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The Beetle Assemblage of Langkawi Island

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ABSTRACT A study of the beetle assemblage was conducted at the forest reserves at Lubok Semilang, Telaga Tujoh, Datai, Durian Perangin, Kisap, *Tetrogona* forest plantation at Sawak Hill and the base camp at Burau Bay, Langkawi Island. 835 beetles from 201 species and 23 families were sampled using net sweeping, leaf litter collection, pitfall traps, Malaise trap and light trapping. The Simpson index of diversity was 39.44 and Margalef index of abundance was 29.73. Staphylinidae was the most diverse beetle family with Scarabaeidae being the most abundant. Light trapping was most efficient collecting 48% (n=415) of the total number of beetles collected. The maximum number of species of beetles collected was from Lubok semilang (84 species). Light trapping at Telaga Tujoh collected high diversity of beetles (Simpson index=22.05). Thus far 67 species of beetles have been identified to species level. New records for Langkawi are *Acceralus laevicollis*, 4 species of *Acerida spp., Apogonia spp,. Copris doriae, Aserid spp,. Onthophagus rugicolis, Onthophagus spp., Schonherri angus, Exopholis hypoleaca, Cylindera minuta, Bulenides spp., Borneola hijau, Borneola spp., Calomictus spp., Luperus spp., Ectamenogus spp., Anchastus spp., Lacon spp., Oxyropterus audoniwi, Colpodes spp., Carabus spp.* 4 species of *Cassinoidea, Dromius spp., Lebia spp., Stenolophus spp., Chlaenius spp., Heterotarsus spp.,* 2 species of *Ceropria spp.* 2 species of *Plesiophthalmus, Episcapha maculate, Platypus cupulatus, Sternolophus, Acceraius laevicollis, Xyleborus foerstei, Bulenidea, Xyloberus* and *Stenochetus*. With the moderate abundance and diversity of beetles on Langkawi Island, it is suggested that future land development in Langkawi be kept away from the forest reserves of Mt. Macincang and Mt. Gunungraya.

ABSTRAK Penyampelan kumbang telah di lakukan di Hutan simpan Lubok Semilang, Telaga Tujoh, Datai, Durian Perangin, Kisap, Ladang pokok Jati di Bukit Sawak dan di Teluk Burau, Pulau Langkawi. 835 kumbang dari 23 families dan 201 species telah dikumpulkan dengan kaedah perangkap cahaya, perangkat lubang, Malaise, sesampah hutan dan jaring sauh. Indeks Kepelbagaian Simpson bagi keseluruhan tempat ialah 39.44 dan indeks Margalef untuk kelimpahan species ialah 29.73. Diversiti Staphylinidae paling tinggi manakala Scarabaeidae mempunyai nilai kelimpahan yang tingi. Perangkap cahaya berhasil menangkap 48% (n=415) kumbang. Spesies terbanyak diperolehi dari Lubok Semilang (84 species). Perangkap cahaya di Telaga Tujoh telah mengutip diversiti kumbang yang tertinggi (Simpson index; 22.05). Dari kajian ini, 67 species kumbang telah dicamkan ke nama saintifik. Rekod baru bagi Langkawi ialah *Acceralus laevicollis*, 4 spesies *Acerida spp., Apogonia spp., Copris doriae, Aserid spp., Onthophagus rugicolis, Onthophagus spp., Schonherri angus, Exopholis hypoleaca, Cylindera minuta, Bulenides spp., Borneola hijau, Borneola spp., Calomictus spp., Luperus spp., Ectamenogus spp., Anchastus spp., Lacon spp., Oxyropterus audoniwi, Colpodes spp., Carabus spp., 4 spesies Cassinoidea, Dromius spp., Lebia spp., Stenolophus spp., Chlaenius spp., Heterotarsus spp.* 2 spesies of *Ceropria spp.* 2 species of *Plesiophthalmus, Episcapha maculate, Platypus cupulatus, Sternolophus, Acceraius laevicollis, Xyleborus foerstei, Bulenidea, Xyloberus* dan *Stenochetus*. Perkembangan Pulau Langkawi selanjutnya dicadangkan dibuat jauh dari kawasan hutan simpan Macincang dan Gunungraya.

(beetle, diversity, abundance, Langkawi Island)

INTRODUCTION

Langkawi is an archipelago of 99 islands situated about 50 km from the coast of Kedah state, peninsular Malaysia. Amongst these islands, Langkawi Island, Tuba Island and Dayang Bunting Island are inhibited by humans. Pulau Langkawi is the biggest with an area of 478.5

km^2. Two thirds of Langkawi are forested. In recent years, this island has become a popular spot for tourists all over the world including a favourite place for national conferences, seminars and several international events. Few studies on cicada fauna [1], the leaf beetle subfamily Galerucine [2] and on Scarabaeidae [3] were done on Langkawi Island. Beetles are useful indicators of diversity as they live in a variety of habitats and each species tends to prefer particular habitats. Beetles are also known to be very successful insects and adaptable to strict environmental conditions. Thus beetles can also be used as an indicator of environmental change. Given the lack of studies on Coleopteran diversity in Langkawi Island, this study was conducted to (i) assess the abundance and diversity of Coleoptera (beetles) on Langkawi Island (ii) to investigate whether recent developments on Langkawi Island have affected beetle abundance, and (iii) to investigate whether Langkawi's beetle diversity and abundance are different from that of the mainland. This paper reports on the beetle investigated during the Langkawi Scientific Heritage Expedition from 11th April to 18th April 2003.

MATERIALS AND METHODS

Sampling schedule

Samplings were conducted at several Dipterocarp rainforests sites in Kisap, Lubok Semilang, Telaga Tujoh, Datai, Durian Perangin, Burau Bay and Sawak Hill. Beetle samplings were conducted for 24 hours at each site using several traps placed along an established transect within a forest plot taken at each location. The transect ran about 1000 m along the pathway or trail through each sampling site.

On 11th April, 10 pitfall traps and one Malaise trap were set up at 09:00 h at Kisap. Leaf litter was collected from a 1 m by 1 m quadrat placed on the ground surface. Foliage and shrubs were randomly swept with a butterfly net until 15:00 h. At night, sorting of the collected specimens was done at base camp in Burau Bay Resort. On the following day, specimens from the pitfall traps and Malaise trap at Kisap were collected and the traps were dismantled. Then net sweeping was done at Datai and later on at Burau Bay until 15.00 h. At night a light trap was set up at Kisap area from 19:00 h to 22:00 h. On 13th April, pitfall traps and Malaise Trap were set up at Lubok Semilang which is 100 m above sea level, in Mt. Gunungraya. Leaf litter collection and net sweeping were also done at Lubok semilang until 15:00 pm. There is a road going up to Lubok Semilang which has become a picnic area and tourist spot. The road was used as a transect in this study and the traps were placed about 200 m apart from each other far inside to the left and the right of this road. That night specimens collected that day and the day before were sorted. On 14th April, specimens from all traps at Lubok Semilang were collected and light trapping was done from 19:00 h to 22:00 h. The light trap was set up across the small river on a hill slope away from the picnic area. On 15th April all traps were set up at Telaga Tujoh waterfall which had dried up during this study. Net sweeping was not done here. Sorting of specimens continued that night. On 16th April, pitfall traps were set up and net sweeping were conducted until 15:00 h at Durian Perangin. That night the team returned to Telaga Tujoh to conduct light trapping from 19:00 h to 22:00 h. On 17th April, the specimens from the pitfall traps at Durian Perangin were collected, followed by the setting up of pitfall traps and Malaise trap at Bukit Sawak. Net sweeping was also done. At 17:00 h light trapping was conducted from 19:00 h to 22:00 h at Bukit Sawak. The following day, sorting continued and beetles were packed in small glass vials containing 70% alcohol before they were transported back to University Malaya for examination and enumeration.

Sampling Methods

a. *Pitfall traps*

A hole was dug in the ground and a white plastic container of 7 cm internal diameter and 10 cm height containing 50 ml of 70% alcohol was placed in it. The pitfall traps were set up by placing one pitfall trap at each corner of a 1 m^2 quadrat and one pitfall placed in the middle. A dried leaf was placed 3 cm above the hole, serving as a cover against rainfall and serving as a camouflage. This method was employed in order to give equal chance to walking and exploring beetles to walk and fall into the pitfall trap from all directions. Two sets of ten pitfalls 200 m apart were placed at each study site.

b. *Malaise Trap*

A Malaise trap was placed within the same plot as the pitfall traps along a transect. It was placed about 200m from where the pitfall traps were set up. The beetles that flew across the trap were

attracted, trapped in the black net and then flew upward into the collecting plastic container containing 70% alcohol. 24 hours after set up the beetles were retrieved, sorted out and kept in 15 ml glass vials containing 70 % alcohol.

c. *Light Trapping*
A white mosquito net was set up in between trees with a 200 watt mercury bulb hanging in front of its opening. A portable generator provided electricity to the bulb thus providing light in the middle of a dark tropical forest area. The light trap was set up from 19:00 h to 22:00 at each sampling location. Beetles that landed or walked onto the lightened up net was collected manually and put into a killing jar. Small beetles were suck using an aspirator.

d. *Leaf litter collection*
Leaf litter within a 1 m^2 was collected from the ground surface of Burau Bay, Kisap and Lubok Semilang. The debris was brushed softly into 70 % alcohol and checked under a hand lens or a binocular microscope for beetles. Fauna in leaf litter had to be sorted within 2 days before the leaves dried up and leaf litter fauna died and decomposed.

e. *Net sweeping*
The foliage of shrubs and trees were randomly swept over around with a butterfly net. Beetles caught were placed in a killing jar with ethyl acetate until sorted out in the night.

Sorting, pinning and identification
In the laboratory in University of Malaya, the beetles preserved in 70% alcohol were taken out, pinned, dried out and identified to species or generic level [4, 5, and 6].

Cross references with other institutions
Cross referencing was also conducted with the beetles' collections from Malaysian Agricultural Research Institute (MARDI), Forest Research Institute Malaysia (FRIM), Agricultural Department Kuala Lumpur and Universiti Kebangsaan Malaysia to identify or confirm species. For species which could not be identified, the specimens were brought to The Natural History Museum on May 2003. Specimens were also brought to Sandakan Forest Department for cross referencing from 28th April to 5th May, 2003.

RESULTS AND DISCUSSION

A total of 835 beetles from 201 species and 23 family were collected from Burau Bay, Kisap, Datai, Lubok Semilang, Telaga Tujoh, Durian Perangin and Bukit Sawak on Langkawi Island. The values for Simpson index of Diversity and Margalef index of abundance were calculated for all beetle families collected (Table 1). The overall beetle diversity for all sites sampled at Langkawi was 39.44 and the overall value of beetle abundance using Margalef index for all sites sampled at Langkawi was 29.73. Both values are lower than those calculated for beetle assemblage at Endau Rompin, Johor [7]. Thus this study shows that beetle fauna in Langkawi is less diverse and less abundant than beetle fauna at Endau Rompin. The area where beetle assemblage was studied was around Selai River on the western side of Endau Rompin. It is a remote virgin forest untouched by human development unlike Langkawi Island which has been earmarked for development.

In this study, the rove beetles from the family Staphylinidae had the highest diversity (Simpson index 15.93) followed by family Scarabaeidae (12.57) (Table 1). In terms of abundance, Scarabaeidae is shown to be most abundant (Margalef index 11.12) followed by the leaf beetle family Chrysomelidae (4.95) and the ground beetle family Carabidae (3.85). Scarabaeidae comprises of 17,000 species all over the world [8].

In terms of number of beetles caught, the most efficient sampling method was the light trap (Figure 1) which had caught 48% of beetles (n=415) while Malaise trap was the least efficient with only 4% beetles caught (n=30). Pitfall trap and Net sweeping are fair methods to use for trapping beetles 20% (n=170) and 23% (n=198), respectively. Different types of traps vary greatly in effectiveness [9].

Table 1. Summary of beetle assemblage at main Langkawi Island (Burau Bay, Lubok Semilang, Telaga Tujoh, Durian Perangin, Datai and Bukit Sawak, 11 – 18 April 2005)

Family	No. of species	No. of Individuals	Simpson Index	Margalef Index
Anthicidae	1	7	1	0
Bostrychidae	5	17	4.07	1.41
Carabidae	15	38	9.38	3.85
Cerambycidae	2	2	2	1.44
Chrysomelidae	25	128	5.29	4.95
Cicindelidae	3	11	2.05	0.83
Coccinellidae	4	4	4	2.16
Curculionidae	8	10	6.25	3.04
Dermestidae	1	2	1	0
Elateridae	12	41	3.18	2.96
Endomycyhidae	2	3	1.8	0.91
Erotylidae	3	3	3	1.82
Lampyridae	1	2	1	0
Languariidae	1	1	1	-
Lycidae	2	2	2	1.44
Mordellidae	3	3	3	1.82
Passalidae	1	1	1	-
Platypodidae	8	100	2.54	1.52
Ptiliidae	3	6	2.57	1.12
Scarabaeidae	64	288	12.57	11.12
Scolytidae	5	44	2.22	1.06
Staphylinidae	14	57	15.93	3.22
Tenebrionidae	18	65	3.53	4.07
Total	**201**	**835**		

Figure 2 shows that 24% of beetles (n=206) was caught at Bukit Sawak followed by Kisap 23% (n=205), Lubok Semilang 18% (n=151) and Telaga Tujoh 13% (n=109). At Datai and Durian Perangin, only two methods i.e. net sweeping and pitfall traps were employed, thus the catches were lower compared to other sampling sites. Despite this, 10% of (n=81) beetles were caught at Durian Perangin compared to Datai which was very low (n=24; 3%).

Figure 3 shows that the most number of species of beetles was caught at Lubok Semilang (84 species) followed by Kisap (67 species) and Telaga Tujoh (60 species). Datai and Burau had the least number of species of beetles caught, 10 and 16 respectively. This could be attributed to lesser number of methods being used to catch beetles in these two areas since each trapping method is targeting specific beetles living at different microhabitats. The pitfall is suitable for ground dwelling beetles, Malaise is suitable to catch flying beetles, light trap is for nocturnal beetles and the decomposer beetles are found in the leaf litter. Net sweeping is used for catching beetles flying in the day or those found on the leaves or tree bark or pollinators of small flower shrubs. At Burau Bay only net sweeping was done on two days and one leaf litter collection was done. 32 species of beetles were assembled at Bukit Sawak. Bukit Sawak is an old plantation forest of *Tetrogona* commonly known as "Pokok Jati". Thus unlike other sampling sites of Dipterocarp forests which have many different trees providing various niches for beetles, the trees at Sawak Hill are of the same age and species thus less niches for beetles. 31 species of beetles were caught at Durian Perangin. Even though three sampling methods (Light Trap, Malaise trap and net sweeping) were employed at Sawak Hill there was not much difference between the number of species caught at Durian Perangin where two methods net sweeping and pitfall were employed.

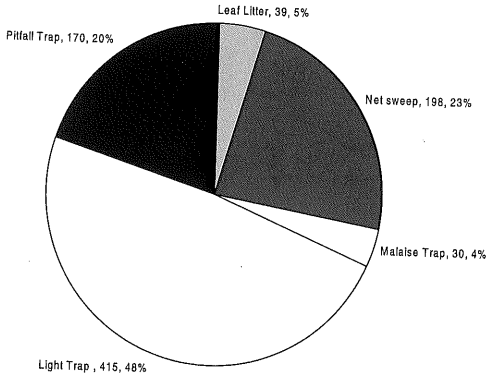

Figure 1. Total no. of beetles caught using different samplings methods on Langkawi Island (11^{th}-18^{th} April 2003)

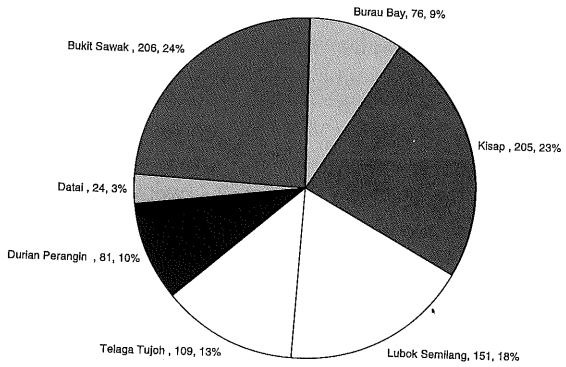

Figure 2. No. of beetles assembled at different sites on Langkawi Island (11^{th} -18^{th} April 2003)

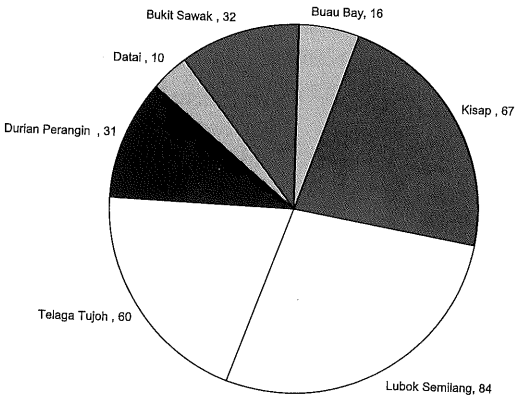

Figure 3. No. of species assembled at different sites at Langkawi Island

Table 2 shows that light trapping at Telaga Tujoh on 16th April caught the most diverse beetles (Simpson index 22.05) followed by light trapping at Lubok Semilang on 14th April (Simpson index 19.83). Net sweeping at Durian Perangin (Simpson index 12.25) and net sweeping at Lubok Semilang (Simpson index 11.64), Pitfall trap at Kisap (Simpson index 10.71) and Pitfall trap at Lubok Semilang also caught high diversity of beetles (Simpson index 10.46). Spence and Niemela [10] stated that pitfall trapping is a realistic way to survey large areas where qualitative inventory and comparison of species assemblages of ground-active arthropods is required. Light trapping on 16th April at Telaga Tujoh (Margalef 5.18) and light trapping at Lubok Semilang (Margalef 4.22) on 14th April caught the most abundant beetles.

Figure 4 shows that leaf litter collection gave 11 species of beetles from families Tenebrionidae, Staphylinidae, Scarabaeidae, Mordellidae, Curculionidae and Chrysomelidae. Figure 5 shows that the pitfall traps caught 41 species of beetles from 10 beetle families. Families Platypodidae, Ptiliidae, Carabidae, Bostrychidae and 2 unknown families which were not present in leaf litter collection but was present in the pit fall traps. Malaise trap collected 28 species of beetles from 19 families (Figure 6). This shows that Malaise trap was good to collect beetles from various families but not good in terms of collecting neither high numbers of species nor number of beetles. Families Scolytidae, Lycidae, Erotylidae, Endomychidae, Elateridae, Cicindellidae and 4 unknown families of beetles which were not caught in the leaf litter or by pitfall trap were caught in the Malaise trap in this study. Net sweeping caught 57 species of beetles from 14 families (Figure 7). Even though it is rather laborious on the operative sweep net is a good way to collect leaf beetles from family Chrysomelidae because 21 species of Chrysomelidae were assembled by net sweeping in this study followed by 16 species of Scarabaeidae. Net sweeping in this study also caught 1 species of Lycidae and 1 species of Languriidae, 2 species of Coccinellidae and 1 unknown family which were not caught by other methods mentioned earlier.

Figure 8 shows that light trap caught 120 species of beetles from 19 families of beetles with 57 species of Scarabaeidae, 12 species of Tenebrionidae, 12 species of Carabidae, 11 species of Elateridae and 8 species of Staphylinidae. One (1) species of Passalidae and 1 species of Lampyridae which were not caught by any other traps were caught by light trap.
Figure 9 to Figure 15 show the dominant beetle families at each sampling site. The dominant family caught at Kisap (Figure 9) was Platypodidae (n=72). These Ambrosia beetles feed on minute fungus (ambrosia) that grow on walls of tunnels bored by these beetles. These beetles are easier to catch in the day which explains high catch at Kisap where much net sweeping was done. Scarabaeidae (n=140) was most dominant at Sawak Hill (Figure 10) followed by Chrysomelidae (n=51). Chrysomelidae is the fourth largest family and their habit of feeding on foliage made it easy to catch. Ptiliidae (n=48) was dominant at Lubok Semilang (Figure 11). Ptiliidae is the smallest of all beetles nearly as small as any insect. They are not usually collected because of their small size and nocturnal habits but abundant in forest floor litter, moss and dead fungi.

At Telaga Tujoh (Figure 12) where the waterfall had dried, Staphylinidae (n=20) and Scarabaeidae (n=23) were dominant. Tenebrionidae (n=30) and Elateridae (n=24) were dominant at Burau Bay (Figure 13). Adult Elateridae are mostly found on leaves and shrubs, Net sweeping was done twice at Burau Bay, and this could explain high catch of this family. Datai had very low catch (Figure 14). Scolytidae (n=32) was dominant at Durian Perangin (Figure 15). Scolytidae spend nearly all their life in host trees and but can be captured during their flight period.

Table 3 gives the list of identified beetles of Langkawi Island. A total of 67 species of beetles has been identified. However 134 species have not been fully identified. A number of these are possibly new species. Ten species of beetles from Burau Bay, 15 species from Kisap, 33 species from Lubok Semilang and 9 species from Telaga Tujoh have been identified to species level. Hammod [11] listed 98 families of beetles from 500 hectares of forest areas in Sulawesi of which many are still unidentified.

Table 2. Values of Simpson index of Diversity and Margalef index of abundance at all sampling sites according to trapping methods

	Leaf litter	Leaf litter	Net Sweep	Net Sweep	Malaise Trap	Malaise Trap	Light Trap	Light Trap	Pitfall Trap	Pitfall Trap
	Simpson	Margalef	Simpson	Margalef	Simpson	Margalef	Simpson	Margalef	Simpson	Margalef
Burau Bay(11/4)			2.64	1.3						
Burau Bay(12/4)	1	0.19	5.4	2.67						
Kisap (11/4)	4	2								
Kisap (12/4)			2.19	2.46	5.44	2.27	2.49	2.31	10.71	2.56
Datai (12/4)			2.72	1.6					2.38	1.26
Lubok Semilang (13/4)	6	2.45	11.64	3.25						
Lubok Semilang (14/4)					14	3.74	19.83	4.22	10.46	2.27
Telaga Tujoh (16/4)					5	2.24	22.05	5.18	4.4	1.8
Durian Perangin (16/4)			12.25	3.47						
Durian Perangin (17/4)									5.07	2.2
Bukit Sawak (18/4)			3.11	0.68	2.67	1.5	5.34	1.85		

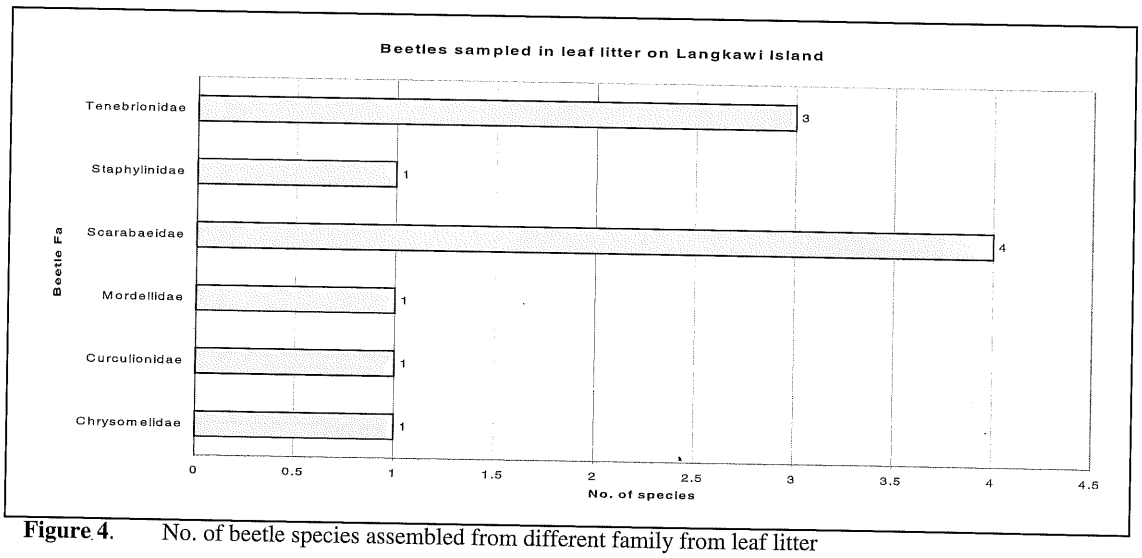

Figure 4. No. of beetle species assembled from different family from leaf litter

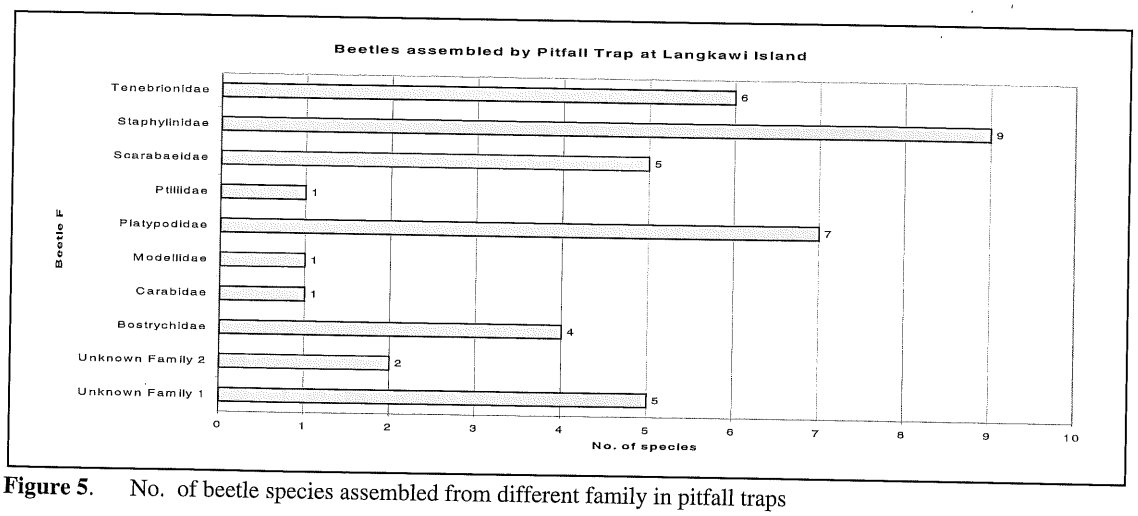

Figure 5. No. of beetle species assembled from different family in pitfall traps

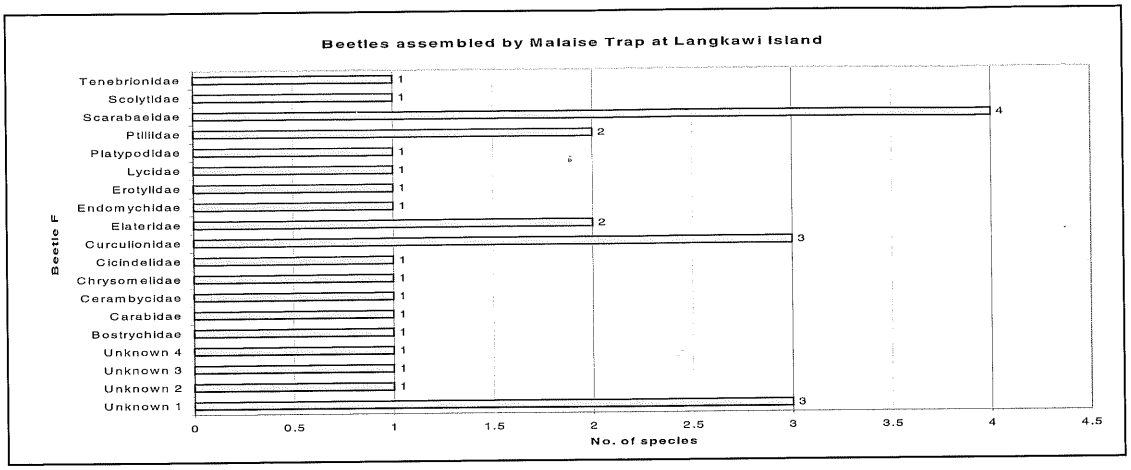

Figure 6. No. of beetle species assembled from different family using Malaise trap

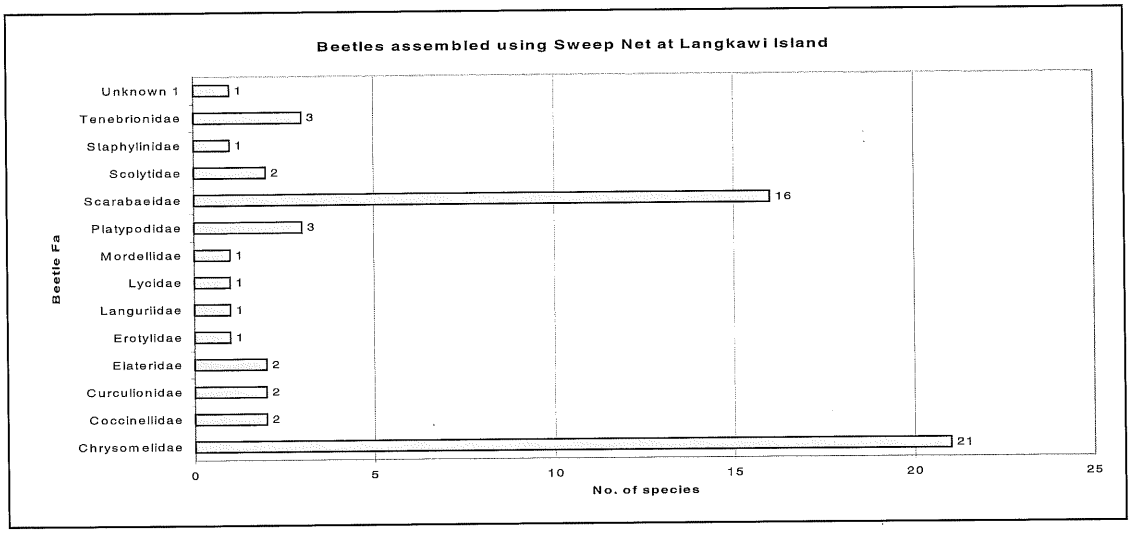

Figure 7. No. of beetle species assembled from different family using sweep net

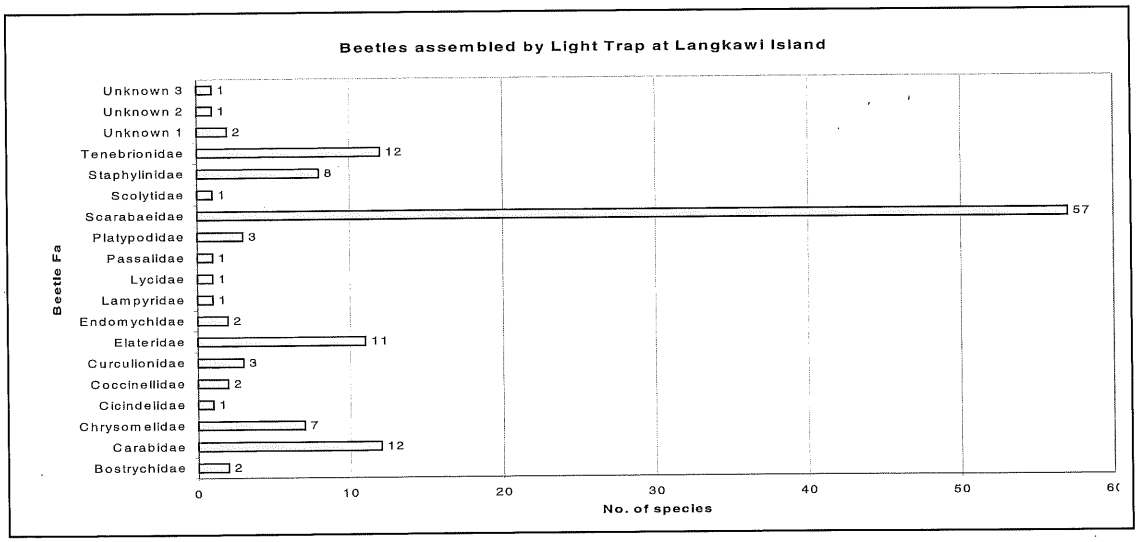

Figure 8. No. of beetle species assembled from different family from light trap

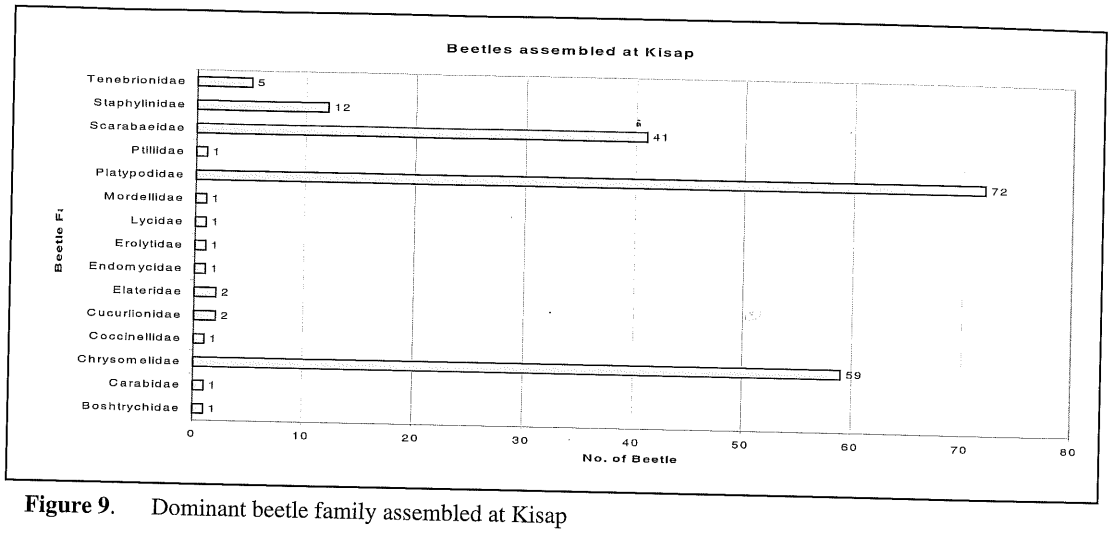

Figure 9. Dominant beetle family assembled at Kisap

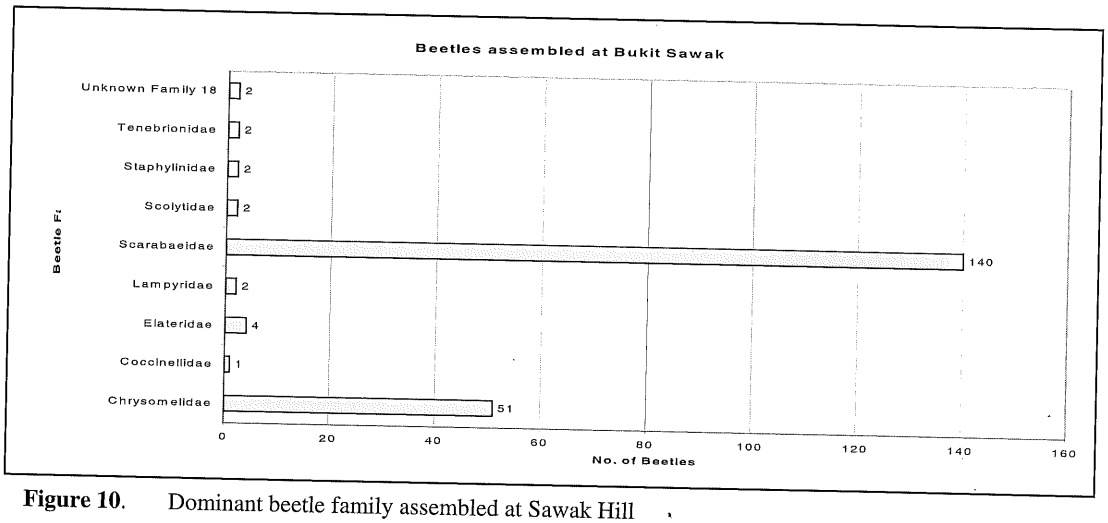

Figure 10. Dominant beetle family assembled at Sawak Hill

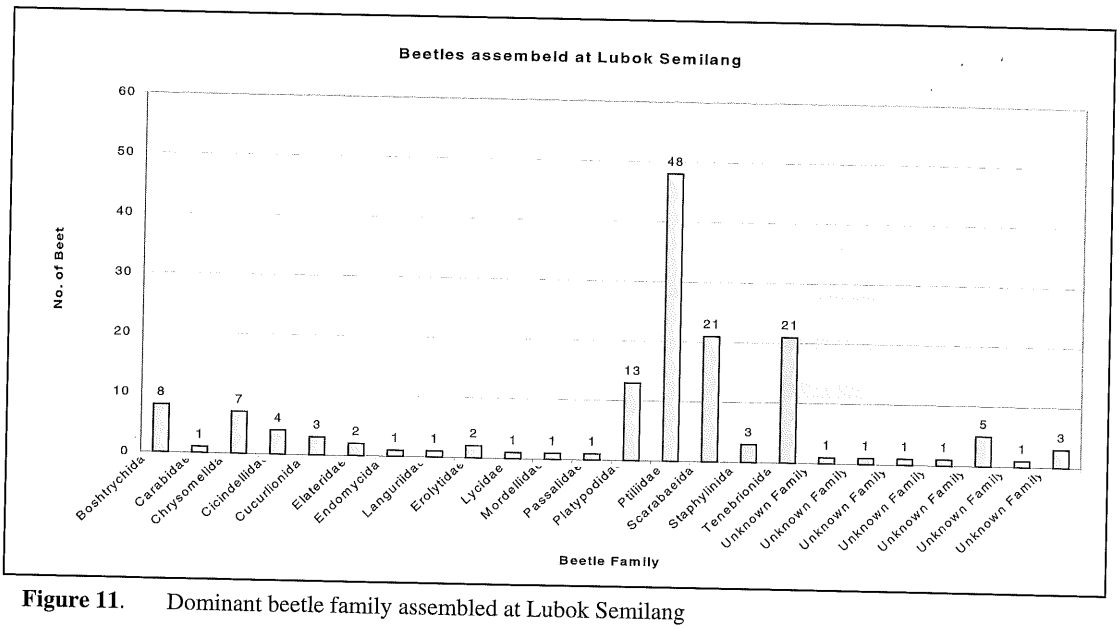

Figure 11. Dominant beetle family assembled at Lubok Semilang

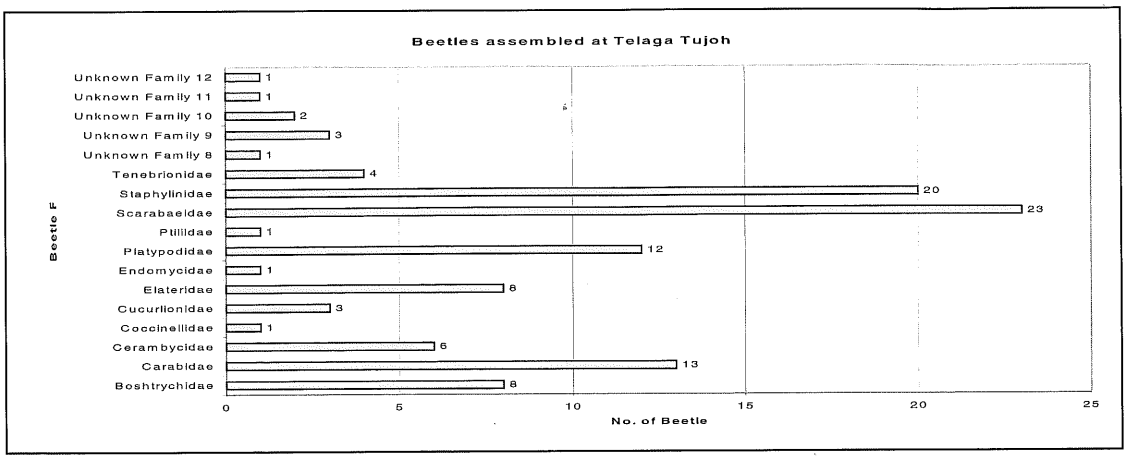

Figure 12. Dominant beetle family assembled at Telaga Tujoh

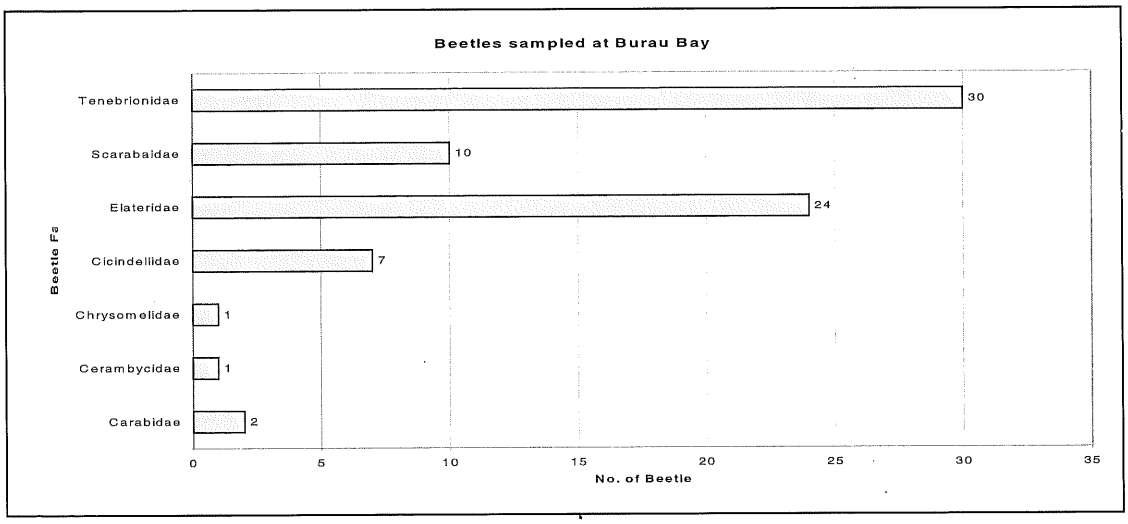

Figure 13. Dominant beetle family assembled at Burau Bay

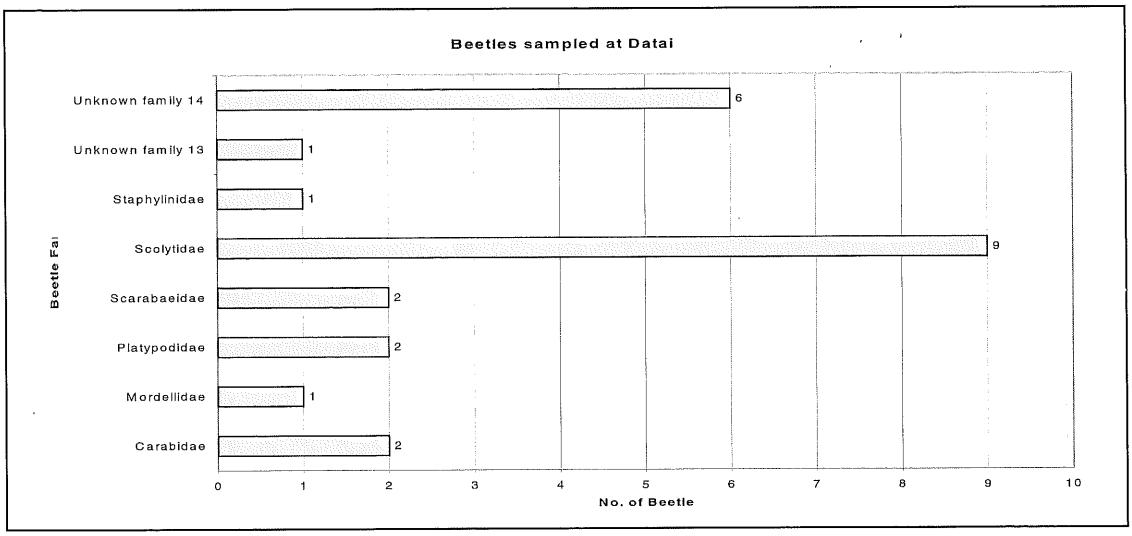

Figure 14. Dominant beetle family assembled at Datai

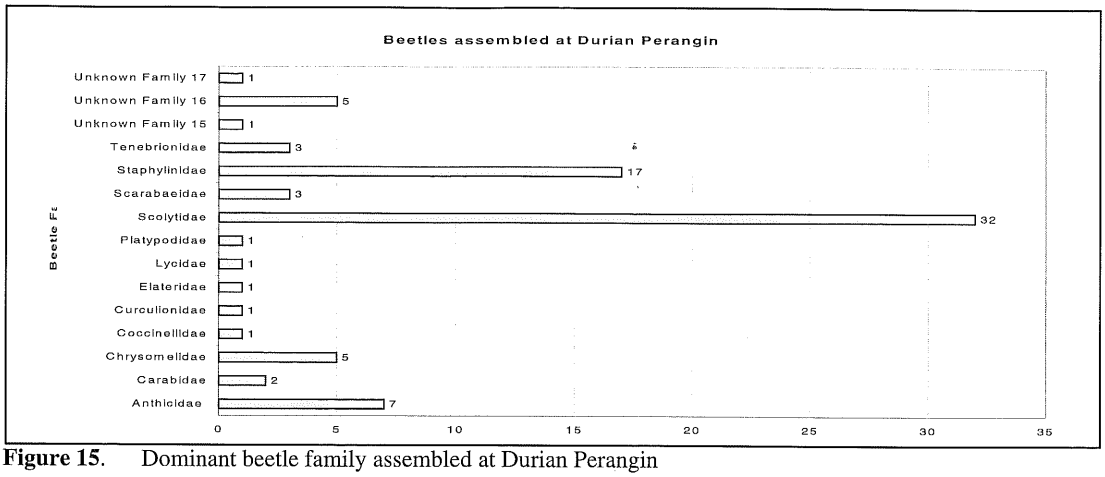

Figure 15. Dominant beetle family assembled at Durian Perangin

Table 3. List of beetles of Langkawi Island identified to the scientific names

Sampling Site	Species name	Beetle Family	Date Apr-03	Sampling Method
Burau Bay	*Cylindera minuta*	Cicindelidae	11th	Sweep Net (SN)
	Adelocera	Elateridae	11th	SN
	Ectamenogus spp	Elateridae	11th	SN
	Anomala sp 2	Scarabaeidae	11th	SN
	Acerida sp 1	Scarabaeidae	11th	SN
	Acerida sp 2	Scarabaeidae	11th	SN
	Acerida sp 3	Scarabaeidae	11th	SN
	Acerida sp 4	Scarabaeidae	11th	SN
	Heterotarsus sp 1	Tenebrionidae	11th	SN
	Heterotarsus sp 2	Tenebrionidae	11th	SN
Kisap	*Colpodes spp.*	Carabidae	12th	Malaise Trap(MT)
	Aulacophora coffea	Chrysomelidae	12th	Sweep Net (SN)
	Aulacophora frontalis	Chrysomelidae	11th	SN
	Aulacophora indica	Chrysomelidae	12th	Light Trap(LT)
	Aulacophora spp.	Chrysomelidae	12th	MT
	Bulenides sp 1	Chrysomelidae	12th	SN
	Ceropria sp 2	Tenebrionidae	12th	Pitfall Trap (PF)
	Anchastus spp.	Elateridae	12th	LT
	Episcapha maculata	Erotylidae	11th	SN
	Platypus cupulatus	Platypodidae	12th	LT
	Apogonia sp 2	Scarabaeidae	12th	PF
	Copris doriae	Scarabaeidae	12th	LT
	Aserid sp 2	Scarabaeidae	12th	LT
	Onthophagus rugicollis	Scarabaeidae	12th	LT
	Onthophagus sp 2	Scarabaeidae	12th	PF
Lubok Semilang	*Carabus spp*	Carabidae	14th	Light Trap(LT)
	Cassinoidea sp 1	Carabidae	14th	LT
	Cassinoidea sp 2	Carabidae	14th	LT
	Cassinoidea sp 3	Carabidae	14th	LT
	Cassinoidea sp 4	Carabidae	14th	LT

	Dromius spp.	Carabidae	14th	LT
	Lebia spp.	Carabidae	14th	LT
	Aulacophora antennata	Chrysomelidae	13th	Sweep Net(SN)
	Borneola hijau	Chrysomelidae	14th	LT
	Borneola spp.	Chrysomelidae	13th	SN
	Calomictus spp.	Chrysomelidae	13th	SN
	Luperus spp.	Chrysomelidae	14th	LT
	Collyris spp.	Cicindellide	14th	Malaise Trap(MT)
	Sternolophus spp.	Dytiscidae	14th	LT
	Lacon spp.	Elateridae	14th	LT
	Tetralanguria spp.	Languriidae	13th	SN
	Acceraius laevicollis	Passalidae	14th	LT
	Anomala sp 1	Scarabaeidae	14th	LT
	Anomala sp 3	Scarabaeidae	14th	LT
	Anomala sp 4	Scarabaeidae	14th	LT
	Anomala sp 5	Scarabaeidae	14th	MT
	Anomala sp 6	Scarabaeidae	14th	MT
	Apogonia expidilionis	Scarabaeidae	14th	LT
	Apoginia sp 1	Scarabaeidae	13th	SN
	Apgonia sp 3	Scarabaeidae	14th	LT
	Onthophagus sp 1	Scarabaeidae	14th	Pitfall Trap (PF)
	Schonherrie angus	Scarabaeidae	14th	Light Trap(LT)
	Xyleborus foersteri	Scolytidae	14th	Pitfall Trap (PF)
	Bolitoxenus spp	Tenebrionidae	14th	LT
	Ceropria sp 1	Tenebrionidae	14th	LT
	Plesiophthalmus sp 1	Tenebrionidae	14th	LT
	Plesiophthalmus sp 2	Tenebrionidae	14th	LT
	Bulenides spp	Lycidae	14th	Malaise Trap(MT)
Telaga Tujoh	*Stenolophus spp.*	Carabidae	17th	Light Trap(LT)
	Chlaenius spp.	Carabidae	17th	LT
	Stenochetus spp.	Curculionidae	17th	LT
	Oxyropterus audoniwi	Elateridae	17th	LT
	Exopholis hypoleaca	Scarabaeidae	17th	LT
	Anomala sp 2	Scarabaeidae	17th	LT
	Xyleborus spp.	Scolytidae	17th	LT
	Acylophorus spp.	Staphylinidae	17th	LT
	Medon spp.	Staphylinidae	17th	Sweep Net (SN)

In this study, a passalid beetle *Acceralus laevicollis* was collected using light trap at Lubok Semilang. This is a new record for Langkawi Island. Idris *et al.* [12] reported finding *Passalus tridens* and *Aceraulis spp.* at Lubok Semilang. 5 species of Scarabaeidae were assembled at Burau Bay namely *Anomala spp.* and 4 species of *Acerida* spp. *Acerida spp.* was not recorded in Langkawi before so these four species are new records for Langkawi. At Kisap, five species of Scarabaeidae collected are new records. These are *Apogonia spp., Copris doriae, Aserid spp., Onthophagus rugicolis* and *Onthophagus spp.* At Lubok Semilang, 6 species of *Anomala spp.* was collected. Idris *et al.* [12] also reported findings of 3 species of *Anomala* namely *Anomala viridus, A. rufocuprea* and *A. matsumurai.* This study also collected 2 other species of Scarabaeidae *Onthophagus spp* and *Schonherri angus* at Lubok Semilang. At Telaga Tujoh, two Scarabaeidae species *Exopholis hypoleaca* and *Anomala spp* were collected. *Onthophagus spp., Schonherri angus* and *Exopholis hypoleaca* are new records for Langkawi Island. *Cylindera minuta* from

family Cicindellidae net swept at Burau bay is a new record for Langkawi. Idris *et al.* [12] found *Cicindela aurulenta* which was not collected by this study.

Mohamedsaid [2] reported the findings of 26 genera of Chrysomelidae from the subfamily Galerucine in Langkawi which includes the genera *Aulocophora*. In this study, *Aulocophora cofea*, *A. frontalis*, *A. indica* were collected from Kisap and *A.antennata* was collected at Lubok Semilang. These three species of *Aulocophora* were also recorded at Danum valley by Mohamedsaid [13]. This study also assembled other beetles belonging to family Chrysomelidae which has not been reported. The new chrysomelids collected in this study are *Bulenides spp* at Kisap and *Borneola hijau*, *Borneola spp.*, *Calomictus spp.*, *Luperus spp.*, at Lubok Semilang. All these five species are new records for Langkawi. New records from other families are also reported in this study. From the family Elateridae, *Ectamenogus spp* found at Burau Bay, *Anchastus spp.* found at Kisap, *Lacon spp.* found at Lubok Semilang and *Oxyropterus audoniwi* found at Telaga Tujoh are new records for Langkawi. *Colpodes spp.* found at Kisap, *Carabus spp.* 4 species of *Cassinoidea* , *Dromius spp. Lebia spp.* found at Lubok Semilang and *Stenolophus spp.* and *Chlaenius spp.* found at Telaga Tujoh are all new records from family Carabidae were caught in this study. Six species of Tenebrionidae collected in this study are new records for Langkawi. 2 species of *Heterotarsus* collected at Burau Bay, 2 species of *Ceropria* collected from Kisap and Lubok Semilang and two species of *Plesiophthalmus* collected at Lubok semilang. One species of beetle from family Erotylidae *Episcapha maculata* and *Platypus cupulatus* from family Platypodidae collected at Kisap are also new records for Langkawi. At Lubok Semilang, *Sternolophus spp* a Dytiscidae, a *Acceraius laevicollis* Languriidae, *Xyleborus foerstei*, a Scolytidae and *Bulenidea spp.* a Lycidae are new records for Langkawi. A *Xyloberus spp.* was also collected at Telaga Tujoh. A beetle from family Curculionidae *Stenochetus spp.* also caught from Lubok Semilang is a new record for Langkawi.

Mohamedsaid [2] reported that Tioman is not as diverse as Langkawi for subfamily Galerucine beetles but it is difficult to compare both studies with the Chrysomelids caught in these studies in terms of diversity because those studies did not use diversity index to calculate diversity.

Forest reserves of Mt. Macincang and Mt. Gunungraya are still intact thus the relatively low development in Langkawi so far did not affect the beetle diversity in the forest reserves. With these findings it is suggested that two third forests covering Langkawi Island be kept as it is. Ecotourism for appreciation of nature may be a good industry which helps the population to appreciate nature thus conserving it for future generations.

Terrestrial arthropod diversity including that of coleopterans (beetles) has been shown to be influenced by coarse woody debris [14, 15 and 16] and the vertical complexity of the habitat [17, 18 and 19], both of which are critical components of structural diversity. Since beetles play many ecological roles in the ecosystem, it is suggested that the present forest areas in Mt. Macincang and Mt. Gunungraya be conserved to keep intact the structural diversity of the forest vegetation. Deforestation for more agricultural, industrial or infrastructured building areas e.g. of hotels and resorts should avoid the undisturbed forests and be confined in or around the present port and Kuah area.

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