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Distribution and abundance of diurnal and nocturnal dipterous flies in the Federal Territory, Putrajaya

Nazni, W.A.[1], Nooraidah, H.[1], Jeffery, J.[2], Azahari, A.H.[1], Mohd Noor, I.[1], Sadiyah, I.[1] and Lee, H.L.[1]
[1] Medical Entomology Unit, Infectious Diseases Research Centre, Institute For Medical Research, Jalan Pahang 50588, Kuala Lumpur, Malaysia
Department of Parasitology and Medical Entomology, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Raja Muda Abdul Aziz, 50300, Kuala Lumpur, Malaysia.
Email: nazni@imr.gov.my
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Abstract. A study of diurnal and nocturnal distribution of flies was conducted in Putrajaya. Six different ecological habitats were selected, namely: botanical garden, lake-area, administration building, wetland, jungle fringes and housing areas. Two different type of traps, cylinderical and rectangular in shape were used in the study. Baits used in these traps were yeast, sugar, salted fish, shrimp paste and fresh liver. Traps were placed at the sites throughout the diurnal and nocturnal periods. The time for sunrise and sunset was determined using a Geographical Positioning System gadget (GARMIN®) at the sites. Both type of traps were equally effective in trapping flies. There was no significant difference between both types of traps in their ability to trap flies ($p > 0.05$). A total of 1,534 flies were collected and identified from both types of trap using the multiple baits and habitats. The collection consisted of 23 species of flies classified under 6 families. The highest number of flies were caught from the lake-area followed by botanical garden, administration building, housing areas, wetland and jungle fringes. The most dominant species was *Chrysomya megacephala*, followed by species of Sarcophagidae and *Musca domestica*. Diurnal period had more numbers of flies (81.55%) compared to the nocturnal periods (18.45%). Some species of flies were strictly diurnal, some exibited both diurnal and nocturnal activities while only one species was strictly nocturnal.

INTRODUCTION

Insects biodiversity and activity is very much affected by the environmental factors in which they live (Gullan & Cranston, 2000). It is believed that diversity evolves through niche specialization and resource partitioning (Rosmoser & Stoffolano, 1998). Flies can be found almost anywhere in the world. Many flies, however, play very useful roles in plant pollination, scavenging, and controlling various insect pests (by either direct feeding or parasitism). They are also of social and economic importance to us. Much of our current knowledge about genetics, development and evolution has come about through our use of flies as models. Flies' close association with humans has led them to be perceived as annoying and unpleasant creatures, and indeed some flies are responsible for causing illness in humans, through the transmission of diseases (Grubel *et al*., 1997; Tan *et al*.,1997). Hence, from a biodiversity perspective, flies fulfill an important function and we should make sure that any actions we might take in terms of pest control, habitat management and the like are carefully considered to ensure their continuous survival.

In Malaysia in a distribution study done by Baharudin *et al.* (2003a) at seven locations of different altitudes along Titiwangsa transect they succeeded in collecting 32 species. In other studies conducted in Kuala Lumpur and Gombak in Selangor, several species were found in these areas (Baharudin *et al.* 2003b,c).

This present study on the distribution and abundance of fly species was conducted in Putrajaya, Malaysia. Putrajaya is an administrative city of Malaysia covering an area of 4,931 hectares of land. The layout of Putrajaya emphasizes on the preservation of its ecosystem. It has both natural and man made recreational areas for tourism catering for both local and international tourist. Hence, being an administrative city in the Multimedia Super Corridor and the host for various international events, the species of flies should be known in order to implement control measures if fly problem is encountered. Therefore, the purpose of this study was to determine the species of flies and its abundance during the diurnal and nocturnal periods of the day using multiple baits so as to enhance the numbers of flies caught.

MATERIALS AND METHODS

The study site consists of six different ecological habitats in Putrajaya, namely botanical garden, lake-area, administration building, wetland, jungle fringes and housing areas. Two types of traps were used: a cylinder shaped cone trap having a diameter of 10 inches and height of 12 inches (WHO, 1991) and a rectangular shaped cone trap having a length of 10 inches breadth of 10 inches and height of 12 inches. Baits used in these traps were yeast, sugar, salted fish, shrimp paste and fresh liver. The baits weighed 25 gram each. The baits were placed in separate containers and then placed in a bigger container prior to introduction into traps.

Three pairs of traps were placed at each study site for diurnal and nocturnal collection of flies. Each pair consisted of a cylindrical and retangular traps. For the diurnal collection traps were set around 7.05 am – 7.06 am and collected before 7.23 pm – 7.24 pm, while for the nocturnal collection traps were set around 7.23 pm – 7.24 pm and collected before 7.05 am – 7.06 am. The time for sunrise and sunset was obtained from Geographical Positioning System gadget (GARMIN®). Four replicates were conducted at each study site. Traps collected were then sealed into a plastic bag and flies caught were killed using chloroform. Flies were brought back to laboratory and identified based mainly on keys by Inder *et al.* (1979) and Kurahashi *et al.* (1997). A statistical analysis using non-parametric Mann-Whitney test was used to determine the effectiveness of the 2 types of trap. Meteorological data of the study site were obtained from the Meteorological Service.

RESULTS AND DISCUSSION

Our study indicated that trap design whether cylindrical or rectangular does not affect the flies attracted to baits. This is shown by 49.15% and 50.85% of flies trapped in cylindrical cone and rectangular cone traps, respectively. Statistical analysis using non-parametric test showed that there was no significant difference between both types of traps $p>0.05$ (p-value = 0.16). Both type of traps caught almost identical species of flies.

The meteoriological data throughout the study period for rainfall was 10ml to 125 ml and the temperature was 24.8°C to 34.5°C. It is worth noting that beside trap design and bait preferences local weather variation influenced collection of flies. For instance during heavy rainfall, traps yielded virtually no flies.

A total of 1,534 flies were collected from the six different ecological habitats. The collections were identified and classified into 6 different families i.e Calliphoridae, Chrysomyidae, Muscidae, Sarcophagidae, Tachinidae and Ullilidae and 23 different species including two species that were indeterminate as shown in Table 1. The largest collection of flies were obtained from the lake-area comprising 31.16% followed by botanical garden (23.34%), administration buildings (17.60%), housing areas (14.41%), wetland (7.17%) and jungle fringes (6.32%). Our study revealed that the botanical garden had higher diversity and density of flies. It was interesting to note that the administration building was second in terms of diversity of flies. Baharuddin *et al.* (2003a) in their study along the Titiwangsa transect

Table 1. Total number of flies collected from various ecological sites in Putrajaya using both cylindrical and rectangular type of fly traps

Families Sub families	Species	No of flies collected at different ecological sites						
		Botanical garden	Lake	Administration building	Wetland	Jungle fringes	Housing area	Total
Calliphoridae								
Calliphorinae	*Hemipyrellia ligurriens*	22	0	6	3	6	3	40
	Lucilia cuprina	7	13	3	3	0	8	34
	Phumosia testacea	0	0	0	0	1	0	1
Chrysomyinae	*Chrysomya megacephala*	259	384	169	76	47	105	1040
	Chrysomya rufifacies	3	5	0	0	0	1	9
Rhiniinae	*Cosmina* sp.	0	0	0	0	3	0	3
	Stomorhina discolor	0	1	0	0	0	0	1
Muscidae								
Phaoniinae	*Anthomyia illocata*	0	0	1	0	0	0	1
	Atherigona sp.	12	10	15	10	5	8	60
	Dichaetomyia sp.	1	0	0	0	0	0	1
	Ophyra chalcogaster	3	0	1	0	0	1	5
	Synthesiomyia nudiseta	0	0	3	0	0	0	3
Coenosiinae	*Lipse* cf. *leucospila*	1	0	0	0	0	0	1
Muscinae	*Musca domestica*	3	2	19	1	2	26	53
	Musca sorbens	0	0	1	1	0	11	13
	Musca ventrosa	0	3	0	1	1	1	6
Sarcophagidae	*Harpagophalla reciproca*	0	0	0	0	2	0	2
	Sarcophaga dux	1	3	6	1	2	7	20
	Sarcophaga misera	1	1	2	1	0	1	6
	sp.	35	37	38	13	27	49	199
Tachanidae	Species indeterminate	0	0	0	0	1	0	1
Ullilidae	*Chrysomyza* cf. *rufipes*	9	19	6	0	0	0	34
	Species indeterminate	1	0	0	0	0	0	1
Total		358	478	270	110	97	221	1534

succeeded in collecting 32 species from seven families namely Muscidae, Calliphoridae, Anthomyiidae, Sarcophagidae, Lauxaniidae, Otitidae and Tephritidae.

The genus C*hrysomya megacephala* (67.80%) was the most dominant species followed by species of Sarcophagidae (12.97%) and *Musca domestica* (3.46%). Baharuddin *et al.* (2003a,c) and Sallehuddin *et al.* (1998) also showed that *C. megacephala* was the most dominant species in their studies in Titiwangsa Range near Kuala Lumpur, in Gombak Selangor and dumping ground in Kuala Lumpur, respectively. From the total number of flies collected 5 species of flies i.e *C. megacephala*, *Atherigona* sp., *M. domestica*, *Sarcophaga dux* and species of Sarcophagidae were present in every sites.

Diurnal traps had significantly higher density of flies compared to nocturnal traps with total numbers of flies caught at 1,251 and 283 flies, respectively. The diurnal traps had higher diversity of flies compared to nocturnal traps with 22 species and 15 species caught respectively.

Our results indicated that some flies were strictly diurnal, i.e. *Musca ventrosa*, *Anthomyia illocata*, *Dichaetomyia* sp., *Phumosia testacea*, *Sarcophaga misera*, *Cosmina* sp., *Stomorhina discolor* and families of Ullilidae and Tachanidae. The strictly nocturnal species was *Lispe* cf. *leucospila*. However, some species exibited both diurnal and nocturnal activities such as *C. megacephala*, *Sarcophaga* sp., *M. domestica*, *Atherigona* sp. *Hemipyrellia*

ligurriens, *Chrysomyza* cf. *rufipes*, *Lucilia cuprina*, *S. dux*, *Musca sorbens*, *Chrysomya rufifacies*, *Ophyra chalcogaster*, *Synthesiomyia nudiseta* and *Harpagophylla reciproca* (Table 2).

It is commonly thought that the blowfly, *C. megacephala* is nocturnally inactive. Blow flies are important in estimation of post mortem interval (PMI) for corpses found at death scene. Blow flies are the species which colonize corpse efficiently. Hence if blowflies were to oviposit during nocturnal hours, there could possibly be up to 12 hours of discrepancies for the estimate of PMI. In Malaysia, based on the review of forensic entomological specimens collected during 1972 – 2002, Lee *et al.* (2004) showed that *C. megacephala* and *C. ruffifacies* comprise 77.45% of total fly larvae recovered from human cardavers. In our study, high percentage of *C. megacephala* was caught at nocturnal period, indicating that this fly was active at night since it was attracted to the bait. Therefore, studies pertaining to the active attraction of these flies at night towards the oviposition medium is in progress and had yet to be verified. Previous research on nocturnal oviposition of blow

Table 2. Total number and percentage of flies collected during diurnal period (daytime) and nocturnal period (night)

Fly species	Total no caught diurnally (%)	Total no caught nocturnally	Total no caught
Chrysomya megacephala	811 (77.98)	229 (22.02)	1040
Chrysomya rufifacies	7 (77.78)	2 (22.22)	9
Sarcophagidae	186 (93.46)	13 (6.5)	199
Sarcophaga dux	19 (95.0)	1 (5)	20
Sarcophaga misera	6 (100)	0	6
Ophyra chalcogaster	4 (80.0)	1 (20)	5
Musca domestica	50 (94.33)	3 (5.66)	53
Musca sorbens	12 (92.31)	1 (7.69)	13
Musca ventrosa	6 (100)	0	6
Anthomyia iliocata	1 (100)	0	1
Synthesiomyia nudiseta	2 (66.67)	1 (33.33)	3
Lipse cf. *leucospila*	0	1 (100)	1
Dichaetomyia sp.	1 (100)	0	1
Atherigona sp.	41 (68.33)	19 (31.66)	60
Lucilia cuprina	31 (91.18)	3 (8.8)	34
Hemipyrellia ligurriens	33 (82.5)	7 (17.5)	40
Phumosia testacea	1 (100)	0	1
Harpagophalla reciproca	1 (50.0)	1 (50.0)	2
Cosmina sp.	3 (100)	0	3
Stomorhina discolor	1 (100)	0	1
Chrysomyza cf. *rufipes*	33 (97.06)	1 (3.03)	34
Family Ullilidae	1 (100)	0	1
Family Tachanidae	1 (100)	0	1
Total	1251 (81.55)	283 (18.45)	1534

flies has yielded varying results. On the one hand, one study demonstrated that blow flies do oviposit during the period from sunset to sunrise (Greenberg, 1990) and, on the other hand, another study failed to record oviposition (Tessmer *et al.*, 1995) .

The fly *L. cuprina* seems to be attracted during the diurnal as well as nocturnal period and this finding is in aggreement with the report by Norris (1965), though it was in contrast to the finding of Baharudin *et al.* (2003b) whereby they stated that this fly was not nocturnal in behaviour.

It is noteworthy to mention that 2 specimens of the species *S. nudiseta* were trapped at the outdoor trap and 1 fly caught indoor placed near the administration building though Baharudin *et al.* (1994) in their findings mentioned that this fly is an inhabitant of carrion or corpse and is not attracted to meat or fish. Baharudin *et al.* (1994), who reported this fly for the first time in the country and Lee *et al.* (2004) also stated that this species may only be trapped indoor. Our study indicated that this species exhibited eusynanthropic character because it was only found near human premises. *Musca domestica* which shows hemi-synanthropic behaviour occurred in higher numbers in collection in administration building and housing area. This finding was in line with that reported by Baharudin *et al.* (2003c). Our study also showed that only female *Atherigona* sp. were collected which indicates that male *Atherigona* sp is not attracted to bait. However, according to Kurahasi (per.com.) males are to be found on vegetation in the vicinity of female activity.

The fly abundace and diversity in a particular site is worth studying in order to understand their behaviour and also to undertake judicious control measures if they posed problem in the respective habitat. Beside, the diversity of flies is important for forensic entomology studies.

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