



## Descriptive study of the species *Limnophora Robineau-Desvoidy 1830* (Diptera: Muscidae) in Iraq – Kerbala

Muna Ibrahim jassem<sup>1</sup>, Haider Naeem Al-Ashbal<sup>2\*</sup>, Asaad Sh. M. Alhesnawi<sup>3\*\*</sup>

<sup>1,2</sup>College of Education for Pure Sciences/ University of Kerbala, Kerbala, Iraq

<sup>3</sup>College of Applied Medical Sciences, University of Kerbala, Kerbala, Iraq

\*haider.naeem@uokerbala.edu.iq

\*\* Corresponding author's E-mail: asaad.sh@uokerbala.edu.iq

\*\* <https://orcid.org/0000-0003-4172-581X>

Article History	Abstract
Received: 20 Feb 2022 Revised: 26 June 2022 Accepted: 26 August 2022	The current study was conducted during the year 2020 in some areas of the holy Kerbala governorate with the aim of diagnosing some species of insects of environmental and biological importance and knowing their distribution and the time of occurrence during seasons. The results showed that the species <i>Limnophora obsignata</i> (Rondani, 1866) (Muscidae: Coenosiinae) was recorded for the first time in Iraq. It was found that throughout the study period, this species was more frequently found in river habitats and seasons with moderate temperatures and humidity (spring and autumn). The external appearance of this species was described, as well as the anatomy of the male reproductive system of the samples.
CC License CC-BY-NC-SA 4.0	<b>Keywords:</b> <i>Diptera, Limnophora, Muscidae, obsignata.</i>

### 1. Introduction

The Muscidae family is one of the most diverse families of Calyprtrae Diptera due to the large number of species it belongs to, which are estimated at more than 5,200 species worldwide (Brown et al., 2009) and can be found in all biogeographic zones (de Carvalho et al., 2005). Their adults can be found in a variety of environments woodland, grasslands, wetlands, areas near waterways, and urban areas, except for the driest. Their larvae are found in dung, carrion, and trash, as well as various materials such as rotting fungi, fresh or decayed vegetative, bird and mammal nests, sewage, mud, and running water (Brown et al., 2009).

The Muscidae family is one of the largest families of the order Diptera, containing eight subfamilies: Atherigoninae, Achanthipterinae, Azeliinae, Mydaeinae, Muscinae, Phaoniinae, Coenosiinae, and Cyrtoneurinae; 77 species have been identified in Ecuador. The family's individuals live in tropical and high highland settings. Most members of this family live in the tropics and highlands. These species exhibit different traits and a variety of behaviors and act as decomposers of organic matter in the ecosystem (Courtney et al., 2017; Loewenberg-Neto & De Carvalho, 2013). The Coenosiinae subfamily is widespread in the Neotropical region, characterized by aquatic larvae, which included *Limnophoriini* and *Coenosiini*,

most species for Limnophoriini are found in humid or dry environments, also it currently includes only 12 genders (Alves et al., 2016)

The genus *Limnophora* includes approximately 230 species spread in different habitats. They live in high and dry forests and can be found from high mountains to valleys, rivers, and streams (Ruiz et al., 2021). Coenosiinae is one of the subfamilies belonging to the family Muscidae, and the common name of its family members is hunter flies or killer flies (de Jong et al., 2014; Martinez & Cocquempot, 2000). It is so named because of the predatory feeding of adults, and therefore it is important in biological control programs, especially in greenhouses (Kühne et al., 1994). The genus *Coenosia attenuata* Stein (1903) called tiger flies is one of the most prominent examples of predatory flies. It is widely found in greenhouses and open fields and is a good predator for whiteflies, leafhoppers, book lice, and other insects (M. S. Couri et al., 2018; M. S. Couri & Salas, 2010). The genus *Lispe* Latreille (1976) is a predator of larvae, pupae, and adults of Anopheles mosquitoes, and the predatory nature of this insect was noted for the first time by (Cuthbertson, 1934; Lamborn, 1920; SHINONAGA & KANO, 1983). They noticed that these species of flies preyed on adult and immature mosquitoes found in the mud on the beach. Whereas Morse *et al.* (1994) confirmed in their research that diagnosed (18) species of the genus *Lispe* that these species are of ecological importance as they can be used as bioindicators of water quality.

As for the genus *Limnophora*, some of its species are good predators of some small invertebrates found in water, as well as the complete and incomplete stages of black flies (Rozkošný & Gregor, 2004; Werner & Pont, 2006). This species of flies are usually found near or around flowing water or small streams and rivers running in low lands or mountain torrents (Werner & Pont, 2006).

This paper dealt with a complete description of the species of *L. obsignata* from the morphological point of view, as well as the anatomy of the male phallus to confirm the diagnosis. Moreover, the results of this study will contribute to increasing the knowledge of these species and the nature of their life, ecology, and biological relationships.

## 2. Materials and Method

The study was conducted from February 2020 to January 2021 within the Husseinia area in Karbala governorate. Adult insects were collected using an aerial net. The spread samples on dead animals and their droppings and on the banks of rivers were collected. The insects were then killed by freezing for several hours, with the location and date information of these specimens noted down.

Some parts, such as the head, chest and abdomen, were photographed directly after placing them on pieces of cork. As for the other parts that need to show some taxonomically important features, slides were made for them.

Diagnostic keys were used to classify samples such as (M. S. Couri et al., 2018; Michelsen, 2021; Adrian C Pont & Ivković, 2013; Werner & Pont, 2006).

## 3. Results and Discussion

### 3.1 The environment and distribution

The results showed that the highest occurrence of *Limnophora obsignata* was 49.52% and 45.71% during the spring and autumn seasons, respectively in Table (1), while the lowest was during the summer and winter seasons, which ranged between 1.90% and 2.86%, respectively. The high percentage of occurrence of this species during the spring and autumn seasons can be attributed to the mild temperatures (25.20, 27.57), respectively, as well as the relative humidity (40.33, 37.33%). The study recorded that the highest occurrence of this species *L. obsignata* (25.71%) was at the edges of rivers, due to the nature of its predatory feeding on small aquatic invertebrates. Moreover, small numbers were collected from scattered places, as they were found in the area of raising cows and other domestic animals, and all the sub-brooks of streams

and many other areas characterized by low temperatures and humidity. The results of this study are in agreement with some studies in terms of the appropriate environmental and spatial conditions for the existence of this species (Werner & Pont, 2006).

The results of the study show the effect of environmental, spatial, and climatic variations on the presence and spread of this species. It was noticed that there was a difference in its seasonal appearance, but exceeded that of its daily presence, as it hides during the high temperatures in humid places and cannot be observed throughout the day. The environmental differences also affected the daily activity and behavior of this species, as with higher rates of temperature and lower relative humidity, the percentage of occurrence of this species in the environment decreases. It is difficult to find this species during these conditions in open places, and the few species that were found were often hiding in shaded places such as the shade of trees and others.

Some studies have indicated the effect of the environment on the external appearance of this genus and its subspecies of *Limnophora*, where this study confirmed the existence of variation in the shape and size of the wing and its dimensions due to environmental changes for a group of samples that were studied from the same geographical area, taking into account the environmental changes that occur during the seasons of the year and their effect on the growth of insect wings. Moreover, these conditions may affect all other species of insects and their growth varies for the same reasons (M. Couri & Pont, 2020).

Table (1) shows the percentage of occurrence (%) of *L. obsignata* during the seasons in different areas.

Study areas and some climatic factors	Seasons			
	Spring	Summer	Autumn	Winter
Drains area	14.29	0.95	16.19	1.90
Edges of small rivers	25.71	0.95	20.95	0.00
Flat land	6.67	0.00	4.76	0.95
Remains of dead animals	2.86	0.00	3.81	0.00
Total	49.52	1.90	45.71	2.86
Temperature °C	25.20	38.43	27.57	14.73
Humidity %	40.33	21.33	37.33	56.67

### 3.2 Taxonomical characteristics of the species *Limnophora obsignata* (Rondani, 1866)

Characteristic that has been identified *Limnophora* Robineau-Desvoidy 1830 Basisternum of prosternum with hairs, meron, and anepimeron altogether bare; dorsal and ventral of a radial node with minor setae, R4+5 vein with hairs in limited specimens; hind tibia without posterodorsal setae, and usually without apical anterodorsal setae, if with small apical anterodorsal setae, the length less than the hind tibia's diameter; tergites three and four always with 1 pair of triangular dark-brown spots; body length 1.4 -5.0 mm. This is consistent with what he said (Xue et al., 2012).

In the current study, the species *Limnophora Obsignata* (Rondani, 1866) was first recorded in Iraq. this genus can be recognized from closely genus by the near nonappearance of brown preciosity on the fronto-orbital and parafacial plates, and by the broader separation of the presutural dark mesonotal marks covering the setulose median part of the acrostichal field, by the slightly narrower postsutural dark band reaching only to the third pair of postsutural dorsocentral setae, and by the cloudy whitish calypteres, male Plate (1 a).

*Limnophora obsignata* (Rondani,1866)

#### 4. Scientific classification

Order: Diptera

Suborder: Brachycera

Family: Muscidae

Subfamily: Coenosiinae

Trib: Limnophorini

Genus: *Limnophora* Robineau-Desvoidy 1830

Species: *L. obsignata*

**Synonym:** - *Limnophora obsignata* (Rondani, 1866)

*Limnophora abdominalis* Zielke, 1971

*Limnophora brunnipes* Santos Abreu, 1976

*Limnophora paraobsignata* Zielke, 1971

*Spilogastera lbicinctus* Bigot, 1885

*Spilogaster obsignata* Rondani, 1866

*Spilogaster ostensackenii* Jaenicke, 1867

**Discerption of the genus:** *Limnophora* can be diagnostic adults of the genus by the absence of a pre-tergoid hair, and by the attendance of blunt-ended spines in the shape of the letter S on the ventral side of the anterior thorax;

**Body:** length about 7-10 mm male and female; general color brown with grey bands across most parts of the body, Plate (1 a).

**Head:** densely silver-white and with a well-developed dark frontal stripe. Proboscis, palpi and antennae dark brown, the longest rays of the arista about half as wide as the 3rd antennal segment. Frons at its narrowest point about 1 - 2 times as wide as the cellar triangle. About 7 pairs of parafrontals, 1 pair of ocellars and 2 pairs of verticals present. All strongly developed. Eyes naked, facets all of same size. Male with frons about one-fifth of head-width compound eye bare without hairs, dioptic, Frons narrow, at most twice as broad as width of postpedicel, and without orbital setae in male but in female eye holoptic, silvery-white or brown pruinosefronto-orbital plate, never velvety-black; antenna pedicel with clear longitudinal fissure and; arista plumose.

**Thorax:** In male scutum with an "Anthomyia - pattern", the two presutural dusky brown spots separated; post sutural band wide; scutellum dusky brown, grey patterns like stripes at apex; notopleuron grey pollinose; frons brunet; antenna, arista and palpus brunet; haltere milky; legs brunet; frontal triangle short; post sutural dorsocentrals 4, the first two short; lower katepisternal weak, inserted closer to the extended posterior one, Prosternum hairy. Female: A broad black transverse stripe stretching from wing-base to wing-base and reaching posteriorly to the third post-sutural dorsocentral seta runs behind the scutum. The longest combined plumosity in Arista is longer than the breadth of the post pedicel.

**Legs:** are brown in color. Mid-femur with a strong anterior in the middle, about 2 posteroventrals at the basal half, a row of posteriors in the apical half with 2 stronger ones at the apex; mid-tibia with 2 posteriors; hind-femur with a row of anterodorsals and about 3 antero-ventrals in the apical part; hind-tibia with 1 antero-dorsal Veins brown and r4+g dorsally and ventrally at the node with some setae. Wings with a

brownish tinge, membrane coated with microtrichiae, membrane covered with microtrichiae, veins brown and r4+g dorsally and ventrally at the node with some setae. Halteres yellow, Calyptrae white black in color to brunet, the hind coxa with hairs at inner posterior margin; fore tibia without a sub median seta; mid femur with two preapical setae, one posterior and one posterodistal; mid tibia with two posterior setae.

**Wing:** hyaline, there are spines at the base of the radial vein on both the upper and lower wing surfaces Plate (1 a and 2 a, b).

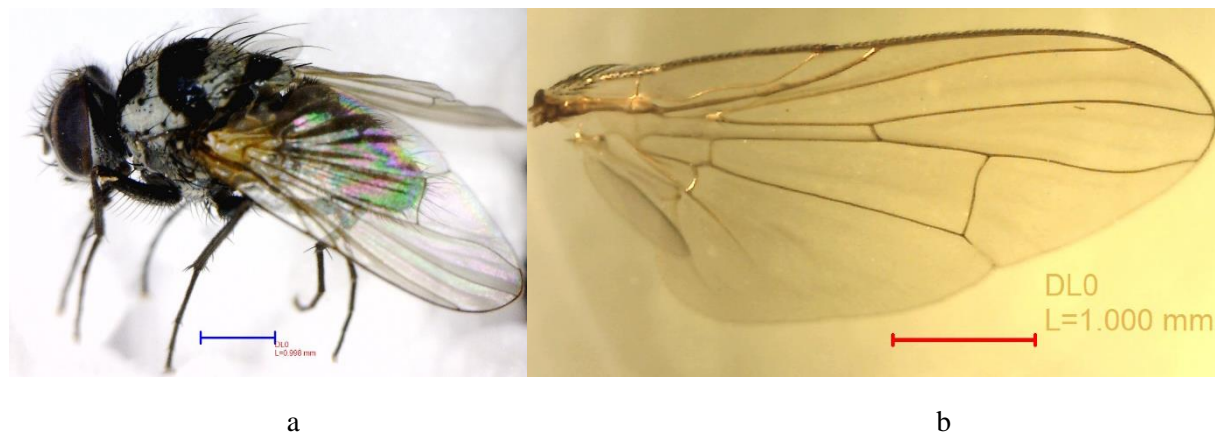
**Abdomen:** The abdomen is grayish in color and contains black spots that do not resemble a checkerboard, as is found in the Sarcophagidae family, as the spots are crosswise and extend to the ventral side of the abdomen. Surstylus it has many strong spines spread on its dorsal surface, as well as a scar-like thickening that is clearly visible in the lateral view as in Plate (3 a, b). Aedeagal complex is enlarged, with a transparent yellowish color, and the ejaculatory canal protrudes from it. It is transparent and very thin, but it is clear and distinct from the rest of the species as in Plate (3 C). Notes. One male dissected and illustrated, the species shows infraspecific variation in the color pattern of the scutum, mainly in the shape, size and color of the two presutural spots.

**Distribution:** Ethiopian (Zielke, 1971); New to Oman and to the Arabian Peninsula, Canary Islands to Iran, Sokotra and Madagascar (A C Pont, 1991; Zielke, 2017); Afrotropical Region (M. S. Couri et al., 2013); Croatia (Adrian C Pont & Ivković, 2013; ZIELKE, 2018; ZIELKE & BAŇAŘ, 2017); South Europe, North Africa, the Middle East, and widespread in the Afrotropical region; New for Armenia (Adrian C Pont et al., 2012); Afghanistan (ZIELKE, 2020); western Canary Islands (Michelsen, 2021).

**Materials examined:** (105 specimens), at spring (31♂♂; 21♀♀) 22.III.2020; (2♂♂; 0♀♀) 2.VI.2020, at summer; (18♀♀; 30♂♂) 21.X. 2020autumn; (3♂♂; 0♀♀) 20. XII. 2020, at winter.

## 5. Conclusion

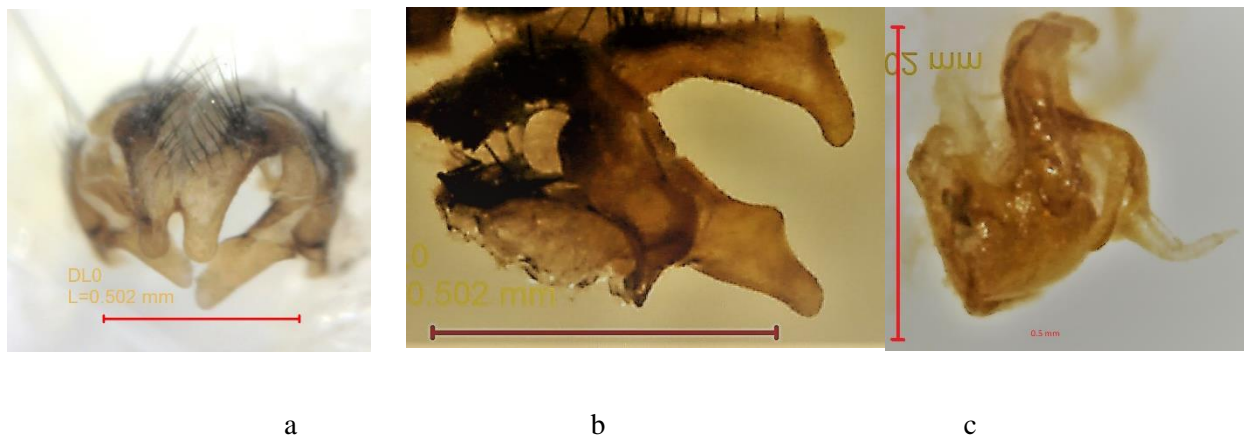
In conclusion, biologically important insect species were investigated in Karbala governorate. The study recorded the emergence of new unregistered species belonging to the Muscidae family, and this species is considered an ecologically important species as it plays an important role in biological control through its predatory nature to many soft larvae. Wet environments near the banks of rivers are considered the most suitable environments for the spread of this species in the study area. Also, the moderate temperatures and humidity in the spring and autumn seasons are suitable for its spread and emergence. The current paper recommends studying the behavior of this species, its activity, and its biotic and ecological relationships, for the ecological role it plays through its biological control of many harmful larvae, as well as the investigation of other species of this genus.



**Plate (1):** *Limnophora obsignata*; (a) Male, lateral view; (b) Wing dorsal view



**Plate (2):** *L. obsignata*; (a) Male, Wing dorsal view; (b) Wing ventral view



**Plate (3):** *L. obsignata*; (a) Male surstyli in dorsal view; (b) surstyli in lateral view; (c) aedeagus in lateral view

## References

- Alves, V. M., Moura, M. O., & de Carvalho, C. J. B. (2016). Wing shape is influenced by environmental variability in *Polietina orbitalis* (Stein)(Diptera: Muscidae). *Revista Brasileira de Entomologia*, 60, 150–156.
- Brown, B. V., Borkent, A., Cumming, J. M., Wood, D. M., Woodley, N. E., & Zumbado, M. (2009). *Manual of Central American Diptera: Volume 1*. NRC Research Press.
- Couri, M., & Pont, A. (2020). Type specimens of Limnophorini (Diptera: Muscidae) deposited in the Museum für Naturkunde, Humboldt-Universität zu Berlin (Berlin, Germany). *Zoologia (Curitiba)*, 37.
- Couri, M. S., Pont, A. C., & Kirk-Spriggs, A. H. (2013). New Muscidae (Diptera) hosts of *Stylogaster Macquart* (Diptera: Conopidae) from the Afrotropical Region: Insecta: Diptera. *African Invertebrates*, 54(2), 401–408.
- Couri, M. S., & Salas, C. (2010). First record of *Coenosia attenuata* Stein (Diptera, Muscidae) from Chile, with biological notes. *Revista Brasileira de Entomologia*, 54(1), 144–145.
- Couri, M. S., SOUSA, V. R., Lima, R. M., & Dias-Pini, N. S. (2018). The predator *Coenosia attenuata* Stein (Diptera, Muscidae) on cultivated plants from Brazil. *Anais Da Academia Brasileira de Ciências*, 90, 179–183.
- Courtney, G. W., Pape, T., Skevington, J. H., & Sinclair, B. J. (2017). Biodiversity of Diptera. *Insect*

- Biodiversity: Science and Society*, 1, 229–278.
8. Cuthbertson, A. (1934). Biological notes on some Diptera in southern Rhodesia. *Proceedings and Transactions of the Rhodesia Scientific Association*, 33.
  9. de Carvalho, C. J. B., Couri, M. S., Pont, A. C., Pamplona, D., & Lopes, S. M. (2005). A catalogue of the Muscidae (Diptera) of the Neotropical Region. *Zootaxa*, 860(1), 1–282.
  10. de Jong, Y., Verbeek, M., Michelsen, V., de Place Bjørn, P., Los, W., Steeman, F., Bailly, N., Basire, C., Chylarecki, P., & Stloukal, E. (2014). Fauna Europaea—all European animal species on the web. *Biodiversity Data Journal*, 2.
  11. Kühne, S., Schrameyer, K., Müller, D. R., & Menzel, F. (1994). *Räuberische Fliegen: ein bisher wenig beachteter Nützlingskomplex in Gewächshäusern*. Blackwell Wissenschafts-Verlag GmbH.
  12. Lamborn, W. A. (1920). The habits of a dipteran predaceous on mosquitos in Nyasaland. *Bulletin of Entomological Research*, 11(3), 279–281.
  13. Loewenberg-Neto, P., & De Carvalho, C. J. B. (2013). Muscidae (Insecta: Diptera) of Latin America and the Caribbean: geographic distribution and check-list by country. *Zootaxa*, 3650(1), 1–147.
  14. Martinez, M., & Cocquemot, C. (2000). La mouche *Coenosia attenuata*, un nouvel auxiliaire prometteur en culture protégée. *PHM Revue Horticole*, 414, 50–52.
  15. Michelsen, V. (2021). Macaronesian Muscidae (Diptera). II. The genus *Limnophora* Robineau-Desvoidy with description of a new Canarian endemic species. *Zootaxa*, 4952(1), zootaxa-4952.
  16. Morse, J. C., Yang, L., & Tian, L. (1994). *Aquatic insects of China useful for monitoring water quality* (Issue 13). Hohai University Press.
  17. Pont, A. C. (1991). A review of the Fanniidae and Muscidae (Diptera) of the Arabian Peninsula. *Fauna of Saudi Arabia*, 12, 312–365.
  18. Pont, Adrian C., Harutyunova, K., Harutyunova, M., & Werner, D. (2012). The hunter-flies of Armenia. III. New records of the genus *Limnophora* Robineau-Desvoidy, 1830, with the description of a new species: (Insecta: Diptera: Muscidae). *Zoology in the Middle East*, 57(1), 127–136.
  19. Pont, Adrian C., & Ivković, M. (2013). The hunter-flies of Croatia (Diptera: Muscidae: genus *Limnophora* Robineau-Desvoidy). *Journal of Natural History*, 47(15–16), 1069–1082.
  20. Rozkošný, R., & Gregor, F. (2004). *Insecta: Diptera: Muscidae* (Vol. 1000). Elsevier.
  21. Ruiz, M. A., ACOSTA-LÓPEZ, C., & SOTO-VIVAS, A. N. A. (2021). Morphometric variations in two populations of *Limnophora marginata* Stein, 1904 (Diptera, Muscidae) in Ecuador. *Biodiversitas Journal of Biological Diversity*, 22(5).
  22. SHINONAGA, S., & KANO, R. (1983). Two new species and a newly recorded subspecies of the genus *Lispe* Latreille from Japan with a key to Japanese species (Diptera, Muscidae). *Medical Entomology and Zoology*, 34(2), 83–88.
  23. Werner, D., & Pont, A. C. (2006). The feeding and reproductive behaviour of the *Limnophorini* (Diptera: Muscidae). *Studia Dipterologica, Supplement*, 14, 79–114.
  24. Xue, W.-Q., Bai, S.-C., Dong, W.-X., & Kerr, P. H. (2012). A study of the genus *Limnophora* Robineau-Desvoidy (Diptera: Muscidae), with descriptions of six new species from China. *Journal of Insect Science*, 12(1).
  25. Zielke, E. (1971). Description of eight new Phaoniinae species from the Ethiopian region (Diptera: Muscidae). *Beiträge Zur Entomologie= Contributions to Entomology*, 21(1–2), 71–77.
  26. Zielke, E. (2017). Some new records of the muscid fauna from Iran, with the description of *Helina irani* spec. nov (Diptera: Muscidae). *Journal of Entomology and Zoology Studies*, 5(5), 442–446.
  27. ZIELKE, E. (2018). Some records of Muscidae (Diptera) from Greece with a description of a new *Phaonia* species and a list of the known muscids from the country. *Acta Musei Moraviae, Scientiae Biologicae*, 103(2), 269–280.
  28. ZIELKE, E. (2020). Records of Muscidae (Diptera) and a new species from Afghanistan and other Asian countries. *Acta Musei Moraviae, Scientiae Biologicae*, 105(1), 103–121.
  29. ZIELKE, E., & BAÑAR, P. (2017). First records of the genus *Mydaea* and of some other Muscidae species from Croatia (Diptera). *Acta Musei Moraviae, Scientiae Biologicae*, 102(1), 43–48.