

Seasonal Abundance of Blow Flies (Diptera: Calliphoridae) in Three Urban Parks of Bangkok, Thailand

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ABSTRACT

Designing effective management programs for insect vectors of human and livestock diseases requires knowledge of the species composition and seasonal abundance of the vectors. The seasonality of blow flies was assessed throughout 1 yr with baited traps in three tropical, urban parks in Bangkok, Thailand. A total of 11,625 blow flies were captured and identified, consisting of five species from three genera—*Chrysomya megacephala* (Fabricius) (73.37%), *C. rufifacies* (Macquart) (22.96%), *Hemipyrellia ligurriens* (Wiedemann) (3.27%), *C. nigripes* Aubertin (0.38%) and *Phumosia indica* (Surcouf) (0.03%). More females were collected than males with a ratio of 2.9:1, respectively. Abundance of the two most common species showed a trimodal pattern with peaks in January, September and June and the three most common species occurred in baited fly traps throughout the year. The greatest number of *C. megacephala* was captured in January while *C. rufifacies* peaked in September. *Hemipyrellia ligurriens* was more abundant during June to October. Abundance levels of the two most common species were negatively correlated with the temperature and relative humidity.

Keywords: blow flies, Calliphoridae, seasonality, Thailand, urban ecology

INTRODUCTION

Filth flies are synanthropic and belong to the families Calliphoridae (blow flies), Muscidae (house flies) and Sarcophagidae (flesh flies). These flies are medically and veterinarily important and are thus a public health concern. In nature, adult flies feed on feces and carrion and breed in human and animal excrement, garbage, animal bedding, decaying organic matter and carcasses (Graczyk *et al.*, 2001, 2005). Some species deposit eggs or larvae on the wounds of warm-blooded animals or humans. Invasion of living tissue by fly larvae is a condition known as myiasis (Seppänen *et al.*, 2004). The feeding and breeding habits of filth flies

make them important vectors of many pathogens of humans and domestic animals (Graczyk *et al.*, 2005). Many studies have demonstrated that flies can serve as mechanical vectors of pathogens. For example, Getachew *et al.* (2007) reported that *Chrysomya rufifacies* and *Musca sorbens* had human intestinal helminthes and protozoan parasites on their cuticle and in their gut. *Chrysomya megacephala* and *Musca domestica* have been identified as bacterial vectors in urban areas of Chiang Mai province (Sukontason *et al.*, 2007). Conn *et al.* (2007) demonstrated that synanthropic flies serve as mechanical vectors of both *Cryptosporidium* and *Giardia*.

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Blow flies can be found near most human habitations and are also associated with animal husbandry. They can be a nuisance and can vector diseases between animals, from animals to humans (zoonoses) and can cause myiasis. Understanding the seasonal abundance of these flies will aid the design and implementation of effective control programs for them. The objective of this study was to identify the species of blow flies prevalent in Bangkok, Thailand, measure their seasonal abundance in public parks and correlate any changes in abundance with meteorological factors.

MATERIAL AND METHODS

Collection sites

The study was carried out in three adjacent public parks in Bangkok, Thailand: Chatuchak Park (13°48'16.66" N, 100°33'14.24" E); Queen Sirikit Park (13°48'24" N, 100°33'0" E); and Wachirabenchat Park (13°48'26.07" N, 100°32'57.17" E). Bangkok province has a tropical climate and it is generally hot and humid with three seasons: the rainy season from June to October, the dry cool season from November to February and the dry hot season from March to May (Youthao *et al.*, 2007).

Specimen collection

Flies were captured from March 2009 to February 2010 with two traps in each park. The commercially available traps consisted of black plastic at the base of the trap and the top was covered with a transparent plastic container (Figure 1). Four types of bait were combined in each trap: raw chicken meat mixed with cooked rice, raw pork small intestine, raw shishamo fish (*Spirinchus lanceolatus*) and fresh squid. Once per month, the traps were hung 1 m from the ground in trees standing 100 m apart. After 24 hr, the traps were placed into black plastic bags and the flies were killed with ethyl acetate vapor. All fly specimens were brought back to the Parasitology

Laboratory, Faculty of Veterinary Medicine, Kasetsart University, where they were pinned, counted and identified using the taxonomic keys of Tumrasvin and Shinonaga (1977), Tumrasvin *et al.* (1978), Tumrasvin and Kano (1979), Tumrasvin *et al.* (1979).

Data analysis

Pearson's correlation analysis implemented in SYSTAT® 8.0 Graphics (SYSTAT Software, 1998) was used to evaluate correlations between abundance levels of different blow fly species and monthly meteorological data for the temperature, rainfall and relative humidity. The test level for significance was set at ($P < 0.05$). Rainfall, relative humidity and temperature measurements were obtained from the Thai Meteorological Department at Don Muang airport (Station 455601; Figure 2).

RESULTS

Across all months, the most abundant family was Calliphoridae (91.67%), followed by Sarcophagidae (7.62%) and Muscidae (0.71%) (Table 1). A total of 11,625 calliphorid flies captured belonged to three genera—namely, *Chrysomya*, *Hemipyrellia*, and *Phumosia*. Within the three genera, five species were identified (Table 2): *Chrysomya megacephala* (Fabricius) (73.37%),



Figure 1 Baited fly trap.

C. rufifacies (Macquart) (22.96%), *Hemipyrellia ligurriens* (Wiedemann) (3.27%), *C. nigripes* Aubertin (0.38%) and *Phumosiya indica* (Surcouf) (0.03%). The female to male sex ratio of flies was 2.9:1, respectively.

Calliphoridae populations had three peaks in January, September and June (Figure 3) and this pattern was driven by fluctuations in the abundance of the two most common species,

C. megacephala and *C. rufifacies*. The three most common species were sampled in every month (Figure 4). *Chrysomya megacephala* was most abundant in January while *C. rufifacies* peaked in September; *H. ligurriens* was more abundant from June to October. There was no significant correlation between the total number of Calliphoridae and the temperature, rainfall and relative humidity (Table 3). The only significant

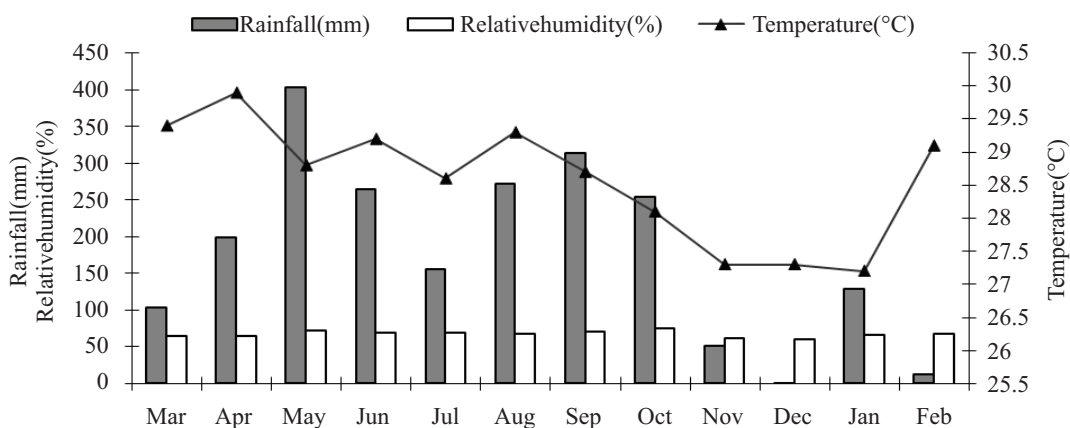


Figure 2 Mean monthly rainfall, relative humidity and temperature from March 2009 to February 2010 from the Thai Meteorological Department at Don Muang Airport (Station: 455601).

Table 1 Taxonomic composition of filth flies captured in three public parks in Bangkok from March 2009 to February 2010.

Family	Chatuchak	Queen Sirikit	Wachirabenchatat	Total	(%)
Calliphoridae	3,003	4,624	3,998	11,625	91.67
Muscidae	32	15	43	90	0.71
Sarcophagidae	302	346	318	966	7.62
Total	3,337	4,985	4,359	12,681	100

Table 2 Number of Calliphoridae species captured in three public parks in Bangkok from March 2009 to February 2010.

Species	Number of flies		Total	(%)
	Female	Male		
<i>Chrysomya megacephala</i> (Fabricius)	6,105	2,424	8,529	73.37
<i>Chrysomya nigripes</i> Aubertin	40	4	44	0.38
<i>Chrysomya rufifacies</i> (Macquart)	2,247	422	2,669	22.96
<i>Hemipyrellia ligurriens</i> (Wiedemann)	269	111	380	3.27
<i>Phumosiya indica</i> (Surcouf)	3	0	3	0.03
Total	8,664	2,961	11,625	100

associations detected were negative correlations between *C. megacephala* and the temperature and relative humidity (Pearson's correlation coefficient (r) = -0.506, P = 0.002 and r = -0.373, P = 0.025,

respectively) and between *C. rufifacies* and the temperature and relative humidity (r = -0.474, P = 0.004 and r = -0.402, P = 0.015, respectively).

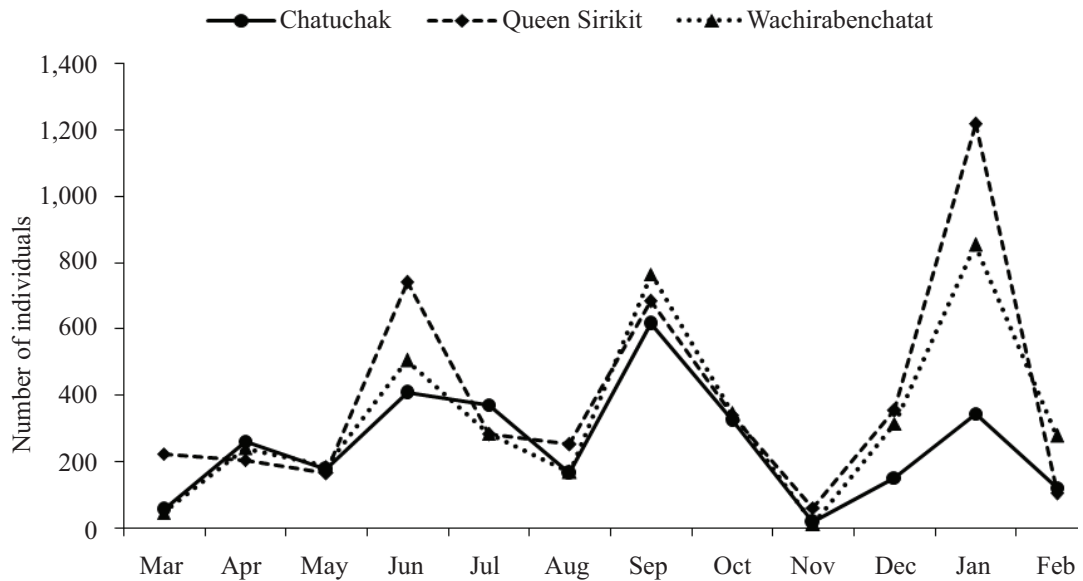


Figure 3 Monthly abundance of Calliphoridae captured in three public parks in Bangkok from March 2009 to February 2010.

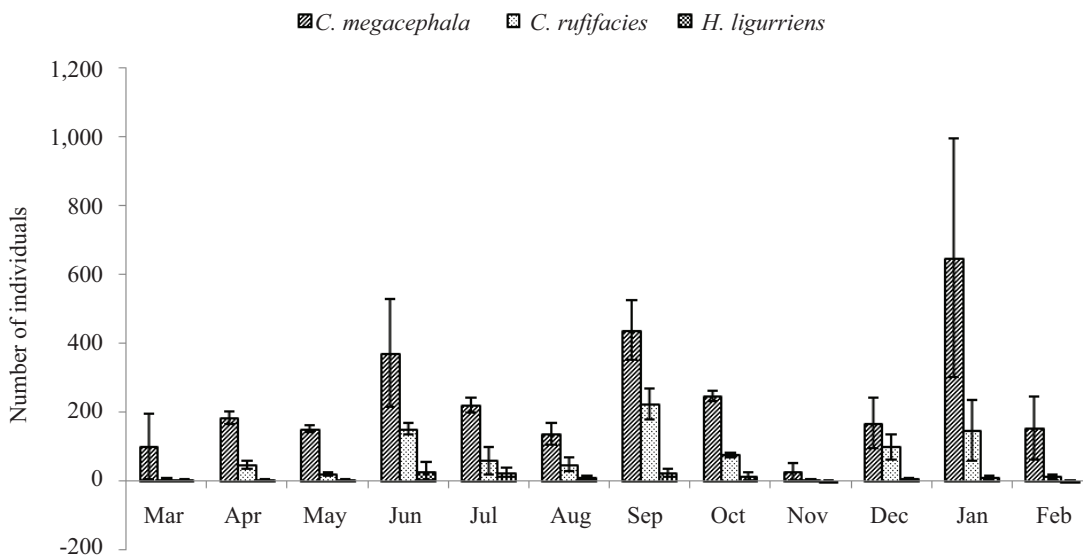


Figure 4 Abundance of the main species (*Chrysomya megacephala* (Fabricius), *C. rufifacies* (Macquart), *Hemipyrellia ligurriens* (Wiedemann)) of the Calliphoridae captured in three public parks in Bangkok from March 2009 to February 2010. (Vertical lines represent \pm SD; Number = 3).

Table 3 Pearson's correlation coefficients values between total abundance and numbers of individuals of Calliphoridae species captured and meteorological data in three public parks in Bangkok from March 2009 to February 2010.

Weather conditions	Abundance	<i>Chrysomya megacephala</i>	<i>Chrysomya nigripes</i>	<i>Chrysomya rufifacies</i>	<i>Hemipyrellia ligurriens</i>	<i>Phumosia indica</i>
Rainfall (mm)	0.234	-0.264	0.071	-0.170	0.048	0.099
Temperature (°C)	-0.203	-0.506*	-0.122	-0.474*	-0.229	-0.176
Relative humidity (%)	0.220	-0.373*	-0.055	-0.402*	-0.167	0.127

* = Significant at $P < 0.05$.

DISCUSSION

In urban Bangkok, *Chrysomya megacephala* was the most abundant calliphorid, followed by *C. rufifacies*, a pattern noted by Sukontason *et al.* (2003). Previous studies of flies of medical and veterinary importance in Thailand reported that *Musca domestica* was the most abundant followed by *C. megacephala* (Sucharit *et al.*, 1976; Tumrasvin *et al.*, 1978, Sucharit and Tumrasvin, 1981), but their choice of bait may have been largely responsible for this difference. For example, Boonchu *et al.* (2003) demonstrated that pork viscera baits were highly attractive to adults of *C. megacephala* and they suggested that the wind direction helped spread the bait odor. Pickens *et al.* (1994) determined that a bait mixture consisting of cooked rice mixed with chicken was the best attractant of *M. domestica*. However, in the current study, the dearth of this species with samples of this bait mixture may have resulted from competitive interactions with calliphorids attracted by other bait components. Different species of flies may prefer different habitats or food items. For example, Leong and Grace (2009) indicated that a large number of *C. megacephala* were found in food garbage, while *C. rufifacies* was most abundant at butchery sites and in outdoor latrines (Getachew *et al.*, 2007). Baited fly traps typically catch more females than males, presumably because females actively search for oviposition sites and require more protein food for

egg maturation (Tachibana and Numata, 2006).

The population fluctuations of *C. megacephala* and *C. rufifacies* were similar during the present study. The monthly abundance of Calliphoridae was predominant in January, September and June in accordance with the rainfall. Similar observations were reported by Batista-da-Silva *et al.* (2011) who found *C. megacephala* in Brazil was abundant in fall (March–May) and summer (November–February). In India, the abundance of *C. megacephala* increased in correlation with the beginning of the rainy season and then declined in the dry hot season (Wall *et al.*, 2001). Marinho *et al.* (2006) reported that the Calliphoridae were most abundant in May, June, September and January, coinciding with low rainfall and the most abundant species were *Phaenicia eximia* (47.0%) and *Hemilucilia semidiaphana* (23.6%) whereas the abundance of *C. megacephala* was less than 1%. The differences in abundance and species richness could probably be due to climatic and environmental differences. Analysis of the data showed a significantly negative correlation for the populations of *C. megacephala* and *C. rufifacies* with the temperature and relative humidity. Seasonal changes in the abundance and distribution of Calliphoridae frequently depend on environmental variables such as altitude, rainfall, temperature, humidity, fauna, flora, breeding substrates and human disturbance (Tumrasvin *et al.*, 1978; Sukontason *et al.*, 2003; Marinho *et al.*, 2006; Baz *et al.*, 2007; Mello *et al.*, 2007;

Pires *et al.*, 2008). In addition, blow flies may occur throughout the year when food debris, garbage, decaying plants, dead animals and manure are available to sustain growing larvae (maggots). In public parks, refuse and food waste left by visitors or associated with restaurants may provide sufficient food for blow flies year-round. Insufficiently cleaned garbage bins can provide a place for flies to breed (Tahir *et al.*, 2007). The current study suggests that environmental factors such as the temperature and relative humidity are correlated with the abundance of blow flies in an urban, tropical setting. However, seasonal changes in the deposition of garbage by park visitors may also contribute to the patterns described.

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LITERATURE CITED

- Baz, A., B. Cifrián, L.M. Díaz-Aranda and D. Martín-Vega. 2007. The distribution of adult blow-flies (Diptera: Calliphoridae) along an altitudinal gradient in Central Spain. **Ann. Soc. Entomol. Fr. (n.s.)**, 43: 289–296.
- Batista-da-Silva, J.A., G.E. Moya-Borja, R. Pinto de Mello and M. Maria de Carvalho Queiroz. 2011. Abundance and richness of Calliphoridae (Diptera) of public health importance in the Tinguá Biological Reserve, Nova Iguaçu, RJ, Brazil. **Entomotropica** 26: 137–142.
- Boonchu, N., S. Piangjai, K.L. Sukontason and K. Sukontason. 2003. Comparison of the effectiveness of baits used in traps for adult fly collection. **Southeast Asian J. Trop. Med. Public Health**, 34: 630–633.
- Conn, D.B., J. Weaver, L. Tamang and T.K. Graczyk. 2007. Synanthropic flies as vectors of *Cryptosporidium* and *Giardia* among livestock and wildlife in a multispecies agricultural complex. **Vector Borne Zoonotic Dis.** 7: 643–651.
- Getachew, S., T. Gebre-Michael, B. Erko, M. Balkew and G. Medhin. 2007. Non-biting cyclorrhaphan flies (Diptera) as carriers of intestinal human parasites in slum areas of Addis Ababa, Ethiopia. **Acta Trop.** 103: 186–194.
- Graczyk, T.K., R. Knight and L. Tamang. 2005. Mechanical transmission of human protozoan parasites by insects. **Clin. Microbiol. Rev.** 18: 128–132.
- Graczyk, T.K., R. Knight, R.H. Gilman and M.R. Cranfield. 2001. The role of non-biting flies in the epidemiology of human infectious diseases. **Microb. Infect.** 3: 231–235.
- Leong, M.K.H. and J.K. Grace. 2009. Occurrence and distribution of flies (Diptera: Calliphoridae and Muscidae) of public health importance on the island of Oahu. **Proc. Hawaiian Entomol. Soc.** 41: 79–88.
- Marinho, C.R., L.S. Barbosa, A.C.G. Azevedo, M.M.C. Queiroz, M.A. Valgode and V. M. Aguiar-Coelho. 2006. Diversity of Calliphoridae (Diptera) in Brazil's Tinguá Biological Reserve. **Braz. J. Biol.** 66: 95–100.
- Mello, R.S., M.M.C. Queiroz and V.M. Aguiar-Coelho. 2007. Population fluctuations of calliphorid species (Diptera, Calliphoridae) in the Biological Reserve of Tinguá, state of Rio de Janeiro, Brazil. **Iheringia, Sér. Zool.** 97: 481–485.

- Pickens, L.G., J. Jaworski, B. Kovac and G.D. Jr. Mills. 1994. Traps and baits for flies (Diptera) on Pacific Islands. **J. Med. Entomol.** 31: 828–832.
- Pires, E.M., V.M. Carraro and J.C. Zanuncio. 2008. Seasonal abundance of *Chrysomya megacephala* and *C. albiceps* (Diptera: Calliphoridae) in urban areas. **Rev. Col. Entomol.** 34: 197–198.
- Seppänen, M., A. Virolainen-Julkunen, I. Kakko, P. Vilkamaa and S. Meri. 2004. Myiasis during adventure sports race. **Emerg. Infect. Diseases.** 10: 137–139.
- Sucharit, S. and W. Tumrasvin. 1981. The survey of flies of medical and veterinary importance in Thailand. **Jap. J. Sanit. Zool.** 32: 281–285.
- Sucharit, S., W. Tumrasvin and S. Vutikes. 1976. A survey of houseflies in Bangkok and neighboring provinces. **Southeast Asian J. Trop. Med. Public Health.** 1: 85–90.
- Sukontason, K., K.L. Sukontason, S. Piangjai, J. Tippanun, S. Lertthamnontham, R.C. Vogtsberger and J.K. Olson. 2003. Survey of forensically-relevant fly species in Chiang Mai, northern Thailand. **J. Vect. Ecol.** 28: 135–138.
- Sukontason, K., L.M. Bunchoo, B. Khantawa, S. Piangjai, Y. Rongsriyam and K. Sukontason. 2007. Comparison between *Musca domestica* and *Chrysomya megacephala* as carriers of bacteria in northern Thailand. **Southeast Asian J. Trop. Med. Public Health.** 38: 38–44.
- SYSTAT Software, 1998. SYSTAT® 8.0 Graphics [Computer software]. SPSS Inc. Chicago, IL, USA.
- Tachibana, S. and H. Numata. 2006. Seasonal prevalence of blowflies and flesh flies in Osaka City. **Entomol. Sci.** 9: 341–345.
- Tahir, N.A., A.H. Ahmad, N.A. Hashim, N. Basari and C.S.M. Rawi. 2007. The seasonal abundance of synanthropic fly populations in two selected food outlets in Pulau Pinang, Malaysia. **Jurnal Biosains.** 18: 81–91.
- Tumrasvin, W. and R. Kano. 1979. Studies on medically important flies in Thailand. VI. Report on 48 species of sarcophagid flies, including the taxonomic keys (Diptera: Sarcophagidae). **Bull. Tokyo Med. Dent. Univ.** 26: 149–179.
- Tumrasvin, W. and S. Shinonaga. 1977. Studies on medically important flies in Thailand. III. Report of species belonging to the genus *Musca* Linné, including the taxonomic key (Diptera: Muscidae). **Bull. Tokyo Med. Dent. Univ.** 24: 209–218.
- Tumrasvin, W., H. Kurahashi and R. Kano. 1979. Studies on medically important flies in Thailand. VII. Report on 42 species of calliphorid flies, including the taxonomic keys (Diptera: Calliphoridae). **Bull. Tokyo Med. Dent. Univ.** 26: 243–272.
- Tumrasvin, W., S. Sucharit and R. Kano. 1978. Studies on medically important flies in Thailand. IV. Altitudinal distribution of flies belonging to Muscidae and Calliphoridae in Doi Indhanondh Mountain, Chiang Mai, in early summer season. **Bull. Tokyo Med. Dent. Univ.** 25: 77–81.
- Wall, R., J.J. Howard and J. Bindu. 2001. The seasonal abundance of blowflies infesting drying fish in south-west India. **J. Appl. Ecol.** 38: 339–348.
- Youthao, S., M. Jaroensutasinee and K. Jaroensutasinee. 2007. Analysis of influenza cases and seasonal index in Thailand. **WASET.** 32: 212–215.