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A CHECKLIST OF BEETLES (ORDER: COLEOPTERA) FROM SARIKEI, SARAWAK, MALAYSIA

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ABSTRACT

A biodiversity survey to document assemblages of beetles was conducted at Sarikei town, Sarawak, Malaysia from 28th August 2021 to 5th September 2021. A combination of active (hand-picking and aerial netting) and passive (modified Pennsylvanian light trap, baited trap and flight-intercept trap) methods were used during the eight days of sampling, covering areas of mixed dipterocarp forest, mangroves and a recreational park. As a result, a total of 440 individuals, representing 146 species from 49 subfamilies and 23 families of beetles were successfully recorded. In general, Scarabaeidae was reported as the most diverse and abundant family with 46 species (31.51%), followed by Tenebrionidae with 15 species (10.27%), Chrysomelidae with 13 species (8.90%), Carabidae with 12 species (8.22%), and Elateridae (7.53%) with 11 species, respectively. In terms of individual count, the most dominant species was recorded by the scarab beetles of *Apogonia destructor* (Melolonthinae) with 32 individuals (7.27%). In conclusion, this study provides baseline data for identifying potential biodiversity hotspot areas for future management and conservation action plans in Sarawak.

Keywords: Insect, species assemblages, diversity, relative abundance, rapid assessment.

ABSTRAK

Tinjauan kepelbagaian biologi untuk mendokumentasikan kumpulan kumbang telah dijalankan di bandar Sarikei, Sarawak, Malaysia pada 28 Ogos 2021 hingga 5 September 2021. Gabungan kaedah aktif (kutip dan jaring udara) dan pasif (perangkap cahaya Pennsylvanian diubahsuai, perangkap berumpan dan perangkap perentas-terbang) telah digunakan semasa lapan hari persampelan, merangkumi kawasan hutan dipterokarpa campuran, hutan bakau dan taman rekreasi. Hasilnya, sebanyak 440 individu yang mewakili 146 spesies daripada 49 subfamili dan 23 famili kumbang berjaya direkodkan. Secara umumnya, Scarabaeidae merupakan famili yang paling pelbagai dan dominan dengan merekodkan 46 spesies (31.51%), diikuti masing-

masing oleh Tenebrionidae dengan 15 spesies (10.27%), Chrysomelidae dengan 13 spesies (8.90%), Carabidae dengan 12 spesies (8.22%) dan Elateridae (7.53%) dengan 11 spesies. Berdasarkan bilangan individu, spesies yang paling dominan direkodkan oleh kumbang najis *Apogonia destructor* (Melolonthinae) dengan 32 individu (7.27%). Kesimpulannya, kajian ini menyediakan data asas bagi mengenal pasti kawasan khas kepelbagaian biologi yang berpotensi untuk pengurusan dan pelan tindakan pemuliharaan di Sarawak pada masa hadapan.

Kata kunci: Serangga, himpunan spesies, kepelbagaian, kelimpahan relatif, penilaian pantas.

INTRODUCTION

Sarawak is one of the Malaysian states situated in Borneo, the third largest island in the world (Hon & Shibata 2013; MacKinnon et al. 1996). It is a megadiversity hotspot that accommodates various forest types, including mixed dipterocarp, mangrove, peat swamp, montane, limestone and heath forests (Hazebrook & Abang Morshidi 2000). With such diverse ecosystems, Sarawak has been reported to host more than 277 mammalian species, 673 bird species, 400 freshwater fishes, 200 species of herpetofauna and at least 15,000 species of flowering plants (Chong et al. 2018). Meanwhile, Hill and Abang (2005) reported a total of 29 orders of class Insecta, representing at least 51,530 identified insect species in Borneo.

However, current practices on biodiversity conservation especially in Sarawak are more focused on protecting charismatic, vulnerable, and/or endangered vertebrates of mammals and birds. Although conservation efforts are beneficial to protect the whole habitats or surroundings of targeted animals, the negligence in studying invertebrates especially insects were becoming apparent, not only due to the lack of recent biodiversity research but also due to the shortage of entomologists and taxonomists. Hence, the taxonomic impediment resulting from the shortage of expert taxonomists and gaps in taxonomic knowledge (Valan 2021) has significantly affected the biodiversity inventory that should be updated accurately and regularly. This consequently caused an imbalance in ecological studies at this state where vertebrates received much attention from experts, whereas the number of invertebrate research is still limited.

Under the class Insecta, beetles (order Coleoptera) represent the largest order of insects about 40% of all arthropods (Grove & Stork 2000) and approximately 30% of the kingdom Animalia (Choate 2008). Due to their high diversity and wide distribution, almost two-thirds of beetles were still waiting for formal description which resulted from the taxonomic impediment in species identification (Gibb et al. 2016; Magura 2017). However, at some local institutions or biological museums, well-organised curatorial works were greatly showcased where local entomologists successfully presented a systematic access and informative reference to biological samples. Thus, a collaborative engagement should be initiated by our local researchers to enable database sharing which could be advantageous in enhancing ecological studies of insects in Malaysia.

Though ecological studies are rapidly conducted at the regional scale (Damken et al. 2017; Goh 2014; Goh & Hashim 2018; Luqman et al. 2018; Musthafa et al. 2019; Noerdjito 2008; Seow-En & Lui 2022), fundamental knowledge on beetle diversity as well as phylogenetic and evolutionary history studies are still very much lacking (Chen et al. 2019; Jusoh et al. 2020; Sazali et al. 2021) especially in Sarawak. As the research gap on beetle studies remains, it is noted that there were recent studies conducted at local scale to document beetle species in Sarawak and Sabah, respectively (Abin et al. 2021; Marcellinus et al. 2020, 2022; Sazali et al. 2021). These initiatives indicated that beetle studies are becoming the subject of local interest, due to their vast ecological and economical importance such as being pollinators, decomposers, biological and environmental indicators, biological control agents as well as agricultural and forestry pests (Bouchard et al. 2017; Chung 2007; da Rocha et al. 2010; Shahabuddin et al. 2014).

Despite their high diversity and abundance, many beetles are also threatened by extinction mostly due to human activities such as deforestation, urbanisation, loan conversion to agricultural activities, pesticide use as well as climate change (Lewis et al. 2020; Valan 2021). These beetles are often not highly dispersed, exist only in particular microhabitats, and are only found in restricted geographical regions (Bouchard et al. 2017). However, many other beetles managed to adapt in real-time by altering their morphology, behaviour, and life history, of which some can alter their geographical ranges (DeWitt & Scheiner 2004; West-Eberhard 2003). Consequently, many beetles exhibit high morphological polymorphism and phenotypic plasticity in response to changing environment, resulting in high morphological and phenotypic variation (Sazali et al. 2019; Sazali & Nasarudin, 2022; Whitman & Ananthrakrishnan 2009).

To fill the research gap of insect biodiversity studies in Malaysian Borneo, this study aims to document the assemblages of beetles from the rural town of Sarikei, the sixth division of Sarawak, providing the checklist of coleopterans in this area.

MATERIALS AND METHODS

Study Sites

This study was conducted from 28 August to 5 September 2021 in the Sarikei division (Figure 1). This small town is surrounded by peatland and is located near the Batang Rajang, which is the longest river in Malaysia. Its main economic activity is agriculture, which involves farming commodities, fruits, and vegetables. In this study, three sampling sites were selected, namely, Sebangkoi Country Park (1°57'23.5"N 111°26'00.0"E) which represents mixed dipterocarp forest, Taman Lalu Lintas (2°08'13"N 111°30'16"E) which lies nearby mangrove area, and Taman Tasik (2°07'17"N 111°31'16"E) which is a recreational park in the city, respectively.

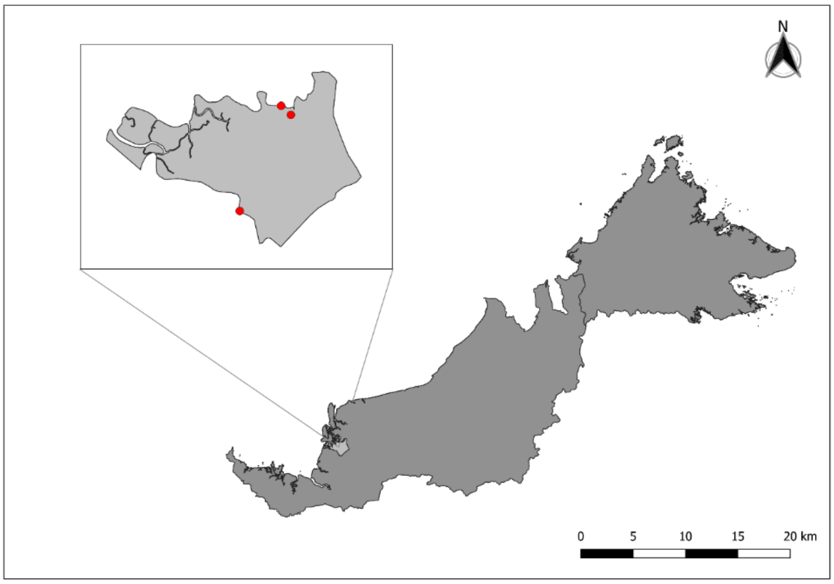

Figure 1. The Sarikei division, Sarawak

Samples Collection

Both active (handpicking and aerial netting) and passive methods (modified Pennsylvanian light trap, baited trap, and flight-intercept trap) were conducted in this study. Active search was done along the trail in the morning and evening for about two hours. For passive methods, two sets of modified Pennsylvanian light traps installed with 15-watt black light were switched on from 6.30 pm until 6.30 am the next morning and all captured insects were collected in a killing jar filled with ethyl acetate. Additionally, 10 baited traps supplemented with rotten pineapple and papaya fruits were hung at tree branches, whereas 10 flight-intercept traps were hung in between tree trunks and lured with mixtures of yeast, honey, beer, and molasses. For these traps, rotten fruits and artificial baits were added to attract beetles and the samples were collected every two days. All collected samples were then sorted, labelled, and processed appropriately.

Samples Identification

All collected beetles were sorted accordingly into family, subfamily and/or species level where possible following descriptions by Chung (2003), Hill and Abang (2005) and Bosuang et al. (2017). Comparisons were also made with voucher specimens deposited at the UNIMAS Insect Reference Collection of Faculty of Resource Science and Technology, Universiti Malaysia Sarawak (UNIMAS) for identification. Smaller specimens were observed using NIKON SMZ445 stereomicroscope.

Data Analysis

The number of individuals per species for each subfamily were recorded in data sheets, respectively. The relative abundance for each species and morpho-species, as well as the number of individuals per subfamily, were calculated using Microsoft Excel, and presented in percentages and graph. Moreover, the species diversity indices (Shannon H', Simpson 1-D and Evenness) were calculated using the Paleontological Statistics (PAST) software 4.3.

RESULTS AND DISCUSSION

Overall, a total of 440 individuals representing 146 species from 49 subfamilies and 23 families of beetles were successfully recorded from three study sites in Sarikei (Table 1). The most speciose family was recorded by Scarabaeidae with 46 species (31.51%), followed by Tenebrionidae with 15 species (10.27%), Chrysomelidae with 13 species (8.90%), Carabidae with 12 species (8.22%), and Elateridae (7.53%) with 11 species, respectively (Figure 2). In general, the diversity indices resulted in a very high beetle diversity (Shannon H' = 4.546; Simpson 1-D = 0.9808; Evenness = 0.6457). Scarabaeidae recorded the highest number of beetle samples with 217 individuals or 49.32% of total relative abundance. Meanwhile, there were many singletons and doubletons species recorded from most of the beetle families, of which Cleridae, Dytiscidae, Hydrophilidae, Meloidae and Scirtidae recorded only one or two individuals, respectively. In general, the use of modified Pennsylvanian light traps was the most effective in capturing these beetles.

From this study, the dung beetles of Scarabaeidae ranked as the most diverse and abundant family, represented by five subfamilies which are Cetoniinae, Dynastinae, Melolonthinae, Rutelinae and Scarabaeinae. Many scarab beetles are black, whereas some are metallic and brightly coloured (Hill & Abang 2005). These beetles have various ecological roles such as agricultural pests, biological control agents, pollinators, and decomposers, as well as biological and environmental indicators of high-quality forest habitat and agriculture (Cave & Ratcliffe 2008; da Rocha et al. 2010; Davis 2000; Hill & Abang 2005; Ghannem et al. 2018).

They also have wide feeding habits which include various parts of plants and decomposing plant materials (Kishimoto-Yamada et al. 2011; Triplehorn & Johnson 2005).

Table 1. Checklist of beetles recorded in Sarikei, Sarawak

Family	Number of subfamilies	Number of Species	Relative abundance, % (based on species total)	Number of Individuals	Relative abundance, % (based on individuals total)
Burprestidae	1	3	2.05	4	0.91
Cantharidae	1	1	0.68	5	1.14
Carabidae	6	12	8.22	21	4.77
Cerambycidae	2	6	4.11	6	1.36
Chrysomelidae	4	13	8.90	31	7.05
Cleridae	1	1	0.68	2	0.45
Curculionidae	4	6	4.11	31	7.05
Dysticidae	1	1	0.68	1	0.23
Elateridae	4	11	7.53	13	2.95
Endomycidae	1	5	3.42	12	2.73
Erotylidae	2	6	4.11	14	3.18
Hydrophilidae	1	1	0.68	1	0.23
Lampyridae	2	3	2.05	5	1.14
Leiodidae	1	2	1.37	8	1.82
Lucanidae	1	2	1.37	3	0.68
Lycidae	3	4	2.74	7	1.59
Meloidae	1	1	0.68	1	0.23
Nitidulidae	1	3	2.05	7	1.59
Passalidae	1	2	1.37	3	0.68
Scarabaeidae	5	46	31.51	217	49.32
Scirtidae	1	1	0.68	1	0.23
Staphylinidae	1	1	0.68	3	0.68
Tenebrionidae	4	15	10.27	44	10.00
Total	**49**	**146**	**100.00**	**440**	**100.00**

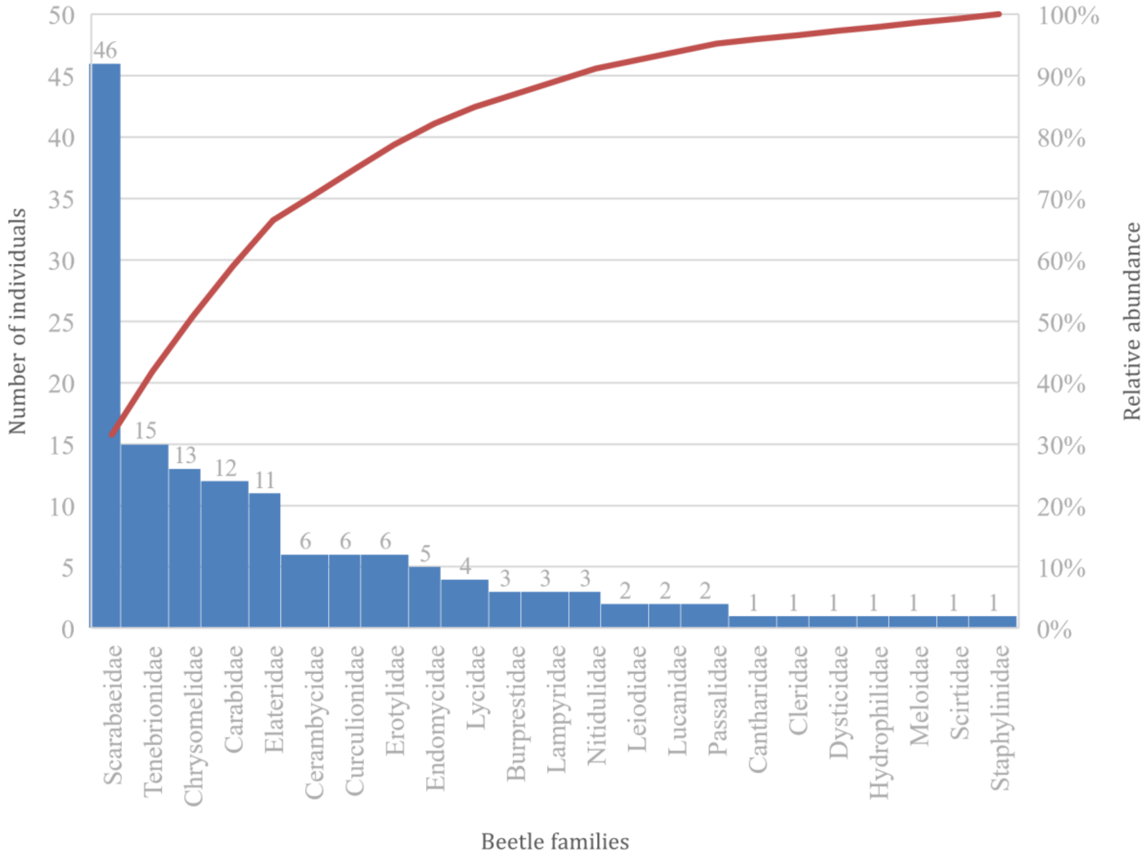

Figure 2. Number of individuals (blue bars) and the relative abundance (red line) of beetle species collected in Sarikei

The second most speciose family was recorded by Tenebrionidae, the darkling beetles, consisting of four subfamilies, namely, Blaptinae, Coelometopinae, Stenochiinae and Tenebrioninae. Most tenebrionids are black or brown and subglabrous, which look similar to ground beetles of Carabidae, meanwhile, greenish-coloured beetles can be found in forests (Hill & Abang 2005). Most of them feed on plant materials and fungi, and some feed on carcasses of dead animals, feces, and mucus (Anon 2009; Cheng et al. 2022; Hill & Abang 2005; Triplehorn & Johnson 2005). Within this family, the genus *Amarygmus* was found to be the most abundant species among its other siblings, and all were collected from the light traps. This finding was consistent with Triplehorn and Johnson (2005) and Bremer (2010) who mentioned that the tenebrionids were attracted to lights at night.

Moreover, the third speciose family, the leaf beetles of Chrysomelidae were composed of four subfamilies, namely, Chrysomelinae, Crocerinae, Cryptocephalinae and Galerucinae. Generally, they are brightly coloured, being phytophagous and their larvae feed on foliage, leaf miners, roots, seed and bore in stems (Triplehorn & Johnson 2005), but none on wood (Hill & Abang 2015). They were also reported to cause notorious damage to cultivated plants, stored products and agricultural crops (Hill & Abang 2005; Muhaimin et al. 2019).

In terms of individual counts, the most dominant species was recorded by *Apogonia destructor* from subfamily Melolonthinae (Scarabaeidae) with 32 individuals (7.27%), followed by *Rhodobaenus* sp. 1 from Dryopthorinae (Curculionidae) with 23 individuals (5.23%) and *Ixorida regia sumatrana* from Cetoniinae (Scarabaeidae), also *Holotrichia serrata* from Melolonthinae (Scarabaeidae) with 16 individuals each, respectively (Table 2). *Apogonia destructor* (Scarabaeidae: Melolonthinae) was common and can be found almost anywhere such as on grassland and nearby plantation or orchard areas. This species was reported to be a minor pest to sugar cane in Java and its other sibling species were suspected to cause damage to cultivated plants in Africa and Asia regions (Brumley et al. 2020). However, the *Apogonia* species were also reported to be beneficial, where Sakai and Inoue (1999) described a new system of dung-beetle pollination for *Orchidantha inouei* (Lowiaceae), an orchid species from Lambir Hills National Park, Miri, Sarawak.

Interestingly, all I. regia sumatrana (Cetoniinae) were exclusively collected from the flight-intercept traps, lured with artificial baits consisting of molasses, beer, honey, and yeast. These sugary-sweet mixtures mimic nectars and thus successfully attracted these pollen-feeders of which most species of Cetoniinae are active during daytime (Krikken 1984; Ritcher 1958). However, the determination of endemism for the listed beetle species remains a challenging task due to the scarcity of available distribution data. While certain species have names that suggested associations with particular locality or area such as Neptosternus sarawakensis (Dysticidae) and Compsolacon borneensis (Elateridae), relying solely on these names is insufficient to establish endemism. Hence, thorough distribution records and taxonomic investigations are needed to provide the necessary information for a more precise assessment of the potential endemism status of beetles in Sarawak and Borneo.

Table 2. List of beetle species recorded in Sarikei

Family	Subfamily	Species	Number of individuals
Burprestidae	Agrilinae	*Agrilus occipitalis* (Eschscholtz, 1822)	2
		Agrilus sp. 1	1
		Agrilus sp. 2	1
Cantharidae	Silinae	*Cantharis rufa* (Linnaeus, 1758)	5
Carabidae	Anthiinae	*Macrocheilus* sp. 1	2
	Cicindelinae	*Callytron doriai* (Horn, 1897)	2
		Callytron sp. 1	1
		Cosmodela aurulenta (Fabricius, 1801)	5
	Harpalinae	CarSp. 1	2
		CarSp. 2	1
		Mochterus sp. 1	1
	Lebiinae	Lebinnae sp. 1	1
	Orthogoniinae	*Hexachaetus lateralis (*Guerin & Meneville, 1843)	2
		Orthogonius sp. 1	1
	Paussinae	*Pseudozaena orientalis* (Klug, 1834)	1
		Paussinae sp. 1	2
Cerambycidae	Cerambycinae	*Aeolesthes* sp. 1	1
		Cyriopalus wallacei (Pascoe, 1866)	1
	Laminae	*Acalolepta rusticatrix* (Fabricius, 1801)	1
		Anipocregyes sp. 1	1

		CerSp. 1	1
		CerSp. 2	1
Chrysomelidae	Chrysomelinae	*Chalcolampra sedecimpustulata* (Stål, 1857)	1
		Plagiodera sp. 1	1
	Crocerinae	*Lema* sp. 1	1
	Cryptocephalinae	*Schenklingia* sp. 1	1
	Galerucinae	*Aplosonyx* sp. 1	1
		Aulacophora indica (Gmelin, 1790)	11
		ChrSp. 1	1
		Clitena sp.	1
		Galerosastra sumatrana Jacoby, 1896	2
		Haplosaenidea variabilis Chapuis, 1876	2
		Metrioidea grandis (Allard, 1889)	1
		Monolepta sp. 1	1
		Syphrea sp. 1	7
Cleridae	Clerinae	CleSp. 1	2
Curculionidae	Apioninae	CurSp. 1	3
	Curculioninae	*Orchestes* sp. 1	1
		Sphinxis sp. 1	2
	Dryopthorinae	*Rhodobaenus* sp. 1	23
	Entiminae	CurSp.2	1
		CurSp. 3	1
Dytiscidae	Laccophilinae	*Neptosternus sarawakensis* (Hendrich & Balke, 1997)	1
Elateridae	Agrypninae	*Compsolacon borneensis* (Ohira, 1973)	2
		Conoderus lividus (DeGeer, 1774)	1
		ElaSp. 1	1
	Athoinae	*Athous* sp. 1	1
	Elaterinae	*Anchastus bicolor* (Goeze, 1777)	1
		Nipponoelater rubiginosus (Candèze, 1889)	2
	Melanotinae	ElaSp. 2	1
		ElaSp. 3	1
		ElaSp. 4	1
		Melanotus sp. 1	1
		Priopus mjobergi (Dunn & Wood) 1939	1
Endomychidae	Lycoperdininae	*Brachytrycherus concolor* Arrow, 1937	2
		Brachytrycherus sp. 1	1
		*Dryadites borneensis (*Frivaldszky, 1833	6
		Eumorphus westwoodi (Guerin-Meneville, 1858)	2

		Spathomeles rizali (Strocheker, 1964)	1
Erotylidae	Erotylinae	*Amblyopus vittatus* (Olivier, 1807)	4
		Encaustes sp. 1	1
		Encaustes sp. 2	6
		Notaepytus tarsatus (Lacordaire, 1842)	1
	Languriinae	*Acropteroxys gracilis* (Newman, 1838)	1
		Languria sp. 1	1
Hydrophilidae	Acidocerinae	*Chasmogenus* sp. 1	1
Lampyridae	Lampyrinae	*Pyrocoelia* sp. 1	2
	Luciolinae	*Luciola niah*	2
		Pteroptyx sp. 1	1
Leiodidae	Leoidinae	*Agathidium* sp. 1	1
		Dermatohomoeus sp. 1	7
Lucanidae	Lucaninae	*Aegus chelifer* (MacLeay, 1819)	2
		LucSp. 1	1
Lycidae	Lycinae	*Cautires obsoletus* (Waterhouse, 1878)	1
		Lycinae sp. 1	2
	Lyropaeinae	*Platerodrilus foliaceus* (Masek & Bocak, 2014)	3
	Platerodinae	*Plateros* sp. 1	1
Meloidae	Meloinae	MelSp1	1
Nitidulidae	Nitidulinae	NitSp1	2
		NitSp2	1
		Stelidota multiguttata (Reitter, 1877)	4
Passalidae	Passalinae	*Aceraius wallacei* (Kuwert, 1898)	2
		Leptaulax bicolor (*Fabricius*, 1801)	1
Scarabaeidae	Cetoniinae	*Ixorida regia sumatrana* (Miksic, 1972)	16
	Dynastinae	*Dichodontus coronatus* (Burmeister, 1847)	4
		Oryctes rhinoceros (Linnaeus, 1758)	2
		Temnorhynchus baal (Linnaeus, 1767)	1
	Melolonthinae	*Apogonia destructor* (Bos, 1890)	32
		Apogonia expeditionis (Ritsema, 1896)	12
		Apogonia sp. 1	1
		Apogonia sp. 2	1
		Apogonia waterstradti (Ritsema, 1904)	6
		Asactopholis pectoralis (Moser, 1908)	10
		Exopholis hypoleuca (Wiedmann, 1819)	3
		Holotrichia serrata (Fabricius, 1781)	16

		Hoplia aurata (Waterhouse, 1877)	4
		Lepidiota sp. 1	15
		Leucopholis staudingeri Brenske, 1892	2
		Maladera sp. 1	6
		Maladera sp. 2	4
		Maladera sp. 3	2
		Maladera sp. 4	1
		Maladera sp. 5	14
		Psilopholis gigantea (Matsumoto, 2010)	1
		Schoenherria hispida (Burmeister, 1855)	1
		Tetraserica vientianeensis (Fabrizi, Dalstein & Ahrens, 2019)	2
	Rutelinae	*Adoretus compressus* (Weber, 1801)	13
		Aderotus sp. 1	1
		Anomala felicia (Arrow, 1910)	7
		Anomala pallida (Fabricius, 1775)	10
		Anomala ptenomeloides (Ohaus, 1916)	4
		Anomala sarawakensis (Ohaus, 1916)	2
		Callistethus hamus (Lu & Zorn, 2018)	2
		Callistethus sp. 1	1
		Mimela maculicollis (Ohaus, 1908)	3
		Parastasia ephippium (LeConte, 1856)	1
		Parastasia sp. 1	3
		ScaSp1	1
		Spinanomala sp. 1	1
	Scarabaeinae	*Carthasius* sp. 1	1
		Carthasius sp. 2	1
		Copris sp. 1	1
		Onthophagus sarawacus (Harold, 1877)	1
		Ontohophagus semiaureus (Lansberge, 1883)	2
		Onthophagus sp. 1	2
		Onthophagus vulpes (Harold, 1877)	1
		ScaSp. 2	1
		ScaSp. 3	1
		ScaSp. 4	1
Scirtidae	Scirtinae	SciSp. 1	1
Staphylinidae	Staphylininae	Staphylininae sp. 1	3
Tenebrionidae	Blaptinae	*Gonocephalum* sp. 1	1
	Coelometopinae	*Androsus corporaali* (Kulzer, 1951)	15
	Stenochiinae	*Derosphaerus borneensis* (Grimm, 2018)	1

	Derosphaerus chewi (Grimm, 2014)	1
	Strongylium sp. 1	1
	Strongylium sp. 2	1
Tenebrioninae	*Amarygmus concolor* (Grimm, 2018)	8
	Amarygmus sp. 1	7
	Amarygmus sp. 2	1
	Amarygmus sp. 3	1
	Argoporis sp. 1	2
	Camptobrachys sp. 1	2
	TenSp. 1	1
	TenSp. 2	1
	TenSp. 3	1

CONCLUSION

In conclusion, this study successfully reported the first preliminary checklists of beetles from Sarikei, Sarawak which presented a high species diversity of coleopterans resulted mostly from Scarabaeidae in this rural area. Moreover, it is suggested that the most effective traps for capturing beetles was the modified Pennsylvanian light traps. However, it is recommended that further studies could examine the habitat-species specificity based on beetles' diversity and abundance in different ecosystems or landscapes. Hopefully, the outcomes from this study could fill in the knowledge gap of beetle studies in Malaysia, and to provide a useful baseline data for identifying potential biodiversity hotspot areas for future biodiversity management and conservation action plans specifically in Sarawak.

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AUTHORS DECLARATIONS

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Conflict of Interest
The authors declare that they have no conflict of interest.

Ethics Declarations
No ethical issue is required for this research.

Data Availability Statement
This is a part of Master of Science project and the data are currently in MSc thesis entitled "Diversity and Spatial Distribution of Scarabaeidae (Insecta: Coleoptera) from Sarawak" (2023).

Authors' Contributions
SNS, TWL, NAZ, ZH, AAM, FNAHAF, RH and NLO conceptualized this research and designed experiments; SNS, TWL, NAZ, ZH, AAM, FNAHAF, RH and NLO participated in the design and interpretation of the data; SNS, TWL and NAZ wrote the paper and participated in the revisions of it. All authors read and approved the manuscript.

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