

Pictorial Handbook
Flower Visiting Flies
(Diptera : Insecta)
of Kolkata and Surroundings

BULGANIN MITRA
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MANU MUKHERJEE
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P. PARUI



ZOOLOGICAL SURVEY OF INDIA

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PREFACE

The Zoological Survey of India has published Handbooks on several invertebrate, vertebrate and entomological groups before. This Pictorial Handbook has partly adapted the style of its predecessors in catering to the needs of the beginner by providing the basic information on the different dipteran families involved in their visit to flowers along with coloured photographs and illustrations.

However, a strong feature of this Handbook on “Flower- visiting Diptera” is the emphasis on the association between the flies and the flowers of the trees, shrubs, herbs, gardens, and medicinal plants. The very reason of structuring this Handbook is that the beginner will be able to relate the flowers and the insects together as an integral part of a given ecosystem and biodiversity strategies.

The Diptera are probably the second most common order of flower–visitors and pollinators worldwide and may rival even the hymenopterans in their diversity especially in tropical countries. Today flies are being considered seriously as alternative pollinating agents of several cash crops and play a major role in maintenance of ecosystem diversity and ensuring food security.

However, in our long experience of working in the field of anthophilous flies, we have realized that this aspect of dipterans as flower-visitors have been grossly neglected and, hence is the need for a Handbook of this nature. The footnotes and remarks are our own observations in the field and the descriptions have been kept as easy and lucid as possible for the amateurs but done with professional expertise

We are extremely grateful to the Director, Zoological Survey of India, Kolkata, whose insightful idea of publishing popular series of handbooks inspired us to prepare the present one. Thanks are also due to Dr. A.K. Hazra, Scientist ‘F’ for his generous support and valuable suggestions. We are thankful to the staff and officers of the Diptera section, Zoological Survey of India, for their co-operation, without whom this book would not have seen the light of the day.

Author’s

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INTRODUCTION

The association between insects and flowers has a long history. The adoption of pollen as a food source by the insects had a fundamental effect on angiosperm evolution, providing an alternative to wind to move pollen from plant to plant. So, modification of plant structures soon developed to increase effectiveness of pollination by insects by producing showy flowers to advertise and nectar for food.

As flowers radiated so did the mouthparts of the insects exploiting them. Pollen has been available for more than 200 million years and the Nematocera (a suborder of Diptera) were able to exploit this food source very early. Fossils dating back to the late Jurassic period, around one hundred and fifty million years ago, described as *Palaepangonius eupterus* Ren, (Fig. 1 A & B) indicate the presence of Diptera with elongate mouthparts similar to the mouthparts of modern-day nectar-feeding species. These findings suggest a pre-Cretaceous origin of flowering plants, or possibly fly adaptations for feeding at the reproductive structures of early seed plants.

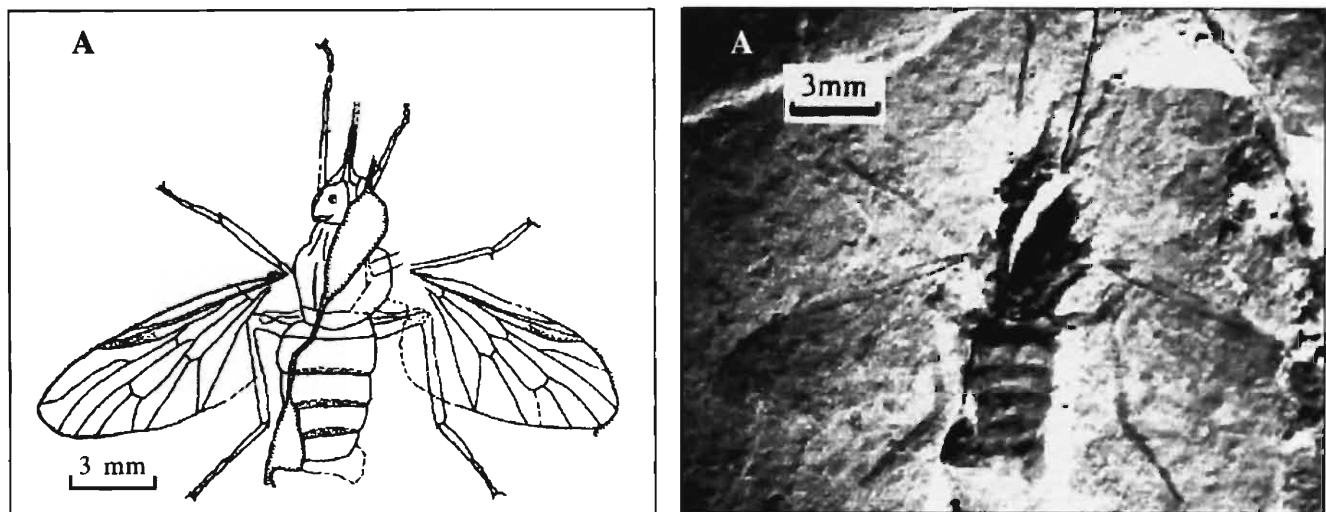


Fig. 1. *Palaepangonius eupterus* Ren, 1998.
(A) Camera lucida drawing of specimen (B) Photograph of body

Studies of fossils show that some of the important flower-visiting “True fly” families - such as flower flies (Syrphidae), bee flies (Bombyliidae), dance flies (Empididae), small headed flies (Acroceridae), flower loving flies (Apioceridae), and tangle veined flies (Nemestrinidae) were present as early as in the late Jurassic or early Cretaceous. However, this dimension of the flies has remained till date largely unexplored and it is only recently that fly pollinators are being valued in agriculture.

The city of Kolkata is one of the most densely populated metropolises of India and is going through a rapid phase of urbanization. (Map. 1) The city has drawn international attention as an “urban hotspot” because of the rapidly rising environmental disorders and is now a focus of sustainable urbanism to comprehensively reduce environmental threats. Non-availability of open spaces, filling up of water bodies, encroachment of parks and available vacant areas is gradually depleting Kolkata’s flora and fauna day by day.

The main objective of this handbook is to provide a guideline for identification and inventorisation of dipteran flower visiting species from Kolkata and its adjoining areas, with a hope that it would spark the imagination of dipterists in the other metropolises of our country. 33 species of flies found as flower visitors of 25 plant species in Kolkata and its adjoining areas. This information will not only provide the base-line data on flower visiting diptera to the interested dipterists but will also serve as an index of reference to the faunal and associated floral depletion of the Kolkata metropolis in years to come.

WHAT ARE THE TWO WINGED FLIES

For the commoner, all sorts of insects are flies, but to the entomologists, only the insect order “Diptera” commonly known as true flies. In compound names containing “fly” for members of this order, the name is written as two words as in “crane fly” For insects that are members of other orders the name is written as a single word as in “butterfly” The major morphological feature which distinguishes flies from other insects is their reduced hind wings, termed halteres (small, club-like structures that function as balancing organs during flight), thus adult flies have only one pair of functional wings, hence their scientific name – *Diptera* (*di*-two; *pteron*-wing).

The family includes many familiar insects such as mosquitoes, black flies, midges, fruit flies, flower flies, blow flies and house flies. True flies are among the most ubiquitous and can be found all over the world including the remotest continent Antarctica. Their close association with humans has led them to be perceived as annoying and unpleasant creatures, and indeed some flies are the cause of millions of deaths and illnesses among human populations. In spite of this, flies are the key components in most ecosystems and are beneficial in many ways.

The earliest fossil flies are known from the Upper Triassic of the Mesozoic geological period, some 225 million years ago. Since that time they have diversified to become one of the largest groups of organisms.

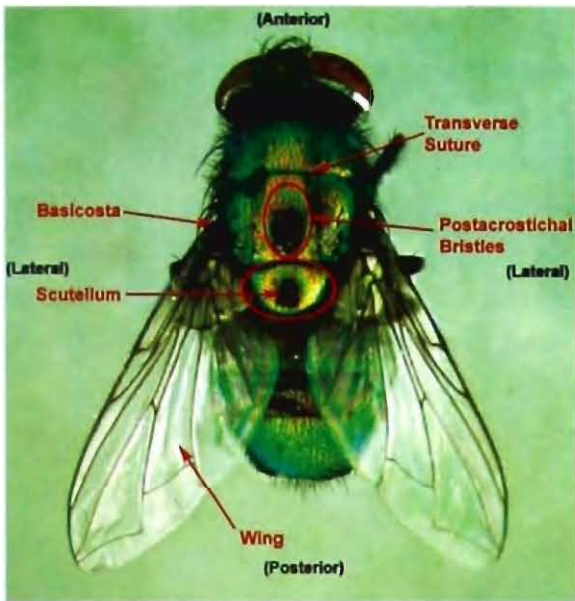


Fig. 2. Dorsal view of True fly

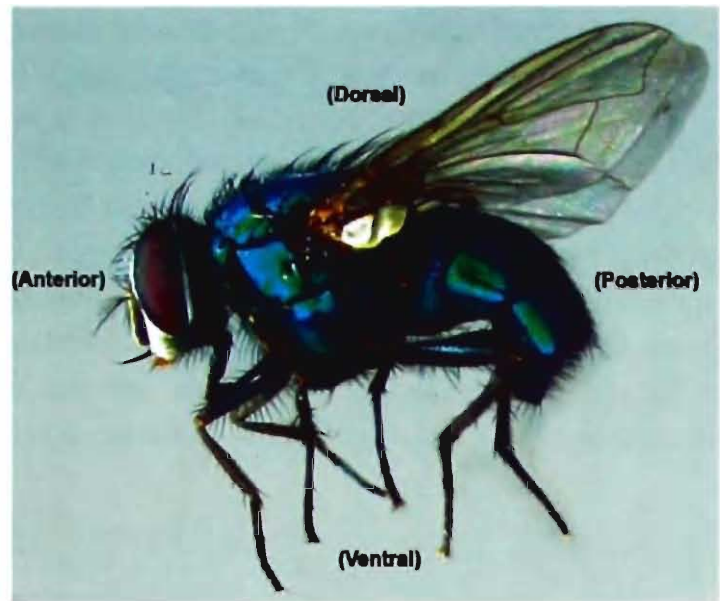


Fig. 3. Lateral view of True fly

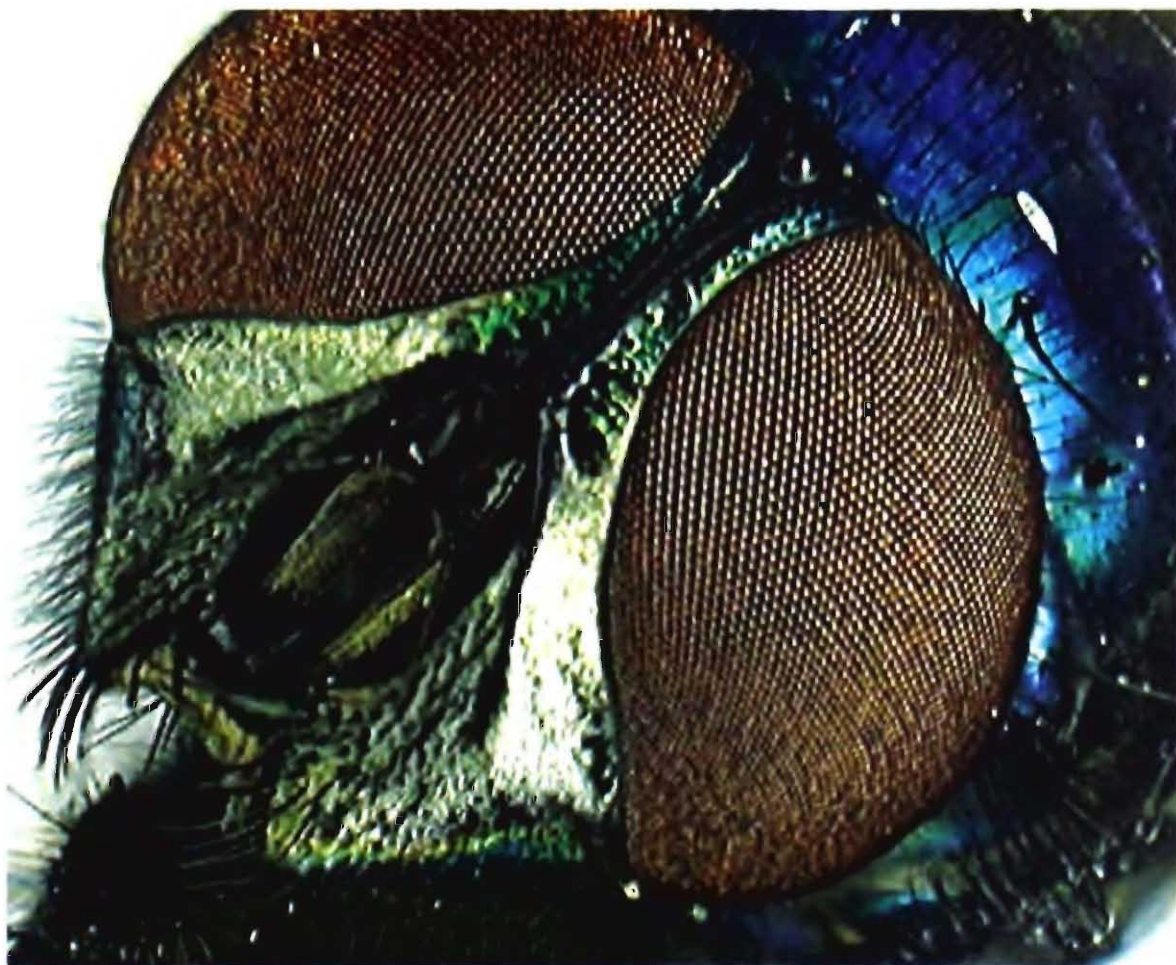


Fig. 4. Head and eyes of True fly

Flies are minute to small soft-bodied insects. Adults range in length from about 0.5 mm (some biting midges, Ceratopogonidae) to about 60 mm with a wingspan up to 75 mm (some robber flies, Asilidae). Head is highly mobile with large compound eyes and antennae are of variable size and structure. The adult mouthparts are modified for sucking liquids; mandibles, used in most insects for chewing, are usually absent. When present (e.g. in mosquitoes), mandibles are in the form of slender stylets that can pierce the skin of larger animals. In some families the mouthparts may be non-functional or even absent. The eyes are often large. Prothorax and metathorax are small and fused with the large mesothorax; wings present only on mesothorax. Legs are with 5-segmented tarsi and abdomen with variable number of visible segments (Fig. 2, 3 & 4).

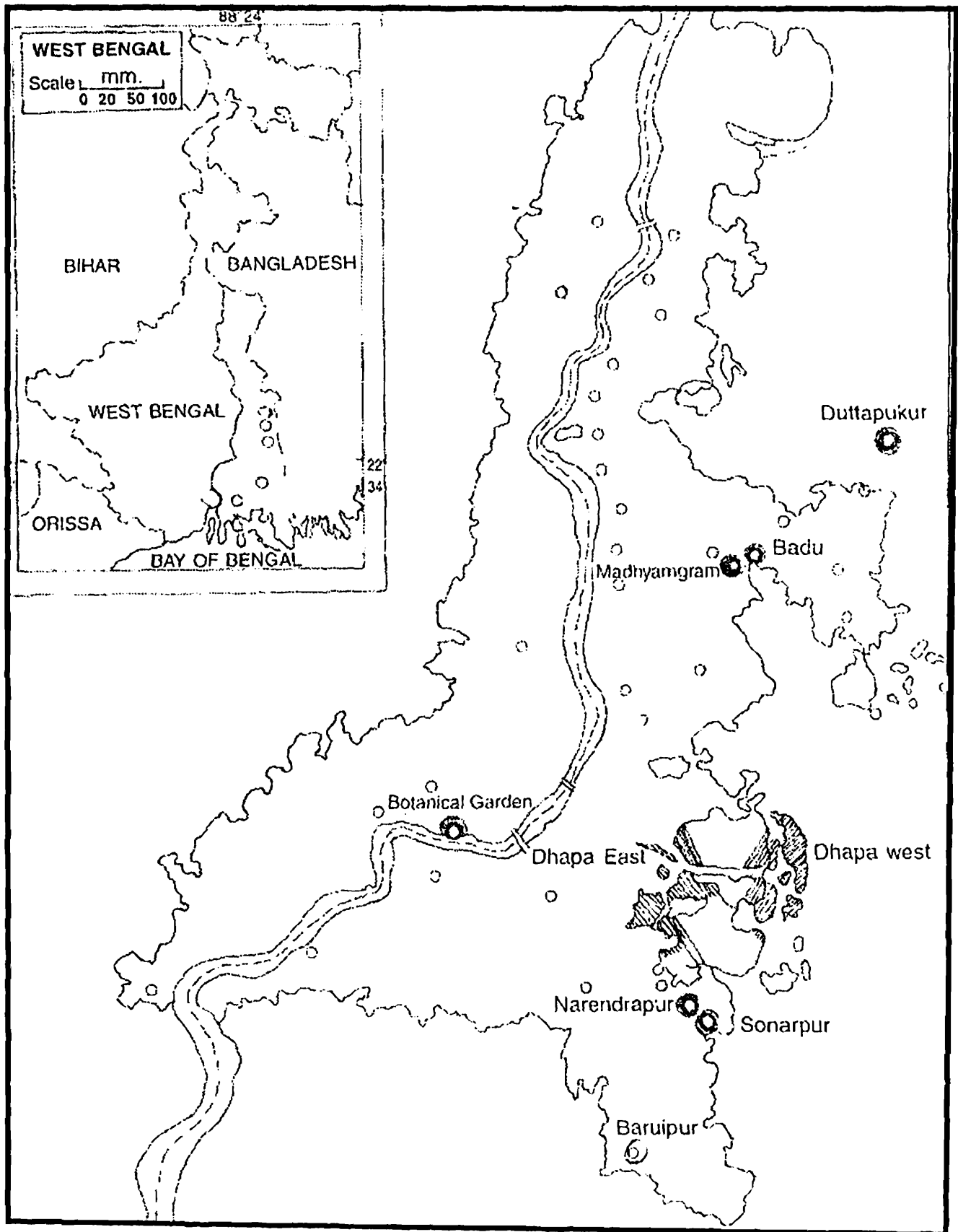
STUDY AREAS

Kolkata is located in eastern India in the Gangetic Delta at an elevation ranging between 1.5 to 9 metres. It is spread linearly along the banks of the River Hooghly in a north-south direction. Much of the city was originally a vast wetland, reclaimed over the decades to accommodate the city's burgeoning population. Like most parts of the Indo-Gangetic plains, the predominant soil type is alluvial.

The core city is sandwiched between the river on the west, the salt lakes to the east and the marshes and the swamps to the south. Kolkata is warm and humid most of the year around. However, the winter months, say, from November to February are cool, sunny, dry and very pleasant. Monsoon hits Kolkata generally in the second week of June and lasts till the end of September. During this period it rains regularly.

The study was conducted in and around the metropolis of Kolkata and its adjoining areas (in between 88°10' and 88°40'E longitudes and 22°20' and 22°45'N latitudes). 9 localities were specifically selected spreading over the north (Madhyamgram, Badu, and Dattapukur), south (Baruipur, Sonarpur and Narendrapur), east (Dhapa east and Dhapa west) and west (Howrah Botanical Garden) as study areas. Most of the localities were urban to semi urban in nature coming under the aegis of the Greater Kolkata region.

Collections were made from different habitats like agricultural fields, orchards, medicinal plant gardens, nurseries, road side herbage, bushes, trees, seasonal flower gardens, managed gardens and wild edge areas, throughout the day (day time only). The flies aggregated mostly during the early to mid morning on the flowers and their density and frequency gradually fell off through the midday as it got warmer. This pictorial hand book is the outcome of surveys made in between the years 2002-2004.



Map. 1. Map of Kolkata with its adjoining areas (not to scale)

DIVERSITY OF FLOWER VISITING FLIES AND FLY POLLINATION

Anthophilous flies are diverse, ranging from opportunistic nectar and pollen consumers to specialized nectarivores. Among the dipterans, a great majority of the members habitually long for flowers and spend much of their time mainly feeding on nectar (Syrphidae, Bombyliidae, Stratiomyidae, Pipunculidae, etc.) or on plant-sap (Ceratopogonidae, Aulacigastridae, a few Agromyzidae and Drosophilidae, etc), or using the flowers as selective ovipositing arena (Tachinidae, Calliphoridae, Muscidae, Tabanidae, Tephritidae, Bibionidae, Chironomidae, Culicidae, Empididae, Mycetophilidae and Cecidomyiidae).

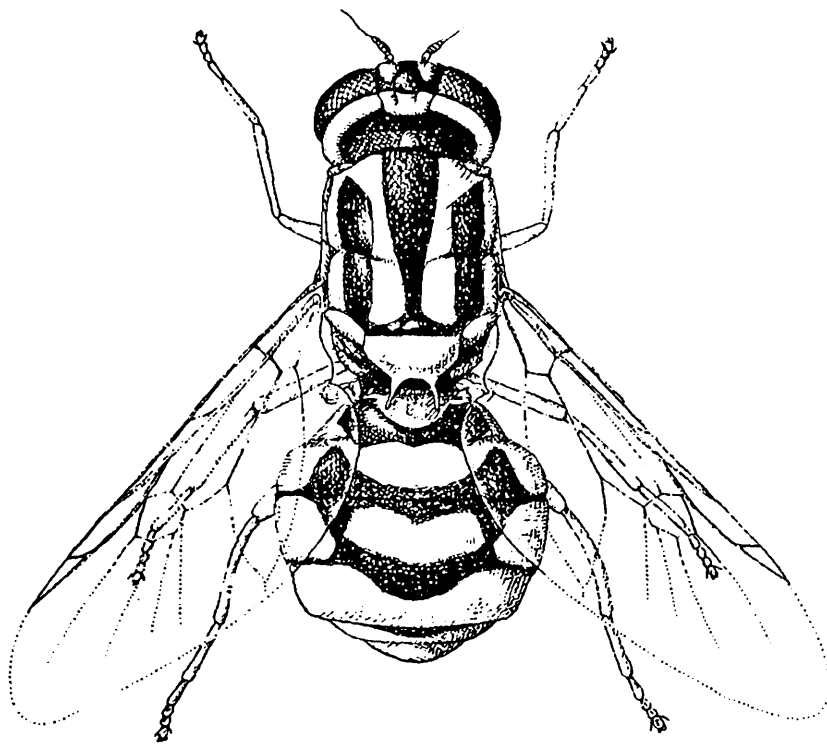
Flies that visit flowers regularly are potential pollinators. Flies that are confirmed as pollinators differ widely in their effectiveness. Many have short tongues, sparse hair which holds little pollen, and a tendency to visit flowers of multiple species. Others are highly coevolved with the plants they visit. A great variation in pollination methods is found among the plants that are fly-pollinated. Flies are important pollinators under certain climatic conditions because they are present at all times of the year. Some plants may be completely dependent on flies for pollination. Even flies that are generalists in their floral visits can contribute to plant reproductive success, and may equal or rival bees as effective pollinators in some cases.

The pollination is of two types, myophily (simple fly pollination) and sapromyophily (a complex type of fly pollination by carrion-fly and dung-fly). Some of the more notable pollinating flies in India belong to the families Syrphidae, Bombyliidae, Tabanidae, Tephritidae, Stratiomyidae, Tachinidae, Calliphoridae, Pipunculidae, Muscidae, Bibionidae, Chironomidae, Culicidae, Empididae, Mycetophilidae, and Cecidomyiidae.

A. Family STRATIOMYIDAE

Stratiomyids or soldier flies, compose a moderately large family of infraorder Stratiomyomorpha under the suborder Brachycera of Diptera that exhibit an extreme array of morphological diversity, as well as a moderate range of life histories.

The soldier flies can be distinguished from wasps by the fact that they have only two, rather than four wings and they never bite or sting. They are mostly strong fliers, and are pollen or nectar feeders, often seen sitting on umbelliferous flowers and herbage, especially in woods, dense vegetation, grass meadows near water or around decaying plants and garbage. When at rest, the wings are folded like scissors across their abdomens.



The adult flies are more or less flattened, and vary in color from black, metallic blue, green or purple, to brightly colored black and yellow patterns. The flies are invariably bare of bristles or spines (except the side thoracic spines in a few genera), but often possess dense soft pubescence extending over the whole body and femora; antennae are characteristic among flies in having a long terminal segment which, when bent, gives a flagged

appearance; thorax generally quadrangular or roughly oblong or oval, more or less pubescent, moderately or considerably arched; abdomen usually 5-7, sometimes eight segmented; wing venation characteristic, discal cell almost always pentagonal, first 3 longitudinal veins crowded upward towards the anterior margin of the wing, 4th posterior cell open.

Stratiomyids are found throughout the world but are particularly diverse in tropical regions. Worldwide there are about 400 genera recognized at present and well over 2,000 species. In India, there are 73 species belonging to 34 genera under 6 subfamilies. During this study, 3 species of 3 genera were found as flower visitors from Kolkata and its surroundings.

1. *Sargus metallinus* (Fabricius)

A medium sized fly (9-10 mm), elongated with bright metallic colour and almost colourless wing; head narrow towards frons, wider towards vertex and distinctly broadening towards antennae, the upper narrower part varying from bronze to bright green and lower part brownish yellow to brown; vertex with some brownish yellow hairs; face and lower part of head including proboscis varying from brownish orange to pale yellowish pubescence; thorax with dorsum and scutellum brilliantly shining metallic green, bronze green, or cupreous in male, and bluish green or green in female, covered with dense fine yellow in male or whitish pubescence in female; abdomen in male brightly metallic yellowish bronze or cupreous and violet or blue in female, in male sides of the abdomen densely yellow pubescent; legs pale yellow, with very short pale yellow pubescence in male and white pubescence in female; wings pale yellowish grey or pale brownish, stigma a little darker; halteres pale yellowish or white.



Sargus metallinus (Fabricius)



Bahuinia variegata var. *candida* Linnaeus

Remarks : The members of the family Stratiomyidae are one of the important pollinator groups of the order Diptera, and the species *Sargus metallinus* (Fabricius) has been collected from *Bahuinia variegata* var. *candida* Linnaeus during the survey.

2. *Oplodontha rubrithorax* (Macquart)

Small in size (5 mm) with black thorax and yellowish abdomen and colourless wing; head in male black, with short pale hairs below; a shining black tubercle immediately below antennae; in female frons forming one-third of the head, shining black with very

short silvery-white pubescence; eyes large; thorax dull black, with short, meagre, golden or brassy pubescence, sides black, with a little white pubescence; scutellum black, gold-dusted, spines very short; abdomen pale yellowish, more or less brownish on apical half; sometimes wholly pale; wings almost colourless, anterior veins pale yellowish, the rest almost invisible; halteres yellow; legs orange yellow, all tips of tarsi slightly darker, front femur with a narrow brown ring in middle or a streak on the underside.



Oplodontha rubrithorax (Macquart)



Tagetes patula Linnaeus

Remarks : *Oplodontha rubrithorax* (Macquart) was consistently encountered on *Tagetes patula* Linnaeus, and was collected only from these flower heads during the present study.

3. *Microchrysa flaviventris* (Wiedemann)

Very small flies (3.5 to 4 mm); head black; usually metallic in colour with clear wings; vertex black, shining with few black hairs; frons blackish with a few short pale hairs; face brilliantly shining metallic green, bare; proboscis and palpi rather bright



Microchrysa flaviventris
(Wiedemann)



Tagetes patula Linnaeus

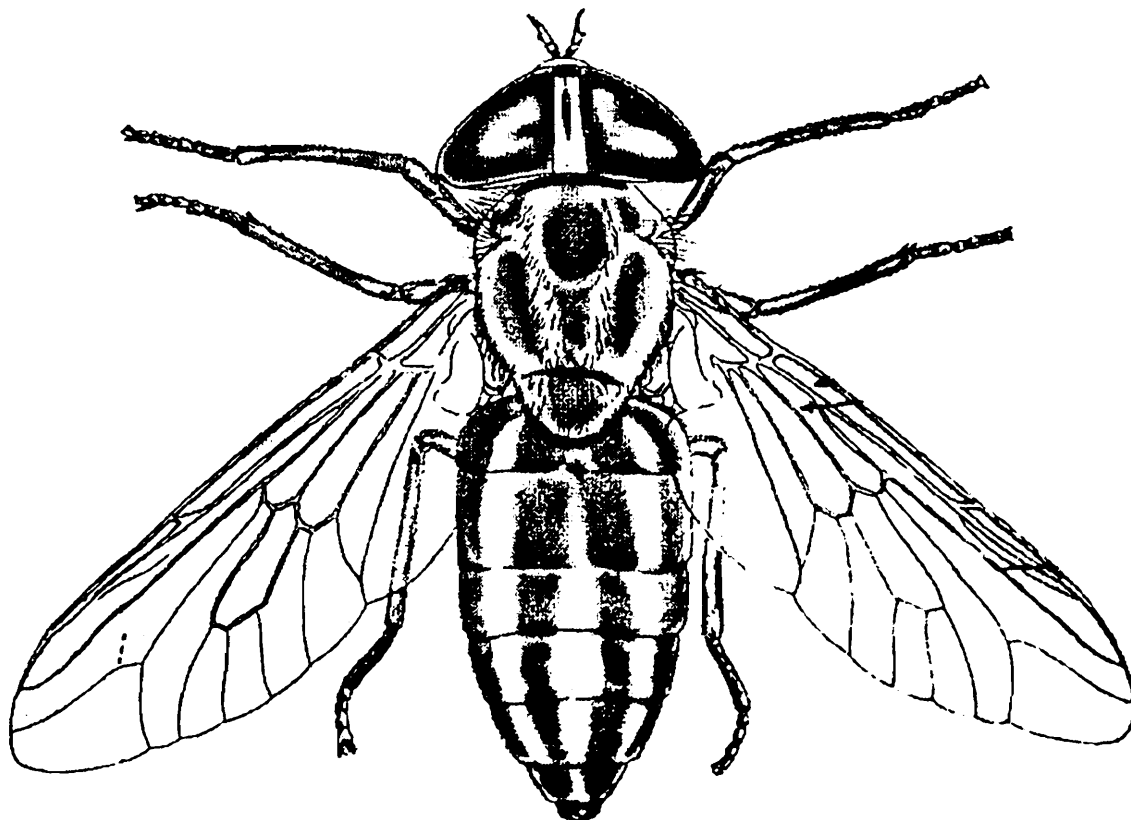
yellow; antennae and arista pale yellow; thorax brilliantly shining metallic green, with very sparse pale yellow pubescence on dorsum and parts of the pleurae; scutellum similar in colour; abdomen in male brownish yellow and brilliantly shining green in female with microscopic pale yellowish pubescence; venter generally brownish, sometimes yellowish or even metallic green; wings colourless, halteres yellow; legs pale yellow, hind femora with broad median brown band and hind tibia with broad apical band, both bands sometimes much paler.

Remarks : Though *Microchrysa flaviventris* (Wiedemann) is known to frequently visit the flowers of *Tagetes patula* Linnaeus, nothing is reported about its role in pollination. During the present study, we too have come across this species, several times and collected from the flower heads of *Tagetes patula* Linnaeus.

B. Family TABANIDAE

The members of the family Tabanidae are commonly known as horse flies, deer flies, clegs etc. The adult flies are medium to large (5-25 mm), stout and bristleless flies with colourful, patterned eyes. Most are black, grey or brown with broad bright bands or markings.

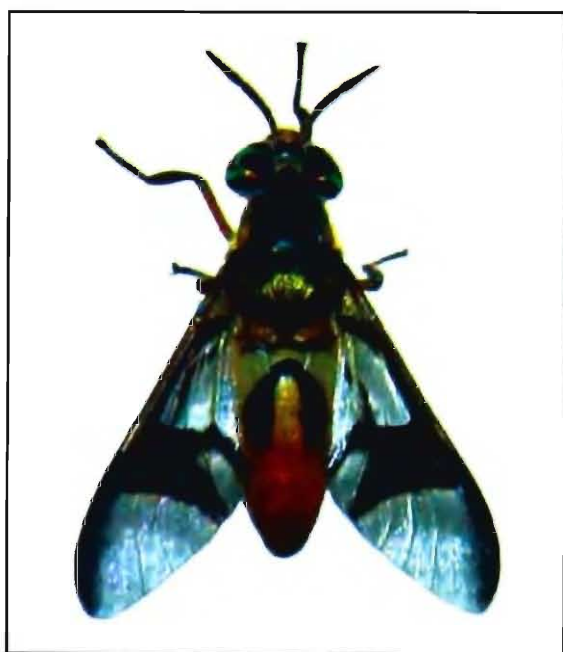
They are easily recognized with their antennae which have three segments and the distal one bearing annulations but no arista. The antenna is stiff and projected forward. The R_4 and R_5 veins of their wings diverge and enclose the wing tip.



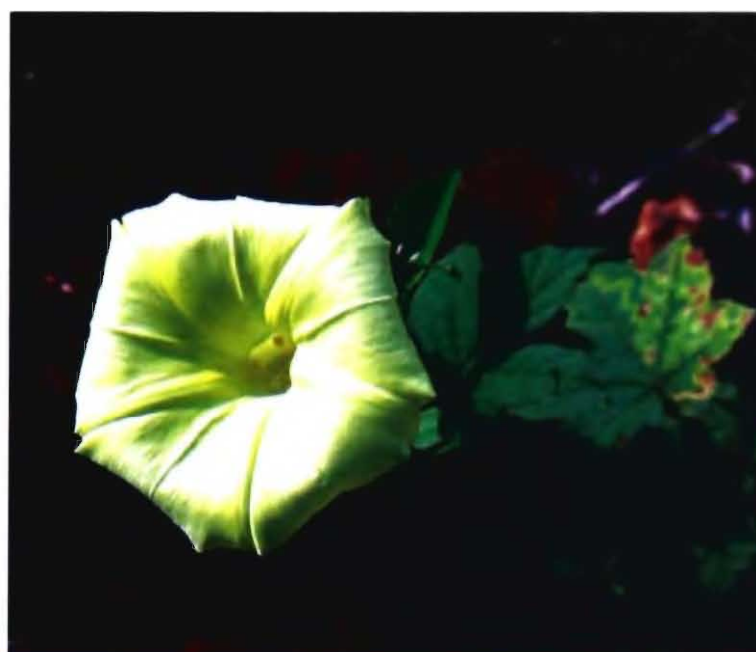
The adults of both sexes feed on nectar and pollen of flowers. They can be serious pests of cattle, horses and other mammals and may be very annoying to man with their persistent attacks. In the Orient they are the important vector of 'Surrah', a trypanosomal disease of horses and caribous. Over 3000 species are spread over the world and nearly 200 species of 12 genera under 3 subfamilies are represented in India. During the present study, only a lone species, *Chrysops dispar* (Fabricius) of this family was reported as flower visitor from the Kolkata and its surroundings.

4. *Chrysops dispar* (Fabricius)

The adult fly is 7–10 mm long, slender, red-yellow with black in colour, with typical V-shaped marking on abdomen; antenna yellowish, long, slender, flagellum darker; thorax dark brown to black; abdomen extensively yellowish with a distinct inverted V-shaped marking on the tergites II to III which may extend to tergum IV; wing clear with posterior cell 5 having a large hyaline area upto hind margin; tibia never swollen.



Chrysops dispar (Fabricius)

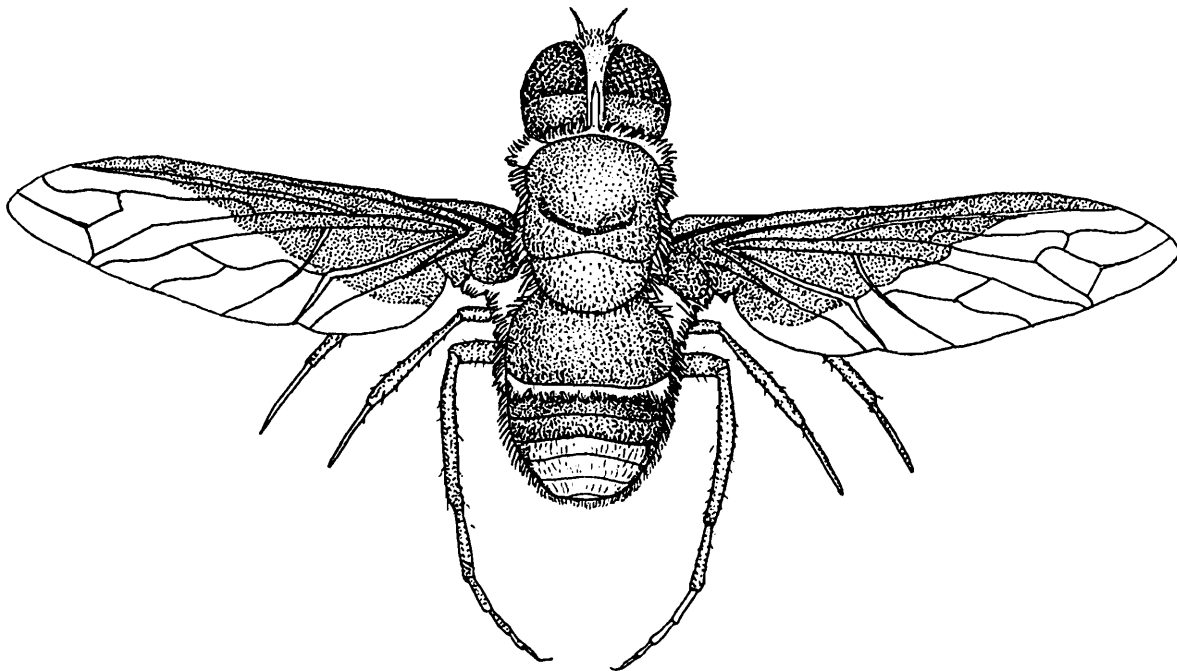


Merremia vitifolia Hallier. f.

Remarks : *Chrysops dispar* (Fabricius) was encountered only once during the entire study period and was collected from the yellow flowers of *Merremia vitifolia* Hallier. f.

C. Family BOMBYLIIDAE

The members of the family Bombyliidae under the superfamily Aşiloidea of the suborder Brachycera have a remarkable range in size (some *Exoprosopa* with wing span of more than 60 mm to the tiny *Apolysis* that can be as small as 1.5 mm in length), and variety of shapes (e.g. *Systropus* mimicking wasps; *Bombomyia* mimicking bumble bees).



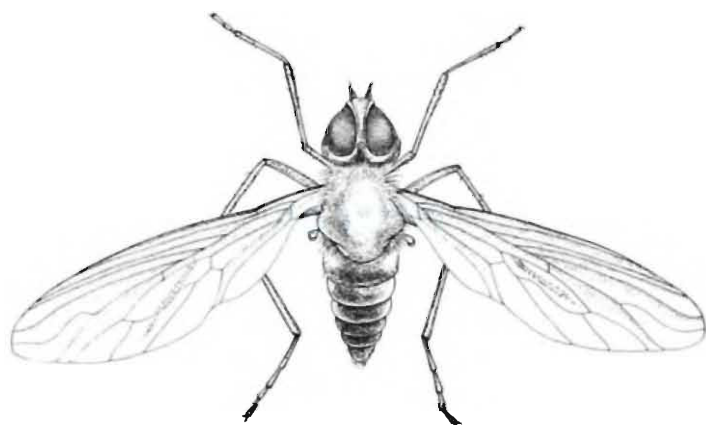
These flies are generally stout and hairy with attractively patterned wings; compact form both in abdomen and thorax; with a long and slender proboscis; thorax with dense furry pubescence, often thicker and scale like about the wing roots; abdomen globular, elongate, slender usually dense furry pubescence or sometimes bare; wings distinctive; show highly variable venation and may be hyaline, dark brown, or show very beautiful pattern of spots, infuscations and iridescence; vein M_1 ending behind wing tip; legs rather long with bristles.

Adult bee-flies are nectar feeders and females are obligatory pollen feeders, obtaining pollen from anthophilous plants and are often the major pollinators of many flowering plants.

Bombyliids, or bee flies as they are commonly called, comprise a diverse assemblage of brachycerous flies. There are around 4547 species known worldwide and in India there are around 138 species under 36 genera of 11 tribes and 8 subfamilies. During the present study, 3 species of 2 genera were found as flower visitors from Kolkata and its surroundings.

5. *Petrorossia ceylonica* (Brunetti)

These are small dark coloured bee flies (6 mm) with grayish white pubescence; head is nearly globular and a little wider than the thorax; occiput is covered with dense pollen-like micro pubescence; antenna black, segment-1 with stiff black hairs, segment-3 shortly onion-shaped, twice as long as the swollen part and bearing an apical spine; thorax black, compact, triangular, with short yellow hairs, sides ashy-grey; scutellum black; abdomen ovate, black with yellow hairs, dorsum same with microscopic black hairs; wings hyaline large and at rest extend beyond the abdomen, grey with costal cell yellowish, R_{2+3} with a deep loop towards the tip, fork of R_{4+5} with distinct appendix; halteres yellow; knob yellowish white with a black mark; legs slender, uniformly tawny yellow with minute bristles, hind tibia with fine black bristles, claws slender, sharp, strongly curved.



Petrorossia ceylonica (Brunetti)



Petrorossia ceylonica (Brunetti)

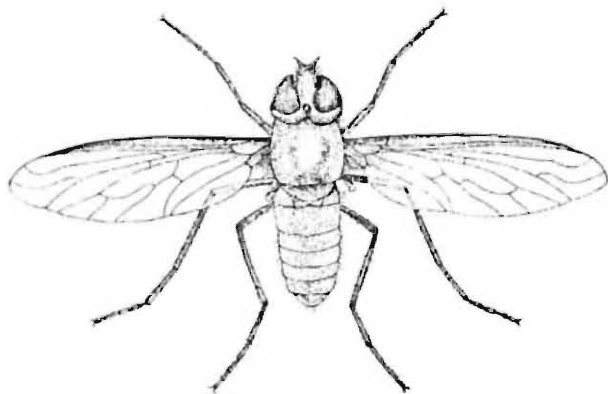


Mimosa pudica Linnaeus

Remarks : Knowledge on the diversity of bee flies in Kolkata and adjoining areas is lacking. However *Petrorossia ceylonica* (Brunetti) has been collected from two different localities from *Mimosa pudica* Linnaeus.

6. *Villa aureohirta* (Brunetti)

These bombyliids are small, dark flies (5 mm) with clear wing; head with face black; ocelli on a small raised tubercle; antennae black with yellow and black hairs above and below, segment-1 and 2 with stiff black hairs; occiput markedly convex, black with yellowish hairs at sides and a fringe of stiff bright yellow hairs at the back; proboscis long, blackish at base; thorax black, with short golden yellow hairs, a bunch of bristly yellow hairs on each side behind shoulder, sides of the thorax ash-grey with some patches of whitish hairs; scutellum black with golden-yellow hairs on the posterior margin; abdomen moderately shining black with a diffused banded pattern, closely covered with short bright golden yellow hairs which form a large fan shaped bunch on each side of 1st segment and with one or more pairs of tufts of black scales on the sides of the abdomen; wings clear with pale brownish infuscation up to and beyond the middle, a patch of silvery yellow scales at the base of the wing and halteres creamy yellow, a large reclinate yellow spine above each wing base; legs



Villa aureohirta (Brunetti)



Villa aureohirta (Brunetti)

black with whitish hairs except femora and tibiae which are yellow with short black bristles.

Remarks : *Villa aureohirta* (Brunetti) has been collected from the flowers of a medicinal plant, *Scaevola sericea* Vahl. Though they are known as flower visitors from other parts of India, they were encountered infrequently during the study and never on the same plant.



Scaevola sericea Vahl.

7. *Villa panisca* (Rossi)

These are medium sized bee-flies (12 mm.), somewhat squarish; head with frons narrow at the vertex; face non-projecting, dull black with long yellow or orange scales and long yellow hairs; proboscis long, narrow; antenna black, segment-1 and 2 with black bristly hairs, flagellum like a blunt triangle, tip produced to a long point with an apical spine; thorax dull black with tawny, scaly pubescence and furry pubescence extends from the shoulder to the wing base; scutellum with black scales, pale pubescence and a row of black bristles on the hind margin and small yellow scales towards the side margins; abdomen black, segments 1-4 covered with tawny pubescence, sides of the 5th and 6th segments with black pubescence, and 7th snow-white; venter with closely adhering black scales and pale yellow pubescence, long black hairs on the side margins, and hind margins of 2nd and 5th segments with pale scales; wings quite clear or very grey, base and fore margin yellowish, brown down to 1st longitudinal vein R_1 or sometimes a little further, basal parts of veins black or brown; occasionally, a black spine present at the base of the wing margin; squamae brownish yellow, dark margined and yellow fringed; halteres small and orange; legs dull black, femora and tibiae with inconspicuous yellowish or blackish pubescence, pulvilli absent.



Villa panisca (Rossi)



Scaevola sericea Vahl.

Remarks : Among the three species of bee flies, *Villa panisca* (Rossi) happens to be the most common visitors of quite a few flowers like *Tagetes patula* Linnaeus and *Dahlia* sp. other than *Scaevola sericea* Vahl. But during our recent studies, it was collected only from flower heads of the medicinal plant *Scaevola sericea* Vahl.

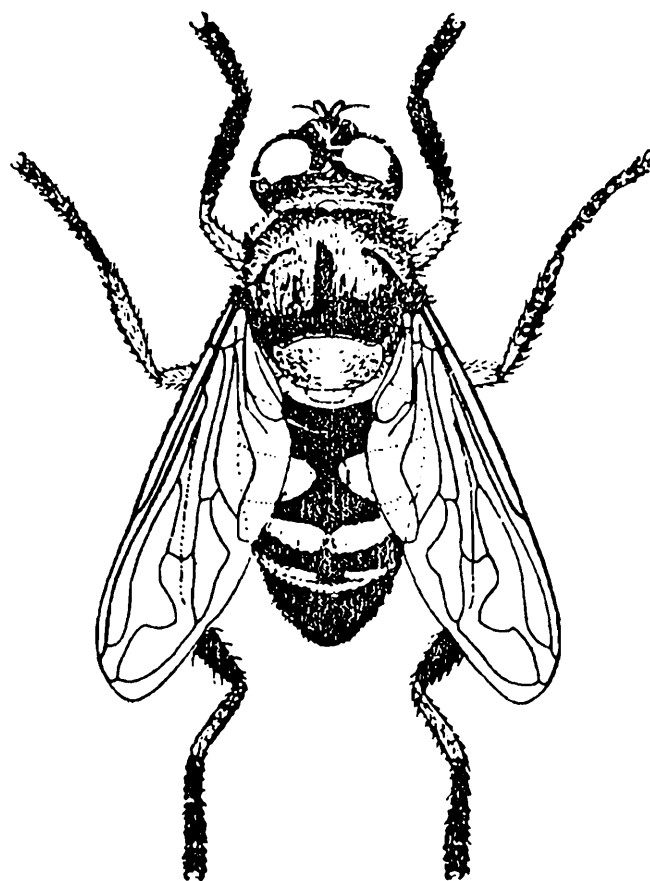
D. Family SYRPHIDAE

The family Syrphidae under the superfamily Syrphoidea of the infra order Cyclorrhapha in the section Aschiza, is one of the largest and easily recognized group of Diptera. The members of this family are commonly known as 'Flower flies' or 'Hover flies'

The members of the family are small to rather large flies (3 to 18 mm), almost always bristleless. Adult flies are very brightly coloured and may be striped, spotted or banded yellow on a blue, black or metallic ground colour. Head variable, usually as broad as or a little broader than thorax; thorax rather large and robust, moderately arched, rarely with bristles; scutellum large, usually convex; abdomen variable in shape, composed of five or six visible segments, rarely only four, generally thinly pilose or bare, sometimes with thick pile; hypopygium rarely prominent, although often large; wings comparatively large, most of which have a false or spurious vein (*vena spuria* of European authors), extending longitudinally and slightly diagonally between the third (R_{4+5}) and fourth (M_{1+2}) longitudinal veins; bristles (macrochaetae) rarely present on any part of the body, never on head; legs weak to moderately strong, occasionally very strong, never elongate.

Nearly all members of this family are attracted to flowers and may frequently be observed poised in air, their wings vibrating with extreme rapidity. In some agro-ecosystems, such as orchards, they out perform native bees in pollinating the fruits.

The family is cosmopolitan in distribution with around 272 species under 66 genera of 3 subfamilies being so far known from India. During the present study, 11 species of 8 genera were reported as flower visitors from the Kolkata and its surroundings.



8. *Asarkina (Asarkina) ericetorum* (Fabricius)

A moderately large species (12 - 13 mm), orange-yellow with some black bands on abdomen, more or less clear wings; eyes in male closely contiguous; ocelli placed some distance from vertex frons yellow; vertex black and both covered with black pubescence; a semicircular shining blackish brown spot on upper side of small antennal prominence; antennae brownish orange, segment-1 and 2 with black stiff hairs; thorax



Asarkina (Asarkina) ericetorum (Fabricius)

aneous with brassy tinge, sides of dorsum and the scutellum orange-yellow, thorax and scutellum densely covered with bright yellow pubescence; abdomen broad, flat, orange yellow, 1st segment with broad, black median stripe, hind border black, anterior and hind margins of other segments black; venter yellowish, apical half more or less obscured; wings pale yellowish grey; halteres orange; legs yellow.

Remarks : One of the common flower visitors and effective pollinator species, *Asarkina (Asarkina) ericetorum* (Fabricius) has been found on the flowers of wild to managed gardens, fruit bearing trees to the flowers of agricultural crops throughout India. During this study, it has been collected from the flowers of the medicinal plants of *Rauvolfia tetraphylla* Benth and *Sida acuta* Burn.



Sida acuta Burn

9. *Episyrphus balteatus* (De Geer)

Slender, elongate flies (8-11 mm), with black-orange and yellow colour patterns; face orange with orange hairs; eyes bare; antennal prominence dull yellow, translucent, bare shining, with a small black dot above base of each antenna; thorax black with 2 narrow lateral greyish stripes, pubescence yellow, erect, fairly abundant; scutellum translucent yellowish, base often slightly darker, black long hairs towards and on



Episyrphus balteatus (De Geer)

margin, and a drooping fringe of yellowish-white hairs below extreme hind margin; abdomen wholly yellow with a black median spot on 1st segment united to a black stripe on hind margin, segments 3 and 4 with narrow sub basal and broad apical black bands, 5th segment with an indistinct black spot above the middle; venter pale yellowish, a black moderately wide band before the hind border on 2nd and 3rd segments; wings nearly clear, with a series of sclerotized dots on the posterior margin; halteres orange; legs long, slender, orange, basal segment of hind tarsi long.



Solanum melongena Linnaeus



Capsicum frutescens Linnaeus



Zinnia sp.

Remarks : *Episyrphus balteatus* (De Geer) happens to be the most common effective pollinator of the family Syrphidae. During the present study, the species was collected from the agricultural crops like *Solanum melongena* Linnaeus and *Capsicum frutescens* Linnaeus.

10. *Ischiodon scutellaris* (Fabricius)

A long, slender fly (8 mm), orange yellow to black; face bright orange yellow with microscopic pubescence; proboscis black, antenna brownish orange to black, segment -3 elongate, arista bare, in male a large square black spot on vertex from eye to eye,



and a median shining black stripe gradually widening; thorax shining black with side margins bright yellow, scutellum yellowish, the center often brownish; both the thorax and scutellum with grayish or pale yellow pubescence; abdomen shining black, 2nd segment with a large sulphur-yellow spot on each side, each spot narrowed and rounded on its inner end, 3rd and 4th segments with a broad yellow band on each,

Ischiodon scutellaris (Fabricius)

slightly narrowed in middle; wings clear, 3rd longitudinal vein upcurved apically and ending well before wing apex; halteres yellow; legs yellow, hind femur with a sub-apical ring; a stick like slender tooth on the underside of the hind trochanter, tips of all tarsal segments blackish.



Tagetes patula Linnaeus



Solanum melongena Linnaeus



Capsicum frutescens Linnaeus

Remarks : *Ischiodon scutellaris* (Fabricius) has been reported as an important flower visitor and pollinator of many agricultural crops and horticultural plants in India. During our study, this species has been found as a common visitor of the flowers of *Tagetes patula* Linnaeus, *Solanum melongena* Linnaeus and *Capsicum frutescens* Linnaeus.

11. *Baccha (Allobaccha) amphithoe* Walker

A long, slender (9-11 mm) wasp like appearance, with black and yellow colouration; vertex and frons shining metallic black; a little yellow on lower part of frons at sides



Baccha (Allobaccha) amphithoe Walker

bearing yellow dust, face and cheeks yellow; antenna orange-yellow, a black stripe on face from antennae to mouth; a small tubercle on face; thorax metallic black, a perpendicular oblong stripe on mesopleura; a round spot on sternopleura; a long oblique spot behind wings with a round spot to its lower end; scutellum yellowish, brownish in middle, with some grey pubescence; 1st abdominal segment pale yellow, 2nd very narrowed pale brown, a yellowish

band before hind margin, 3rd yellowish, a reddish-brown triangular patch on each side margin and a blackish band on head margin, 4th segment yellowish, a large triangular black spot on hind margin, 5th segment with a black median basal spot, venter more or less as dorsum; wings clear grey, sub costal cell blackish, costal cell and about the basal half of the marginal cell brownish, and the costa from the end of the stigma to the tip of the 3rd vein, narrowly and distinctly black suffused; halteres yellow; fore legs bright yellow, a broad median band on hind femora, hind tarsi orange-yellow.



Helichrysum sp.

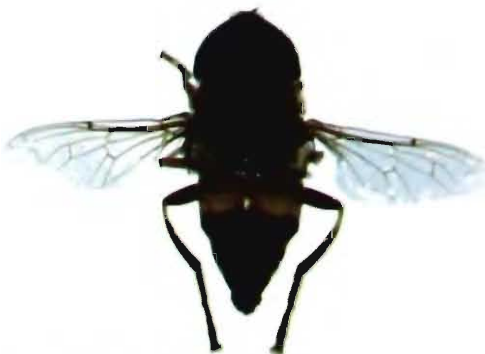
Remarks : Nothing much is known about the pollination activities of *Baccha (Allobaccha) amphithoe* Walker and during the present study, this species was found only from the flowers of *Helichrysum* sp.

12. *Paragus serratus* (Fabricius)*Paragus serratus* (Fabricius)

A small sized fly (5 mm.), body punctate with yellowish brown and whitish pubescence; head flattened; eyes with 3 vittae of white hairs; vertical triangle elongate, shining black or blue-black with short black hairs, frontal triangle very small, face orange yellow with whitish pubescence, a narrow brownish black stripe on face; antennae large and elongate, arista bare; thorax shining blue- black with a pair of greyish median stripe on anterior part; scutellum black with yellow margin, strongly serrated with 13-16 teeth posteriorly; whole dorsum with yellowish-brown pubescence,

sides of thorax shining black; abdomen yellow with brown markings, 1st segment usually black, 2nd generally reddish brown, 3rd and 4th each with a whitish band on each side anteriorly, broken in mid-line, 5th with a similar but continuous band placed diagonally; 6th segment from orange brown to black, with whitish pubescent at tip; venter yellowish; wings clear, halteres yellowish; legs mainly black with some parts orange or yellowish.

Remarks : *Paragus serratus* (Fabricius) though rarely known to pollinate flowers, has been encountered in our study, visiting occasionally the medicinal plant *Weddelia calendulaceae* Less.

*Weddelia calendulaceae* Less*Eristalinus (Eristalinus) arvorum*
(Fabricius)13. *Eristalinus (Eristalinus) arvorum* (Fabricius)

Robust species (10-12 mm), yellowish, ornamented with black spots, bands and patches; frons and face covered with yellowish grey tomentum; vertical triangle small black with black pubescence; ocelli large, orange to red; antennae bright orange, arista orange, bare, with black tip; dorsum with four conspicuous, equidistant, shining black narrow stripes from anterior to hind margin;

*Santalum album* Linnaeus*Tagetes patula* Linnaeus

dorsum and scutellum covered with dense yellow pubescence, center of scutellum with black pubescence abdomen as a whole black, 1st segment pale yellow, 2nd with two large, oblong yellow spots practically filling the whole surface, 3rd segment also with a pair of large, oblong, oval spots placed obliquely, 4th segment black with a curved

bright yellow spot, convex side forward, reaching across middle of segment touching anterior margin, pubescence of abdomen following ground colour except all yellow on 4th segment; venter mainly yellowish on anterior half, blackish on remainder, pubescence sparse, pale yellow; wings nearly clear, costa pale yellow with a minute blackish brown dot at each end; halteres yellow; legs brownish yellow or orange, blackish, pubescence of femora pale yellow.

*Mangifera indica* Linnaeus

Remarks : *Eristalinus* (*Eristalinus*) *arvorum* (Fabricius) is a frequent flower visitor and extremely well known as a pollinator in India. In our study it has been observed to frequent the flowers of *Tagetes patula* Linnaeus, *Santalum album* Linnaeus and *Mangifera indica* Linnaeus on several occasions.

14. *Eristalinus (Eristalinus) obscuritarsis* (de Meijere)

A medium to large species (9-10 mm) of black and reddish colour; eyes bare, except for a little pubescence on upper part, black spotted; frontal triangle grey dusted with black hairs, a shining triangular space above base of antenna; vertical triangle blackish



Eristalinus (Eristalinus) obscuritarsis (de Meijere)

brown with black hairs; antennae reddish yellow, arista reddish yellow, bare; thorax shining black with long yellowish hair, anterior part with three narrow yellow stripes, posteriorly faded, side margin wax-yellow; scutellum honey-yellow; abdomen pitch black with metallic blackish green hind margin, on anterior segments the black colour is restricted through the very large yellow side spots, 1st abdominal segment only with yellow sides spots 2nd practically entirely occupied by the spots with two large yellowish spots, 3rd segment black with a large yellowish quadrate spot on each anterior corner, a broad



Tagetes patula Linnaeus



Aegle marmelos Corr.

median black stripe and a yellowish curved band across middle of segments not reaching sides, 4th segment black, 3rd and 4th with distinct curved whitish band, 5th segment shining black with metallic blackish green hind margin; wings clear; squamae brownish-white; halteres yellow; legs black, tips of all femora yellow; pubescence yellow.

Remarks : *Eristalinus (Eristalinus) obscuritarsis* (de Meijere) even though not known as an effective pollinator, has been observed to visit commonly the flowers of *Aegle marmelos* Corr. and *Tagetes patula* Linnaeus during our study.

15. *Eristalinus (Eristalinus) quinquestriatus* (Fabricius)

A medium sized fly (8-9 mm); eyes unstriped but with minute black spots; vertical triangle smaller; frons and face with yellowish-grey tomentum (except on the face just below antennae, where it is whitish) and concolorous pubescence; no median stripe; antennae and bare arista all brownish orange, tip of segment-3 narrowly blackish; thorax yellowish-grey with concolorous pubescence; dorsum shiny, brightly yellowish and with black stripes; pubescence very fine; abdominal segments 1st and 2nd yellowish, later with a rather broad black band on hind margin, enlarged triangularly in middle; 3rd segment yellowish with a similar black band and an irregularly shaped black spot on middle of anterior margin; 4th segment



Eristalinus (Eristalinus) quinquestriatus
(Fabricius)

shining black with a curved, dull yellow, transverse band with parallel sides (sometimes in the shape of a wide open inverted 'V') across centre of segment, pubescence of abdomen almost yellow throughout, but blackish-brown on black parts of 2nd segment; venter yellowish with soft yellowish-grey pubescence; tip of the abdomen more or less blackish; wings nearly clear; stigma very pale yellow, small, its inner end with a minute dark brown spot at tip of auxiliary vein; legs mainly black or blackish-brown; anterior femora rather narrowly orange at tips, pubescence of legs mainly yellowish-grey, but black on hind tibiae.



Tagetes patula Linnaeus

Remarks : *Eristalinus (Eristalinus) quinquestriatus* (Fabricius) was collected from the flowers of *Tagetes patula* Linnaeus during our study.

16. *Mesembrius bengalensis* (Wiedemann)

A large and robust species (10-12 mm) with black and yellow body colour, frons and face covered with yellow tomentum and concolorous pubescence, face with narrow median black stripe, central bump small, in male upper facets of the eyes



Mesembrius bengalensis (Wiedemann)

distinctly larger than lower ones; vertical triangle elongate, shining black; segment-1 and 2 of antennae black, segment-3 dark brown, with bare, brown arista, in female antennal prominence and antennae shining orange brown to blackish; proboscis black; vertex with yellowish tomentum and black pubescence; thorax bright yellow with three longitudinal black stripes, the median one slightly wider than the others, the outer stripes narrowly separated from the median one but narrower in front and behind barely attaining anterior and hind margins; scutellum translucent yellow, a little darker at base; 1st abdominal segment black,



Sida acuta Burn



Tagetes patula Linnaeus



Weddelia calendulacea

remainder orange yellow, 2nd segment with basal and hind marginal black bands, joined by a median black band, 3rd segment with a depressed black triangular black spot on hind margin, 4th segment with yellowish or orange tomentum, an inverted V-shaped deep orange to black mark across middle of the segment, pubescence yellow, venter yellow with yellowish pubescence; wings pale grey; halteres yellow; coxae black, femora shining black, middle pair in male with a tooth below near base and suddenly contracted at tip, pubescence of all femora wholly yellow except some long black pubescence towards tip on under side of hind pair; hind tibiae distinctly curved, with mainly black pubescence, a peculiar fan-like fringe of hairs with thickened tips at extreme base of hind metatarsi.

Remarks : *Mesembrius bengalensis* (Wiedemann), quite a well known and regular flower visitor of the orchards and managed gardens, has been collected from *Weddelia*, *Tagetes* and *Sida* spp. during our study.

17. *Mesembrius quadrivittatus* (Wiedemann)

Very much similar to *Mesembrius bengalensis* (Wiedemann) but differs from the other species of this genus by the following characters: middle femora in male without tooth below and very gradually narrowed apical part, 4th abdominal segment without 'V' mark.



Mesembrius quadrivittatus (Wiedemann)

The robust fly (10-12 mm) with black and yellow body colour, frons and face covered with yellow tomentum and concolorous pubescence, face with narrow median black stripe; central bump small, in male upper facets of the eyes distinctly larger than lower ones; vertical triangle elongate, shining black; 1st and 2nd joints of antennae black, 3rd dark brown with bare, brown arista; in female antennal prominence and antennae shining orange brown to blackish; proboscis black, vertex with yellowish tomentum and black pubescence; thorax bright yellow with three longitudinal black stripes, the median one



Aegle marmelos Corr.



Rauvolfia serpentina

slightly wider than the others, the outer stripes narrowly separated from the median one but narrower in front and behind barely attaining anterior and hind margins; scutellum translucent yellow, a little darker at base; abdomen mainly orange, 1st segment sometimes with centre of hind margin black, 2nd segment with a large triangular brown spot on base, not reaching sides but extends



Weddelia calendulacea

hindwards as median stripe and then form a triangle, 3rd segment with similar flattened black triangle on hind margin reaching side margin, 4th segment with apical half mainly black, the black colour widest in the middle 5th segment with a large, shining black triangle, with yellow pubescence; wings pale grey; halteres yellow; legs with yellow pubescence rather brighter than *M. bengalensis*, in male hind femora with a distinct comb-like fringe of short, stiff, black hairs on inner underside from base to tip, hind tibiae suddenly contracted at tip, forming a small tooth at point of compression.

Remarks : *Mesembrius quadrivittatus* (Wiedemann), also a very frequently encountered flower visitor of the flowering and fruiting shrubs and trees, was collected during this study from *Weddelia*, *Aegle* and *Rauvolfia* flowers.

18. *Syritta indica* (Wiedemann)

Elongated, slender body (8-10 mm) with black and yellow colouration; head



Syritta indica (Wiedemann)

flattened; vertical triangle elongate, blackish round the ocelli; frontal triangle small, hardly produced, bare, dusted with yellowish-white; vertex shining black; occiput black; antennae orange, arista black; thorax dull black, humeri and sides of dorsum as far as suture, and pleurae, wholly yellowish or whitish-grey; scutellum flat on disc, slightly margined at the tip, pleura wholly yellow; abdomen dull black, 2nd and 3rd abdominal segments with complete yellow bands, when in the form

of spots, the dividing black line much narrower; wings clear, haltere pale yellow, subcostal cell and stigma pale brownish yellow; hind femora extremely incrassate, serrate below, the serration being on the apical third situated on a ridge; three or four distinct small spines near tip; hind tibiae black; hind femora wholly orange or brownish from one-third to two-third of their length from the base and the rest black.



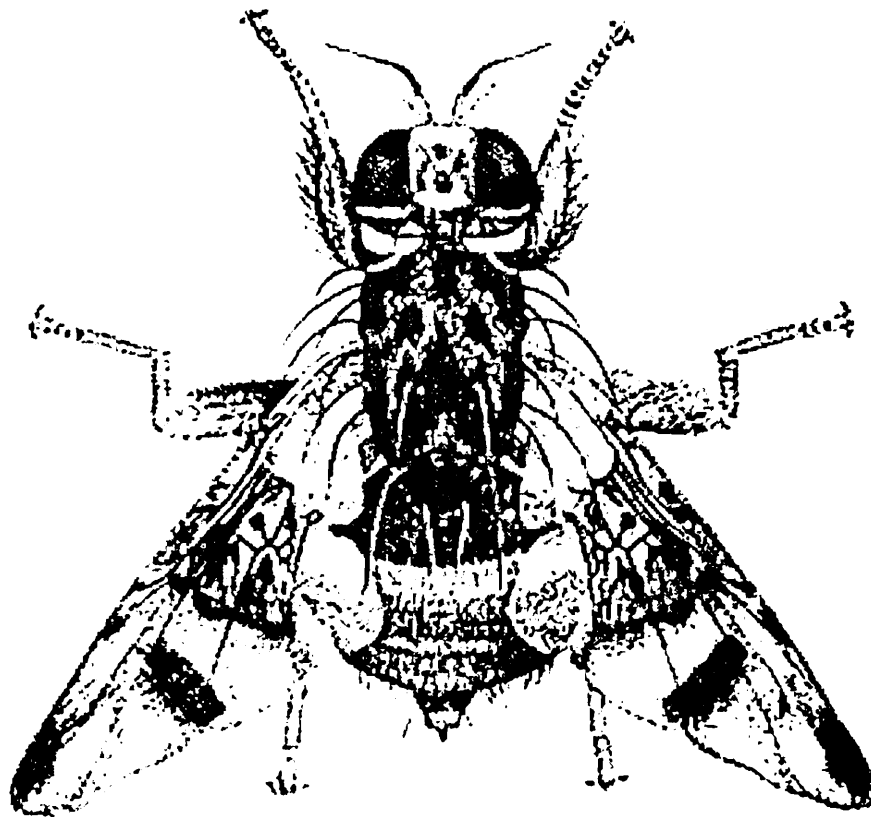
Persicaria chinensis Linnaeus

Remarks : *Syritta indica* (Wiedemann) is not commonly seen in the fields to visit flowers, has been however observed to visit the flowers of *Persicaria chinensis* Linnaeus in our study.

E. Family TEPHRITIDAE

The family Tephritidae belongs to the suborder Brachycera, infraorder Muscomorpha, section Schizophora and Superfamily Tephritoidea.

The members of the family Tephritidae are commonly called as “fruit flies”, although the majority of the world’s species are not frugivorous. They are easily recognized by their maculated, spotted or ornate colouration of their wings. Adult flies are 1 to 35 mm. in length; body variously colored but non-metallic; frons with both inclinate frontal bristles and 1-2 (rarely 3) orbital bristles; ocelli present; anepisternum with vertical suture on posterior third; anepimeron with at least one seta medially and with greater ampulla usually well developed; wing usually patterned; costa with humeral and subcostal breaks; subcosta bent sharply forward subapically and usually weaker or fold like beyond the bend; vein R1 densely setulose dorsally almost to base.



The adult tephritids typically rest on flowers, fruit or vegetation with flexed wings and oviposit on the flower heads of the family Asteraceae. The fruit flies are an easily recognizable family of cosmopolitan flies with around 4000 species worldwide, of them 327 are known from the Indian subcontinent and 187 under 70 genera and 4 subfamilies are known from India. During our study, 2 species under 2 genera were collected as flower visitors from Kolkata.

19. *Bactrocera cucurbitae* Coquillett

The adult fly, noticeably larger than a house fly, has body length of about 6 to 8 mm; distinctive characteristics of the adult are the wing patterns, third antennal segment long and the head yellowish with black spots. This species has also been known as: *Chaetodacus cucurbitae* (Coquillett), *Dacus cucurbitae* Coquillett, *Strumeta cucurbitae* (Coquillett) and *Zeugodacus cucurbitae* (Coquillett).

The color of the fly is very variable, but there are prominent yellow and dark brown to black markings on the thorax; head light yellow, occiput reddish yellow, a small black spot on each side of face near the middle and a brown spot on the middle of each cheek; antennae, palpi, proboscis yellow, the latter mottled with brown; thorax reddish yellow, a median vitta on the posterior half of mesonotum, another on each side above



Bactrocera cucurbitae Coquillett

the insertion of wings; scutellum bears two bristles; generally, the abdomen has two horizontal black stripes and a longitudinal median stripe extending from the base of the third segment to the apex of the abdomen; ovipositor is very slender and sharply pointed; wings hyaline; a large brown spot on the upper part of the outer corner of first posterior cell; anal cell brown; posterior cross vein with brownish border and extending to the hind margin of the wing; upper

ends of cross vein bordered with brown; legs light yellow with broad apices of femora and the last four joints of tarsi reddish yellow, hind tibia reddish yellow or dark brown.

Remarks : As the name suggests *Bactrocera cucurbitae* Coquillett is very commonly found to visit the flowers of *Cucurbita maxima* Duchesne and has also been collected from the flowers of the same plant in present study.



Cucurbita maxima Duchesne

20. *Campiglossa cribellata* Bezzi

Small size flies (1-2 mm); entirely cinereous; whitish on head; frons geminate, ferruginous spot over lunula; antennae dark yellow; palpi paler; proboscis darkened; thorax entirely grey, with well developed yellow pubescence and black bristles; pleura with long yellow hairs and a row of whitish bristles on the hind border of mesopleura, below the humeral bristle and before the prothoracic stigma are dense tufts of bristly whitish hairs; scutellum like thorax with 4 bristles, the basal pair being stronger and inserted upon a pair of black spots like those of back; abdomen wholly grey, with strong pale yellowish pubescence and short yellow bristles on the sides, first segment unspotted, the others with a pair of round black spots in the middle and one on each side less distinct; wings black, with the base whitish hyaline, stigma with two hyaline round spots, the second larger in size; hyaline spots more numerous, the portion after the fifth vein and the ocellar lobe are also black with numerous hyaline spots, the rays of the fore border are shorter, equal in number the second posterior cell shows the 3 marginal spots and 5 discal spots, all of smaller size; squamae whitish; haltere dark yellow; legs yellow, femora cinereous, front femora with black bristles.



Campiglossa cribellata Bezzi

Remarks : *Campiglossa cribellata* Bezzi, is a well known and typical fruit fly and was collected from the flowers of *Persicaria chinensis* Linnaeus.

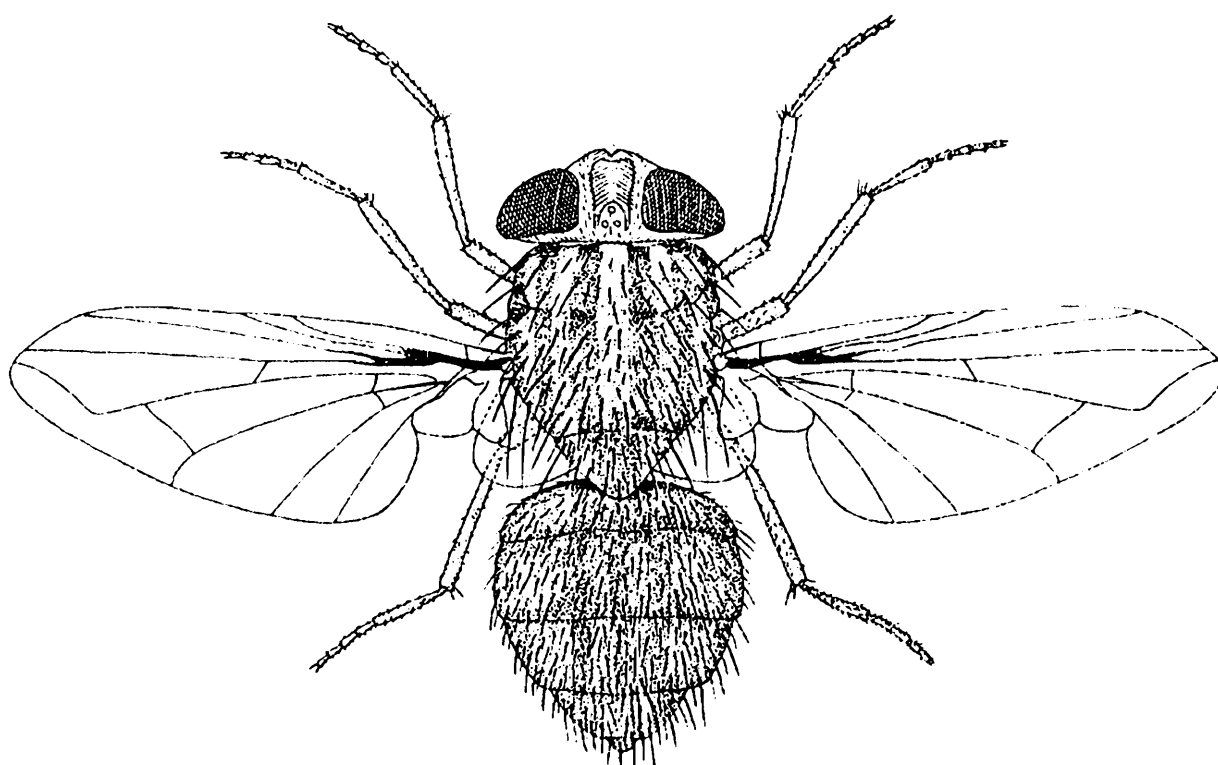


Persicaria chinensis Linnaeus

F. Family MUSCIDAE

The family Muscidae or “house flies” are one of the most diversified and economically important group of the calyprate Diptera belonging to the suborder Brachycera.

Adults of extant forms can be predaceous, haematophagous, saprophagous, or feed on a number of types of plant and animal exudates. By and large the muscids are closely associated with decaying organic matter, especially dung and also on the flower heads. But many groups have acquired special habits, which may be widely different.



Adult Muscidae are generally small to medium sized flies and seldom exhibit any striking developments of colour or form; antennae 3-segmented, arista usually plumose for the entire length; hypopleuron usually without bristles; generally more than one sternopleural bristle; $1R_5$ cell either parallel sided or narrowed distally, frontal suture present, vein 2A short and not reaching wing margin; calypters well developed, lower calypter nearly always longer than upper one.

Muscidae are well represented in all zoogeographic regions and are extremely numerous in the Oriental region, though as yet only a small percentage of the species has been described. In India, there are about 253 species under 39 genera of 6 subfamilies so far known. During this study, 3 species of 2 genera of this family are found to be flower visitors from Kolkata and its surroundings.

21. *Musca (Musca) domestica* Linnaeus

Most of the flies are drab coloured, medium in size (4-8 mm), with dark bristles and long, slender legs; sponge-like mouth parts for lapping fluids or piercing for sucking blood; eyes bare; interfrontalia black, more or less parallel-sided in male, somewhat narrowed in front and behind in female; parafacialia, face and jowls silver-grey dusted, with yellow sheen in certain lights; antennae and palpi black; ocellar bristles poorly developed in male, distinct in female; thorax black, covered with yellowish-grey tomentum; dorsum with four black vittae of more or less equal width, inner pair terminating towards posterior end of thorax, outer pair continued on to sides of scutellum, the latter black on median apical part; propleural depression with fine erect setulose hairs; suprasquamal ridge without black setulae; abdomen in male orange, with patches of silver-gold tomentum; first visible segment mainly orange, darkened centrally, second and third visible segments with black median vitta, slightly broader on second than on third, but the third usually wholly darkened; fourth visible segment somewhat darkened, in female abdomen grey with shifting pollinose pattern, first and second segments usually to a varying extent orange, second and third with central dark stripe; wings clear, basicosta yellow; stem vein with one or two hairs on upper posterior side; node with a few fine setulae below; legs black with setae.



Musca (Musca) domestica Linnaeus



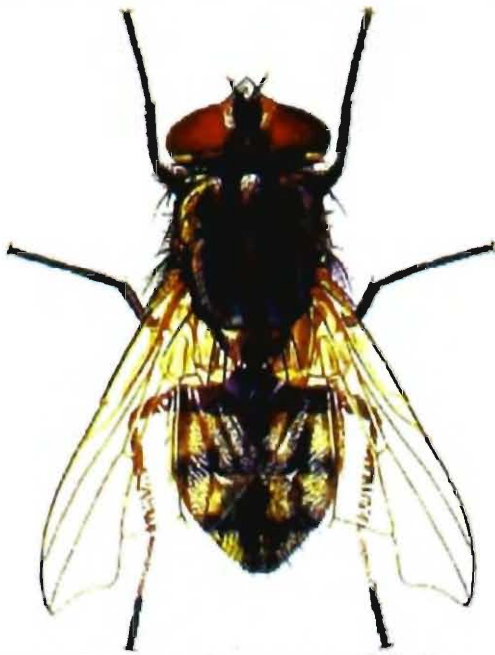
Weddelia calendulacea

Remarks : *Musca (Musca) domestica* Linnaeus is well known flower visitor and pollinator of the plant families viz., Asclepidaceae, Rhamnaceae, Combretaceae, Brassicaceae and Asteraceae. During our study, this species has been collected many times from the flowers of *Weddelia calendulaceae* Less.

22. *Musca (Byomya) ventrosa* Wiedemann

Very similar to *Musca domestica* in shape, colour and size (4-6 mm) but different from *Musca (Musca) domestica* Linnaeus in the absence of proplural hairs.

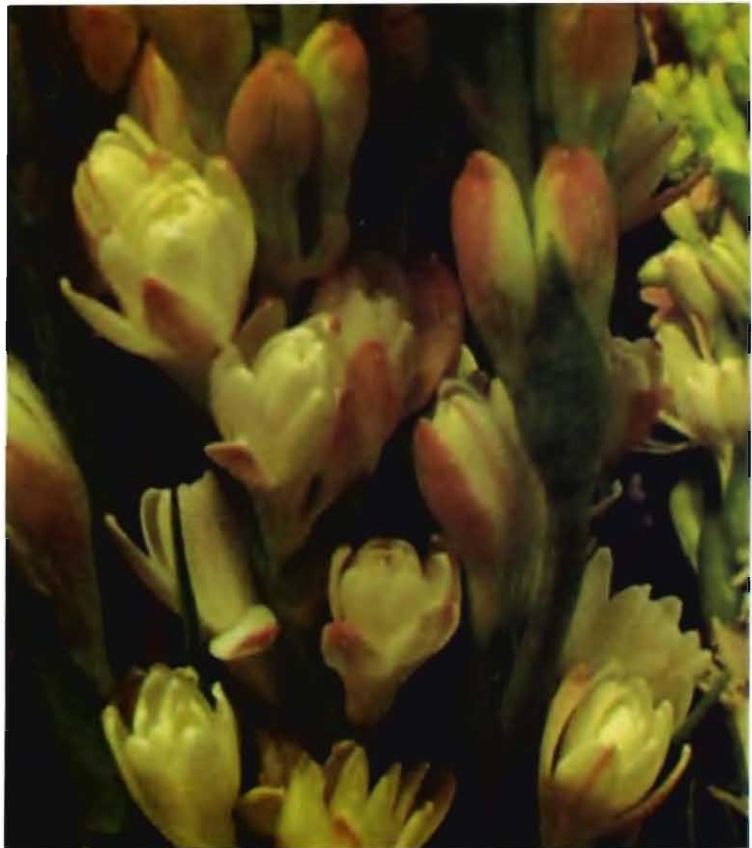
Eyes bare, in male separated by less than half width of third antennal segment, in female by slightly over a quarter head-width; parafrontalia black towards vertex, thickly silver-or grey-dusted anteriorly; parafacialia shining silver-dusted in male, less brilliantly dusted in female; ocellar bristles indistinct in male, well developed in female; thorax shining black, thinly and evenly covered with whitish-grey dust, dorsum with four narrow rather inconspicuous vittae, the broad central silver pollinose stripe more definite; abdomen entirely orange, with a few small patches of silver dust; wings hyaline, veins yellow towards base; stem vein with one



Musca (Byomya) ventrosa Wiedemann

bristle on upper posterior side, basicosta yellow; squama yellowish-white; halteres yellow; legs black, with setae, hind tibia with a row of short and unequal rather strong and pointed semi-decumbent antero-dorsal setulae.

Remarks : *Musca (Byomya) ventrosa* Wiedemann though a very well known pollinator of several plants in India were encountered occasionally on flowers of *Polianthes tuberosa* Benth in our surveys.



Polianthes tuberosa Benth

23. *Orthellia timorensis* Robineau-Desvoidy

These are generally brightly metallic bronze-green, blue-green or purple-blue in colour and small to medium in size (5.5-8.4 mm); head fuscous with metallic occiput and templates; palpi and antennae also fuscous; palpi markedly compressed and



Orthellia timorensis Robineau-Desvoidy

appearing clavate in lateral view; eyes practically bare, in male contiguous with the facets more or less enlarged on inner side; parafacialia of male much, female little, narrower than third antennal segment, base of 3rd antennal segment sometimes reddish, in female somewhat contrastingly dusted whitish-grey; thorax rather thickly dusted grayish to brownish-white anteriorly, with a pair of linear brown vittae in front; 1+3 stpl, the second often small, other pleural setae normal; abdomen with the hair much more erect on fourth segment, without setae; wings with light brown veins and wholly hairy membrane, basicosta

brown, subcostal sclerite with some long dark setulae, stem vein with one setula, m with an obtuse bend, straight behind it; lower calyptra fringed, brown in male, brownish white in female; halteres pale yellow; legs dark brown to fuscous, thinly dusted, without metallic reflections.

Remarks : Members of this genus are well known pollinators in India and *Orthellia timorensis* Robineau-Desvoidy has been collected on a regular basis from the flowers of *Scaevola sericea* Vahl. during the present study.

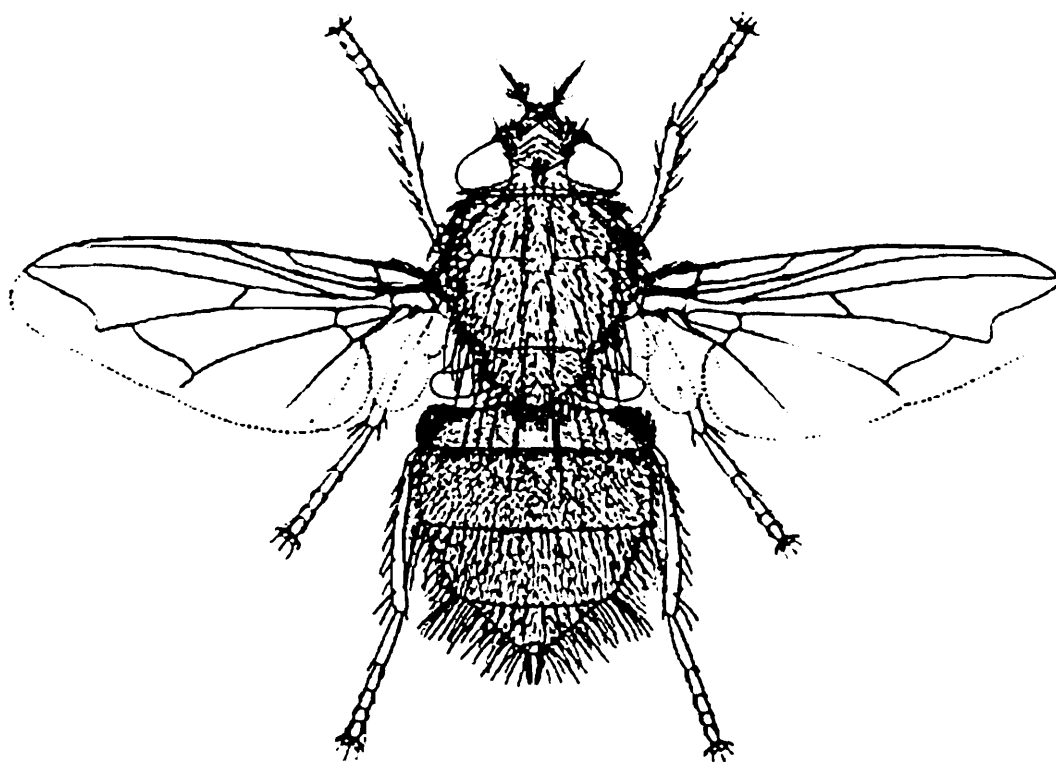


Scaevola sericea Vahl.

G. Family CALLIPHORIDAE

The family Calliphoridae is a cosmopolitan group of about 1000 species, commonly called blowflies, blue bottles, or green bottles, predominantly tropical in distribution, closely related to Tachinidae, Muscidae and Sarcophagidae. Absence of postscutellum (separates from Tachinidae); presence of only 2 notopleurals and 2 sternopleural bristles (separates from Sarcophagidae) presence of hypopleural bristles (separates from Muscidae).

Body metallic blue, green, or black; antennae 3-segmented, arista plumose for entire length, 2nd antennal segment with longitudinal seam; frontal suture present; calypter well developed.



Calliphorids are generally ubiquitous. Adults are often attracted to sweet liquids, and can be collected at flowers, where they feed on nectar. They also feed on the liquid products of organic decomposition, which provide the proteins essential to the female for egg maturation. Most species breed in carrion, but may parasitize earthworms. Some of the species of *Calliphora*, *Chrysomya*, and *Lucilia* are of significant veterinary importance, causing cutaneous myiasis of livestock.

These fairly large, robust, often metallic-colored calyprate flies found worldwide, are represented by 112 species under 30 genera of 9 subfamilies in India. During this study, 8 species of 7 genera of this family are found as flower visitors from Kolkata and its surroundings.

24. *Lucilia porphyrina* (Fabricius)

Metallic coloured and of medium sized flies (6-8 mm); eyes closely approximated, narrower in male than female; antenna dark brown, third segment of antenna five times



Lucilia porphyrina (Fabricius)

as long as second; thorax green to purple, very slightly dusted in front, two pair of postsutural acrostichal bristles which lie in front of the two corresponding pair of postsutural dorso-central bristles; abdomen shining green to purple; wings faintly and uniformly tinged with brown, darker slightly at the base, basicostal scale black, subcostal sclerite with stiff black hairs; squama testaceous to very dark brown; legs dark brown, one

anterodorsal bristle to middle tibia in both sexes.

Remarks : There is no such report about the pollinating ability of *Lucilia porphyrina* (Fabricius) in India. But we have collected this species several times from the flowers of *Scaevola sericea* Vahl. during our study.



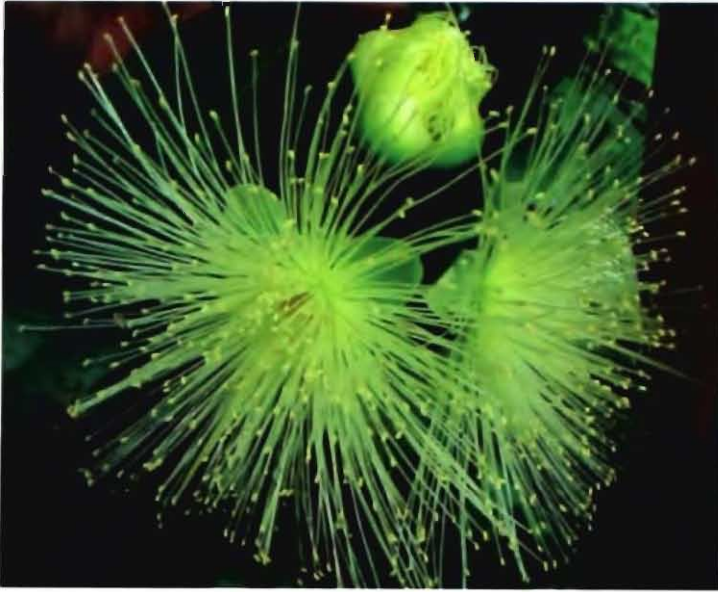
Scaevola sericea Vahl.



Stomorhina discolor (Fabricius)

25. *Stomorhina discolor* (Fabricius)

These are smaller to medium sized flies (6-7 mm.); head and thorax dark, abdomen yellowish brown in colour; frons in male subholoptic, in female one-third of head width, frontal stripes dark brown, parafrontalia and parafacialia whitish pollinose with shining black spots; face and epistome shining black, genae shining black on anterior half and yellowish white on posterior half, covered with hairs of



Syzgium jambos Alston



Callistemon citrinus

similar colour ; antennae brown, thickly grey dusted; palpi brown; thorax green, thickly grey dusted, covered with small black spots and small black bristles, presutural acrostichal absent, postsutural acrostichal single, postalars two; pleura with whitish or golden yellow pile forming a stripe; abdomen yellowish brown, hind margin of all the segments black, a median longitudinal stripe present in some specimens, interrupted in second segments; wings clear with apex more or less infuscated, first posterior cell narrowly open; front coxae yellow, other two pairs black, anterior femora all black, middle pair yellowish hind pair with basal third brownish- yellow, remainder black.



Tagetes patula Linnaeus

Remarks : *Stomorhina discolor* (Fabricius) is one of the most common pollinator species of the family Calliphoridae. Adults are mostly found to visit flowers in swarm. During our study, this species was collected from the flowers of *Tagetes patula* Linnaeus, *Syzgium jambos* Alston. Besides this, the species is also reported as the pollinator of several plant species of the family Rhamnaceae, Asclepidaceae, Polygoniaceae and Combretaceae.

26. *Hemipyrellia ligurriens* (Wiedemann)

A small to medium sized fly (8-10 mm); often metallic shining green to purple in colour; separated from *H. pulchra* by the elongated lateral lobes of eyes, very sparsely haired; facial tomentum greyish; third antennal segment generally dark brown; frons much narrowed, occasionally obliterated for a short space; parafrontalia narrowed but



Hemipyrellia ligurriens (Wiedemann)

not obviously compressed; parafrontalia, cheeks, and jowls silver-grey; antenna tawny-yellow to dark brown; palpi orange; vibrissae ascending about halfway up the facialia in a rather irregular row; thorax shining green to purple, rather heavily dusted anteriorly and on the lower part of the hypopleura; abdomen shining green to purple, the hind margin of the segments sometimes darkened, in male first visible sternite and edges of tergites with sparse and short bristly hairs; wings hyaline or slightly tinged with yellow; legs black.



Persicaria chinensis Linnaeus

Remarks : *Hemipyrellia ligurriens* (Wiedemann) is not reported so far as a pollinator in India. In our study, we have encountered this species quite a few times but only from the flowers of *Persicaria chinensis* Linnaeus.

27. *Hemipyrellia pulchra* (Wiedemann)

A moderately medium sized fly (9 mm) with metallic colour of green to bluish green; eyes almost contiguous but at frons separated by a distance equal to the width of third antennal segment which separates it from *ligurriens*; parafacialia and jowls silvery, the



Hemipyrellia pulchra (Wiedemann)

latter is reddish and covered with profuse black hairs; third antennal segment of female orange, segment more large and wide in female; thorax metallic green or blue with purple reflections and heavily dusted anteriorly and on the hypopleura; abdomen greenish or bluish with purple reflections, tergites laterally and sternite all over with long bushy hairs, in female the hind margin of segments slightly banded, sides and fourth visible segment very heavily dusted, venter without noticeable hairs; wings hyaline, veins brown, tending to orange in the region of the second and third



Santalum album Linnaeus



Psidium guajava Linnaeus

basal cells; legs black, fore femora with a comb of bristles, ventrally, and mid- tibia with one antero-dorsal bristle.

Remarks : During our study, we have collected *Hemipyrellia pulchra* (Wiedemann) several times from the flowers of *Psidium guajava* Linnaeus and only once from the flowers of *Santalum album* Linnaeus.

28. *Isomyia viridaurea* (Wiedemann)

Large sized fly (11-15 mm); often golden green in colour; frons reduced to a line; face dull yellowish-brown; parafrontalia dull ashy-yellow; genae similar in colour as face; parafrontal bristles run down to the parafacialia, in two black rows ; antennae dark brownish yellow, third segment grey pollinose, widely separated by short tubercular carina, palpi yellow, apically spatulate; thorax golden green, with very little white pile; pleura with long, soft, sparse golden hairs, upper angle of mesopleuron with a bunch of small black bristles; abdomen golden green with some white pilose tessellation, segments 1-3 black banded posteriorly, a median blackish stripe on segments 2 to 4, broad only on 2nd; costal margin of wings yellowish, including the two basal scales and some infuscations preapically, 3rd bristly on node and a little beyond it on both sides; femora metallic, tibiae brown, with broad black tips, tarsi black.



Isomyia viridaurea (Wiedemann)



Catharanthus roseus Linnaeus

Remarks : *Isomyia viridaurea* (Wiedemann) is not commonly known to visit flowers and not reported as a pollinator either. Throughout our study, we encountered this species only twice on the flower of *Catharanthus roseus* Linnaeus.

29. *Phaenicia cuprina* (Wiedemann)

Medium sized fly (6-8 mm.) with shining metallic gesture throughout the body; eyes in male at point of closest proximity separated by distance three to four times width of third antennal segment, frons at narrowest point about twice width of one of the



Phaenicia cuprina (Wiedemann)

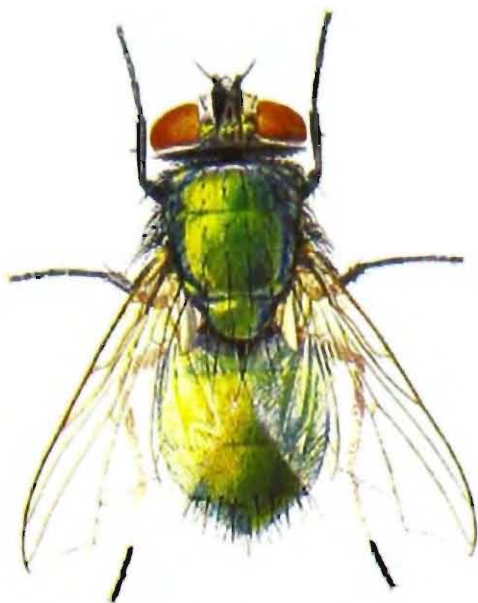


Tabernaemontana coronaria R. Br.

parafrontalia at same point; parafrontalia bare except for frontal bristles; thorax shining green, three postsutural acrostichal bristles; abdomen shining green, the sternites and edges of tergites with bunches of long thick hairs; wings hyaline, slightly yellow at the base, basicostal scale yellow, subcostal sclerite without upstanding hairs; squama white; legs black middle tibia with one antero-dorsal bristle.

Remarks *Phaenicia cuprina* (Wiedemann) has never been reported as a flower visitor or pollinator but during the present study the species was found to be mostly attracted to the white flowers of *Tabernaemontana coronaria* R. Br.

30. *Phaenicia sericata* (Meigen)



Phaenicia sericata (Meigen)

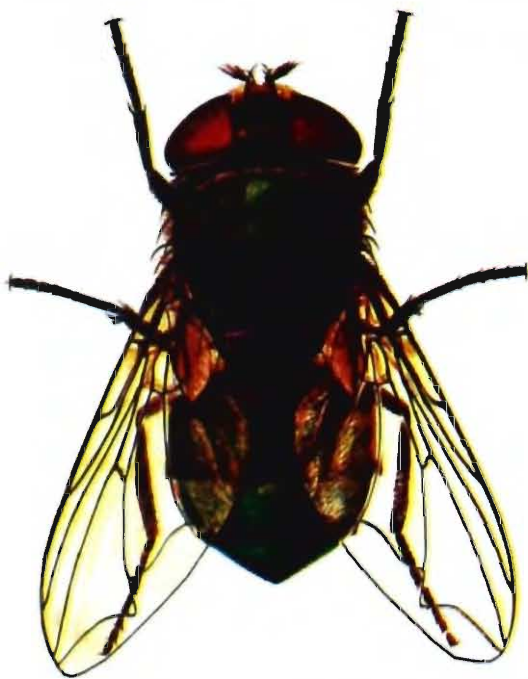
Medium sized fly (6-8 mm.); often shining in colour; head narrower towards vertex, leaving frons slightly wider above antennae; antenna dark brown; palpi orange, parafrontalia covered with minute bristles; thorax shining green, three postsutural acrostichal bristles present; abdomen shining green, evenly covered on dorsum and venter with short bristles, no macrochatae on margin of second visible segment, in female abdomen heavily dusted with silver tomentum, with a dark longitudinal line on second visible segment; wings hyaline; basicostal scale yellow; subcostal sclerite with decumbent, dark brown, felted pubescence; squama white; legs black, mid tibia with one antero-dorsal bristle.

*Tabernaemontana coronaria* R. Br.*Begonia* sp.

Remarks : *Phaenicia sericata* (Meigen) has been found to visit the flowers of two plant species, *Tabernaemontana coronaria* R. Br. and *Begonia* sp. As a pollinator, this species, however, has not been reported from anywhere in India.

31. *Chrysomya megacephala* (Fabricius)

A medium sized (11 mm) green or blue coloured fly; upper eye faceted, greatly enlarged, sharply demarcated from the rest of the lower facets; in female vertex is one fourth of head with uniformly small facets; parafrofrontalia in male reduced to a fine line,

*Chrysomya megacephala* (Fabricius)

in female each parafrofrontalia is slightly narrower than the width of frons, covered with golden tomentum anteriorly but appears black towards vertex; frons in female nearly parallel sided but in male almost obliterated in its entire length; parafacialia, jowls, face and epistome orange and covered with golden tomentum except epistome; thorax greenish blue with purple reflections, its anterior region with two black longitudinal stripes and a black triangular spot situated in a posteromedial position to each humeral callus, scutellum concolourous with thorax; abdomen greenish-blue with purple reflections, first tergite black, second and third generally black-banded on posterior margins, sternites and edges of tergites with inconspicuous golden hairs; wing hyaline, slightly darkened at base; subcostal



Mikania cordata (Burn. f)

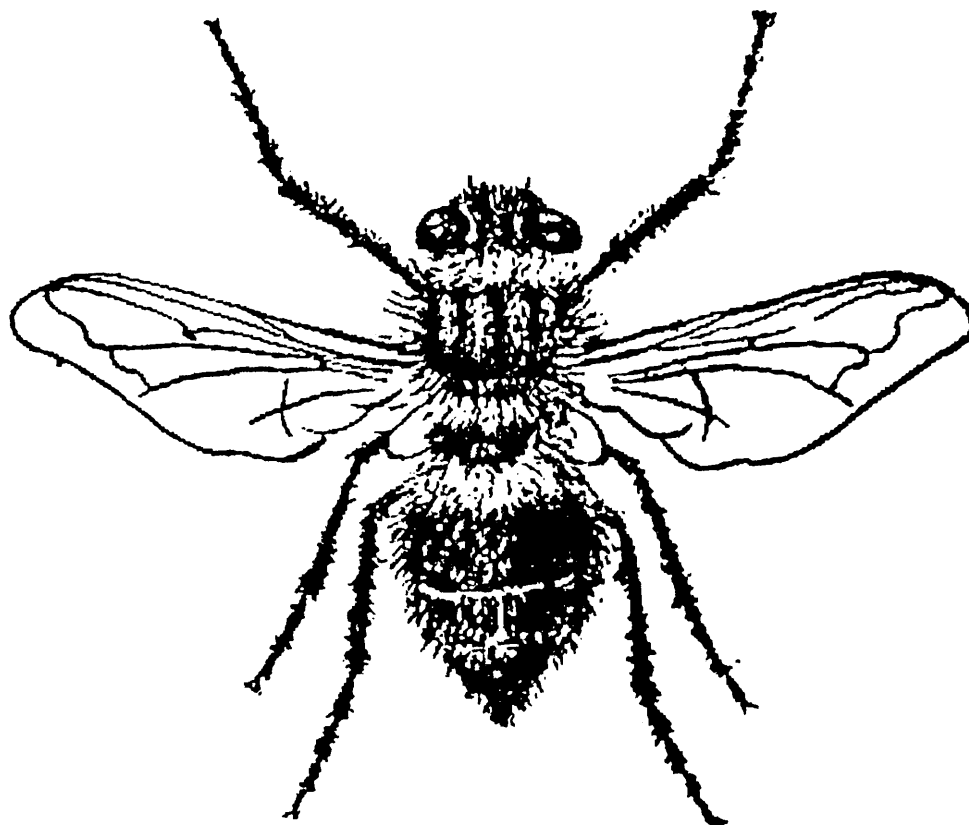
sclerite covered with soft brown pubescence and a few fine short erect hairs; upper squama white with partly dark margin, lower squama brown to dark brown; legs black, fore femur with row of bristles both dorsally and ventrally, mid and hind femur with row of ventral bristles only; mid tibia with single anterodorsal bristle near apex.

Remarks : *Chrysomya megacephala* (Fabricius) is reported as flower visitor of a number of plant species and as a well known pollinator throughout India. During this study, a large number of specimens were collected from the white flowers of *Mikania cordata* (Burn. f).

H. Family SARCOPHAGIDAE

The Sarcophagidae, commonly called as “flesh flies” comprise a group of medium to fairly large sized flies (4 mm to 8 mm in length), and are widely distributed all over the earth except polar regions.

These flies are generally non-metallic, greyish to black with silvery to golden or yellowish pollen; thorax mostly with three dark longitudinal stripes or sometimes entirely grey or black or blackish but without long golden hairs; without postscutellum bristles; abdomen with or without silvery-grey pollen forming more or less a tessellate pattern, usually setose strongly; hypopleural bristles, usually with pteropleural bristles; wings generally hyaline or infuscated along anterior margin; vein M_1 angled usually nearer apex of discal cell than apex of wing.



These flies are usually attracted to animal carcasses, organic garbage and dung and also in breed in such media. However, some species of this group are regular flower visitors.

Over 3,000 species of flesh flies are known all over world of which 65 species under 26 genera of 3 subfamilies are reported from India. During this study, a lone species of this family was found to visit flowers.

32. *Iranihindia futilis* (Senior-White)

These are medium sized, striped, greyish black flies (9-11 mm); head with frontal vitta black; parafacial blackish brown with silvery pollen and a row of (8-10) long, black hairs near the margins of eye; antennal scape black, pedicel brown with an orange tip, flagellum black with a long arista which is plumose at the base, facial ridge blackish-brown with white pollen; long vibrissae; proboscis black; thorax black with three black longitudinal stripes, with well developed prostigmatic, propleural bristles, apicoscutellar and discoscutellar bristles well developed; abdomen black with silvery



Iranihindia futilis (Senior-White)

chekered pattern, 2nd and 3rd abdominal tergites with well developed median marginal bristles, 5th sternite with Y-shaped spines laterally and long hairs terminally on arms; wings hyaline with brown veins, R₁ bare, R₄₊₅ with 9-10 dorsal short setae, costal spines stout, epaulet, black with short spines, basicostal scale yellowish; squama white; haltere brown; legs black with rows of bristles on fore femur, fore tibia.



Tabernaemontana coronaria R. Br.



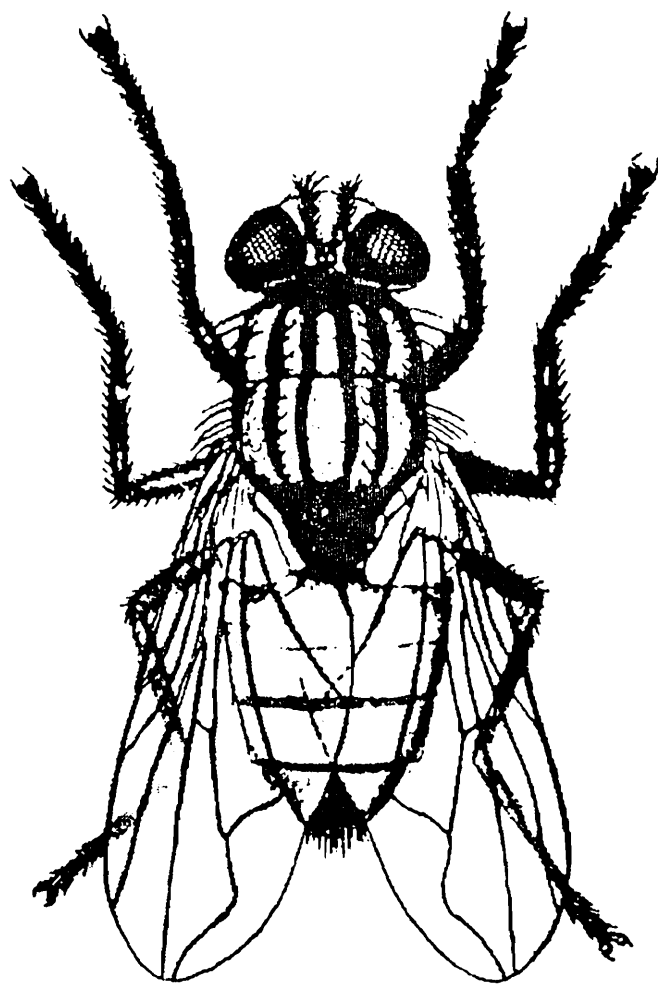
Scaevola sericea Vahl.

Remarks : Very few species of flesh flies are reported as pollinators. Throughout the study, *Iranihindia futilis* (Senior-White) was found from the flowers of *Tabernaemontana coronaria* R. Br. and *Scaevola sericea* Vahl.

I. Family TACHINIDAE

Tachinidae commonly known as 'tachina flies', are one of the most diverse and ecologically important families of the order Diptera. This immense family of flies is very heterogeneous in the adult morphology, but biologically uniform because the larvae are all endoparasites in Arthropods. Some of them are recognized as biological control agent against different insect species but a few others, the so called-oozy fly cause serious damage to the sericultural industry.

They often resemble house flies, but are usually larger, hairier, and more robust; arista usually bare, but plumose in some species; bristles present on both the hypopleuron and pteropleuron; postscutellum well developed, appearing as a prominent lobe beneath the scutellum; abdominal terga often overlap with the sterna.



Adult flies can be found in almost all habitats resting on foliage, feeding at flowers or, in the case of females, flying quietly in search of hosts. They are often grey or black and sit at rest with their wings spread in a delta shape. Males may be seen resting on larger tree trunks, which they leave to intercept passing insects before returning rapidly. Smaller species may be collected by sweeping low vegetation.

The cosmopolitan family Tachinidae is one of the largest families of Diptera. Recent catalogs from all zoogeographic regions place the world fauna at ca. 8,200 species. During this study, only a lone species of this family was found as flower visitors from Kolkata and its surroundings.

33. *Thelaira macropus* (Wiedemann)

Large sized flies (11-15 mm); black, subdorsum and sides of abdomen from near base to middle of T_4 yellow, proboscis shorter than head height; palpi filliform, extending to epistome; parafacialia bare; orbitals not differentiated; arista plumose, scutellars total 3. apicals raised, subapicals little longer than apicals, 3+3 ac, 3+3 dc,



Thelaira macropus (Wiedemann)

and 1+3 ia; R_1 more than half way to apex and R_{4+5} upto r-m setulose; abdominal segments T_{1+2} and T_3 each with a pair of submedian raised marginals, T_3 and T_4 with a pair of raised discals; segments 2, 3 & 4 bright yellow, frontal margin of 5th segment pale yellow.

Remarks : Very little is known about the pollination activities of the Genus *Thelaira*, and *T. macropus* (Wiedemann) has been observed to visit only the flowers of *Helichrysum* sp. in our study.



Helichrysum sp.

THREATS AND CONSERVATION

For many animals, including most birds and mammals, the basic information that allows people to identify key species in need of conservation exists and is accessible. On the other hand, the flies tend to be small, noncharismatic, and difficult to identify. The basic biology of most species is poorly understood. These factors are also likely to be responsible for the minimal conservation focus on the group. For the flower visiting insects, that provide the vital service of pollination, however, information is often hidden in scientists' files or is lacking altogether. The first step to protect the subset of these insects that are at-risk of extinction in the near- or long-term is to identify those species in need of conservation attention. Therefore, more research is needed into population distribution, life history, and habitat needs so that we can determine the best course of conservation action.

We hope that this document enables scientists, biologists, ecologists, horticulturalists, conservationists, and the general citizenry of Kolkata to prioritize these species for further research and conservation.

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Table-I : Dipteran flower visitors and their visited plant species in and around Kolkata.

No.	Insect species	Family	Plant species	Family
1.	<i>Sargus metallinus</i>	Stratiomyidae	<i>Bauhinia variegata</i> <i>v. candida</i>	Leguminosae
2.	<i>Oplodontha rubrithorax</i>		<i>Tagetes patula</i>	Asteraceae
3.	<i>Microchrysa flaviventris</i>		<i>Tagetes patula</i>	Asteraceae
4.	<i>Chrysops dispar</i>	Tabanidae	<i>Merremia vitifolia</i>	Convolvulaceae
5.	<i>Petrorossia ceylonica</i>	Bombyliidae	<i>Mimosa pudica</i>	Leguminosae
6.	<i>Villa aureohirta</i>		<i>Scaevola sericea</i>	Goodeniaceae
7.	<i>Villa panisca</i>		<i>Scaevola sericea</i>	Goodeniaceae
8.	<i>Asarkina (Asarkina)</i> <i>ericetorum</i>	Syrphidae	<i>Sida acuta</i>	Malvaceae
9.	<i>Episyrphus balteatus</i>		<i>Zinnia sp.</i>	Asteraceae
			<i>Solanum melongena</i>	Solanaceae
			<i>Capsicum frutescens</i>	Solanaceae
10.	<i>Ischiodon scutellaris</i>		<i>Tagetes patula,</i>	Asteraceae
			<i>Solanum melogena,</i>	Solanaceae
			<i>Capsicum frutescens</i>	Solanaceae
11.	<i>Baccha (Allobaccha)</i> <i>amphithoe</i>		<i>Helichrysum sp.</i>	Asteraceae
12.	<i>Paragus serratus</i>		<i>Weddelia calendulaceae</i>	Asteraceae
13.	<i>Eristalinus (E) arvorum</i>		<i>Tagetes patula</i>	Asteraceae
			<i>Santalum album</i>	Santalaceae
			<i>Mangifera indica</i>	Anacardiaceae
14.	<i>Eristalinus (E)</i> <i>obscuritarsis</i>		<i>Tagetes patula</i>	Asteraceae
15.	<i>Eristalinus (E)</i> <i>quinquestriatus</i>		<i>Tagetes patula</i>	Asteraceae
16.	<i>Mesembrius bengalensis</i>		<i>Sida acuta</i>	Malvaceae
			<i>Weddelia calendulaceae</i>	Asteraceae
			<i>Tagetes patula</i>	Asteraceae

No.	Insect species	Family	Plant species	Family
17.	<i>Mesembrius quadrivittatus</i>		<i>Weddelia calendulaceae</i>	Asteraceae
			<i>Aegle marmelos</i>	Rutaceae
			<i>Rauwolfia serpentina</i>	Apocyanaceae
18.	<i>Syrhitta indica</i>		<i>Periscaria chinensis</i>	Polygoniaceae
19.	<i>Bactrocera (Bactrocera) cucurbitae</i>	Tephritidae	<i>Cucurbita maxima</i>	Cucurbitaceae
20.	<i>Campiglossa cribellata</i>		<i>Periscaria chinensis</i>	Polygoniaceae
21.	<i>Musca (M) domestica</i>	Muscidae	<i>Weddelia calendulaceae</i>	Asteraceae
22.	<i>Musca (Byomya) ventrosa</i>		<i>Polianthes tuberosa</i>	Amarylhidaceae
23.	<i>Orthellia timorensis</i>		<i>Scaevola sericea</i>	Goodeniaceae
24.	<i>Lucilia porphyrina</i>	Calliphoridae	<i>Scaevola sericea</i>	Goodeniaceae
25.	<i>Stomorhina discolor</i>		<i>Tagetes patula</i>	Asteraceae
			<i>Syzygium jambos</i>	Myrtaceae
			<i>Callistemon citrinus</i>	Myrtaceae
26.	<i>Hemipyrellia liguirriens</i>		<i>Periscaria chinensis</i>	Polygoniaceae
27.	<i>Hemipyrellia pulchra</i>		<i>Psidium guajava</i>	Myrtaceae
			<i>Santalum album</i>	Santalaceae
28.	<i>Isomyia viridaurea</i>		<i>Catharanthus roseus</i>	Apocyanaceae
29.	<i>Phaenicia cuprina</i>		<i>Tabernaemontana. coronaria</i>	Apocyanaceae
30.	<i>Phaenicia sericata</i>		<i>Tabernaemontana. coronaria</i>	Apocyanaceae
			<i>Begonia sp.</i>	Begoniaceae
31.	<i>Chrysomya megacephala</i>		<i>Mikania cordata</i>	Asteraceae
32.	<i>Iranihindia futilis</i>	Sarcophagidae	<i>Tabernaemontana. coronaria</i>	Apocyanaceae
33.	<i>Thelaira macropus</i>	Tachinidae	<i>Helichrysum sp.</i>	Asteraceae

Table-II. Plant species and their Dipteran flower visitors in and around Kolkata

No.	Plant species	Family	Insect species	Family
1.	<i>Aegle marmelos</i>	Rutaceae	<i>Mesembrius quadrivittatus</i>	Syrphidae
			<i>Eristalinus (E) obscuritarsis</i>	Syrphidae
2.	<i>Bauhinia variegata</i> <i>v. candida</i>	Leguminosae	<i>Sargus metallinus</i>	Stratiomyidae
3.	<i>Mimosa pudica</i>		<i>Petrorossia ceylonica</i>	Bombyliidae
4.	<i>Begonia sp.</i>	Begoniaceae	<i>Phaenicia sericata</i>	Bombyliidae
5.	<i>Capsicum frutescens</i>	Solanaceae	<i>Ischiodon scutellaris</i>	Syrphidae
			<i>Episyrphus balteatus</i>	Syrphidae
6.	<i>Solanum melongena</i>		<i>Ischiodon scutellaris</i>	Syrphidae
			<i>Episyrphus balteatus</i>	Syrphidae
7.	<i>Cucurbita maxima</i> <i>cucurbitae</i>	Cucurbitaceae	<i>Bactrocera (Bactrocera)</i>	Tephritidae
8.	<i>Mangifera indica</i>	Anacardiaceae	<i>Eristalinus (E) arvorum</i>	Syrphidae
9.	<i>Merremia vitifolia</i>	Convolvulaceae	<i>Chrysops dispar</i>	Tabanidae
10.	<i>Polianthes tuberosa</i>	Amaryllidaceae	<i>Musca (Byomya) ventrosa</i>	Muscidae
11.	<i>Polygonum chinensis</i>	Polygoniaceae	<i>Hemipyrellia liguirriens</i>	Calliphoridae
12.	<i>Psidium guajava</i>	Myrtaceae	<i>Hemipyrellia pulchra</i>	Calliphoridae
13.	<i>Callistemon citrinus</i>		<i>Stomorhina discolor</i>	Calliphoridae
14.	<i>Syzygium jambos</i>		<i>Stomorhina discolor</i>	Calliphoridae
15.	<i>Santalum album</i>	Santalaceae	<i>Hemipyrellia pulchra</i>	Calliphoridae
16.	<i>Scaevola sericea</i>	Goodeniaceae	<i>Orthellia timorensis</i>	Muscidae
			<i>Lucilia porphyrina</i>	Calliphoridae
			<i>Villa aureohirta</i>	Bombyliidae
			<i>Villa panisca</i>	Bombyliidae
17.	<i>Sida acuta</i>	Malvaceae	<i>Mesembrius bengalensis</i>	Syrphidae
			<i>Asarkina (Asarkina) ericetorum</i>	Syrphidae

No.	Plant species	Family	Insect species	Family
18.	<i>Tabernaemontana coronaria</i>	Apocyanaceae	<i>Phaenicia cuprina</i>	Calliphoridae
			<i>Phaenicia sericata</i>	Calliphoridae
			<i>Iranihindia futilis</i>	Sarcophagidae
19.	<i>Catharanthus roseus</i>		<i>Isomyia viridaurea</i>	Calliphoridae
20.	<i>Rauvolfia serpentina</i>		<i>Mesembrius quadrivittatus</i>	Syrphidae
21.	<i>Tagetes patula</i>	Asteraceae	<i>Oplodontha rubrithorax</i>	Stratiomyidae
			<i>Microchrysa flaviventris</i>	Stratiomyidae
			<i>Ischiodon scutellaris</i>	Syrphidae
			<i>Stomorhina discolour</i>	Calliphoridae
			<i>Eristalinus (E) arvorum</i>	Syrphidae
			<i>Mesembrius bengalensis</i>	Syrphidae
			<i>Eristalinus (E) quinquestriatus</i>	Syrphidae
			<i>Eristalinus (E) obscuritarsis</i>	Syrphidae
22.	<i>Weddelia calendulaceae</i>		<i>Mesembrius bengalensis</i>	Syrphidae
			<i>Mesembrius quadrivittatus</i>	Syrphidae
			<i>Paragus serratus</i>	Syrphidae
			<i>Musca (M) domestica</i>	Muscidae
23.	<i>Zinnia elegance</i>		<i>Episyrphus balteatus</i>	Syrphidae
24.	<i>Helichrysum sp.</i>		<i>Thelaira macropus</i>	Tachinidae
			<i>Baccha (Allobaccha) amphithoe</i>	Syrphidae
25.	<i>Mikania cordata</i>		<i>Chrysomya megacephala</i>	Calliphoridae