye height; eye length in profile 0.6× of its height; occiput setose (Fig.19); scape pubescent, 4.5 × as long as wide; pedicel setose, 0.4 × as long as scape, flagellum with numerous short setae; antennal formula: 11143; relative length: width ratio of antennal segments: scape = 181:40, pedicel = 75:36, fu_1 = 95:44, fu_2= 102:47, fu_3 = 109:47, fu_4 = 89:50, clava = 141: 47 (Fig. 20).

Mesosoma. 1.13 × narrower than head; pronotum subconical, finely reticulated anteriorly and strongly reticulated posteriorly (Fig. 22); mesoscutum metallic with yellow lusture, strongly reticulate (pit like close reticulation), notauli complete; MLM with 4 pairs of setae; scutellum as long as wide, with two pairs of setae, reticulations of scutellum similar to that of mesoscutum; axilla shiny, moderately reticulated similar to that on face, with a small brown flap at anterolateral margin (Fig. 23); dorsellum finely reticulate, 2.0 × as broad as long; propodeum moderately reticulated, 3.1 × broader than long, without median carina and plicae; spiracle round, separated from mesonotum by a distance subequal to its diameter (Fig. 24); lateral panel of pronotum, prepectus, mesepisternum and metapleuron strongly reticulate; upper and lower mesepimeron with fine reticulation, trans epimeral sulcus deep and curved (Fig. 25). Forewing 2.7 × as long as its width; speculum closed, cubital line of setae wavy up to middle, reaches wing margin; CC setose, 10.5 × as long as wide, basal cell bare, basal vein with four setae, marginal fringes moderately long, relative lengths of *smv*: *mv*: *stv*: *pmv*= 85:163:25:55 (Fig. 26). Metacoxa delicately reticulated basodorsally, 2.6× as long as wide, hind femora setose, medially widened and tapering at both ends, 4.0 × as long maximum width; hind tibia densely setose, slightly longer than hind femur; metatibial spur short, not reaching the middle of basitarsus (Fig. 18)

Metasoma. Sessile, collapsing, with fine reticulations, as wide as mesosoma, 0.8 × combined length of head and mesosoma; 1.5 × as long as wide; posterior margin of Gt_1 convex, Gt_2–Gt_8 sparsely setose; hypopygium reaching 0.4 × of metasoma; cercal setae unequal, one long and sinuate (Fig. 27).

Male. Unknown.

Discussion

Butterflies are flagship species for biodiversity conservation and thus the knowledge of their associated natural enemies is important. Parasitoid complexes of butterflies were studied in detail describing *Sympiesis thyrsisae* Gupta on *Gangara thyrsis* (Fabricius) (Lepidoptera: Hesperiidae) on the host plant *Cocos nucifera* L. (Arecaceae), *Coladenia indrani* (Moore) (Hesperiidae) as a host for the genus *Sympiesis* and *Idea malabarica* Moore (Lepidoptera: Nymphalidae) for a *Brachymeria* sp. from India (Gupta et al., 2015). Binoy et al. (2021, 2022) discovered two species of chalcidid wasps namely *Epitranus uterellophagus* Binoy & Santhosh and *Neohaltichella uterellophaga* Binoy parasitizing the household case-bearer moth, *Phereoeca uterella* (Walsingham) from southern India. The information thus augmented on the host parasitoid data household case-bearer moth, *Phereoeca uterella* (Walsingham) from southern India. The information thus augmented on the host parasitoid index provides the most important factor in selecting natural enemies for application in biological control programs. Among other deciding factors, understanding the foraging behaviour (preference of host species and stage, switching, and functional response) of the incoming parasitoids is of at most importance in selecting a potent and efficient natural enemy for a pest species (Jervis & Kidd, 1996; Fathipour & Maleknia, 2016). It is also important to consider that the data acquired in laboratory conditions (rearing experiments and induced parasitisation by a generalist parasitoid) will be off by a margin when the parasitoid is released in the field, probably due to larger host choice than in the laboratory. This in turn affects the efficacy of the parasitoid in orienting to the targeted host (Goulart et al., 2011). Thus, a link should be established between both field observations and rearing experiments in laboratories and maintaining an updated index of interaction between a host and its natural enemy is of significant importance.

A curious case of hyperparasitism

In the present observation, multiple specimens of both *Brachymeria* and *Sympiesis* emerged from the host (*Brachymeria* specimens followed by *Sympiesis*), leading to the assumption that the feeding of both the parasitic wasps were mutually exclusive with respect to the host pupa, either co-existing without competition (multiparasitism) or the chalcidid serves as a host for the eulophid wasp (hyperparasitism). Cases of multiparasitism are often indeterminate and can favour the species that attacked first but it can also be fixed with a strong competitor being the victor whatever the sequence of attack. However, multiparasitism and host discrimination are difficult to explain as an adaptive phenomena (Bakker et al., 1985, Turlings et al. 1985) and can occur randomly. Hyperparasitism often occurs among species, and multitrophic relationships with the primary parasitoid either obligatorily getting fed on by the secondary parasitoid or facultative within the same host on which both the parasitoid species associate with (Godfray, 1994). Taking into account that the majority of *Sympiesis* recorded are known to be solitary or gregarious ectoparasites of leaf mining lepidopterous larvae (Bouček & Askew, 1968), a few as hyperparasitoids of Diptera and Hymenoptera, and as they were collected from parasitized *Pelopidas* pupa with no ectoparasitic activity, it is safe to infer that the

Sympiesis species are hyperparasitic on the chalcidid species. Since individuals of both the species emerged from the leaf-roller pupa, the *Sympiesis* species can be considered as facultative hyperparasitoid of the primary parasitoid, *Brachymeria* in habit.

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Author contributions The authors confirm contribution to the paper as follows: study conception and design: CB; data collection: CB; analysis andinterpretation of results: CB, RVJ & SS; draft manuscript preparation: CB, RVJ; plate preparation: CB. All authors reviewed the results and approved the final version of the manuscript.

Declarations

Competing interests The authors declare no competing interests.

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