

Identification key to the species of blowflies (Diptera: Calliphoridae) of northwestern Libya

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Abstract

Necrophagous blowflies are considered one of the most important evidence in legal investigations. Although similar in appearance, the various species differ in their evolutionary biology, ecology, and behavior. The correct identification of flies, especially of the family Calliphoridae, is the central to their use as evidence in forensic entomology. Samples were collected for six months in the year 2021 from some areas of the northwestern part of Libya, using a fly trapping net and baits, and since the area is located in the same climatic zone with no clear geographical barriers, we assume that the species of blowflies that were recorded in this key are likely to be found in the entire region. The key is provided to seven species of Calliphoridae: *Chrysomya albiceps*, *Chrysomya megacephala*, *Calliphora vicina*, *Calliphora vomitoria*, *Pollenia* sp., *Lucilia sericata*, *Lucilia cuprina*. With no clear database for forensic entomology species in Libya that were found or is likely to be found in the northwestern region of Libya, and with no identification key for these species; this key will represent the key stone for other forensic entomology studies. New forensic entomologists, researchers, or even students can easily use this key.

Keywords: Calliphoridae, *Calliphora*, *Pollenia*, *Chrysomya*, *Lucilia*, North werstren Libya.

Introduction

Insects are the most diverse living organism on earth, accounting for about half of the living organisms. The species of living organisms have been estimated at about three-quarters of all known animals, and it is believed that more species of insects are yet to be discovered than are known at present (Wijesekara and Wijesinghe, 2003).



Forensic entomology is using insects as evidence linked to criminal investigations, and deals not only with insects involved in crimes, such as murder or suicide, but includes hospital and nursing home neglect, sudden deaths, traffic accidents...etc. (Hans, 2011).

The family Calliphoridae exhibits great diversity in behavior and ecology and it depends on animal carcasses or decomposing organic materials as source for food (Yang et al., 2014). However, one of the main problems in the identification of carrion flies is the lack of taxonomists or available keys that can identify even the most common species, which sometimes leads to wrong identification (Carvalho, 2002).

Blowflies (Diptera, Calliphoridae) have many important characteristics such as the color and shape of some structures on parts of the body of the fly, for example, the head with compound eyes and one pair of antennae, the thorax with three pairs of jointed legs and wings, and the abdomen. It is characterized all these traits are of great importance in the identification of flies at the species level. The correct definitions provide access to relevant information about these species of flies, especially important studies in development (Villet, 2015).

Blowflies are well known as important insects in medical entomology and forensic entomology. Many diseases are transported by blowfly species or cause a direct effect on human health and animals (Marinho *et al.* 2006). On the other hand, blowfly species can help in the legal investigation in determining the post-mortem intervals (PMI) as usually among the first species to arrive at human remains and therefore can help in determining the time of death (Sharma et al. 2015). In the first 72 hours after death, the pathologist is usually considered to be able to accurately and reasonably determine the time of death. This was based on the state of the body, and features such as the decrease in body temperature, after this time; there is less medical information linking post mortem interval, so another area of expertise is required to clarify the time of death. Forensic entomologist can provide a measure of the possible period of time after death, based on the life cycle stages of the species of flies recovered from the body, or the sequence of insects on the body, and give this



estimate over hours, weeks, or years. The onset of the post-mortem period is considered to coincide with the point when the fly first laid its eggs on the body. The duration of this stage, in relation to a particular stage of decay, gives an accurate measurement of the probable length, of the time at which the person died, and maybe the best estimate available (Gennard, 2012).

The fauna of necrophagous blowflies has been intensively studied in many countries (Akbarzadeh, et al., 2015). Libyan blowflies are not well documented or studied except in Zavattari (1934) when cited as an alist of species recorded from a different area of Libya. Studies on forensic insects are very poor and only started in 2015 when the first study to shed light on insects related to animal carrions was conducted by Ahmed (2015) during her B.Sc. project. and the first related publication on the diversity and abundance of blowflies and some other families was conducted by Bin Barka et al. (2017).

The correct identification of blowflies is important in forensic entomology and is crucial in determining the PMI (Wells and Lamotte, 2001). Many identification keys can help in the identification of Libyan blowflies species (Whitworth, 2006; Whitworth, 2010; Akbarzadeh et al. 2015; Lutz et al., 2018), but these keys contain many species that are not present in Libya and can make these keys difficult for beginners in forensic entomology, researchers and students. Therefore, this paper aims to present a basic identification key for blowflies collected from some parts of the western region of Libya.

Material and Methods

The northwestern region of Libya here means the area from Misurata to the Libyan-Tunisian border and from the coastal line to the base of Nafusa mountain.

Samples used in this key were collected during the months of February, May, August, September, October and November, for the year 2021, from different sites in the northwestern part of Libya including Tripoli (the capital) (32°52'31"N 13°11'15"E), Al-Shaafiin- Misalata (32°22'40"N 15°05'24"E), Zawia (32°45'16"N 12°43'47"E), and Farwa near Zuwara (33°06'32"N 11°44'28"E) (Fig 1). All samples were

collected by the authors. Some species that were documented as forensic important species by Bin Barka *et al* (2017) are included as well. *Calliphora vomitoria* have not collected in our study but recorded by Zavattari (1934). Therefore, it is included in this key.

The figures in Withworth (2006), Akbarzadeh *et. al.*, (2015), and Lutz *et al.*, (2018) can assist in identifying the specimens.

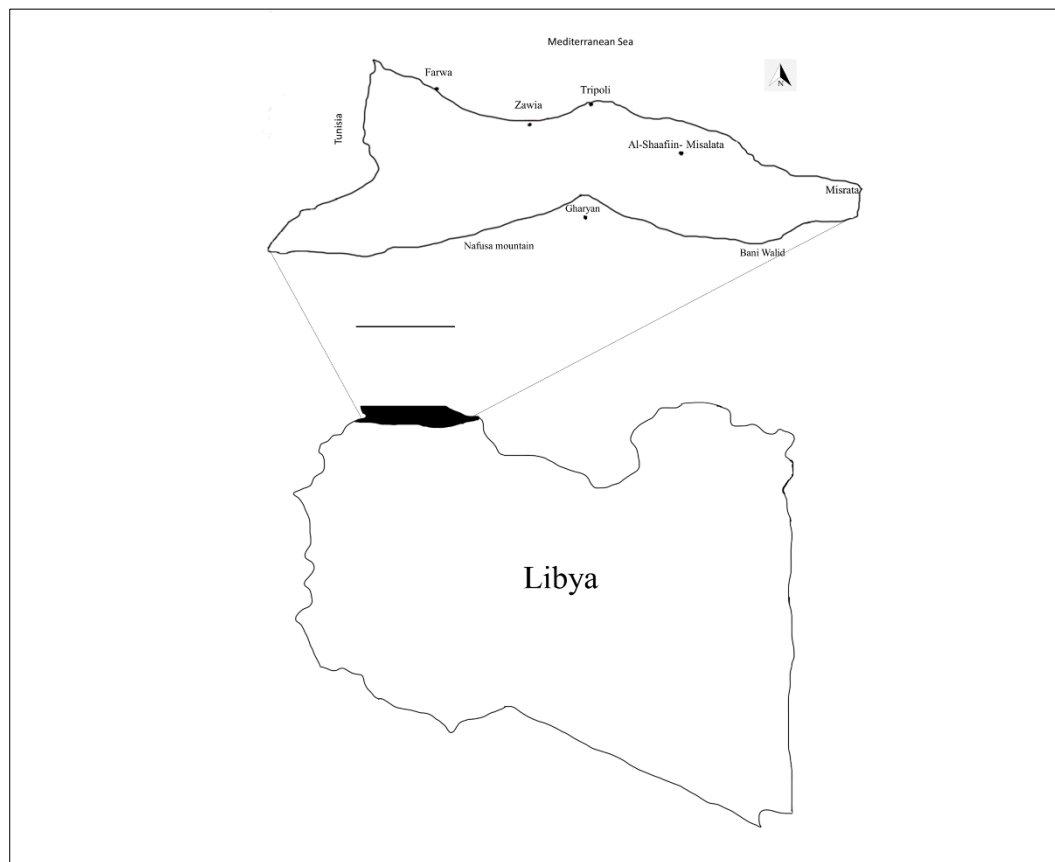


Fig.1. Map of study area. Scale bar represent 50km.

Results

For the correct identification, the researcher should know the principle characters of blowflies that used in this key which described in the Figures (1, 2, 3, 4).

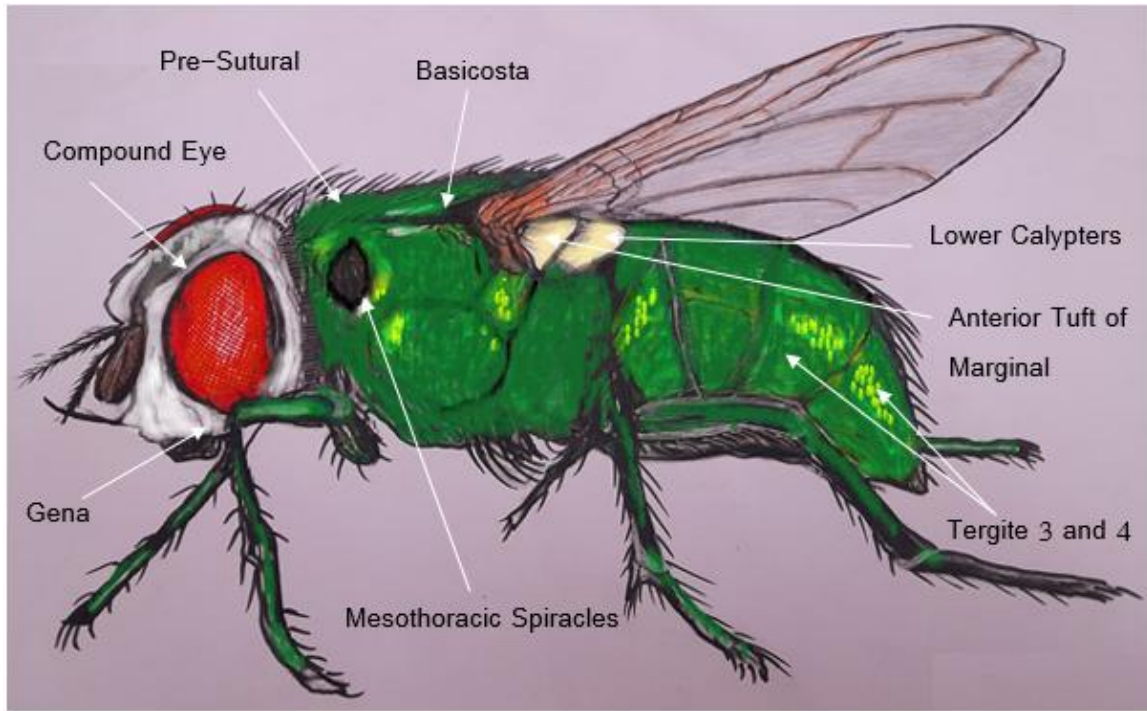


Fig (1). Lateral view of blowfly



Fig (2). Basal part of wing and lower calypter. **a** *Ch. albiceps* stem vein. **b** *C. vicina* lower calypters.

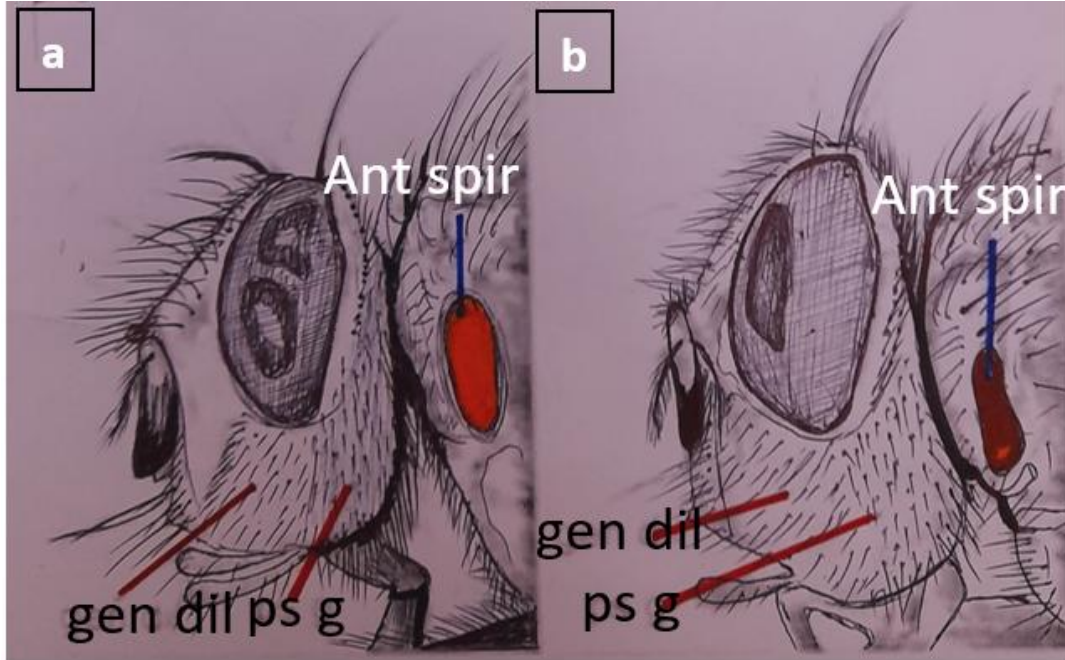


Fig (3). Lateral view of head. **a** *C. vicina*. **b** *C. vomitoria*. *ant spir* anterior spiracle, *gen dil* genal dilation, *ps g* post gena.

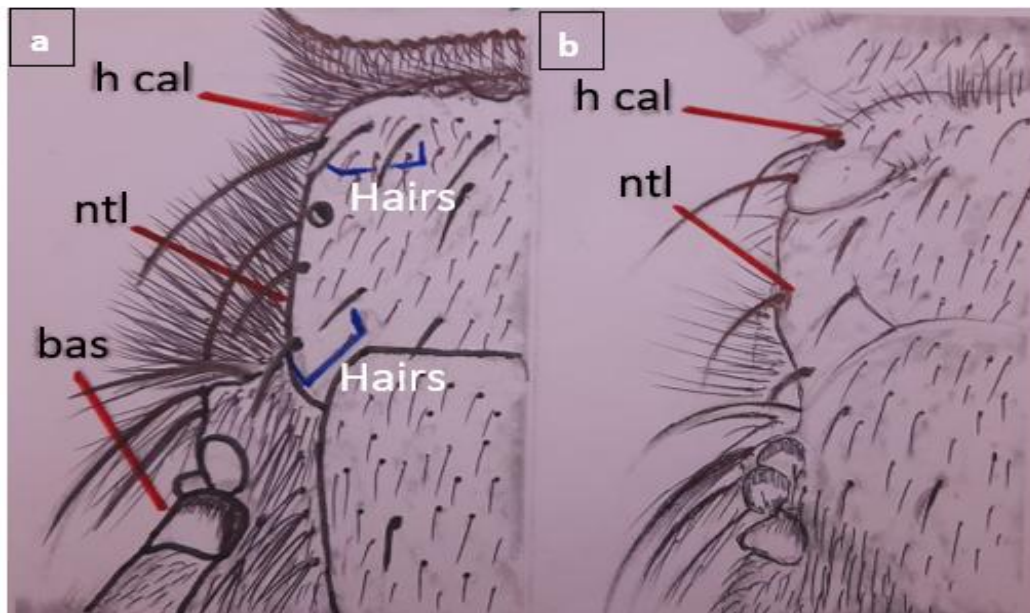


Fig (4). Dorsal view of thorax. **a** *L. sericata*. **b** *L. cuprina*. *h cal* humeral callus, *ntl* notopleuron, *bas* basicosta.

- 1-Dull colored with golden hair on the thorax.....*Pollenia*
- Without golden hair on the thorax.....2
2- Stem vein with setose (Akbarzadeh *et al.* 2015, Fig. 1 a).....3
- Stem vein without setose.....4
3- Anterior spiracle white or yellowish (Akbarzadeh *et al.* 2015, Fig.1d).....
.....*Chrysomya albiceps*
- Anterior thoracic spiracle dark brown. (Akbarzadeh *et al.* 2015, Fig. 1i).....
.....*Chrysomya megacephala*
4- Thorax non-metallic (Akbarzadeh *et al.* 2015, Fig.2k).....5
- Thorax bright green metallic or bronzy(Akbarzadeh *et al.* 2015, Fig.3a,b)6
5- anterior part of genal dilation orange and basicosta bright to dark yellow
(Akbarzadeh *et al.* 2015, Fig. 2 l)*Calliphora vicina*
- postgena and lower part of genal dilation with orange hair and basicosta dark
(Akbarzadeh *et al.* 2015, Fig. 2 m).....*Calliphora vomitoria*
6- the posterior slope of the humeral callus with 6–8 hairs. (Akbarzadeh *et al.* 2015,
Fig. 3 a).....*Lucilia sericata*
- the posterior slope of humeral callus with 0–4 hairs. (Akbarzadeh *et al.* 2015, Fig. 3
b) *Lucilia cuprina*

Discussion

Key for six Calliphoridae species and one genera of forensic importance that were collected from different sites (except *C. vomitoria*) in the northwestern part of Libya is presented. The northwestern part of Libya fall within the same climate zone (Tantawi, 2005) which makes us assume that the distribution of blowfly could be similar in the whole area especially since no geographic barriers can affect the distribution of these species. Therefore, we expect the key will be useful for specimens collected from the same area. Other keys for blowflies identification (Akbarzadeh et al. 2015; Lutz et al. 2018) which are published and contain the same species that is presented in this key can be useful but contain many species that are not recorded in Libya which might make these keys difficult to use for researchers who are new to forensic entomology field. Other difficulties that might face the new researchers using this key are the condition of the specimens and how reserved where usually the color of spiracles can be affected if the specimen is preserved in alcohol or some setae that are important in identification dropped when the specimen is handled or prepared for pinning. The identification character of *Lucilia sericata* and *L. cuprina* is the most difficult and need proper magnification and depends on the angle of observation but other character described by Williams and Villet (2014) can help easily to differentiate between the two species.

More studies on other regions could reveal more species that help in forensic entomology in Libya.

Conclusion

Insects in general and flies in particular are considered organisms that have a direct and indirect relationship with humans. Blowflies among them are of great medical and veterinary importance that can be used in forensic science, especially for the estimation of the postmortem interval. This study prepared a taxonomic key for the two-winged species of the family of blowflies, which are related to the criminal investigations. This key is one of many steps that needed in building the forensic entomology branch in Libya and more studies can reveal more species of blowflies that are important in this science.

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