Tropical Biomedicine 29(1): 107–112 (2012)

Case Report

An occurrence of *Synthesiomyia nudiseta* (Wulp) (Diptera: Muscidae) from a human corpse in a high-rise building in Malaysia: A case report

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Received 14 July 2011; received revised form 18 October 2011; accepted 20 October 2011

Abstract. This is the first report of *Synthesiomyia nudiseta* (Wulp) (Diptera: Muscidae) on a human corpse discovered in a high-rise building in Malaysia. On 5 March 2008, a decomposing body of an adult female was found on the top floor of a thirteen-story building in Kuala Lumpur, Malaysia. Her body was colonized by *S. nudiseta* larvae, which were normally associated with corpses found indoors at ground level. The post-mortem interval (PMI) was estimated at approximately 5 to 9 days. This case is significant as it demonstrates that this species can locate a dead body even in a high-rise building. Further findings of fly distribution especially in high-rise buildings should be reported to assist entomologists in PMI analysis.

INTRODUCTION

The distributions of flies are not only confined to ground levels but can also be found at higher altitudes. Study done by Omar *et al.* (2003) on blow flies (Diptera: Calliphoridae) demonstrated they could be found up to the fourth floor of a building in Malaysia. In Australia, Norris (1965) also recorded a number of flies at a rooftop of 26-meter building. They also found that the fly density decreased with increasing level of the building, and that certain species of flies were restricted to certain elevations. The above findings highlighted the importance of a better understanding of fly behaviour and distribution in forensic investigations, especially when deaths occur in high-rise buildings.

Case History

On 5 March 2008, the body of an adult female was found at the top floor of a thirteen-story building (approximately 40-meter height) in Cheras, Kuala Lumpur, Malaysia (3.10°N, 101.73°E) (Fig. 1A). Prior to the discovery, police were called to investigate a foul odour emanating from an elevator in the building. The odour originated from the secured top floor which accommodated an air-condition maintenance room and an elevator engine motor. It was an enclosed area, with small

gaps between the wall and the roof (which were suspected to be the only means for the flies to enter the top floor).

The body was found face-down, approximately two meters from the elevator engine motor. Body fluid had pooled around the corpse as a result of decomposition process (Fig. 1B). A post-mortem examination of the remains was done on the subsequent day at 1030 hrs. Examination concluded the remains were moderately decomposed. Larvae were infesting around the neck region (Fig. 1C) but no suspicious injury was seen on the body. Post-mortem examination showed the cause of death was due to pelvic injury sustained from an accidental fall. Follow-up of the case indicated that the decedent had been missing approximately 12 days prior to the time of discovery. She was a psychiatric patient on treatment and did not return home following her usual weekly appointment at hospital.

Climatological data, including maximum and minimum temperatures and relative humidity were obtained from a government weather station located a short distance from where the corpse was found. The minimum and maximum temperatures within eight days prior to the corpse discovery were 22ºC and 33ºC, respectively, with an average relative humidity of 80%. We further monitored the temperature in the room where the remains were discovered for 30 days by placing thermohygrometer EL-USB-2-Data Logger (LASCAR Electronics, UK) at the death scene and we found that the average temperature was 29.6 ± 1.3ºC.

Larval specimens were collected by the attending pathologist based on the method described by Smith (1986) and Catts & Haskell (1990). A sample of the live larvae were cultured on beef liver provided *ad libitum* in plastic containers measuring 10cm x 10cm x 6cm, while some of the larvae were preserved in glass vials containing 70% alcohol. Both live and preserved specimens were kept in the room (approximately 28ºC) before sending to Forensic Entomology Laboratory for post mortem interval (PMI) analysis. In the laboratory, the preserved larvae samples were prepared according to the method described by Omar *et al.* (1994). The instar and species of the larvae were subsequently observed under light microscope for identification based on the identification keys of Ishijima (1967). Documentation of maggots' length, stage and species was conducted by using Leica EZ4D digital microscope fitted with digital camera and LAS Version 2.8.1 computer software (Leica, Switzerland). For live specimens, the wandering larvae were transferred into another similar-sized containers with sawdust

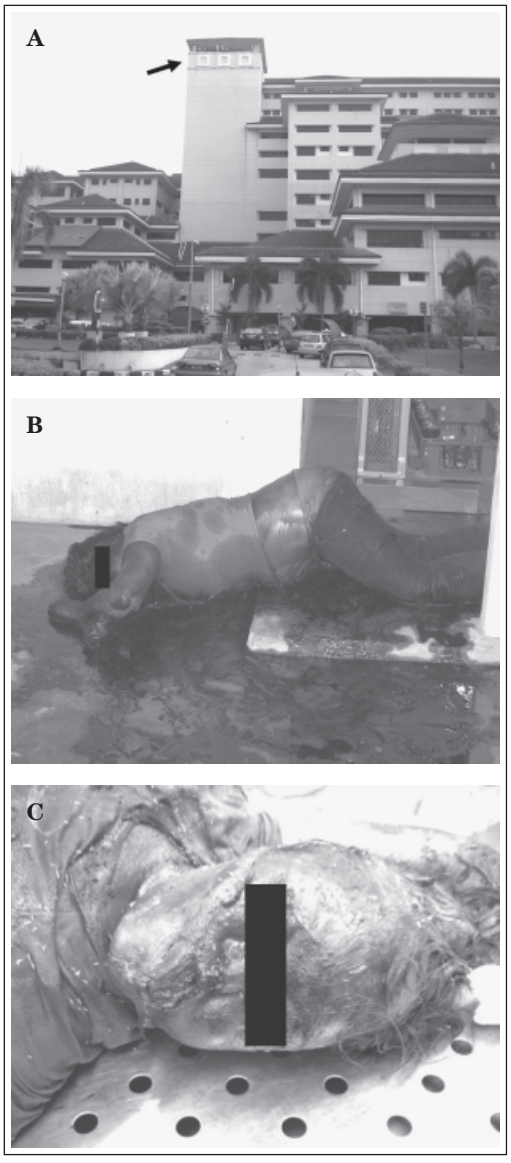

Figure 1. (**A**) Location where the corpse was found (arrow). (**B**) Position of the corpse at the scene. (**C**) Presence of maggots observed during autopsy

filling approximately a ¼ of the container. The containers were kept in an incubator at 28 ± 1ºC, RH 70-85%, photoperiod (L:D)(h) 12:12. The development of the larvae was monitored and the adult flies that subsequently emerged were later pinned for identification and confirmation of larval species based on the identification keys of Tumrasvin & Shinonaga (1982).

Examination of the fly larvae revealed the presence of third-instar larvae from a single species. Under light microscope, it was observed that a pair of posterior spiracles was pronounced (Fig. 2A). Each spiracle had a complete peritreme and contained three 'S-shaped' slits which radiated from a prominent button. At the anterior end, the cephalopharyngeal skeleton was observed with a strong hook, equipped with an accessory sclerite placed beneath the hook (Fig. 2B). The anterior spiracle was composed of six papilae arranged in a single row (Fig. 2D).

As for reared specimen, pupa formation was observed on 12 March 2008 while adult emergence was on 20 March 2008. The analysis of both preserved and reared specimens revealed that the corpse was exclusively colonized by the muscid fly *Synthesiomyia nudiseta* (Wulp) (Diptera: Muscidae). Based on the climatic conditions and knowledge of the complete life cycle of this species (Rabinovich, 1970), it was estimated that the body was likely colonized approximately 5 to 9 days prior to discovery.

DISCUSSION

The fly larvae collected from this corpse were identified morphologically as *S. nudiseta*. Findings also showed that live

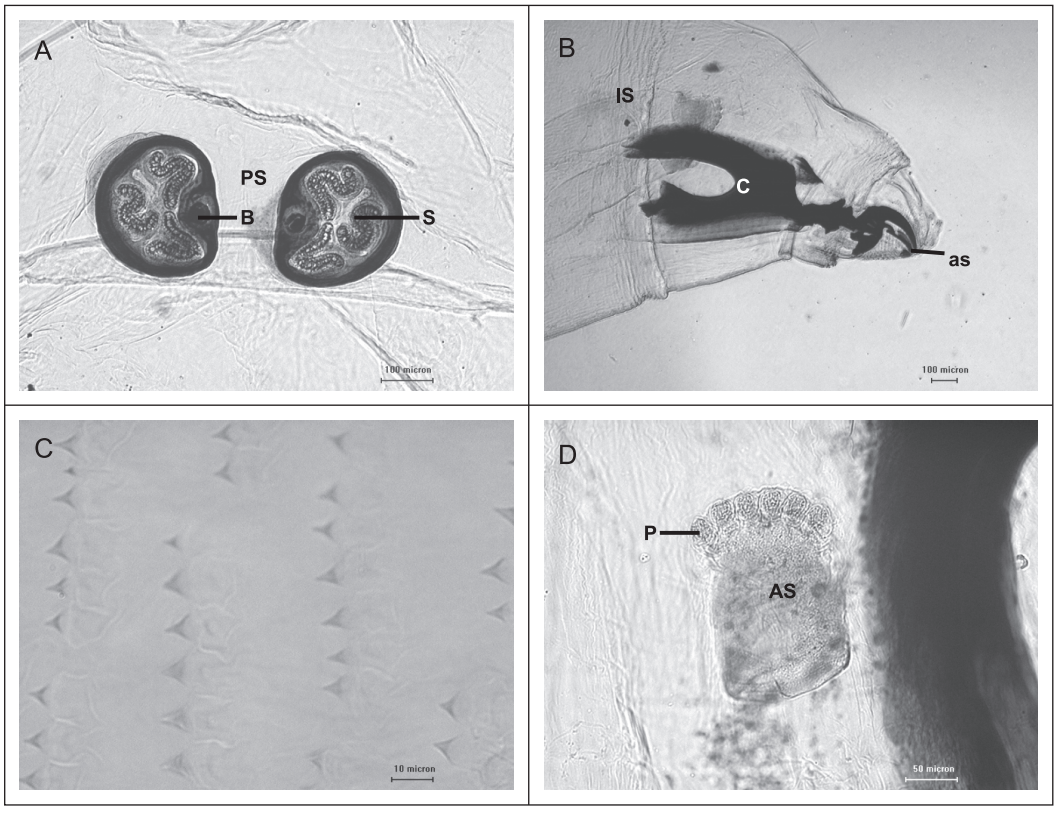

Figure 2. Important taxonomic characters of third instar larva of *S. nudiseta*. **(A)** Posterior part showing posterior spiracles with three S-shaped spiracular slits *(S)* and apparent buttons *(B)* with complete peritreme. **(B)** Anterior part showing intersegmental spines *(IS)*, cephalopharyngeal skeleton *(C)* and accessory sclerite (as). **(C)** Intersegmental spines grouped in a row, each showing triangular shape with a pointed tip. **(D)** Anterior spiracle with six papillae arranged in a single row

larvae which were reared to adulthood also confirmed to be of the same species. *Synthesiomyia nudiseta* is an uncommon species, and was known to be easily attracted to putrid meat (Von Emden, 1965), suggesting the possibility that it is a latecomer species associated with the decompositional stage of corpse (Omar *et al.*, 1994).

Omar *et al.* (1994) reported the first record of *S. nudiseta* in Malaysia and its involvement in decomposing corpses inside buildings. It was found that in one case, larval specimens of *S. nudiseta* were observed on a partially immersed body in the basement of a high-rise building. Whereas in the other four cases, larval specimens were collected from the victims of a collapsed condominium at Kuala Lumpur. The occurrences of this species on human corpses in indoor death scenes were further recorded by several authors as had been reported in Malaysia (Nor Afandy *et al.*, 2003; Lee *et al.*, 2004; Ahmad *et al.*, 2007; Kumara *et al.*, 2009) and Thailand (Sukontason *et al.*, 2007).

Albeit larval stages of *S. nudiseta* are commonly found on corpses indoors, several studies in other regions indicated that artificial media such as fish baits (D'almeida 1994), decomposing beef liver (Oliveira *et al.*, 2002), and carrions sources, such as rabbits (Tantawi *et al.*, 1996; Calderon-Arguedas *et al.*, 2005; de Souza *et al.*, 2008) and laboratory rats (Rabinovich, 1970) were capable of attracting this species in various outdoor habitats. In addition, a study conducted by Nazni *et al.* (2007) on fly distribution in Putrajaya, Malaysia showed that the adults of *S. nudiseta* could be caught using outdoor fly trap placed near to human premises, thus exhibiting eusynanthropic character of this fly species.

PMI for this case was estimated based on the complete life cycle of *S. nudiseta*. Given that no study had been reported on the larval development of this species in Malaysia before the year 2008, data from Rabinovich (1970) was used. Rabinovich (1970) indicated that at 28 ± 1°C, RH 90%, the duration of the immature stage (eggs until pupae) was 9.6 ± 1.6 days while the pupation period (pupal stage until emergence) was 8.2 ± 0.5 days. Thus, the total time taken from eggs till adult emergence was 17.8 ± 2.1 days. Based on the date of pupation and emergence of adults in this case were on 12 March 2008 and 20 March 2008 respectively, egg deposition could have occurred between 29 February 2008 and 4 March 2008. Considering that this species might be attracted to corpses that were already putrid (Omar *et al.*, 1994), an additional four days of pre-colonization period (Tomberlin *et al.*, 2011) were added into calculation. Therefore, the estimated PMI was 5 to 9 days from the date of specimen collected, indicating that the death could have occurred between 25 February 2008 and 29 February 2008. Based on evaluation of post mortem changes, this estimation was in agreement with the conclusions drawn by the forensic pathologist who reported that the PMI was estimated to be between 5 to 10 days.

However, there was a conflicting opinion with a recent study on developmental time of *S. nudiseta* in Malaysia. Kumara *et al.* (2009) reported shorter developmental time at 28.5 ± 1.5°C and 67 to 85% RH which took approximately 322 ± 19 hours (13.4 + 0.8 days) from eggs until adult emergence. If our findings were to be compared with this developmental study result, oviposition would have possibly occurred between 7 March to 9 March 2008 based on adult emergence on 20 March 2008. This was very unlikely to occur since the dead body was discovered on 5 March 2008 already being colonized by L3 larvae of *S. nudiseta*. This inconsistency between our findings and developmental duration of *S. nudiseta* could be probably due to several variations such as fluctuating environmental temperatures (Niederegger *et al.*, 2011) and rearing methodology in the laboratory (Kaneshrajah & Turner, 2004; Ireland & Turner, 2006).

Knowledge of biology and behaviour of forensically important flies is important for interpretation of entomological evidence collected from death investigations cases. Such data will allow entomologists to make informed PMI estimations. In this particular scenario, distribution records of insect species at high elevation is important, given the emergence of more high-rise buildings

in Kuala Lumpur. The information obtained could be very useful in forensic investigations for the determination of death intervals of bodies found at high elevation.

This case is reported for its rarity. Compared to other previous cases where occurrence is at a ground level, this is the first report of *S. nudiseta* associated with a human corpse in a high-rise building in Malaysia, if not the world. However, literature regarding forensic entomology cases from high-rise building is sparse. Whether the presence of this species on corpse at high elevation is due to the fly behaviour or is merely a coincidence, is worthy of further investigation.

Acknowledgement. The authors thank the Head of Department, Parasitology & Medical Entomology, Faculty of Medicine, UKM for providing research facilities. We also would like to thank Forensic Unit, UKM Medical Centre for providing the entomological specimens. Thanks are also due to Malaysia Meteorological Department for providing climatological data of the government weather station. Special thanks to the anonymous reviewer/s for improving the manuscript. The publication of this article is funded by the research grant UKM-FF-03-FRGS0001-2009.

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