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Effect of the climate and some different protein diets on the visitation pattern of flesh and blow flies of Gebel Al- Baher, Al- Baha Province, Kingdom Saudi Arabia

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ABSTRACT

This work compares the effect of the climate and some different protein diets on the activity of flesh and blow fly populations in one of the biggest mountains of Sarah region, south-west Kingdom of Saudi Arabia. Trapping of adult flies revealed the presence of three populations, namely, *Engelisca adhamae* (Lehrer & AbouZied, 2008) and *Liosarcophaga babiyari* (Lehrer, 1995), in addition to a single calliphorid species *Calliphora vicina* (R−D, 1830). Adults of *L. babiyari* showed a year round activity, with the major peak during August. The species *E. adhamae* showed its major peak during May and June, while in addition, adults of *C. vicina* showed spring activity during the period from March to April.

Adult *activity of L. babiyari* showed a direct correlation with both of the temperature and the wind velocity, but it was inversely correlated with the relative humidity. Otherwise, adult *C.vicina* was directly correlated with rainfall. However, the studied climatic factors showed a very weak effect on the activity of adult *E. adhamae*. The trophic niches, was predicted to affect male *L. babiyari* which showed great affinity to be trapped with fish followed by liver then meat. In comparison, male *E. adhamae* preferred fish, followed by both, liver and beef. Meanwhile, female *L.babiyari*, showed higher tendency to both, fish and liver compared with both, beef and hash-hash. In contrast, female *E.adhamae* showed nearly the same tendency to fish, liver and beef. However, male and female *C. vicina* showed more attraction to liver compared with both fish and beef.

Keywords: Sarcophagidae, Calliphoridae, Seasonal abundance, Thermal Environment, Food preference, Macroclimate.

INTRODUCTION

Blow flies and flesh flies are well known as scavengers that serve as decomposers of materials of animal origin such as faeces and carcasses (Kurahashi, 1997a, b; Terry & Douglas, 2008; Sharanowski *et al.,* 2008; Voss *et al*., 2008; Jonathan & Nedler, 2009; Nidya, *et al*., 2009; Sasha *et al*., *2009*; Reibe & Madeaa, 2010 and Szymon, *et al.,* 2010). Moreover, blow flies play an important role as vectors of bacterial and viral pathogens (Lindsay and Scudder, 1956), meanwhile, flesh flies act as predators (Schwendinger and Pape, 2000) and as parasitoids (Allen & Pape, 1996 and Mckillup *et al*., 2000). They were also used to estimate the length of postmortem interval (PMI) to provide evidence in criminal investigations (Greenberg, 1985; Anderson, 1997; Amendt *et al.,* 2000 and Wang *et al.,* 2008).

Furthermore, microhabitat selection may be influenced with each species' preference and tolerance of field temperature and humidity regimes (De los Santos *et al.,* 2006). Some species of flies select microhabitats and activity times based on the thermal regimes (Kurahashi, 2001; Henning *et al*., 2005 and Battan *et al*., 2007).

Meanwhile, other species prefer humid habitats rather than thermal regimes (Davis & Laurence, 1992; Shah & Tanzeela, 2004 and Henning *et al.,* 2005) and several studies reported that some species did not show clear patterns (Cottam *et al*., 1998 and Mulieri *et al.,* 2008). Additionally, the wind may be a new niche variable but Cottam *et al*., (1998) reported that wind and rain were less important for many species.

It is expected that populations of flesh fly and blow fly species would show particular food preferences in terms of their physiological optima. Hence, some species suffered high mortality rates when fed on liver diet (Charles & Robert, 1988). Other sarcophagid flies preferred fish as breeding substrates, in urban areas, rural areas and forests (Lopes, 1973; D'Almeida, 1986, 1993 and D'Almeida & Barbosa, 1996) and other species even preferred faeces or liver. On the other hand, Mulieri *et al*., (2008) stated that most of the recorded flesh flies showed preference for faeces as bait, in the woodland occurring at the coastline of Buenos Aires, but only in some cases exhibited similar preference for both faeces and liver. Some species preferred liver for breeding in urban areas, but in rural areas preferred fish. These niche changes also, have been reported by other authors working in, different geographical areas (D'Almeida & Barbosa, 1996; Thomas, 1951 and Norris, 1965). Yin *et al*., (1994) and (1999), reported on the need for liver as a diet, which was essential for the activation of the sexual receptivity and supported full oocyte development.

Despite the importance of these flies, the fauna of the adult carrion flies of Al-Baha Province (Kingdom of Saudi Arabia) was not studied before. Therefore, the objective of the present work is, to study the effect of the macroclimate and some different protein diets on the activity of the flesh and the blow fly populations inhabiting this area. These factors were predicted to affect the seasonal patterns of adult flies populations. The author examined the hypothesis of the niche segregation (Pianka & Huey, 1978; Kuusela, 1983 and Rohde, 2005). Such hypothesis was explored in relation to the environmental factors, for which, analyses of the seasonal activity patterns and its' relationship with climatic parameters, were carried out. At last, the author explored the hypothesis that the coexistence of species, also, required trophic niche segregation, for which the activity of the fly populations, inhabiting this area in relation to their attraction to the baited traps, was studied.

MATERIAL AND METHODS

The study area

Al-Baha Province (11,000 square km) is situated in the south west of the Kingdom of Saudi Arabia between Mecca and Aseer (Fig. 1).

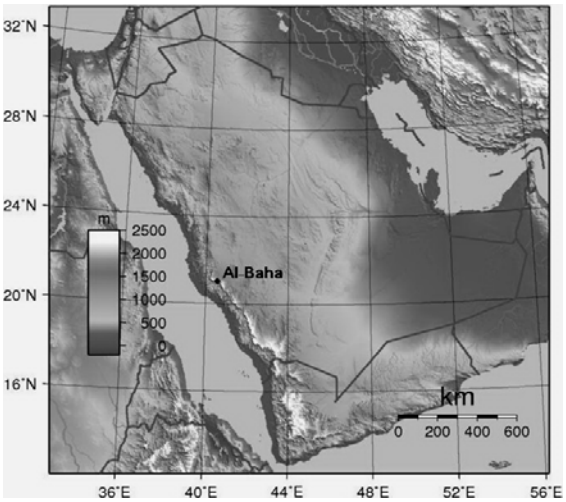

Fig. 1: Location of study site in Gebel Al-Baher, Al-Baha Province, Kingdom of Saudi Arabia. The numbers in abscissas (latitude as the angular distance, in degrees of a point north of the Equator) and ordinates (longitude as the angular distance, in degrees, of a point east of the Prime –Greenwich- Meridian) are used to identify locations on the Earth.

Although this province is divided into three distinct regions, collection was focused in the region, which is called Sarah. It is characterized by high mountains with temperate weather and rich plant cover resulting from a relatively high annual rainfall. The second region, Tohama, is situated west of Sarah. Tohama is a low land area, which is characterized by very hot humid weather with very little rainfall season. The third region, the eastern hills, 1550-1900 m asl, which is characterized by cool winter, hot summer and poor plant cover.

Climate of Al-Baha

Climatic conditions (mean monthly values for the study period), such as the temperature, rainfall, wind velocity and relative humidity, were all obtained from Al-Baha station of weather and climate (20º17′4″N, 41º38′35″E; 1652 m asl). According to the metrological data, the climate of Al-Baha showed a characteristic pattern (Fig. 2). The rainfall was recorded all the year round with three peaks. The most high amount of rainfall was recorded during spring months (March, April and May), with the peak of maximum amount of rainfall, during April (42.9 ml/m^2). During winter, especially January, the peak of rainfall amount was 20.6 ml/m^2. During autumn months, the maximum amount of rainfall was recorded, during October (13.1 ml/m^2). The rainfall amount during the summer season was nearly the same during both July and August (10.2 and 9.8 ml/m^2), respectively.

The temperature scale, showed a very narrow range of fluctuations with a high range of temperature (29^{o}C − 27.6^{o}C), during the period from June to September. The moderate temperature scale was recorded, during spring months (20^{o}C − 26 ^{o}C). The threshold of the warm season (26^{o}C), was recorded during May and the threshold of low temperature scales (15.8 ^{o}C), was recorded during January (Fig. 2).

The relative humidity curve showed an inverted elbow shape. The higher rates of relative humidity were achieved during January (55%), December (53%) followed by November (49%). The spring season showed a moderate humidity values (42 − 47 %). However, the least values of relative humidities were recorded during June and September (23%), followed by July (25%).

The scale of wind velocity seemed to be linear or regular all the year round, except from May to September. During this period, there was a slight increase in the values ranging between 8, 9.75 and 8.8 km/h, during June, July and August, respectively. Meanwhile, the least values of the wind velocity were recorded during November, December and January being 5.13, 5.63 and 6.4, km/h, respectively.

Collection of the adult flies

The adult flies were collected using baited traps placed at Gebel Al-Baher (Sarah region). The site of trapping was determined by GPS (20º0′50.4″N, 41º27′43.56″E; 2209 m asl). The traps were made of, a top, inverted transparent plastic container (500 ml), with a yellow cap like bottom, its base possess a twisted spiral valve to close the top and the bottom firmly. In between the top and the bottom, a yellow plastic cone is found with a narrow hole, near the top of the container. Four traps were used during this study. Traps were placed in, one row, 10 meters apart and hanged at, 1.5 meters height from the soil. Three traps, out of the four used, traps were provided with fresh beef, whole fish and liver. The fourth trap was provided with a commercial product named “Hash-Hash”, simulating the odor of decaying organic matter.

Traps were transported to the insectery house of the essential sciences department, Community College, twice weekly. After freezing of the collected alive flies for 30 minutes, the traps were emptied. Catch was recorded, taking into consideration, the sex and the species. Finally, baits had been renewed and the traps were returned back again to the site of the collection at Gebel Al- Baher. Collection of the flies started during January (2008) and

continued for one year round, finished in December, 2008. For accuracy and more confirmation of the data, collection was repeated for a second year round, from January-December, 2009. Data were treated, statistically, as one unit, the average of the two years, especially for the linear regression analysis. The average of the monthly catch per trap was calculated, for the two years (n = 12). Therefore, the curve of the adult abundance was estimated, determining the period of maximum abundance of each species.

Attractivity of the adult flies to different baits

During the month of the maximum abundance of each species, Second year round 2009, baited traps were rotated in position and arrangement, day after day. The catches were recorded daily (n = 30), taking into consideration, number species, sex and type of the bait.

Statistical analyses

Analyses of the data were carried out using "SPSS" version (11). Either (ANOVA) test or, simple linear regression test (Person's correlation test), was used for the suitable estimation of the data obtained.

RESULTS

1. Activity of the adult carrion flies populations

From the results obtained (Table 1 and Fig. 2), it appeared that, *L. babiyari* population activity was affected by temperature, relative humidity and wind velocity.

Table (1): The effect of the climate on the activity of adult carrion flies populations inhabiting Gebel Al-Baher, K.S.A

Population	Climatic factors examined	Correlation coefficient (r)	(P) value
L. babiyari	Temperature (^{o}c)	0.843	0.001 **
	Relative Humidity (%)	- 0.758	0.004**
	Rainfall (ml/m^2)	- 0.184	0.567
	Wind Velocity (Km/h.)	0.670	0.017*
E. adhamae	Temperature (^{o}c)	0.503	0.096
	Relative Humidity (%)	- 0.438	0.155
	Rainfall (ml/m^2)	0.257	0.420
	Wind Velocity (Km/h.)	0.180	0.576
C.vicina	Temperature (^{o}c)	- 0.121	0.709
	Relative Humidity (%)	0.220	0.492
	Rainfall (ml/m^2)	0.731	0.007**
	Wind Velocity (Km/h.)	- 0.054	0.868

(N = 12)

(**) means that the correlation is significant at the level (P<0.01)

(*) means that the correlation is significant at the level (P<0.05)

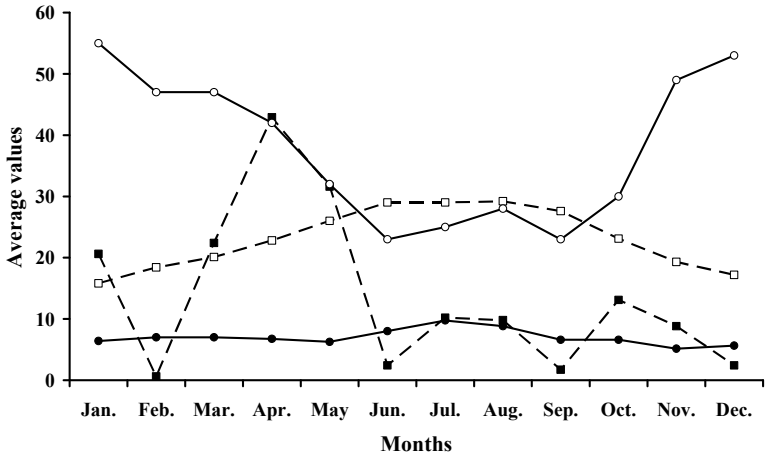

Fig. 2: Climate of Al-Baha Province during the study period. Seasonal distribution in monthly average of mean temperature in ºC (white squares), rainfall in ml/m^2 (black squares), relative humidity in % (white circles) and wind velocity in km/h (black circles).

During February-March (Fig. 3) adult flies appeared in minor catches (Seven flies/trap/month). As the temperature rose during April and June, a steady increase in the mean catch of the adult flies, was observed. The adult catches were, 38 and 64 flies/trap/month, respectively. The highest peak of *L. babiyari* flies was recorded during August (at 29.2 ^{o}C, 28% and 8.8 knots/hour) reaching 142 flies/trap/month. During September (27.6 ^{o}C), a decline in the activity of *L. babiyari* population was recorded (99 flies/trap/month), followed by a sharp and sudden decrease, during October (31 ^{o}C), as only nine flies/trap/month. During November and December (19.3 ^{o}C and 17.2 ^{o}C), an average of one fly/trap/month, was recorded. In January, adults of *L. babiyari* disappeared completely from Gebel Al- Baher. Pearson's correlation test revealed a positive significant correlation ($r = 0.843$, $P < 0.01$) between the adult activity of *L. babiyari* and the temperature scale. Both of the relative humidity and the wind velocity significantly affected the activity of *L. babiyari* adults showing a negative correlation with the relative humidity scale ($r = -0.758$, $P < 0.01$) and a positive correlation ($r = 0.67$, $P < 0.05$), with wind velocity, (Table1).

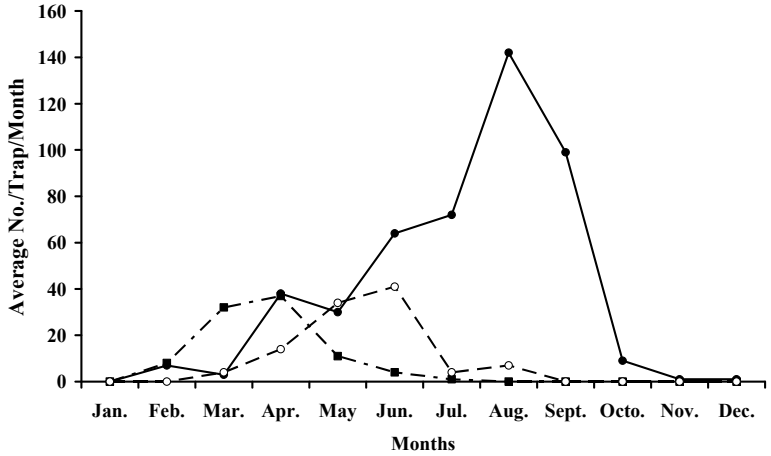

Fig. 3: Seasonal abundance of adult fly populations inhabiting Gebel Al-Baher, Al-Baha Province, KSA. (black circles correspond to *Liosarcophaga babiyari* ; white circles to *Engelisca adhamae;* and black squares to *Calliphora vicina*)

In case of *E. adhamae* and *C. vicina* (Fig. 3), the activity of adult population showed a very short period during the year round. The activity period of *E. adhamae* adults started with the emergence of adults during spring months (20−29 ^{o}C) March, April and May, reaching the maximum adult activity during June (41 flies/trap/month). The adult activity was reduced to its minimum values, during the hot months of July, August and September (27 ^{o}C− 29 ^{o}C) (Fig 2). The temperature, rainfall, and wind velocity insignificantly ($P > 0.05$) affected the activity of *E. adhamae* adults showing a positive correlation of 0.503, 0.257 and 0.180, respectively. Although, a negative correlation (−0.438) was observed with *E. adhamae* adults, relative humidity, also, insignificantly affected the adult activity (Table 1).

In comparison, during February, the activity of *C. vicina* adults started in low numbers (Eight flies/trap/month), then increased in number during March (32 flies/trap/month), reaching the maximum during April (37 flies/trap/month). The adult population of *C.vicina* started to decrease from May (11 flies/trap/month) to July (one fly/trap/month). The adults completely disappeared during the period from August up to January (Fig. 3).

Table (1) and figure (3) showed that, rainfall was highly affecting the activity of adult *C. vicina* ($r = 0.731$ and $P < 0.01$). However, both of the wind velocity and the temperature showed negative and least insignificant effect on *C. vicina* adults ($r = -0.054$ and $r = -0.121$, respectively). Meanwhile, relative humidity showed insignificant but, positive correlation ($r = 0.22$) with the activity of adult *C. vicina*.

2. The attraction of adult fly populations to different baited traps

Data represented in table (2) revealed that, the fish baited trap was the foremost, first rank, attractant to *L. babiyari* adults (8.67 flies/trap/day). Fish baited traps showed significant difference ($P < 0.05$), when compared with liver (5.73 flies/trap/day), beef (3.6 flies/trap/day) as well as Hash-Hash (0.73 flies/trap/day). Adult flies of *L. babiyari* showed higher attraction (the second rank) towards liver when compared with the catch of the beef baited trap. A significant difference ($P < 0.05$) was recorded between the catches of the liver and the beef baited traps.

Table (2): Attractivity of baited traps to adult carrion fly populations inhabiting Gebel Al- Baher, Al-Baha Province, K.S.A

Population		Mean ± s.e			
		Fish baited trap	Liver baited trap	Beef baited trap	Hash-Hash baited trap
L. babiyari	Male	3.53±0.41 [a]	1.87±0.30 [b]	1.40±0.37 [c]	0.13±0.06 [d]
	Female	4.93±0.62 [a]	4.53±0.91 [a]	2.20±0.36 [b]	0.60±0.13 [c]
	Total	8.67±0.78 [a]	5.73±0.97 [b]	3.60±0.65 [c]	0.73±0.16 [d]
E.adhamae	Male	1.25±0.33 [a]	0.70±0.15 [b]	0.20±0.14 [b]	0.07±0.05 [c]
	Female	1.57±0.33 [a]	1.97±0.29 [a]	1.80±0.35 [a]	0.07±0.05 [b]
	Total	2.87±0.51 [a]	2.60±0.38 [a]	2.00±0.42 [a]	0.10±0.07 [b]
C. vicina	Male	0.73±0.19 [b]	1.60±0.23 [a]	0.07±0.05 [b]	0
	Female	0.60±0.22 [b]	2.57±0.27 [a]	0.20±0.10 [b]	0
	Total	1.13±0.33 [b]	4.07±0.42 [a]	0.27±0.13 [b]	0

N = 30, Mean = catch/ trap/day, (s.e) = the standard error.
Symbols in each row, which are different, refer to significant difference ($P<0.05$) between the values of each baited trap mean, examined by Post Hoc test. No comparisons were constructed between columns, different sexes and species.

The same conclusion was true for *L. babiyari* males, as fish attracted more significant ($p < 0.05$), number of males (3.53 males/trap/day) compared with liver (1.87 males/trap/day), beef (1.4 males/trap/day) and Hash-Hash (0.13 males/trap/day). However, both the fish and the liver baited traps showed nearly, the same attraction to female *L.babiyari* since, insignificant difference ($P > 0.05$) was recorded between the catch of the two former traps (4.93 and 4.53 female/trap/day, for fish and liver, respectively). Both of the beef and Has-Hash baited traps showed the least level of attraction (2.2 and 0.6 female/trap/day) to females of *L. babiyari* but with significant preference ($P < 0.05$) to beef compared with Hash-Hash.

The adult population of *E. adhamae* showed no preference to offered baits, with little insignificant tendency towards fish (2.87 lies/trap/day) followed by liver (2.6 flies/trap/day) then beef (2 flies/trap/day). The same conclusion was true in case of *E. adhamae* females. The average daily catch's was insignificantly ($P> 0.05$) different among fish (1.57 female/trap/day), liver (1.97 female/trap/day) and beef (1.80 female/trap/day). However, *E. adhamae* males showed significant ($p < 0.05$) tendency for fish (1.25 male/trap/day), compared with, liver (0.70 male/trap/day) and beef (0.20 male/trap/day). Both, the liver and beef baited traps showed nearly the same attraction (the second rank) for *E. adhamae* males ($P > 0.05$). Hash-Hash showed the least significant attraction to *E. adhamae* males and females.

The calliphorid *C. vicina* adult population showed a significant tendency ($p < 0.05$) towards liver (4.07adults/trap/day) when compared with both catches of fish (1.13 adults/trap/day) and beef (0.27 adults/trap/day). Males of *C. vicina* showed

significant tendency ($P < 0.05$) to liver (1.6males/trap/day), when compared with both fish (0.73 males/trap/day) and beef (0.07 males/trap/day). Also, female *C. vicina* preferred liver (2.57females/trap/day) more significantly ($P < 0.05$), than both, fish (0.6 females/trap/day) and also beef (0.2 females/trap/day). Both sexes of *C. vicina*, showed no catches in traps baited with Hash-Hash during the study period. The Hash-Hash baited trap was the least significant attractant to the three adult fly populations (Table 2). It is not recommended to use this product to attract adult flesh and blow flies.

DISCUSSION

It could be assumed that these three species did not show conservatism of ecological niches in evolutionary time, i.e. phylogenetic history, (Peterson *et al*., 1999 and De los Santos *et al.* 2006) since, different selective pressures have probably led to the development of different life cycles (behaviour, diapause, egg maturation, etc.), at environmental fluctuations.

The study showed that these three species, which are not congeneric, have very different life histories that likely evolved in response to conservatism of thermal optima, across a highly variable temperature environment. Hence *L. babiyari* disappeared completely from Gebel Al-Baher area during January, meanwhile *E. adhamae* adults disappeared during the period from September up to February, and *C. vicina* adults were not present from August up to January. Similarly, Tachibana and Numata (2006) mentioned that the flesh flies were not captured during winter as flesh flies have a pupal diapause. Also, Kurahashi and Ohtaki (1989) and Kurahashi (1997b) reported that *Sarcophaga* sp. also disappeared in winter. However, Mulieri *et al*., (2008) stated that the two flesh flies *Oxysarcodexia paulistanensis* (Mattos, 1919) and *Oxysarcodexia varia* (Walker, 1836), showed their highest abundance in December and February. *Microcerella muehni* (Blanchard, 1939), displayed a different seasonal pattern with the abundance in September and October. In comparison, Gabre and AbouZied (2003) collected *C. vicina* only during the spring season, in both urban and rural areas of Suez province, Egypt. Henning *et al.,* (2005) mentioned that *C. vicina* was abundant in March-May during two years survey in North Island, New Zealand. Tachibana and Numata (2006) captured a closely related species, *Calliphora nigribarbis* (Vollenhoven, 1863), between October and mid June, but not in summer season. Meanwhile, *Chrysomya megacephala* (Fabricius, 1794) population showed the highest activity during the period from September to October.

The authors also, reported seven species of calliphorid flies showing the maximum abundance during both spring and autumn. Our results showed the presence of one activity peak for *C. vicina* at Al-Baha (20º17′4″N) suggesting that this species can not over winter in regions at or above 30 ^{o}N, because of the low temperature, which restricted their growth (Kurahashi, 2001). The presence of this species in such regions is caused by temporal invasions, from late summer to autumn (Kato, 1960; Miyazaki, 1960 and Kurahashi, 2001). Similarly, *C. megacephala* population showed a single peak per year (Tachibana and Numata, 2006), however seven species of calliphorid flies showing bimodal pattern of abundance during both spring and autumn.

The temperature as well as the relative humidity scale showed a positive and a negative, significant correlation with the activity of adult *L. babiyari*. Similarly, the abundance of other sarcophagid flies (*O. varia*, *Tricharaea (Sarcophagula) occidua*

(Fabricius, 1794) and *O. paulistanensis*), was influenced by minimum and maximum daily temperature, as well as, the night humidity (Henning *et al.,* 2005).

Meanwhile, in case of *E. adhamae*, the relative humidity scale showed a negative insignificant correlation. Similarly, Shah and Tanzeela (2004) showed no specific visitation pattern for *Sarcophaga* sp. with respect to changes in the relative humidity.

Also, Mulieri *et al.,* (2008) confirmed that *O. varia* did not show a clear pattern towards the relative humidity scale.

In case of adult *C. vicina* population, the adult activity was insignificantly or weakly affected with the change in the temperature scale, relative humidity and wind velocity, but significantly affected with rainfall. In contrast, Cottam *et al.,* (1998) showed that wind and rain were less important for *C. vicina*, *C. hilli* Patton, 1925, *C. stygia* (Fabricius, 1782), *C. quadrimaculata* (Swederus, 1787), *L. cuprina* (Wiedemann, 1830), *Lucilia sericata* (Meigen, 1826) and *Chrysomya rufifacies* (Macquart, 1843).

The hypothesis of the conservative evolution in ecological niches, (Peterson *et al*., 1999 and De los Santos *et al.,* 2006), may be applied to these three species. This would explain the similarity between the thermal and trophic preferences found in this study, compared with the range of values reported by other authors. Thus, in relation to the functional component of the niche, results showed that, adult population of *L. babiyari* preferred whole fish as a bait, when compared with both liver and beef.

Meanwhile, adult population of *E. adhamae* showed nearly the same tendency to fish, liver and beef. However, female *L. babiyari* showed nearly the same tendency to both fish and liver followed by beef. In contrast, female *E. adhamae*, showed nearly the same tendency towards fish, liver and beef. Lopes (1973) and D'Almeida (1986 & 1993) reported that *Peckia chrysostoma* (Wiedemann 1830) preferred fish as breeding substrates, in urban areas, rural areas and forests. Also, D' Almeida, (1993) stated that *Sarcodexia innota* (Walker, 1861) preferred fish as a substrate more than liver.

Meanwhile, *Sarcophagula* sp. preferred faeces as collection substrate. D'Almeida and Barbosa (1996) reported that, mashed fish was a highly attractant diet to the larvae of the sarcophagid fly *Ravinia belforti* (Prado & Fonseca, 1932).

On the other hand, males of *L. babiyari* showed a great Preference to fish followed by liver then beef. In comparison, male *E. adhamae* preferred fish as first rank followed by liver and beef as the second rank.

Since *E. adhamae* (Lehrer and AbouZied, 2008), is recently described species from Gebel Al-Baher, no data are available about its food preference. Further detailed investigations and studies are required, especially, for the species *E. adhamae* and also, for *L. babiyari*, to determine which protein material is essential for the males and the females of each population.

Data also revealed that, adult *C. vicina* showed great attractivity towards liver as a bait when compared with both fish and beef. Similar results were obtained by D'Almeida (1986, 1993) for *C. megacephala*, *Fannia* sp. and *Phaenicia eximia* (Wiedemann, 1819), as both preferred bovine liver, followed by fish as a breeding media. Also, *Synthesiomyia nudiseta* (Van der Wulp, 1883) preferred liver for breeding in urban areas, but in rural areas *S. nudiseta* preferred fish. However, mashed fish was a highly attractant diet to the larvae of *C. megacephala* (D'Almeida and Barbosa, 1996). However, both of Thomas (1951) and Norris (1965) found that *C. megacephala* preferred faeces.

Data also revealed that both males and females of *C. vicina* showed higher tendency to liver, followed by fish and beef. Yin *et al.,* (1994) and (1999) reported that, more than 10 mg of dietary liver was required for each *Phormia regina* (Meigen,1826) male to result in 80% insemination of the female and 20 mg of liver was required for each *P. regina* female, to allow 78% of females to become inseminated. Between 10-15 mg of protein meal (liver), was required to activate the sexual receptivity in 71% of the *P. regina* females, while between 15-20 mg of liver was needed to support full ooyte development in 70% of the females.

As a final conclusion, males of either calliphorid, or sarcophagid flies, were attracted to the expected niches (baited traps, in this study), where the females are available, either for breeding, feeding, or deposition of eggs.

In summary, this work had shown some segregation of niches between species of flies, based on weather conditions and food availability, but with a high degree of overlap. The preferences found in this area were very similar to those described for these groups of flies in other geographic regions, supporting the hypothesis of conservation of ecological niches in the colonization of the mountainous habitats, facilitating the coexistence of a definite species.

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REFERENCES

Allen, G. and Pape, T. (1996): Description of female and biology of *Blaesoxipha ragg* Pape (Diptera: Sarcophagidae), a parasitoid of *Sciarasaga quadrata* Rentz. *Australian Journal of Entomology, 35, 147- 51.*

Amendt, J.; Krettek, R.; Niess, C.; Zehner, R. and Bratzke, H. (2000): Forensic entomology in Germany. *Forensic Science International,* 113: 309–14.

Anderson, G. (1997): The use of insects to determine time of decapitation: a case study from British Columbia. Journal of Forensic Science 42: 947–50.

Battan, H.; Linhares, X.; Beatriz, R. and Garc, D. (2007): Species composition and seasonal succession of *saprophagous calliphorids* in a rural area of Córdoba, Argentina. *Biological Research,* 40: 163-171.

Charles, F. and Robert, I. (1988): Amino Acids in Artificial Nectar: Feeding Preferences of the Flesh Fly *Sarcophaga bullata*. *American Midland Naturalist,* 120 (1): 156-162.

Connell, J.H. (1980): Diversity and the coevolution of competitors, or the ghost of competition past. *Oikos,* 35: 131−138.

Cottam, Y.; Blair. H. and Potter, M. (1998): Monitoring some muscoid fly populations on Massey University sheep farms in the Manawatu. *Proceedings of the New Zealand Society of Animal Production,* 58: 220 - 223.

D'Almeida, J. (1983): *Sinanotropia em dipteros caliptratos na area metropolitana do Rio de Janeiro*. UFRRJ, M. Sc. Thesis, 193 p.

D'Almeida, J. (1986): Substratos utilizados para a criacao de dipterous caliptratos em uma area rural do Estado do Rio Janeiro. *Arquivos doUniversidad Federal do Rural do Rio de Janeiro,* 9:13- 22.

D'Almeida, J. (1993): Capture of calyptrate flies with different breeding substrates on beaches in Rio de Janeiro, RJ, Brazil. *Memórias do Instituto Oswaldo Cruz,* 88(2): 215- 220.

D'Almeida, J. and Barbosa, S. (1996): Feeding Preference of the Larvae of *Chrysomya megacephala* (Fabricius) (Diptera: Calliphoridae) and *Ravinia belforti* (Prado e Fonseca) (Diptera: Sarcophagidae) Concerning Different Diets. *Memórias do Instituto Oswaldo Cruz, Rio de Janeiro,* 91(1): 137-138.

Davies, L. and Laurence, B. (1992): The distribution of *Calliphora* species in Britain and Ireland (Diptera: Calliphoridae). *Entomologist's Monthly Magazine,* 128: 207- 213.

De los Santos, A.; Ferrer, F. and de Nicolás, J. (2006): Thermal habitat and life history of two congeneric species of darkling beetles (Coleoptera: Tenebrionidae) on Tenerife (Canary Islands). *Journal of the Arid Environment,* 65: 363–385.

Gabre, R. and AbouZied, E. (2003): Sarcosaprophagous flies in Suez Province, Egypt: II-synanothropic and abundance degrees. *Bulletin of the Entomological Society of Egypt,* 80: 125- 132.

Greenberg, B. (1985): Forensic Entomology: Case studies. *Bulletin of the Entomological Society of America,* 31: 25- 28.

Henning, J.; Schnitzler, F.; Pfeiffer, D. and Davies, P. (2005): Influence of weather conditions on fly abundance and its implications for transmission of rabbit hemorrhagic disease virus in the northern Island of New Zealand. *Medical and Veterinary Entomology,* 19(3): 251- 262.

Jonathan, A. and Nedler, P. (2009): Cool-weather activity of the forensically important hairy maggot blow fly *Chrysomya rufifacies* (Macquart) (Diptera: Calliphoridae) on carrion in Upstate South Carolina, United States. *Forensic Science International,* 195:139- 142.

Kato, Y. (1960): Flies in Nansatu district of Kagoshima prefecture. *Igaku-kenkyu,* 30:72- 94.

Kurahashi, H. (1997a): [Blowflies (Diptera: Calliphoridae)]. In: Ishii M, Ohtani T, Johki Y (eds). *The Encyclopedia of Animals in Japan 9, Insect* II: 155–156. Heibonsha, Tokyo. (In Japanese).

Kurahashi, H. (1997b): Flesh flies (Diptera: Sarcophagidae). In: Ishii, M., Ohtani, T., Johki, Y. (Eds.). *The Encyclopedia of Animals in Japan 9, Insect II*. Heibonsha Limited Publishers, Tokyo. (In Japanese).

Kurahashi, H. (2001): [Visiting the origin of the chrysominae (Diptera: Calliphoridae)]. In: Shinonaga S., Shima H. (eds). *The Natural History of Flies,* 265- 292. Tokai University press, Tokyo.

Kurahasi, H. and Ohtaki T. (1989): Geographical variation in the incidence of pupal diapause in Asian and Oceanic species of the flesh fly *Boettcherisca* (Diptera: Sarcophagidae). *Physiological Entomology, 14: 291- 298.*

Kuusela, S. (1983): Community structure of carrion flies along an island gradient. *Holarctic Ecology,* 6 (4): 372-380.

Lehrer, Z. (1995): Sur la valdite des especes *Sarcophaga dux*, Thomson et *Sarcophaga exuberans* Pandelle, avec la description d' une nouvelle espece africaine du genre *Liosarcophaga* Enderlein (Diptera: Sarcophagidae). *Review of Roman Biology of Animals,* 40(2): 85- 97.

Lehrer, Z. and AbouZied, E. (2008): Une espèce nouvelle du genre *Engelisca* Rohdendorf de la faune d'Arabie Saoudite (Diptera, Sarcophagidae). *F. Dipterologica,* 14: 1- 4.

Lindsay, D. and Scudder, H. (1956): Nonbiting flies and disease. *Annual Review of Entomology,* 1: 323–46.

Lopes, H. (1973): Collecting and rearing Sarcophagidae flies (Diptera) in Brazil during forty years. *Anais da Academia Brasileira de Ciências,* 45: 279- 291.

Mckillup, S.; Mckillup, R. and Pape, T. (2000): Flies that are parasitoids of a marine snail: the larviposition behaviour and life cycles of *Sarcophaga megafilosia* and *Sarcophaga meiofilosia*. *Hydrobiology,* 439: 141–9.

Miyazaki, T. (1960): On flies of medical importance in South Kyusyu, I, fly fauna in Hyuga City. *Medical Journal of Kago. University,* 11: 102- 127.

Mulieri, R.; Schnack, A.; Mariluis, C. and Torretta, P. (2008): Flesh flies species (Diptera: Sarcophagidae) from a grassland and a woodland in a Nature Reserve of Buenos Aires, Argentina. *Revista de Biologica Tropical (International Journal of Tropical Biology and Conservation),* 56(3): 1287-1294.

Nidya, A.; William, U.; Magda, C.; Lilian, C. and Felio, B. (2009): Succession pattern of cadaverous entomofauna in a semi- rural area of Bogota, Colombia. *Forensic Science International,* 187: 66- 72.

Norris. K. (1965): The bionomics of blow flies. *Annual Review of Entomology,* 10: 47- 68.

Peterson, A.; Soberón, J. and Sánchez–Cordero, V. (1999): Conservatism of ecological niches in evolutionary time. *Science,* 285:1265-1267.

Pianka, E. and Huey R. (1978): Comparative ecology, niche segregation, and resource utilization among gekkonid lizards in the southern Kalahari. *Copeia,* 691– 701.

Reibe S. and Madeaa, B. (2010): How promptly do blowflies colonise fresh carcasses? A study comparing indoor with outdoor locations. *Forensic Sci.Internat.,* 195: 52- 57.

Rohde, K. (2005): *Nonequilibrium Ecology. Series: Ecology, Biodiversity and Conservation*. Cambridge University Press, Cambridge, 223 pp.

Sasha, C.; Hellen, C. and Ian R (2009): Annual and seasonal patterns of insect succession on decomposing remains at two locations in Western Australia. *Forensic Science International,* 193: 26-36.

Schwendinger, P. and Pape, T. (2000): *Metopia sinensis* (Diptera: Sarcophagidae), an unusual predator of *Liphistius* (Araneae: Mesothelae) in Northern Thailand. *Journal of Arachnology,* 28: 353–6.

Shah, Z. and Tanzeela, S (2004): The effect of flesh age, trap colour, decomposition stage, temperature and relative humidity on the visitation pattern of blow and flesh flies. *International Journal of Agriculture and Biology,* 6(2): 370 –374.

Sharanowski, J.; Walker, E. and Anderson, G. (2008): Insect succession and decomposition patterns on shaded and sunlit carrion in Saskatchewan in three different seasons. *Forensic Science International,* 179: 219–240.

Szymon, M.; Daria, B.; Szymon, K. and Krysztof, S. (2010): An initial study of the insect succession and carcass decomposition in selected forests of central Europe. Part 2: Composition and residency patterns of carrion fauna. *Forensic Science International,* 195:42- 51.

Tachibana, S. and Numata, H. (2006): Seasonal prevalence of blowflies and flesh flies in Osaka City. *Entomological Science, 9, 341–345.*

Terry, L. and Douglas, A. (2008): A preliminary investigation of insect colonization and succession on remains in New Zealand. *Forensic Sci. International,* 176: 217– 223.

Thomas, H. (1951): Some aspects of blow flies genus *Chrysomya* R-D, *Lucilia* R. D., *Hemipyrellia* Thed. and *Calliphora* R. D., from south eastern Szechman, China. *Proceedings of Zoology of London,* 121: 147- 200.

Voss, S.; Forbes, S. and Dadour, L. (2008): Decomposition and insect succession on cadavers inside a vehicle environment. *Forensic Sci. of Medicine and Pathology,* 4: 22–32.

Wang, J.; Zhigang L.; Chen Y.; Chen, Q.; Yin X. (2008): The succession and development of insects on pig carcasses and their significances in estimating PMI in south China. *Forensic Science International,* 179: 11–18.

Yin, C.; Qin, W. and Stoffolano, G. (1999): Regulation of mating behaviour by nutrition and the corpus allatum in both male and female *Phormia regina* (Meigen). *Journal of Insect Physiology,* 45: 815–822.

Yin, C.; Zou, B. and Stoffolano, J. (1994): Discovery of a midgut peptide hormone which activates the endocrine cascade leading to oogenesis in *Phormia regina* (Meigen). *Journal of Insect Physiology,* 40:283–292.

ARABIC SUMMARY

تأثير العوامل المناخية وبعض أنواع البروتينات على أنماط زيارة الذباب الأزرق وذباب اللحم لجبل الباهر بمحافظة الباحة بالمملكة العربية السعودية

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يشتمل موضوع البحث على دراسة مقارنة لتأثير كل من العوامل المناخية وبعض المواد البروتينية على نشاط عشائر الذباب الأزرق وذباب اللحم في واحد من أعلى الجبال (جبل الباهر) في سلسلة جبال منطقة السراة بمحافظة الباحة ٢٢٠٩ متر فوق سطح البحر.

تم استخدام المصايد المزودة بثلاثة أنواع من البروتينات (السمك- اللحم البقرى- الكبد الطازج) بالإضافة إلى مصيدة رابعة تحتوى على طعم مصنع تجاريا باسم "هاش هاش" يعطى رائحة تشبه المواد العضوية المتحللة. تم وضع المصايد على أبعاد متساوية ١٠ متر بين كل مصيدة والتي تليها واستمرت الدراسة على مدار عامين متتاليين (٢٠٠٨- ٢٠٠٩).

تم تجميع نوعين من ذباب اللحم الأول نوع جديد يسجل لأول مرة في العالم *إنجليسيكا أدهامى* والنوع الآخر يسجل لأول مرة في المملكة *ليوساركوفاجا بابيارى* بالإضافة إلى تجميع نوع واحد من ذباب *كاليفورا فيسينا*.

- أظهرت النتائج انتشار أفراد عشيرة *ليوساركوفاجا بابيارى* على مدار شهور العام باستثناء شهر يناير الذي اختفى فيه الطور اليافع ذكور وإناث بينما كانت أعلى معدلات العشيرة خلال شهر أغسطس. بينما كان نشاط كلا العشيرتين *إنجليسيكا أدهامى* و عشيرة *كاليفورا فيسينا* محدودا على مدار شهور العام. فالنوع الأول بدأ نشاطه في شهر مارس بينما سجل أعلى معدلات النشاط خلال شهر يونيو واستمر في النشاط حتى شهر سبتمبر ولكن بأقل معدلات النشاط ليختفي خلال باقي شهور العام ، بينما بدأ نشاط عشيرة *كاليفورا فيسينا* في شهر فبراير واستمر حتى يوليو بينما سجلت العشيرة أعلى انتشار لأفرادها خلال فترة الربيع (مارس – ابريل).

- سجلت التحاليل الإحصائية (باستخدام مقياس معامل الارتباط) تأثيرا طرديا ومعنويا لكل من درجة الحرارة وسرعة الرياح على معدلات انتشار الطور اليافع لعشيرة *ليوساركوفاجا بابيارى* بينما على النقيض ، كان تأثير الرطوبة النسبية عكسيا ومعنويا على نشاط الطور اليافع لنفس العشيرة. بينما كان تأثير معدلات هطول الأمطار إيجابيا ويتناسب طرديا مع نشاط الطور اليافع لعشيرة *كاليفورا فيسينا*. أما في حالة الطور اليافع لعشيرة *إنجليسيكا ادهامى* ، اظهر التحليل الإحصائى تأثيرا ضعيفا غير معنويا للعوامل الجوية المختلفة على نشاط أفراد العشيرة.

- سجلت النتائج تفضيل ذكور عشيرة *ليوساركوفاجا بابيارى* للانجذاب تجاه المصايد المزودة بالأسماك في المرتبة الأولى ثم تبعتها المصايد التي تحتوى على الكبد في المرتبة الثانية وتلتها المصايد التي تحتوى على اللحوم في المرتبة الثالثة. أما في حالة الإناث، فقد سجلت النتائج تفضيل الإناث للمصايد المزودة بالأسماك والكبد في ا لمرتبة الأولى، إذا ما قورنت بالمصايد المزودة باللحوم. على سبيل المقارنة ، فإن عشيرة *إنجليسيكا أدهامى* لم تظهر أية تمييز بين الثلاثة أنواع المختبرة من البروتينات. على النقيض كلا الجنسين في عشيرة *كاليفورا فيسينا* كانا أكثر انجذابا لمصايد المزودة بالكبد بصورة معنوية كبيرة إذا ما قورنت بمصايد المزودة بكل من الأسماك واللحوم (المرتبة الثانية). وبصورة عامة سجلت المصايد المزودة بمادة "هاش هاش" أقل الرتب في جذب الذكور والإناث لعشائر *ليوساركوفاجا بابيارى* و *إنجليسيكا أدهامى* بينما لم ينجذب لها مطلقا كلا الجنسين من عشيرة *كاليفورا فيسينا*.

و خلاصة البحث أنه برغم تواجد الثلاثة أنواع من الذباب في نفس البيئة الجبلية وأيضا برغم توحد العوامل الجوية أو الظروف المناخية في هذا المكان بالإضافة إلى توحيد نوعية الطعام المتاح في المصايد إلا أن النتائج أظهرت بعض " الفصل بين المنافذ " بين الأنواع الثلاثة كنتيجة طبيعية لتغير توقيتات النشاط الموسمي واختلاف تأثيرات العوامل الجوية على أفراد كل عشيرة وهو ما أدى إلى استمرار تواجد الثلاثة أنواع من الذباب في هذه البيئة الجبلية عبر سنون طويلة.