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Original Article

New findings of the genera *Townesilitus* Haeselbarth & Loan, 1983 and *Peristenus* Foerster, 1862 (Hymenoptera: Braconidae: Euphorinae) in India

Fiza Farooq [1] | **Altaf Hussain Mir** [1] | **Ankita Gupta** [2]

1 Entomology Research Laboratory, Department of Zoology, University of Kashmir, Srinagar-190006, Jammu and Kashmir, India; draltaf@uok.edu.in

2 ICAR-National Bureau of Agricultural Insect Resources (NBAIR), P.B. No 2491, H. A. Farm Post, Bellary Road, Hebbal, Bangalore-560024, Karnataka, India; ankita.gupta@icar.gov.in

Corresponding author: Fiza Farooq | ✉ fiza.zoscholar@kashmiruniversity.net

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ABSTRACT. In the present study, genus, *Townesilitus* Haeselbarth & Loan, 1983, represented with a single species, *T. bicolor* (Wesmael, 1835), and two species of the genus *Peristenus* Foerster, 1862, *P. angifemoralis* van Achterberg & Guerrero, 2003, and *P. picipes* (Curtis, 1833) (Hymenoptera: Braconidae: Euphorinae) were reported for the first time from India. Specimens of *T. bicolor*, were collected from the Ganderbal district, *P. angifemoralis,* from the Anantnag district, and *P. picipes,* from the Pulwama and Ganderbal districts of the Kashmir valley, India. The geographical distribution and taxonomic features of all three taxa are presented. Additionally, a revised identification key for the Indian *Peristenus* species is also provided.

KEYWORDS: Distribution, flea beetles, Identification key, Kashmir, Miridae, parasitoid

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INTRODUCTION

The Euphorinae Foerster, 1862, represents one of the largest subfamilies of Braconidae, having a cosmopolitan distribution. It comprises 59 genera and 1270 species (Yu et al. 2016). Stigenberg et al. (2015) provided a revised classification of the subfamily Euphorinae and recognized 14 tribes within this subfamily. Many Euphorinae (excluding Meteorini) are koinobiont endoparasitoids that primarily target adults of several orders, including Coleoptera, Hemiptera, Hymenoptera, Neuroptera, and Psocoptera (Chen & van Achterberg 1997; Beyarslan 2021), but they also parasitize larval stages of Coleoptera.

Townesilitus Haeselbarth & Loan, 1983, is a relatively small genus within the tribe Townesilitini and currently comprises approximately 10 described species, worldwide (Stigenberg 2017). The species of this genus attack adult beetles belonging to the family Chrysomelidae, especially the flea beetles of the genus *Phyllotreta* Chevrolat (Stigenberg 2017). *Townesilitus* is phylogenetically close to *Microctonus* Wesmael, 1835 (tribe Perilitini) (Stigenberg et al. 2015; Zhang et al. 2018). This genus is mainly Holarctic in distribution (Chen & van Achterberg 1997) and is recorded for the first time from India in the present study. The genus *Peristenus* Foerster, 1862 (tribe Euphorini) comprises parasitoids that specialize on nymphs and adults of mirid bugs (Hemiptera: Miridae) (Chen & van Achterberg 1997). This genus was recognised as a separate genus from *Leiophron* Nees, 1818 by Loan & Bilewicz-Pawihska

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(1973), a distinction supported by morphological studies (Goulet & Mason 2006) and confirmed by subsequent molecular phylogenies (Stigenberg et al. 2015; Zhang et al. 2018). *Peristenus* and *Leiophron* can be distinguished from each other mainly by the differences in their first metasomal tergite. In *Peristenus*, tergite I is usually ventrally closed in the anterior portion, but is usually open in *Leiophron*. In India, the genus *Peristenus* was first reported by Shamim et al. (2008), who described several new species. The present work reports new distributional records of *Peristenus* species from India.

This study adds new faunistic and distributional records of Euphorinae in India. Three species from the genera *Townesilitus* and *Peristenus* are recorded for the first time in the country, extending their known distribution into the northwestern Himalayas. Key diagnostic characters and distributional records from the Kashmir Valley are presented, along with an updated identification key to the Indian species of *Peristenus*, which promotes future research on Euphorinae diversity in the region.

MATERIAL AND METHODS

The specimens of the newly recorded species were collected using sweep netting from different locations in the Kashmir Valley. The collected specimens were preserved in 70% ethanol. After that, the specimens were sorted using a stereozoom microscope (Magnus® MSZ-BI) and then dehydrated using various grades of ethanol, *viz.*, 70%, 90%, and 100% for 15 to 20 minutes in each grade (van Achterberg, 2009). The specimens were then dried and mounted on triangular cards. Species identification was conducted using the following sources: Loan (1974), Chen & van Achterberg (1997), van Achterberg and Guerrero (2003), and Stigenberg (2017). Morphological terminology in general follows van Achterberg (1993). The following abbreviations are used: POL: Posterior Ocellar Line, OOL: Ocular ocellar line, OD: Ocellar Diameter, T1: first metasomal tergite, T2: second metasomal tergite, and T3: third metasomal tergite. Photographs of specimens were taken using a Leica® MZ16 A stereo zoom microscope equipped with a Leica DFC 420 inbuilt camera at NBAIR, Bengaluru, Karnataka, India. Images were combined using the Combine ZP software. The specimens are deposited in the National Insect Museum ICAR–NBAIR, Bengaluru, Karnataka, India, and the Museum at the Department of Zoology, University of Kashmir, India. Acronyms for the depositories: **TFMC –** Museo de Ciencias Naturales, Santa Cruz de Tenerife, Canary Islands; **NMVM** – National Museum of Victoria, Melbourne).

RESULTS

Class Insecta Linnaeus, 1758

Order Hymenoptera Linnaeus, 1758

Superfamily Ichneumonoidea Latreille, 1802

Family Braconidae Latreille, 1829

Subfamily Euphorinae Foerster, 1863

Genus *Townesilitus* Haeselbarth & Loan, 1983

Type species. *Microctonus bicolor* Wesmael, 1835.

Diagnosis. Clypeus about as wide as face; basal flagellomeres cylindrical; length of scape about twice its width; fore wing veins 1-SR+M and r-m absent; vein M+CU of fore wing entirely sclerotized; T1 very narrow basally and ventrally fused at the base; tarsal claws simple.

Townesilitus bicolor (Wesmael, 1835)

Microctonus bicolor Wesmael, 1835:61. Holotype ♀.– Belgium.
Microctonus breviradialis Tobias, 1976:231, 235.

Fig. 1

Material examined. 1♀. India, Jammu & Kashmir, Ganderbal, Gotli Bagh (34°16'48"N, 74°50'5"E) 11.VII.2023, sweep net, leg. Fiza Farooq.

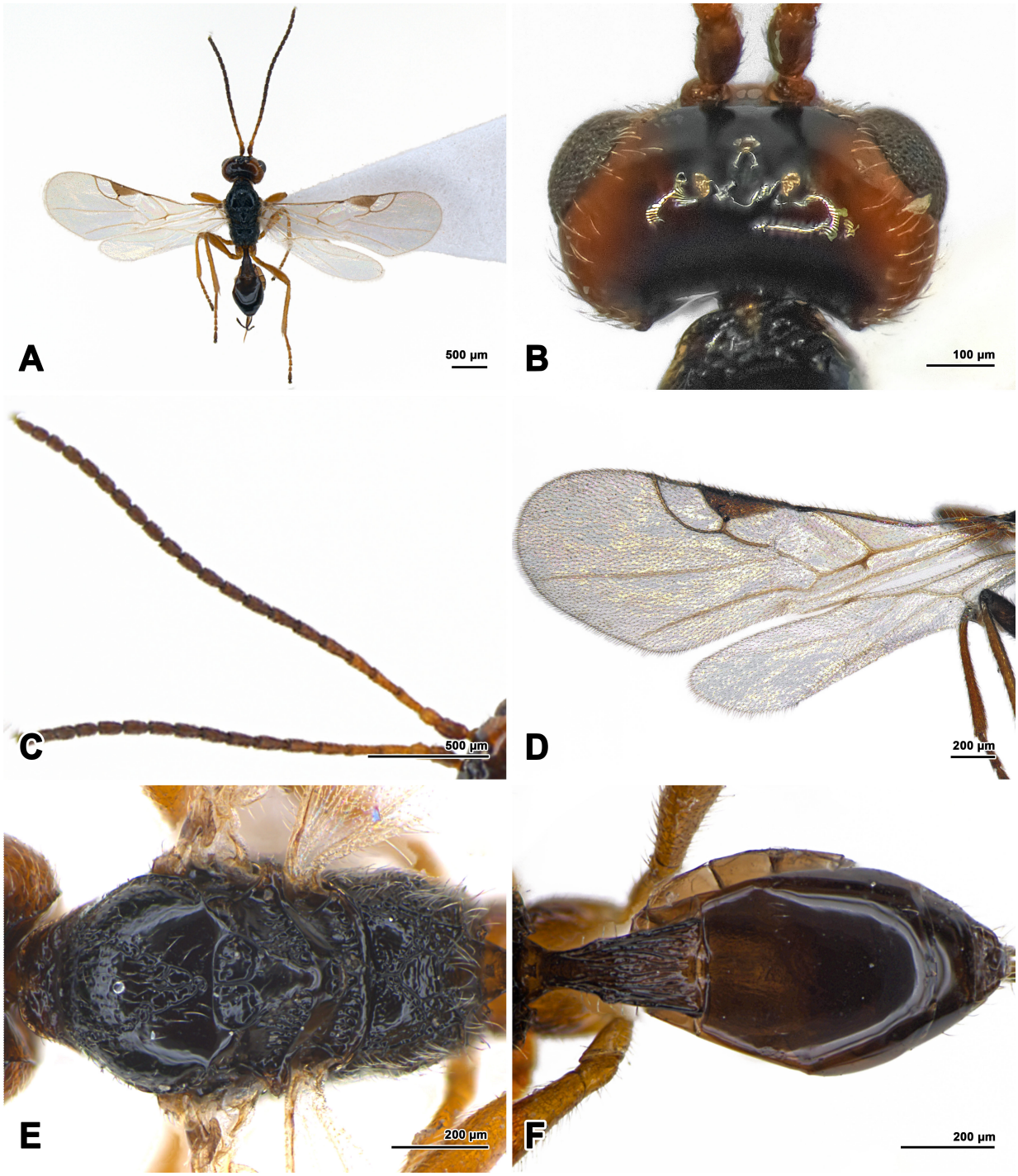

Figure 1. *Townesilitus bicolor* (Wesmael, 1835). **A.** Habitus; **B.** Head; **C.** Antenna; **D.** Wing; **E.** Mesosoma; **F.** Metasoma.

Diagnosis. Female: Body length 2.0 mm (Fig. 1A); fore wing length 2.2 mm; antenna with 22 segments (Fig. 1C), scape length 1.5× its width, F1 slightly shorter than F2, F1 and F2 2.4× and 2.7× as long as their width, respectively; POL:OD:OOL = 10:3:12; length of eye almost equal to temple length in dorsal view (Fig. 1B); face punctate and setose; frons smooth and shiny; notauli complete and crenulate; median lobe of mesoscutum densely setose and punctate, lateral lobes almost smooth, only anteriorly with sparse hairs; propodeum with carina laterally and dorsally with pentagonal area (Fig. 1E); length of pterostigma 3.6× its width and 2.1× length of vein 1-R1, veins 1-SR+M and 2-SR+M of fore wing absent (Fig. 1D); T1 2.2× as long as its width apically and longitudinally striate (Fig. 1F); rest of the tergites smooth; ovipositor thin and slender; ovipositor sheath 0.55 mm.

Colouration. Body predominantly dark brown (Fig. 1); ocelli transparent, antenna brownish with pedicel and some other basal flagellomeres yellowish; legs yellowish; wings transparent with pterostigma yellowish.

Distribution (Fig. 4). PALAEARCTIC: Albania, Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, France, Germany, Greece, Hungary, Iran Ireland, Italy, Kazakhstan, Latvia, Lithuania, Moldova, Netherlands, Norway, Poland, Romania, Russia, Serbia, Spain, Sweden, Switzerland, Turkey, United Kingdom, Uzbekistan (Yu et al. 2016); India (**new record** – Kashmir), representing the Palaearctic part of the western Himalaya.

Genus *Peristenus* Foerster, 1862

Type species. *Microctonus barbiger* Wesmael, 1835

Diagnosis. Occipital carina complete; fore wing vein M+CU1 unsclerotized, basal, sub-basal, and sub-discal cells evenly setose, marginal cell short; hind wing vein cu-a fully present; T1 ventrally fused in the basal portion; ovipositor short.

Peristenus angifemoralis Van Achterberg & Guerrero, 2003

Peristenus angifemoralis van Achterberg & Guerrero, 2003:80. Holotype: ♀ (TFMC). – Canary Islands.

Fig. 2

Material examined. 1♀, 1♂. India, Jammu & Kashmir, Anantnag, Gopalpora (33°43'29"N, 75°12'33"E) 17.VII.2023, sweep net, leg. Fiza Farooq.

Diagnosis. Female: Body length 1.9 mm (Fig. 2A); fore wing length 1.73 mm; antenna with 16 segments (Fig. 2C), F1 slightly longer than F2 and 3.1× as long as wide, F2 2.3× as long as wide, penultimate flagellomere 1.3× as long as wide; length of eye almost equal to temple length in dorsal view (Fig. 2B); OOL:OD:POL = 6:3:11; scutellar sulcus with one distinct median carina; notauli distinct and crenulate; propodeum reticulate rugose (Fig. 2E); fore wing basal and sub basal cells sparsely setose than apical cells (Fig. 2D); length of pterostigma 2.3× its width; vein 1R1 0.26× pterostigma length and 0.65× width of pterostigma; length of T1 1.7× its apical width; T1 longitudinally rugose (Fig. 2F) and remainder of tergites smooth; ovipositor sheath hardly visible and pointed.

Colouration. Body mostly black; antenna dark coloured but basally yellowish; metasoma after T1 with a brownish tinge; pterostigma light brownish with a light spot basally; legs almost yellowish.

Distribution (Fig. 4)**.** PALAEARCTIC: Canary Islands, Spain (van Achterberg & Guerrero 2003), India (**new record** – Kashmir).

Peristenus picipes (Curtis, 1833)

Leiophron picipes Curtis, 1833:476. Lectotype ♀ (NMVM).
Euphorus coactus Marshall, 1887:59.
Leiophron (*Peristenus*) *picipes*: Tobias, 1986:240.

Fig. 3

Material examined. 2♀♀, 3♂♂. India, Jammu & Kashmir, Pulwama, Tral 33°56'3"N, 75°6'49"E), 4.IV.2025 and 1♀, 1♂ India, Jammu & Kashmir, Ganderbal, Gotli Bagh (34°16'48"N, 74°50'5"E) 21.V.2025, sweep net, leg. Fiza Farooq.

Diagnosis. Female: Body length 2.0 mm (Fig. 3A); fore wing length 1.7 mm; antenna with 16 segments (Fig. 3C), F1 2.7×, F2 2.6×, and F3 2.2× their width respectively; length of eye 1.4× its temple; occipital carina complete (Fig. 3B); mesosoma 1.5× its height; lateral and median lobes of mesoscutum smooth and shiny; notauli complete and crenulate; scutellum nearly smooth and setose; propodeum rugose (Fig. 3E); length of fore wing 3.0× its width; vein 1R1 0.6× pterostigma width and 0.3× pterostigma length (Fig. 3D); length of T1 2.0× its apical width and 0.53× as long as hind tibia; T1 longitudinally striate (Fig. 3F) and rest of tergites smooth and shiny.

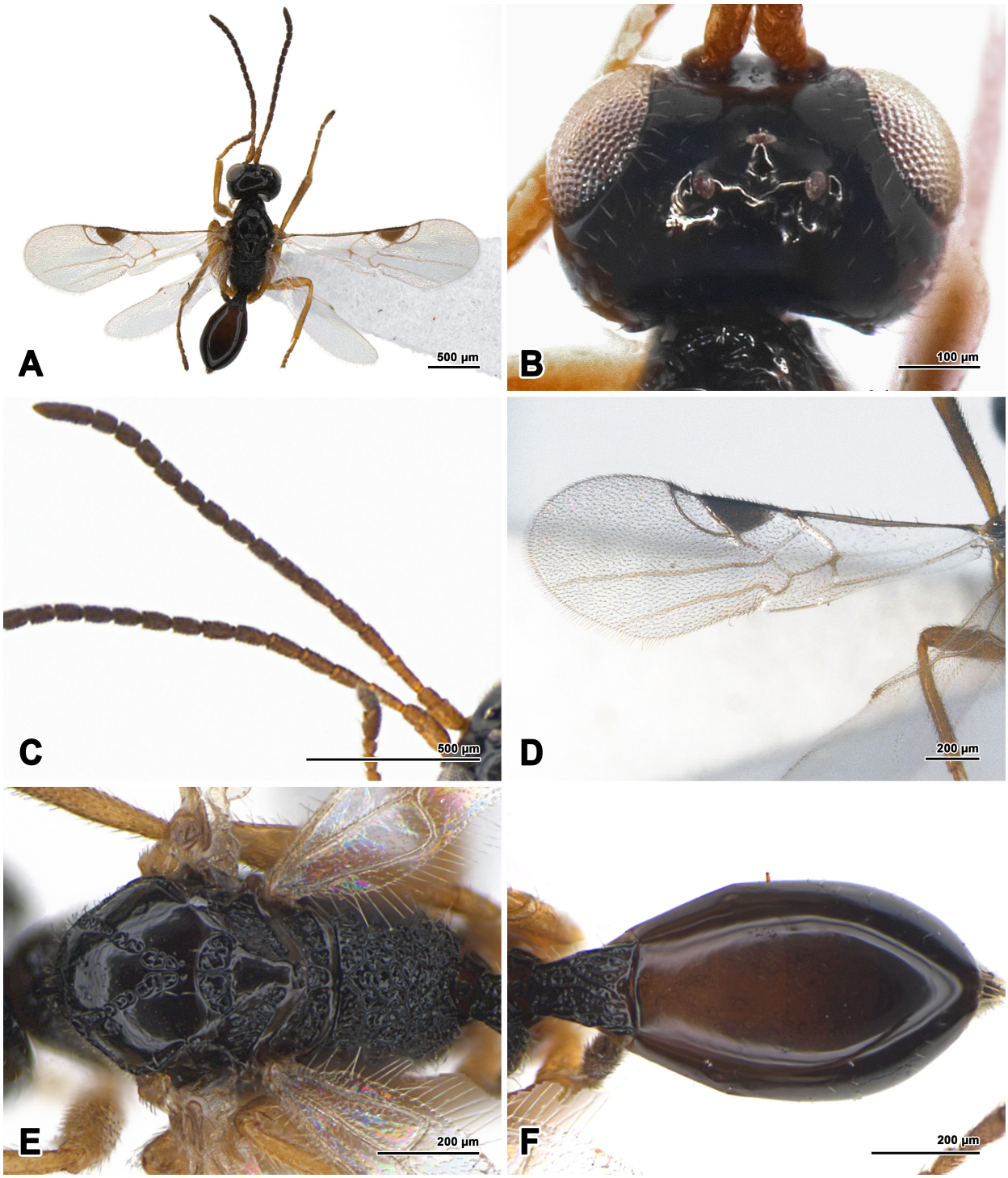

Figure 2. *Peristenus angifemoralis* Van Achterberg & Guerrero. **A.** Habitus; **B.** Head; **C.** Antenna; **D.** Wing; **E.** Mesosoma; **F.** Metasoma.

Colouration. Body overall black; antenna light brownish and metasoma after T1 brownish; wings transparent; pterostigma light brownish and legs yellowish brown.

Distribution (Fig. 4)**.** PALAEARCTIC: Azerbaijan, China, Czech Republic, Finland, Germany, Hungary, Iran, Ireland, Italy, Kazakhstan, Lithuania, Moldova, Norway, Poland, Russia, Serbia, Sweden, Switzerland, Turkey, Ukraine, United Kingdom, Uzbekistan (Gadallah et al. 2022), and Mongolia (Chen & van Achterberg 1997).

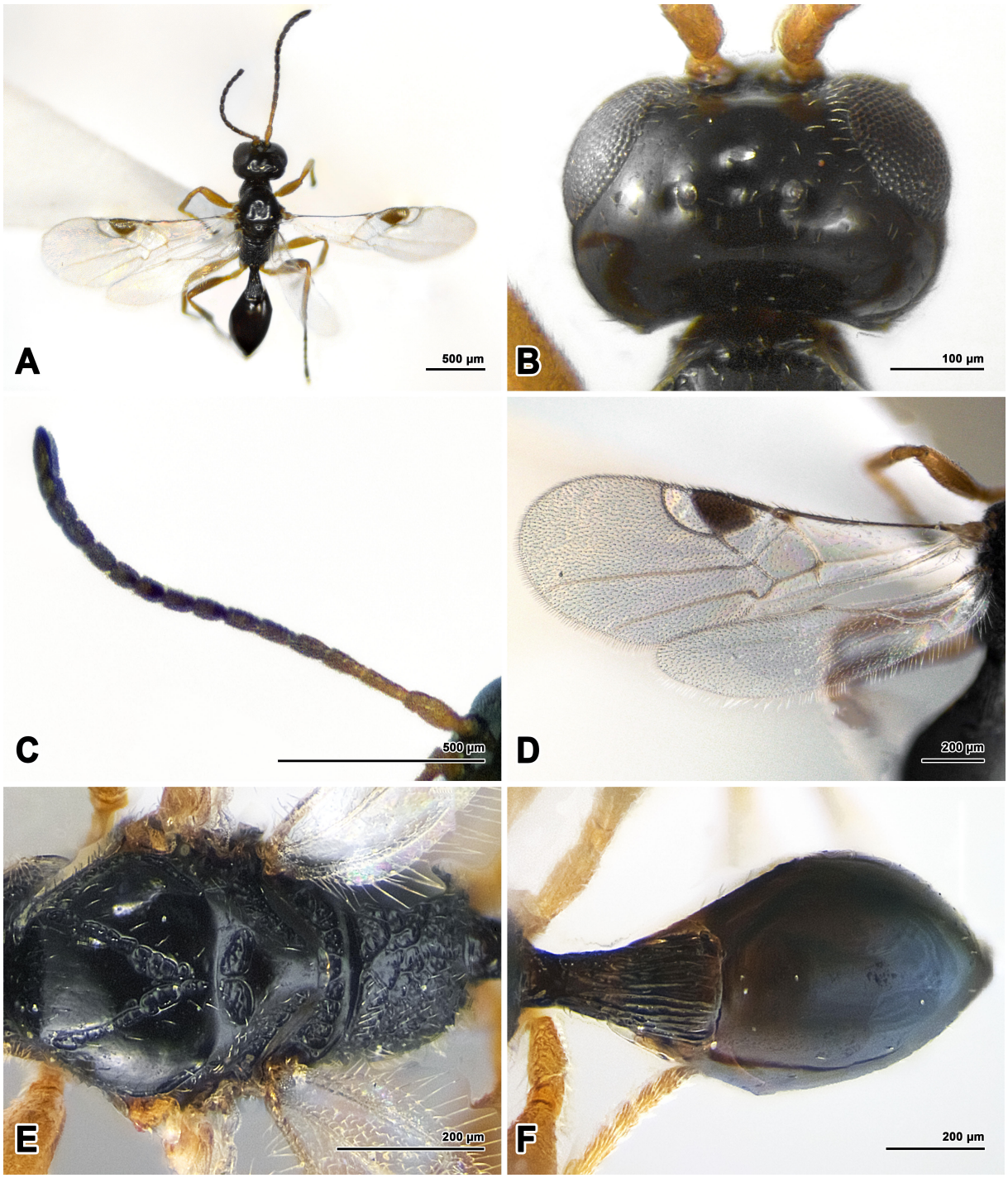

Figure 3. *Peristenus picipes* (Curtis, 1833). **A.** Habitus; **B.** Head; **C.** Antenna; **D.** Wing; **E.** Mesosoma; **F.** Metasoma.

Revised key to the Indian species of Genus *Peristenus* (Females) (after Shamim et al. 2008).

1 Median lobe of mesoscutum smooth; vein 1-R1 of fore wing 0.5–0.7× pterostigma width. **2**

– Median lobe of mesoscutum punctate; vein 1-R1 of fore wing about as long as pterostigma width. **3**

2 Vein 1-R1 of fore wing about half as long as width of pterostigma; T1 longitudinally striate. ..... ***P. picipes* (Curtis)**

– Vein 1-R1 of fore wing 0.7× pterostigma width; T1 longitudinally rugose. ..... ***P. angifemoralis* van Achterberg & Guerrero**

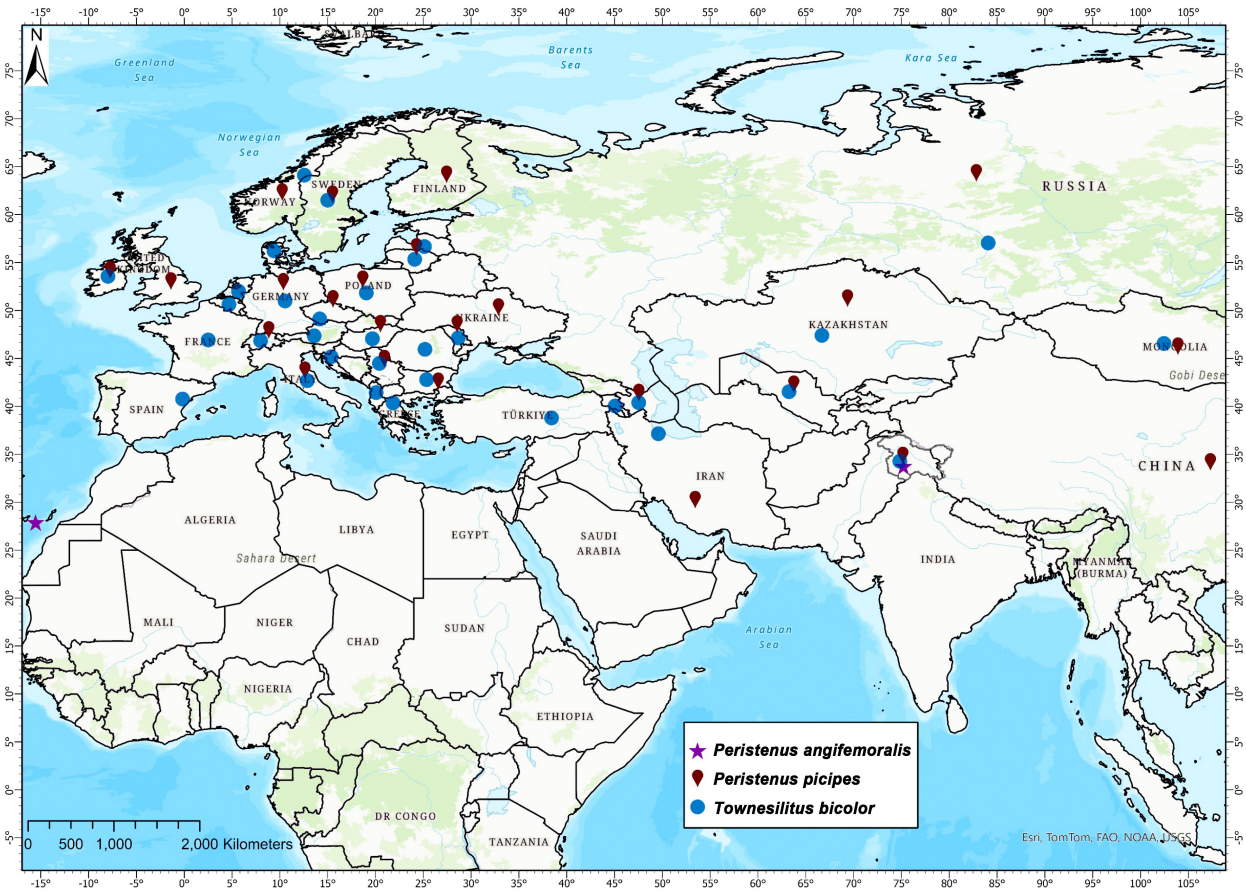

Figure 4. Distribution map of *Peristenus angifemoralis* Van Achterberg & Guerrero, 2003; *Peristenus picipes* (Curtis, 1833), and *Townesilitus bicolor* (Wesmael, 1835).

3 Eye as long as temple in dorsal view; scutellar sulcus deep with one median carina; T1 2.2× its apical width. ..... ***P. nitidus* Shamim & Ahmad**

— Eye 1.8–3.0× as long as temple in dorsal view; scutellar sulcus with one median and six faint lateral carinae; T1 1.5–1.8× its apical width. **4**

4 Mesopleuron completely coarsely punctate; length of face equal to its width. ..... ***P. punctatus* Shamim & Ahmad**

— Mesopleuron medially smooth; length of face 2× its width. **5**

5 Fore wing vein m-cu postfurcal, 2.55× as long as wide; length of hind wing 4× its width; pronotum antero-dorsally narrowly punctate, medially mostly crenulate, postero-ventrally smooth; width of head in dorsal view 1.1× its length. ..... ***P. alami* Shamim & Ahmad**

— Fore wing vein m-cu antefurcal, 2.7× as long as wide; length of hind wing almost 5× its width; pronotum completely crenulate; width of head in dorsal view 1.4× its length. ..... *P. **indicus** Shamim & Ahmad*

DISCUSSION

The present study adds three new records to the Indian fauna of the subfamily Euphorinae (Hymenoptera: Braconidae). One genus, *Townesilitus* Haeselbarth & Loan, 1983, and two species, *Peristenus angifemoralis* van Achterberg & Guerrero, 2003, and *Peristenus picipes* (Curtis, 1833), are reported for the first time from India. Previously, *Peristenus* was reported in India by Shamim et al. (2008), with the description of four new species (*Peristenus nitidus* Shamim & Ahmad, 2008, *P. punctatus* Shamim & Ahmad, 2008, *P. alami* Shamim & Ahmad, 2008, and *P. indicus* Shamim & Ahmad, 2008). With the addition of these newly recorded taxa, the total known Euphorinae species from India now

stands at approximately 87 (Shamim et al. 2008; Gupta 2022; Gupta et al. 2024). These records indicate the expanded distribution range of these species, highlighting the region's previously unexplored biodiversity despite its rich biodiversity. Overall, this study highlights the importance of conducting comprehensive surveys and taxonomic studies in under-explored areas.

Biogeographically, India spans two major realms: the Oriental realm across most lowlands, and the Palearctic realm across the high mountains. The western Himalaya, including Ladakh and Kashmir, falls within this Palaearctic zone (Mani 1974). The newly recorded species are collected from Kashmir, which lies within the Palaearctic biogeographic zone of India. Therefore, these records represent an addition to the Palaearctic fauna of India. While the majority of Euphorinae previously reported from India are associated with the oriental biogeographic realm. The specimens of *Townesilitus bicolor* collected from Kashmir, correspond well with the redescription given by Stigenberg (2017) in all major diagnostic characters, including body length (2.0 mm); 22 antennomeres; fore wing length (2.2 mm); propodeum with carina laterally and dorsally with pentagonal area; hind femur 5.5 as long as wide, and an S-shaped ovipositor. A minor difference was observed in the ovipositor sheath length (0.5 mm *vs* 0.6–0.7 mm in redescription). Similarly, *Peristenus angifemoralis* from Kashmir fully matches the original description in diagnostic features such as OOL:OD:POL (6:3:11); reticulate rugose propodeum; densely setose fore wing basal and sub basal cells; T1 longitudinally rugose and pointed ovipositor sheath. The only difference observed in antennomere number (16 *vs* 17 in the original description). Likewise, *Peristenus picipes* specimens conform to the lectotype description provided by Loan (1974) in all key characters, including body length (2.0 mm); 16 antennomeres; strong and complete occipital carina; rugose propodeum; T1 twice as long as wide and longitudinally striate. A slight variation was observed in F1–F3 ratios relative to their width (2.7, 2.6, 2.2 *vs* 2.6, 2.3, 2.0 in Loan's description). The records of *Peristenus* and *Townesilitus* from Palaearctic India fit well within the broader distributional trends observed in other Euphorinae. These genera and their related ones, such as *Syntretus* Foerster, 1862, and *Streblocera* Westwood, 1833, have broad distributions that span both the Palaearctic and Oriental realms (Stigenberg 2017; Gupta et al. 2024). This wide biogeographic overlap is likely driven by the distribution of their phytophagous hosts, many of which occur across both zones.

The documented host records indicate that *T. bicolor* parasitizes flea beetles (Chrysomelidae: Alticinae), including *Chaetocnema hortensis* (Geoffroy, 1785), *C. aridula* (Gyllenhal, 1827) (Pavlov 1960), and *Phyllotreta Cruciferae* (Goeze, 1777) (Wylie & Loan 1984) in the Palaearctic region. Among these, only *P. cruciferae* has published records from Jammu & Kashmir, while *Chaetocnema* species are reported at the genus level (Bhat et al. 2011). The occurrence of *T. bicolor* in Kashmir may therefore be associated with *Phyllotreta* hosts, though further surveys are needed to confirm host associations in this region. For *Peristenus angifemoralis* and *P. picipes*, species-specific host data are lacking. At the generic level, however, *Peristenus* species are known as koinobiont endoparasitoids of mirid bugs (Hemiptera: Miridae) (Chen & van Achterberg 1997), which are abundant and widespread in Kashmir (Bhat et al. 2011), indicating that their occurrence in Kashmir is likely linked to the abundance of suitable hosts.

AUTHOR'S CONTRIBUTION

The authors confirm their contribution to the paper as follows: FF collected, mounted, and identified specimens, took photographs, and drafted the initial manuscript. AH contributed to the writing, editing, and revision of the manuscript. AG verified species identifications and revised the manuscript. All 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 the National Insect Museum ICAR–NBAIR, Bengaluru, Karnataka, India, and the Museum at the Department of Zoology, University of Kashmir, India and are available from the curator upon request.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study only included arthropod material, and all required ethical guidelines for the treatment and use of animals were strictly adhered to in accordance with international, national, and institutional regulations. No human participants were involved in any studies conducted by the authors for this article.

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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یافته‌های جدید از جنس‌های *Townesilitus* Haeselbarth & Loan, 1983 و *Peristenus* Foerster, 1862 (Hymenoptera: Braconidae: Euphorinae) از هند

فیض فاروغ[1]، الطاف حسین میر[1]، آنکیتا گوپتا[2]

۱ آزمایشگاه مطالعات حشره‌شناسی، گروه جانورشناسی، دانشگاه کشمیر، سریناگار، جامو و کشمیر، هند.
۲ موسسه ملی مطالعات کشاورزی و منابع طبیعی، بنگلور، کارناتاکا، هند.

نویسندهٔ مسئول: فیض فاروغ | ✉ fiza.zoscholar@kashmiruniversity.net

ویراستار علمی
مصطفی غفوری‌مقدم

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چکیـده: در این تحقیق، جنس *Townesilitus* Haeselbarth & Loan, 1983 با گونهٔ *T. bicolor* (Wesmael, 1835)، به همراه دو گونه از جنس *Peristenus* Foerster, 1862 شامل *P. angifemoralis* van Achterberg & Guerrero, 2003 و *P. picipes* (Curtis, 1833) (Hymenoptera: Braconidae: Euphorinae) برای اولین بار از هند گزارش شدند. نمونه‌های مربوط به گونهٔ *T. bicolor* از منطقه گاندربال، گونهٔ *P. angifemoralis* از آنانتناگ و نمونه‌های *P. picipes* از مناطق پولوانا و گاندربال در دره کشمیر هند جمع‌آوری شدند. انتشار جغرافیایی و خصوصیات تاکسونومیک هر سه گونه ارایه شد. به‌علاوه، یک کلید بازبینی شده برای شناسایی گونه‌های جنس *Peristenus* در هند ارایه شد.

واژگـان کلیدی: پراکنش، کک‌چلیپاییان، کلیدشناسایی، کشمیر، سن‌های برگ، انگل‌واره