

ADDITIONAL NOTES ON THE GENUS *PARAGUS* LATREILLE (DIPTERA: SYRPHIDAE) FROM PAKISTAN WITH A NEW COUNTRY RECORD

M. A. Hassan^{*1}, K. Ghorpadé², I. Bodlah¹, K. Mahmood³ and Z. Iqbal¹

¹Laboratory of Biosystematics, Department of Entomology, Faculty of Crop and Food Sciences, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan; ²University of Agricultural Sciences, Karnataka, India; ³Department of Entomology, Faculty of Agriculture, The University of Poonch, Rawalakot, Azad Jammu and Kashmir.

*Corresponding Author Email: kakojan112@gmail.com; imranbodlah@gmail.com

ABSTRACT

Six species of the genus *Paragus* Latreille, viz. four species under subgenus *Pandasyopthalmus* and one species each under subgenera *Paragus* and *Serratoparagus* are reported from Pakistan. These known species are distributed as follows: *Paragus (Paragus) quadrifasciatus* Meigen, 1822 and *P. (Paragus) compeditus* Wiedemann, 1830 from Gilgit-Baltistan; *Paragus (Pandasyopthalmus) annandalei* Ghorpadé, 1992, *P. (Pandasyopthalmus) haemorrhous* Meigen, 1822 and *P. (Pandasyopthalmus) politus* Wiedemann, 1830 from Azad Kashmir and *P. (Serratoparagus) serratus* (Fabricius, 1805) and *P. (Pandasyopthalmus) politus* Wiedemann, 1830 has been recorded from Punjab province of Pakistan. ***Paragus (Paragus) quadrifasciatus* Meigen, 1822** is a new country record for Pakistan. The six here collected species are mentioned along with their local distributional notes, remarks and diagnostic characters. Photographs of the morphological characters and drawings of male terminalia of all known species have been provided. A checklist of the seven known species of the genus *Paragus* Latreille is given along with distributional notes.

Key words: *Paragus*, Syrphidae, Pakistan, New Record.

INTRODUCTION

The genus *Paragus* Latreille, 1804 (Diptera: Syrphidae) belongs to the subfamily Syrphinae, tribe Paragini, with more than 100 described species worldwide, with 50 species from the Palaearctic and 24 species from the whole Oriental region (Sorokina, 2009; Thompson and Ghorpadé, 1992). It comprises four subgenera (Vujić *et al.*, 2008), the subgenus *Paragus* being easily identified from the subgenus *Pandasyopthalmus* by the presence of vertical bands of hairs on the eyes (Sorokina, 2009). The subgenus *Serratoparagus* have double band of hairs on the eyes and scutellum with distinct teeth on the posterior margin, while subgenus *Afroparagus* includes Afrotropical species (Vujić *et al.*, 2008). Both the larvae and adults are of economic importance, as the adults play their role in pollinating the crops while the larvae are predators of soft-bodied Hemiptera and some other insects. The adults are small (2.5–6.5 mm) and black with yellow or orange marks on the abdomen. The flies mainly prefer arid biotopes and usually occur near the ground surface in low grasses (Sorokina, 2009).

Thompson and Ghorpadé (1992) presented a key to 14 Oriental species of *Paragus* Latreille with three new species of the subgenus *Paragus* Latreille and two new species of the subgenus *Pandasyopthalmus* Stuckenberg, with illustrations of male genitalia. They also provided new regional records of the species from

the Indian subcontinent. Claußen and Weipert (2004) worked on the subgenus *Pandasyopthalmus* Stuckenberg from Nepal and described a new species, *Paragus (Pandasyopthalmus) karnaliensis* sp. nov. and compared it with *P. abrogans* Goeldlin, 1971 that was declared a distinct species which was hitherto treated as a synonym of *P. rufocinctus* (Brunetti, 1908) by Thompson and Ghorpadé (1992); they also presented identification keys to the subgenus *Pandasyopthalmus* Stuckenberg from Nepal and adjacent areas of the Palaearctic region. Sorokina and Cheng (2007) provided distributional notes, key to species and listed 21 species of the genus *Paragus* Latreille, along with the descriptions of three species under the subgenus *Paragus* Latreille and one species under the subgenus *Pandasyopthalmus* Stuckenberg, from China. Illustrations of head, antennae, abdomen, male genitalia and the terminal segment of the female abdomen were also provided. Khaghaninia and Hosseini (2013) worked on the genus *Paragus* Latreille, 1804 from East Azerbaijan and Kordestan province of Iran and reported nine species, with *Paragus* *cinctus* Schiner & Egger, 1853 as a new country record, and also provided a key to species, distribution, diagnostic characters supported with micrographs of the species.

Ghorpadé and Shehzad (2013) provided new distributional records of four already recorded species and added one new country record of species under the genus *Paragus* Latreille in the checklist of Syrphidae of Pakistan. Additionally they were with the assumption that six additional species given in the supplementary

checklist of Syrphidae, recorded from Afghanistan and Indian administrated Jammu and Kashmir may also be found in Pakistan. Later, Turk *et al.*, (2014) collected *Paragus haemorrhous* Meigen from several localities of Quetta, Baluchistan and provided a checklist of the genus *Paragus* (Latreille, 1804) from Pakistan. Hassan *et al.*, (2017) reported *Pandasyopthalmus annandalei* Ghorpadé, 1992 as a new country record from Azad Kashmir.

At present, about 7 species of the genus are known from Pakistan, but the work on this genus from Pakistan needed to be further explored. So the present study was conducted to explore the taxonomic work and present an updated checklist of this group from Pakistan.

MATERIALS AND METHODS

Adult hoverflies were collected from several localities in Punjab Province (Rawalpindi and adjacent areas of Islamabad), Azad Kashmir (District Poonch: Rawalakot, Hajira, Banjosa, Jandali) and Gilgit-Baltistan (District Skardu) having height ranges 975-2225m, during various months of years 2015 and 2016. The species were mostly collected from dry areas with few flowering plants, forest areas and along road-sides. Most of them were collected while found hovering over different crops, vegetation and flowers. The specimens were killed by placing them in a killing jar containing Potassium Cyanide for at least 30-40 minutes and then pinned to study taxonomic characters. The specimens were identified under a CZM6 Labomed Binocular Microscope and with the help of literature viz., (Claußen and Weipert, 2004; Khaghaninia and Hosseini, 2013; Sorokina, 2009; Sorokina and Cheng, 2007; Thompson and Ghorpadé, 1992; Turk *et al.*, 2014 and Van Veen, 2004). The photographs of the species were taken with the help of a Nikon SMZ 1500 Binocular Microscope with an attached Nikon Digital Sight DS Fil camera. The identified specimens will be deposited in the Laboratory of Biosystematics, Department of Entomology, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan, for future studies.

RESULT

In this study, six species were collected and identified. *Paragus (Paragus) quadrifasciatus* Meigen, 1822 is a new country record for the Syrphid fauna of Pakistan. The diagnostic characters, local distributional notes, remarks, photographs and drawings of male terminalia of all known species have been provided. A checklist of the seven known species of the genus *Paragus* Latreille is given along with distributional notes.

FAMILY SYRPHIDAE

Subfamily Syrphinae

Genus *Paragus*

Subgenus *Pandasyopthalmus* Stuckenberg, 1954

Paragus (Pandasyopthalmus) annandalei Ghorpadé, 1992 (Figure 1. a-c)

Material Examined (4 ex.): Azad Kashmir: Rawalakot: Goi-Nala, 1660m, 7.vi.2016, 1♀, 7.viii.2016, 2♂ 1♀, leg. M.A. Hassan.

Distribution: Azad Kashmir: Rawalakot (Hassan *et al.*, 2017).

World Distribution: India: Jammu & Kashmir (Thompson and Ghorpadé, 1992).

Remarks: Hassan *et al.*, (2017) reported only a female specimen of this species from Rawalakot at an elevation 1637m on 09.v.2015 and also presented the preferable habitat of this species as *Solanum nigrum* near standing water. We again collected both male and female specimens from the same habitat. Thompson and Ghorpadé (1992) identified this as a new species and gave the diagnostic characters as follows: spurious vein short and ending before the junction of fourth vein and sub-apical cross vein; tergum 3 with a pair of narrow yellow spots anteriorly; fore and mid tibia orange yellow and female with a whitish pair of pollinose spots on frons anteriorly.

Paragus (Pandasyopthalmus) politus (Wiedemann, 1830) (Figure 2. a-b)

Material Examined (8 ex.): Azad Kashmir: Rawalakot, 1645m, 21.vi.2015, 1♂, Jandala, 1000m, 1.v.2015, 1♂, Hajira, 914m, 2.vi.2016, 1♂, leg. M.A. Hassan, Pakistan: Islamabad: Shakarparia, 584m, 15.x.2016, 2♂, Arid Agricultural University, 508m, 22.x.2016, 1♂, Quaid-e-Azam University, 622m, 23.x.2016, 2♂, leg. M.A. Hassan.

Distribution: Pakistan: Balakot, Timurgarh, Swat, Kohat, Murree, Balochistan (Ghorpadé and Shehzad, 2013).

World Distribution: Afghanistan, China, India, Indonesia, Malaysia, Nepal, Philippines, Thailand, West Bengal (Ghorpadé, 2015).

Remarks: Ghorpadé and Shehzad (2013) recorded this species from several localities of Pakistan. Thompson and Ghorpadé (1992) differentiated this morphologically similar species from *P. tibialis* on the basis of male genital characters of long and curved paramers. Hypandrium anteriorly convex, posterior-ventral on basal side rounded, superior lobe of hypandrium half as long as theca, sur-stylus apically dilated (Sorokina and Cheng, 2007; Claußen and Weipert, 2004). This species has been collected while found hovering over *Solanum nigrum* plants near ground level.

Paragus (Pandasyophthalmus) haemorrhous Meigen, 1822 (Figure 3. a-b)

Material Examined (8 ex.): Azad Kashmir: Rawalakot, 1645m, 9.v.2015, 1♀, 14.iv.2016, 1♀, Jandala, 1000m, 1.v.2015, 1♀, Hajira, 914m, 14.iv.2016, 2♀, leg. M.A. Hassan. Pakistan: Islamabad: Shakarparia, 584m, 15.x.2016, 3♀, leg. M.A. Hassan.

Distribution: Pakistan: Balochistan, Quetta, Sariab, Huna lake, Sabzal (Turk *et al.*, 2014).

World Distribution: Afghanistan, China, Iran, Ireland, Israel, Italy, Kazakhstan, Malta, Mongolia, North Africa, North America, Norway, Russia, Tajikistan, Turkey, Turkmenistan (Sorokina and Cheng, 2007; Sorokina 2009; Khaghaninia and Hosseini, 2013; Ghorpadé 2015).

Remarks: Khaghaninia and Hosseini (2013) gave the following diagnostic characters of this species as sternite 4 and sternite 3 having equal length. Van Veen (2004) provided the diagnostic characters for the male as: lateral margins of abdomen black, at least on tergite 2 or completely black, vertex triangle covered with distinctly black or black and yellow hairs as against the similar species *Paragus abrogans* Goeldlin, 1971 which was listed from the Indian sub-continent by Ghorpadé (2015). *Paragus abrogans* Goeldlin, 1971 and has lateral margin of abdomen red along tergites 2-5 and vertex covered with yellow hairs only. Sorokina (2009) gave the key characters for both male and female of this species as: female with face strongly projecting forward, median facial strip wide, occupying 1/2-1/3 of face width, frons mainly with black hairs, mesonotum non-shiny and without blue tint, tergite 4 mainly with black hairs. Turk *et al.*, (2014) collected the species *Paragus haemorrhous* Meigen from the various localities of Quetta, Baluchistan during April to June and October to early days of December and recorded the most active period of this species from Quetta being October and November. Synonyms and re-descriptions of both male and female were given and diagnostic characters as both male and female having slightly waisted abdomen, tergite 3 in male being orange while in female it is black and the spurious vein in female touching the M1 vein. We collected this species mostly from under the shade of *Pinus wallichiana* at ground level in forest and dense vegetation of mint flowers (Lamiaceae) near running water.

Subgenus *Paragus* (Latr. 1804)

Paragus (Paragus) quadrifasciatus Meigen, 1822 (Figure 4. a-b)

Material Examined (3 ex.): Gilgit-Baltistan: Skardu, 2225m, 25.vii.2016, 2♂ 1♀, leg. M.A. Hassan.

Distribution: Pakistan: New country record.

World Distribution: Afghanistan, China, India, Iran, Kazakhstan, Kirghizia, Russia, Tajikistan,

Turkmenistan (Sorokina, 2009; Ghorpadé and Shehzad, 2013).

Remarks: This species was also included in the supplementary checklist on the Syrphidae of Pakistan by Ghorpadé and Shehzad (2013) and later, Shehzad *et al.*, (2017) did not mention this species in the updated checklist of Syrphidae of Pakistan. So during the current study we collected both male and female specimens of this species from vegetable fields (Potato) at Skardu at an elevation of 2225m. Khaghaninia and Hosseini (2013) keyed out this species with characteristics as: mesonotum with distinct pale pruinose stripes which reach posterior margin of notum, interrupted in middle; posterior margin of sternite 4 with a rounded projection. This species has been collected while found hovering over *Solanum nigrum* plants infested by *Aphis fabae* near ground level.

Paragus (Paragus) compeditus Wiedemann, 1830 (Figure 5. a-b)

Material Examined (3 ex.): Skardu, 2225m, 16.viii.2016, 1♂ 1♀, 17.viii.2016, 1♂, leg. M.A. Hassan.

Distribution: Pakistan: Khyber Pakhtunkhwa: Peshawar (Ghorpadé and Shehzad, 2013).

World Distribution: Afghanistan, Iran (Khaghaninia and Hosseini, 2013; Ghorpadé, 2015).

Remarks: This species has been collected while found hovering over *Solanum nigrum* plants infested by *Aphis fabae* near ground level.

Subgenus *Serratoparagus* Vujic' & Radenkovic', 2008

Paragus (Serratoparagus) serratus (Fabricius, 1805) (Figure 6. a-c)

Material Examined (3 ex.): Pakistan: Rawalpindi (Ayub Park), 520m, 10.x.2016, 1♀, Islamabad (Shakarparia), 584m, 15.x.2016, 2♂, leg. M.A. Hassan.

Distribution: Pakistan: Butkhela, Dir, Malakand, Swat, Parachinar, Khanawal, Multan, Muzafargarh, Karachi (Ghorpadé and Shehzad, 2013).

World Distribution: Afghanistan, India, Nepal, Sri Lanka (Thompson and Ghorpadé, 1992; Ghorpadé, 2015).

Remarks: This species was placed in a new subgenus "*Serratoparagus*" by (Vujic' *et al.*, 2008) and by (Ghorpadé, 2015) who followed this classification and treated this species as in the genus *Serratoparagus*. Thompson and Ghorpadé (1992) differentiated this species by the presence of serrate on posterior margin of scutellum, first abdominal tergite being medially reddish and hind femora yellow with narrow dark brownish annulus, mesonotalpile short, wing hyaline. This species was collected from flowers of *Brassica campestris*.

CHECKLIST OF GENUS *PARAGUS* FROM PAKISTAN

Paragus (Pandasyophthalmus) annandalei Ghorpadé, 1992

Pakistan: Azad Kashmir (Rawalakot) (Hassan *et al.*, 2017).

Paragus (Pandasyophthalmus) haemorrhous Meigen, 1822

Pakistan: Pakistan: Balochistan (Huna lake, Quetta, Sabzal, Sariab) (Turk *et al.*, 2014), Punjab (Shakarparia), Azad Kashmir (Rawalakot, Jandala and Hajira).

Paragus (Pandasyophthalmus) politus (Wiedemann, 1830)

Pakistan: (Khyber Pakhtunkhwa) Balakot, Kohat, Swat, Timurgarh, (Punjab) Murree, (Quetta) Balochistan (Ghorpadé and Shehzad, 2013).

Paragus (Paragus) bicolor (Fabricius, 1794)

Pakistan: (Khyber Pakhtunkhwa) Abbottabad, Dera Ismail Khan, Peshawar, (Balochistan) Quetta (Ghorpadé and Shehzad, 2013).

Paragus (Paragus) compeditus Wiedemann, 1830

Pakistan: (Khyber Pakhtunkhwa) Peshawar (Ghorpadé and Shehzad, 2013).

Paragus (Paragus) quadrifasciatus Meigen, 1822

Pakistan: (Gilgit-Baltistan) Skardu. New country record.

Paragus (Serratoparagus) serratus (Fabricius, 1805)

Pakistan: (Khyber Pakhtunkhwa) Butkhela, Dir, Malakand, Swat, (Federally Administered Tribal Areas) Parachinar, (Punjab) Khanewal, Multan, Muzafargarh, (Sindh) Karachi (Ghorpadé and Shehzad, 2013). (Punjab) Ayub Park (Rawalpindi) and Shakarparia (Islamabad).



Figure 1. (a-c): (a) *P. (Pandasyophthalmus) annandalei*; (b) tergum 3 with a pair of narrow yellow spots, (c) spurious vein short ending before junction of fourth vein and subapical cross vein.

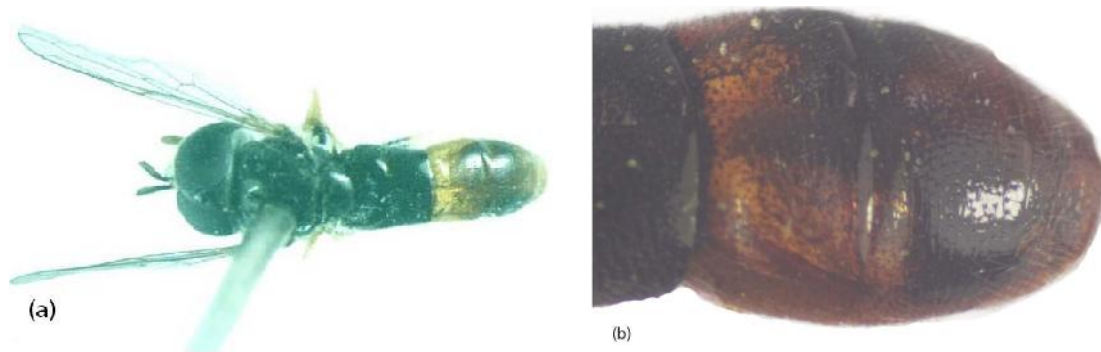


Figure 2. (a-b): a) *P. (Pandasyophthalmus) politus*; (b) abdomen extensively red.

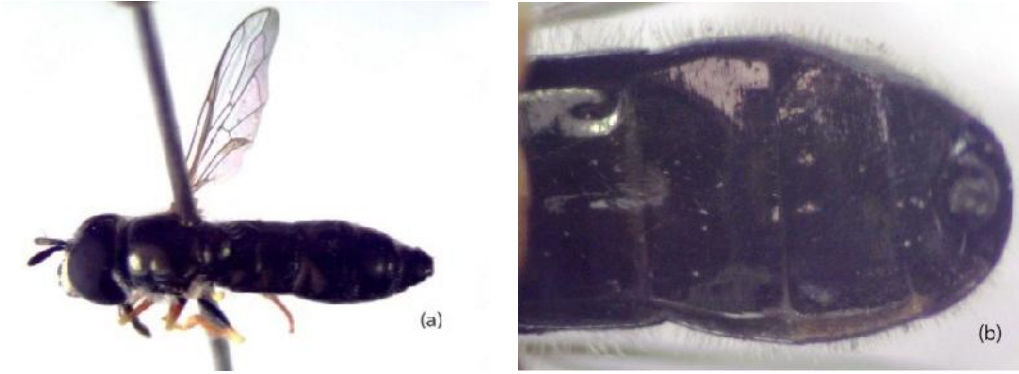


Figure 3. (a-b): a) *P. (Pandasyopthalmus) haemorrhous*; (b) sternite 4 as long as sternite 3.

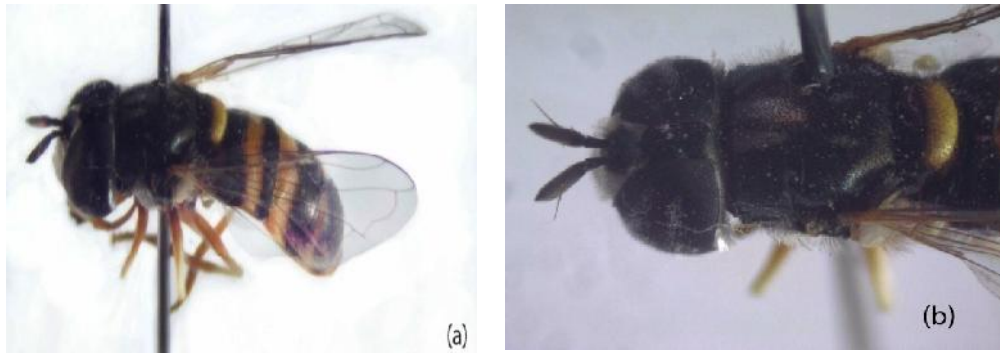


Figure 4. (a-b): (a) *P. (Paragus) quadrifasciatus*; (b) mesonotum pruinosity interrupted in the middle.

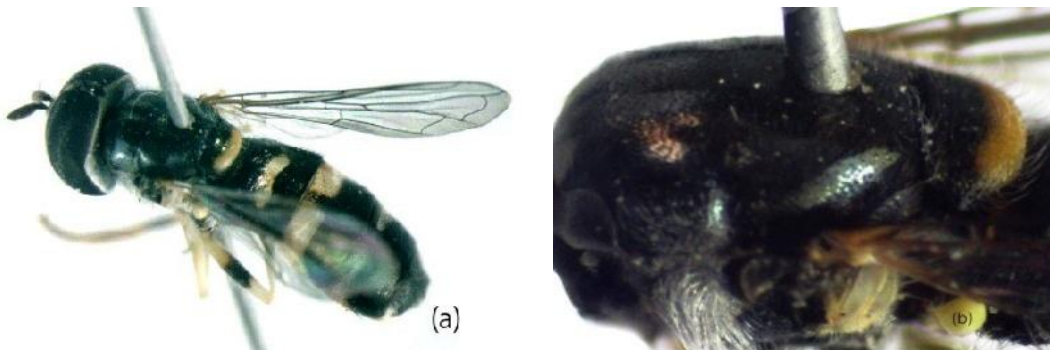


Figure 5. (a-b): (a) *P. (Paragus) compeditus*; (b) mesonotum with short stripes of pale pruinosity.

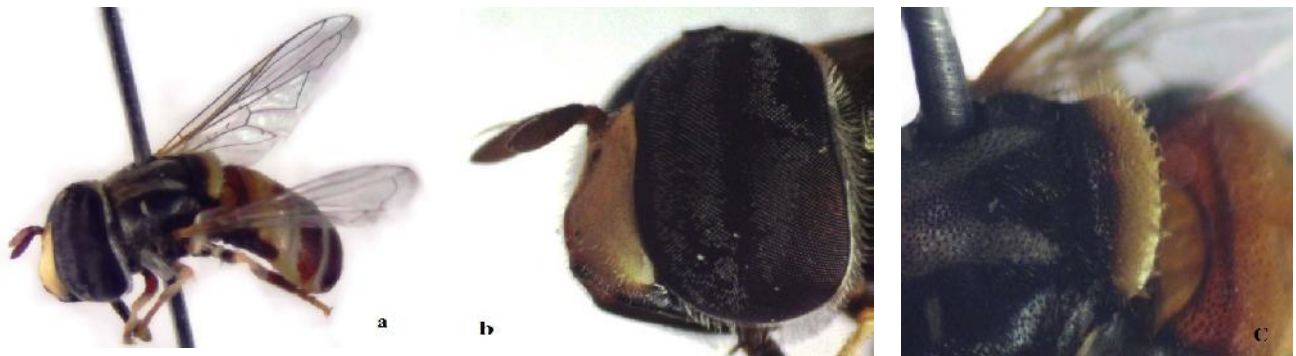


Figure 6. (a-c): (a) *P. (Serratoparagus) serratus*, (b) eyes forming three bands of hairs, (c) serrate on posterior margin of scutellum.

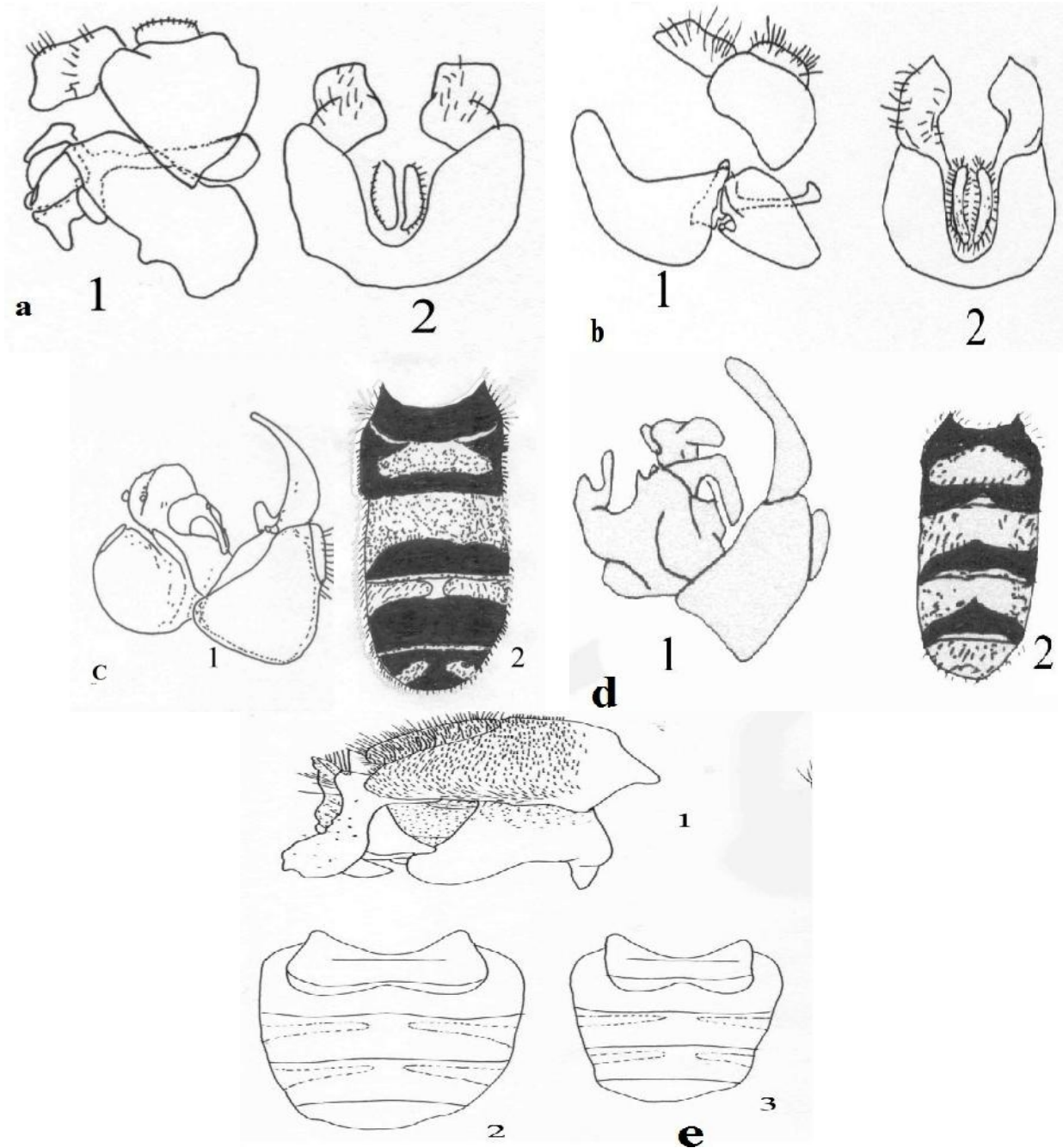


Figure 7: (a) *P. (Pandasyopthalmus) annandalei*; 1-lateral, 2-dorsal view of male genitalia. (b) *P. (Pandasyopthalmus) politus*; 1-lateral, 2-dorsal view of male genitalia. (c) *P. (Paragus) quadrifasciatus*; 1-lateral view of male genitalia, 2-dorsal view of male abdomen. (d) *P. (Paragus) compeditus*; 1-lateral view of male genitalia, 2-dorsal view of male abdomen. (e) *Paragus (Serratoparagus) serratus*; 1- lateral view of male genitalia, 2, 3-dorsal view of male and female abdomen.

DISCUSSION

The eyes are completely hairy in subgenus *Pandasyopthalmus* and with double band of hairs, hind margin of scutellum with distinct teeth in subgenus *Serratoparagus* and without teeth in subgenus *Paragus*.

During this study four species under subgenus *Pandasyopthalmus* and one species each under subgenera *Paragus* and *Serratoparagus* have been reported from Pakistan. To avoid the confusion in sub-generic rank Vujić *et al.*, (2008) is followed. All of the species were collected from the close vicinity of water channels or

from the flowers of *Brassica campestris* and *Solanum nigrum* under the shade of pine trees near standing water. The checklist of all known species of this genus has also been provided. Shehzad *et al.*, (2017) updated the hoverflies of Pakistan and did not mention many species that Ghorpadé and Shehzad (2013) provided in the supplementary checklist on the Syrphidae of Pakistan. So, the supplementary checklist and some questionable species included as Syrphidae of Pakistan should also be investigated and examined thoroughly from Pakistan. The present study was aimed at exploring the genus *Paragus* from Pakistan and to confirm the questionable species of Ghorpadé and Shehzad (2013). We reported *Paragus (Paragus) quadrifasciatus* Meigen, 1822 as a new country record for Pakistan.

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