BEETLES RECORDED TO VISIT ELEPHANT DUNG IN TEMENGGOR FOREST, MALAYSIA

Thary Gazi Goh*[1], Johannes Huijbregts[2], Hii Ning[3] & Ahimsa Campos-Arceiz[3]

[1]Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603, Kuala Lumpur, Malaysia
[2]National Museum of Natural History Naturalis, Postbus 9517, NL-2300 RA Leiden, The Netherlands
[3]School of Geography, University of Nottingham Malaysia Campus, Semenyih 43500, Selangor, Malaysia

**Corresponding author: u_loji@yahoo.com*

ABSTRACT

Little is known about the beetles associated with Elephant dung in the South East Asian region. Elephant dung was inspected for beetles by manually pulling apart dung present at elephant salt licks. Two sites were visited on 3 occasions and at least 20 piles of dung were inspected on each visit. 11 taxa of dung beetle were collected, *Copris numa*, *Cp. bellator*, *Cp. doriae*, *Copris sp., Heliocopris tyrannus, Liatongus femoratus*, *Paragymnopleurus maurus, Sisyphus thoracicus, Onthophagus mulleri*, *O. rutilans* and *Megatelus* sp. Most species were from the large tunnelers class in comparison to small tunnelers that tend to dominate other types of dung. While this is merely a preliminary sample, most of the species encountered have not been found in locations where elephants are absent. Larva of *Campsiura nigripennis*, a flower beetle was found to dwell inside the dung. The larvae were successfully bred to adulthood in elephant dung in laboratory conditions. Predatory Histeridae were found to also oviposit on the dung, in which the larvae preyed on other beetle and fly larva. One larva in a dung ball possibly belonging to *Paragymnopleurus* sp. was found. These observations match observations in tropical Africa, in which some large dung beetle species are dependent on elephant dung. It is possible that this beetle assemblage is similar and dependent on the presence of elephants or large herbivores.

Keywords: Dung Beetles, Asian Elephant, *Scarabaeidae*, *Scarabaeiinae*, *Cetoniinae*

INTRODUCTION

While there is much attention given to large charismatic animals like elephants, there is little focus on the smaller animals which may depend on them. Due to the current threats to large megafauna (Sukumar, 1992), it is vital to look at communities that are dependent on such large mammals for their survival. The loss or reduction of a single large mammal species may cause a collapse of communities which depend on them for shelter, food or breeding spaces (Hanski & Cambefort, 1991). Dung beetles which depend on large mammals perform various ecological functions and services such as nutrient cycling, soil aeration and secondary seed dispersal (Nichol *et al*., 2008). Perturbations to elephant populations will affect the dung beetle community that depends on it and this in turn will cause the loss of valuable ecosystem functions.

Much of the work that has been previously done on dung Beetle-Elephant association in tropical environments has been conducted in the Afrotropical region, mainly concerning forest dwelling African

Forest Elephants (*Loxodonta cyclotis*) (Cambefort & Walter, 1991). It was found that there were dung beetles that were dependent on elephant dung as opposed to dung from omnivores or other herbivores (Cambefort & Walter, 1991). The elephant dung dependent beetles tended to be from the Tribes Coprini and Oniticellini, which are usually associated with large mammals, while omnivorous dung tended to attract tribe Onthophagini, which has more varied feeding habits (Cambefort & Walter, 1991). Elephant dung provides a much different habitat to that of omnivore dung; it is more fibrous, contains less nutrients and tends to exist in excess due to the elephants being prolific defecators (Sukumar, 1992). It was found that while human dung placed in the field was almost always completely buried within a day, only 1/5th of elephant dung piles are buried (Cambefort & Walter, 1991).

In Peninsular Malaysia, trapping has been conducted using elephant dung collected from zoos in several sites (Doll *et al*., 2014). However, this study used only 10ml of dung per trap, which is a highly unrealistic amount for elephant dung in which a single bolus can be more than 500ml in volume and six to seven boli were usually found per pile in the field. This study recorded 41 species of dung beetles in Temenggor Forest Reserve.

METHODOLOGY

Elephant dung was inspected for beetles by manually pulling apart dung present at elephant salt licks. While the collection is not as reliable or unbiased as pitfall traps, manually collecting allows for collection of beetles that dig or dwell in the dung instead of trying to burrow underneath it. Two sites were visited on 3 occasions and at least 20 piles of dung were inspected on each visit. All the collection was done in the daytime.

Species were identified by comparing the specimens to existing collections in the Naturalis Biodiversity Center in Leiden, the Netherlands.

RESULTS AND DISCUSSION

11 taxa of dung beetle were collected – *Copris numa, Cp. bellator, Cp. doriae, Copris sp., Heliocopris tyrannus, Liatongus femoratus, Paragymnopleurus maurus , Sisyphus thoracicus, Onthophagus mulleri , O. rutilans* and *Megatelus* sp. (Table 1). Most species were from the large tunnelers class in comparison to small tunnelers that tend to dominate other types of dung. Most of the recovered beetles were found burrowing inside of the dung bolus or under the dung. Burrows could be seen in the soil below some of the older dung pats, indicating that beetles had fed on it. Previous collections in the Temenggor Forest Reserve also indicate a higher proportion of large Tunneler *Copris* species being present in this location (Doll *et al*., 2014).

While this is merely a preliminary sample, most of the species encountered have not been found in locations where elephants are absent. Several species collected are possibly new to science, with unknown *Copris* and *Megatelus* species found. These specimens were deposited in the Museum of Zoology, University of Malaya.

We discovered a single specimen of *Heliocopris tyrannus*, which is rarely found in modern collections from Peninsular Malaysia but quite common in older museum collections. This very large (58-64mm) species depends on the dung of large herbivores such as elephants. As historical collections have recorded the presence of this species as far south as Malacca, this probably indicates that it has declined in areas with widespread deforestation. A related species, *H. bucephalus*, is bred using water buffalo dung in northern Thailand (Leksawasdi, 2010).

One larva in a dung ball possibly belonging to *Paragymnopleurus* sp. was found, indicating that elephant dung is used for oviposition of some species. The dung ball was found inside of the dung pat, which is unusual for dung roller beetles. While the dung ball was collected, the beetle pupa did not survive until adulthood. Some adult *Copris numa* were collected alive and placed with elephant dung in captivity. However, instead of using the dung for oviposition they merely buried and fed on some of it.

Some Scarabaeied larvae were found in the dung, ranging from first to third instars. Seven larvae were successfully bred to adulthood in elephant dung under laboratory conditions (25°C, 0:24 light/dark ratio) and were identified as *Campsiura nigripennis,* a flower beetle from the Scarabaeidae subfamily Cetoniinae. The beetle larvae constructed ovoid cocoons roughly 30mm in height and 20mm in width out of the dung matrix for pupation and emerged a month later. *Campsiura* species have been recorded to use cow dung as a medium for oviposition and pupation (Yiu, 2010). Additionally, the African species *Campsiura trivittata* has been recorded to breed in African Forest Elephant dung (Lumaret & Cambefort, 1988).

Predatory Histerid adults and larvae were found to also oviposit on the dung, in which the larvae preyed on other beetle and fly larva. Several of the *C. nigripennis* larvae were attacked and eaten by Histerid larvae in both the larva and pupa stages. It is likely that Staphylinids found on the dung are predatory as well. In one waterlogged site where a hot spring was present, Hydrophilid beetles from the genus *Coelostoma* was found to aggregate in submerged dung piles. These beetles are likely not predacious, but merely feeding on the submerged portions of the dung pats.

These observations match observations in tropical Africa, in which some large dung beetle species are dependent on elephant dung. It is possible that this beetle assemblage is similar and dependent on the presence of elephants or large herbivores. However, a more complete study will have to be done before any reasonable conclusions can be made. Comparative studies could be conducted using other baits such as omnivorous dung and carrion. Additionally, long term sampling programs may shed light on the true diversity of dung beetles in Belum-Temenggor Forest Complex.

Table 1. Checklist of species collected from elephant dung in Temengor salt licks

Family	Tribe	Genus	Species	Feeding behavior
Scarabaeidae	Coprini	*Heliocopris*	*tyrannus*	Coprophage
	Coprini	*Copris*	*numa*	Coprophage
	Coprini	*Copris*	*bellator*	Coprophage
	Coprini	*Copris*	*doriae*	Coprophage
	Coprini	*Copris*	sp.	Coprophage
	Coprini	*Catharsius*	*molossus*	Coprophage
	Gymnopleurini	*Paragymnopleurus*	*maurus*	Coprophage
	Sisyphini	*Sisyphus*	*thoracicus*	Coprophage
	Onthophagini	*Onthophagus*	*mulleri*	Coprophage
	Onthophagini	*Onthophagus*	*rutilans*	Coprophage
	Oniticellini	*Liatongus*	*femoratus*	Coprophage
	Aphodini	*Megatelus*	sp.	Coprophage

Scarabaeidae (Cetoniinae) (Larva)	*Campsiura*	*nigripennis*	Coprophage
Histeridae			Predator
Staphylinidae			Predator
Hydrophilidae	*Coelostoma*	sp.	Coprophage
Tenebrionidae			Unknown

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