

CASE REPORT

BLOW FLY MAGGOTS (DIPTERA: CALLIPHORIDAE) FROM A HUMAN CORPSE IN A VEHICLE

Pongruk Sribanditmongkol¹, Tawachai Monum¹, Anchalee Wannasan²
Jeffery K Tomberlin³, Kom Sukontason² and Kabkaew L Sukontason²

¹Department of Forensic Medicine, ²Department of Parasitology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand; ³Department of Entomology, Texas A&M University, College Station, Texas, USA

Abstract. Correct species identification and development data of insects associated with a cadaver can help estimate the time of colonization which could be used to infer a minimal post-mortem interval (minPMI) for forensic investigations. Human remains are found in a variety of locations ranging from open fields to inside automobiles. We report the investigation of blow fly larvae collected from a decomposing body located in the trunk of a car. There were two blow fly (Diptera: Calliphoridae) species: *Achoetandrus rufifacies* (Macquart) and *Chrysomya megacephala* (Fabricius). Blow flies can enter the vehicle and colonize human remains. Based on age estimations of third stage larvae of *A. rufifacies*, the minPMI was estimated to be 4-5 days, which was within the range of 3-5 days estimated by other forensically relevant information.

Keywords: forensic entomology, post-mortem interval, *Achoetandrus rufifacies*, blow flies, automobile

INTRODUCTION

Human remains can be discovered in a variety of environments ranging from open fields to concealed places such as automobiles. Although approximately 30 forensic entomology cases have been examined in northern Thailand (Sukontason *et al*, 2007), none have been

discovered in an automobile that were recorded. Although such cases are rarely reported, entomological evidence coupled with the findings of the forensic autopsy are often jointly helpful to determine the time of death (Anderson, 2001; Hitosugi *et al*, 2007; Williams, 2008). Case studies can provide information about arthropod colonization of human remains providing guidance with future death investigations. We present here data regarding the use of entomological evidence from a forensic investigation in Thailand involving the remains of a woman located in an automobile. This case demonstrates the use of entomological evidence with other

Correspondence: Dr Kabkaew L Sukontason, Department of Parasitology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand.

Tel: +66 (0) 53 945342 ext 502; Fax: +66 (0) 53 945347

E-mail: kabkaew.s@cmu.ac.th

Table 1
Occurrence of *A. rufifacies* among human corpse in Thailand^a.

Species	Number of cases		PMI estimation ^b
	Indoor	Outdoor	
<i>A. rufifacies</i>		1	Yes
<i>A. rufifacies</i> + <i>C. megacephala</i>	1	3	No/Yes ^c
<i>A. rufifacies</i> + <i>C. megacephala</i> + <i>Chrysomya villeneuvei</i>		2	No
<i>A. rufifacies</i> + <i>C. megacephala</i> + <i>Lucilia cuprina</i>		1	No
<i>A. rufifacies</i> + <i>C. megacephala</i> + <i>Synthesiomyia nudiseta</i>	1		Yes
<i>A. rufifacies</i> + <i>C. megacephala</i> + <i>Lucilia cuprina</i> + <i>Sarcophaga</i> spp		2	No
<i>A. rufifacies</i> + <i>C. megacephala</i> + <i>Coelonomys nigripes</i> + <i>Megaselia scalaris</i>		1	Yes
<i>A. rufifacies</i> + <i>Piophilidae casei</i> + <i>Hydrotaea spinigera</i> + <i>Sargus</i> spp + <i>Dermestes maculatus</i>		1	No
<i>A. rufifacies</i> + <i>C. megacephala</i> + <i>Sarcophaga</i> spp	1		No

^aSukontason *et al* (2007) from northern Thailand.

^bBased on age of *A. rufifacies*

^cSritavanich *et al* (2009) from Khon Kaen Province, northeastern Thailand.

evidence to determine the minimum post-mortem interval (minPMI) of the deceased individual.

CASE REPORT

The nude body of a female was discovered in the trunk of a car (Honda, Japan) parked near a bamboo forest in Chiang Mai Province during the summer of 2013. The remains were severely bloated, blackened, with partial skin loosening on the arms and fingers. At autopsy done at the Department of Forensic Medicine, Chiang Mai University, maggots were found scattered along the body, especially on the face, neck and along the inside of the victim's thighs. The fly larvae were identified as third instar blow flies (Diptera: Calliphoridae): *Achoetan-drus rufifacies* (Macquart) and *Chrysomya megacephala* (Fabricius) with *A. rufifacies* being the most developed. Therefore, age

estimates of these larvae were 4-5 days. This estimate was within the range of 3-5 days provided by other forensic finding to determine the minPMI.

DISCUSSION

Little information is published regarding forensic cases involving the concealment of remains within a vehicle (Anderson, 2001). The case presented here illustrates that *A. rufifacies* and *C. megacephala* can successfully colonize human remains concealed in the trunk of a vehicle. The results generated from this case are in agreement with Anderson (2001) who observed a large number of blow flies in a vehicle in British Columbia. She concluded the flies gained access to the remains via many entrances, including drainage holes in the trunk. She suggested that the car itself did not provide much of an obstacle. Apparently, a number of

different species of fly larvae in British Columbia were collected from the remains in the car trunk, such as blow flies [*Lucilia (Phaenicia) sericata* (Meigen), *Phormia regina* (Meigen), *Protophormia terraenovae* Robineau-Desvoidy and *Calliphora vomitoria* (L.)]; flesh flies (Sarcophagidae *Liopygia argyrostoma* Robineau-Desvoidy); and skipper flies (Piophilidae) [*Stearibia nigriceps* (Meigen) and *Piophila casei* (L.)].

A. rufifacies is one of the most common species of blow flies found on dead bodies, often arriving within 10 minutes of death (Goff, 2000). In our case our estimate fell within the 3-5 days estimation developed in conjunction with other forensically relevant information. However, in similar circumstances of concealed death scenes, such as wrapping, delay in the arrival of flies to oviposit may be encountered. Voss *et al* (2008) determined blow fly colonization of vertebrate carrion was delayed within a car by 24-28 hours. Research in Malaysia found wrapping monkey carcasses (macaques) in rice sacks (made from plastic mesh) delayed the arrival of forensically important flies by 1 to 13 days depending on species (Ahmad *et al*, 2011). It was also reported in Malaysia that in an enclosed environment, fly arrival may be delayed by 1-3 days (Nazni *et al*, 2011). More research is needed to explore the insect arrival and oviposition in a vehicle death scene, so the most accurate estimate of minPMI can be made.

Our finding support a previous study that both *C. megacephala* and *A. rufifacies* are flies commonly associated with human death scenes both inside human dwellings and in open environments in urban, suburban, rural and high elevation areas in Thailand (Sukontason *et al*, 2007). This is also similar to forensic cases reported from Malaysia (Cheong *et al*, 1973; Lee *et al*, 2004; Kumara *et al*, 2012; Kavitha *et al*,

2013), Taiwan (Shiao and Yeh, 2008), Hawaii in the USA (Goff and Odom, 1987; Goff *et al*, 1988), and Colombia (Barreto *et al*, 2002). In Panama, both these species of blow flies are found along with *Cochliomyia macellaria* (Fabricius) from human remains (Sergio Bermudez and Pachar, 2010). These findings are also similar to a report from Chiang Mai, Thailand (Ngoen-klan *et al*, 2011). In Nakhon Sawan Province, Thailand, *A. rufifacies* was the most abundant species found on chicken remains and *C. megacephala* was the second most abundant (Dr Kittikhun Moophayak, unpublished).

This case demonstrates more than one species can colonize human remains concurrently in Thailand (Table 1). This finding is similar to reports from Malaysia (Lee *et al*, 2004; Kumara *et al*, 2012) and Panama (Sergio Bermudez and Pachar, 2010). Therefore, it is recommended investigators not assume single species occurrence. Care should be taken to identify all larvae sampled from human remains. This approach is important since different species may develop at different rates. If larvae are incorrectly assumed to be a single species, the estimate of the minPMI could be less accurate.

ACKNOWLEDGEMENTS

This work was supported by the Thailand Research Fund (RSA5580010 to KLS). The authors are grateful to the Faculty of Medicine and Chiang Mai University for defraying the publication cost.

REFERENCES

- Ahmad A, Ahmad AH, Dieng H, *et al*. Cadavers wrapping and arrival performance of adult flies in an oil palm plantation in northern Peninsular Malaysia. *J Med Entomol* 2011; 48: 1236-46.

- Anderson GS. Insect succession on carrion and its relationship to determining time of death. In: Byrd JH, Castner JL, eds. *Forensic entomology: the utility of arthropods in legal investigations*. Boca Raton: CRC Press, 2001: 143-75.
- Barreto M, Burbano ME, Barreto P. Flies (Calliphoridae, Muscidae) and beetles (Silphidae) from human cadavers in Cali, Colombia. *Mem Inst Oswaldo Cruz* 2002; 97: 137-8.
- Cheong WH, Mahadevan S, Inder SK. Three species of fly maggots found on a corpse. *Southeast Asian J Trop Med Public Health* 1973; 4: 281.
- Goff ML. A fly for the prosecution: how insect evidence helps solve crimes. Cambridge: Harvard University Press, 2000.
- Goff ML, Odom CB. Forensic entomology in the Hawaiian Islands. Three case studies. *Am J Forensic Med Pathol* 1987; 8: 45-50.
- Goff ML, Omori AI, Gunatilake K. Estimation of postmortem interval by arthropod succession. Three case studies from the Hawaiian Islands. *Am J Forensic Med Pathol* 1988; 9: 220-5.
- Hitosugi M, Chigusa Y, Ishii K, et al. Estimation of the postmortem interval of the cadaver placed in a car with the growth of fly larvae. *Acta Criminol Med Leg Jap* 2007; 73: 31-5.
- Kavitha R, Nazni WA, Tan TC, Lee HL, Azirun MS. Review of forensically important entomological specimens collected from human cadavers in Malaysia (2005-2010). *J Forensic Legal Med* 2013; 20: 480-2.
- Kumara TK, Disney RHL, Abu Hassan A, et al. Occurrence of oriental flies associated with indoor and outdoor human remains in the tropical climate of north Malaysia. *J Vector Ecol* 2012; 37: 62-8.
- Lee HL, Krishnasamy M, Abdullah AG, Jeffrey J. Review of forensically important entomological specimens in the period of 1972-2002. *Trop Biomed* 2004; (Suppl): 69-75.
- Nazni WA, Chen CD, Heo CC, et al. Comparative insect fauna succession on indoor and outdoor monkey carrions in a semi-forested area in Selangor, Malaysia and implication on forensic entomology. *Asian Pacific J Trop Biomed* 2011; 1:S232-8.
- Ngoen-klan R, Moophayak K, Klong-klaew T, et al. Do climatic and physical factors affect populations of the blow fly *Chrysomya megacephala* and house fly *Musca domestica*? *Parasitol Res* 2011; 109: 1279-92.
- Sergio Bermudez C, Pachar JV. Arthropods associated with human corpses in Panama City, Panama. *Rev Colomb Entomol* 2010; 36: 86-9.
- Shiao SF, Yeh TC. Larval competition of *Chrysomya megacephala* and *Chrysomya rufifacies* (Diptera: Calliphoridae): behavior and ecological studies of two blow fly species of forensic significance. *J Med Entomol* 2008; 45: 785-99.
- Sritavanich N, Jamjanya T, Chamsuwan A, Hanboonsong Y. Biology of hairy maggot blow fly, *Chrysomya rufifacies* and its application in forensic medicine. *KKU Res J* 2009; 9: 10-5 (in Thai with English abstract).
- Sukontason K, Narongchai P, Kanchai C, et al. Forensic entomology cases in Thailand: a review of cases from 2000 to 2006. *Parasitol Res* 2007; 101: 1417-23.
- Voss SC, Forbes SL, Dadour IR. Decomposition and insect succession on cadavers inside a vehicle environment. *Forensic Sci Med Pathol* 2008; 4: 22-32.
- Williams RE. Case histories of the use of insects in investigations. In: Haskell NH, Williams RE, eds. *Entomology and death: a procedural guide*. Clemson: East Park Printing, 2008: 10-39.