PRELIMINARY SURVEY OF DUNG BEETLE DIVERSITY IN KRAU WILDLIFE RESERVE, PAHANG, MALAYSIA

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ABSTRACT

A preliminary survey of dung beetle diversity was conducted in the area surrounding the Kuala Lompat Field Station in the Krau Wildlife Reserve. Pitfall traps baited with rotten fish, human dung and dead millipedes were placed along the main trial for 24 hours. Rat carcasses were also placed along the trail to observe the succession pattern of dung beetles on small mammal carcasses in the rainforest. A total of 236 individuals from 20 species were captured in the 4.5 day sampling period. The species accumulation curve did not reach the asymptote, indicating that more intensive sampling is required for a conclusive study of dung beetle fauna in this location. As with other rainforests surveyed, *Onthophagus semifex* was the dominant species. Large rollers such as *Paragymnopleurus* were more common than large tunnelers, which were composed of only *Synapsis* and *Copris* species. Dung beetles were most attracted to carcasses in the decay stage, although some arrived at the fresh carcass. Some beetles were attracted to dead millipedes in spite the presence of other bait types, possibly some species have adapted to exploiting this resource.

Keywords: Scarabaeinae, Dung Beetles, *Onthophagus,* Species composition, Primary forest

INTRODUCTION

Dung beetles are amongst the most diverse group of animals in the world (Cambefort and Hanski, 1991). These beetles play and important role in the regulation of ecosystem functions such as nutrient cycling and soil aeration (Nichols *et al.*, 2008). Dung beetle diversity in Sundaland has been sporadically documented, with studies being conducted in Borneo (Hanski, 1983; Davis *et al.*, 2001), Thailand (Boonrotpong *et al*., 2004), Sulawesi (Hanski and Niemela, 1989) and Java (Kahono and Setiadi, 2007). Peninsular Malaysia remains poorly sampled, with only a few studies concerning the ecology of dung beetles being published (Lee *et al.*, 2009). As dung beetle communities are believe to be a good indicator for the health of a habitat, sampling a primary forest such as Krau Wildlife Reserve will provide invaluable information on the diversity and structure of a relatively undisturbed dung beetle community. A preliminary survey of the dung beetle community was conducted in the area surrounding the Kuala Lompat Field Station.

METHODOLOGY

Collection

Trapping was carried out at 50m intervals along the main trail of the Kuala Lompat Field Station (3°43′N, 102°10′E), in the Krau Wildlife Reserve, Pahang. A total of four trapping stations were set up

and 4 pitfall traps with an opening of 12cm were placed at each station. Trapping was conducted for four and a half days. The traps were filled with a concentrated salt solution and bait was suspended about the trap. Different baits were placed together at each trapping station to test the feeding preferences of each species. The baits used were rotten fish, dead millipedes and human dung. All baiting stations had two traps baited with rotten fish, while only one station was baited with dung and millipedes because of the lack of availability of other baits. The traps were checked at 0800 and 1800 every day to determine the activity period of some of the species.

Additionally, rat carcasses that were euthanized for parasitical research were placed in the forest and checked at similar intervals as the traps. The part of the carcasses that was in contact with the ground was examined for necrophagus beetle species.

Analysis

Species were identified using a reference collection of specimens at the Museum of Zoology, University of Malaya. Species that could not be matched to a reference specimen were classified into Recognisable Taxonomic Units (RTUs).

A Species Accumulation curve was constructed using the vegan package (Oksanen *et al.*, 2013) in R ver.2.15.3 (R Development core team, 2013) to ascertain if the sampling effort was sufficient.

RESULTS AND DISCUSSION

A total of 204 individuals from 18 species were collected from the pitfall traps over the period of 4.5 days (Table 1). The most common species was *Onthophagus semifex*, which was caught exclusively in fish baited traps. This supports the current hypothesis that this is a specialized necrophagus species. The larger number collected could have been due to bias as there were more fish baited traps than dung baited traps.

O. babirusoides was the second most common species, mainly collected from dung baited traps and occurring sporadically in fish baited traps where a corresponding dung baited trap was not present. This indicates that while preferring dung, this species appears to opportunistically feed on carrion. Boonrotpong *et al.* (2004), which used only dung baited traps, reported this species to be common in primary and secondary forests.

Some species, such as *Ochicanthon* sp., *Onthophagus* cf. *"babirusa* group" sp. Br and *O. rudis* selected traps baited with dead millipedes despite the presence of traps baited with rotting fish. Previously only *O. penicillatus* and *O. rudis* have been recorded to be attracted to defensive secretions of giant millipede (Brühl and Krell, 2003). This suggests that arthropod carcasses may possibly be utilized as an alternative food source by necrophagus dung beetles.

Large rollers such as *Paragymnopleurus* were common in both fish and dung baited traps while small rollers tended to be attracted to dung baited traps. These beetles are regularly found in both primary and secondary forests (Boonrotpong *et al.*, 2004).

Conversely large tunnelers such as *Synapsis* were rare and only visited dung baited traps. Several species that are thought of as very common were rare or non-existent during this survey. *Catharsius mollusus*, a large tunneler that is widely found across South East Asia (Cambefort and Hanski, 1991), was not present. Only three individuals of *Phaeochroops*, a common necrophagus secondary forest

species, were collected from a rat carcass. Large numbers of these genera are reported to occur in Borneo (Hanski, 1983) and other parts of South East Asia (Kuijten, 1981). As these species have been collected using similar methods before (Goh, T.G., Unpublished data), this curious absence may have been due to the limited sampling time or some unknown ecological reason.

Table 1. Abundance of beetles collected from baited traps. Bait type: D = Dung, F =Rotten Fish, M = Millipede. Active period: Un = Uncertain, Di = Diurnal, No = Nocturnal.

Species	Day					Total	Bait type:	Active period:
	1	2	3	4	5			
Copris doriae		1	1			2	D	Un
Cp. haroldi			1	1		2	FD	Un
Cp. ramosciceps	1		3			4	FD	Di/No
Onthophagus babirusoides	6	3	12	12	1	43	FD	Di
O. egregious			2			2	D	Di
O. cf. pacificus	2		2	1	2	7	F	Di
O. peninsulocupreus		1				1	F	Di
O. rudis	1	1	2			4	FM	Di
O. semifex	28	9	6	1	5	58	F	Di
O. vulpes		4	3	2	3	12	FD	Di
Onthophagus cf."babirusa group"Sp.A					1	1	D	Un
Onthophagus sp. BH				1		1	D	Di
Onthophagus cf. "babirusa group"Sp. Br			1			1	M	Un
Ochicanthon	7	2		2	1	12	FDM	Di
Paragymnopleurus maurus	2	1	3	5	1	12	FD	Un
Paragymnopleurus striatus	9	3	4			16	FD	Un
Sisyphus thoracicus		1	8	1	3	22	FD	Di
Synapsis sp.			1	3		4	D	No

In terms of diel activity, most species that responded to fish baited traps and rat carcasses were found to be active during daytime (Table 2). Additionally dung feeding species such as *O. babirusoides* and *O. vulpes* were found to be still alive when the traps were checked at 1800. One *Copris ramosciceps* was collected from a carcass at 0900, indicating that this species may be active in daytime. This contradicts Cambefort and Hanski (1991) which noted that *Copris* are the dominant nocturnal coprophages in South East Asia, but the results from this study in regards of *Copris* are inconclusive.

Succession on rat carcasses showed that fresh carcasses attracted dung specialist beetles such as *P. maurus*, *O. vulpes* and *O.* cf. *pacificus*. The decaying carcass tended to attract carrion specialists such as *O. semifex*, *O. egregious* and *O. rudis*. Large numbers of *Phaeochroops* and Silphidae were absent from the carcass, a result that was different from previously conducted succession studies on monkeys in secondary forests (Nazni *et al*. 2011).

The asymptote of the species accumulation curve (Figure 1) was not reached during this sampling period, indicating that a much longer sampling period would be necessary to properly survey the diversity of this area.

It is obvious from this study that current knowledge on dung beetle ecology in South East Asia is limited and fragmented. More comprehensive surveys of dung beetle diversity in Krau Wildlife Reserve in the future may aid in creating a more comprehensive understanding of this important group of animals.

Table 2. Beetles collected during the decomposition of a rat carcass. Vertebrate scavengers ate the carcass after day 2.

Day	Day 0	Day 1	Day 2	Day 2
Stage	Fresh	Decay	Decay	Decay
Time	6pm	6pm	9am	6pm
Species	Abundance			
Copris ramosciceps			1	
Onthophagus babirusoides			1	1
O. egregious			1	2
O. cf. pacificus	1			
O. .rudis			1	2
O. semifex		7	1	2
O. vulpes	1			
Onthophagus sp. BH	3			
Paragymnopleurus maurus	2			

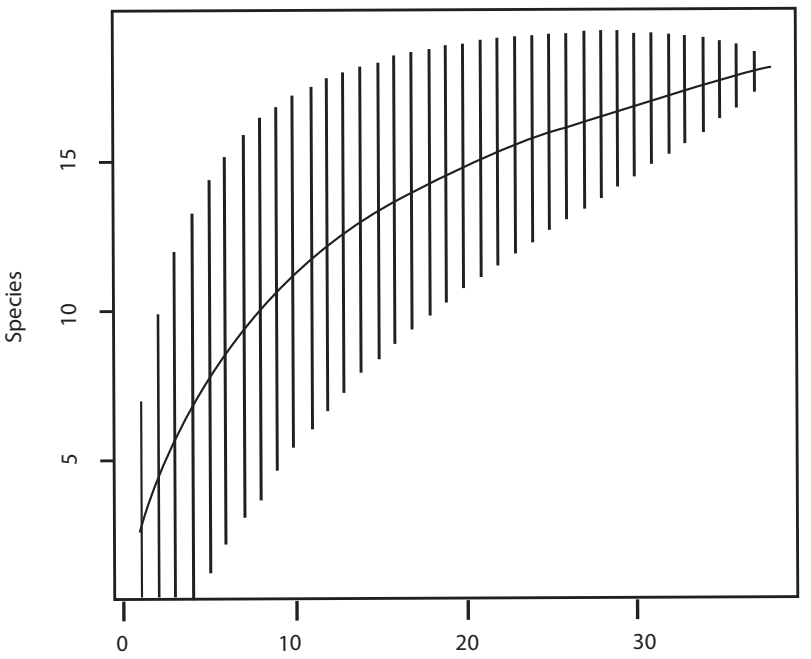

Figure 1. The species accumulation curve for 38 traps placed during the sampling period

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