The Libyan Journal of Science (An International Journal): Volume 20, 2017

Diversity, Seasonality and Abundance of Blowflies (Diptera: Calliphoridae) in University of Tripoli with Notes on Other Families

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Abstract

The blowflies (Calliphoridae) have both negative and positive importance. They can act as vectors for many pathogens. On the other hand, they can play a major role in environment as decomposers. In addition, they are important in forensic investigations to determine the post mortem intervals. Libyan blowflies obtained little attention and were only mentioned in old references. This study aims to determine the diversity of forensically important blowflies and their monthly abundance at the University of Tripoli, Libya during the period from January 2016 to February 2017. Five baited traps (Sardine fish) were used to achieve the study aim. The most abundant families of Diptera were Muscidae, Chloropidae, Calliphoridae and Sarcophagidae. Six calliphorid species were recorded in this study: *Chrysomya megacephala*, *Chrysomya albiceps*, *Lucilia sericata*, *Lucilia cuprina*, *Calliphora vicina* and *Pollenia* sp, but the most abundant species was *Ch. megacephala*. All calliphorid species show similar seasonal trend with high abundances in moderate and cold months while no individuals were captured during the months of July and August. Three new records were added to Libyan insect fauna; two of them belong to the family Calliphoridae: *Lucilia cuprina*, *Pollenia* sp. while the third; *Zaprionus indianus*, belongs to the family Drosophilidae.

Key words: Calliphoridae; Libya; Seasonality; Abundance; Forensic.

Accepted for publication: 3/12/2017

المستخلص

الذباب النافخ التابع لفصيلة Calliphoridae ذو أهمية إيجابية وسلبية، حيث يعمل كناقل للعديد من مسببات الأمراض. على الجانب الآخر، له دور أساسي من الناحية البيئية، حيث يعد من الممحلالات. بالإضافة إلى ذلك، يعد الذباب النافخ من الحشرات المهمة في التحقيقات الجنائية، في تحديد زمن الوفاة. لقى الذباب النافخ في ليبيا اهتمام بسيط، حيث ذكر فقط في المراجع القديمة. تهدف هذه الدراسة إلى التعرف على تنوع ووفرة الذباب النافخ ذو الأهمية الجنائية، بجامعة طرابلس، ليبيا خلال الفترة من يناير 2016 وحتى فبراير 2017. أستخدمت خمسة مصائد طعوم (سمك السردين) لتحقيق هدف الدراسة. مثلت فصائل Muscidae و Chloropidae و Chaliphoridae و Sarcophagidae الأكثر وفرة. سجلت خلال هذه الدراسة ستة أنواع تابعة لفصيلة الذباب النافخ وهي Chaliphoridae: *Chrysomya megacephala* و*Chrysomya albiceps* و *Lucilia sericata* و *Lucilia cuprina* و *Calliphora vicina* و *Pollenia* sp. وكان *Ch. megacephala* الأكثر وفرة. أظهرت جميع الانواع التابعة لفصيلة الذباب النافخ نفس النمط الموسمي حيث كانت أعلى وفرة لها خلال الاشهر المعتدلة والباردة بينما لم يتم مسك أي حشرة خلال شهري يوليو وأغسطس. تم تسجيل ثلاثة أنواع جديدة غير مسجلة في السابق في ليبيا: إثنان منها تابعين لفصيلة الذباب النافخ Calliphoridae: *Lucilia cuprina* و *Pollenia* sp. بينما النوع الثالث *Zaprionus indianus* تابع لفصيلة Drosophilidae.

Introduction

Forensic entomology is one of the major branches of forensic science, where collected information from insects and arthropods that are found in crime scene are used to help in solving crimes (Williams and Villet, 2006). It has been categorized into medico-legal forensic entomology, urban forensic entomology and stored-product forensic entomology (Williams and Villet, 2006). Insects are used in crime investigation in determining the time of death (Post mortem intervals PMI) and the possibility of corpse movement (Catts and Goff, 1992)

Diptera (true flies) is one of the most diverse insect orders with about 150,000 described species in 158 families, and worldwide distribution. Many fly species are important for humans and livestock as they can directly transport infectious agents due to their affinities with feces or by acting as a vector for several diseases (Carvalho and Mello-Patiu, 2008). Many families of Diptera are associated with carrion, or have forensic importance; Calliphoridae, Sarcophagidae, Muscidae, Fanniidae, Phoridae, Piophilidae, Anthomyiidae, Sepsidae, Ulidiidae, Sphaeraceridae, Drosophilidae, and Stratiomyidae (Carvalho and Mello- Patiu, 2008).

Calliphoridae (blowflies) with about 1000 known species are found throughout the world. Some members of the family show medical, veterinary and forensic importance (Vasconcelos and Barbosa, 2015; *Phasuk et al., 2013*). Larvae of some species of blowflies feed on dead tissue and could be used in maggot therapy (Anderson and Kaufman, 2001). Blowfly larvae fulfil an important ecological function in the decomposition of animal remains (Dehkordi *et al.*, 2014). Calliphorid flies are normally the first invaders of surface carrion, therefore considered the most important family in forensic investigation to estimate the post mortem interval (PMI) (Dehkordi *et al.*, 2014; Zabala *et al*., 2014).

Forensic entomology is a new branch of science and has not been used in Libyan legal system. Therefore, this branch needs more information in all aspects. In general, Libyan forensic fauna was mentioned only in few references related to Libyan insect diversity fauna (Zavattari, 1934; Hammad, 1974). Therefore, this study is considered the first study on Libyan forensic blowflies. The purpose of this paper is to study blowflies' diversity, their seasonality and abundance in University of Tripoli, Libya in addition to some notes on other important families related to forensic entomology.

Material and Methods

The study was conducted at the University of Tripoli, Libya (32° 50' N and 13° 13'). The study period started from January 2016 to February 2017. In general, Tripoli has four different seasons with cold and rainy weather in winter (December to February) and mild weather in spring (March to May) and autumn (September to November) and hot and dry summer (June to August). Five baited traps (head of sardine) were set out at the study area twice a month (every two weeks) and remained exposed for 48 hours. The bait was kept at room temperature for 24 hrs to start rotting before using. Traps were distributed in places more than 400 m apart from each other in places with easy access and little human activity and hanged 1.5m from the ground. One trap was set up at the Agriculture Experimental Station of the Faculty of Agriculture. The second trap was set near olive trees orchard. The third was set in a car parking with few olive trees and the rest were set close to the University buildings. Collected specimens were separated using dissecting microscope and identified to species level using an appropriate identification keys in the Laboratory of Zoology Department, Faculty of Science, University of Tripoli. Trap design was as described by Whitworth (www.blowflies.net/collecting.htm) with one modification; a funnel was added to the big bottle to insure that flies do not escape from the trap. Temperature and humidity were recorded every hour by data logger 32 for temperature and humidity.

Results

The temperature ranged from 5.1 to 35 °C in cold months during study period (January- March and October to December) and from 14.2 to 46.7 °C in moderate and hot months (April- September) whereas relative humidity ranged from 7 to 92.7 % (Fig. 1).

A total of 1450 dipteran (ten families) flies were collected during the study period. Muscidae was the most represented family (38.3%), followed in order by Chloropidae (21.0%), Calliphoridae (18.5%), and Sarcophagidae (16.6%). Specimens from other families were also captured and included; Piophilidae, Fanniidae, Phoridae, Ulidiidae, Tephritidae and Drosophilidae which were represented only by 5.5%. In addition, specimens from other orders were also collected; Coleoptera and Hymenoptera.

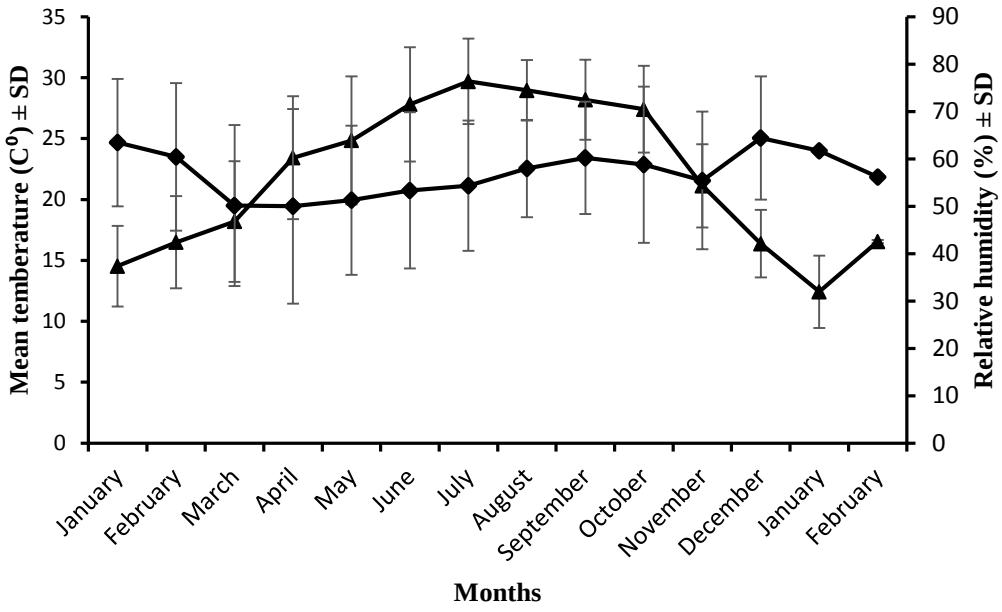

Fig. 1. Monthly temperature and relative humidity (mean ± SD) recorded at Tripoli University during study period. (▲) Mean temperature; (♦) Mean relative humidity

Across all months, the most abundant four families that are forensically important showed the same seasonal trend (Fig. 2) with high numbers in cold and moderate temperature months compared to hot months. No calliphorid flies were captured during July and August. However, muscid and sarcophagid flies abundances showed high individual numbers during most study months than other

families. The most abundant species of carrion flies is *Ch. megacephala* (Table 1) followed by *L. sericata* and *L. cuprina*, whereas only one specimen of *Pollenia* sp. was collected

A total of 268 calliphorid flies were captured belonging to six species within four genera (Table 1). *Ch. megacephala* was the most abundant species (n= 150, 55.97%), *Ch. albiceps* (n= 8, 2.99%), *C. vicina* (n= 32, 11.94%), *L. sericata* (n= 37, 13.81%), *L. cuprina* (n= 40, 14.93%) and one specimen of *Pollenia* sp (excluded from Fig. 3). All the calliphorid species show similar seasonal trend cross all the months (Fig. 3) with two peaks; one between January and June 2016 and the other between September 2016 and January 2017, whereas no calliphorid flies were captured during the hot months (July and August).

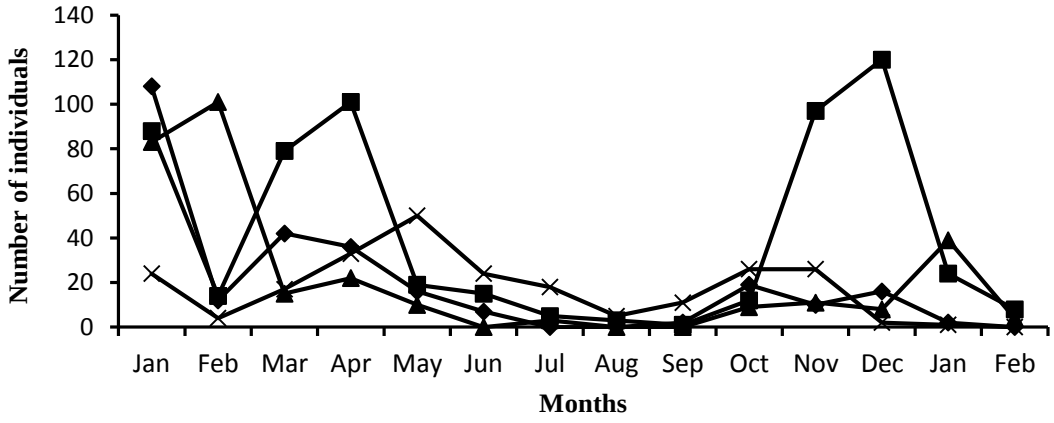

Fig. 2. Monthly abundance of the four most abundant dipteran families captured in the study period. (♦) Calliphoridae; (■) Muscidae; (×) Sarcophagidae; (▲) Chloropidae.

New records

Despite the small study area, three species new to Libyan insect fauna were recognized; two belong to family Calliphoridae: *Lucilia cuprina* and *Pollenia* sp. and the third belongs to family Drosophilidae, *Zaprionus indianus*.

Discussion

Our study of calliphorid species diversity, abundance and seasonality in University of Tripoli is the first of its kind in Libya. In addition, some other information on some forensically important families was collected. Muscidae was the most abundant family followed with Chloropidae and Calliphoridae. Sucharit

Table 1. Number of insects captured by baited traps during study period.

Order	Family	Species	Number
Diptera	Calliphoridae	*Ch. megacephala*	150
		Ch. albiceps	8
		L. sericata	37
		L. cuprina	40
		C. vicina	32
		Pollenia sp.	1
	Sarcophagidae		241
	Muscidae	*Musca domestica*	9
		Muscina stabulans	136
		Musca autumnalis	6
		Atherigona spp.	405
	Chloropidae		305
	Fanniidae	*Fannia canicularis*	6
	Phoridae		23
	Piophilidae	*Piophilia casei*	15
	Ulidiidae	*Physiphora alcea*	15
	Drosophilidae	*Zaprionus indianus*	6
	Tephritidae		15
Coleoptera	Nitidulidae	*Nitidula vlavomaculata*	3
	Dermestidae		4
Hymenoptera	Formicidae		427
	Unidentified		12

and Tumrasvin (1981) showed that muscid flies can be more abundant than Calliphorid flies, whereas Hwang and Turner (2005) showed the opposite.
The higher number of muscid flies was driven by genus *Atherigona* and *Muscina*. *Atherigona* was mostly recorded from one trap located at the Agriculture

Experimental Station at Faculty of Agriculture where many crops can be hosts to this genus. Many *Atherigona* spp are known to be secondary pests on agricultural crops (Ribeiro *et al*., 2016). However, some *Atherigona* species were collected when animal baits were used in forensic studies (Rodríguez and Liria, 2017). Many other forensically important families were collected especially Piophilidae which also has forensic importance (Rochefort *et al*., 2015).

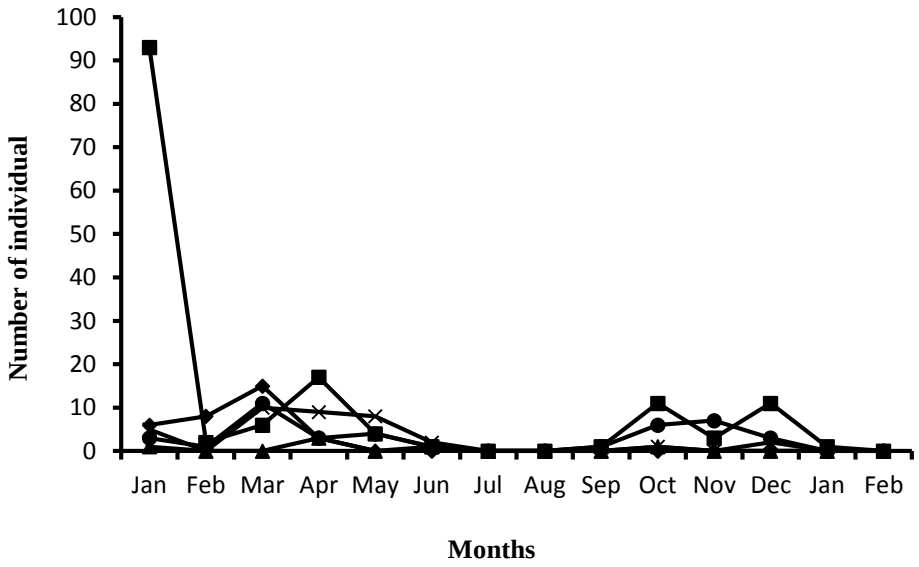

Fig. 3. Monthly abundance of calliphorid species captured in the study period. (♦) *C. vicina*. (■) *Ch. megacephala*. (▲) *Ch. albiceps*. (●) *L. cuprina*.(×) *L. sericata*.

The most abundant families reported in this study (Muscidae, Chloropidae, Calliphoridae and Sarcophagidae) showed similar seasonal trend through the study period with high abundance in moderate and cold months and low abundance in hot months. Calliphorid population had two peaks during the moderate temperature months, whereas Phasuk, *et al*. (2013) showed three peaks. Variation of fluctuation in population abundance can be due to climatic factors especially air temperature and humidity where flying activity and release of stimuli can be reduced (Wall, *et al*., 2001; Hwang and Turner, 2005).

The six calliphorid species that were recorded in this study (*Pollenia* sp excluded as only one sample was collected) were higher in abundance with similar seasonal trend from January 2016 to May 2016 and from September 2016 to January 2017. Similar trend had been shown by Barratt *et al*. (2001). From January to early May, flies can be attracted to trees that start blossoming and the

presence of food can help in attraction flies and this can aid of flies capture (Marinho *et al*., 2006). In summer, no calliphorid species were collected and this finding concurs with the study of Azevedo and Krüger (2013). *Ch. megacephala* was more abundant than other calliphorid species where this might be due to the bait type. Bait type can influence the attractiveness of calliphorid species where *Ch. megacaphala* more attracted to fish bait (Wall *et al*., 2001). In addition, *Ch. megacephala* abundance was correlated with the beginning of rainy season, whereas in hot dry season the population declined (Wall *et al.*, 2001).

Despite the small study area, three other insect species (*Lucilia cuprina*, *Pollenia* sp. and *Zaprionus indianus*) were added to Libyan fauna as the first time records. Studying longer periods and wider areas can reveal more data on forensic insects. Libyan forensic entomology needs more effort and studies to use it in legal system.

Acknowledgment

We are indebted to Dr. Taher Shaibi for providing us with data logger 32 for temperature and humidity. We also acknowledge anonymous referee and the Editor of the Journal for their valuable suggestions in improving the manuscript.

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