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STUDY OF MUSCID AND CALLIPHORID FLIES IN GABORONE (INSECTA : DIPTERA)

J. ALLOTEY, S.O. PATELELO, N. MAKATE AND M. MPHO
DEPARTMENT OF BIOLOGICAL SCIENCES,
UNIVERSITY OF BOTSWANA, GABORONE, BOTSWANA
(e-mail : alloteyj@mopipi.ub.bw)

A survey of synanthropic species of flies in Gaborone, Botswana was carried out in various areas namely Block 9, Block 8, Village, Extension 16, Tlokweng, Block 3, Phase 4, Gaborone West, Block 5 and Extension 10. Fly maggots were collected from dustbins. Collection was done 3 times per dustbin for a period of 10-14 days. Fly maggots were identified using the posterior spiracles. Adult venation, thoracic bands and hairs of reared maggots were also used for identification. Two species, *Musca domestica* (Family Muscidae) and *Chrysomyia megacephala* (Family Calliphoridae) were identified. *C. megacephala* was the most predominant species and had the highest number recorded compared with *M. domestica*. There was a significant difference ($F=4.66$; $P<0.05$) in the number of maggots collected and this could be due to factors such as the contents of the dustbins, the refuse collection time of the dustbins and environmental factors such as humidity and temperature. The pupation time of the reared from maggots studied at temperature range 28-32^{0}C and relative humidity of 65-68 R.H. was 5 days for *M. domestica* and 5-6 days *C. megacephala*.

Key words : Muscid flies, Calliphorid flies, *Musca domestica, Chrysomyia megacephala,* Diptera.

INTRODUCTION

The insect families in the Diptera most often represent and belong to the Muscidae (true flies such as the housefly) and Calliphoridae (blow flies). Flies as pests go beyond mere annoyances and may in fact be one of the more serious insect pests around and are found worldwide (Mandell *et al.*, 2004). *Musca domestica* and *Chrysomyia megacephala* breed in a variety of human-controlled places including other organic substrates such as fecal and decaying matter. Flies are known to become contaminated with many species of pathogenic organisms, including the causative organisms of amebic and bacillary dysentery, typhoid fever, cholera, salmonellosis, anthrax, leprosy, yaws, trachoma, poliomyelitis, infectious hepatitis and many more others (West, 2001; Allotey, 2011). The housefly, *M. domestica*, can transmit a large number of diseases to man owing to their habit of visiting almost indiscriminately feces and other unhygienic matter and then the food of man. In addition, they vomit during feeding and frequently defecate on food. They are also vectors of amebic dysentery caused by *Entamoeba histolytica*, *Giardia lamblia*, and eggs of a variety of tapeworms, for example. *Taenia* spp., including *T. solium*, *Hymenolepsis nana*, *H. diminuta*, *Diphyllobothrium latum*, and *Dipylidium caninum*. They also carry parasitic nematodes such as *Necator americanus*, *Ancylostoma duodenale*, *Enterobius vermicularis* and *Ascaris lumbricoides* (Allotey, 2011). Blow flies (*Calliphora* and *Lucilia*) are commonly heavily contaminated with microorganisms. They have access to carrion and offal in slaughter houses and have been shown to be contaminated with the bacteria *Salmonella* and *Clostridium* (Greenberg, 1960 & 1963; Allotey, 2011). There is also evidence that *Lucilia* spp. may carry poliomyelitis. Meat or fish intended for human consumption must be protected from oviposition by blow flies; otherwise, it will be fly blown (Allotey, 2011). Flies cause problems in the food industry such as the food-processing plants, restaurants and the slaughterhouses (Mulla & Mian,

2000). Outbreaks of diarrheal diseases in urban and rural areas of (predominantly) developing countries are closely related to the seasonal increase in abundance of filth flies, and fly control is closely related to the decline in cases of enteric diseases (Olsen, 1998). Flies that can adapt to, or have adapted to humans will flourish whereas those that cannot adapt will be restricted to ever decreasing natural environments (Robinson, 1996). Because of increasing human population in cities and towns there are problems that arise such as reduced sanitation and increased air and water pollution that lead to prevalence of many insects including flies. In urban environments, the flies that are closely related and associated with humans are encouraged by food and harborage provided by the dwellings and human activities.

The readiness with which fly lay eggs and the presence of the fly maggots on many human-inhabited environments such as in the washrooms, kitchens and in their clothing exposes people to a higher risk of getting myiasis. Many different types of dipterous larvae are capable of invading body tissues of humans and other animals (Goddard, 1996). Although flies of the family Oestridae and Calliphoridae are most commonly associated with myiasis, more than a dozen other families of Diptera are known to cause myiasis in humans (Catts & Mullen, 2002).

An increase in the fly population around humans increases the chances of flies to transmit pathogens and to invade the human bodies. Recently there had been cases where large numbers of maggots were found in the domestic dustbins around Gaborone because of late collection of garbage. However, to date no studies have been done to determine the population size of flies and the different species that are commonly found in association with humans (Fam.: Muscidae, Sarcophagidae and Calliphoridae) in Gaborone.

The present study was carried out to investigate the most common species of the synanthropic flies and their population size in different areas around Gaborone. The objectives were; to find out the species of the flies that are found breeding in domestic rubbish bins; to find out the predominant fly species found in dustbins and to study some aspects of the developmental period of the different species collected and identified.

MATERIALS AND METHODS

A survey of flies in dustbins was undertaken to find dustbins which had flies breeding in them. 10 dustbins were randomly chosen for the collection of maggots. The study sites were; Block 9(BK 9), Block 8(BK8), Village (VIL), Extension 16 (EX16), Tlokweng (TLK), Block 3(BK3), Phase 4(PH4), Gaborone West (GW), Block 5(BK5) and Extension 10 (EX10). This was the better method for collecting the flies. Traps were made to catch the adult flies but some of the traps were taken away by the garbage collectors and therefore the traps were not used. Collection and sampling were performed randomly and 3 samples were collected from each of the 10 dustbins for a period of 6 weeks. The samples were designated as; sample 1 (week 1-2), sample 2 (week 3-4) and sample 3 (week 5-6). Maggots were collected from the ten (10) sites in two weeks for each sample. The maggots were collected using sterile forceps and placed into glass vials (25 mm diameter x 76 mm deep) with a perforated lid to allow for aeration. The maggots were collected at 8 am and taken to the insectary of the department of Biological Sciences, University of Botswana for experimentation.

At the insectary, a collection of the maggots was identified using the posterior spiracle and then counted. The posterior maggots' spiracle was cut with a scalpel and placed on a glass slide for observation under a stereomicroscope. The flesh around the spiracles was removed using pins for clear viewing. The spiracles were then identified using standard literature. Some of the larvae were reared in glass cages (30x23x23cm) using potatoes. The cages were covered with perforated cardboards to allow for aeration. The maggots reached the adult stage before identification. The emerged adults were identified based on their morphological characteristics. These involved the identification of the wing venation, the antennae, the thoracic hairs (colour, stripes and description) and the abdomen by band and colour. The flies were counted and recorded.

Statistical analysis using ANOVA and multiple range tests and graph were utilized for the results.

RESULTS AND DISCUSSION

The results obtained showed that there was a significant difference in the mean of the maggots obtained from the 10 dustbins ($F = 4.66$; $P<0.05$). The results are shown in Figs 1, 2 & 3. The results reflect the fact that the contents of the10 dustbins might not be the same. Other explanation for the results could be that some of the dustbins provided more maggots and hence the difference in mean numbers of maggots collected. Also since the dustbins were not collected at the same time and same day, some of the dustbins allowed more time for the maggots to grow than others. During the time of collection, the maggots were found to be in different developmental stages of development. Table I shows the results for the statistical analysis using Statistical Analysis Software (SAS) for Windows 9.1.

There was a significant difference ($F = 8.79$; $P<0.05$) in the mean numbers of maggots collected from the different dustbins. The results obtained in week 1 and week 3 were not significantly different but there were increased numbers of maggots recorded in week 2 (134 maggots of different flies) as compared to week 1 and 3 which had 98 and 100 maggots of different flies recorded, respectively. The increase in the number of maggots in week 2 was due to the high numbers of maggots collected in most of the dustbins. In addition to the reasons for obtaining different numbers of maggots, environmental conditions such as temperature, water and relative humidity could also be playing a role in maggot abundance. The maggots were collected for 6 weeks. Longer term monitoring is required to establish seasonal variation in fly abundance caused by meteorological variables (Howard, 2001).

In the present study the flies that were found breeding in the dustbins around Gaborone were identified to be *M. domestica* and *C. megacephala*. Bohart & Gressit (1951) observed that odours from garbage dumps attracted a vast number of flies and *C. megacephala* was among the predominant species. Figs. 1, 2 & 3 show that the number of *M. domestica* maggots was found to be lower compared to that of the *C. megacephala* suggesting that the most predominant species of flies that are found breeding in the dustbins in Gaborone are of the family Calliphoridae. Fig. 4 shows the number of maggots of different fly species collected from the 10 dustbins in 3 weeks. There was a

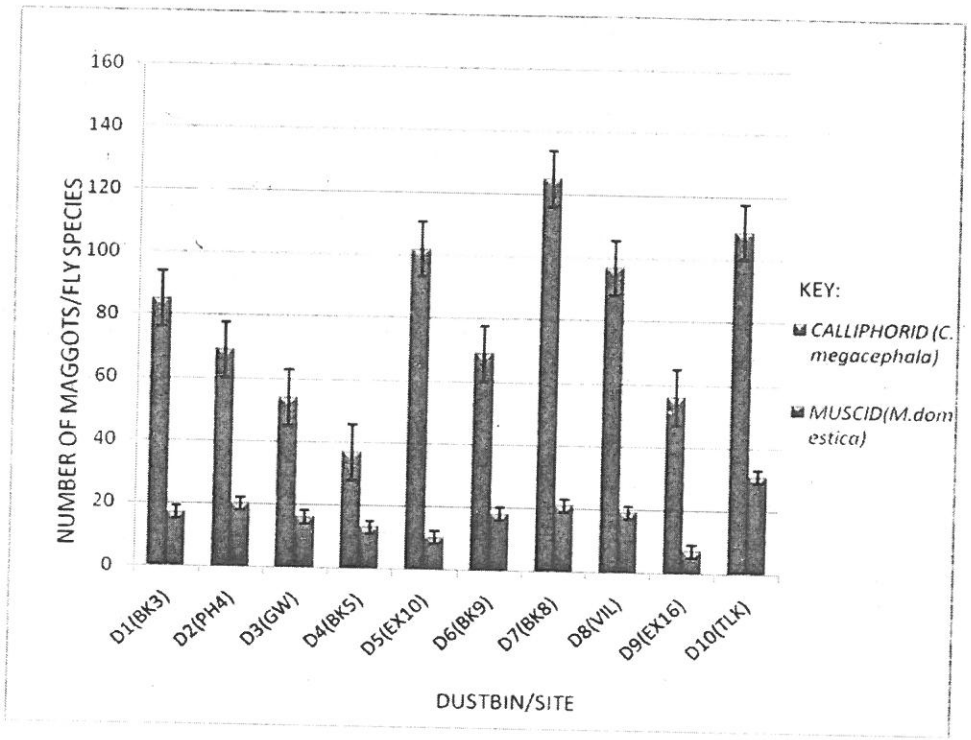

Fig. 1 : Number of maggots of different fly species collected from sample 1 (weeks 1&2) from the 10 dustbins; D = Dustbin, BK = Block, GW = Gaborone West, EX = Extension, VIL = Village, TLK = Tlokweng.

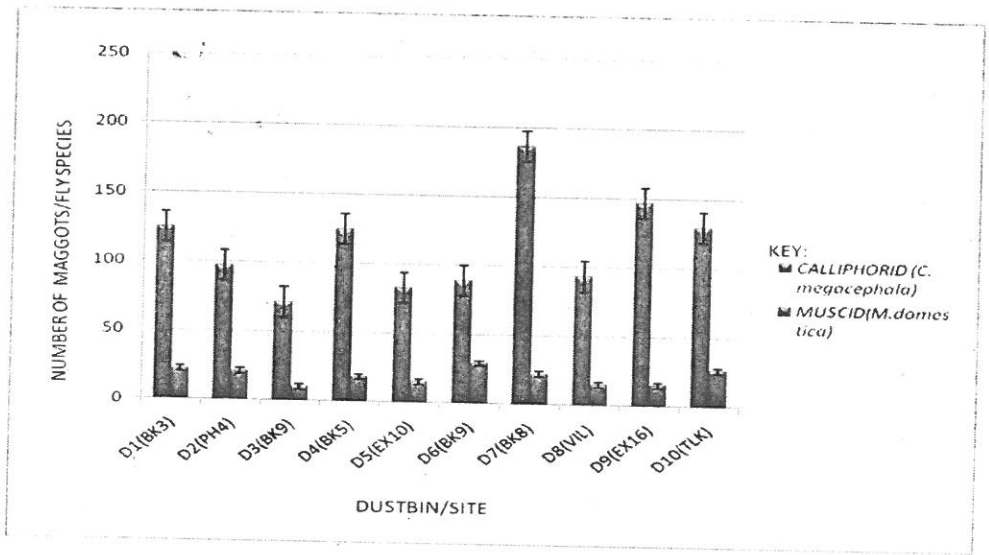

Fig. 2 : Number of maggots of different fly species collected from sample 2 (weeks 3&4) from the 10 dustbins.

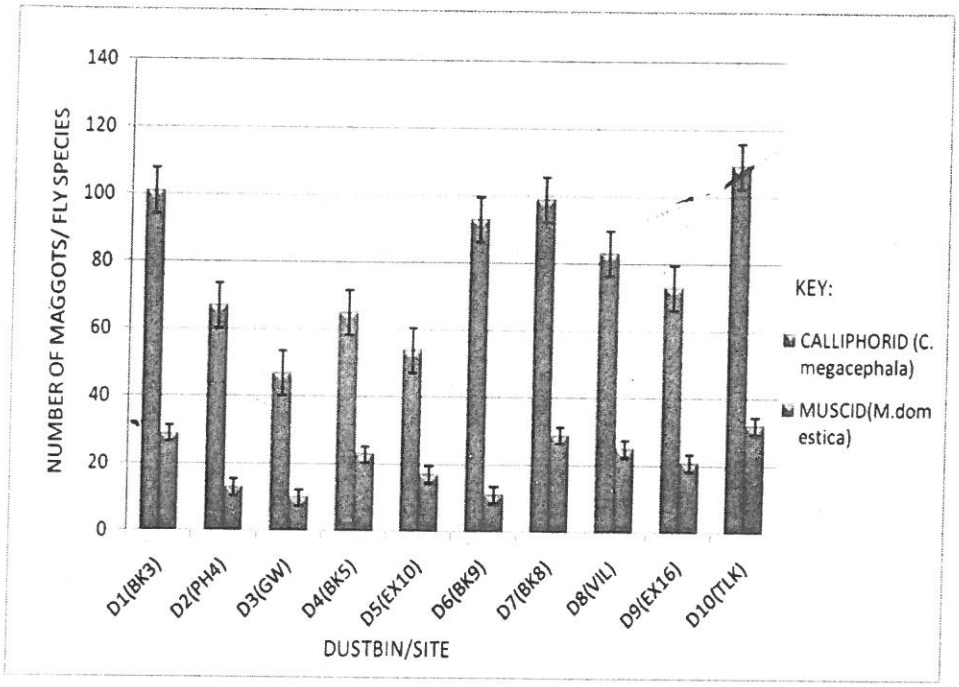

Fig. 3 : Number of maggots of different fly species collected from sample 3 (weeks 5 & 6) from the 10 dustbins.

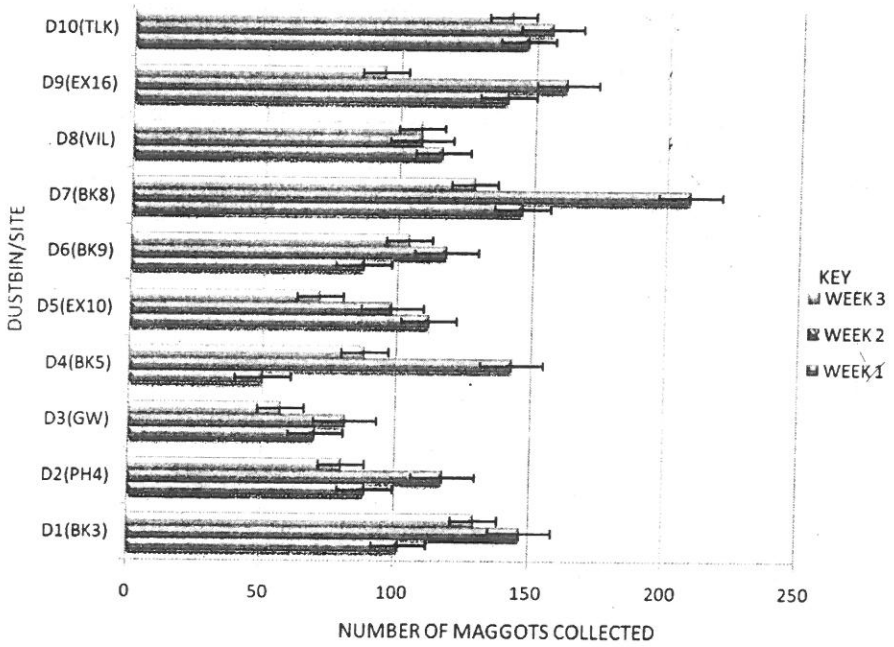

Fig. 4 : Number of maggots of different fly species collected from the 10 dustbins in 3 weeks.

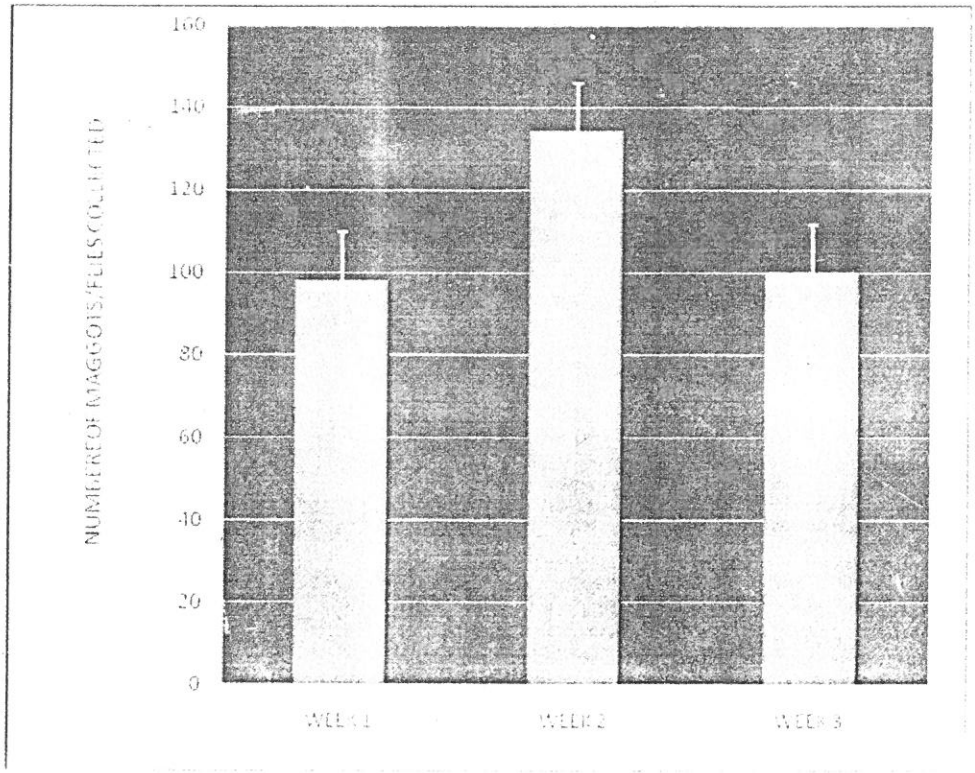

Fig. 5 : Average number of maggots together of different fly species collected in each week

high number of maggots of different fly species recorded in week 2 in D7(BLK 8) compared to other areas. The lowest number of maggots of different fly species for week 2 was obtained in D3(GW). Fig. 5 shows the average number of maggots together of different fly species collected in each week.

The most number of maggots of different fly species obtained from the dustbins was recorded in week 2. No significant difference was seen between the average number of maggots obtained in week 1 and week 3. Nurita *et al.* (2008) reported that *C. megacephala* was the predominant species in the garbage collection sites. *M. domestica* was recorded in low numbers in the present study and this agrees with the results obtained by Ikeda *et al.* (1972) who reported low proportions of *M. domestica* for flies emerging from garbage in Hawaii as compared to other species.

Both *C. megacephala* and *M. domestica* undergo complete metamorphosis. The developmental stages include egg, larva, and pupa and adult stages. The larva of *C. megacephala* is cream white in colour, measuring about 16 mm, and spiracles are brown. The adult has a shiny, metallic thorax and abdomen. The pupal case is black in colour and about 10 mm in length. At temperature range of 28-30^{0}C and relative humidity of 65-68% R.H. in the present study, the average pupation time was 5-6 days. Like the name suggests, their heads are extremely large and they have conspicuous red eyes and the fourth wing vein is sharply angled. The flies can be nuisance to humans and can even cause accidental myiasis (Smith, 1973). The amount of food is important in determining

Table I : Results for the statistical analysis using Statistical Analysis Software (SAS) for Window 9.1

The SAS System 02:31 Thursday, April 19, 2012

The GLM Procedure

Class Level Information

Class	Levels	Values
dustbin	10	D1(BK3) D10(TLK) D2(PH4) D3(GW) D4(BK5) D5(EX10) D6(BK9) D7(BK8) D8(VIL) D9(EX16)
week	3	1 2 3

Number of Observations Read 30

Number of Observations Used 30

The GLM Procedure

Dependent Variable: maggots

Source	DF	Sum of Squares	Mean Square	F Value	PR> F
Model	11	28072.20000	2552.01818	5.41	0.0008
Error	18	8489.26667	471.62593		
Corrected Total	29	36561.46667			

R-Square	CoifVary	Root MSE	maggots Mean
0.767808	19.64742	21.71695	110.5333

Source	DF	Type I SS	Mean Square	F Value	PR> F
dustbin	9	19778.13333	2197.57037	4.66	0.0027
week	2	8294.06667	4147.03333	8.79	0.0022

The SAS System (continued on next pageno.192)

02:31 Thursday, April 23, 2012

The GLM Procedure

t Tests (LSD) for maggots

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

0.05	Alpha
18	Error Degrees of Freedom
471.6259	Error Mean Square
2.10092	Critical Value of t
37.253	Least Significant Difference

Means with the same letter are not significantly different.

dustbin	t Grouping	Mean	N
D7(BK8)	A	161.00	3
D10(TLK)	B A	145.67	3
D1(BK3)	B A B A C	126.33	3
D8(VIL)	B C B C	110.67	3
D9(EX16)	D C	106.33	3
D6(BK9)	D C D C	103.00	3
D2(PH4)	D C D C	95.67	3
D5(EX10)	D C D C	93.67	3
D4(BK5)	D C D C	93.67	3
D3(GW)	D D	69.33	3

02:31 Thursday, April 19, 2012

The GLM Procedure

t Tests (LSD) for maggots

NOTE: This test controls the Type I comparison wise error rate, not the experiment wise error rate.

Alpha	0.05
Error Degrees of Freedom	18
Error Mean Square	471.6259
Critical Value of t	2.10092
Least Significant Difference	20.404

Means with the same letter are not significantly different.

t Grouping	Mean	N	week
A	134.000	10	2
B	100.100	10	3
B			
B	97.500	10	1

their survival and reproduction (Baumgartner & Greenberg, 1984). The larvae of M. *domestica are* cream white in colour but are smaller in length compared to that of *C. megacephala*, measuring about 10 mm and spiracles are light brown. The pupal case is brown in colour and about 7 mm. In this study the average pupation time was about five days at temperature range: 28-30°C and relative humidity: 65-68% R.H. The adults are 8-12 mm long. The thorax of the adult fly is grey, with four longitudinal dark lines on the back. The whole body is covered with hair-like projections.

M. domestica and *C. megacephala* breed in domestic and peri-domestic environments on decaying organic matter and fecal material, around houses, refuse dumps, in carcasses, meat processing plants (Service, 2000; Mulla & Mian, 2000). Thus maggots of these flies thrive in such environments (Goulson *et al.*, 1999). The present study shows that the most predominant fly species that are found in dustbins in Gaborone are the Muscid fly, *M. domestica* and the Calliphorid fly *C. megacephala.*

C. megacephala was the most predominant species and was recorded in large numbers in every sample that was collected. It is recommended that the study should be extended to other principal towns such as Francis town, large and small villages to identify the synanthropic fly species in Botswana. The effects of environmental conditions such as temperature should be studied for longer period of time to determine the abundance of the flies in Botswana in various seasons. Dustbins should be emptied frequently to interfere with the life cycle of the flies and hence regulating their population. There is the need to recognize the importance of educating people about flies and their association with diseases especially in areas where there is poor sanitation.

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