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Two new species and a new generic record of Pteromalidae (Hymenoptera: Chalcidoidea) from Western Ghats, India

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ABSTRACT. A new species, *Stenomalina kasaragodensis* **sp. nov.**, from the Western Ghats has been discovered resulting in the first report of the genus *Stenomalina* Ghesquière, (1946) (Hymenoptera: Pteromalidae: Pteromalinae) from India. A thorough overview and key to the Oriental species of *Stenomalina* are given, together with descriptions, illustrations, and comparisons with congeneric materials for the new species. A new species of the genus *Stictomischus* Thomson, 1876 (Hymenoptera: Pteromalidae: Miscogastrinae) i.e., *Stictomischus sahyadriensis* **sp. nov.**, was also found in the Western Ghats. The new species is described, illustrated and compared with congeneric and a comprehensive review and key to the Indian species of Stictomischus are also provided.

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INTRODUCTION

The Pteromalidae family, a cosmopolitan group of chalcids, is a diverse group found in all biogeographical regions of the world. They are primarily parasitoids on Diptera, Coleoptera, Lepidoptera, Siphonoptera, Hymenoptera, and some arachnids (Bouček, 1988). The genus *Stenomalina* Ghesquière, 1946, having as type species *Stenomalina crassicornis* (Thomson) is classified in the subfamily Pteromalinae, tribe Pteromalini (Burks et al., 2022) and currently comprises 24 species in the world, including one species in the Oriental region (Lotfalizadeh et al., 2020; UCD Community, 2023). The members of the genus are known to be entomophagous parasitoids of stem-boring hosts (Graham & Claridge, 1965). The genus *Stictomischus* Thomson, 1876, is represented by 31 species worldwide and 11 species in the Oriental region (UCD Community, 2023). According to Bouček (1988), they are parasitoids of the Agromyzidae, Anthomyiidae, and Scatophagidae families attacking thicker parts of certain herbaceous plants.

The present study focuses on the first record of the genus *Stenomalina* with a new species, *S. kasaragodensis* **sp. nov.**, and the discovery of a new species of the genus *Stictomischus*, *S. sahyadriensis* **sp. nov.**, from the lesser explored Western Ghats in India. The study also includes a key to the Oriental species of *Stenomalina* and the Indian species of *Stictomischus*.

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MATERIAL AND METHODS

The specimens were collected using a sweep net from Gavi (9°25'45"N, 77°08'52"E, 1036 m a.s.l.) in the Pathanamthitta district of Kerala, and Ranipuram (11°25'35"N, 75°21'24"E, 720 m a.s.l.) in Kasaragod district of Kerala both belonging to the megadiverse biodiversity hotspot of India, the Western Ghats. The specimens preserved in 70% ethanol were later dried, card mounted and studied under a Leica M 205A stereomicroscope and imaged using an attached Leica DFC 500 camera. Measurements were obtained using Leica® LAS (Leica Application Suite V3.80). Specimens from the National Collections of Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK) were also examined. Images at varying focal planes were stacked into a single image using Leica Automontage Software V4.2 and final illustrations were post-processed for contrast and brightness using Adobe® Photoshop CS5 (Version 12.0×64). The type specimens of the new species are deposited in the 'National Zoological Collections' of the Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK).

Museum abbreviations. ZSIK: National Zoological Collections, Western Ghat Regional Centre, Zoological Survey of India, Kozhikode, India. The terminology follows mainly that of Bouček (1988) unless noted otherwise. The nomenclature for cuticular sculpturing follows Harris (1979). The general abbreviations of the terms are as follows: **fu_x**: funiculars, x being the number of funiculars; **Gt_x**: Gastral terga, x being the tergite number; **MV**: marginal vein; **OOL**: ocello-ocular line, *i.e.* the shortest distance between inner orbit and outer margin of posterior ocellus; **PMV**: postmarginal vein; **POL**: posterior ocellar line, *i.e.* shortest distance between inner margins of posterior ocelli; **SMV**: sub-marginal vein; **STV**: stigmal vein; **sp. nov.**: *species nova*, new species.

RESULTS

Taxonomic hierarchy

Class Insecta Linnaeus, 1785

Order Hymenoptera Linnaeus, 1758

Superfamily Chalcidoidea Linnaeus, 1758

Family Pteromalidae Dalman, 1820

Genus *Stenomalina* Ghesquière, 1946

Etroxys (*Stenomalus*) Thomson, 1878. *Hym. Scand.*, 5:87, 88. **Type species:** *Stenomalus crassicornis* Thomson: designated by Ashmead, 1904:316; junior primary homonym of *Stenomalus* Gemminger & Harold, 1872:370; *Stenomalina* Ghesquière, 1946, *Rev. Zool. Bot. Afr.* 39:370 (replacement name for *Stenomalus* Gemminger & Harold).

Diagnosis. Anterior margin of clypeus bearing a median tooth or tubercle and having a slight angular projection on each side of the tooth; antennal clava in females with micropilosity present to a greater or less degree on the ventral surface; mesoscutellum weakly convex; propodeum relatively long, its median length from half to two-thirds that of mesoscutellum, its median area produced distinctly caudad of hind edges of supracoxal flanges (Bouček & Heydon, 1997).

Distribution. Nearctic, Oriental and Palaearctic regions (UCD Community, 2023).

Host. Known species of *Stenomalina* are entomophagous parasitoids of stem-boring hosts (Graham & Claridge, 1965).

Key to the Oriental species of *Stenomalina* Ghesquière (Based on females)

1 Propodeum with a complete longitudinal carina; head and mesosoma metallic green; POL 1.9× as long as OOL; malar space about half eye height; MV 1.6× as long as STV; PMV 1.1× as long as MV; femora basally black; gaster twice as long as broad. ..... ***Stenomalina micans*** (Olivier)

– Propodeum with an incomplete longitudinal carina (Fig. 1F); head and mesosoma black; POL 1.4× as long as OOL (Fig. 1D); malar space less than half eye height (Fig. 1B); MV 1.8× as long as STV; PMV 1.5× as long as MV (Fig. 1H); femora basally yellowish brown; gaster thrice as long as broad (Fig. 1G). .....***Stenomalina kasaragodensis*** Surya & Sureshan **sp. nov.**

***Stenomalina kasaragodensis* Surya & Sureshan sp. nov.** (Figs 1–2)
https://zoobank.org/urn:lsid:zoobank.org:act:B1F3DBEC-B0E5-4EDC-A8AA-0A1BBD6DE0C5

Type material. **Holotype** ♀ (Figs 1A–H), mounted on triangular card, deposited at ZSIK. India: Kerala, Kasaragod district, Ranipuram (11°25'35"N, 75°21'24"E, 1048 m a.s.l.), 05.i.2012, Coll. K. Rajmohana, ZSIK Regd. No. ZSI/WGRC/IR/INV.22932. **Paratype** 1♂, mounted on triangular card (Figs 2A–D), ZSIK Regd. No. ZSI/WGRC/IR/INV.22933.

Etymology. The species is named after Kasaragod, the district in Kerala from where the types were collected.

Diagnosis. This new species closely resembles *Stenomalina fervida* Graham, 1965 in general morphology and in having gaster ovate; fu_4 transverse; combined length of pedicel and flagellum equal to the width of the head; micropilosity present nearly halfway towards the base of clava (Fig. 1B) and however, the new species differs from *S. fervida* in having: 1) Head and thorax black (Figs 1B, 1C, 1D) (in *S. fervida* head and thorax bluish black); 2) fore wing hyaline (Fig. 1H) (in *S. fervida,* fore wing slightly yellowish near speculum); 3) fu_3 quadrate (Fig. 1B) (in *S. fervida* fu_3 slightly to distinctly elongate); 4) antennal scape and femora testaceous (Fig. 1A) (in *S. fervida,* antennal scape and femora 1 Breddish); 5) mesoscutellum 1.4× as broad as long (Fig. 1E) (in *S. fervida,* mesoscutellum about as broad as long); 6) median carina incomplete and slightly irregular (Fig. 1F) (in *S. fervida,* median carina complete, strong, straight or only very slightly irregular, sometimes crossed by one or two short transverse ridges). The new species also resembles *S. oxygyne* (Walker, 1835) in anterior margin of clypeus with tooth; metasoma longer than head plus mesosoma and tuft of micropilosity extending over at most about one third the length of the clava but differs in: 1) body colour black, funicles black (Fig. 1A) (in *S. oxygyne* body colour metallic bluish-green, funicles brown); 2) gaster ovate, not longer than head and thorax combined (Fig. 1G) (in *S. oxygyne* conical, acuminate, much longer than head and thorax combined); 3) POL1.4× OOL (Fig. 1D) (in *S. oxygyne* POL1.15× OOL) and 4) SMV 2.1×MV, MV 0.66× PMV, PMV 2.7× STV (Fig. 1H)(in *S. oxygyne* SMV 0.19×MV, MV 0.66× PMV, PMV 1.5× STV).

Description. — **Holotype** ♀. Body length 5.03 mm, length of fore wing 3.08 mm

Colour (Figs 1A)**.** Body black, except for gaster brown with greenish lustre anteriorly on Gt_1; antenna brown, except scape testaceous; tegula brown; legs testaceous with tips of tarsi brown, coxae concolorous with thorax, femora brown posteriorly; wings hyaline, venation brown.

Head. In frontal view head (Fig. 1C) width 1.5× length, distinctly reticulate; clypeus strigose, anterior margin bearing a median tooth, mandibles shiny, left mandible tridentate and right mandible tetradentate; POL 1.4× OOL (Fig. 1D); face distinctly reticulate; malar groove distinct; gena reticulate; malar space 0.37× as long as eye in lateral view (Fig. 1B); eyes bare, eye length 1.3× width in profile view; vertex reticulate; occipital carina absent; antennae inserted almost in the middle of the face, with two anelli, six funiculars, clava with three clavomeres, scape reaching median ocellus, 1.35× as long as first two funiculars combined; pedicel 1.49× as long as broad, 1.04× fu_1, fu_2 0.86× longer than fu_1; clava almost as long as last two preceding segments combined, funiculars with three or four rows of long white irregularly arranged sensilla, ventral surface of antennal clava with a patch of micropilosity extending about halfway along the clava (Figs 1B–C).

Mesosoma (Figs 1E–F)**.** Mesosoma 0.6× as broad as long dorsally, distinctly reticulate; mesoscutum 1.49× as broad as long; notauli incomplete; mesoscutellum weakly convex, 1.4× as broad as long; frenum and frenal groove indistinct; dosellum narrow and shiny; propodeum (Fig. 1F) moderately long, 1.79× as broad as long medially, distinctly reticulate, median carina short and incomplete; spiracle oval, close to metanotum, separated from hind margin by a distance lesser than its diameter; callus with white pubescence; nucha short; mesepimeron, mesepisternum and metapleuron reticulate entirely; legs slender, hind tibia with one spur; hind coxa moderately reticulate; fore wing (Fig. 1H) 2.5× as long as broad, speculum moderate, basal cell bare, marginal fringe short, stigma small; uncus distinct, discal pubescence dense; relative lengths of SMV, MV, PMV and STV in the ratio 71:33:50:18.

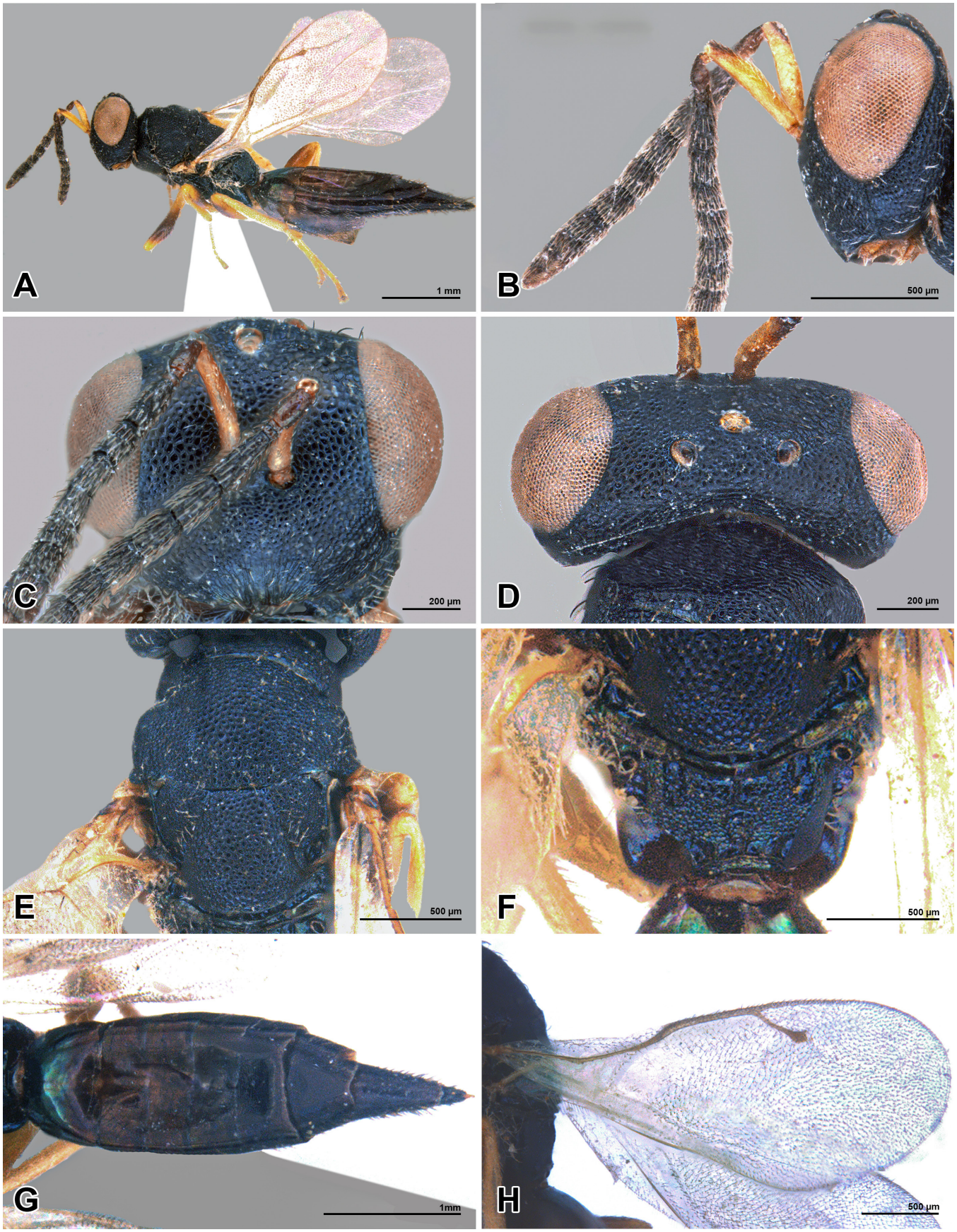

Figure 1. *Stenomalina kasaragodensis* Surya & Sureshan **sp. nov.**, Holotype, **f**emale; **A.** Habitus, lateral view; **B.** Head and antennae, lateral view; **C.** Head, frontal view; **D.** Head, dorsal view; **E.** Mesosoma, dorsal view; **F.** Propodeum, dorsal view; **G.** Metasoma, dorsal view; **H.** Fore wing.

Metasoma (Fig. 1G). Gaster sessile, ovate, finely reticulate, 3.4× as long as broad, 0.8× as long as combined lengths of head and mesosoma; Gt_1 largest, Gt_2, Gt_3 and Gt_4 almost equal, Gt_5 shorter than Gt_4; remaining tergites retracted; ovipositor and ovipositor sheath slightly exerted.

Male (Figs 2A–D). Similar to female in general morphology, body length 4.87 mm but differs in the following: gaster oval without greenish lustre anteriorly on Gt_1; antenna slender and hairy, ventral surface devoid of micropilosity; speculum narrow; metasoma 1.2× as long as combined lengths of head and mesosoma.

Distribution. India: Kerala.

Host. Unknown.

Genus *Stictomischus* Thomson, 1876

Stictomischus Thomson, 1876:220, 234. **Type species**: *Stictomischus scaposus* Thomson: designated by Ashmead, 1904. For the complete list of synonyms see UCD Community (2023).

Diagnosis. Fore wing with stigma conspicuously enlarged; PMV longer than MV; notauli deep; mesoscutum with numerous dark setae; prepectus with vertical carina; frenal groove distinct; gaster on conspicuous petiole from hardly shorter than to about twice as long as broad, dorsally with distinct reticulation (Bouček, 1988).

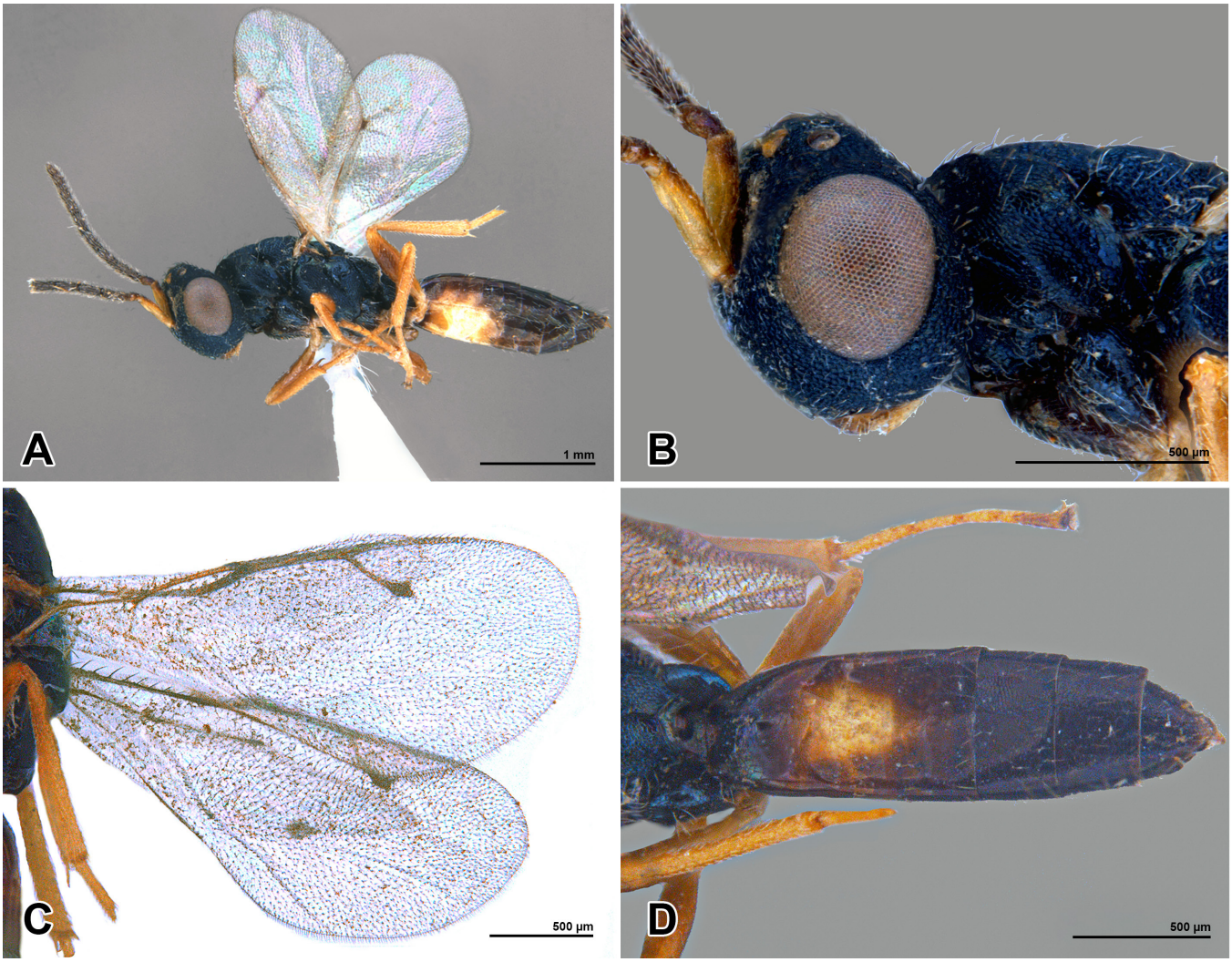

Figure 2. *Stenomalina kasaragodensis* Surya & Sureshan **sp. nov.**, Paratype, Male; **A.** Habitus, lateral view; **B.** Head, lateral view; **C.** Fore wings; **D.** Metasoma, dorsal view.

Distribution. Indo-Australian, Oriental and Palaearctic regions (UCD Community, 2023).

Host. Parasitoids of Agromyzidae, Anthomyiidae and Scatophagidae (Diptera) boring in stems and thicker parts of certain herbaceous plants (Bouček, 1988).

Key to the Indian species of *Stictomischus* Thomson (Based on females)

1	Body black or bright metallic green. **2**
—	Body bright metallic blue; [clava longer than two preceding segments; SMV 1.7× PMV]. ..... ***Stictomischus turneri* Sureshan**
2	Vertex without long bristles; clypeus weakly reticulate; POL 1.54×OOL; fore wing 1.3× as long as broad, SMV 1.3×PMV; prepectus as long as tegula. ..... ***Stictomischus gangtokicus* Narendran**
—	Vertex with long bristles; clypeus smooth (Fig. 3B); POL 1.26×OOL (Fig. 3C); fore wing 2.3× as long as broad, SMV 2.2×PMV (Fig. 3G); prepectus shorter than tegula. ..... ***Stictomischus sahyadriensis* Surya & Sureshan sp. nov.**

***Stictomischus sahyadriensis* Surya & Sureshan sp. nov.** (Figs 3A–H)
https://zoobank.org/urn:lsid:zoobank.org:act:7F663A7C-7DAB-47BD-B8B1-F1E8D3ED6AA0

Type material. **Holotype** ♀, mounted on triangular card, deposited at ZSIK. **India**: Kerala, Pathanamthitta district, Gavi (9°25'45"N, 77°08'52"E, 1036 m a.s.l.), 10.iv.2013, Coll. P. M. Sureshan, ZSIK Regd. No. ZSI/WGRC/IR/INV.9061.

Etymology. The species name is derived from "Sahyadri", the vernacular name for the Western Ghats mountain ranges.

Diagnosis. This species closely resembles *S. gangtokicus* (Narendran, 2011) in having gaster brown; antenna inserted in middle of face; clava longer than preceding two segments combined and in general morphology but differs from the same in having: 1) Body bright metallic green (Fig. 3A) (in *S. gangtokicus* body black with metallic greenish blue lustre); 2) vertex with long bristles (Fig. 3C) (in *S. gangtoticus,* vertex without long bristles); 3) clypeus smooth (in *S. gangtoticus,* clypeus weakly reticulate); 4) POL 1.25×OOL (Fig. 3C) (in *S. gangtokicus* POL 1.54×OOL); 5) fore wing 2.3× as long as broad (Fig. 3C) (in *S. gangtoticus,* fore wing 1.3× as long as broad); 6) SMV 2.2×PMV (Fig. 3G) (in *S. gangtoticus,* SMV 1.3×PMV); 7) prepectus shorter than tegula (Fig. 3F) (in *S. gangtoticus,* prepectus as long as tegula). The new species *S. sahyadriensis* **sp. nov** differs from the other Indian species *S. turneri* in having: 1) body bright metallic green (Fig. 3A) (in *S. turneri* body bright metallic blue); 2) mesoscutum with mid lobe moderately reticulate (Fig. 3E) (in *S. turneri* mesoscutum with mid lobe punctate reticulate); 3) prepectus shorter than tegula (Fig. 3F) (in *S. turneri* prepectus as long as tegula) and 4) SMV 2.2× PMV (Fig. 3G) (in *S. turneri* SMV 1.7× PMV). *Stictomischus sahyadriensis* **sp. nov.** is also reported from higher elevations from forest patches belonging to the Western Ghats. *Stictomischus sahyadriensis* **sp. nov.** also resembles *S. japonicus* Kamijo, 1960 in general body colouration, abdominal petiole longer than propodeum, thorax arched in profile and Gt_1 more than half of gaster but differs in: 1) petiole 1.8× as broad as long (Fig. 3H) (in *S. japonicus* petiole 1.5× as broad as long); 2) speculum narrow (Fig. 3G) (in *S. japonicus* speculum absent); 3) scape 1.2× long as fu_1 and fu_2 combined (Fig. 3D) (in *S. japonicus* scape as long as fu_1 and fu_2 combined), 4) funicles with three or four rows of sensillae (Fig. 3D) (in *S. japonicus* funicles with two rows of sensillae) and 5) PMV 2× STV (PMV 2.2× STV) (Fig. 3H).

Description. — **Holotype** ♀. Body length 1.85 mm, length of forewing 1.88 mm.

Colour. Body bright metallic green, except for gaster brown, with bluish lustre; antennae brown, except scape testaceous; mesepisternum black; tegulae brown; legs testaceous with tips of tarsi brown, coxae concolorous with thorax; wings hyaline, venation brown.

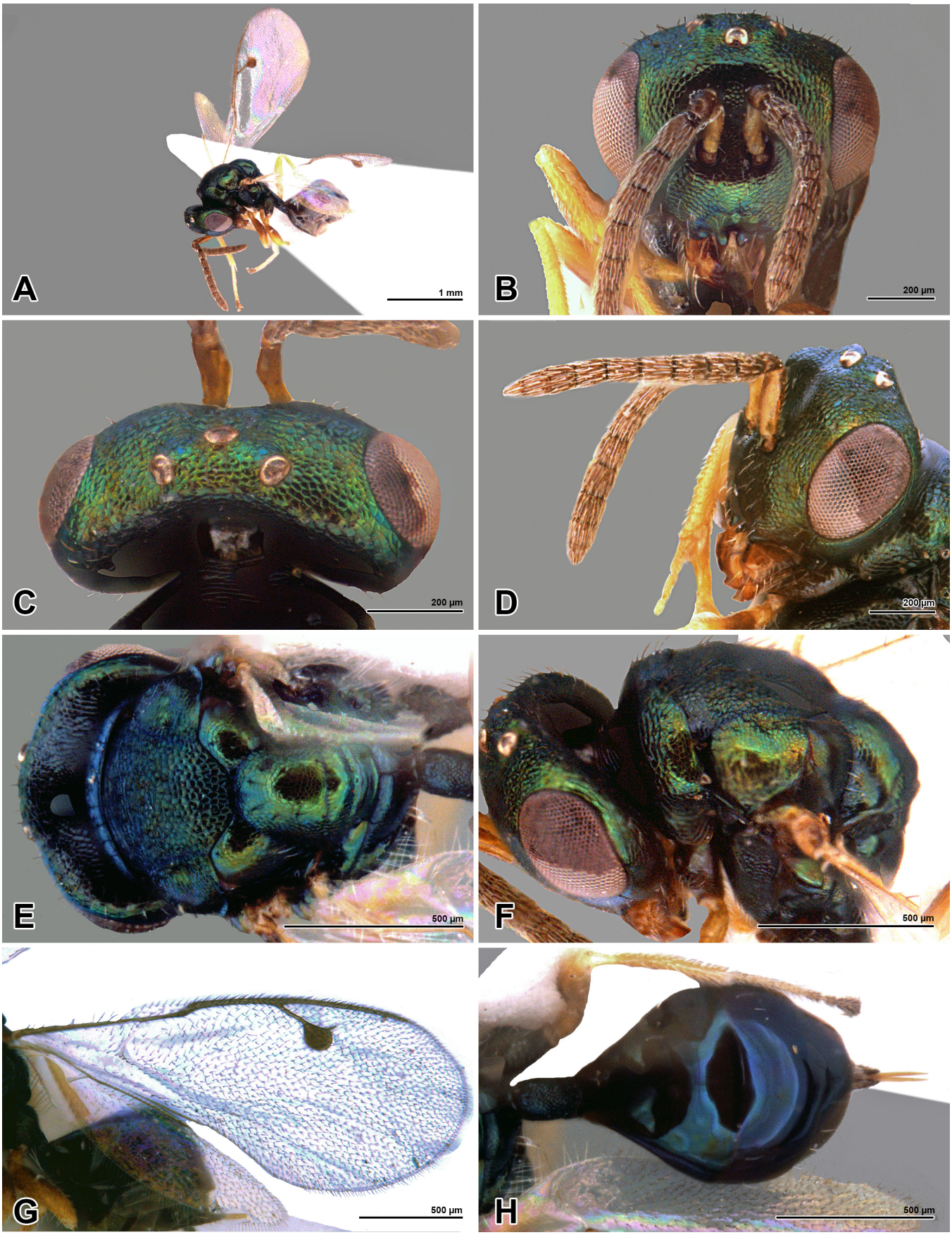

Figure 3. *Stictomischus sahyadriensis* Surya & Sureshan **sp. nov.**, **Holotype**, Female; **A.** Habitus, lateral view; **B.** Head, frontal view; **C.** Head, dorsal view; **D.** Head and antennae, lateral view; **E.** Mesosoma, dorsal view; **F.** Mesosoma, lateral view; **G.** Fore wing venation; **H.** Metasoma, dorsal view.

Head. In frontal view (Fig. 3B) head width 1.3× length, moderately reticulate; clypeus smooth, shiny, left mandible tridentate and right mandible tetradentate; POL 1.26× OOL; face moderately reticulate; malar groove distinct; gena engraved reticulate; malar space 0.24× as long as eye length in lateral view (Fig. 3D); eyes bare, eye height 1.5× width in profile view; vertex reticulate; occipital carina absent; scrobal area deep, not reaching median ocellus; antennae (Figs 3B, 3D, 3F) inserted in middle of the face, with two anelli, six funiculars, clava with three clavomeres, scape not reaching median ocellus, 1.2× as long as first two funiculars combined; pedicel 1.4× as long as broad, 0.52× fu_1 0.77× longer than fu_2, fu_2 0.85× fu_3; clava 1.2× longer than last two preceding segments combined, funiculars with three or four rows of long white irregularly arranged sensilla.

Mesosoma (Fig. 3E)**.** Mesosoma 0.74× as broad as long dorsally; pronotum moderately reticulate with backwardly directed long pubescence; mesoscutum 1.6× as broad as long; mid lobe moderately reticulate, lateral lobes and axillae engraved reticulate; notauli complete; mesoscutellum engraved reticulate, 0.8× as broad as long; frenum present, frenal groove distinct; dorsellum broad and shiny; propodeum 3× as broad as long medially, engraved reticulate, median carina distinct; spiracles oval, close to metanotum; post spiracular groove reaching posterior margin; callus with long white pubescence; prepectus shorter than tegula, engraved reticulate with sharp anterior carina; nucha short; upper and lower mesepimeron, smooth except for a narrow reticulate punctate area; mesepisternum reticulate punctate; metapleuron engraved reticulate (Fig. 3F); legs slender, hind tibia with one spur; hind coxa moderately reticulate; fore wing (Fig. 3G) 2.35× as long as broad, discal pubescence dense, speculum very narrow, basal cell bare, basal vein with few hairs, marginal fringe moderately long; stigma conspicuously enlarged; uncus distinct, discal pubescence dense; relative lengths of SMV, MV, PMV and STV in the ratio 76:35:52:25.

Metasoma (Fig. 3H)**.** Gaster petiolate; metasoma 0.82× as long as combined lengths of head and mesosoma; petiole 1.85× longer than broad, with anteriorly converging sides, reticulate punctate, 3.45× length of gaster; Gt_1 and Gt_2 covering most of gaster; Gt_1 0.53× length of gaster; Gt_2 1.8× as long as Gt_2; remaining tergites strongly retracted; ovipositor and ovipositor sheath slightly exerted.

Male. Unknown.

Distribution. India: Kerala.

Host. Unknown

DISCUSSION

Our grasp of the pteromalid fauna of the Western Ghats remains far from satisfactory, even though the southern parts of the Western Ghats have been more probed for the taxonomic research of Pteromalidae than the northern and central parts. Sureshan (2015) published a comprehensive account of the pteromalid fauna of the southern Western Ghats which includes 114 species belonging to 56 genera and 12 subfamilies. Later, Sureshan (2020) reported the pteromalid fauna from the Western Ghats consisted of 148 species, representing 63 genera and 13 subfamilies. The present study records the two interesting genera *Stictomischus* and *Stenomalina* from the Western Ghats, with *Stenomalina* being recorded for the first time from India. *Stenomalina* is a rare genus in the Oriental region, currently represented by only two species (including the new species described here) *i.e.*, *S. micans* (Olivier, 1813), and *S. kasaragodensis* Surya & Sureshan **sp. nov.** This makes the newly described species the sole representative of the genus from India.

With the biology of only a few conspicuous species published, our overall knowledge of this genus is poor. *Stictomischus* is a rare genus in the Oriental region, currently represented by only three species (including the new species described here) from India *i.e.*, *S. turneri* Sureshan, *S. gangtokicus* Narendran and *S. sahyadriensis* Surya & Sureshan **sp. nov.** The first record of the species from India was made by Sureshan (2002) when he reported *S. turneri* from Eravikulam National Park, Kerala. *Stictomischus gangtokicus* was added to the list of Indian *Stictomischus* by Narendran & Abhilash (2011). They also provide an updated checklist of the world species of *Stictomischus*. *Stictomischus sahyadriensis* **sp. nov**. is also reported from higher elevations from forest patches belonging to the Western Ghats.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: K.S. Surya: Identification, digital imaging of specimens, funding acquisition and drafting and revising the manuscript; P.M. Sureshan: Supervisor, confirmation of the identified species and technical review of the manuscript. The authors read and approved the final version of the manuscript.

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AVAILABILITY OF DATA AND MATERIAL

The specimens listed in this study are deposited in 'National Zoological Collections' of the Zoological Survey of India, Western Ghat Regional Centre, Kozhikode (ZSIK) and are available from the curator, upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

CONSENT FOR PUBLICATION

Not applicable.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this paper.

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دو گونهٔ جدید و اولین گزارش جنس از خانواده Pteromalidae (Hymenoptera: Chalcidoidea) از گهات غربی، هند

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چکیده: گونهٔ جدید *Stenomalina kasaragodensis* **sp. nov.** از منطقه گهات غربی هند کشف شد و این اولین گزارش از حضور جنس *Stenomalina* Ghesquière, 1946 (Hymenoptera: Pteromalidae: Pteromalinae)، در هند نیز می‌باشد. نمای کلی و کلید شناسایی برای گونه‌های خاورزمین جنس *Stenomalina* و همچنین توصیف تصاویر و مقایسه گونه جدید با گونه‌های مشابه نیز ارایه شد. گونه جدید دیگر از جنس *Stictomischus* Thomson, 1876 (Hymenoptera: Pteromalidae: Miscogastrinae) به‌نام *Stictomischus sahyadriensis* **sp. nov.** نیز در همین منطقه یافت شد. این گونه در منطقه گهات غربی یافت شد. گونه جدید توصیف شده، تصاویر افتراقی آن ارایه و گونه‌های مشابه مقایسه شد. کلید شناسایی گونه‌های جنس *Stictomischus* در هند نیز ارایه شد.

واژگان کلیدی: کساراگود، پاتهانامتیتا، گونه جدید، *Stenomalina*، *Stictomischus*