Journal of Wildlife and Parks, 34: 81-93 (2019)

CONSERVATION OF DUNG BEETLES (SCARABAEIDAE: SCARABAEINAE) IN PENINSULAR MALAYSIA

***Thary Gazi Goh & Rosli Hashim**

Institute of Biological Sciences, Science Faculty, University of Malaya, 50603, Kuala Lumpur, Malaysia.

*Corresponding author's e-mail: u_loji@yahoo.com

ABSTRACT

Dung beetles (Scarabaeidae: Scarabaeinae) have emerged as useful taxa for biodiversity monitoring due to their close association with mammalian diversity and forest structure. While an estimated 170 species have been found in Peninsular Malaysia thus far and several ecological studies have been conducted, very little has been discussed about the conservation of this subfamily. In this review, we examine the current legal provisions for the protection of dung beetles, identify potential threats to dung beetle diversity, describe challenges that arise from a lack of information about the ecology of most dung beetle species and suggest conservation recommendations to protect the existing dung beetle diversity. Additionally, we provide a species list of common species that were derived from unpublished data and existing literature.

Keywords: Dung beetles, Scarabaeidae, Scarabaeinae, conservation

Received (02-March-2018); Accepted (03-October-2018); Available online (11-October-2019)

Citation: Goh, T.G. & Hashim, R. (2019). Conservation of dung beetles (Scarabaeidae: Scarabaeinae) in Peninsular Malaysia. *Journal of Wildlife and Parks,* **34**: *81-93.*

INTRODUCTION

Dung beetles (Scarabaeidae: Scarabaeinae) are a species-rich group, with the current informal estimate of Peninsular Malaysia at roughly 14 genera and 170 species (Table 1) (J. Huijbregts, pers. comm., 2017). Many of these species are still undescribed. These beetles carry out important ecological functions such as secondary seed dispersal, soil aeration through bioturbation, pest and parasite suppression, plant growth enhancement and pollination of plants (Nichols *et al*., 2008). Dung beetles are an important indicator species for monitoring forest health and biodiversity, as they are sensitive to habitat alteration and the loss of mammalian biodiversity (Spector, 2006).

Thus far, the need for the conservation of dung beetles has been neglected in Peninsular Malaysia. Within the context of Peninsular Malaysia, we review the current ecological knowledge on dung beetles, identify threats to their conservation, discuss challenges for conserving these species and suggest conservation recommendations to protect the existing dung beetle diversity.

Table 1 Diversity and breeding behaviour of dung beetles in Peninsular Malaysia

Tribe	Genus	Breeding behaviour	Number of species
Gymnopleurini	*Paragymnopleurus*	Roller	3
Sisyphini	*Sisyphus*	Roller	1?
Canthonini	*Ochicanthon*	Roller	3?
Coprini	*Copris*	Tunneler	16?
	Catharsius	Tunneler	1
	Synapsis	Tunneler	3
	Heliocopris	Tunneler	3
	Panelus	Roller	>1?
Oniticellini	*Liatongus*	Tunneler	2?
	Oniticellus	Dweller	2
	Yvescambefortius	Tunneler	1
Onitini	*Onitis*	Tunneler	>3?
Onthophagini	*Onthophagus*	Tunneler	>100?
	Caccobius	Tunneler/kleptoparasite	2?

LEGAL PROTECTION OF BEETLES IN MALAYSIA

Internationally and within Malaysia, there are no Malaysian dung beetle species that are legally protected. No Malaysian dung beetles are listed under CITES (CITES, 2017) or the Wildlife Protection Act 2010 (Akta Pemuliharaan Hidupan Liar 2010). There are only two species of beetle listed under CITES *Dynastes satanus* (Appendix II) and *Colophon* spp (Appendix III) (CITES, 2017), both of which are not dung beetles. Only a single beetle is listed in Schedule 1 of the Wildlife Protection Act 2010 (Akta Pemuliharaan Hidupan Liar 2010): the South African endemic stag beetle *Colophon* sp. (Cape Stage Beetle). There is little to no information regarding the trade of beetles in Malaysia, although large Scarabaeid beetles from the subfamily Dynastinae are often sold as souvenirs.

THREATS TO DUNG BEETLES

The Ornamental Insect Trade

Dung beetles are not particularly popular with insect collectors; only a few species are prized for their horns and colouration. The largest and most impressive Peninsular Malaysian dung beetles fetch only a quarter of the price of more popular horned beetles (Dynastinae). Most collectors of dung beetles in the South East Asian Region collect them for scientific purposes and tend to deposit their collections in museums. Beetle breeders for South-East Asian species are non-existent, as most breeders prefer more colourful Central American species such as *Phanaeus vindex* (Barney & McMonigle, 2012).

Exotic Food

Dung beetles are eaten in rural Thailand (Watanabe & Satrawara, 1984; Hanboonsong, 2010) and Laos (Boulidam, 2010), where they are collectively known as *Kudchi*. Some nutritional studies have been carried out on these species (Raksakantong *et al.*, 2010; Bophimai & Siri, 2010). All the species used in Thai cuisine are open area species that are associated with cow or buffalo dung. These species are mostly Indochinese species and are less common south of the Isthmus of Kra (Goh T.G., unpublished data). There is no evidence that this entomophagical trend has spread to Peninsular Malaysia.

Traditional Chinese Medicine Trade

The traditional Chinese medicine (TCM) trade is one of the largest threats to wildlife in the region (Still, 2003). Dung beetles are not exempt from being used as traditional medicines. *Catharsius mollosus* is used in Chinese medicine and there are currently efforts to extract active ingredients from this species (Ahn *et al.*, 2003, Jiang *et al.*, 2012). A superficially similar species is present in Peninsular Malaysia, *Catharsius renaudpauliani* (Ochi & Kon, 1996), however traditional Chinese medicine practitioners likely do not care about taxonomic details. As *C. mollosus* is widespread in Southern China and Indochina (Arrow, 1931), the local *Catharsius* species are not exploited for the TCM trade.

Habitat Destruction

Dung beetles are known to be sensitive to changes in habitat and some species have been proposed as indicator species for habitat disturbance (Davis *et al*., 2001). Comparison of the dung beetle diversity between old-growth logged forests in Johor and secondary forests in Singapore indicates that secondary forests had significantly less dung beetle species and abundance (Lee *et al*., 2009). Forested islands created by the flooding of the Tasik Kenyir had less diverse species assemblages on smaller islands but there was no clear pattern on community structure, which indicated that random effects played a

large role in the dung beetle community of smaller islands (Qie *et al*., 2011). Comparison between adjacent logged and unlogged forests found no significant difference between the number of species or abundance of beetles; however, there was a difference in species composition of both forests (Hosaka *et al*., 2014). A comprehensive study of forests within Peninsular Malaysia, comprising primary and secondary forests, suggested that mammalian diversity, which is also a response of forest size and encroachment, might be the actual factor affecting dung beetle diversity (Doll *et al*., 2014).

Mammalian Extinction

Dung beetles are primarily dependent on mammalian dung and are at risk of going extinct following the removal of the mammals (Nichols *et al*., 2009). Through the removal of large mammals due to hunting, traffic accidents or poaching, or the poaching of smaller mammals such as monkeys, a case of trophic collapse can occur in the dung ecosystem. Trophic collapses can cause a restructuring of ecosystems, or a total failure of an ecosystem due to changes in the food web (Terborgh & Estes, 2009). While there are no studies regarding this in Peninsular Malaysia, several studies in the Neotropics indicate decreasing mammalian biomass and biodiversity leads to a loss of dung beetle diversity and abundance (Andresen & Laurence 2007; Culot *et al*., 2013; Feer & Boissier, 2015).

Endemism

Several endemic species or subspecies of dung beetle can be found in Peninsular Malaysia (Table 2). Some are found in isolated habitats such as mountains or islands. Sites with unique conditions like *kerangas* forests and limestone karsts have not been intensively surveyed but reports from Gunung Mulu in Sarawak indicate that they may harbour undescribed endemic species (Hanski, 1983). Table 2 represents an incomplete list as there is a lack of distributional data on many species and further surveys of isolated or unique localities are required.

Table 2 Dung beetle species endemic to Peninsular Malaysia. (Note: Endemic to Langkawi= *, Endemic to Fraser's Hill= **)

Species	Reference
Anoctus laevis	Balthasar (1963)
Copris (Microcopris) hosakai	Ochi and Kon (2014b)
Copris johkii	Ochi and Kon (2014c)
*Copris novaki**	Zelenka (1992)
*Copris hatayamai***	Ochi and Araya, 1992
Haroldius maruyamai	Utsunomiya and Masumoto (2005)
Haroldius pahangensis	Kral (2003)

Larhodius maruyamai	Masumoto and Utsunomiya (2003)
Larhodius hashimi	Masumoto and Utsunomiya (2003)
Onthophagus horii	Ochi, Kon and Tsubaki (2009)
O. semipersonatus	Ochi, Kon and Tsubaki (2009)
O. paracentricornis	Ochi and Kon (2014d)
O. uenoi	Ochi (1995)
O. tsubakii	Ochi and Kon (2009)
O. (Gibbonthophagus) viridicervicapra	Ochi, Kon and Tsubaki (2009)
O. (Gibbonthophagus) rufiobscurior	Ochi, Kon and Tsubaki (2009)
O. (Gibbonthophagus) nigriobscurior	Ochi, Kon and Tsubaki (2009)
O. (Indachorius) semiwaroae	Ochi, Kon and Masumoto (2014a)
O. (Indachorius) maruyamai	Ochi, Kon and Masumoto (2014a)
O. (Indachorius) ulugombakensis	Ochi, Kon and Masumoto (2014a)
O. (Indachorius) perakensis	Ochi, Kon and Masumoto (2014a)
O. (Indachorius) semiperakensis	Ochi, Kon and Masumoto (2014a)
O. (Indachorius) viridiperakensis	Ochi, Kon and Masumoto (2014a)
O. (Onthophagialus)suginokoichii	Ochi and Kon (2008)
O. (Parascatonomus) pseudoriekoae	Ochi, Kon and Masumoto (2012)
O. (Parascatonomus) satoi	Ochi, Shimada and Kon (2003)
O. (Pseudophanaeomorphus) parachandrai	Ochi, Kon and Tsubaki (2009)
Ochicanthon peninsularis	Krikken and Huijbregts (2007)
Ochicanthon niinoi	Ochi and Kon (2014b)
Ochicanthon okudai	Ochi and Kon (2014b)
Synapsis roslihashimi	Ochi, Kon and Kawahara (2008)
Synapsis punctatus	Ochi, Kon and Kawahara (2008)

CHALLENGES

Incomplete Biogeographic Distribution Information

At the moment distribution information of many species of dung beetles is rather incomplete, and the political boundaries of Peninsular Malaysia do not reflect the biogeographical zone of the Malay Peninsula, which also includes parts of Thailand south of the Isthmus of Kra. Grossly the biogeography of dung beetles on the Malay Peninsula mirrors that of mammalian fauna, with the Kedawi region being a transitional zone between Sundaland beetles and Asiatic mainland species (Goh, T.G., unpublished data). This leads to problems identifying 'rare' species, as some species that are considered 'rare' on the Malay Peninsula are actually common in Thailand. For example, *Copris nevinsoni* is considered to be rare in the Malay Peninsula (Goh

et al., 2014b) but it is commonly found in Thailand markets (Hanboonsong, 2010). Future biogeographical studies that include the Asiatic mainland can help to identify and categorise these species.

Unknown Ecology

If the bait of a species is not known, it can be mistaken as a 'rare' species due to non-detection. Some species rarely occur in baited traps; however, this may not be representative of the actual population sizes of certain species as many species of dung beetle may not be attracted to the standard baits. Species such as *Onthophagus tsubakii* appear to be rare when monkey or human dung is used, but relatively easy to collect using elephant dung (Goh, T.G., unpublished data).

Despite being dung beetles, many species of Scarabaeinae do not feed entirely on dung. Other diets include saprophagy, frugivory, necrophagy and parasitism (Hanski & Cambefort, 1991). Without using a variety of baits, some of these beetles are not detected or collected as singletons during conventional sampling. An example would be *Onthophagus rudis*, which is listed as a rarely occurring species in Arrow (1931) but it can be collected in quite large numbers with flight interception traps (Davis *et al.*, 2001) or rotten fish baited pitfalls traps (Goh, 2014a).

Due to the lack of ecological information on both 'rare' and uncommon species, very little is known about many species aside from the localities and forest types that they are collected from. The lack of population-based studies and the unknown geographical ranges of most species prevent the proper classification of these beetles under the criteria of the IUCN Red List (IUCN, 2017).

Lack of Charisma

Perhaps the most obvious problem with the protection of dung beetles is the question of "Why bother? " Dung beetles are small uncharismatic animals that do not elicit any sympathy with the public. Instead of being directly targeted by poaching, dung beetles are more threatened by indirect means such as deforestation and loss of mammalian diversity. Perhaps the most pragmatic approach is to practice an umbrella species concept by using large charismatic animals to protect the habitat that less charismatic animals depend on. Another alternative is to emphasise the utility of these beetles as indicators of environmental health (Spector, 2006). A forest with a healthy dung beetle community is indirectly a forest with higher mammalian diversity.

RECOMMENDATIONS

Continue With Current Conservation Strategies

As previously mentioned, the umbrella species concept is a practical approach to conserving the current diversity of dung beetles. As such, the National Tiger Action Plan (DWNP, 2008) and the Elephant Management Plan (DWNP, 2006), as well as the Central Forest Spine (CFS) plan, seem to be good strategies for the conservation of dung beetles species. As large mammals require a large habitat range, protecting large mammal habitats has the 'trickle-down effect' of also preserving dung beetle diversity. Ensuring that the mammals on the current Department of Wildlife and National Parks (DWNP) red list (DWNP, 2010) are protected also prevents the occurrence of a trophic collapse that may harm dung beetle populations. Additionally, the gazettement of geoparks and Environmentally Sensitive Areas (ESA) (DTCP, 2010) may protect yet undiscovered endemic species.

Least Concern Species

Perhaps the first step to protecting dung beetle species is to define what is not "data deficient". Table 3 is a list of common beetles derived from species records from the Museum of Zoology, University of Malaya and species lists of Boonrotpong *et al.* (2004), Lee *et al.* (2009), Qie *et al.*, (2011), Hosaka *et al.* (2014), Doll *et al.* (2014) and Goh (2014a). These are species that are common, widespread and adaptable to human encroachment. We suggest the following list of species as meeting the criteria for least concern under the IUCN Red List (IUCN, 2017).

Table 3 Proposed Least Concern (LC) species of dung beetles for Peninsular Malaysia

Tribe	Species	Habitat
Sisyphini	*Sisyphus thoracicus*	Primary forests, secondary forests, forest edges, oil palm estates.
Gymnopleurini	*Paragymnopleurus maurus*	Primary forests, secondary forests
Canthonini	*Ochicanthon peninsularis*	Primary forests, secondary forests
Oniticelini	*Liatongus femoratus*	Primary forests, secondary forests, forest edges
	Oniticellus cinctus	Cow farms
	Oniticellus tessellatus	Primary forests, secondary forests, forest edges
	Yvescambefortius sarawacus	Primary forests, secondary forests
Coprini	*Copris (Microcopris) doriae*	Oil palm estates

Tribe	Species	Habitat
	Copris (Microcopris) reflexus	Cow farms, secondary forests, forest edges
	Copris (Paracopris) punctulatus	Cow farms, forest edges
	Copris (Paracopris) ramosiceps	Primary forests, secondary forests
	Copris spinator	Primary forests, secondary forests
	Catharsius renaudpauliani	Primary forests, secondary forests, oil palm estates
Onthophagini	*Onthophagus (Parascatonomus) peninsulocupreus*	Primary forests, secondary forests, oil palm estates
	Onthophagus (Parascatonomus) rudis	Primary forests, secondary forests, oil palm estates
	Onthophagus (Parascatonomus) semifex	Primary forests, secondary forests, oil palm estates
	Onthophagus aphodiodes	Primary forests, secondary forests, forest edges, oil palm estates
	Onthophagus babirussa	Primary forests, secondary forests, oil palm estates
	Onthophagus crassicollis	Forest edge, open areas.
	Onthophagus deflexicollis	Primary forests, secondary forests.
	Onthophagus leusermontis	Primary forests, secondary forests, forest edges, oil palm estates.
	Onthophagus orientalis	Primary forests, secondary forests, forest edges, oil palm estates, open areas
	Onthophagus proletarius	Secondary forests, open areas, cow farms.
	Onthophagus pacificus	Primary forests, secondary forests, forest edges, oil palm estates
	Onthophagus rugicollis	Primary forests, secondary forests,
	Onthophagus saggitarius	Cow farms
	Onthophagus rectecornutus	Cow farms
	Onthophagus viridicervicapra	Primary forests, secondary forests
	Onthophagus vulpes	Primary forests, secondary forests, oil palm estates
	Onthophagus waterstradti	Primary forests, secondary forests, forest edges, oil palm estates.

ACKNOWLEDGEMENTS

We would like to thank PERHILITAN for the support and permits that have allowed us to collect dung beetles throughout Peninsular Malaysia. Johannes Huijbregts, Teruo Ochi and Masahiro Kon contributed greatly by sharing information and publication with us. Additionally, we are grateful for the proofreading help from Loo Jey Sern.

REFERENCES

Akta Pemuliharaan Hidupan Liar 2010 (Akta 716). (2017) Retrieved from http://www.wildlife.gov.my/images/document/penerbitan/akta/AKTA%20716%20AKTA%20PEMULIHARAAN%20HIDUPAN%20LIAR%202010.pdf. (Version on October 2017).

Ahn, M.Y., Hahn, B.S., Ryu, K.S., Kim, J.W., Kim, I. & Kim, Y.S. (2003). Purification and characterization of a serine protease with fibrinolytic activity from the dung beetles, *Catharsius molossus*. *Thrombosis Research*, **112**(5): 339-347.

Andresen, E. & Laurance, S.G. (2007). Possible indirect effects of mammal hunting on dung beetle assemblages in Panama. *Biotropica*, **39**(1): 141-146.

Arrow, G.J. (1931). *The fauna of British India including Ceylon and Burma. Coleoptera-Lamellicornia Part III (Coprinae)*. London, UK: Taylor and Francis.

Balthasar, V. (1963). *Monographie der Scarabaeidae und Aphodiidae der palaearktischen und orientalischen Region*. der Tschechoslowakischen Akademie der Wissenschaften. Prague. (In German).

Barney, S. & McMonigle, O. (2012). *The complete guide to rearing the rainbow scarab and other dung beetles*. US: Elytra & Antenna.

Boonrotpong, S., Sotthibandhu, S. & Pholpunthin, C. (2004). Species composition of dung beetles in the primary and secondary forests at Ton Nga Chang Wildlife Sanctuary. *Science Asia*, **30**: 59-65.

Bophimai, P. & Siri, S. (2010) Fatty acid composition of some edible dung beetles in Thailand. *International Food Research Journal*, **17**: 1025-1030.

Boulidam, S. (2010). Edible insects in a Lao market economy. In *Forest insects as food: Humans bite back* (Durst, P.B., Johnson D.V., Leslie, R.N. & Shono K., eds), pp. 131-140. *Proceedings of a workshop on Asia-Pacific resources and their potential development*. Bangkok, Thailand: Food and Agriculture Organisation of the United Nations.

CITES. (2017). CITES Appendices. Retrieved from https://www.cites.org/eng/app/index.php. (Version on October 2017)

Culot, L., Bovy, E., Vaz-de-Mello, F.Z., Guevara, R. & Galetti, M. (2013). Selective defaunation affects dung beetle communities in continuous Atlantic rainforest. *Biological Conservation*, **163**: 79-89.

Davis, A.J., Holloway, J.D., Huijbregts, J., Krikken, J., Kirk-Spriggs, A.H. & Sutton, S.L. (2001). Dung beetles as indicators of change in the forests of northern Borneo. *Journal of Applied Ecology*, **38**(3): 593-616.

Doll, H.M., Butod, E., Harrison, R.D., Fletcher, C., Kassim, A.R., Ibrahim, S. & Potts, M.D. (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.

DTCP (Department of Town and Country Planning). (2010). *National Physical Plan 2.* Kuala Lumpur: Department of Town and Country Planning.

DWNP (Department of Wildlife and National Parks). (2006). *Pelan pengurusan gajah Semenanjung Malaysia*. Kuala Lumpur: Department of Wildlife and National Parks.

DWNP (Department of Wildlife and National Parks). (2008). *National Tiger Action Plan for Malaysia.* Kuala Lumpur: Department of Wildlife and National Parks.

DWNP (Department of Wildlife and National Parks). (2010). *Red List of mammals for Peninsular Malaysia*. Kuala Lumpur: Department of Wildlife and National Parks.

Feer, F. & Boissier, O. (2015). Variations in dung beetle assemblages across a gradient of hunting in a tropical forest. *Ecological Indicators*, **57**: 164-170.

Goh, T.G. (2014a). Preliminary survey of dung beetle diversity in Krau Wildlife Reserve, Pahang, Malaysia. *Journal of Wildlife and Parks*, **28**: 131-136.

Goh, T.G., Huijbregts, J., Hii, N. & Campos-Arceiz, A. (2014b). Beetles recorded to visit elephant dung in Temenggor Forest, Malaysia. *Journal of Wildlife and Parks*, **29**: 45-48.

Hanboonsong, Y. (2010). Edible insects and associated food habits in Thailand. In *Forest insects as food: Humans bite back* (Durst, P.B., Johnson D.V., Leslie, R.N. & Shono K., eds), pp. 173-182. *Proceedings of a workshop on Asia-Pacific resources and their potential development.* Bangkok, Thailand: Food and Agriculture Organisation of the United Nations.

Hanski, I. & Cambefort, Y. (1991). *Dung beetle ecology*. New Jersey, US: Princeton University Press.

Hanski, I. (1983). Distributional ecology and abundance of dung and carrion-feeding beetles Scarabaeidae in tropical forests in Sarawak, Borneo. *Acta Zoologica Fennica*, **167**: 1-45.

Hosaka, T., Niino, M., Kon, M., Ochi, T., Yamada, T., Fletcher, C.D. & Okuda, T. (2014). Impacts of small-scale clearings due to selective logging on dung beetle communities. *Biotropica*, **46**(6): 720-731.

IUCN. (2017). The IUCN Red List of Threatened Species. Version 2017-3. <http://www.iucnredlist.org>. Downloaded on 27 February 2018.

Jiang, Q., Tan, C., Ma, J. & Yang, M. (2012). Screening of active fraction of anti-benign prostatic hyperplasia from *Catharsisus molossus*. *Pharmacology and Clinics of Chinese Materia Medica*, **6**: 30-35.

Kral, D. (2003). The genus Haroldius (Coleoptera: Scarabaeinae): two new species, range extension, catalogue. *Acta Societatis Zoologia Bohemoslovaca,* **67**: 193-198.

Krikken, J. & Huijbregts, J. (2007). Taxonomic diversity of the *Ochicanthon* in Sundaland (Coleoptera:Scarabaeidae:Scarabaeinae). *Tijdschrift voor Entomologie*, **150**: 421-479.

Lee, J.S.H., Lee, I.Q.W., Lim, S.L.H., Huijbregts, J. & Sodhi, N.S. (2009). Changes in dung beetle communities along a gradient of tropical forest disturbance in South-East Asia. *Journal of Tropical Ecology*, **25**: 677-680.

Masumoto, K. & Utsunomiya, Y. (2003). Two new *Larhodius* (Coleoptera, Scarabaeidae, Dichotomini) from Peninsular Malaysia. *Elytra,* **31**(2): 379-383.

Nichols, E., Spector, E.S., Louzada, J., Larsen, T., Amezquita, S., Favila, M.E. & The Scarabaeidae Research Network. (2008). Ecological functions and ecosystem services provided by Scarabaeinae dung beetles. *Biological Conservation,* **141**: 1461–1474.

Nichols, E., Gardner, T.A., Peres, C.A. & Spector, S. (2009). Co-declining mammals and dung beetles: an impending ecological cascade. *Oikos*, **118(4)**: 481-487.

Ochi, T. (1995). A new *Onthophagus* (Coleoptera, Scarabaeidae) from the Malay Peninsula. *Special Bulletin of the Japan Society of Coleopterology*, **4**: 389-393.

Ochi, T. & Araya, K. (1992). Studies on the coprophagus scarab beetles from East Asia. II. (Coleoptera, Scarabaeidae). *Giornale Italiano di Entomologia*, **6**(31): 79-108.

Ochi, T. & Kon, M. (1996). Studies on the coprophagus scarab beetles from East Asia. IV. (Coleoptera, Scarabaeidae). *Giornale Italiano di Entomologia*, **8**(42): 17-28.

Ochi, T. & Kon, M. (2008). Notes on the coprophagus scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia. (XVI). Three new species of *Onthophagus* (*Onthphagiellus*) from Sumatra and the Malay Peninsula. *Entomological Review of Japan,* **62**(2): 223-232.

Ochi, T. & Kon, M. (2009). Notes on the coprophagus scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia. (XX). Two new species of the genus *Onthophagus* from Borneo and the Malay Peninsula. *Entomological Review of Japan*, **64**(1): 107-112.

Ochi, T. & Kon, M. (2014b). Notes on the coprophagus scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia. (XXIII). Two new species of *Ochicanthon* and one new species of *Microcopris* from the Malay Peninsula. *Elytra, Tokyo,* **16**: 79-89.

Ochi, T. & Kon, M. (2014c). *Copris* (Coleoptera, Scarabaeidae) from Langkawi Is., off the Malay Peninsula, with description of a new species. *Japan Journal of Systematic Entomology*, **20**(2): 315-318.

Ochi, T. & Kon, M. (2014d). Notes on the coprophagus scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia. (XXIV). Four new species of *Onthophagus* from Malaysia. *Japan Journal of Systematic Entomology*, **20**(2): 341-346.

Ochi, T., Kon, M. & Masumoto, K. (2012). New species of the genus *Parascatonomus* (Coleoptera: Scarabaeidae) from the Malay Peninsula. *Kogane*. **13**: 139-142.

Ochi, T., Kon, M. & Masumoto, K. (2014a). Six new species of the subgenus *Indachorius* of the genus *Onthophagus* (Coleoptera: Scarabaeidae) from the Malay Peninsula. *Giornale Italiano di Entomologia*, **15**(59): 557-572.

Ochi, T., Kon, M. & Kawahara, M. (2008). Notes on the coprophagus scarab-beetles (Coleoptera, Scarabaeidae) from Southeast Asia. (XIX). Three new taxa of *Synapsis* from Southeast Asia. *Entomological Review of Japan*, **63**(2): 191-199.

Ochi, T., Kon, M. & Tsubaki, Y. (2009). Notes on the coprophagus 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**(2): 217-236.

Ochi, T., Shimada, T. & Kon, M. (2003). A new species of the genus *Onthophagus* (Coleoptera, Scarabaeidae) from the Malay Peninsula. *Special Bulletin of the Japan Society of Coleopterology*, **6**: 211-215.

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**(4): 792-804.

Raksakantong, P., Meeso, N., Kubola, J. & Siriamornpun, S. (2010). Fatty acids and proximate composition of eight Thai edible terricolous insects. *Food Research International*, **43**(1): 350-355.

Spector, S. (2006). Scarabaeine dung beetles (Coleoptera: Scarabaeidae: Scarabaeinae): an invertebrate focal taxon for biodiversity research and conservation. *The Coleopterists Bulletin*, **60**(5): 71-83.

Still, J. (2003). Use of animal products in traditional Chinese medicine: environmental impact and health hazards. *Complementary Therapies in Medicine*, **11**(2): 118-122.

Terborgh, J. & Estes, J.A. (2010). *Trophic cascades: predators, prey, and the changing dynamics of nature*. Washington, DC: Island Press.

Utsunomiya, Y. & Masumoto, K. (2005). A new *Haroldius* (Coleoptera, Scarabaeoidea) from the Malay Peninsula. *Elytra, Tokyo*. **33**(2): 487-489.

Watanabe, H. & Satrawara, R. (1984). A list of edible insects sold at the public market in Khon Kaen, Northeast Thailand. *Southeast Asian Studies*, **22**(3): 316-325.

Zelenka, W. (1992) Beschreibung von zwei neuen Coprinen aus Südostasien (Coleoptera: Scarabaeidae). *Koleopterologische Rundschau*, **62**: 165-168.