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MOTH (LEPIDOPTERA: HETEROCERA) OF SUNGAI SEDIM FOREST RESERVE, KEDAH, MALAYSIA

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ABSTRACT

Sampling of moth in Sungai Sedim Forest Reserve in Kedah Malaysia were conducted from August 17th until 19th and December 7th until 9th 2007. The objective of the study was to determine the diversity of moth species (Lepidoptera : Heterocera). A total of 196 individual representing 116 species in 12 families were collected during six days of sampling. Noctuidae is the most dominant family with 41 species, followed by Geometridae (36 species), Lymantridae (11 species), Sphingidae (10 species), Notodontidae (5 species), Arctiidae (3 species), Uranidae (3 species), Drepanidae (2 species), Saturnidae and Nolidae (each with two species); and Lasiocampidae and Limacodidae (each with one species). In general, the most abundant species is *Gangaridea vardena* Swinhoe (Notodontidae), while the common species is *Hypochrosis binexata* Walker (Geometridae). A total of 81 species (69.83%) are known as rare species. The Shannon Weiner index value was highest (H'=3.37) recorded for sampling during 18/08/07, followed by sampling at H'= 3.37 (19/08/07), H'=3.30 (17/08/07), H'=2.84 (07/12/07) and H'=2.78 (08/12/07), respectively. The overall H' value for 5 days sampling is 4.46 while the Evennes index (E') is 0.94. The highest values of H' and E' indices show that Sungai Sedim Forest Reserve, Kedah has a very high diversity of moth species and is evenly distributed.

INTRODUCTION

Moths are a group of specialized, night-flying Lepidoptera. Generally they can be recognized by their dull colours, and feathery antennae, but also by the way they rest, with the wings stretch and expanded. The base of the hindwing is expanded and strengthened, supporting and coupling with the forewing when flight. Moths have a wide variety of wing shape. This study was conducted in the Sungai Sedim Forest Reserve, district of Kulim Kedah. This forest is classified as a dipterocarp forest. The area covers almost 100 km^2 with coordinate 100°47'10.7" E and 05°24'50.3" N. Sungai Sedim Forest Reserve is situated 33 km from Kulim and 130 km from Alor Setar. It located within the Gunung Inas Forest Reserve is one of the best places to go for white water rafting. The 15km long river has fast flowing waters and rapids excellent for white water sports activities. The river is also one of the best heart-stopping water rapids in the world. Sungai Sedim is a very nice place to go to enjoy the nature because of the diversity of flora and fauna. Sungai Sedim famous as conservation forest, catchment's water area, virgin forest, wildlife conservation forest, research forest and recreation forest. This study documented the diversity of moth fauna of Sungai Sedim Forest Reserve.

MATERIALS AND METHOD

A study of moths fauna was conducted at Sungai Sedim Forest Reserve, Kedah was carried out from from August 17th until 19th and December 7th until 9th 2007. Sampling of moths was using 160 watt mercury vapour bulb light traps powered by a portable generator, hang in front of a white

cloth screen that are directed towards the surrounding of the forest from 1900 to 2200 hours. Moths that came and trapped at the screen were collected manually. The specimens were killed in the killing jars containing cotton wools soaked with ethyl acetate. Later, the specimens were pinned, oven-dried, identified, labeled and classified in the laboratory at the Centre for Insect Systematic, Universiti Kebangsaan Malaysia (CIS-UKM). Species identification is done with the aid of standard references such as Borror & Delong (1971), Barlow (1982), Carter (1992) and Holloway (1987). Spesies identified than reposited in CIS-UKM depository.

RESULT AND DISCUSSION

Moth Fauna

A total of 196 individual representing 116 species in 12 families were collected during six days of sampling. Noctuidae is the most dominant family with 41 species, followed by Geometridae (36 species), Lymantridae (11 species), Sphingidae (10 species), Notodontidae (5 species), Arciidae (3 species), Uranidae (3 species), Drepanidae (2 species), Saturnidae and Nolidae (each with two species); and Lasiocompidae and Limacodidae (each with one species) (Appendix 1). This comprises approximately 9.59% of the total known species in the Borneo (Table 1) and constituted the new record for this forest reserve, since there is no previously published report of fauna moth in this area.

In general, the highly abundant species is *Gangaaridea vardena* Swinhoe (Notodontidae), while the common species is *Hypochrosis binexata* Walker (Geometridae). A total of 81 species (69.83%) are known as rare species. The most dominant family found is Noctuidae with 41 species or 3 5.34% of the total moths collected. This is because Noctuidae family around the world is exceeding 25,000 species whilst the number of Geometridae family is 15,000 species (Carter 1992). They vary in size from ten millimeters in wingspan to 20 centimeters or more, although with only a few exceptions they are dull moths with grey, brown or black wings and few obvious markings. Two marks on the forewing - one circular and one kidney-shaped are often diagnostic.

Table 1 : Comparative number and percentage of moth species found at the Sungai Sedin Forest Reserve, Kedah and those of the Borneo.

Family	No. of species in each family in Sedim Forest Reserve (Present Study)	No of species in each family in Borneo (Halloway)	Percentage of species compared to those of the Borneo
Noctuidae	41	480	8.54%
Geometridae	36	385	9.53%
Lymantridae	11	76	14.47%
Uranidae	3	11	27.27%
Nolidae	1	0	0
Sphingidae	10	42	23.81%
Arctiidae	3	70	4.29%
Notodontidae	5	35	14.29%
Drepanidae	2	26	7.69%
Lasiocampidae	1	16	6.25%
Limacodidae	1	12	8.33%
Saturnidae	2	5	40%
Total	116	1210	9.59%

Comparison With Moth Species in Other Areas of Malaysia

In comparison, the total number of moths species recorded in this study (116 species) is lower compared to those of Kinabalu Park (706 species) (Jainah 1984), Universiti Kebangsaan Malaysia Reserve Forest (766 species) (Norela 1993) and Sayap Forest in Sabah (722 species) (Chong 1993), respectively (Table 2). The most probably reason is the limited duration of sampling period compared to those locations that cover much more time of sampling in order to have a good picture of the moths fauna diversity. On the other word, Sungai Sedim Forest Reserve Hutan has been converted into recreational areas and developed with basic infrastructures for visitors, and this could be the underlying factor for the decrease in species richness observed. Thus this result might be one of the factor that cause the lower number of species obtained in this study. In conclusion, the diversity of moths fauna in this study was considered moderate, taking into account the limited sampling period and area covered as compared to similar efforts from other part of Malaysia.

Table 2 : comparative number and percentage of species recorded at Sungai Sedim Forest Reserve (SDFR), Kinabalu Park (KP), Hutan Simpan Universiti Kebangsaan Malaysia, Bangi (UKM), and Sayap Sabah (SS).

No	Family	Number of species in each family			
		SDFR*	KP	UKM	SS
1	Noctuidae	41	269	178	280
2	Geometridae	36	240	143	181
3	Lyamantridae	11	47	39	33
4	Uranidae	3	4	2	4
5	Nolidae	1	0	2	0
6	Sphigidae	10	11	0	46
7	Arctiidae	3	52	83	79
8	Notodontidae	5	26	14	33
9	Drepanidae	2	14	20	13
10	Lasiocampidae	1	11	3	11
11	Limacodidae	1	1	18	8
12	Saturnidae	2	5	0	7
13	Cossidae	0	2	2	9
14	Bombycidae	0	8	1	8
15	Zygaenieda	0	0	4	1
16	Epiplemidae	0	6	4	1
17	Eupterotidae	0	5	0	4
18	Callidulidae	0	1	0	1
19	Hepialidae	0	0	0	0
20	Metarbelidae	0	1	0	1
21	Brahmaeidae	0	0	0	2
22	Cycliydidae	0	0	0	0
23	Thyatiridae	0	3	0	0
24	Pyralidae	0	0	207	0
25	Thytiridae	0	3	14	0
26	Tortricidae	0	0	10	0
27	Lecithoceridae	0	0	6	0
28	Tineidae	0	0	5	0
29	Gelechiidae	0	0	3	0
30	Oecophoridae	0	0	2	1
31	Pyraustidae	0	0	2	0
32	Psyschidae	0	0	1	0
33	Xylorytiidae	0	0	1	0
34	Eriocottidae	0	0	1	0
35	Choreutidae	0	0	1	0
	Total	116	706	766	722
	% of Borneo	9.59%	58.35%	63 .31%	59.67%

Sources : Jainah, 1984 (KP) ; Norela, 1993 (UKM); Chong 1993 (SS); present study (SDFR)*

Cumulative Species Diversity

Table 3 shows the values of Shannon-Wiener diversity index (H'), Shannon-Wiener Evenness index (E') and total cumulative species (S') for five sampling occasions.

Table 3: values of Shannon-Wiener diversity Index (H^+), Shannon-Wiener Evenness (E^+) and Total cumulative species (S^+).

Index	1	2	3	4	5	Total
	(17/08/07)	(18/08/07)	(19/08/07)	(07/12/07)	(08/12/07)	1+2+3+4+5
E'	0.96	0.98	0.97	0.95	0.91	0.94
H'	3.30	3.37	3.47	2.48	2.78	4.46

Notes : H' values with the same alphabets are not significantly different ($p>0.05$).

Cumulative analysis is used to determine the adequate of sampling efforts; whether more samplings are otherwise needed to point out the true species diversity and richness of the study area. The cumulative Shannon-Weiner diversity Index (H') for day one is 3.30 (Table 3). The index for second day sampling was slightly increased to 3.37 and getting increase again for the third day sampling occasion. However, the differences were statistically not significant ($p>0.05$) between day one with day two sampling; and day two with day three. The H' decreases to 2.48 for the fourth day and the difference is statistically significant ($p<0.05$) compared to other days. The fifth sampling effort was not significantly difference ($p>0.05$) compared to fourth day and this could be due to recaptured the same species in the subsequent sampling. Thus, it can be generally concluded that the minimum sampling efforts required providing a representative description of moth species diversity at Sungai Sedim Forest Reserve for fifth day sampling occasion. The Evenness value (E') was almost constant from the first to fifth sampling occasion with range from 0.91 to 0.98 (Table 3), which seem to indicate the lack of diversity in food plants and climate factor.

It can be deduced that more regular surveys, more longer duration of sampling and more wider areas would provide a better representative picture of the moths fauna for the area. Thus, this would include not only in terms of species diversity, eveness and richness composition but also the status of the biological diversity that occur in the area, that has an interaction with the moth fauna.

CONCLUSION

A total of 196 individual representing 116 species in 12 families were collected during six days of sampling. Noctuidae is the most dominant family with 41 species, followed by Geometridae (36 species), Lymantridae (11 species), Sphingidae (10 species), Notodontidae (5 species), Arctiidae (3 species), Uranidae (3 species), Drepanidae (2 species), Saturnidae and Nolidae (each with two species); and Lasiocampidae and

Limacodidae (each with one species). In general, the most abundant species is *Gangaridea vardena* Swinhoe (Notodontidae), while the common species is *Hypochrosis binexata* Walker (Geometridae). The overall H' value for 5 days sampling is 4.46 while the Evennes index (E') is 0.94. The highest values of H' and E' indices show that Sungai Sedim Forest Reserve, Kedah has a very high diversity of moth species and is evenly distributed.

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Appendix 1 : Number of specimens of each moth species recorded for Sungai Sedim Forest Reserve, Kulim Kedah over the sampling occasion.

No.	Taxa	Sampling ocassion				
		August 2007			December 2007	
		17	18	19	7	8
	NOCTUIDEA					
	Subfamili: Ophidernia					
1	*Anisoneura aluco* Fabricius	1	0	0	0	0
2	*Anisoneura salebrosa* Guenee	1	0	0	0	0
3	*Bastilla arcuata* Moore	1	0	0	0	0
4	*Catocala mocula* Hampson	0	1	0	0	0
5	*Ischja inferna* Swinhoe	1	0	0	0	0
6	*Ischja hemiphaea* Hampson	1	0	0	0	0
7	*Marapana flavicosta* Guenee	1	0	0	0	0
8	*Pangrapta chilana* Swinhoe	1	0	0	0	0
9	*Tochera olivacea* Swinhoe	2	0	0	0	0
	Subfamili : Acronictinae					
10	*Aburina uniformis* Swinhoe	0	1	0	0	0
11	*Buzara saikehi* Walker	0	1	0	0	0
12	*Pangrapta poeto ides* M.G. Allen	0	1	0	0	0
13	*Platyja umminia* Cramer	0	1	0	0	0
	Subfamili: Stictopterinae					
14	*Bamra albico* Walker	0	0	1	0	0
15	*Daddala quadrisingnata* Walker	0	0	1	0	0
16	*Erebus aphesperis aphesperis* Hubner	0	0	1	0	0
17	*Gardirtha inexacta* Walker	0	1	0	0	0
18	*Holodes caranea* Cramer	0	0	1	0	0
19	*Platja umbrina* Doubleday	0	0	2	0	0
20	*Simplica rufaoaccidentalis* Holloway	0	2	0	0	0
21	*Sperredonia alix* Guenee	0	0	2	0	0
22	*Tochara creberrima* Walker	0	0	1	0	0
23	*Vestura minereusalis* Walker	0	1	0	0	0
	Subfamili : Hypeninae					
24	*Achaea serva* Fabricius	0	0	0	0	1
25	*Avatha tepescens* Walker	0	0	1	0	0
26	*Avitta guttulosa* Swinhoe	0	0	1	0	0
27	*Episparis costistriga* Walker	2	0	0	0	0
28	*Ophiusa trapezium* Guenee	0	0	2	0	0
29	*Sypna persubsignata* Walker	0	0	1	0	0
30	*Ugia serrilinea* Hampson	0	0	1	0	0

	Subfamili: Acontinae					
31	*Heterospila fulgerea* Guenee	4	0	1	2	0
32	*Hypopyra assigero ides* Sp.n	0	0	0	0	1
33	*Hypospila bolinoides* Guenee	4	2	0	0	0
34	*Ischyja subreducta* Sp.n	1	0	0	1	0
	Subfamily : Catocalinae					
35	*Hamodes lutea* Walker	1	0	1	0	0
36	*Ischyja paraplesius* Rothschild	0	1	2	0	0
37	*Ugia disjungens* Walker	0	1	1	0	0
	Subfamili: Sarrothripnae					
38	*Asota preducta* Buttler	0	0	1	0	1
39	*Ercheia cyllaria* Cramer	0	0	1	0	1
40	*Hamodes prop itia* Guerin-Meneville	0	0	0	2	1
41	*Othresis fuionia* Clerck	0	0	0	0	1
	GEOMETRIDAE					
	Subfamili: Oenochrominae					
42	*Amblychia hymenaria* Prout	1	0	0	0	0
43	*Catoria tamsi* Prout	1	0	0	0	0
44	*Cleora pendleburyi* Prout	0	1	0	0	0
45	*Dysphania glaucescens* Walker	1	0	0	0	0
46	*Lapho bates mesotoechia* Prout	1	0	0	0	0
47	*Ormithospila avicularia* Guenee	1	0	0	0	0
48	*Sarcinodes malakarius* Prout	0	1	0	0	0
49	*Sundascellia epelys* Prout	1	0	0	0	0
50	*Teldenia unistrigata* Walker	1	0	0	0	0
	Subfamili: Geometrinae					
51	*Cleoria atlenaria* Walker	0	1	0	0	0
52	*Cyclophora flavissima* Prout	0	1	0	0	0
53	*Ophthalmitis basiscripta* Walker	0	0	1	0	0
54	*Peratophyga xanthyala* Hampson	0	1	0	0	0
55	*Semiothisa avitusaria* Walker	0	1	0	0	0
56	*Tanaorhinus rafflesii* Moore	0	1	0	0	0
57	*Thalassodes depulsata* Walker	0	2	0	0	0
58	*Xerodes pilosa* M.G. Allen	0	0	1	0	0
59	*Zeheba lucidata* Walker	0	1	0	0	0
	Subfamili : Ennominae					
60	*Celerena signata* Walker	0	0	0	0	1
61	*Cleora batillata* Fletcher	0	0	1	0	0
62	*Cleora determinata* Walker	0	0	0	1	0

63	*Dindica polyphaenaria* Guenee	0	0	1	0	0
64	*Fascellina aurifera* Warren	0	0	0	1	0
65	*Hypocrosis binexata* Walker	1	2	1	3	0
66	*Hypocrosis pyrrhopheata* Walker	0	3	0	0	8
67	*Hypocrosis sternaria* Guenee	0	0	1	0	0
68	*Lassaba vinacea* Prout	0	0	0	1	0
69	*Luxiaria hyalodela* Prout	0	0	0	1	0
70	*Nadagara synocha* Prout	0	0	0	1	0
71	*Orathalassodes flaccosa* Prout	0	0	0	0	1
72	*Pingasa rubimontana* Hooloway & Sommerer	1	0	0	0	0
73	*Xylinophylla hypocausta* Warren	1	0	0	0	0
	Subfamili : Sterrhinae					
75	*Aparandria specularia* Guenee	0	0	1	1	0
76	*Omiza lycoraria* Guenee	1	0	0	2	0
77	*Tanaorhinus viridiluteata*Walker	0	0	2	2	0
	LYMANTRIDAE					
78	*Arctornis magnaclava* Collenette	3	0	0	0	2
79	*Arctornis naptha* Sp.n	0	0	0	0	1
80	*Arctornis perfecta* Walker	1	0	1	0	0
81	*Hema petriinnae* Bryk	0	0	2	0	0
82	*Imaus manda* Walker	0	0	1	0	0
83	*Leu coma impressa* Snellen	0	1	0	0	0
84	*Lymantria minora* Van Eecke	1	1	0	0	0
85	*Micromorphe chalcostoma* Collenette	0	1	0	0	0
86	*Nygmia guttulata* Snellen	0	0	0	0	1
87	*Nygmia peperites* Collenette	0	2	0	1	0
88	*Situla denudate* Walker	0	0	0	2	0
	URANIDAE					
89	*Barachydecetia rufescens* Butler	1	0	0	0	0
90	*Phazaca erosioides* Walker	0	1	0	0	0
91	*Uraptero ides astheniata* Guene	0	0	0	3	0
	NOLIDAE					
92	*Bienina donnas* Walker	1	0	0	0	0
	SPHINGIDAE					
	Subfamily : Sphinginae					
93	*Callambulyx rubicosa Amanda* Rothschild	0	0	1	0	0
94	*Cechenena helops* Walker	0	1	0	0	0
95	*Oxyyambulyx pryeri* Distant	1	0	0	0	0
96	*Theretra nessus* Drury	1	0	0	0	0

	Subfamily : Macroglossinae					
97	*Acosmeryx Socrates* Boisduva	0	0	1	0	0
98	*Enpinanga borneensis* Butler	0	0	1	0	0
99	*Enpinanga borneensis* Butler	0	0	0	0	3
100	*Megacorma oblique* Walker	0	0	0	0	1
101	*Panacra dohertyi* Rothschild	0	0	0	0	3
102	*Teheretra nessus* Drury	0	0	0	0	1
	ARCTIDAE					
	Subfamily : Lithosinae					
103	*Anagnra subfascia* Walker	0	0	1	0	0
104	*Asota subsimiis* Walker	0	0	0	0	1
105	*Barsine roseororatus* Butler	0	1	0	0	0
	NOTODONTIDAE					
106	*Formogentonia orbifer* hampson	0	1	0	0	0
107	*Gangarides rosea* Walker	0	0	2	0	0
108	*Gangarides vardena* Swinhoe	0	0	5	5	2
109	*Hyperaeschrella insulicola* Kiriakoff	0	0	0	1	0
110	*Tarsolepis rufobronnea* Rothschild	0	0	0	1	0
	DREPANIDAE					
111	*Albara reversaria reversaria* Walker	0	1	0	0	0
112	*Camptopsestis malayana* Yoshimato	0	0	0	1	0
	LASIOCAMPIDEA					
113	*Trabala indra* Roepke	0	0	2	0	0
	LIMACODIDAE					
114	*Scopelodes athela* Swinhoe	0	0	0	0	2
	SATURNIDAE					
115	*Attacus atlas* Linnaeus	0	0	0	1	0
116	*Samia borneensis* Drury	0	0	0	0	1
Cumulative no. of individuals		16	57	104	118	149
Cumulative no. of species		10	27	38	44	51
Total no. of specimens		171				
Total no. of species		60				