

Research Note

The colonization of carrion by soldier fly, *Ptecticus melanurus* (Walker) (Diptera: Stratiomyidae) in a tropical forest in Malaysia: A new potential species for minimum PMI estimation

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Abstract. This paper discusses the colonization of the stratiomyid species *Ptecticus melanurus* (Walker) (Diptera: Stratiomyidae) in monkey carrion and its potential for the determination of the minimum time since death (PMI). A study was conducted in a tropical forest at Bangi, Malaysia from 13 November 2009 to 8 June 2011. Twelve monkey carcasses (*Macaca fascicularis* Raffles) were used and divided in equal number into three different field trials. Adults of *P. melanurus* were first observed on monkey carrions on the second day the carcasses were placed in the field while their penultimate instar larvae were found in the wet soil under and beside carcass from day 8 to 31 days postmortem.

The estimation of the minimum postmortem interval (PMI) of decomposing remains can sometimes be facilitated by the examination of arthropod evidence collected at crime scene or during autopsy. A diversity of species might be found during an investigation although the blowflies (Diptera: Calliphoridae) are most commonly used to calculate the minimum time since death (PMI). The larvae of soldier flies (Diptera: Stratiomyidae) are also associated with dead bodies and forensically important. For instance, the larvae of *Hermetia illucens* (L.) have been used in forensic investigations in the United States (Lord *et al.*, 1994), Brazil (Pujol-Luz *et al.*, 2008), Italy (Turchetto *et al.*, 2001) and Spain (Martínez-Sánchez *et al.*, 2011).

The Stratiomyidae contains over 2,650 species distributed throughout the world (Woodley, 2001). Adult flies can be

distinguished by their flat appearance and small discal cell of the wing and many species have a metallic luster and bright colours and this is why they are often known as 'soldier flies'. *Ptecticus* Loew is stratiomyid genus consisting of more than 40 known species and 12 Malaysian species were described by Rozkosny & Kovac (1996). *Ptecticus melanurus* belongs to Sarginae subfamily and characterized by a yellow thorax, black abdominal tip beginning from the fifth segment and a dark wing apex reaching the discal cell (Rozkosny & Hauser, 2009). However, *H. illucens* larvae look identical to *P. melanurus* and both could be present on the same decomposing dead body or carrion. Therefore, it is possible that an investigation might assume the later species as *H. illucens*. In addition, they might have different developmental rate and thus can lead one to make error in estimating a

minimum PMI. This study reports on the *P. melanurus* adults and their penultimate larvae in decomposing of monkey carcasses in a tropical forest in Malaysia.

The study was conducted at Universiti Kebangsaan Malaysia, Bangi Campus (9°N, 101.8°E, at an altitude 42m above sea level) which is located in a forested area with little human activities. Twelve monkeys were provided by Department of Wildlife and National Parks, Federal Territory of Malaysia (PERHILITAN) (mean weight: 5.54±0.88kg). Monkeys were euthanized by intravenous injection of sodium pentobarbital (Dorminal®) and thus fulfilled the animal ethic guidelines as approved by the Animal Ethic Committee, Faculty of Medicine, Universiti Kebangsaan Malaysia. The study was split into three trials with four monkeys each and numbered as 1M1 to 1M4 in the first trial, 2M1 to 2M4 in the second trial and 3M1 to 3M4 in the third trial. To protect from scavengers, wire meshed cages (30 inch x 30 inch x 30 inch) were staked at four inches into the ground surrounding the carcasses.

Three sampling methods were practiced in this study: aerial net, hand collection and pitfall traps. Pitfall traps were made from three different sizes of plastic containers followed a design by Morrill (1975). Two pitfall traps were set up at dorsal and ventral position of carcass at a distance of 30mm from carcass body. The aerial netting targeted stratiomyid adults while hand collection (including taking soil sample underneath carcass) and pitfall trap were applicable to sample stratiomyid larvae. Stratiomyid adults were sampled by 10 aerial net sweeps above and around the carcasses. Thirty minutes were allocated at every carcass for observation, hand collection and pitfall trap collection. During the study period, the sampling frequency was as follows: every 24 hr at 3 pm during the first 14d; every 48 hr interval during the following 8d and every 72 hr interval onwards. Stratiomyid larvae specimens collected were split into two sets. The first set was for live specimens (which were collected by hand) were reared to adults in top-ventilated plastic containers filled with commercial sawdust and a portion of wet soil and decomposing tissues (both obtained

from carcass to maintain natural condition). Emerged adults were killed and pinned for identification. Adult specimens were identified to species following key by Rozkosny & Hauser (2009) and also sent to the author for species confirmation. Larvae in the second set (in the pitfall) were preserved in 70% ethyl alcohol for future reference.

Mean temperature in the field trial one, two and three were 25.60°C(±0.64), 24.63°C(±0.55), 25.81°C(±1.08) respectively while relative humidity (Rh) were 94.61%(±3.07), 96.75%(±3.11), 95.57%(±9.74) respectively. In the study, one monkey carcass (3M2) in the experiment three was scavenged by a monitor lizard (*Varanus salvator* Laurenti) therefore no data were available for this carcass. Five decomposition stages were recognized namely fresh, bloated, decay, postdecay and remains stage as described by Tullis & Goff (1987). Throughout our study, 50 adults *P. melanurus* were collected and the earliest arrival recorded was on day two (during bloated stage) and they were observed mating on the same day (Table 1). However, adults were more apparent during postdecay and remains stage (Table 1). Arrival time of the species was considered earlier compared to its relative, *H. illucens* which was reported arrived on carcass on day six after carcass placement (Azwandi & Abu Hassan, 2009). According to Sheppard *et al.* (2002), adult *H. illucens* tolerate a wide range of temperature and can mate and oviposit at temperature ranges from 24°C to 40°C: which is within our temperature range. In South Georgia USA, Tomberlin *et al.* (2005) reported *H. illucens* oviposited on pig carcasses six days after they were placed in the field.

All the stratiomyid larvae collected from monkey carrion were *P. melanurus* species at the penultimate stage of development and approximately 17 mm in length. Larvae of penultimate instar are easily recognized by their size and well-developed mandibular maxillary complex. In the present study, the time of oviposition was unpredictable and eggs and early larval instars were not found. In our study, penultimate larvae were first observed on day eight (in carcass 1M2) and

Table 1. Adult and penultimate instar larvae of *P. melanurus* occurrence in monkey carcasses

Field Trial	Carcass	Stage	Fresh			Bloated			Decay			Postdecay					Remains						
			0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	22	25	28
1	1M1	A				*							*	*		*	*	*	*	*			
		L																			*	*	*
	1M2	A											*	*		*	*	*	*	*	*	*	*
		L												*	*		*	*	*	*	*	*	*
	1M3	A											*	*		*	*	*	*	*	*	*	*
		L												*	*		*	*	*	*	*	*	*
	1M4	A																			*	*	*
		L																			*	*	*
2	2M1	A													*								
		L																			*	*	*
	2M2	A					*				*	*			*				*	*	*	*	*
		L									*	*			*			*	*	*	*	*	*
	2M3	A			*					*	*			*	*	*	*	*	*	*	*	*	*
		L								*	*			*	*	*	*	*	*	*	*	*	*
	2M4	A						*						*		*			*	*	*	*	*
		L												*		*			*	*	*	*	*
3	3M1	A							*				*			*		*	*	*	*	*	*
		L											*			*		*	*	*	*	*	*
	3M3	A			*								*	*		*		*	*	*	*	*	*
		L											*	*		*		*	*	*	*	*	*
	3M4	A															*	*	*	*	*	*	*
		L															*	*	*	*	*	*	*

* indicate "presence", A refers to adult stage while L refers to larvae at penultimate stage

this would indicate that they developed from eggs laid on or around the corpses whilst these were still in the bloat or early decay stage of decomposition. The penultimate larvae were found in wet soil under and beside carcasses, concurrent with third instar *Hydrotaea spinigera* Stein (Diptera: Muscidae) larvae. *Ptecticus melanurus* penultimate larvae were more apparent in remains stage (from day 12 to 31), which were observed in six out of eleven monkey carcasses and some larvae were found buried in soil (Table 1). In relation to decomposition, Reed (1958) found *Ptecticus* sp. larvae colonized during dried phase of carcass decomposition.

Even though this finding is preliminary and *P. melanurus* has never been reported in human cadaver in Malaysia, the occurrence of this species in carrion could indicate the possibility of the species infesting human corpse and signified a potential of the species in future forensic investigation. It is recommended that developmental study of *P. melanurus* be carried out to illuminate its life cycle in the field and laboratory which could be beneficial in future minimum PMI estimation.

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