

Notes on plants visited by genus *Paragus* Latreille, 1804 (Diptera, Syrphidae) with an updated key to Indian species

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ABSTRACT: Among Diptera, hoverflies (Syrphidae) are important flower visitors, with the genus *Paragus* Latreille, 1804, widely distributed worldwide. Of more than 100 described species, 11 valid species are currently known from India, to which this study adds one additional species. An updated list of plant associations for Indian *Paragus*, including 13 newly recorded plants, along with a taxonomic key to the Indian *Paragus*, is presented. This study contributes to the taxonomic knowledge of Indian hoverflies and highlights their ecological role as pollinators.

KEY WORDS: Flower flies, pollinator, identification, new record

INTRODUCTION

Order Diptera constitutes one of the most diverse and ecologically significant groups of flower-visiting insects worldwide, often contributing proportions of floral visitors comparable to those of Hymenoptera and even dominating the pollinator assemblage in certain habitats, particularly at higher altitudes and latitudes (Klecka *et al.*, 2018). At least 86 dipteran families have been recorded visiting flowers, and more than 1100 plant species from 172 families are known to receive floral visits from flies (Inouye *et al.*, 2015). In the Indian context, Mitra (2010) reported 116 dipteran species belonging to 16 families associated with 92 flowering plant species from 39 families, demonstrating that Syrphidae is the most prominent flower-visiting family- recorded from 46 plant species, while Asteraceae stands out as the most frequently visited plant family. Notably, Mitra (2010) also reported

five species of the genus *Paragus* Latreille, 1804, exceeding the number recorded for any other syrphid genus in the dataset, indicating a high representation of *Paragus* in the documented floral visitation records of Indian Syrphidae. Owing to their predatory larvae, which feed primarily on aphids and other soft-bodied pests, species of *Paragus*, also hold considerable economic importance in agricultural and horticultural systems, serving as biological control agents (Thompson and Ghorpade, 1992).

The genus *Paragus* comprises over 100 described species and is distributed across all continents except Antarctica (Tot *et al.*, 2018; Barahona-Segovia *et al.*, 2021). The genus is currently classified into four subgenera: *Afroparagus* Vujic & Radenkovic, 2008; *Pandasyopthalmus* Stuckenberg, 1954a; *Paragus*; and *Serratoparagus* Vujic & Radenkovic, 2008 (Vujic

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et al., 2008; Tot *et al.*, 2018). The Oriental Region harbours 14 species of *Paragus*, belonging to three subgenera— *Pandasyopthalmus*, *Paragus*, and *Serratoparagus* (Thompson and Ghorpade, 1992), these three subgenera are also documented from India.

The Indian hoverfly fauna currently comprises 366 species in 77 genera, of which *Paragus* includes 12 species (Sengupta *et al.*, 2024). However, one of these species, *Paragus ambalaensis* Sodhi & Singh, 1991, was treated as *species incertae sedis* by Ghorpade (2014) and is therefore not considered a valid member of the Indian *Paragus* in the present study. Accordingly, *P. ambalaensis* is excluded from the current account. This study further restores one *Paragus* species to the Indian syrphid fauna that was previously known but omitted from the updated catalogue of Sengupta *et al.* (2024). Additionally, a consolidated list of recorded plant species visited by *Paragus* is provided, including 13 newly recorded floral associations for the genus. A brief generic diagnosis, an updated identification key to the Indian *Paragus* and representative photographs of floral visitation are also presented to facilitate accurate identification and to promote further ecological and taxonomic research on this group.

MATERIAL AND METHODS

The specimens were collected with sweep nets from agricultural lands of Bangur locality, North 24 Parganas, West Bengal, with an approximate geo coordinate range of 22°36'26"N; 88°24'37"E and approx. elevation of 23 meter in India. All the collected specimens were pinned, stretched, and examined under the Leica EZ4 microscope. The taxonomic key to the Indian species of *Paragus* was constructed based on Brunetti (1923), Thompson and Ghorpade (1992), Vujic *et al.* (2008), Haarto (2014), and Tot (2021), and the morphological terminologies follow van Steenis *et al.* (2023). The identified specimens were deposited in the National Zoological Collection of the Diptera section, Zoological Survey of India, Kolkata. The visited plants have been identified by plant taxonomist from the Indian Council of Forestry Research and Education (ICFRE).

Abbreviations used in the text: cell: bm— basal medial cell, c— costal cell, dm— discal medial cell; crossvein: dm-m— apical crossvein between M₄ (4th branch of medial vein) and M (medial vein).

RESULTS AND DISCUSSION

Genus *Paragus* Latreille, 1804

Diagnosis: Head broader than thorax; face produced into a central knob; eyes pilose; abdomen either entirely black or black with white or red fasciae; abdominal tergum 1 well developed, terga minutely punctate; r-m crossvein positioned before the middle of cell dm.

Key to the Species of Indian *Paragus* Latreille, 1804

1. Compound eye uniformly pilose, not forming vittae of contrasting colour; scutellum entirely black (Subgenus *Pandasyopthalmus* Stuckenberg, 1954a).....3
 - Pilosity of compound eyes arranged in two or more vertical vittae of different colours or reflecting light differently; scutellum entirely black or black with apex narrowly yellow or reddish 2
2. Eye pilosity forming two white vittae; posterior margin of scutellum not serrated (Subgenus *Paragus* Latreille, 1804) 8
 - Eye pilosity forming three distinct white vittae; posterior margin of scutellum distinctly serrated (Subgenus *Serratoparagus* Vujic & Radenkovic, 2008).....9
3. Face entirely yellow, without median black vitta 4
 - Face with distinct median black vitta 5
4. Terga shining black, without any coloured markings; metatarsus distinctly incrassate*atratus* Meijere, 1906
 - Tergum 3 with paired yellow maculae; metatarsus not incrassate.....*P. annandalei* Ghorpade, 1992
5. Postpedicel three times longer than wide; sternum

Table 1. Floral visitation records of the species of Indian *Paragus*.

No.	Species	Plants	Indian records	References
i.	<i>Paragus atratus</i> Meijere, 1906	<i>Solanum nigrum</i> (Solanaceae)	Assam, Uttarakhand	Mitra and Banerjee, 2007
ii.	<i>Paragus politus</i> Wiedemann, 1830	<i>Amaranthus spinosus</i> (Amaranthaceae), <i>Cynodon</i> sp. (Poaceae), <i>Lantana camara</i> (Verbenaceae), <i>Solanum nigrum</i> (Solanaceae)	Assam, Himachal Pradesh, Meghalaya, Punjab, Sikkim, Uttarakhand, West Bengal, Jammu & Kashmir	Datta and Chakraborty, 1984; Mitra and Banerjee, 2007
iii.	<i>Paragus annandalei</i> Ghorpade, 1992	<i>Solanum nigrum</i> (Solanaceae)	Himachal Pradesh, Jammu & Kashmir, Uttarakhand.	Datta and Chakraborty, 1984
iv.	<i>Paragus haemorrhous</i> Meigen, 1822	<i>Rubus fruticosus</i> agg. (Rosaceae)	West Bengal	Herkenrath, 2014
v.	<i>Paragus rufocinctus</i> (Brunetti, 1908)	<i>Amaranthus spinosus</i> (Amaranthaceae), <i>Cynodon</i> sp. (Poaceae), <i>Solanum nigrum</i> (Solanaceae)	Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Jammu & Kashmir, Kerala, Meghalaya, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.	Datta and Chakraborty, 1984
vi.	<i>Paragus tibialis</i> (Fallén, 1817)	<i>Nicotiana tabacum</i> (Solanaceae), <i>Solanum nigrum</i> (Solanaceae), <i>Amaranthus spinosus</i> (Amaranthaceae)	Arunachal Pradesh, Bihar, Himachal Pradesh, Jammu & Kashmir, Kerala, Meghalaya, Tripura, Uttar Pradesh, West Bengal.	Krsteska, 2008; Mitra and Banerjee, 2007
vii.	<i>Paragus auritus</i> Stuckenberg, 1954b	<i>Spermacoce</i> sp. (Rubiaceae), <i>Guizotia abyssinica</i> (Asteraceae), <i>Mangifera indica</i> (Anacardiaceae)	Andhra Pradesh, Karnataka, Odisha, Tamil Nadu, West Bengal.	Thompson and Ghorpade, 1992
viii.	<i>Paragus bicolor</i> (Fabricius, 1794)	<i>Lantana camara</i> (Verbenaceae), <i>Solanum nigrum</i> (Solanaceae)	Jammu & Kashmir	Datta and Chakraborty, 1984
ix.	<i>Paragus crenulatus</i> Thomson, 1869	<i>Phyla nodiflora</i> (Verbenaceae)*, <i>Persicaria</i> sp. (Polygonaceae)*, <i>Acmella uliginosa</i> (Asteraceae)*, <i>Ocimum</i> sp. (Lamiaceae)*, <i>Croton bonplandianus</i> (Euphorbiaceae)*, <i>Mikania micrantha</i> (Asteraceae)*, <i>Eclipta prostrata</i> (Asteraceae)*, <i>Mimosa pudica</i> (Fabaceae)*, <i>Ipomoea aquatica</i> (Convolvulaceae)*, <i>Lippia alba</i> (Verbenaceae)*	Assam, Bihar, Kerala, Karnataka, Maharashtra, Tamil Nadu, Tripura, West Bengal	Present study
x.	<i>Paragus quadrifasciatus</i> Meigen, 1822	<i>Cynodon</i> sp. (Poaceae)	Jammu & Kashmir	Datta and Chakraborty, 1984

xi.	<i>Paragus serratus</i> (Fabricius, 1805)	<i>Anacardium occidentale</i> (Anacardiaceae), <i>Euphorbia milii</i> (Euphorbiaceae)*, <i>Tridax procumbens</i> (Asteraceae), <i>Impatiens balsamina</i> (Balsaminaceae)*, <i>Ageratum conyzoides</i> (Asteraceae), <i>Lantana camara</i> (Verbenaceae), <i>Oxalis stricta</i> (Oxalidaceae)*, <i>Persicaria orientalis</i> (Polygonaceae), <i>Solanum nigrum</i> (Solanaceae), <i>Mangifera indica</i> (Anacardiaceae), <i>Wedelia calendulacea</i> (Asteraceae)	Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Goa, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Mizoram, Odisha, Punjab, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Dadra Nagar Haveli, Daman & Diu, Delhi, Jammu & Kashmir, Lakshadweep	Thompson and Ghorpade, 1992; Datta and Chakraborty, 1984; Mitra and Banerjee, 2007
xii.	<i>Paragus yerburiensis</i> Stuckenberg, 1954b	<i>Ageratum conyzoides</i> (Asteraceae), <i>Anacardium occidentale</i> (Anacardiaceae), <i>Euphorbia hirta</i> (Euphorbiaceae), <i>Guizotia abyssinica</i> (Asteraceae), <i>Mangifera indica</i> (Anacardiaceae), <i>Mimosa pudica</i> (Fabaceae), <i>Vicoa indica</i> (Asteraceae)	Andhra Pradesh, Bihar, Karnataka, Kerala, Madhya Pradesh, Odisha, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal, Delhi	Thompson and Ghorpade, 1992

*indicates newly recorded floral association

3 trapezoidal.....*P. rufocinctus* (Brunetti, 1908)

– Postpedicel twice as long as wide, sternum 3 squarish.....6

6. Vena spuria long, extends beyond cell dm and crossvein dm-m (Vujic *et al.*, 2008: Fig. 22); postgonite small, convex dorsally (Haarto, 2014: Fig. 2).....*P. haemorrhous* Meigen, 1822

– Vena spuria short, ending before cell dm and crossvein dm-m (Thomson and Ghorpade, 1992: Fig. 1; Tot, 2021: Fig. 8); Postgonite large, concave dorsally (Thomson and Ghorpade, 1992: Fig. 18; Haarto, 2014: Fig. 4).....7

7. Postgonite bent at a smaller angle and measures approximately equal in length as hypandrial theca (Haarto, 2014: Fig. 4).....*P. tibialis* (Fallén, 1817)

– Postgonite bent at a larger angle and approximately twice as long as the hypandrial theca (Thomson and Ghorpade, 1992: Fig. 18) *P. politus* Wiedemann, 1830

8. Wing extensively bare, cell c and bm bare; tergum 7 in female, with a pair of prominent tubercles.....*P. quadrifasciatus* Meigen, 1822

– Wing extensively microtrichose, apical ½ or more

of cell c microtrichose; apical ¼ of cell bm microtrichose; tergum 7 in female, without tubercles *P. bicolor* (Fabricius, 1794)

– Tergum 1 nearly all black, especially behind transverse ridge, only narrowly reddish on posterior margin; wing nearly completely bare, hyaline, with only a few scattered microtrichia apically; profemur without black markings, even at base*P. yerburiensis* Stuckenberg, 1954b

– Tergum 1 extensively reddish medially, not black behind transverse ridge; profemur variably black or not at all 10

9. Large species (7.3–9.0 mm); antennae longer than face; profemur wholly brownish-yellow, with no black markings; metatibia without dark-brown annulus subapically, sometimes a brownish tinge may be present*P. auritus* Stuckenberg, 1954b

– Smaller species (5.1–6.8 mm); antennae as long as face; profemur at least basally brownish-black or black; metatibia with distinct dark-brown annulus subapically.....11

10. Wing suffused with yellowish-brown at least in cell c; metafemur almost entirely dark brown; mesonotal pile long; terga with conspicuous,

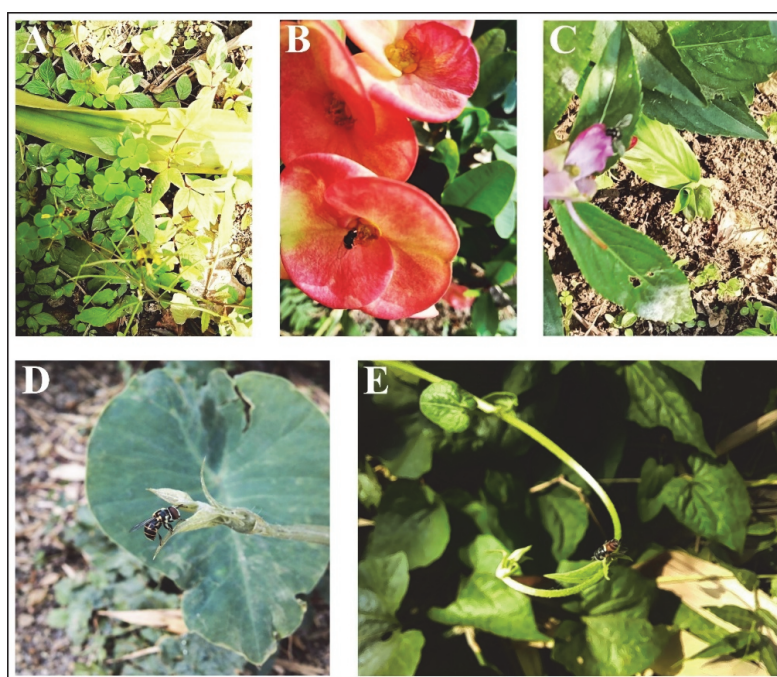


Fig. 1 A–E. Adult flies of the subgenus *Serratoparagus* visiting different plants. A. *Oxalis stricta*; B. *Euphorbia milii*; C. *Impatiens balsamina*; D–E. *Mikania micrantha*.

reclinate black pile
*P. crenulatus* Thomson, 1869
 – Wing clear, never suffused with yellowish-brown;
 metafemur yellow, with narrow dark brown
 annulus; mesonotal pile short; terga with sparse and
 inconspicuous black pile
*P. serratus* (Fabricius, 1805)

A total of 12 species of the genus *Paragus* were presented along with their associated host plants (Table 1). The present study highlights the diversity of plant associations among *Paragus* species. Species of the subgenus *Serratoparagus* (Fig. 1) tend to be more generalist, visiting multiple plant families, which may reflect their ecological flexibility and adaptability to diverse habitats. In contrast, some species of the subgenus *Paragus* appear more selective, feeding on specific plants, which could influence their local distribution and abundance. The present findings extend the previous reports by Datta and Chakraborty (1984), Thompson and Ghorpade (1992), and Mitra (2010). The broad host range observed in species like *P. serratus* and *P. crenulatus* suggests potential for their use in pollination studies and biological control

programs. However, the limited number of plant records for species such as *P. haemorrhous* and *P. quadrifasciatus* highlights the need for additional field observations to enhance the understanding of the ecological interactions within this genus.

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