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**MACRO-MOTH FAUNA (LEPIDOPTERA :  
HETEROCERA) OF TASIK CHINI, PAHANG,  
MALAYSIA**

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**ABSTRACT**

A study on aesthetic insects (macro-moth fauna) was conducted at three different locations of Tasik Chini area in Pahang, Malaysia. The three locations were the base camp (site A), an abandoned mine (site B) and Kampung Melai (site C). Samplings were conducted from 22-26<sup>th</sup> May 2004 and from 22-24<sup>th</sup> July 2004, using a light-trap (illuminated by a 160-watt mercury vapour bulb). A total of 176 species has been recorded, comprising 106 species (310 individuals) from location A, 99 species (362 individuals) from location B and 28 species (210 individuals) from location C, respectively. This total encompassed 19 families, Geometridae (67 species), Noctuidae (38 species), Arctiidae (17 species), Sphingidae (9 species), Notodontidae (8 species), Lymantriidae (8 species), Lasiocampidae (7 species), Limacodidae (5 species), Drepanidae (4 species), Uraniidae, Bombycidae, Saturniidae (two species each), Chalcosiidae, Nolidae, Agaristidae, Cossidae, Cyclidiidae, Callidulidae, and Epiplemididae (one species each). All of the 176 species recorded in this study are preliminary

records since there has been no previous publication of moths from Tasik Chini, Pahang. The Shannon's diversity index ( $H'$ ) for location A ( $H'=4.23$ ) was significantly higher ( $p<0.05$ ) than that of location B ( $H'=3.71$ ) or location C ( $H'=2.01$ ), respectively. In terms of the cumulative value for species diversity of moths ( $H'$ ) the study found that seven sampling occasions were still insufficient for location A, six samplings were minimally sufficient for location B and two samplings were minimally sufficient for location C. Percentages of overlapping species were all low between A and B (22.62%), B and C (15.74%), and A and C (12.5%), respectively. A total of 12 species were found to be common spatially (i.e. found in all three locations). Among all the species, *Hypochrosis binexata* Walker (Geometridae) was found to be the most common spatially as well as temporally (i.e. found on every sampling occasion, with an overall total of 180 individuals). Some 79 species appeared rare, each represented by only one individual throughout the study period.

**Keywords:** Macro-moth, Lepidoptera, Heterocera, Tasik Chini

### ABSTRAK

Kajian serangga estetik (fauna rama-rama makro) di Tasik Chini, Pahang telah dijalankan di tiga lokasi persampelan, iaitu A (kawasan perkhemahan), B (bekas lombong terbiar) dan C (Kampung Melai). Persampelan telah dilakukan dari 22-26 Mei 2004 dan dari 22-24 Julai 2004) dengan menggunakan perangkap cahaya (yang diterangi dengan lampu wap raksa 160 watt). Sejumlah 176 spesies rama-rama telah berjaya direkodkan, iaitu sebanyak 107 spesies (310 individu) dari lokasi A, 99 spesies (362 individu) dari lokasi B dan 28 spesies merangkumi 19 famili, iaitu Geometridae (67 spesies), (210 individu) dari lokasi C, masing-masing. Jumlah ini Noctuidae (38 spesies), Arctiidae (17 spesies), Sphingidae (9 spesies), Notodontidae (8 spesies), Lymantriidae (8 spesies), Lasiocampidae (7 spesies), Limacodidae (5 spesies), Drepanidae (4 spesies), Uraniidae, Bombycidae, Saturniidae (masing-masing 2 spesies), Chalcosidae, Nolidae, Agaristidae, Cossidae, Cyclidiidae, Callidulidae, dan Epiplemididae (masing-

masing satu spesies). Kesemua 176 spesies dalam 19 famili yang ditemui dalam kajian ini merupakan rekod awal bagi Tasik Chini, Pahang. Indeks Kepelbagaian Shannon's ( $H'$ ) bagi rama-rama di ketiga-tiga lokasi persampelan menunjukkan perbezaan signifikan ( $p < 0.05$ ) di antara satu sama lain. Indeks kepelbagaian di lokasi A ( $H' = 4.23$ ) adalah signifikan ( $p < 0.05$ ) lebih tinggi berbanding lokasi B ( $H' = 3.71$ ) atau C ( $H' = 2.01$ ). Perbandingan kepelbagaian spesies rama-rama ( $H'$ ) secara kumulatif menunjukkan bahawa tujuh kali pensampelan belum memadai bagi lokasi A, enam pensampelan adalah minimum memadai bagi lokasi B dan dua pensampelan adalah minimum memadai bagi lokasi C. Peratus pertindihan spesies bagi lokasi A dan B (22.62%), B dan C (15.74%) dan A dan C (12.5%) adalah rendah semuanya. Sejumlah 12 spesies didapati umum secara spatial (iaitu ditemui disemua lokasi persampelan). Secara keseluruhan *Hypochrosis binexata* Walker (Geometridae) bukan sahaja merupakan spesies paling umum secara spatial, malahan ia juga adalah spesies umum secara temporal (iaitu ditemui dalam setiap pensampelan) dan juga melimpah (iaitu jumlah keseluruhan 180 individu). Sebanyak 79 spesies adalah berstatus langka iaitu masing-masing ditemui dengan satu individu sahaja sepanjang tempoh kajian.

**Kata kunci:** Rama-rama macro, Lepidoptera, Heterocera, Tasik Chini

## INTRODUCTION

Tasik Chini, which is the second largest natural lake in Malaysia, after Tasik Bera, consists of 12 interconnecting small lakes (called 'laut' by the local community). These lakes are namely: Gumum, Pulau Balai, Chenahan, Tanjung Jerangkung, Lusu, Labuhand Jemberau. Tasik Chini is surrounded by about 4,975 hectares of lush tropical forest, comprising lowland dipterocarp forest and peat swamp forest. The high biodiversity of Tasik Chini is well documented and this natural heritage has a high potential for eco-tourism development. Tasik Chini was identified as water sources for surrounding area. Any develop activities should disturb the ecosystems and will disturb the water quality and the diversity of

flora and fauna. During the Tasik Chini Scientific Expedition from 22<sup>nd</sup> to 27<sup>th</sup> May 2004, the Pahang State Government and Universiti Kebangsaan Malaysia (UKM) had launched the establishment of the UKM Tasik Chini Research Centre, which is now the centre of interdisciplinary research activities for graduate students, faculty members and their foreign counterparts. This study, which reports the initial findings of our surveys on the lepidopteran biodiversity of Tasik Chini, is focused on macro moths, which possess wingspans of over 5 mm. To date, there has been no published record as yet on the comprehensive biodiversity checklist of the moth fauna of Tasik Chini. The results obtained, and hereby presented, provide a preliminary insight of the moth fauna of this fresh water lake ecosystem.

## **MATERIALS AND METHOD**

Sampling were conducted at three different locations namely the site A (base camp), site B (abundant mine) and site C (Kampung Melai). Samplings were conducted from 22-26<sup>th</sup> May 2004 and from 22-24<sup>th</sup> July 2004, using a light-trap (illuminated by a 160-watt mercury vapour bulb; powered by portable generator), hung in front of a white-cloth screen and directed towards the surrounding forest in each location. For each night, each trap was set to operate from 1900hours to 2400hours. Moths that landed on the screen were collected manually and the collected specimens were killed in the killing jars containing cotton wools soaked with ethyl acetate. The killed specimens were kept in dry plastic containers before being pinned, oven-dried, labelled, identified and classified. Identified specimens were stored properly at the Centre for Insect Systematics, Universiti Kebangsaan Malaysia (CIS-UKM).

Species identification and taxonomic classification of the moth specimens were based on the standard taxonomic references (e.g. Barlow, 1982; Holloway, 1983, 1985, 1986, 1989, 1993, 1996, 1997, 1998, 2001, 2003, 2005). The specimens of each moth species accumulated from the locations were accordingly tabulated to facilitate visualization of some interesting aspects of the moth fauna manifested. These include the assessment of the moth

species as being rare, common or abundant, and also the calculation of Shannon-Weiner species diversity index ( $H'$ ) and evenness index ( $E'$ ) for each sampling location (Robinson, 1991).

## RESULTS AND DISCUSSION

The sampling results of moth fauna of Tasik Chini as shown in Table 1 recorded a total of 176 species in 19 families. Species composition appeared highest for Geometridae (67 species), followed by Noctuidae (38 species), Arctiidae (17 species), Sphingidae (9 species), Notodontidae (8 species), Lymantriidae (8 species), Lasiocampidae (7 species), Limacodidae (5 species), Drepanidae (4 species), Uraniidae, Bombycidae, Saturniidae (two species each), Chalcosiidae, Nolidae, Agaristidae, Cossidae, Cyclidiidae, Callidulidae, and Epiplemidae (one species each), respectively. To date, there has been no previous published record on moths from any of the locations selected in this study.

**Table 1:** Checklist of moth species and total individuals recorded at locations A, B and C of Tasik Chini, Pahang

No.	Taxon	Location			
		A	B	C	A+B+C
<b>ZYGAENOIDEA</b>					
<b>Limacodidae</b>					
1	<i>Contheyla lola</i> Swinhoe	0	6	0	6
2	<i>Phocoderma velutina</i> Koll	10	5	0	15
3	<i>Praesetora divergens</i> Moore	0	5	0	5
4	<i>Scopelodes anthela</i> Swinhoe	15	39	7	61
5	<i>Thosea vetusta</i> Swinhoe	6	0	0	6
<b>Chalcosiidae</b>					
6	<i>Pompelon marginata</i> Guerin	42	0	0	42
<b>COSSOIDEA</b>					
<b>Cossidae</b>					
7	<i>Xyleutes strix</i> Linnaeus	2	7	0	7
<b>BOMBYCOIDEA</b>					
<b>Bombycidae</b>					
8	<i>Penicillifera apicalis</i> Walker	14	0	0	14

No.	Taxon	Location			
		A	B	C	A+B+C
9	Bombycidae species 1 <b>Saturniidae</b>	0	2	0	2
10	<i>Attacus atlas</i> Linnaeus	0	5	0	5
11	Saturniidae species 1 <b>Lasiocampidae</b>	0	2	0	2
	<i>Alompra roepkei sarotes</i>				
12	Tams <i>Digglesia australasiae</i>	6	11	0	17
13	Walker <i>Gastropacha pardale</i>	0	0	7	7
14	Walker <i>Halicarnia albipectus</i>	0	2	0	2
15	Walker	0	0	10	10
16	<i>Lebeda cognata</i> Grunberg <i>Paralebeda uniformis</i>	2	0	0	2
17	Holloway <i>Syrastrena sumatrana</i>	0	19	0	19
18	<i>malayensis</i> Holloway <b>Sphingidae</b>	0	6	0	6
	<b>Sphinginae</b>				
19	<i>Daphnusa ocellaris</i> Walker <i>Marumba juvenus</i>	5	19	51	75
20	Rothschild & Jordan	0	0	7	7
21	<i>Oxyambulyx pryeri</i> Distant <i>Oxyambulyx subocellata</i>	11	0	0	11
22	Felder	0	2	0	2
23	Sphinginea species 1 Macroglossinae	1	0	0	1
24	<i>Cechenena helops</i> Walker	0	6	0	6
25	<i>Daphnis hypothous</i> Cramer <i>Enpinanga assamensis</i>	0	5	0	5
26	<i>bigens</i> Butler <i>Enpinanga borneensis</i>	6	0	0	6
27	Butler <b>NOTODONTOIDEA</b>	0	0	5	5
	<b>Notodontidae</b>				
	<i>Benbowia dudgeoni</i>				
28	Kiriakoff	4	2	0	6
29	<i>Brykia horsfieldi</i> Moore	0	5	0	5
30	<i>Chadisra bipars</i> Walker	0	5	0	5
31	<i>Dudusa nobilis</i> Walker <i>Eupydna testacea postrubra</i>	7	0	0	7

No.	Taxon	Location			
		A	B	C	A+B+C
32	Swinhoe	0	19	0	19
33	<i>Gangarides rosea</i> Walker	16	0	12	28
	<i>Quadricalcarifera eusebia</i>				
34	Kiriakoff	17	6	5	28
35	Notodontidae species 1	0	2	0	2
	<b>NOCTUOIDEA</b>				
	<b>Arctiidae</b>				
	<b>Lithosiinae</b>				
	<i>Asura strigipennis</i> Herrich-Schäffer	32	0	0	32
36	<i>Cyana malayensis</i> Hampson	0	11	4	15
37	<i>Cyana perornata</i> Walker	0	7	13	20
	<i>Lambula malayana</i>				
38	Holloway	17	0	0	17
	<i>Miltochrista cornicornutata</i>				
39	Holloway	0	3	0	3
	<i>Miltochrista euprepioides</i>				
40	Moore	0	8	0	8
	<i>Parasiccia marginipuncta</i>				
41	Talbot	0	3	0	3
	<b>Arctiinae</b>				
42	<i>Baroa siamica</i> Hampson	0	4	0	4
43	<i>Nyctemera baulus</i> Boisduval	5	5	0	10
	<i>Pericallia gatactina</i>				
44	<i>trigonalis</i> Vollenhoven	0	72	0	72
45	Arctiinae species 1	0	7	0	7
	<b>Aganainae</b>				
46	<i>Asota caricae</i> Fabricius	0	3	0	3
47	<i>Asota producta</i> Butler	6	17	0	23
48	<i>Asota subsimilis</i> Walker	0	13	0	13
49	Aganainae species 1	0	2	0	2
50	Aganainae species 2	2	0	0	2
	<b>Ctenuchinae</b>				
	<i>Syntomis euryptera</i>				
51	Hampson	0	0	21	21
	<b>Nolidae</b>				
52	<i>Roeselia aperta</i> Walker	10	0	0	10
	<b>Lymantridae</b>				
	<i>Cassidia peninsularis</i>				
53	Holloway	17	0	0	17
	<i>Euproctis digramma</i>				
54	Boisduval	6	0	0	6

No.	Taxon	Location			
		A	B	C	A+B+C
56	<i>Euproctis fumosa</i> Snellen	1	0	0	1
57	<i>Leucoma impressa</i> Snellen	18	0	0	18
	<i>Lymantria singapura</i>				
58	Swinhoe	5	3	0	8
	<i>Scarpona ennomoides</i>				
59	Walker	2	0	0	2
60	<i>Sitvia denudata</i> Walker	24	0	0	24
61	Lymantriidae species 1	1	0	0	1
	<b>Agaristidae</b>				
	<i>Mimeusemia vittata jordani</i>				
62	Pendlebury	0	6	0	6
	<b>Noctuidae</b>				
	<b>Ophiderinae</b>				
	<i>Arcte modesta</i> van der				
63	Hoeven	0	6	0	6
	<i>Calyptra minuticornis</i>				
64	Guenée	8	0	0	8
65	<i>Chilkasa falcata</i> Swinhoe	1	0	0	1
66	<i>Episparis tortuosalis</i> Moore	11	0	0	11
67	<i>Homodes crocea</i> Guenée	0	12	0	12
68	<i>Ischyja ferrifracta</i> Walker	2	2	0	4
69	<i>Ischyja inferna</i> Swinhoe	6	11	10	27
	<i>Ommatophora luminosa</i>				
70	Cramer	11	0	0	11
71	<i>Othreis fullonia</i> Clerck	9	0	7	16
72	<i>Rivula monorema</i> Holoway	6	0	0	6
	<i>Sarobides inconclusa</i>				
73	Walker	8	0	0	8
74	<i>Vestura minereusalis</i> Walker	0	22	0	22
75	Ophiderinae species 1	0	5	0	5
76	Ophiderinae species 2	0	0	7	7
77	Ophiderinae species 3	1	0	0	1
	<b>Acronictinae</b>				
78	<i>Borbotana nivifascia</i> Walker	6	0	0	6
	<i>Chasmina nigropunctata</i>				
79	Bethune Baker	0	5	0	5
80	<i>Dyrzela plagiata</i> Walker	0	6	0	6
	<b>Acontiinae</b>				
81	<i>Amyna punctum</i> Fabricius	14	6	0	20
82	<i>Metamaene atrigutta</i> Walker	42	0	0	42



No.	Taxon	Location			
		A	B	C	A+B+C
83	Acontiinae species 1	1	0	0	1
	<b>Hypeninae</b>				
	<i>Simplicia circumscripta</i>				
84	Walker	7	0	0	7
	<b>Stictopterinae</b>				
	<i>Lophoptera aequilinea</i>				
85	Walker	14	0	0	14
	<i>Lophoptera ferrinalis</i>				
86	Walker	0	5	0	5
87	<i>Odontodes aleuca</i> Guenée	6	0	0	6
	<i>Stictoptera describens</i>				
88	<i>paragiata</i> Walker	0	6	0	6
	<b>Sarrothripinae</b>				
89	<i>Blenina donans</i> Walker	5	0	0	5
	<i>Nanaguna variegata</i>				
90	Hampson	7	0	0	7
	<b>Chloephorinae</b>				
91	<i>Maurilia iconica</i> Walker	7	0	9	16
	<i>Paracrama dulcissima</i>				
92	Walker	9	0	0	9
	<i>Tympanistes fusimargo</i>				
93	Prout 7	6	0	13	
94	<i>Urbona dentilinealis</i> Moore	36	17	0	53
	<i>Westermannia argentea</i>				
95	Hampson	0	7	0	7
	<b>Catocalinae</b>				
96	<i>Achaea serva</i> Fabricius	0	6	0	6
97	<i>Ercheia cyllaria</i> Cramer	16	0	0	16
	<i>Erebus ephesperis</i>				
98	<i>ephesperis</i> Hübner	0	2	0	2
99	<i>Parallelia arcuata</i> Moore	0	3	9	12
	<i>Parallelia fulvotaenia</i>				
100	Guenée	0	3	0	3
	<b>GEOMETROIDEA</b>				
	<b>Drepanidae</b>				
	<b>Drepaninae</b>				
	<i>Tridrepana albonotata</i>				
101	Moore	7	0	0	7
	<i>Tridrepana flava contracta</i>				
102	Watson	6	0	0	6

No.	Taxon	Location			
		A	B	C	A+B+C
103	<i>Tridrepana fulvata</i> Snellen <b>Oretinae</b>	0	5	0	5
104	<i>Oreta bicolor</i> Warren <b>Cyclidiidae</b>	0	5	7	12
105	<i>Cyclidia orciferaria</i> Walker <b>Geometridae</b> <b>Oenochrominae</b>	0	5	0	5
106	<i>Alex palparia</i> Walker	81	270	68	419
107	<i>Eumelea rosalia</i> Stoll <i>Sarcinodes restitutaria</i>	1	0	0	1
108	Walker	88	7	0	95
109	Oenochrominae species 1	2	0	0	2
110	Oenochrominae species 2	8	6	0	14
111	Oenochrominae species 3 <b>Geometrinae</b>	2	4	0	6
112	<i>Agathia eromena</i> Prout <i>Archaeobalbis subtepens</i>	0	20	0	20
113	Walker <i>Archaeobalbis sundana</i>	7	0	0	7
114	Holloway	0	15	0	15
115	<i>Epipristis nelearia</i> Guenée <i>Ornithospila submonstrans</i>	14	30	3	47
116	Walker	63	50	54	167
117	<i>Ornithospila succincta</i> Prout	0	0	3	3
118	<i>Pingasa chlora</i> Stoll	0	11	6	17
119	<i>Pingasa ruginaria</i> Guenée	9	35	11	55
120	<i>Pingasa subviridis</i> Warren	0	2	0	2
121	<i>Pingasa venusta</i> Warren	13	2	0	15
122	<i>Tanaorhinus rafflesii</i> Moore	7	2	0	9
123	<i>Terpna erionoma</i> Swinhoe <i>Timandromorpha energes</i>	7	5	0	12
124	Prout	0	5	0	5
125	<i>Geometrinae</i> species 1	1	0	0	1
126	<i>Geometrinae</i> species 2	2	2	0	4
127	<i>Geometrinae</i> species 3	0	3	0	3
128	<i>Geometrinae</i> species 4 <b>Sterrhinae</b>	0	2	0	2
129	<i>Zythos turbata</i> Walker	1	0	0	1
130	Sterrhinae species 1 <b>Lerentiinae</b>	9	0	0	9
131	<i>Chloroclystis semiscripta</i> Warren <i>Ziridava kanshireiensis</i>	7	0	0	7

No.	Taxon	Location			
		A	B	C	A+B+C
132	Prout <b>Ennominae</b>	6	0	0	6
133	<i>Alcis periphracta</i> Prout <i>Anisodes argyromma</i>	7	6	0	13
134	Warren	6	3	0	9
135	<i>Auzeodes coctata</i> Warren	5	0	0	5
136	<i>Boarmia costaria</i> Guenée	51	110	19	180
137	<i>Boarmia uoptilaria</i> Swinhoe <i>Chorodna complicataria</i>	0	12	0	12
138	Walker	1	3	0	4
139	<i>Cleora determinata</i> Walker	11	26	0	37
140	<i>Cleora pupillata</i> Walker	13	17	0	30
141	<i>Cleora repepita</i> Butler	5	0	0	5
142	<i>Cleora tenebrata</i> Fletcher <i>Diplurodes exprimata</i>	3	5	0	8
143	Walker <i>Diplurodes fimbripedata</i>	15	0	0	15
144	Warren <i>Diplurodes semiparata</i>	32	0	0	32
145	Walker <i>Elphos brabanti</i> Thieriy-	5	0	0	5
146	Mieg	0	11	0	11
147	<i>Fascellina clausaria</i> Walker <i>Hetrolocha falconaria</i>	15	2	0	17
148	Walker <i>Hypochrosis binexata</i>	27	0	0	27
149	Walker <i>Hypochrosis lycoraria</i>	84	256	527	867
150	Guenée	7	5	0	12
151	<i>Hyposidra talaca</i> Walker	0	5	0	5
152	<i>Luxiaria emphatica</i> Prout	12	0	0	12
153	<i>Luxiaria phyllosaria</i> Walker	7	0	0	7
154	<i>Micronia astheniata</i> Guenée <i>Mimochroa angulifascia</i>	3	0	0	3
155	Meyrick <i>Ophthalmitis pertusaria</i>	0	5	0	5
156	Walker <i>Ourapteryx claretta</i>	84	0	0	84
157	Holloway <i>Peratophyga venetia</i>	0	10	0	10
158	Swinhoe <i>Petelia medardaria</i> Herrich-	0	5	0	5

No.	Taxon	Location			
		A	B	C	A+B+C
159	Schäffer	8	0	0	8
160	<i>Plutodes cyclaria</i> Guenée	1	27	9	37
	<i>Plutodes malaysiana</i>				
161	Holloway	0	12	0	12
	<i>Ruttellerona cessaria</i>				
162	Walker	9	0	0	9
	<i>Semiothisa avitusaria</i>				
163	Walker	7	2	0	9
164	<i>Semiothisa khasiana</i> Moore	0	2	0	2
165	<i>Synegia botydaria</i> Guenée	5	0	0	5
	<i>Zamaranda eogenaria</i>				
166	Snellen	0	14	0	14
167	Ennominae species 1	3	0	0	3
168	Ennominae species 2	3	0	0	3
169	Ennominae species 3	1	0	0	1
170	Ennominae species 4	13	0	0	13
171	Ennominae species 5	1	0	0	1
172	Ennominae species 6	2	0	0	2
	<b>Uraniidae</b>				
	<b>Uraniinae</b>				
173	<i>Lyssa zampa docile</i> Butler	0	62	0	62
	<b>Microniinae</b>				
174	<i>Micronia astheniata</i> Guenée	13	8	41	62
	<b>Epiplemidae</b>				
175	<i>Epiplema quadricaudata</i> Walker	5	0	0	5
	<b>Callidulidae</b>				
176	Callidulidae species 1	0	0	3	3
	Total individual each location	310	362	210	882
	Total species each location	107	99	28	176
	H' values	4.23	3.71	2.01	4
	E' values	0.9	0.81	0.6	0.77

Geometridae and Noctuidae were the two largest families of moths in the study area. According to Carter (1992), there were more than 25,000 species of Noctuidae and over 15,000 species of Geometridae worldwide. Our studies from Gunung Stong in Kelantan, Sungkai in Perak, and elsewhere in Peninsular Malaysia (Zaidi et al. 2004; Norela et al. 2006) also supported this statement. However, at Tasik Chini the number of Geometridae species was more than that of Noctuidae (Table 2), and this could

be due to the composition of vegetation that comprised the food sources and breeding sites for Geometridae. Holloway (1996 & 1997) reported that members of the Geometridae family are suitable for indicator of disturbed ecosystems. Our preliminary records of moths for the Tasik Chini area also indicated that from a total of 176 species identified, 79 species appeared rare (i.e. each represented by only one individual throughout the study period).

**Table 2.** Number of moth species and individual recorded at locations A, B and C of Tasik Chini, Pahang.

No.	Family	A Species (Individuals)	B Species (Individuals)	C Species (Individuals)	A+B+C Species (Individuals)
1	Geometridae	50 (191)	39 (224)	9 (157)	67 (572)
2	Noctuidae	24 (48)	18 (28)	5 (9)	38 (85)
3	Arctiidae	5 (11)	13 (47)	3 (8)	17 (66)
4	Sphingidae	4 (7)	4 (8)	3 (14)	9 (29)
5	Notodontidae	4 (10)	6 (10)	2 (4)	8 (24)
6	Lymantriidae	8 (15)	1 (1)	0 (0)	8 (16)
7	Lasiocampidae	2 (2)	4 (9)	2 (4)	7 (15)
8	Limacodidae	3 (6)	4 (11)	1 (2)	5 (19)
9	Drepanidae	2 (2)	2 (2)	1 (1)	4 (5)
10	Uraniidae	1 (6)	2 (16)	1 (10)	2 (32)
11	Bombycidae	1 (2)	1 (1)	0 (0)	2 (3)
12	Saturniidae	0 (0)	2 (2)	0 (0)	2 (2)
13	Chalcosiidae	1 (7)	0 (0)	0 (0)	1 (7)
14	Nolidae	1 (2)	0 (0)	0 (0)	1 (2)
15	Agaristidae	0 (0)	1 (1)	0 (0)	1 (1)
16	Cossidae	0 (0)	1 (1)	0 (0)	1 (1)
17	Cyclidiidae	0 (0)	1 (1)	0 (0)	1 (1)
18	Callidulidae	0 (0)	0 (0)	1 (1)	1 (1)
19	Epiplemlidae	1 (1)	0 (0)	0 (0)	1 (1)
Total		107 (310)	99 (362)	28 (210)	176 (882)

Of all the species, *Hypochrosis binexata* Walker (Geometridae: Ennominae) (Figure 1) was identified as the most common species spatially as well as temporally (i.e. found on every sampling occasion, with an overall total of 180 individuals), followed by *Alex palparia* Walker (Geometridae: Oenochrominae) (79 individuals) and *Boarmia costaria* Guenée (Geometridae: Ennominae) (42 individuals). *H. binexata* was found to be the

most abundance at location C compared to the other two forested areas (Table 1). The land use of location C comprised a mosaic of fragmented logged-over forest, oil palm and rubber plantations, and the Orang Asli settlement. Due to its ubiquity in such habitats, this species thus, has the potential to be a very suitable candidate as a biological indicator for disturbed ecosystems.

Overall, the Shannon's species diversity index of moths in location A ( $H' = 4.23$ ) is significantly higher than that of B ( $H' = 3.71$ ,  $p < 0.05$ ) and C ( $H' = 2.01$ ,  $p < 0.05$ ) but not significantly different from that of locations A&B combined ( $H' = 4.17$ ) (Table 3 and Table 4). This was also supported by the highest value of species evenness index for location A ( $E' = 0.90$ ), followed by that of B ( $E' = 0.81$ ) and C ( $E' = 0.60$ ) (Table 3).

The cumulative value of  $H'$  at location A by the 8<sup>th</sup> sampling night was not significantly higher ( $p > 0.05$ ) than those obtained by the 7<sup>th</sup> sampling visit (nights 1 to 7) and the 6<sup>th</sup> sampling visit (nights 1 to 6), but was significantly higher ( $p < 0.05$ ) than that of the 5<sup>th</sup> sampling visit (nights 1 to 5). This indicated that six sampling nights appeared minimally sufficient in depicting the high moth diversity at location B, while eight sampling nights were still insufficient in depicting the much higher moth diversity at location A (Table 4).

**Table 3.** Shannon's species diversity index ( $H'$ ) and evenness index ( $E'$ ) of moths at locations A, B and C.

Index value	Locations			
	A	B	C	A+B+C
$H'$	4.23 <sup>d</sup>	3.71 <sup>b</sup>	2.01 <sup>a</sup>	4.00 <sup>c</sup>
$E'$	0.90	0.81	0.60	0.77

Note:  $H'$  values marked with the same alphabet are not significantly different ( $p > 0.05$ ).

**Table 4.** Shannon's species diversity index ( $H'$ ) for accumulated data of eight sampling nights at the three study locations

Location	Cumulative $H'$ value according to total sampling nights							
	1	2	3	4	5	6	7	8
A	2.61 <sup>a</sup>	3.03 <sup>b</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>
B	2.36 <sup>a</sup>	2.71 <sup>b</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>
A&B	2.95 <sup>a</sup>	4.06 <sup>b</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>	4.06 <sup>a</sup>

Note:  $H'$  values in each row marked with the same alphabet are not significantly different ( $p > 0.05$ ) from one another.

## CONCLUSION

From the results of the study, it can be concluded that more comprehensive and regular surveys, each conducted over longer duration and covering more areas would provide a better representation of the moth fauna of the Tasik Chini area in terms of species richness and composition. The status of the species *H. binexata* has been identified as being both relatively most common and abundant spatially and temporally compared to other species. Although currently it appears that location A is generally more accessible than location B for the study and appreciation the moth fauna of Tasik Chini forest reserves, it is hoped that the study area could be expanded and the current species checklist be revised further in the coming future.

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**Figure 1.** *Hypochrosis binexata* Walker (Geometridae: Ennominae)