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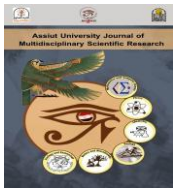

Prevalence and Seasonal Abundance of Synanthropic Filth Flies Collected from Animal-Rearing Stations in Assiut Governorate, Egypt.

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ABSTRACT

Synanthropic filth flies are naturally evolved to live in close proximity to human and animal habitations, more than any other group of insects; they have a major negative economic impact, and significant veterinary and medical implications on people and animals. Although the high importance of synanthropic flies, yet, the information concerning species diversity, prevalence and seasonal abundance of these flies in Assiut Governorate is deficient. Therefore, the current study's objectives were to identify various species of synanthropic filth flies in the selected animal rearing stations and over the course of one-year duration, as well as to ascertain how seasonal variation affected the abundance of these flies in selected study sites in the Assiut Governorate, Upper Egypt. A total of 12749 flies were collected from three animal rearing stations in Assiut Governorate, from July 2020 to June 2021. The collected fly species were classified according to standard taxonomic keys. They belonged to seven dipteran families; Muscidae,

Sphaeroceridae, Fannidae, Ulidiidae, Sepsidae, Calliphoridae and Sarcophagidae. Family Muscidae was the most prevalent family in all the studied stations (62.58%) while the least abundant families were family Calliphoridae (0.055%) and family Sarcophagidae (0.02%). There were statistically significant differences in numbers of collected flies in relation to seasonal variations (*P*. value <0.05). Summer and spring witnessed the highest incidence rates of flies followed by autumn, meanwhile the winter showed the least flies' abundance. For the assessment of the risk of vector-borne diseases, it is essential to know the prevalence of fly species. Thus these results are helpful for determining the suitable time of fly control programs in animal-production sites.

1. INTRODUCTION

Diptera, true flies, is the largest and most diverse order of insects all over the world with estimated 240,000 species including mosquitoes, gnats, midges, black flies, sand flies, houseflies, etc. [1]. Dipteran insects have a more significant health impact on humans and animals than any other group of insects. Some flies have harmful effects as pests of agricultural plants, or as vectors for transmitting diseases to humans and domestic animals. On the other hand, many flies have beneficial effects, particularly those pollinating flowering plants, serving as bio-control agents of insect pests, or aiding in the decomposing of organic matter [2].

Flies can be classified according to co-existence with human into eusynanthropic, hemisynanthropic and asynanthropic flies. Eusynanthropic flies are those live in the same human environment, close to or even inside residences [3]. While, hemisynanthropic flies live in intermediate environments; fluctuating between natural and human residences and asynanthropic flies live in pristine forests or natural environments [4]. Filth flies usually use animal manure and human excrement (coprophagic flies), and also use garbage, animal bedding, and decaying organic matter (saprophagous flies) for nutrition, oviposition, and breeding [1, 5, 6]. Temperature, moisture and the availability of breeding places are three critical factors that can alter fly abundance [7].

Flies disturb the animals leading to aggressive behavior, reduced milk production, poor growth and thus negative economic impact. The house fly, *Musca domestica* (L) and the sedentary fly, *Stomoxys calcitrans* (L) are the common synanthropic flies of livestock farms. The presence of these fly species in animal rearing sites causes significant

nuisance problems to animals and also flies bites can elevate physiological stress of animals as indicated by increased cortisol levels [8]. Stress responses are correlated with animal age as younger cattle reacting more strongly to biting flies than older animals [9], potentially resulting in greater economic effects as young cattle are in a period of rapid growth [10]. The information concerning species diversity, prevalence and seasonal abundance of these flies in Assiut Governorate is deficient. Therefore, the current study's objectives were to identify various species of synanthropic filth flies in selected animal rearing stations over the course of one-year duration. Also to ascertain that the abundance of these flies varies due to seasonal variation in the selected study sites in the Assiut Governorate, Upper Egypt.

2. MATERIALS AND METHODS

2.1 General Survey

A preliminary search for animal farms in different regions at Assiut Governorate, Upper Egypt was carried out to choose the appropriate collection sites where livestock is permanently present so flies from different barns have the opportunity to feed and breed on calves' waste.

2.2 Study sites

Three animal-rearing stations were selected for the study. Animal rearing station (A) is located at El-Hammam, Abnoub district (about 9.01 Km northeast Assiut City, 27°15'26.7"N 31°09'56.3"E). This station is about 14 acres, consisting of 14 barns containing different ages of Dutch cows (Holstein Friesian) are raised indoors at about 15-17 animals/barn. The age categories of the raised calves include; baby calves, 1-day old to 1-month old, pre-weaned, 1-month old to 3-months old, weaned, 3-months old to 7-months old, growing, 7 months old to 1-year old and elders (heifers and adults), 1-year old to 5-years old. Animal rearing station (B) is located at Bani Murr village, El-Fath district (about 4.37 Km northeast Assiut City, 27°13'03.0"N 31°11'23.4"E). The area of this station is about 7 acres with 9 barns including Egyptian buffaloes at about 20-27 animals/barn. Animals are raised indoors, the ages categories include; babies, pre-weaned, weaned, growing, and elders (each 20-27 animals/barn). Animal rearing station

(C) is the animal production farm of the Faculty of Agriculture, Assiut University. It is located 2.73 Km northwest Assiut City, 7°11'14.2"N 31°09'36.0"E, near Assiut University Hospitals. Its area is about 12 acres in which Dutch cows (Holstein Friesian), Egyptian cows, and buffaloes are raised outdoors in 16 barns, at 7-12 animal/barn. Categories of animal ages include babies, pre-weaned, weaned, growing, and elders.

Animal conditions

The different age groups of animals were kept in separate barns, Female animals were reared for dairy production, while males were reared for meat production. Animals were fed on green fodders and grass when available, while hay and straw were used when green fodders became scarce in dry months. Concentrates, containing 25% soya bean meal were used for dairy females, given to the animals twice a week as a supplement. Butox 5% (Organophosphate acaricides) spray was applied at irregular intervals every 2-3 months, upon ectoparasites, ticks or mites infestations. There wasn't any pest control management against flies in the three animal rearing stations.

2.3 Fly samples collection

This study was conducted for a period of twelve months started from July 2020 to June 2021 to scrutinize the abundance of synanthropic flies in the study sites. From each animal-rearing station; fly samples were collected twice a month. The first was collected in the middle of the month during days 14-16, while the second collection was at the end during days 28-30 (except February) to ensure collecting as many samples as possible at different weather conditions. Each collection was taken from 9.00-12 am as standard time [11] at which flies were actively swarming over animal feces annoying them. Throughout the whole study period, weather conditions (temperature and relative humidity) were measured using a mercury thermometer/hygrometer. The measured temperature and relative humidity data were confirmed by the Central Laboratory for Agriculture Climate, Faculty of Agriculture, Assiut University.

Fly samples collections were performed using cleaned and sterilized insect sweep nets [12] with a white gauze bag. Flies were trapped randomly over surfaces of fresh cattle and buffalo calves' feces inside the gauze, the flies were collected in sterile, labeled

plastic jars**,** closed and transferred immediately to the General Entomology Laboratory, Zoology/Entomology Department, Faculty of Science, Assiut University. Jars of the collected flies were briefly exposed to low temperature (-20°C) in a freezer to be immobilized. The collected flies were examined using 4X magnification binocular microscope, counted and classified to the family, genus, and species levels using the taxonomic keys [13, 14]. Prevalence and seasonal abundance were studied and also the frequency and dominance of the collected synanthropic flies were calculated according to equations of Oliveira and Vasconcelos (2010) [15] as follows:

The Frequency of occurrence (FO) was calculated as follows:

$$\mathbf{FO} = \frac{\textbf{Number of samples containing family X}}{\textbf{Total number of samples}} \textbf{ x 100}$$

If the FO value was ≥ 50% the family was classified as very frequent; 25% ≤ FO <50%, the family was classified as frequent, and if FO was <25%, the family was classified as infrequent.

The Dominance (D) was calculated as follows:

$$\mathbf{D} = \frac{\textbf{Abundance of the family}}{\textbf{Total abundance of the specimens}} \textbf{ x 100}$$

When D ≥5% the family was considered dominant family, 2.5% ≤ D < 5% the family considered accessory, and when D<2.5% the family considered occasional family.
Abundance was expressed as the number of flies captured per data.

2.4 Statistical analysis

All analyses were performed with the IBM SPSS 26.0 software. Categorical variables were described by number and percent (N, %), Chi-square test and fisher exact test used to compare between categorical variables. A two-tailed $p < 0.05$ was considered statistically significant.

3. RESULTS

3.1 Assessment of environmental conditions in the studied areas

Variations in temperature and relative humidity were recorded monthly from July 2020 to June 2021 according to the Central Laboratory for Agriculture Climate at the

Faculty of Agriculture, Assiut University. The present data showed that the mean minimum temperatures in the three animal stations during one-year interval ranged between 17.00°C to 32°C ± 0.5°C. While the average maximum temperature ranged from 32.5°C to 40.5°C ± 0.5°C. The highest temperatures were recorded during summer (June to August) with relative humidity ranged between 20.5% to 36.3% ± 0.5 %. Whereas the lowest recorded temperatures were during winter (December and January) with relative humidity ranged between 52.75% to 55.3% ± 0.96% **(Figure 1)**.

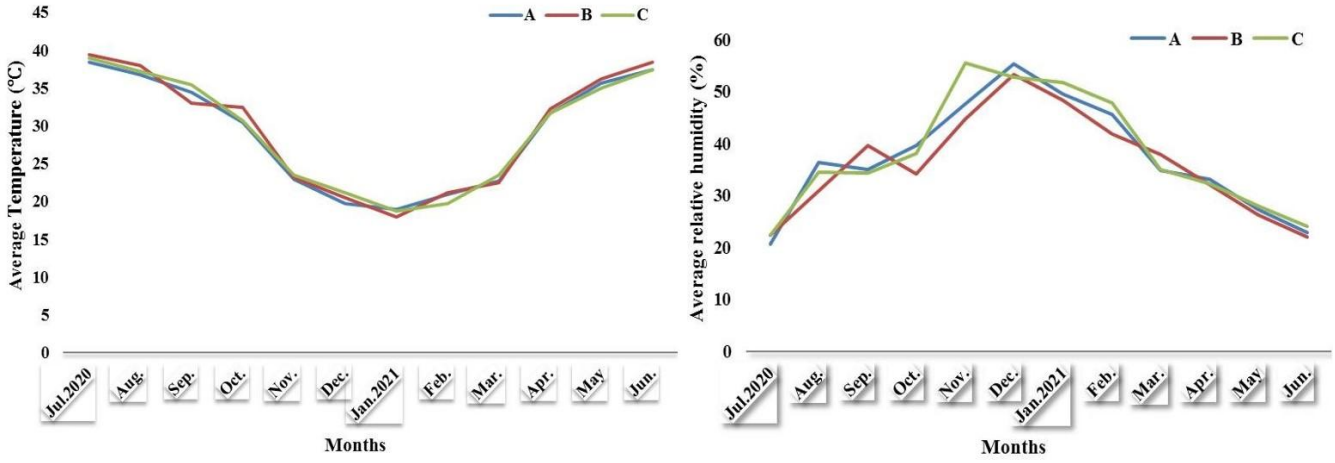

Figure (1): Variations in mean temperature and relative humidity during the period of study in the three animal rearing stations (A, B and C) in Assiut Governorate, Egypt.

3.2 Abundance of the studied dipteran species according to the animal rearing stations:

Results obtained concerning the abundance of the collected flies in the different stations during the present study are presented in (**Table 1)**.

The highest numbers of flies were collected from animal rearing Bani Murr station (B) (5890, 46.20%) followed by El-Hammam station (A) (4323, 33.91%), and the least numbers of flies were collected from the animal production farm station (C) (2536, 19.89%).

The fly species captured in this study belonged to seven dipteran families;

1. Family Muscidae was the most abundant family (62.58%) including three species, namely; *Musca domestica*, *Musca sorbens*, and *Stomoxys calcitrans*.

2. Family Sphaeroceridae was the second most abundant family including only *Borborillus vitripennis* (22.83%).

3. Family Fannidae (8.89%) including *Fannia canicularis.*

4. Family Sepsidae (4.56%) including two species; *Sepsis punctum* and *Meroplius minutus*.

5. Family Ulidiidae (1.07%) including *Physiphora alceae*.

The least abundant families were family Calliphoridae (0.055%), including three species; *Calliphora vicina*, *Chrysomya megacephala*, and *Lucilia sericata*, and family Sarcophagidae (0.02%) is represented by *Sarcophaga* sp.

All the collected families were represented in the three animal rearing stations except for family Sarcophagidae which was collected from animal rearing stations (A and C), Calliphoridae; *Calliphora vicina* from animal rearing stations (B and C), and *Chrysoma megacephala* only from the animal rearing station (B).

Frequency and dominance of the collected synanthropic filth flies were calculated in relation to families and species as illustrated in **(Table 2)**.

The distribution of families in each of the animal station included in the study was represented in (**Figure 2)**. Family Muscidae was the most prevalent family in all stations followed by families Sphaeroceridae, Fannidae, Ulidiidae, and finally Sepsidae.

Calliphoridae and Sarcophagidae were the least presented families in all collection sites. Also, family Sarcophagidae wasn't detected in station (C) during the study.

Different fly species collected from the three animal stations were photographed **(Figure 3 A-O)**.

Table (1): Distribution of the studied dipteran families and species collected from the three animal-rearing stations in Assiut Governorate, Egypt.

Family	Scientific name	Common name	Station	Flies' No.	Total No.	%	Family %
Muscidae	*Musca domestica* Linnaeus, 1758	House fly	A	2628	7715	60.51	62.58
			B	3668			
			C	1419			
	Musca sorbens Wiedemann, 1830	Bazaar fly	A	42	65	0.51	
			B	23			
			C	0			
	Stomoxys calcitrans (Linnaeus, 1758)	Stable fly	A	12	198	1.55	
			B	19			
			C	167			
Calliphoridae	*Calliphora vicina* Robineau-Desvoidy, 1830	Blue blowfly, Blue bottle fly	A	0	2	0.02	0.055
			B	1			
			C	1			
	Chrysomya megacephala (Fabricius, 1794)	Oriental latrine fly	A	0	2	0.02	
			B	2			
			C	0			
	Lucilia sericata (Meigen, 1826)	Green bottle fly	A	1	3	0.02	
			B	1			
			C	1			
Sarcophagidae	*Sarcophaga* sp.	Flesh fly	A	1	2	0.02	0.02
			B	0			
			C	1			
Ulidiidae	*Physiphora alceae* (Preyssler, 1791)	Picture-winged fly	A	105	137	1.07	1.07
			B	16			
			C	16			
Sphaeroceridae	*Borborillus vitripennis* (Meigen, 1830)	Lesser dung fly	A	900	2910	22.83	22.83
			B	1240			
			C	770			
Fanniidae	*Fannia canicularis* (Linnaeus, 1761)	Lesser house fly, little house fly	A	431	1134	8.89	8.89
			B	621			
			C	82			
Sepsidae	*Sepsis punctum* (Fabricius, 1794)	Black scavenger fly	A	178	495	3.88	4.56
			B	277			
			C	40			
	Meroplius minutus (Wiedemann, 1830)		A	25	86	0.67	
			B	22			
			C	39			
Total					12749		

Table (2): Frequency and Dominance of synanthropic flies in relation to families and species.

Family	No. of species	Total No. of individuals	Abundance	Frequency (Occurrence)	Dominance
Muscidae	3	7978	High	Very frequent	62.6% Dominant
Calliphoridae	3	7	Low	Infrequent	0.06% Occasional
Sarcophagidae	1	2	Low	Infrequent	0.02% Occasional
Ulidiidae	1	137	Intermediate	Infrequent	1.07% Occasional
Sphaeroceridae	1	2910	High	Very frequent	22.8% Dominant
Fanniidae	1	1134	High	Very frequent	8.9% Dominant
Sepsidae	2	581	High	Frequent	4.6% Accessory
Total	12	12749			

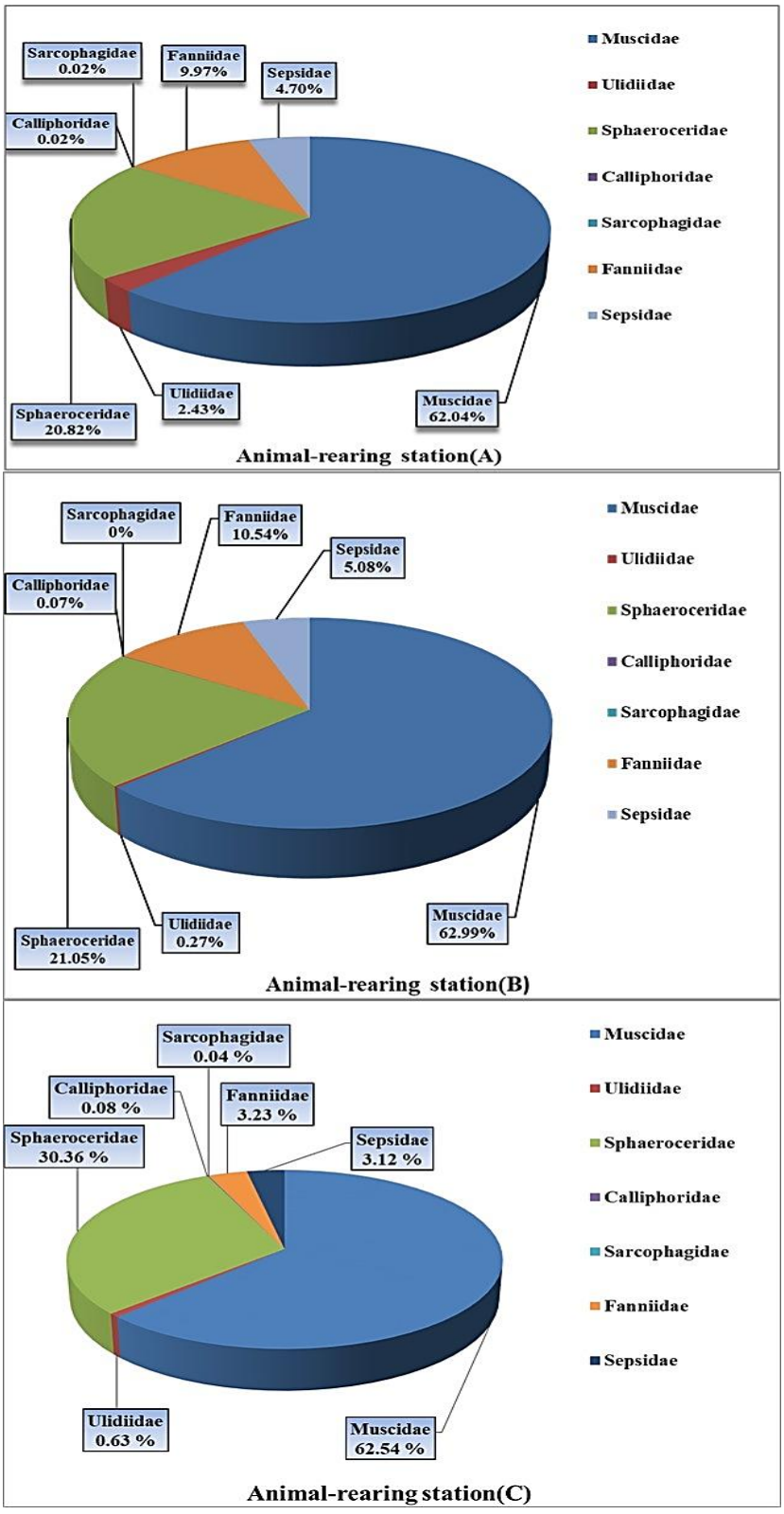

Figure (2): Distribution of fly families in animal stations A, B and C.

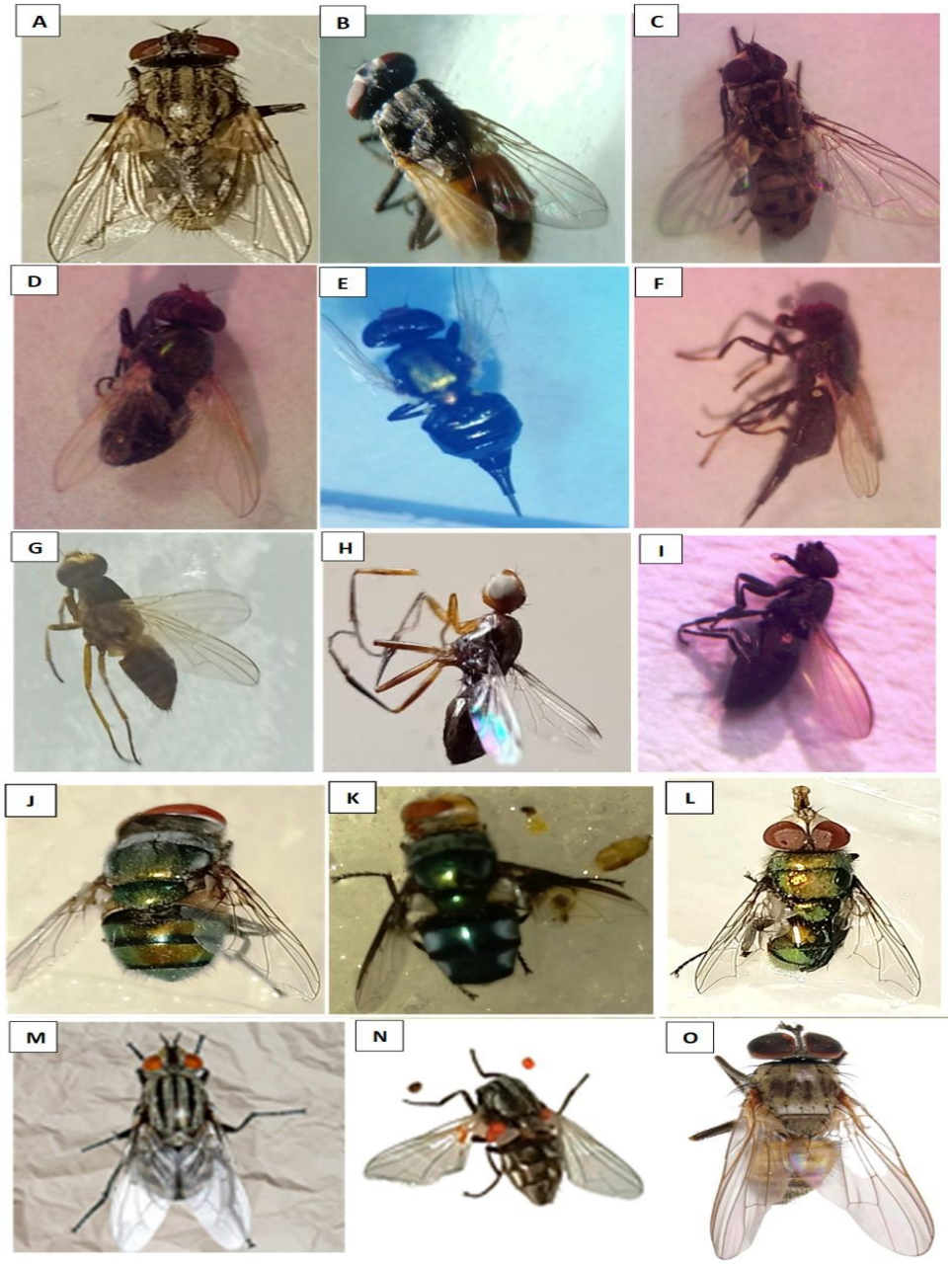

Figure (3): Photograph showing collected fly species from the three animal rearing stations, Assiut Governorate: **(A – C): Family Muscidae (***M. domestica, M. sorbens* and *Stomoxys calcitrans*, respectively. **(D - F): Family Ulidiidae (***Physiphora alceae***, adult male (D) and adult female, (E and F).** (**G and H) Family Sepsidae (G):** *Meroplius minutus***, (H):** *Sepsis punctum***). I: Family Sphaeroceridae (***Borborillus vitripennis***). (J-L) Family Calliphoridae (J:** *Calliphora vicina***, K:** *Chrysomya megacephala***, L:** *Lucilia sericata***). (M and N) Family Sarcophagidae (***Sarcophaga* sp.**), O: Family Fanniidae (***Fannia canicularis***).**

Seasonal abundance of dipteran species in the three animal rearing stations in relation to families:

Data on fly species collected in the three different stations were analyzed during different seasons. Family Muscidae was the most prevalent family in all stations, with variations depending on the season.

1. The seasonal variation of family Muscidae in the three animal stations:

Data obtained showed that Muscidae was the most prevalent fly species all over the seasons in the three collection sites. *M. domestica*, *M. sorbens,* and *Stomoxys calcitrans* were collected in all seasons of the study. Out of these, *Musca domestica* was the most prevalent species by far. Its highest abundance was in summer followed by spring and autumn, respectively whereas winter showed the least fly abundance. Regarding the collection sites, station (B) showed the highest abundance in *M. domestica*, compared with other stations, in summer, autumn, and winter with statistically significant difference (P <0.001). However, animal station (A) showed high prevalence of *M. domestica* in spring (P <0.001) detailed in **(Table 3)**.

Regarding to *S. calcitrans*, station (C) was the most common location for this species. The highest percentage of this species were reported in summer followed by spring, and autumn with statistically significant difference (P <0.001). *Musca sorbens* showed the least pronounced existence found in stations A and B during the summer and autumn **(Table 3).**

Table (3): Seasonal variation of Family Muscidae in the three collection sites, Assiut Governorate, Egypt.

Species	Season	Total	Station A	Station B	Station C	*P.* value
Musca domestica	**Summer**	**2426**	708 (29.2%)	1193 (49.2%)	525 (21.6%)	<0.001**
	Autumn	**1968**	611 (31%)	1119 (56.9%)	238 (12.1%)	<0.001**
	Winter	**1063**	374 (35.2%)	501 (47.1%)	188 (17.7%)	<0.001**
	Spring	**2258**	935 (41.4%)	855 (37.9%)	468 (20.7%)	<0.001**
Total		**7715**				
Musca sorbens	**Summer**	**56**	35 (62.5%)	21 (37.5%)	0 (0%)	0.082
	Autumn	**9**	7 (77.8%)	2 (22.2%)	0 (0%)	0.182
	Winter	**0**	0 (0%)	0 (0%)	0 (0%)	-
	Spring	**0**	0 (0%)	0 (0%)	0 (0%)	-
Total		**65**				
Stomoxys calcitrans	**Summer**	**74**	8 (10.8%)	6 (8.1%)	60 (81.1%)	<0.001**
	Autumn	**42**	1 (2.4%)	3 (7.1%)	38 (90.5%)	<0.001**
	Winter	**27**	1 (3.7%)	4 (14.8%)	22 (81.5%)	<0.001**
	Spring	**55**	2 (3.6%)	6 (10.9%)	47 (85.5%)	<0.001**
Total		**198**				

2. The seasonal variation of family Sphaeroceridae in the three animal stations:

Family Sphaeroceridae, *Borborillus vitripennis*; was the second most prevalent species in the study. It was collected throughout the whole period of study in the three studied sites. The highest abundance of *B. vitripennis* was in summer followed by spring then autumn, while winter showed the least abundance of this species. Station (B) showed the highest prevalence throughout the period of study compared to other stations with statistically significant difference (P <0.001) **(Table 4)**.

Table (4): Seasonal variation of Family Sphaeroceridae, *Borborillus vitripennis* in the three collection sites, Assiut Governorate, Egypt.

Season	Total No.	Station A	Station B	Station C	*P.* value
Summer	**980**	320 (32.7%)	340 (34.7%)	320 (32.7%)	0.665
Autumn	**545**	135 (24.8%)	270 (49.5%)	140 (25.7%)	<0.001**
Winter	**450**	130 (28.9%)	250 (55.6%)	70 (15.6%)	<0.001**
Spring	**935**	315 (33.7%)	380 (40.6%)	240 (25.7%)	<0.001**
Total	**2910**				

3. The seasonal variation of family Fannidae in the three animal stations:

Family Fannidae, *Fannia canicularis*; was the third most prevalent fly species in the present study. Its highest prevalence was observed in summer, spring, and autumn. Station (B) was highly infested with this species in comparison with other collection sites with a high statistical difference (P <0.001) as shown in **(Table 5)**.

Table (5): Seasonal variation of Family Fannidae, *Fannia canicularis* in the three collection sites, Assiut Governorate, Egypt.

Season	Total No.	Station A	Station B	Station C	*P.* value
Summer	**387**	142 (36.7%)	208 (53.7%)	37 (9.6%)	<0.001**
Autumn	**223**	87 (39%)	128 (57.4%)	8 (3.6%)	<0.001**
Winter	**180**	66 (36.7%)	110 (61.1%)	4 (2.2%)	<0.001**
Spring	**344**	136 (39.5%)	175 (50.9%)	33 (9.6%)	<0.001**
Total	**1134**				

4. The seasonal variation of family Sepsidae in the three animal stations:

Throughout the period of study, family Sepsidae was recorded and represented by two species; *Sepsis punctum* and *Meroplius minutu*s. Both species showed a seasonal variation in relation to the three collection sites **(Table 6)**.

Sepsis punctum showed its highest abundance in summer season followed by spring and autumn. Regarding the collection sites, station (B) showed a significant increase in the prevalence of this species compared to other stations (P <0.001). On the other hand; *Meroplius minutu*s was reported in low numbers mainly in summer and spring and was collected mainly from station (C).

Table (6): Seasonal variation of Family Sepsidae in the three collection sites, Assiut Governorate, Egypt.

Species	Season	Total	Station A	Station B	Station C	*P.* value
Sepsis punctum	**Summer**	**179**	66 (36.9%)	96 (53.6%)	17 (9.5%)	<0.001**
	Autumn	**88**	41 (46.6%)	42 (47.7%)	5 (5.7%)	<0.001**
	Winter	**71**	21 (29.6%)	47 (66.2%)	3 (4.2%)	<0.001**
	Spring	**157**	50 (31.8%)	92 (58.6%)	15 (9.6%)	<0.001**
Total		**495**				
Meroplius minutus	**Summer**	**30**	7 (23.3%)	7 (23.3%)	16 (53.3%)	0.067
	Autumn	**11**	1 (9.1%)	5 (45.5%)	5 (45.5%)	0.234
	Winter	**13**	4 (30.8%)	4 (30.8%)	5 (38.5%)	0.926
	Spring	**32**	13 (40.6%)	6 (18.8%)	13 (40.6%)	0.216
Total		**86**				

5. The seasonal variation of family Ulidiidae in the three animal stations:

In the present work; family Ulidiidae was represented only by *Physiphora alceae* and showed a relatively low prevalence compared to previously reported families (*i.e.,* Muscidae).

P. alceae was collected mainly from station (A) in small numbers in both summer and spring while in sporadic numbers during autumn and winter. Station (A) showed a significant increase in the prevalence of *P. alceae* compared to other stations (P <0.001) **(Table 7)**.

Table (7): Seasonal variation of Family Ulidiidae, *Physiphora alceae* in the three collection sites, Assiut Governorate, Egypt.

Season	Total	Station A	Station B	Station C	*P.* value
Summer	**52**	38 (73.1%)	6 (11.5%)	8 (15.4%)	<0.001**
Autumn	**3**	1 (33.3%)	1 (33.3%)	1 (33.3%)	1.000
Winter	**22**	16 (72.7%)	4 (18.2%)	2 (9.1%)	<0.001**
Spring	**60**	50 (83.3%)	5 (8.3%)	5 (8.3%)	<0.001**
Total	**137**				

The rest of the dipteran fly families collected in the study, Calliphoridae and Sarcophagidae, were represented by very small numbers and showed the lowest abundance of all the families. Sporadic specimens of the family Calliphoridae, seven specimens, were collected throughout the study including three samples of *Lucilia sericata*, one from each station, which were collected in summer and spring, two specimens of *Calliphora vicina*, one from station (B) and the other from station (C) were collected in autumn and spring. Another two specimens of *Chrysomya megacephala* were collected from station (B) in summer and spring. Regarding to family Sarcophagidae, *Sarcophaga* sp., a single specimen was collected in two occasions in summer and spring from station (A) and (C) **(Table 1)**.

4. DISCUSSION

This study was conducted on different animal-rearing stations in Assiut Governorate where animal livestock including cattle and buffaloes are raised in close proximity to human dwellings.

Cattle manure is a favorite breeding place and food source for synanthropic flies. Moreover, as the same time animal farming is a very common practice in Egypt, making zoonosis of a major public health concern. The animal-rearing places were chosen because cattle feces are known to strongly attract synanthropic flies. Rearing stations

under investigations are near human households enhancing flies contact with humans and reared animals increasing the abundance of filth flies [16].

The current study described the abundance of synanthropic filth flies (12749 flies), belonged to seven dipteran families in three different animal stations during the period of study from July 2020 to June 2021. Family Muscidae was the most abundant and prevalent family (62.58%) including three species; *Musca domestica*, *Musca sorbens*, and *Stomoxys calcitrans* followed by family Sphaeroceridae including only *Borborillus vitripennis* (22.83%). Family Fannidae was the third most abundant family represented by *Fannia canicularis* species accounting for 8.89%. Family Sepsidae (4.56%) including two species; *Sepsis punctum* and *Meroplius minutus* and family Ulidiidae (1.07%) including *Physiphora alceae*. The least abundant families were family Calliphoridae (0.055%) including three species; *Calliphora vicina*, *Chrysomya megacephala*, and *Lucilia sericata*, and family Sarcophagidae (0.02%) represented with only *Sarcophaga* sp.

The observed high prevalence of synanthropic filth flies in the studied sites could be attributed to the warm climate in Upper Egypt resulted in increasing their rate of reproduction and development [6, 20]. Moreover, poor sanitation had a significant impact on increase the potential numbers of synanthropic flies in animal and human habitations due to the availability of food and breeding places [21]. The current data showed that the environmental conditions in the sites of study support the prevalence of different species of flies leading to high species diversity. The diversity of flies' species in the three studied sites is closely similar; this could be due to similar weather conditions. The effects of temperature, relative humidity, rainfall, and other weather conditions on fly populations have been previously studied in many countries all over the world [17–19]. These environmental factors have been considered essential since they can directly influence the population dynamic of dipterans [20–22].

Despite the similarity in the species of flies collected from the three study sites due to the reasons mentioned above, the numbers of flies varied from one station to the other and station (B) was the most dominant station from which the highest numbers of flies were collected compared with the other stations. This could be due to poor periodic sanitation in station (B), this station is the closest to human households, this increased the

contact with humans and so increased the abundance of flies [16]. Also, most animals in station (B) showed episodes of diarrhea that attracted more flies to the station.

Housefly, *M. domestica*, is the most common fly species of all synanthropic flies representing more than 91% of all collected flies in animal and human habitations. It is one of the most widely distributed insects found all over the world from the hot to cold regions near humans or their activities [23, 24]. The present results revealed that *M. domestica* represents the most prevalent and abundant fly species accounting more than 60% of all the collected flies in the three collection sites and throughout the study period. These results were consistent with a previous study conducted in Sohag Governorate which reported that the housefly was the most common species found in the study by 69.7% [25]. In Suez province; investigation of seasonal distribution and sex ratio of the most dominant sarcosaprophagous flies, *C. megacephala*, *L. cuprina* and *M. domestica* was carried out [3, 26].

Family Sphaeroceridae, the lesser dung flies, was recorded to be among the most common insects associated with decaying organic materials [27, 28]. They are often unnoticed due to their small size and generally drab appearance. In the current study; they were recorded in large numbers including *Borborillus vitripennis* that was formerly studied describing its Palaearctic distribution including Egypt [27]. However, the present information about its abundance in Egyptian governorates and in Upper Egypt was deficient.

Family Fannidae and Sphaeroceridae were recorded in high numbers during the study period representing approximately one-third of the collected fly species. Family Fannidae is considered one of the most medically important fly families associated with livestock and animal systems throughout the world [28]. Therefore its high abundance that recorded in this study foreshadowed many problems and dangers that expected to exist in the study sites.

The present data is consistent with the previous reports in Iran, Middle East, where families Muscidae and Fanniidae were reported as the most prevalent families in different locations in Tehran city including animal farms, gardens, stockbreeding, garbage and rotting debris, animal excrement, and dead animal carcasses [29].

In this work, the collected fly species belonging to families Sarcophagidae and Calliphoridae were the least prevalent species. These results are in agreement with previous findings in Upper Egypt [25] where the environmental conditions are almost similar to those in Assiut Governorate. *C. megacephala* was represented in very small numbers. That agreed with observations by Nmorsi *et al.*, 2006 who reported that *C. megacephala* was not the dominant synanthropic fly [30]. The very low number of flesh flies (Sarcophagidae) throughout the study period could be attributed to the fact that those fly species are more attracted to carrion and bloody or soiled hair, fur or wool and their larvae prefer to feed on carrion rather than any other decaying organic matter.

In this study, seasonal variations in temperature were recorded in summer, autumn, winter, and spring that ranged from 22-40°C, 19-33°C, 18-25°C, and 20-33°C, respectively. Simultaneously the relative humidity was measured (Fig. 1). It was revealed that both temperature and relative humidity affect flies' abundance where the highest numbers were recorded in summer and the lowest fly numbers were recorded in winter as low temperatures affect adult emergence and activity. These present results agreed with the data recorded in Buraydah, Saudi Arabia, showed synanthropic fly species reached their maximum abundance in May and minimum occurrence in January [31]. Moreover, the present data established with that houseflies has the highest population at temperature range of 20-35°C, and population decreases at low temperatures [32]. The current study agreed with previous reports from the north island of New Zealand in which species' numbers differed between seasons and years, and the abundance of flies varied according to habitat and species [33]. Moreover, the mean temperature and relative humidity were studied to have influence on the richness of blowflies, with greater richness and abundance in late spring and early summer [34]. Findings of the present work confirm the recorded data in Sohag, Upper Egypt that showed spring and summer were the most suitable for the flies activity in different species, followed by autumn, and then the population decreased during winter. Thus differences of flies numbers during the different seasons are largely affected by climate change, especially temperature [25].

5. CONCLUSION

Based on the study's findings, the most important fly species spread in animal production farms and the seasons which are characterized by a high fly prevalence became clear, making it advantageous to base control timing decisions on the fly's active period.

6. RECOMMENDATIONS

Animal rearing stations have to move away from major human activities, cities, villages, hospitals, etc. Manure of animal rearing stations should be removed regularly at short intervals as it is a main factor help attraction of synanthropic filth flies to avoid high fly abundance with the subsequent risk of pathogen transmission and disease distribution.

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