DIVERSITY AND COMPOSITION OF BEETLES (ORDER: COLEOPTERA) IN THREE DIFFERENT AGES OF OIL PALMS IN LEKIR OIL PALM PLANTATION, PERAK, MALAYSIA

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ABSTRACT

The diversity and composition of beetles from oil palm plantation in Ladang Lekir, Perak, Malaysia were collected each month using Malaise trap, yellow pan and window traps from three different sites on the basis of their oil palm aged i.e. five (Plot 1), seven (Plot 2) and 12 (Plot 3) years old from November 2015 to October 2016. From 3862 individuals, 110 species and 83 morphospecies from 40 families and 59 subfamilies were successfully collected. From all samples recorded, the five years old oil palm showed the highest Shannon Diversity Index (H' = 3.42), Peilou Equality Index (E' = 0.23) and Margalef Richness Index (R'= 17.33) with species accumulation curve near to asymptote. The most abundant species recorded from the three sites was *Elaeidobius kamerunicus* with 940 individuals (relative abundance, RA = 24%). Plot 1 had the highest beetle species with 132 individuals (68.4%), while Plot 2 was the lowest with 85 individuals (44%). The t-test analysis showed that there was no significant difference in term of the diversity index (H') between Plot 3 and Plot 2 (p-value=0.092), while there were significant differences between these two plots (Plot 2 and Plot 3) with Plot 1 (p-value= 0.47 and 0.046). This study would provide basic information for future research in sustainable oil palm plantations management in Malaysia.

Keywords: Species richness, species evenness, abundance, agriculture, oil palm

ABSTRAK

Kepelbagaian dan komposisi kumbang dari ladang sawit di Ladang Lekir, Perak, Malaysia dikumpulkan setiap bulan menggunakan perangkap Malaise, perangkap dulang kuning dan perangkap tingkap daripada tiga umur kelapa sawit yang berlainan iaitu lima (Plot 1), tujuh (Plot 2) dan 12 (Plot 3) dari November 2015 hingga Oktober 2016. Daripada 3862 individu, 110 spesies dan 83 morfospesies dari 40 famili dan 59 subfamili berjaya dikumpulkan. Daripada semua sampel yang dicatatkan, umur kelapa sawit lima tahun (Plot 1) menunjukkan hasil tertinggi bagi ketiga-tiga analisis yang dijalankan, Indeks Kesaksamaan Peilou (E'= 0.23), Indeks Kepelbagaian Shannon (H' = 3.42) dan Indeks Kekayaan Margalef (R'= 17.33) dengan lengkuk pengumpulan spesies hampir mencapai asimtot. Spesies paling melimpah yang direkodkan daripada ketiga-tiga plot adalah *Elaeidobius kamerunicus* dengan 940 individu (kelimpahan relatif, RA = 24%). Plot 1 mempunyai spesies kumbang tertinggi dengan 132 individu (68.4%) manakala Plot 2 adalah paling rendah dengan 85 individu (44%). Analisis t-test menunjukkan tidak terdapat perbezaan yang signifikan dari segi indeks kepelbagaian (H') antara Plot 3 dan Plot 2 (p-*value*= 0.092), manakala terdapat perbezaan yang signifikan antara kedua-dua plot tersebut (Plot 2 dan Plot 3) dengan Plot 1 (p-*value*= 0.047 and 0.046). Dapatan kajian ini penting sebagai data asas untuk kajian yang selanjutnya bagi pengurusan kelapa sawit yang mapan.

Kata kunci: Kekayaan spesies, kelimpahan spesies, pertanian, kelapa sawit

INTRODUCTION

Malaysia has become one of the leading oil palm producers in Southeast Asia after Indonesia, with an estimated of 5.74 million hectares of total area of planted oil palms and formed the largest commodity crop produce in this country (Basiron 2007). Both countries also hold more than 80% of Southeast Asia’s remaining forest where many flora and fauna are threatened due to deforestation and land conversion to agriculture (Sodhi et al. 2010). Such bases had led to issues with regards to ecosystem destruction and contribute to biodiversity losses e.g. Koh and Wilcove (2007); Fitzherbert et al. (2008); Struebig et al. (2011). Till date, very few studies assessed the diversity of arthropods in oil palm plantation in Malaysia e.g. Chung et al. (2000); Norman and Basri (2003); Mohd Hanysyam et al. (2013).

Among the known arthropods are beetles which had been recognized as the most diverse group of insects and constitute about 25-40% of described species (Hammond 1992). Beetles are diverse insects that play a major role in the food chain (Izfa Riza et al. 2015), environment (Farrell 1998), economic importance (Mohd-Basri & Norman 1997; Huger 2005) and are very sensitive to human activities (Mckinney 2009). Beetle group are also used as bioindicators to indicate disturbances in the environment and reflect the responses of other species or the overall biodiversity (Rainio & Niemelä 2003). Some beetles are not only beneficial but also can be pests and bring great losses to agriculture industry (e.g. Afzan et al. (2013); Ramle et al. (2005).

This study focuses on the diversity and abundance of beetles at different oil palm ages i.e. five, seven and 12 years old in Ladang Lekir, Perak, Malaysia. The area is divided into three different plots in order to get an idea on the variety of beetles found at different niche within the oil palm ecosystem (e.g. Ulyshen et al. 2004; Didham et al. 1998).

MATERIALS AND METHODS

The study was carried out from November 2015 until October 2016 at three different oil palm ages i.e. five years old (Plot 1), seven years old (Plot 2) and 12 years old (Plot 3) at Ladang Lekir, Perak, Malaysia (4.126481, 100.780812). Malaise trap, yellow pan and window traps were set up randomly in all three plots and the samples were collected each month. Three units for each trap were used. Every month, malaise trap was left for one week and two days for yellow pan and window trap for one year. Different trapping methods used in this study were to increase the collection numbers of beetle. The beetles captured were then stored in bottles containing 70% ethanol and brought back to the laboratory. Samples were then pinned, dried in oven and labelled. Samples were then identified to the lowest taxonomic level as possible following the keys of Coleoptera in the Borror and DeLong's Introduction to the study of Insects 7th edition book under the stereomicroscope and compared to the existing collection at the Centre for Insect Systematics (CIS), Universiti Kebangsaan Malaysia (UKM). Species that could not be assigned to a species name or at least to the genus level were assigned as morpho-species designation, for example: Gen sp1., Gen sp2., etc. All specimens were deposited at the CIS, UKM for future references. Comparison on the diversity and composition of beetles between sites were analyzed by Shannon Diversity Index (H'), Evenness Index (E'), Richness Index (R) and t-test using the Paleontological Statistics (PAST) software.

RESULTS AND DISCUSSIONS

A total of 3862 individuals of beetles consisting 110 identifiable species, 83 morphospecies from 59 subfamilies and 40 families were successfully collected from Ladang Lekir, Perak (Table 1). The highest abundant captured were from the family Nitidulidae with 1144 individuals (29.6%), followed by Curculionidae with 986 individuals (25.5%) and Scarabaeidae with 522 individuals (13.5%). Seven families which were Aspidiphoridae, Dytiscidae, Endomychidae, Lucanidae, Mycetophagidae, Passalidae and Pselaphidae represents only a single individual or 0.026% captured from Lekir Plantation, respectively. The species represent only single individual is known as a rare species or singleton (Anne *et al.*, 2005). Coddington *et al.*, (2009) stated the existence of this single species closely related to the biology of the beetle species, the availability of food choice and host plant.

The highest beetle individuals captured was from Plot 1 (2036 individuals or 52.7%), followed by Plot 3 (954 individuals or 24.7%) and Plot 2 (872 individuals or 22.6%). The differences in number of individuals between the three plots were mainly influenced by the high number of individuals belonging to three main beetle species, *E. kamerunicus* (Curculionidae) with 421 specimens (11%) at Plot 2, while *Urophorus humeralis* (Nitidulidae) with 328 individuals (8.5%) and *Urophorus* sp1 (Nitidulidae) with 199 individuals (5.2%) at Plot 1 (Table 3). Beside that, obviously one of the factors for the differences of abundance in each plot of oil palm was due to its different vegetation exist from young oil palm to old oil palm plantations. Luskin and Potts (2011) also stated that different ages of oil palm plantation have different favorable vegetation. Based on observation, younger oil palm plot has more weeds, grass and shrubs grow naturally compare to older oil palm plot. Younger oil palm means shorter canopy that will allow more light penetrate to soil and enhance more vegetation as likely to be a major factor in attracting herbivorous insects.

In comparison between the three plots, *E. kamerunicus* appeared to have the highest number of individuals captured at Plot 2 due to the presence of more male flowers of oil palm where they live, feed and breed as they are highly dependent on them. Meanwhile, *U. humeralis* (Nitidulidae) and *Urophorus* sp1 (Nitidulidae) were found in greater number at Plot 1 due to the abundance of rotten fruit in this plot that became their main food sources. Field observation showed that parthenocarpic fruit bunches problem is serious for this plot that will attract nitidulid beetle as they feed on rotten fruit. Crowson et al. (2013) stated that nitidulid beetles can be found in sap flow and fresh wounds on oil palm trees. In addition, beetles from this family also have a various type of food choices such as feed on flowers, fruits, sap, fungi, stored products, decaying and fermenting plant tissues from diverse trees and crops (Roubik 1995). Sap beetles are often considered minor pests (Rondon *et al.*, 2004). However, nitidulid beetles also play an important role in the palm plantation as one of the active pollinating agents (Silberbauer-Gottsberger 1990). However, more studies need to be conducted to provide information about nitidulid beetle to determine their status whether they can be considered as a pest or pollinator in oil palm plantations. Besides that, biotic factors i.e. availability of food sources and vegetation structure may have influenced the diversity of beetles in this oil palm plantation (Ahmad Bukhary et al. 2017; Fauziah & Shukri 2012).

The three plots showed high beetle diversity (H'> 2.0) in descending order, Plot 1 (H'=3.42), Plot 3 (H'= 2.97) and Plot 2 (H'= 2.56). In addition, Plot 1 account the highest value for Shannon Diversity Index (H'= 3.42), Margaleff Richness Index (R'=17.33), Evenness Index (E'=0.23) (Table 2.) and the greatest number of morphospecies (Table 1). This result is consistent with previous studies study that younger oil palm trees had higher diversity than older oil palm trees (Izfa-Riza et al. 2015). Based on the species-accumulation curve, plot 1 was nearly reached the asymptote, while plot 2 and plot 3 were far from reaching the asymptote (Figure 1). According to Komonen (2003), a species-accumulation curve that did not reach the asymptotic is due to the presence of the dominant species. Hence, the non-dominant species would be much less as they compete for similar resources with the dominant species.

From the t-test, there were significant differences in term of diversity index between the three plots. The presence of beneficial plants i.e. *Turnera subulata*, *Cassia cobanensis* and *Antigonon leptopu* at planted nearby the three plots may have influenced the differences in the beetle diversity. Predatory insect populations may increased when introducing flowering plants at the edges of oil palm plantation (Wilcove & Koh 2008). Tews et al. (2004) stated that the presence of many plants or vegetation on the soil profile are likely to be a major factor in attracting other insects as they provide food source and habitat. Therefore, it is likely that beneficial plants have lured many other insects into the oil palm plantations.

Table 1 The number of individuals for each family of coleopteran collected from Lekir plantation based on different oil palm ages.

Family	Subfamily	Morpho- species	Number of individual per oil palm age (morpho-species)			∑	%
			Plot 1	Plot 2	Plot 3		
Anobiidae	1	1	0	2	0	2	0.052
Aspidiphoridae	1	1	0	1	0	1	0.026
Carabidae	3	5	1	8	14	23	0.596
Chrysomelidae	6	23	119	15	32	166	4.298
Cicindelidae	1	6	17	3	9	29	0.751
Coccinellidae	6	35	223	39	37	299	7.742
Curculionidae	6	14	321	430	235	986	25.531
Dermestidae	1	2	8	0	0	8	0.207
Drilidae	1	2	0	0	3	3	0.078
Elateridae	3	14	25	21	21	67	1.735
Erotylidae	2	11	20	5	3	28	0.725
Lampyridae	1	4	1	6	3	10	0.259
Languriidae	1	2	15	0	0	15	0.388
Lucanidae	1	1	0	1	0	1	0.026
Lyctidae	1	3	12	32	40	84	2.175
Nitidulidae	4	12	668	152	324	1144	29.622
Scaphidiidae	1	1	3	1	0	4	0.104
Scarabaeidae	5	20	257	82	183	522	13.516
Scirtidae	1	8	31	3	1	35	0.906
Staphylinidae	1	4	2	1	6	9	0.233

Throscidae	1	3	17	6	1	24	0.621
Lycidae	1	7	46	12	10	68	1.761
Bostrichidae	1	1	2	1	3	6	0.155
Brentidae	1	2	49	2	0	51	1.321
Colydiidae	1	1	0	7	0	7	0.181
Derodontidae	1	1	3	0	0	3	0.078
Haliplidae	1	2	70	8	7	85	2.201
Histeridae	1	1	13	7	7	27	0.699
Malacidae	1	2	37	2	4	43	1.113
Mordellidae	1	3	5	0	3	8	0.207
Mycetophagidae	1	1	0	1	0	1	0.026
Hydrophilidae	2	4	17	6	3	26	0.673
Passalidae	1	1	1	0	0	1	0.026
Rhysodidae	1	1	6	0	0	6	0.155
Cerambycidae	1	2	3	0	0	3	0.078
Pselaphidae	1	1	1	0	0	1	0.026
Anthribidae	1	1	6	0	0	6	0.155
Endomychidae	1	1	1	0	0	1	0.026
Dytiscidae	1	1	0	0	1	1	0.026
Scolitinae	2	2	36	18	4	58	1.502
∑ of individuals	-	-	2036	872	954	3862	100
∑ of subfamilies	59	-	54	46	45	-	-
∑ of morpho-species	-	193	132	85	95	-	-

Table 2 Shannon diversity index (h'), Evenness index (e') and Margaleff richness index (r) for total number of coleopteran by oil palm age.

Diversity Index	**Oil Palm Age**		
	PLOT 1[a]	**PLOT 2[b]**	**PLOT 3[b]**
H'	3.24	2.56	2.97
E'	0.23	0.15	0.20
R	17.33	12.41	13.7

* The values of H ' that has the same letter are not significantly different (t-test, P> 0.05).

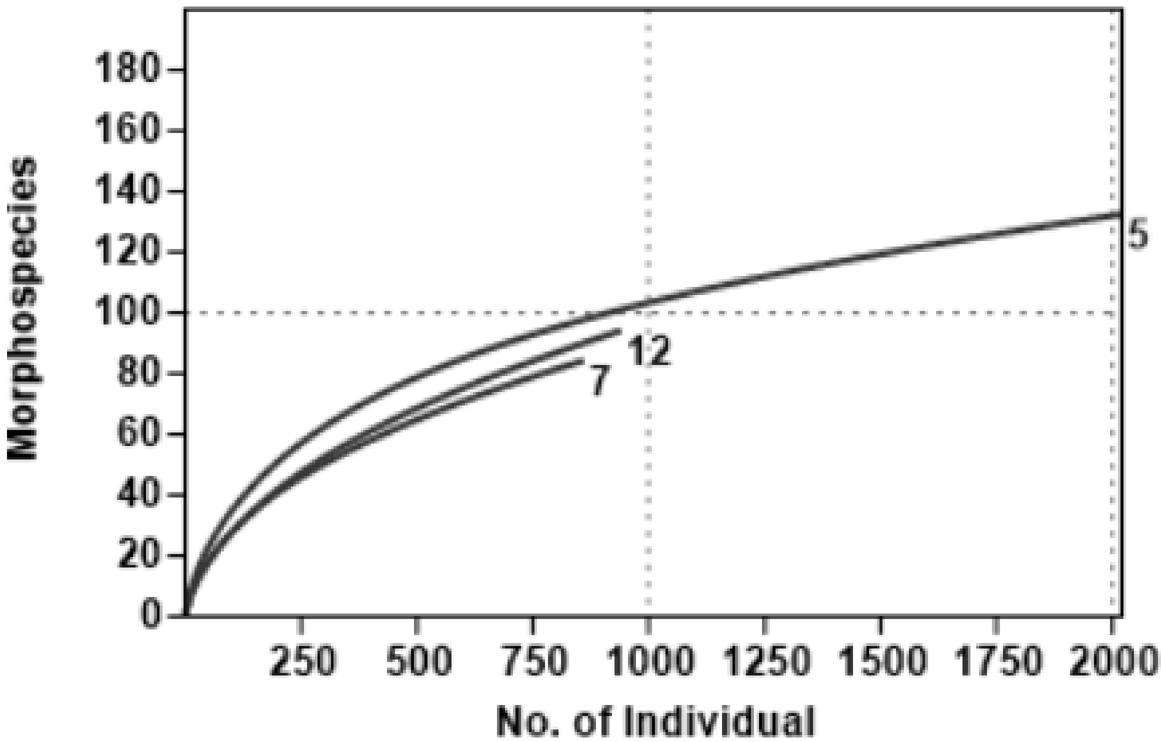

Figure 1 Species accumulation curves based on oil palm ages

Table 3 List of species and morphospecies collected from Lekir plantation, Perak based on different oil palm age.

Famili/Subfamili	Genus	Morphospecies	No. of Individual			Total
Anobiidae			**Plot 1**	**Plot 2**	**Plot 3**	
Family 1	Gen 1	sp.1	0	2	0	2
Aspidiphoridae						
Family 1	Gen 1	sp.1	0	1	0	1
Carabidae						
Harpalinae	*Amara*	sp.1	0	0	1	1
	Agonum	sp.1	1	1	12	14
	Poecilus	sp.1	0	1	0	1
Carabinae	*Calsoma*	sp.1	0	6	0	6
Family 1	Gen 1	sp.1	0	0	1	1
Chrysomelidae						
Galerucinae	*Chrysomela sp.*	sp.1	3	0	0	3
	Aulacophora	*lewisii*	0	2	4	6
		sp.1	0	0	1	1
	Lema	sp.1	0	0	1	1
	Capraita	sp.1	0	1	0	1
	Glyptina	sp.1	0	0	1	1
	Podagrica	sp.1	1	0	0	1
		sp.2	1	0	0	1
		sp.3	0	2	9	11
	Monolepta	sp.1	0	0	1	1
		sp.2	0	2	0	2

	Neocrepidodera	sp.1	0	0	2	2
	Gen 1	sp.1	1	0	0	1
		sp.2	4	0	1	5
		sp.3	2	0	0	2
Hispinae	*Dactylispa*	*higoniae*	1	1	0	2
		sp.1	1	1	2	4
		sp.2	1	0	0	1
Cassidinae	Gen 1	sp.1	1	0	0	1
Criocerinae	*Neolema*	sp.1	0	1	0	1
Cryptocephalinae	*Pachybrachis*	*nero*	1	0	0	1
		sp.1	3	0	1	4
Alticinae	*Altica*	*oleracea*	99	5	9	113
Cicindelidae						
Cicindelinae	*Cicindela*	*aurulenta*	1	0	3	4
		punctulata	0	1	1	2
	Collyris	sp.1	4	0	1	5
	Cicindela	sp.1	11	0	3	14
	Neocollyris	*celebensis*	0	2	0	2
	Gen 1	sp.1	1	0	1	2
Coccinellidae						
Chilocorinae	*Exochomus*	*aethiops*	1	0	0	1
	Chilocorus	*nigritus*	2	0	0	2
	Exochomus	sp.1	0	9	10	19
	Gen 1	sp.1	1	0	0	1
		sp.2	1	10	0	11
		sp.3	1	2	5	8
		sp.4	4	0	0	4
		sp.5	1	0	0	1
		sp.6	2	0	0	2
		sp.7	1	0	0	1
		sp.8	0	0	1	1
		sp.9	0	1	0	1
Coccidulinae	*Coccinella*	*transversalis*	6	1	6	13
	Coelophora	*inaequalis*	11	0	0	11
	Anovia	sp.1	1	0	0	1
	Rodolia	sp.1	3	1	1	5
	Gen 1	sp.1	0	0	3	3
Epilachninae	*Epilachna*	*borealis*	10	0	0	10
		indica	3	0	1	4
		sp.1	12	0	1	13
		sp.2	19	0	3	22
		sp.3	5	0	0	5
	Henosepilachna	*kaszabi*	47	0	0	47
Scymninae	*Cryptolaemus*	*montrouzieri*	0	1	0	1
		sp.1	0	0	1	1
	Zilus	*horni*	0	4	0	4
		sp.1	0	0	1	1
Sticholotidinae	*Microweisea*	sp.1	0	5	0	5

	Gen 1	sp.1	0	2	1	3
		sp.2	0	3	0	3
	Stic	Sp.1	1	0	0	1
Coccinellinae	*Menochilus*	*sexmaculatus*	4	0	1	5
		sp.1	65	0	2	67
		sp.2	17	0	0	17
	Gen 1	sp.1	5	0	0	5
Curculionidae						
Curculioninae	*Elaeidobius*	*kamerunicus*	306	421	213	940
	Alcidodes	*porosus*	0	1	0	1
	Gen 1	sp.1	1	0	0	1
		sp.2	8	2	8	18
Cossoninae	*Rhyncolus*	sp.1	1	0	0	1
Dryopthorinae	*Cactophagus*	sp.2	0	0	4	4
	Gen 1	sp.1	1	0	0	1
		sp.2	0	1	0	1
		sp.3	0	0	1	1
Entiminae	Gen 1	sp.1	0	1	0	1
Rhynchitinae	*Deporaus*	*betulae*	0	1	0	1
	Gen 1	sp.1	4	0	8	12
		sp.2	0	2	0	2
Baridinae	Gen 1	sp.1	0	1	1	2
Dermestidae						
Attegeninae	*Attegenus*	sp.1	2	0	0	2
		sp.2	6	0	0	6
Drilidae						
Family 1	Gen 1	sp.1	0	0	1	1
		sp.2	0	0	2	2
Elateridae						
Agrypninae	*Aeolus*	sp.1	4	0	0	4
		sp.2	0	1	6	7
	Conoderus	*lividus*	10	9	5	24
Negastriinae	*Neohypdonus*	sp.1	3	0	0	3
	Gen 1	sp.1	0	0	1	1
		sp.2	0	4	0	4
		sp.3	0	0	5	5
		sp.4	0	1	0	1
		sp.5	6	0	1	7
		sp.6	1	0	0	1
Elaterinae	*Glyphonyx*	*nanus*	0	1	1	2
	Sephilus	sp.1	0	1	2	3
	Mel	sp.1	1	1	0	2
	Glyphonyx	sp.1	0	3	0	3
Erotylidae						
Erotylinae	*Tritoma*	sp.1	1	0	0	1
	Triplax	*toracica*	15	1	2	18
		sp.1	0	0	1	1
	Gen 1	sp.1	0	3	0	3

		sp.2	0	1	0	1
Megalodacninae	Gen 1	sp.1	2	0	0	2
		sp.2	2	0	0	2
Lampyridae						
Luciolinae	*Luciola*	sp.1	1	1	1	3
	Gen 1	sp.1	0	2	0	2
		sp.2	0	0	1	1
		sp.3	0	3	1	4
Languriidae						
Languriinae	*Languria*	sp.1	7	0	0	7
	Gen 1	sp.1	8	0	0	8
Lucanidae						
Lucaninae	*Lucanus*	sp.1	0	1	0	1
Lyctidae						
Lyctinae	*Lyctus*	sp.1	2	9	2	13
	Silvanus	sp.1	6	1	17	24
	Gen 1	sp.1	4	22	21	47
Nitidulidae						
Carpophilinae	*Carpophilus*	*brachypterus*	1	0	0	1
		sp.1	2	1	0	3
		sp.2	8	0	2	10
	Urophorus	*humeralis*	328	54	116	498
		sp.1	199	30	99	328
Epuraeinae	*Epuraea*	*aestiva*	5	10	1	16
		Epuraea sp.	9	2	0	11
	Haptoncus	*luteus*	72	52	98	222
Nitidulinae	*Stelidota*	*geminata*	20	1	0	21
		sp.1	1	0	0	1
	Gen 1	sp.1	0	1	1	2
Cillaeinae	*Conotelus*	sp.1	23	1	7	31
Scaphidiidae						
Family 1	Gen 1	sp.1	3	1	0	4
Scarabaeidae						
Dynastinae	*Orytes*	sp.1	1	0	0	1
Melolonthiane	*Serica*	sp.1	121	20	99	240
	Nipponoserica	*peregrina*	0	0	1	1
	Plectris	*aliena*	15	19	53	87
Rutelinae	*Anomala*	sp.1	9	0	0	9
		sp.2	6	0	0	6
	Chrysina	sp.1	1	0	0	1
		sp.2	0	0	1	1
Scarabaeinae	*Onthophagus*	*rorarius*	1	0	1	2
		orientalis	7	31	3	41
		sp.1	4	0	1	5
	Dichotomius	sp.1	2	0	0	2
	Digitonthophagus	sp.1	1	0	0	1
	Gen 1	sp.1	0	0	1	1
		sp.2	1	0	0	1

			sp.3	5	0	0	5
			sp.4	1	0	0	1
	Aphodiinae	*Aphodius*	sp.1	9	0	0	9
		Gen 1	sp.1	59	10	17	86
			sp.2	14	2	6	22
Scirtidae							
	Family 1	Gen 1	sp.1	1	1	0	2
			sp.2	0	0	1	1
			sp.3	3	0	0	3
			sp.4	0	1	0	1
			sp.5	0	1	0	1
			sp.6	2	0	0	2
			sp.7	1	0	0	1
			sp.8	24	0	0	24
Staphylinidae							
	Staphylininae	*Ocypus*	sp.1	0	1	1	2
		Gen 1	sp.1	1	0	2	3
			sp.2	0	0	1	1
			sp.3	1	0	2	3
Throscidae							
	Throscinae	*Aulonothroscus*	*convergens*	17	5	0	22
		Trixagus	*dermestoides*	0	0	1	1
		Gen 1	sp.1	0	1	0	1
Lycidae							
	Erotinae	*Eropterus*	*trilineatus*	1	0	0	1
		Pyropterus	sp.1	17	0	0	17
		Gen 1	sp.1	5	0	0	5
		Gen 2	sp.1	0	0	2	2
			sp.2	10	1	5	16
			sp.3	10	11	2	23
			sp.4	3	0	1	4
Bostrichidae							
	Family 1	Gen 1	sp.1	2	1	3	6
Brentidae							
	Family 1	Gen 1	sp.1	3	2	0	5
			sp.2	46	0	0	46
Colydiidae							
	Family 1	Gen 1	sp.1	0	7	0	7
Derodontidae							
	Family 1	Gen 1	sp.1	3	0	0	3
Haliplidae							
	Family 1	Gen 1	sp.1	68	8	6	82
			sp.2	2	0	1	3
Histeridae							
	Histerinae	*Platysoma*	*leconti*	13	7	7	27
Malacidae							
	Family 1	Gen 1	sp.1	36	2	4	42
			sp.2	1	0	0	1

Mordellidae						
Family 1	Gen 1	sp.1	0	0	3	3
		sp.2	4	0	0	4
		sp.3	1	0	0	1
Mycetophagidae						
Mycetophaginae	*Typhaea*	*stercorea*	0	1	0	1
Hydrophilidae						
Hydrophilinae	*Hydrobius*	*fuscipes*	7	6	0	13
Family 1	Gen 1	sp.1	5	0	1	6
		sp.2	5	0	1	6
		sp.3	0	0	1	1
Passalidae						
Family 1	Gen 1	sp.1	1	0	0	1
Rhysodidae						
Family 1	Gen 1	sp.1	6	0	0	6
Cerambycidae						
Family 1	Gen 1	sp.1	2	0	0	2
		sp.2	1	0	0	1
Pselaphidae						
Family 1	Gen 1	sp.1	1	0	0	1
Anthribidae						
Anthribinae	Gen 1	sp.1	6	0	0	6
Endomychidae						
Eumorphinae	Gen 1	sp.1	1	0	0	1
Dytiscidae						
Family 1	Gen 1	sp.1	0	0	1	1
Scolytidae						
Platypodinae	*Crossotaresus*	*nitescens*	19	11	1	31
Scolytinae	*Xyleborus*	*ferrugineus*	17	7	3	27

CONCLUSIONS

This study successfully captured a total of 3862 individuals from 110 species and 83 morphospecies, from 40 families, 59 subfamilies at Ladang Lekir, Perak, Malaysia. The overall results showed that Plot 1 had the highest individuals (2036 individuals or 52.1%) while Plot 2 had the lowest individuals (872 individuals or 22.6%) in term of the abundance captured. Future studies should include other sampling techniques such as pitfall trap, litter sifting and canopy fogging to increase the capture rate success.

ACKNOWLEDGEMENT

We would like to thank Ms. Nurul Fatihah, Ms. Noor Farehan and Mr. Muhammad Fahmi for the assistance extended to us during the study. Special thanks goes to Mr. Devan, the Manager of Lekir Plantation, for allowing us to sample the beetle. This research was supported by the FRGS grant (FRGS/2/2014/STWN03/UKM/03/1).

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