

New records of flower visiting Calyptrate flies (Diptera: Muscidae, Calliphoridae, Polleniidae) from Kozhikode and Malappuram districts in Kerala, India

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Abstract

A taxonomical study was conducted on Calyptrate flies (Diptera: Brachycera) from various localities in Kozhikode and Malappuram districts, Kerala. Calyptrate flies are identified as belonging to ten genera and three families, namely Muscidae (seven species), Calliphoridae (seven species), and Polleniidae (one species). Among them, four species (*Musca inferior* Stein, *Neomyia diffidens* Walker, *Dichaetomyia nubiana* Bigot, and *Chrysomyia rufifacies* Macquart) and two genera (*Dexopollenia* Townsend and *Catapicephala* Macquart) are newly recorded for the state of Kerala. A detailed systematic account along with updated distributional locations and ecological roles of each newly recorded species is provided.

Keywords Calyptrate flies; Muscidae; Calliphoridae; Polleniidae; new records; Malappuram district; Kozhikode district; Kerala.

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1 Introduction

The clade Calyptratae (Order Diptera, Suborder Brachycera) is a well-known and highly diversified dipteran fly group, distributed in almost all zoogeographic regions throughout the World. The faunal diversity of the clade Calyptratae is mainly divided into three superfamilies: Hippoboscoidea, Muscoidea, and Oestroidea (Pape et al., 2011). Most of the species in this group are usually oviparous but a few are viviparous and breed on decaying organic matter such as rotten fruits, carrion, and cow dung (Sinha, 2015). Many families of fly species in this group are of high economic importance as they are potential pollinators in agricultural and horticultural lands (Larson et al., 2001). Some are of medical and veterinary importance as they carry various types of germs (Cadavid et al., 2015).

According to Pape et al. (2011) the clade Calyptratae comprises more than 23,000 species belonging to 15 families. The knowledge and information about the Calyptrate flies, especially the Muscidae and Calliphoridae

families, from the state of Kerala are fairly well. Only a few species are reported from Kerala in scattered publications. Joseph and Parui (1986) worked on the Diptera group from Silent Valley National Park in Kerala and reported a total of five species of Calyprate flies of which three were from the Muscidae (viz. *Musca bezzii* Patton and Cragg, *Orthellia claripennis* Malloch and *Orthellia timorensis* R-D) and two from the Calliphoridae (*Stomorhinadiscolor* Fabricius and *Idiellauidielloides* Senior-White). Shinonaga and Tewari (2008) studied muscid flies in India, Sri Lanka, and Bangladesh. They also documented 14 species of Muscidae from this state. The first report of *Chrysomya albiceps* Wiedemann (family Calliphoridae) from Kerala was made by Radhakrishnan et al. (2012) where, fully grown third-stage larvae of *C. albiceps* were recovered from free-ranging sambar deer. Paul and Binoy (2021) observed the development rate on *Hemipyrellia ligurriens* Wiedemann for the calculation of exact postmortem interval assessment which is helpful in forensic investigations. There has been no taxonomic research work on this group from Kerala except Sreejith et al. (2021), described flies of family Sarcophagidae from the campus of the University of Calicut with documentation of 11 species, four of which were newly recorded from the state and one fly was reported in the mainland India for the first time. The main intent of the present study is to provide a short systematic account and ecological roles of each newly recorded flower visiting Calyprate flies in the state of Kerala, India.

2 Materials and Methods

2.1 Study area

The study was carried out in the campus of the University of Calicut (UOC) and various localities in Kozhikode (11°15'31.5108" N and 75°46'49.4796" E) and Malappuram (11° 4' 19.3260" N and 76° 4' 26.4180" E) districts of the state of Kerala (Fig. 1), which included open grass land, cattle shed, flowering gardens, local forest patches and bushes, a decomposing garbage area, roadside vegetation, and open grazing land. But most of the study area were covered with open fields, flowering gardens, local forest patches, and bushes. The average humidity and rainfall of these surveyed districts are $\pm 70\%$ and ± 129 inches, respectively. These districts are mostly characterized by local forest patches and steep hillslopes.

2.2 Methods of collection and identification

All the specimens in this survey were collected by using a butterfly hand net followed by the standard sweeping method. Following collection, the flies were paralysed in a euthanizing jar with liquid benzene vapour before being transported to the laboratory for dry preservation. In the laboratory, flies were pinned with entomological pins (No. 1) passing through the prothoracic segment, and each fly was labelled with the collection locality and date. The flies were identified using a stereoscopic microscope (Model: SYS-45ETR) following keys of Emden (1965); Gisondi et al. (2020); Senior White et al. (1940). Dissection of male genitalia was performed in case of few to confirm identification. Few terminologies were used after Cumming and Wood (2017).

3 Results

From the entire examined specimens, a total of 15 species of Calyprate flies were identified (Table 1, Fig. 2), out of which seven species each from the families Muscidae and Calliphoridae and one from the Polleniidae family. Four species (*Musca inferior* Stein, 1909; *Neomyia diffidens* Walker, 1857; *Dichaetomyia nubiana* Bigot, 1885 and *Chrysomya rufifacies* Macquart, 1842) and two genera namely *Dexopollenia* Townsend, 1917 and *Catapicephala* Macquart, 1851 have been recorded in Kerala for the first time. The collection site and diversity index of each identified species are also given in Table 1. A short systematic account and updated distribution sites along with the ecological roles of each newly recorded species is given herein.

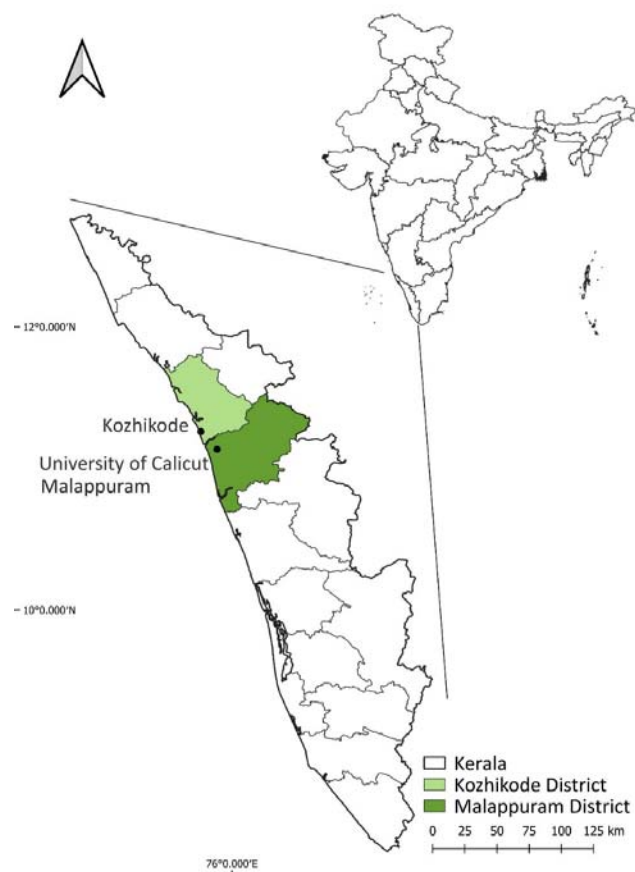


Fig. 1 Geographical locations of sampling sites.

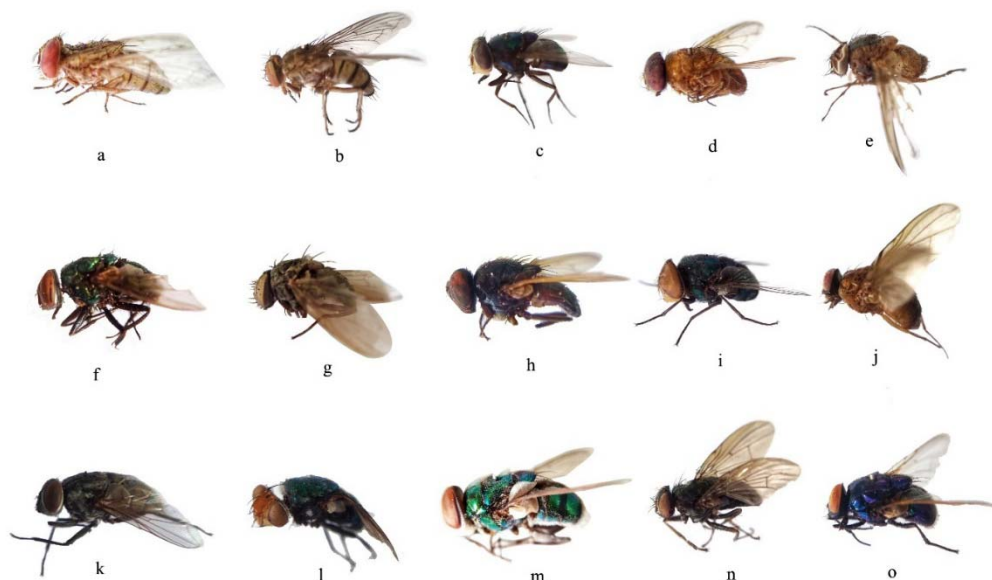


Fig. 2 Different species of flower visiting Calyptrate flies reported in Kozhikode and Malappuram districts, Kerala, India. a. *Bengalia torosa*, b. *Bengalia jejuna*, c. *Chrysomya* sp., d. *Dexopollenia* sp., e. *Dichaetomyia nubiana*, f. *Hemipyrellia ligurriens*, g. *Myiospila* sp.2, h. *Ophyra* sp., i. *Chrysomya megacephala*, j. *Dichaetomyia* sp., k. *Musca inferior*, l. *Catapicephala* sp., m. *Chrysomya rufifacies*, n. *Myiospila* sp.1, o. *Neomyia diffidens*.

Table 1 List of Calyprate flies identified from Kozhikode and Malappuram districts in Kerala(*newly recorded species for state of Kerala; UOC- University of Calicut).

Family	Species	Collection sites	No. of collected specimens	Abundance / diversity index	Records
Muscidae	*1. <i>Neomyia diffidens</i> Walker, 1857	Kozhikode: Kozhippara, Janaki Forest, Janakikkadu.	12	High	Mitra (2006); Emden (1965)
	*2. <i>Musca inferior</i> Stein, 1909	Malappuram: Campus of UOC, Thenjipalam.	10	High	Mitra (2006); Emden (1965)
	3. <i>Myospila sp.1</i>	Manjeri	2	Moderate	Shinonaga and Tewari (2008)
	4. <i>Myospila sp.2</i>	Palakkad: Ottapalam	2	Low	Shinonaga and Tewari (2008)
	5. <i>Ophyra sp.</i>	Malappuram: Kottakkal	2	Moderate	Emden (1965)
	6. <i>Dichaetomyia sp.</i>	Malappuram: Kakkadampoyil	2	Low	Shinonaga and Tewari (2008)
	*7. <i>Dichaetomyia nubiana</i> Bigot, 1885	Kozhikode: Perambra	2	Moderate	Emden (1965)
Calliphoridae	8. <i>Chrysomyia megacephala</i> Fabricius, 1794	Thrissur: Guruvayur, Arimpoor. Palakkad: Ottapalam, Kuzhaimannam. Malappuram: Campus of UOC, Vallikkunnu, Kottakkal.	22	High	Stevens et al. (2008)
	*9. <i>Chrysomyia rufifacies</i> Macquart, 1842	Malappuram: Campus of UOC, Irimbiliyam, Thenjipalam,	12	High	Nandi (2004)
	10. <i>Hemipyrellia ligurriens</i> Wiedemann, 1830	Malappuram: Thenjipalam, Campus of UOC, Kakkadampoyil, Tanur. Thrissur: Arimpoor Kozhikode: Medical College	14	High	Paul and Binoy (2021)
	11. <i>Bengalia torosa</i> Wiedemann, 1819	Malappuram: Nilambur	4	Low	Nandi (2002)
	12. <i>Bengalia jejuna</i> Fabricius, 1787	Malappuram: Vallikkunnu	2	Low	Nandi (2004)
	*13. <i>Catapicephala sp.</i>	Malappuram: Campus of UOC	4	Moderate	Nandi (2004); Senior White et al. (1940)
	14. <i>Chrysomyia sp.</i>	Malappuram: Kottakkal	4	Moderate	Nandi (2004)
Polleniidae	*15. <i>Dexopollenia sp.</i>	Malappuram: Campus of UOC	4	Low	Gisondi (2020); Nandi (2004)

*Systematic accounts of newly recorded species.

i. *Neomyia diffidens* Walker, 1857

1857. *Musca (Pyrellia) diffidens* Walker, *Journal of the proceedings of the Linnaeus Society*, **I**, 26.

Material Examined: 2♂, Kerala: Kozhikode, Janaki Forest, 30.III.2018, N. Jana; 2♀, Kerala: Kozhikode, Kozhippara, 10.III.2018, N. Jana.

Diagnosis: Medium size fly, body dark purple to bluish in colour. Both male and female body sizes range between 6–8 mm. Head: compound eyes in male are holoptic in nature and dichoptic in female; in male lower one third of parafrofrontalia and upper two thirds of parafacial have glossy silvery pollinosity. Thorax: mesonotum is dark purple to deep bluish in colour, without any recognizable stripes or vittae; suprasquamal ridge is hairy; presutural acrostichal and presutural dorsocentral bristles are absent; one pair of each postsutural acrostichal and dorsocentral bristles is present; katepisternal bristle 0+1. Wings: hyaline, not entirely hairy; posterior margin of the stem vein hairy; wing vein M1+2 bend rounded. Legs: blackish in colour.

Remarks: Most of this fly in the survey we collected from flowering plants.

Distribution: Widespread, in India this species reported from the states of Arunachal Pradesh, Assam, Chhattisgarh, Karnataka, Madhya Pradesh, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal, and Kerala.

Ecological roles: The adult flies were found on flowering plants and dung. The adults are good pollinators, have potential role in pollination in Agri and Horticulture fields.

ii. *Musca inferior* Stein, 1909

1909. *Musca inferior* Stein, *Tijdschr. Ent.*, **LII**, 213; 1918, *Ann. Mus. Hungar.*, **XVI**, 149

Material examined: 1♂, Kerala: Malappuram, UOC, 25.VIII.2017, N. Jana; 4♂, Kerala: Malappuram, Thenjipalam, 15.IX.2018, N. Jana.

Diagnosis: The length of this fly ranges from 6 to 9 mm. Head: frons in males is subcontiguous; arista short and plumose type; proboscis is hardly sclerotized and thickened. Thorax: mesonotum is greyish in colour with four longitudinal stripes; the suprasquamal ridge is hairy; prosternum, anepisternum, and anepimeron are hairy and meron is devoid of hairs. Abdomen: densely greyish pollinosity with a black-coloured median vittae and two lateral brown-coloured vittae are also present. Wings: hyaline and wholly hairy; vein M1+2 bend anteriorly; the dorsal surface of the lower squama contains much black setulae. Legs: blackish to dark brown in colour.

Remarks: The type species of this fly was described in nature from Java (Bezzi, 1920). In the survey these flies were collected from bushes in open grazing land and from cow shed.

Distribution: This species widely distributed in India, reported from the states of Assam, Arunachal Pradesh, Andhra Pradesh, Tamil Nadu, West Bengal, and Kerala.

Ecological roles: This species is a potent haematophagous on cattle and wildlife animals. They are usually observable near cattle shed, open grazing land, especially cattle in fields.

iii. *Dichaetomyia nubiana* Bigot, 1885

1885. *Spilogaster nubianus* Bigot, *Annales de la Société Entomologique de France* (6), **IV**, 288.

Material examined: 1♂, Kerala: Kozhikode, Perambra, 10.IV.2017, N. Jana.

Diagnosis: The size of this fly is moderately large, with length ranging from 6 to 8 mm. Head: compound eyes reddish in colour, holoptic or contiguous in male; antennal segments are orange to yellowish in colour; Proboscis with well-developed labella. Thorax: mesonotum glossy yellowish to golden in colour; vertex infuscate; anepimeron, anepisternum, and prosternum covered with hairs; post dorsocentral bristles 3; numerous fine hairs present on the lateral side of the scutellum below the marginal setae. Wings: hyaline, wholly hairy; wing vein M1+2 straight forward. Abdomen: all tergites and sternites in male are yellowish in

colour. Legs: coxa, femur, tibia yellowish to orange in colour and slightly brownish tarsus tip.

Remarks: Male and female flies of this species are usually found together. During the survey one fly was collected from flowering plants in shady area and one from decaying organic matters.

Distribution: India: Andhra Pradesh, Maharashtra, Uttar Pradesh, the Eastern Himalaya, West Bengal, and Kerala.

Ecological roles: The flies of this species are basically found in shady forested areas. Adults are saprophagous by nature, feed on decaying organic materials, rotten fruits, and leaves.

iv. *Chrysomya rufifacies* Macquart, 1842

1842. *Lucilia orientalis* Macquart, *Mem. Soc. Roy. Sci. Arts. Lille, Annee* p. 302.

Material examined: 1♂, 2♀, Kerala: Malappuram, UOC, 12.V.2019, N. Jana; 1♀, Kerala: Malappuram, Thenjipalam, 26.VI.2019, N. Jana; 1♀, Kerala: Malappuram, Irimbiliyam, 02.III.2019, N. Jana.

Diagnosis: A large fly measures between 8 and 10 mm in length. Head: male eyes are contiguous or holoptic, while female eyes are dichoptic in nature; gena is whitish silvery dusted; antennal segments are orange in colour. Thorax: greenish yellow in colour, with whitish anterior spiracle; katapisternal bristles 1+1. Abdomen: all tergites are uniformly greenish-yellow in colour. Wings: hyaline; the posterior margin of the stem vein has numerous setulae; the upper surface of the lower squama is covered with pale, whitish-coloured hairs. Legs: blackish in colour.

Remarks: Adult fly of this species is easily recognized with the character posterior margin of 2nd, 3rd, and 4th abdominal tergites have dark band.

Distribution: Cosmopolitan by nature. In India: Jharkhand, Pondicherry, Sikkim, West Bengal, the Nicobar Islands, and Kerala.

Ecological roles: Adults are generally attracted by wounds and abscess in vertebrate animals and efficiently implicated myiasis in domestic animals, wildlife, and human beings. This fly has great medicolegal importance as it has been reported as a myiasis-causing fly (Verma, 2013).

v. *Catapicephala* sp.

Material examined: 2♀, Kerala: Malappuram, UOC, 18.IV.2018, N. Jana.

Genus diagnosis: The length of this fly is between 9 and 10 mm. Head: male and female compound eyes are dichoptic in nature, and yellowish colour face. Thorax: greenish colour; post alar wall on scutellum covered with fine hairs. Wings: hyaline, covered with hairs; upper surface of stem vein has no hairs or setulae; basal portion is slightly infuscate; dorsal surface of lower squama is bare. Abdomen: all tergites are blueish to greenish colour; the ventrobasal scale is hairy and tergites on sternites do not overlap. Legs: blackish in colour.

Remarks: This species much hairy and frons in female solid orange in colour.

Distribution: In India, this genus reports from the states of Arunachal Pradesh, Himachal Pradesh, Uttarakhand, West Bengal, and Kerala.

Ecological roles: The flies were collected from bushes in shady area at campus of UOC and not much known about their life cycle.

vi. *Dexopollenia* sp.

Material examined: 1♂, Kerala: Malappuram, UOC, 15.II.2017, N. Jana.

Genus diagnosis: Medium-sized fly, with length 6 and 7 mm. Head: in male compound eyes are holoptic in nature; arista plumose type with brownish face. Thorax: mesonotum is golden yellowish in colour, with yellowish-orange colour anterior and posterior spiracles. Wings: hyaline and completely covered with hairs;

the posterior margin of the stem vein has no hairs or setulae. Abdomen: all tergites and sternites are usually yellowish in colour. Legs: coxa, femur, tibia, and all tarsi are yellow in colour.

Remarks: The flies of this genus are basically yellowish abdomen. The flies were collected near flowering garden.

Distribution: In India, this genus is reported from the states of Assam, Uttarakhand, West Bengal, and Kerala.

Ecological roles: Field observations of this fly on flowering plants suggested that this fly is efficient pollinators and play a vital role in pollination for flowering plants.

4 Discussion

The present survey reported a total of fifteen species including seven species each from family Calliphoridae and Muscidae and one from family Polleniidae. Being a good bioindicator, the diversity of Calyptrate flies indicates a well-balanced ecosystem. Synanthropic nature of these flies indicates faunal diversity in this area. Fly species such as *Neomyia diffidens* Walker, *Dichaetomyia nubiana* Bigot and *Dexopollenia* sp. have been observed to be flower visitors and thus play an important role in crop pollination. Three species of the family Calliphoridae, namely *Chrysomya megacephala* Fabricius, *Chrysomya rufifacies* Macquart, and *Hemipyrellia ligurriens* Wiedemann, have forensic importance as they cause myiasis in humans, cattle, and wild animals (Badenhorst and Villet, 2018; Nandi, 2004). Adults of some species, being synanthropic in nature, have the potential for the mechanical transmission of pathogenic organisms (Crosskey and Lane, 1993). Therefore, it is relevant to study diversity and distributional information that will be helpful to entomologists during entomological investigations. Some species including *Dichaetomyia nubiana* have been observed in the survey to play a major role in decomposing and recycling decaying organic matter. Further studies can provide valuable information on their ecology and behaviour. This survey is a step forward towards understanding the Calyptrate flies in Kerala, India.

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