

Serangga 21(1): 147-159

*ISSN 1394-5130 © 2016, Centre for Insects Systematic,
Universiti Kebangsaan Malaysia*

DUNG BEETLES (COLEOPTERA: SCARABAEOIDEA) FROM TASIK CHINI BIOSPHERE RESERVE, PAHANG

Aruchunnan, G., Y. F. Ng, I. R. Hazmi & S. L. Wee

Centre for Insects Systematic, School of Environmental and Natural
Resources Science, Faculty of Science and Technology, University
Kebangsaan Malaysia, 43600 Bangi, Selangor Darul Ehsan, Malaysia

Corresponding author: wary88@yahoo.com

ABSTRACT

A total of 15,747 dung beetles belong to 13 genera and 60 species were captured successfully at Tasik Chini Biosphere Reserve, Pahang from May 2014 to April 2015. Forty-five baited pitfall trap with light sources were installed using transects method at core, buffer and transition zones of Biosphere Reserve. *Onthophagus* with 43 species (71.7% of the total species) represents the most diverse dung beetle genus at Tasik Chini, Pahang. The most abundant dung beetle species in the area was *Sisyphus thoracicus*, represented by 9,544 (60.6%) individuals. Followed by *O. crassicollis* and *O. rorarius*, which were represented by 1,041 and 9,49 individuals respectively. The Biosphere Reserve is also categorized by the occurrence of rare dung beetle species such as *Onthophagus* sp. 1, *O. avocetta*, *O. namnaoensis*, *O. semiperakensis*, *Ochicanthon okudai* and *Copris haroldi*. The list presented with 60 species of

Tasik Chini dung beetles could serve as baseline data for further studies on dung beetle diversity in Peninsular Malaysia.

Keywords: Dung beetle, list, Tasik Chini, Pahang

ABSTRAK

Sejumlah 15,747 kumbang najis mewakili 13 genera dan 60 spesies telah berjaya ditangkap di Rizab Biosfera Tasik Chini, Pahang, dari Mei 2014 hingga April 2015. Empat puluh lima perangkap lubang berumpan dengan sumber lampu telah dipasang menggunakan kaedah transek di zon teras, penampakan dan peralihan Rizab Biosfera. *Onthophagus* merupakan genus yang paling pelbagai dengan 43 spesies (71.7% daripada jumlah keseluruhan spesies). Spesies kumbang najis yang paling melimpah di kawasan tersebut ialah *Sisyphus thoracicus* yang diwakili oleh 9,544 (60.6%) individu. Ini diikuti oleh *O. crassicolis* dan *O. rorarius*, yang masing-masing diwakili oleh 1,041 dan 9,49 individu. Rizab Biosfera ini juga telah diwakili dengan kehadiran spesies langka seperti *Onthophagus* sp. 1, *O. avocetta*, *O. namnaoensis*, *O. semiperakensis*, *Ochicanthon okudai* dan *Copris haroldi*. Senarai yang dipersembahkan dengan 60 spesies kumbang najis dari Tasik Chini boleh dijadikan sebagai data asas untuk kajian lebih lanjut mengenai kepelbagaian kumbang najis di Semenanjung Malaysia.

Kata kunci: Kumbang najis, senarai, Tasik Chini, Pahang

INTRODUCTION

Tasik Chini is the second largest natural lake in Malaysia after Tasik Bera, Pahang. The lake was nominated by UNESCO as biosphere heritage reserve in 2008. It was surrounded with 4,975 hectares of rich tropical secondary forest, comprising of lowland dipterocarp and peat swamp forest. Unfortunately, a vast area of southern district of this lake was cleared for core mining and plantation. Forest deterioration for mining and plantation creates obvious and immediate changes to all aspects of the ecology of this biosphere reserve, that includes declining of biodiversity and water quality of the natural lake and surroundings forest habitat. Therefore, research on biodiversity which include the survey of dung beetles diversity as a potential bio-indicator was conducted at different biosphere zones.

Dung beetle belongs to the largest order Coleoptera with about 6,000 species and more than 257 genera distributed throughout the world and records high species diversity in tropical forest systems (ScarabNet taxon database). Dung beetles plays a significant role in ecological functions, such as nutrient recycling, secondary seed dispersal, controlling pest population, soil fertilization and aeration and often used as indicators to access habitat disturbance (Nichols et al. 2008). Overall, dung beetles ecology are well-studied and has been increasing recently in Malaysia. However, a significant proportion of the Peninsular dung fauna yet not correctly identified or described. Though, many researchers are started working on it since 2007. Among the studies on Peninsular dung beetles conducted by Ochi et al. (2009), Lee et al. (2009a), Qie et al. (2011), Kudavidanage et al. (2012) and Hannah et al. (2014) are still lacks in producing a proper dung beetles occurrence data for Peninsular Malaysia. Within Malaysia, the number of species of dung beetles has not been finalised yet, but it is estimated to be 150 to 200 species.

Previously, there has been no documentation of dung beetles from Tasik Chini. A one-year study was conducted in attempt to study the diversity of the dung beetles from Tasik Chini, Pahang. The list presented is expected to be very useful and will provide a preliminary insight of the dung beetle fauna in Tasik Chini by setting up a reference collection.

MATERIALS AND METHODS

Sampling was conducted at the Tasik Chini Biosphere Reserve, Pahang state (3°24'40"N to 3°26'42"N and 102°52'18"E to 102°55'54"E). A total of 45 baited pitfall with light trapping method was used to collect dung beetle at the core, buffer and transition zones of Tasik Chini from May 2014 to April 2015. The collected dung beetles were placed in plastic bags with 70% of ethanol solution and brought back to the laboratory for identification to species level after treated with laboratory procedures such as pinning and labelling. Collected beetles were identified to species level using Ochi et. al (1996) and confirmed by referring to dung beetles collections at Natural History Museum London.

RESULTS AND DISCUSSION

A total of 15,747 individuals of dung beetles were collected from three different biosphere zones at Tasik Chini throughout one-year sampling period. A total of 60 species belonging to two subfamilies of Aphodiinae and Scarabaeinae in the superfamily Scarabaeoidea were obtained in the fieldwork. Table 1 contains a full list of the dung beetle species and abundance of each species collected at Tasik Chini. In addition, 12 genera of dung beetles commonly caught from Peninsular Malaysia was provided with illustration in Figure 1. Of the 60 species collected, 59 species from 12 genera of 6 tribes were found in subfamily Scarabaeinae. Subfamily Aphodiinae with

only 30 individuals (0.2% of the total individuals) and belongs to a single genus, *Aphodius*. The true dung beetles comprises of three families, namely Scarabaeidae, Aphodiidae and Geotrupidae. However, this study shows that the majority of dung beetles are found in the subfamily Scarabaeinae because they are the most species rich in the tropical region and the strategy used for allocating dung for feeding or nesting makes them easier to be collect (Hanski and Cambefort 1991).

Genus *Onthophagus* represents the most diverse genus with 43 species (71.7% of the total species). *Onthophagus* is the species-rich genus in tropical rainforests (Hanski and Krikken 1991) and selected as a good indicator for the health of a habitat fragmentation and perturbation (Davis et al. 2001). This might be due to the advantages of *Onthophagus* in terms of survival in a disturbed area and this genus is also reported to be prevalent in many other types of disturbed habitats (Davis et al., 2001; Shahabuddin et al., 2005, 2010). Amongst all, *Sisyphus thoracicus*, is the most abundant species, representing 60.6% (9,544 individuals) of the total capture. The superabundance of the species *Sisyphus thoracicus* might be showing that Tasik Chini was disturbed, because this species is a good indicator of heavy disturbance (Davis1993). This species usually found in high abundance in both primary and secondary forests in South East Asia (Davis et al. 2000). Distribution of species *O. crassicollis* and *O. rorarius*, follows later with 1,041 and 9,49 individuals respectively.

Low abundance of species could be reflected in *Liatongus femoratus* (0.2%), *Oniticellus tessellatus* (0.1%) and *Yvescambefortius sarawacus* (0.2%) from tribe Oniticellini. Presence of tribe Oniticellini is strongly associated with the presence of larger herbivore dung pats and only breed successfully in undisturbed dung pats (Cambefort 1991; Hanski and Krikken 1991; Krell et al. 2003). Hence, we could assume that the low abundances of dung beetle species from tribe

Oniticellini in the Tasik Chini may indicate the lower movement of large herbivorous mammals and less availability of large dung pats in this forest habitat. However, this sampling cannot attracting much this type of species due to our smaller cow dung bait.

Other commonly found large sized species ($> 10\text{mm}$) from genus *Paragymnopleurus* (3.42%), *Catharsius* (0.41%) and *Copris* (0.35%) were also denoted with a lower abundance than small sized species ($< 10\text{mm}$) from genus *Sisyphus* (60.6%) and *Onthophagus* (32.2%) at Tasik Chini, Pahang. Dung beetles have been proposed as an indicator group for examining forest changes that could significantly alter the habitat in terms of food resources, vegetation structure, microclimatic variable and soil characteristics because such changes generally reduced diversity and abundance of dung beetles (Shahabuddin et al. 2005; Spector 2006). Apart from that, body size is another factor that serves as the key indicator to evaluate forest disturbance (Hosaka et al. 2014). Previous studies proved that larger-bodied dung beetle species are more sensitive to habitat disturbance because the results have found a significant decrease of biomass with increasing land-use intensity (Shahabudin et al. 2010; Gardner et al. 2008). Large beetles are most important groups in maintaining ecosystem functions because they are more efficient than small beetles at removing dung and seeds (Slade et al. 2007). Therefore, it can be expected that lower abundance of this ecologically important group may significantly alter ecosystem functioning at Tasik Chini. According to Halffter and Arellano (2002), smaller sized dung beetles were discovered highly in more disturbed forest due to fewer dung amounts excreted by the mammals to feed larger dung beetles. Thus, a disturbed forest may appear with high diversity, but give smaller body sized dung beetles, as reflected in this study (Filgueiras et al. 2011).

Table 1. List of dung beetles recorded at Tasik Chini Biosphere Reserve, Pahang from May 2014-April 2015.

Tribe	Genus	Species	Total
Subfamily: Aphodiinae			
Aphodiini	<i>Aphodius</i>	1. <i>marginellus</i>	30
Subfamily Scarabaeinae			
Canthonini	<i>Ochicanthon</i>	2. <i>peninsularis</i> 3. <i>okudai</i>	12 1
Coprini	<i>Catharsius</i> <i>Copris</i>	4. <i>molossus</i> 5. <i>agnus</i> 6. <i>haroldi</i> 7. <i>ramosiceps</i>	64 22 1 32
	<i>Microcopris</i>	8. " <i>cf reflexus</i> " 9. <i>doriae</i>	2 5
Gymnopleurini	<i>Paragymnopleurus</i>	10. <i>maurus</i> 11. <i>striatus</i>	518 21
Oniticellini	<i>Liatongus</i> <i>Oniticellus</i> <i>Yvescambefortius</i>	12. <i>femoratus</i> 13. <i>tessellatus</i> 14. <i>sarawacus</i>	32 20 32
Onthophagini	<i>Anoctus</i> <i>Caccobius</i> <i>Onthophagus</i>	15. sp. 1 16. <i>unicornis</i> 17. sp. 1 18. <i>aphodiodes</i> 19. <i>avocetta</i> 20. " <i>babirussoides</i> " 21. <i>cervus</i> 22. <i>crassicollis</i> 23. <i>cf dayacus</i> 24. <i>deflexicollis</i> 25. " <i>denticollis_1</i> " 26. <i>fuscopunctulatus</i> 27. " <i>Hairy group</i> " 28. <i>incisus</i> 29. <i>javanensis</i> 30. <i>karenensis</i> 31. sp. 2 32. <i>cf lindae</i> 33. <i>mulleri</i>	22 317 1 15 1 630 149 1041 4 30 2 401 23 21 16 5 39 12 57

		34. <i>namnaoensis</i>	4
		35. <i>nigriobscurior</i>	58
		36. <i>orientalis</i>	142
		37. " <i>orientalis_1</i> "	141
		38. " <i>pacificus_1</i> "	456
		39. " <i>pacificus_3</i> "	90
		40. <i>pedator</i>	18
		41. " <i>peninsulotagal</i> "	12
		42. " <i>peninsularis</i> "	2
		43. <i>peninsulomerus</i>	8
		44. <i>cf phatoensis</i>	2
		45. <i>phanaeides</i>	25
		46. <i>poletarius</i>	63
		47. <i>rectecornutus</i>	35
		48. <i>rorarius</i>	949
		49. <i>rudis</i>	7
		50. <i>rufiobscurior</i>	110
		51. <i>rugicollis</i>	17
		52. <i>rutilans</i>	89
		53. <i>semifex</i>	25
		54. <i>semiperakensis</i>	1
		55. " <i>sumaveiensis</i> "	9
		56. <i>taeniatus</i>	15
		57. <i>cf vitalisi</i>	1
		58. <i>vulpes</i>	167
		59. <i>waterstradti</i>	179
Sisyphini	<i>Sisyphus</i>	60. <i>thoracicus</i>	9544
Total no. of specimens			15,747

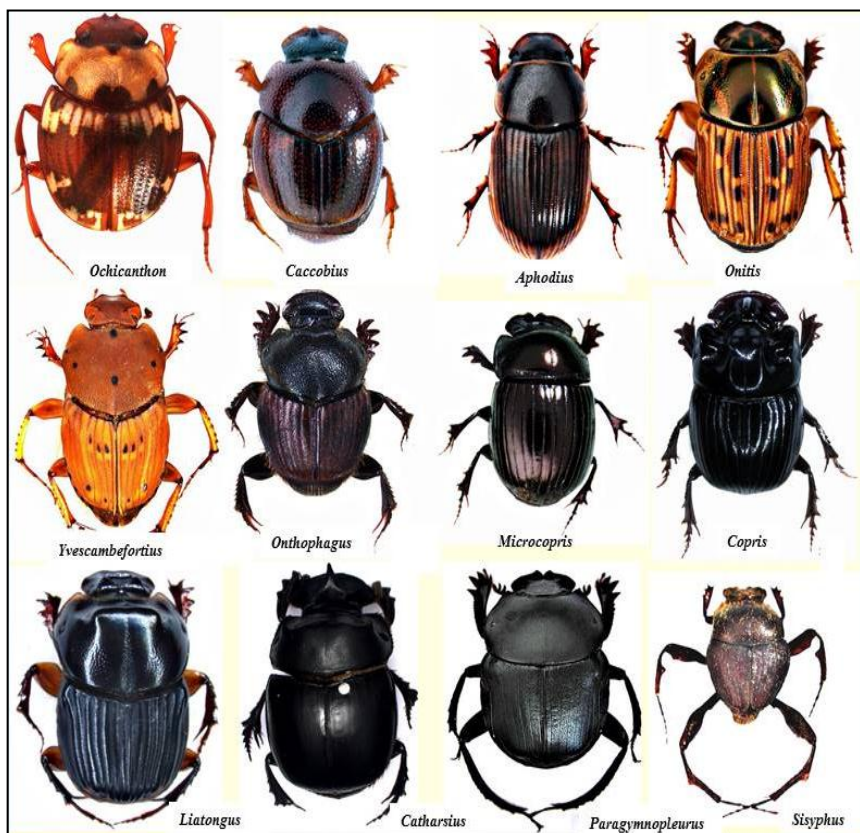


Figure 1. Twelve different genera of dung beetles from Tasik Chini Biosphere Reserve

A relatively high number of dung beetle species was recorded from the present study if compared to the recent study at eight different sites throughout Peninsular Malaysia which encompass only 64 species of dung beetles (Hannah et al. 2014). This indicates that despite of being disturbed, this biosphere reserve still sustains a high number of dung beetles species. The Tasik Chini is also characterized by the occurrence of rare dung beetle species such as *O. sp. 1*, *O. avocetta*, *O. namnaoensis*, *O. semiperakensis*, *Ochicanthon okudai* and

Copris haroldi, which represented by only one individual. This study allow us to present a general overview of dung beetle diversity and information on the occurrence and distribution of dung beetle species in Peninsular Malaysia, particularly, Tasik Chini. The study should be conducted intermittently to compare the level of ecosystem health and its' management in this Biosphere Reserve. As a conclusion, provided dung beetle list of Tasik Chini could serve as baseline data for further studies on dung beetle diversity in Peninsular Malaysia.

ACKNOWLEDGEMENTS

We thank Johannes Huijbregts from the National Museum of Natural History Naturalis, Leiden, The Netherlands for his guidance in species identification. We would also like to thank Pak Man, Mr Safarizal, Mr Adha and Mr Fazli for their field assistance. This study was funded by the UKM Tasik Chini research grant LRGS/BU/2012/UKM/BS.

REFERENCES

- Cambefort, Y. 1991. Dung beetles in tropical savannas. In: Dung beetle ecology. Eds. I. Hanski & Y. Cambefort.
- Davis, A.J., Holloway, J.D., Huijbregts, H., Krikken, J., Kirk-Spriggs, A. & Sutton, S.L. 2001. Dung beetles as indicators of change in the forests of northern Borneo. *The Journal of Applied Ecology*, 38:593–616.
- Davis, A.J. 1993. The ecology and behaviour of rainforest dung beetles in northern Borneo. Ph.D.dissertation, University of Leeds, UK. Filgueiras, B.K.C., Iannuzzi, L., & Leal, I.R. 2011. Habitat fragmentation alters the structure of dung beetle communities in the Atlantic Forest. *Biological Conservation*, 144, 362-369.

- Gardner, T.A., Hernández, M.I.M., Barlow, J. & Peres, C.A. 2008. Understanding the biodiversity consequences of habitat change: the value of secondary and plantation forests for neotropical dung beetles. *Journal of Applied Ecology*, 45, 883–893.
- Halffter, G., & Arellano, L. 2002. Response of dung beetle diversity to human-induced changes in tropical landscape. *Biotropica*, 34, 144-154.
- Hannah, M.D., Elizabeth, B., Rhatt, D.H., Christine, F., Abdul Rahman Kassim., Shamsudin Ibrahim & Matthew, D.P. 2014. Environmental and geographic factors driving dung beetle (Coleoptera: Scarabaeidae: Scarabaeinae) diversity in the dipterocarp forests of Peninsular Malaysia. *Raffles Bulletin of Zoology*, 62: 549–560.
- Hanski, I. & Krikken, J. 1991. *Dung beetles in tropical forests in South-East Asia*. In: I. Hanski & Y. Cambefort (eds), *Dung beetle ecology*. Pp.179-197. Princeton Univ. Press, Princeton, New Jersey.
- Hanski, I. & Chamberfort, Y. 1991. *Dung Beetle Ecology*. Princeton University Press, Princeton. NJ.
- Hosaka, T., Niino, M. Kon, M., Ochi, T. Yamada, T., Fletcher, C., & Okuda, T. 2014. Effects of logging road networks on the ecological functions of dung beetles in Peninsular Malaysia. *Forest Ecology and Management*, 326, 18-24.
- Krell, F.T., Westerwalbesloh, S.K., Weib, I., Eggleton, P. & Linsenmair, K.E. 2003. Spatial separation of Afrotropical dung beetle guilds: a trade-off between competitive superiority and energetic constraints (Coleoptera: Scarabaeidae). *Ecography*, 26: 210–222.

- Kudavidanage, E.P., Qie, L. & Lee, J.S.H. 2012. Linking biodiversity and ecosystem functioning of dung beetles in South and Southeast Asian tropical rainforests. *The Raffles Bulletin of Zoology*, 24: 141–154.
- Lee, J.S.H., Yat, K.C. & Qie, L. 2009a. Possible extinctions of dung beetles (Coleoptera: Scarabaeidae) in Bukit Timah Nature Reserve, Singapore. *Raffles Bulletin of Zoology*. 57: 537–542.
- Nichols, E., Spector, S., Louzada, J., Larsen, T., Amezcuita, S.A., & Favila, M.E. 2008. Ecological functions and ecosystem services provided by Scarabaeinae dung beetles. *Biological Conservation*, 141: 1461–1474.
- Ochi, T., Kon, M. & Tsubaki, Y. 2009. Notes on the coprophagous scarab-beetles (Coleoptera: Scarabaeidae) from Southeast Asia (XXI). Nine new species and two new subspecies of *Onthophagus* from the Malay Peninsula, Sumatra and Borneo. *Entomological Review of Japan*, 64: 217–236.
- Ochi, T., Kon, M. & Kikuta, T. 1996. Studies on the family Scarabaeidae (Coleoptera) from Borneo. I. Identification keys to subfamilies, tribes and genera. *Giornale Italia Entomologia*, 8: 37–54.
- Qie, L., Lee, T.M., Sodhi, N.S. & Lim, S.L.-H. 2011. Dung beetle assemblages on tropical land-bridge islands: small island effect and vulnerable species. *Journal of Biogeography*, 38: 792–804.

- Shahabuddin, P., Hidayat, S., Manuwoto, W., Noerdjito, T., Tschardtke, T. & C. Schulze. 2010. Diversity and body size of dung beetles attracted to different dung types along a tropical land-use gradient in Sulawesi, Indonesia. *Journal of Tropical Ecology*, 26, 53-65.
- Shahabuddin, C., Schulze, H. & Tschardtke, T. 2005. Changes of dung beetle communities from rainforests towards agroforestry systems and annual cultures in Sulawesi (Indonesia). *Biodiversity and Conservation*, 14, 863-877.
- Slade, E.M., Mann, D.J., Villanueva, J.F. & Lewis, O.T. 2007. Experimental evidence for the effects of dung beetle functional group richness and composition on ecosystem function in a tropical forest. *Journal of Animal Ecology*, 76: 1094–1104.
- Spector, S. 2006. Scarabaeine dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae): an invertebrate focal taxon for biodiversity research and conservation. *Coleopterists Bulletin*, 5, 71-83.