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Survey and taxonomy of phorid flies (Phoridae: Diptera) with newly recorded Genus in Egypt

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Abstract

The study was carried out successfully from October 2020 to December 2023 throughout 9 Governorates (Sharquia, Giza, Qalyubia, Monufia, Beheira, Alexandria, Fayoum, Beni Suef, and Kafr El-Shaikh). The Governorates of Kafr El-Shaikh and Beni Suef were among the Governorates in which samples of large specimens were collected, especially *Megaselia scalaris* (Loew, 1866), of which large numbers were collected in both Governorates, followed by Fayoum and then Alexandria. Giza, Qalyubia and Monufia, in ascending number. It is noted that the samples of this family are present in general throughout the year, but they increase in the months of July, August and September, and the numbers decrease significantly during the months of December, January, and February. The species *Megaselia koffleri* Schmitz, 1935 Name updated by *Megaselia curtineura* (Brues, 1909); *Megaselia luttela* Schmitz, 1929; *Megaselia xanthozona* (Strobl, 1892); *Spiniphora bergenstammii* (Mik, 1864). The study gave a newly recorded genus and species *Conicera tibialis* Schmitz,1925 (Diptera: Phoridae) in Egypt was collected from Wadi El-Natron, Beheira, and Giza Governorates. In this paper, the economic importance, survey, morphology, and taxonomy were studied. Also, keys for two subfamilies Phorinae and Metopininae, and genera are provided.

Introduction

The Phorid flies (Phoridae: Diptera) are a family of small, humpbacked flies resembling fruit flies. It can often be identified by their escape habit of running rapidly across a surface rather than taking to the wing. This behavior is a source of one of their alternate names, scuttle fly. Another vernacular name, coffin fly, refers to *Conicera tibialis* Schmitz,1925 (Diptera: Phoridae) About 4,000 species are known in 230 genera. In Egypt, there are five species represented by two genera (Steyskal and El-Bialy, 1967). The most well-known species is cosmopolitan *M. scalaris*, at 0.4 mm in length, the world's smallest fly is the phorid.

Traditionally, phorids were classified in Egypt into two subfamilies: Phorinae and Metopininae (Brues, 1932). Phorid flies are found worldwide, though the greatest variety of species is to be found in the tropics. The Phoridae show the greatest diversity of all the

dipterous families. Larvae are found in the nests of social insects and some aquatic habitats, in organic detritus such as dung, carrion, insect frass, and dead snails. On the history of life, the oldest record of Phoridae (Fruit flies) was found in Latreille (1796), where it was found for the first time in the family Phoridae, and it was found parasitizing on pine trees, as well as it was found parasitizing on termite nests, and it was described as very small and flat flies in the front and back direction, and it was found that the front has thorns, especially veining The family Phoridae is very distinctive from the rest of the families of the order Diptera, where the first, second and third veins are thick.

The hind legs are relatively large. The genus *Megaselia* sp. is relatively young in terms of evolution. Its first representatives are known from the Dominican amber, which is 23 million years old, as well as the Eocene amber, which is about 35 years old. - 40 million years, where the oldest groups of roots of the family Phoridae were found, those Sunday flies in the bucket from the Cretaceous period, which is more than 100 million years old, among the *Megaselia* sp, where there are quaternary discoveries in Africa and Madagascar as well as varied habits in food. Their food ranges from dead or live animals, fruits, fungi, and laboratory foods (Disney, 2008). Importantly, this organism has been reported to feed on inedible materials such as shoe polish or paint (McCrae, 1967). Insects' ability to obtain nutrients from various food sources affects their size; Well-fed animals are larger than well-fed animals (Chapman, 1998). In flies, the size of the larvae at the moment of pupation will determine the size of both the pupae and the adults.

Two terms define the size of the larva before metamorphosis: the critical weight is the size at which the larvae begin to produce the hormones needed to initiate metamorphosis while the minimum application size is the size at which the larvae will be able to survive metamorphosis After reaching a critical weight, the larvae can still grow if they continue to feed, but failure to feed will not prevent pupation. If larvae are starved before critical weight, pupation is at risk (Caissie, 2008).

Differences in terms of the low nutritional value of the food and the critical weight and minimum size of viable flies Family Phoridae, including what is herbivorous, some of them are scavengers associated with fungi, parasites, and herbivores, some of them are predators and represent disease-causing conditions such as human myiasis, some of them have different habits, as they are controlled by the environmental impact represented by crop pests, I found green bugs parasitizing. They are named Phoridae (Curtis, 1833), unique flies are known colloquially as "Pail" flies because of their sparse movement patterns. Unique flies choose to run erratically across surfaces rather than fly, which may help distinguish them from other groups of flies. Work aims to carry out a survey and taxonomical studies for the first time in Egypt in this now time.

The present work deals with the economic importance, survey, morphology, and taxonomy of the family Phoridae. Also, keys for two subfamilies Phorinae and Metopininae, and genera are provided.

Materials and methods

The study was carried out successfully from October 2020 to December 2023.

1. Review:

Classification keys were made to separate and define samples that are not defined by the different collections that were visited, and their data are mainly dependent on Mostovski (2016); Disney (1988); Wang (2016); Sawaby (2018); Brown (1992) and Brown *et al*. (2010).

2. Insect collections in Egypt:

2.1. Insect collection at the Plant Protection Research Institute (The Egyptian Reference Museum of Insects).

2.2. Entomological Collection at Al-Azhar University in Cairo, Faculty of Agriculture.

2.3. Entomological Collection at Cairo Univeristy, Faculty of Science.

2.4. Entomological Collection at Ain Shams University, Faculty of Science.

3. Specimens Investigations:

The specimens were proposed as in the following:

3.1. Insect body parts Were dissected under a stereo microscope by using fine forceps dissected parts were removed from the specimens as spread as possible and mounted at a point where some parts as mouthparts, antennae, legs, and halters were kept in diluted.

KOH solution, thoroughly washed with tap water then Dehydrated in Ethyl Alcohol 70%, and cleared in Xylene, and mounted in Canada balsam (Karolyi *et al*, 2014). Female genitalia were given (Posteriorly) in form.

3.2. The fort of the abdomen was removed and macerated in cold KOH. The illustration was made from the genitalia in Glycerin.

3.3. Drawings were made from bent specimens and microscopic slides by using a stereo microscope with a magnification of 40x genitalia parts were examined in a drop of Glycerin under the light microscope with a magnification of 40x.

4. Collection tools (Traps):

4.1. The Light Trap which consists of an Ultraviolet light trap (Disney, 1983) and (Brown, 1992).

4.2. Sweeping Net Method (Finch and Collier, 1989).

4.3. The Sticky Trap Yellow Traps (Disney, 2001).

4.4. Malaise Traps (Penny, 1990, and Arias *et al*., 1982).

4.5. Manual Attracted Trap.

Manual Attracted Trap **(**Figure 1) It consists of (Used) plastic bottles that have a tight lid and contain gross materials such as (Old cheese) mixed in a vinegar solution of Acetic Acid, a little liquid soap, and a little water. Holes are made in the bottle, tied with a rope, and hung in the places that were determined after collecting many samples in it. It is left for several days, and then the counting process is carried out in the laboratory as follows: The solution is poured onto a funnel with a piece of gauze (With narrow holes), and then the samples are separated into suborders and then into species based on the taxonomic keys used Number of samples collected from the field according to the type of trap.

Figure (1): Manual Attracted Trap.

5. Field survey:

Conduct a field inventory of the available species of this family in different Governorates in different regions by trap in Table (1).

Table (1): Governorates and type of traps with agriculture hosts.

Governorates	Type of traps.	Hosts.
Sharquia	Manual Attracted Trap (M.A.T.), Sweeping Net Trap (S.N.T.), Malaise Trap (M.T.) and Light Trap (L.T.).	Markets, garbage places in the aforementioned areas, chicken, rabbit farms and desert crops.
Giza	M.A.T and S.N.T.	Chicken, rabbit farms, stables, and livestock barns in the Zoo.
Qalyubia	M.A.T. and S.N.T.	Places for planting trees, green and markets.
Monufia	M.A.T., S.N.T., M.T., L.T. and Stick Trap.	All areas from which it was collected were hospitals, homes, and desert crops.
Beni Suef	M.A.T. and M.T.	Markets chicken, rabbit farms, and desert crops.
Fayoum	M.A.T., M.T., S.N.T. and S.T.	Desert crops and markets.
Alexandria	M.A.T. and S.N.T.	Markets, chicken, and rabbit farms.
Kafr El-Shaikh	M.A.T., S.N.T. and M.T.	Markets, chicken, and rabbit farms.
Beheira	M.T., M.A.T. and S.N.T.	Chicken and rabbit farms.

M.A.T: Manual Attracted Trap, S.N.T: Sweeping net Trap, L.T: Light Trap, M .T: Malaise Trap, S.T: Stick Trap.

Results and discussion

1. Survey:

The phorid flies were collected over three successive years, from October 2020 to December 2023, the traps were used, Sweeping Net Trap, Malaise Trap, Light Trap, Sticky Trap and Manual Attracted Trap, and the Manual Attracted Trap was manufactured simply and easily. In provinces based on the survey.

The 9 Governorates were identified as follows Sharquia (Zagazig City, Mynia El-Qamh and Belbeis Desert) Giza (Doqqi, Giza Zoo and Abu El-Nomrous) Qalyubia (Shibin Al-Qanater, Al-Qanater Al- Chayrya and Kafr Shukr) Monufia (Ashmoun City, Sadat City, and Shibin El-Kom) Alexandria (Sidi Bishr Al-Bahr, Sidi Jaber Al-Bahr, and Bacchus Al-Bahr) Beheira (Wadi El-Natron City and El-Brygat City) Fayoum (Fayoum City, The Desert Surroundings of Lake Qarun and the agricultural surroundings of Lake Qarun) Beni Suef (Snors, Beni Suef City and Beni Suef Desert) Kafr El-Shaikh (Kafr El-Shaikh City, Balteem and Elhamool). Samples were collected from all the previously mentioned governorates, which were collected using different traps day and night. These samples were counted numerically from different regions and different families, as well as identifying the samples that were counted in insect groups in Egypt (Table 2 and Figure 2).

Table (2) clearly that the phorid species were active daytime and nocturnal but most numbers at specimens were collected by different traps as nocturnal, where (855, 520,279,231 and 15 species but the daytime specimens were recorded (463, 395, 369, and 25), respectively for Manual Attracted Trap, Sweeping Net Trap, Light Trap, Malaise Trap, and Stick Trap types of for all traps.

It is clear from Table (2) that the highest population of flies of this family was recorded by Manual Attracted trap at different Governorates (1250) on different hosts followed by Sweep Net Trap (899) specimens then Malaise Trap (694) specimens. The specimens were also collected from different regions using different traps on different families, as shown

in Table (3). The highest number of specimens of Phoridae were recorded at Beheira in the El-Brygat City region (207) followed by the Sharquia in the Zagazig City region (192). where the lowest number of specimens of Phoridae were recorded at Giza governorate in Giza Zoo, (50) were recorded. The highest number of *M. scalaris* was recorded at Sharquia Governorate (250), followed by the Beheira (240), and Monufia Governorate (200) where the lowest number of *M. scalaris* was recorded at Giza governorate (35), The Data in Table (3) also recorded the lowest number of *M. luttela* at Qalyubia (6). Data in Table (3) stated that six species of family Phoridae under three genera were recorded, *M scalaris* (1400 individuals), *Conicera tibialis* (395 individuals) *Spiniphora bergenstammii* (Mik, 1864) (353 individuals) *M. xthanthozona* (152 individuals) and *M. luttela* (100 individuals) as descending number of individual species. The highest population recorded was M. *scalaris* and the lowest population was *M. luttela*.

Table (2): The number of specimens collected by the traps in different Governorates on different hosts over three years.

Traps	Daytime	Nocturnal	No. of Specimens	Governorates	Hosts
Manual Attracted Trap	295	755	1050	All Governorates	Chicken and rabbit farms, stables and livestock barns and hospitals and homes places for planting trees, green and desert crops.
Sweeping Net Trap	300	500	800	All Governorates	Markets and garbage places in the aforementioned areas.
Malaise trap	400	194	594	Sharquia and Monufia and Beheira	Places for planting trees, green and desert crops.
Light trap		217	217	Sharquia and Monufia	Chicken and rabbit farms, stables and livestock barns.
Sticky trap	19	10	29	Monufia	Hospitals and homes.

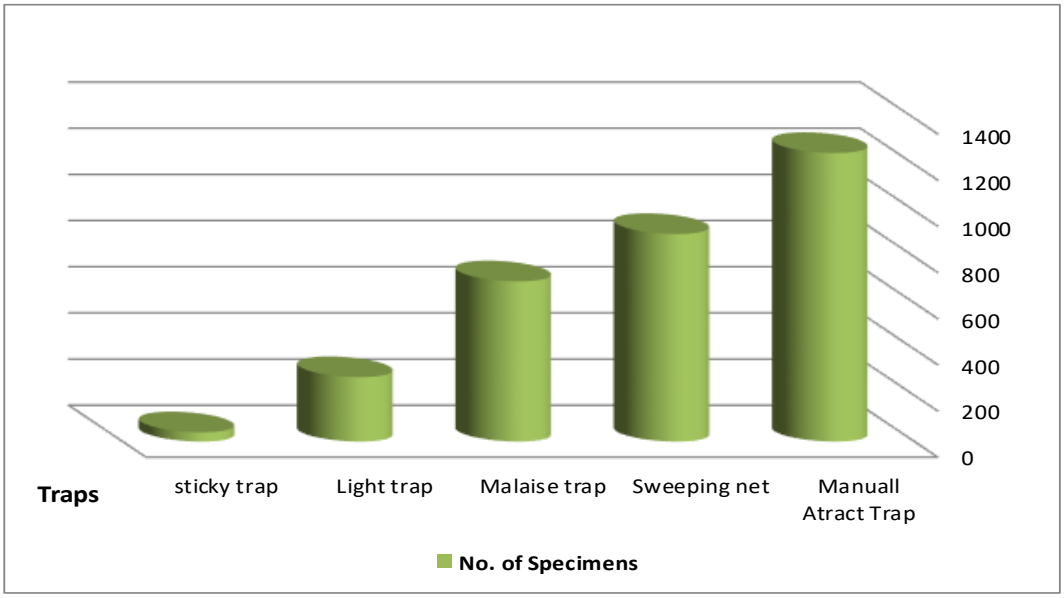


Figure (2): The number of specimens collected by the traps over three years.

From Table (3) it is clear that the large population of this family is abundant in Beheira Governorate through three years, followed by Sharquia Governorate, then Monufia Governorate, then Kafr El-Shaikh Governorate. The reason for the increasing presence of flies in this family is due to the presence of poultry farms, as well as the presence of rabbit farms. It is also consistent with El-Hawagry *et al.* (2021). The locations of the presence were concentrated in poultry and rabbit farms and some livestock pens, where there is a lot of waste on which they feed. The use of light traps on farms was also confirmed despite the small numbers. As for farms specializing in vegetable crops only, more than 15 samples were collected, for example, of the green bug infected with members of that family, *M. scalaris*. The species *M. scalaris, M. curtineura* are abundant in the period from July to October. As for the species *Conicera tibialis*. *M. xanthozona* is abundant in the period from July to September. In the area of livestock farms, sheep pens, and stables, the species *M. scalaris* is common in areas in areas targeted for collection in most months of the year, but it increases in the months from July to October. It decreases during September, December, January, and February, and continues to appear again in March, April, May, and June. From this, it becomes clear to us that members of this species are present throughout the year in different proportions.

Table (3): Number of species collected from different regions in different Governorates.

Governorates	Region	No. of Specimens	Species	No. of Collected Species
Sharquia	Zagazig City	192	*Megaselia curtineura*	100
	Belbeis Desert	94	*Megaselia xanthozona*	41
	Mynia El -Qamh	105	*Megaselia scalaris*	250
Giza	Doqqi	30	*M. scalaris*	35
	Giza Zoo	5	*Spiniphora bergenstammii*	9
	Abu El-Nomrous	40	*M. xanthozona*	31
Qalyubia	Shibin Al -Qanater	98	*M. scalaris*	150
	AlQanater Al - Chayrya	88	*M. curtineura*	100
	Kafr Shukr	70	*Megaselia luttela*	6
Monufia	Ashmoun City	141	*M. scalaris*	200
	Sadat City	99	*S.bergenstammii*	70
	Shibin El-Kom	130	*Conicera tibialis*	100
Alexandria	Sir,Bishr Al-Bahr	86	*M. scalaris*	150
	Sidi Jaber Al-Bahr	97	*S. bergenstammii*	53
	Bacchus Al-Bahr	100	*M.luttela*	30
			Conicera tibialis	50
Fayoum	Fayoum City	79	*M.scalaris*	169
	TheDesert surroundings of Lake Qarun	138	*M. curtineura*	60
			M. luttela	35
	The agricultural surroundings of Lake Qarun	107	*Conicera tibialis*	50
Beni Suef	Bebba	75	*M.scalaris*	87
	Beni Suef city	58	*M.curtineura*	58
	Beni Suef Desert	117	*S.bergenstammii*	55
			Conicera tibialis	50
Kafr El-Shaikh	Kafr El-Shaikh City	83	*M. scalaris*	94
	Balteem	180	*M.curtineura*	59
	Elhamool	39	*S. bergenstammii*	79
			C. tibialis	70
Beheira	Wadi El-Natron	310	*M. scalaris*	240
			C. tibialis	110
	El-Brygat City	207	*S. bergenstammii*	67
			M.luttela	29
			M. xanthozona	71

2. Taxonomy:

The study gave a newly recorded genus and species *C. tibialis* for the first time in Egypt was collected from Wadi El–Natron, Beheira, and Giza Governorates. The general key of the family Phoridae will be given to facilitate the important characteristics of each species as follows:

1. Middle tibia with a pair of strong bristles at basal fourth: supra antennal bristles directed backward Plate (1) (Figure 6): mesopleuron not divided, Plate (1) (Figure 5)……**…… …… …Sub Family Phorinae (2)**

-Middle tibia lacking bristles. supra-antennal bristles directed forward Plate (1), Figure (4) or lacking: mesopleuron divided by Plate (1) (Figure 3)……..…..... **Sub Family Metopininae (4)**

2. Middle tibia always with at least a closely situated dorsal pair on the basal half; other tibiae sometimes with similar bristles Radial sector is simple, not forked Plate (1) (Figure 8). Male antenna with a third segment produced, cone-shaped Plate (1) (Figure 7), Rs unforked Plate (1) Figure (8) .....**Genus *Conicera* Meigen (3)**

- Tibiae with distinct, though sometimes short or weak, bristles;. Wings fully developed in both sexes Plate (1) (Figure 1) …...……..... ***Conicera tibialis* Schmitz**

3. Middle tibia with anterior bristle in distal half which is clearly longer than the width of the tibia at point of insertion For tibia with a bristle in proximal two–thirds that is longer than the maximum breadth of the tibia and with a row of short robust near dorsal spines blow tithe bristle Plate (2) (Figure 5): first two tarsal segments of for leg a clearly definite short dorsal apicial super: middle tibia with anterior bristle in distal half which is clearly longer than width of tibia at point of insertion Plate (2) (Figure 5)……. ….**Genus *Spiniphora* Malloch**

- Middle tibia, in addition to a proximal pair of bristles, with a stout anterior bristle some distance from its apex all tibial bristles strong, Plate (2) (Figure 8)…….. ***Spiniphora bergenstammii* (Mik)**

4. Costa ending distinctly before the middle of the wing, Radial sector forked, Halteres yellow Plate (2) (Figure 2)……...**Genus (*Megaselia*) Rondani (5)-**

Costa very short, extending only about one third the wing length: costal cilia very short Plate (2) (Figure 4)**……..……..…..... *Megaselia curtinura* (Brues)**

5. Abdominal segment of terga black on the side and yellow in the median portions, Plate (2) (Figure 14) …… ***Megaselia scalaris* (Loew)**

-Abdominal segment of terga not black on the side and not yellow inter median portions, generally yellow Plate (2) (Figure 15)…….....……***Megaselia lutella* Schmitz**

6. Front and thorax all yellow to rufous, Abdominal terga black on the side and yellow in the median portions upper post antennal bristles widely paced the distance between the two is twice the distance between the lower pair Hypopygium as. The bristles at tip of anal tube are longer than longest hairs of cerci. The longest hair of left side of epandrium is almost bristle-like, and clearly differentiated from rest of hairs Plate (2) (Figure 2) …….. ***Megaselia scalaris* (Loew)**-

Front and thorax brown to black. Abdomen black with not more than narrow yellow markings on the apices of the segments, Dorsal or near-dorsalpalisade-like row (P) of setulae on hind tibia, Hypopygium is often largely straw yellow. The inner face of the epandrium comprises elaboratecavities lined with fine pale hairs of Plate (2) (Figure 3)…….. ……. ……..……***Megaselia xanthozona* Strobl**.

Plate (1)

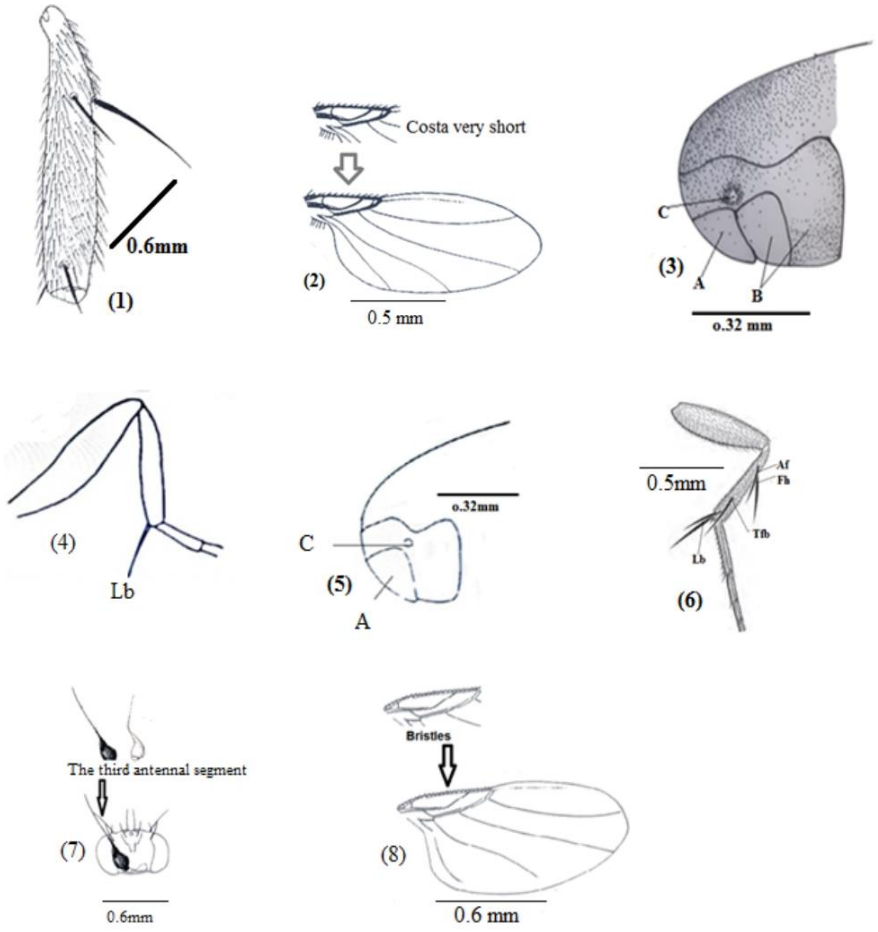
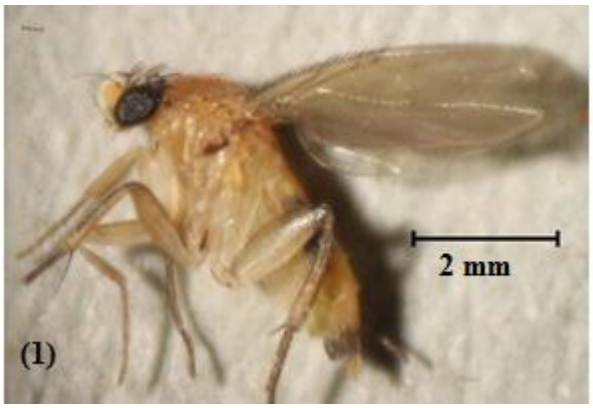
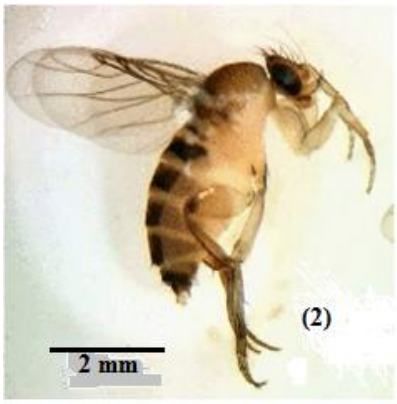
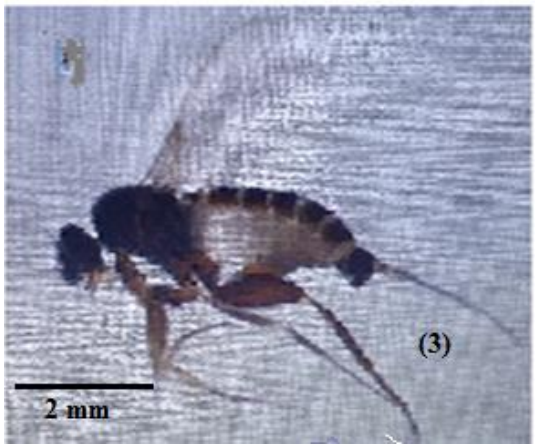


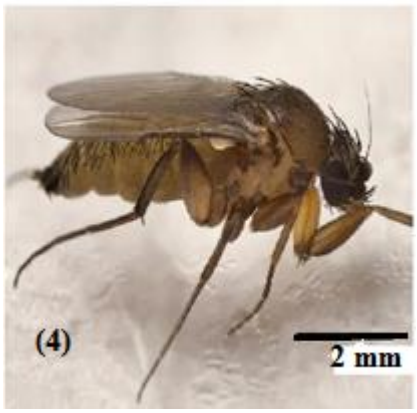
Figure.(1) Male anterior face of mid tibiaof *Conicera* Meigen, **Figure.(2)** Wing of *Megaselia curtinura,* **Figure.(3)** Thorax of Metopininae**,** A:Prothorcic side plate,B:Medium chest side plate, C:Prussian respiratory holes, **Figure.(4)** Leg of Metopininae, Lb:Last bristle or The hairs (semi:orthopedic dorsal hairs) of Metopininae, **Figure.(5)** Thorax of Phorinae, **Figure.(6)** Leg of Phorinae, Ar :Alawite front hairs,Fb:Frmer hairy hair,Tfb : The lower front back, **Figure.(7)** head of *Conicera* Meigen **Figure.(8)** Wing of *Conicera* Meigen Scale bars 0.1mm.

Plate (2)









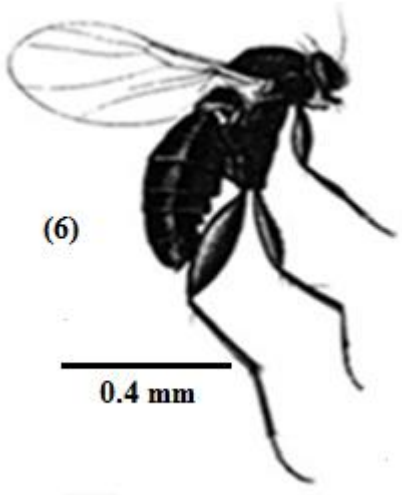


Figure (1): Female of *Megaselia luttela* Schmitz, 1929**, Figure (2):** Female of *Megaselia scalaris* Loew. Herman,1866, **Figure (3):** Female of *Megaselia xanthozona* (Strobl, 1892), **Figure (4):** Female of *Megaselia curtineura*, **Figure (5):** Female of *Spiniphora bergenstammii*,(Mik, 1864) and **Figure (6):** Female of *Conicera tibialis* Schmitz, 1925.

Genus: *Conicera* Meigen, 1830.

Type of the genus: *Phora douci* Megien : *Conicera atra* Megien is a syn name see Scimitz (1956:381) and Coleyr (1957:232). The Genus *Conicera* consists of 23 species and is divided into three subgenera, viz *Conicera* . For information on the larval stages of the three subgenera, refer to Schmitz (1952:238). Only the subgenera Tritoconicera is represented. These are the small flies Characterized by the un-forked radial vein; the special arista and the baried basal bristles on the hind tibia; the third antennal segment is elongated and cone-shaped in the male, rounded in the female. The costa has fringed-in bristles from a single row at the tip rather than the usual double series.

***Conicera tibialis* Schmitz, 1925: 119.**

This primarily western Palaearctic species is the infamous coffin fly, but it is not restricted to breeding in buried human corpses (Disney, 1994). *Conicera tibialis* was defined using international keys, catalogs and customs to obtain taxonomic details tennal bristles directed backward: mesopleuron not divided phorinae Tibiae with distinct, though sometimes short or weak, bristles; mid tibia always with at least a closely situated dorsal pair on basal half; other tibiae sometimes with similar bristles. Wings fully developed in both sexes.

Frons bristled along the entire lateral margin supra-antennal bristles, when present, recumbent. This fly is often a problem around mausoleums and mortuaries, where the larvae develop in burial vaults, producing large numbers of adults (Katz, 1992). A small black European species called the coffin fly *C. tibialis* is commonly associated with buried human remains that have remained underground for up to a year (Smith, 1986). This primarily western Palearctic species is the infamous coffin fly, but it is not restricted to breeding in buried human corpses (Disney, 1994). Whether its occurrence in the Azores and the Canary Islands and the occasional Nearctic record is due to introductions by man is not known.

Its presence in Tasmania is almost certainly due to man. Based on the survey process that increased in two consecutive years from October 2020 to December 2022, it became clear that the species *M. scalaris* is present throughout the year, but its population increases in July, August, and September, and it is abundant in places of public markets, barns, and horse stables, especially in places in Monufia, the Ashmoun City and Shibin El-Kom region, and Sharquia, Minya Al Qamh region, Zagazig City and Qalyubia, Al-Qanater Al-Khayrya region, Al-Qalyubia and Kafr El-Shaikh , the Kafr El-Shaikh City region, as well as Beheira (Wadi El-Natron City and El-Brygat City). *C. tibialis* Schmitz and *Spiniphora bergenstammii* (Mik), are present in a lower percentage than *Megasilia* in the census and are found in the Governorates of Beni Suef and Fayoum.

The population is more abundant in the months of August and September and less in the months of April. And May and no individuals of this species were collected for the rest of the year. The species *Megaselia koffleri* Schmitz, 1935 Name updated by *Megaselia curtineura* (Brues, 1909). It is found in the months of July, August, and September in areas where there are crops, where the larvae of several agricultural pests were collected and by rearing them they were found parasitizing them, and that was in the months of April in Kafr El-Shaikh , the central area of Kafr El-Shaikh and Monufia in the areas of Ashmoun City, Shibin El-Kom, and Sadat City, and it is not found definitively the rest of the year.

As for the species *M. luttela*, it has not been observed in the population except in small, negligible numbers, which was mentioned in six by George Estyskal in 1967. The study gave a newly recorded genus and

species *C. tibialis* for the first time in Egypt was collected from Wadi El-Natron, Beheira, and Giza Governorates. The general key of the family Phoridae will be given to facilitate the important characters of each species. The family Phoridae is divided into two subfamilies: Phorinae and Metopininae (Brues, 1932).

Phorinae has two Genera (Spiniphora and *Conicera*), two species (*S. bergenstammii, C. tibialis*. Metopininae have Genus Megaselia, 4 Species, *M. koffleri* Name updated by *M. curtineura* (Brues, 1909), *M. luttela*, *M. scalaris* , *M. xanthozona* .

The present survey and taxonomic study are an attempt to contribute and purpose for further studies of the family Phorhidae in Egypt, the future studies will give us a clear vision through studies based on field surveys of all Governorates of Egypt and molecular taxonomy science.

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