Moth diversity in Tropical Rain Forest of Maliau Basin, Sabah, Malaysia, with special reference to Ginseng Camp

Chey Vun Khen

Forest Research Centre, Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah, Malaysia.

ABSTRACT. Short sampling revealed that the moth diversity (as measured by Williams Alpha) in the primary forest of Ginseng Camp in the southern part of Maliau Basin, was the highest (262.28 $\pm$ 31.91) compared to other primary sites in Sabah, namely Lake Linumunsut (134.72 $\pm$ 48.69), Imbak Canyon (140.47 $\pm$ 29.13), and Danum Valley (195.24 $\pm$ 23.73). Endemism was also high with about 10% of the 355 species sampled being endemic. In view of the high biodiversity of the area as indicated by moths, and the average diameter of its commercial timbers being below the allowable felling size, the area has rightly been gazetted for biodiversity conservation.

Keywords: Biodiversity, endemism, Ginseng Camp, Maliau Basin, moths, tropical rain forest.

INTRODUCTION

The Maliau Basin Conservation Area, comprising some 58,840 hectares, is classified as a Class I Protection Forest under the Sabah Forest Enactment. Until now, much of the basin located in south-central Sabah, remains unexplored, lending it an air of mystery and earning it the name 'Lost World' of Sabah.

This study on the moth fauna was part of the Maliau Basin Scientific Expedition in February-March, 2005. Previously, there were three major scientific expeditions in Maliau: the Gunung Lotung Expedition in 1988, the Camel Trophy Expedition in 1996, and the Lake Linumunsut Expedition in 2001. The Gunung Lotung and Lake Linumunsut expeditions were conducted north of the Basin, while Camel Trophy is one of the camps located in the south. The expedition in 2005 focused on a camp called Ginseng, about six hours walk from Agathis Camp in the south.

Apart from a study on the moths of Lake Linumunsut in the north (Chey & Lim-Hasegawa, 2008), not much is known about the moth fauna of Maliau. The present study aims to find out the diversity of moths in the south, to compare it with Linumunsut as well as other rain forest habitats in Sabah, and to indicate the biodiversity value of each, with implications on forest management.

Moths are used as indicators of biodiversity. In their larval stage, moths are mainly phytophagous leaf-feeders (Holloway *et al*. 2001), and some of the moth caterpillars also belong to other guilds such as detrivores of plant and animal material; flower, fruit, and seed predators; stem borers; lichen and algal browsers; fungal feeders; as well as insectivores (Holloway & Stork, 1991). Some are hostplant specific specialists with limited ecological tolerance, while others are generalists indicative of a disturbed habitat. Caterpillars of moths of the *Lophoptera* lineage (Noctuidae: Stictopterinae) are known to be leaf-feeders of Dipterocarpaceae, and those species are likely to be absent in highly degraded forest sites (Chey, 2002). Thus, abundance or absence of moths will reflect on the biodiversity of vegetation of the area being sampled. Compared with other faunal groups which are less readily sampled or observed, moths can be readily sampled using a light-trap

at night. Also, the taxonomy of moths is better known compared to other insects, apart from butterflies. Moths are, however, more speciose than butterflies which facilitate data analysis. Hence, moths fulfil most of the requirements as effective biodiversity indicators (Holloway & Stork, 1991).

MATERIALS AND METHODS

Locality

The sampling site was at the dipterocarp forest in Ginseng Camp, facing a northwest direction opposite a helipad clearing with a sloping forest canopy in the distance. The altitude was at 620 m. Vegetation comprised mainly primary forest of dipterocarp trees, as well as towering trees of *Agathis borneensis*.

Sampling

A light-trap was used comprising a vertical white sheet (3 m^2) illuminated by a 250W mercury-lithium bulb powered by a portable generator (Plate 1). The trap was set on the forest floor and run from around 6:30 pm to 10:30 pm, peak hours of moth activity. Altogether approximately 12 trapping hours were employed from three consecutive sampling nights (February 27 – March 1, 2005).

Moths attracted to light were sampled using killing bottles charged with ethyl acetate, papered and labelled. Samples were subsequently sent to the Forest Insect Museum in Sepilok for identification.

Identification

Moths were mainly identified using monographs by Barlow (1982), Holloway (1983, 1985, 1986, 1987, 1988, 1989, 1993, 1996, 1997, 1998, 1999, 2001, 2003, 2005, 2008, 2009), Kobes (1985, 1989, 1994), and by referring to the moth collection in the Forest Insect Museum. Only the macromoths were sorted, as the micromoth taxonomy is incompletely studied in the region.

Data Analysis

Williams Alpha diversity index (log series) based on the numbers of individuals and species sampled was used to measure moth diversity. This diversity index is commonly used for light-trapped moth samples, as it is the measure most independent of sample size (Fisher *et al*., 1943), where samples only partially capture total species richness at a locality (Beck & Schwanghart, 2010). Higher value of the index means higher diversity.

RESULTS AND DISCUSSION

A complete list of the macromoths sampled at Ginseng Camp is given in Appendix 1. Altogether 355 species were sampled comprising 753 individuals. This yielded a very high diversity value at 262.28 ± 31.91.

Compared with the diversity values of similarly sampled forest sites in Sabah such as Lake Linumunsut (Chey & Lim-Hasegawa, 2008), Imbak Canyon (Lim-Hasegawa & Chey, 2009), and Danum Valley (Chey, 2006), Ginseng in Maliau produced the highest diversity (Table 1, Figure 1).

This high value reflects the high biodiversity present in the undisturbed natural forest around the southern rim of Maliau Basin. The mixed dipterocarp forest in Maliau is reported to be extremely species-rich with at least 70 species of dipterocarps of the genera *Shorea*, *Dipterocarpus*, *Parashorea*, *Dryobalanops*, *Vatica* and *Hopea* (Hazebroek *et al*., 2004). As mirrored in the samples, there was a rich assemblage of moths of the *Lophoptera* lineage (15 species) such as *Lophoptera* spp. (Plate 2) as well as *Odontodes* spp. (Noctuidae: Stictopterinae) with dipterocarps as hostplants of their caterpillars,

Table 1. Diversity value (Alpha) of moths in Ginseng compared with those of other similarly sampled primary forest sites in Sabah. N = number of individuals, S = number of species.

Site	Altitude (m)	N	S	Alpha ± 95% confidence range
Ginseng Camp, Maliau	620	753	355	262.28 ± 31.91
Lake Linumunsut, Maliau	400	130	91	134.72 ± 48.69
Imbak Canyon	400	286	156	140.47 ± 29.13
Danum Valley	170	717	301	195.24 ± 23.73

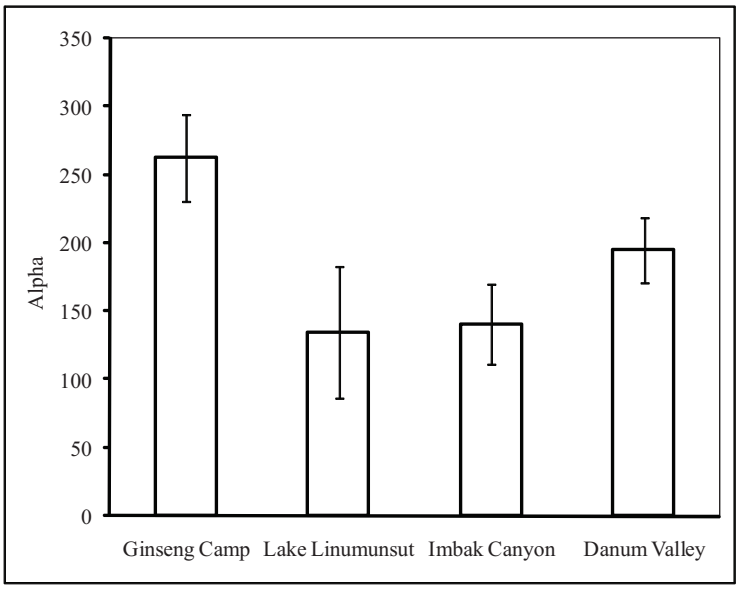

Figure 1. The diversity value (Alpha) of Ginseng moths is the highest compared with those of other sites in Sabah.

though the *Odontodes*/*Lophoptera* lineage has also been recorded from Euphorbiaceae.

The moth samples are noted for their evenness in abundance, indicative of a climax vegetation in ecological equilibrium. There was an absence of high abundance of certain r-strategist species indicative of disturbed forest habitats. Only six species with ten individuals or more were sampled. These are, in decreasing order of abundance, *Lophoptera pallibasis* Holloway (18 individuals), *Hypochrosis binexata* Walker (13), *Odontodes seranensis* Prout and *Artena inversa* Walker (both 12), "*Tigrioides*" *leucanioides* Walker (11), *Maceda mansueta* Walker (10). Both *Lophoptera* and *Odontodes* are dipterocarp feeders as mentioned earlier, while *Hypochrosis binexata* Walker is generally common in the rain forest of Borneo.

Also, situated at an altitude of 620 m, the forest saw an overlap of both lowland and montane elements, and moths are reported to be more diverse between 500 m and 1,000 m above sea level (Chey, 1998). This is in line with the values for samples from the forests of Mulu in Sarawak from the lowlands to 1,000 m (Holloway, 1984).

Out of 355 species sampled, there were 39 known endemics or about 10% of the total. This was relatively high compared to endemism in other parts of Borneo (Chey, 2000). Some of the specimens were not identifiable based on the existing literature. They could be either new records, or even new taxa.

Several highly charismatic emperor moths (Saturniidae), particularly *Antheraea* spp. as well as *Archaeoattacus staudingeri* Rothschild (atlas moth group, Appendix 2), were collected. The rare and attractive brahmaeid moth *Brahmaea hearseyi* White (Brahmaeidae; Appendix 2) was also present. Some of these were found beyond the sampling period, and a more intensive programme will undoubtedly produce a more comprehensive checklist.

CONCLUSION

As found in this study, biodiversity of the area as indicated by moths is extremely rich. Endemism is also relatively high. Gait *et al*. (1998) commented that despite the presence of high quality timbers such as *Shorea* and *Agathis* in Maliau Basin, the average diameter of trees is mostly below the minimum allowable felling size, and none of which are easily accessible. In view of these factors, the Sabah State Government made the wise decision in gazetting the area as Class 1 Protection Forest, to conserve its rich biodiversity.

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Appendix 1. Moths collected at Ginseng Camp, Maliau, using light-trap, with numbers of individuals. Samples were taken on February 27 – March 1, 2005 (I, II, III).#
*Recorded Bornean endemics.

1. Family: Cossidae	**I**	**II**	**III**
Cossus cinereus Roepke	3	2	1
Cossus kinabaluensis Gaede	1		
Cossus vandeldeni Roepke		1	
Cossus sp. 1	1		
Cossus sp. 2	2		
Cossus sp. 3	1		
Xyleutes adusta Roepke	2	5	1
Xyleutes ceramica Walker		1	
Xyleutes quarlesi Roepke*		1	
Xyleutes cf. *quarlesi* Roepke		1	1
Xyleutes strix Linnaeus			2
Zeuzera lineata Gaede		1	

2. Family: Limacodidae	**I**	**II**	**III**
Allothosea lola Swinhoe			1
Birthama rubicunda Walker		1	1
Birthamula chara Swinhoe			1
Cania bandura Moore	4	1	3
Narosa concinna Swinhoe		1	
Nirmides basalis Walker	2	2	3
Nirmides purpurea Holloway			2
Parasa pastoralis Butler	1	1	
Scopelodes albipalpalis Hering*	3		
Scopelodes pallivittata Snellen	5		1
Scopelodes unicolor Westwood	2	1	
Setora cupreiplaga Walker*		5	4
Thosea lutea Heylaerts	4	2	2

3. Family: Sphingidae	**I**	**II**	**III**
Callambulyx rubricosa Walker			1
Daphnusa ocellaris Walker	1		
Enpinanga vigens Butler		1	

4. Family: Bombycidae	**I**	**II**	**III**
Andraca apodecta Swinhoe		1	
Ernolatia moorei Hutton			2
Gunda javanica Moore	1		
Mustilia dierli Holloway	6	3	

Ocinara albiceps Walker			2
Penicillifera apicalis Walker	2	3	4
Trilocha friedeli Dierl			1
5. Family: Saturniidae	**I**	**II**	**III**
Antheraea celebensis Watson		1	
Antheraea diehli Lemaire (Plate 3)		1	
Antheraea jana Stoll		1	
6. Family: Lasiocampidae	**I**	**II**	**III**
Hallicarnia albipectus Walker		1	
Kunugia austroplacida Holloway	2		
Lebeda cognata Grunberg	2		
Syrastrena sumatrana Tams	1		
7. Family: Notodontidae	**I**	**II**	**III**
Ambadra rafflesi Moore	1		1
Benbowia virescens Moore	1		
Gangarides vardena Swinhoe		1	
Hyperaeschrella producta Kiriakoff		1	
Neostauropus liturata Walker	1		
Pseudohoplitis vernalis Gaede		1	
Quadricalcarifera charistera fraseriana Kiriakoff	2		
Suzukiana pallida Nakamura			1
8. Family: Lymantriidae	**I**	**II**	**III**
Arctornis heteroides Collenette		1	
Arctornis magnaclava Holloway*	1	1	1
Arctornis obtusa Walker	1	1	1
Arctornis poecilonipha Holloway*		1	1
Arctonis prasioneura Toxopeus*	1		1
Arctornis rhopica Toxopeus			2
Arctornis rutila Fabricius			1
Arctornis ungula Holloway*	2		
Arctornis sp. 1		1	1
Arctornis sp. 2	3		
Arctornis sp. 3	1	2	
Arctornis sp. 4	4		
Carriola ecnomoda Swinhoe	4		
Cozola subrana Moore	1		
"*Euproctis*" *pseudoarna* Holloway*	1		
?*Leucoma* sp.	1		
Lymantria minor van Eecke			1

Lymantria sublunata Rothschild	1	1	2
Lymantria temburong Holloway*		2	
Nygmia amplior Collenette			1
Nygmia fumosa Snellen	1		
Nygmia guttulata Snellen		2	2
Nygmia longitegumen Holloway	2		
Nygmia moalata Swinhoe	1		
Nygmia puli Schintlmeister			1
Nygmia sp. 2613			1
Orvasca subnotata Walker		1	
Psilochira venusta Collenette	2	2	
Somena similis Moore	1		
Toxoproctis hemibathes Swinhoe			2
9. Family: Arctiidae			
i. Subfamily: Syntominae	**I**	**II**	**III**
Amata egenaria Walker*	3	1	4
Auriculoceryx pterodactyliformis Holloway*	2	1	
ii. Subfamily: Arctiinae	**I**	**II**	**III**
Spilosoma hypogopa Hampson		1	
iii. Subfamily: Lithosiinae	**I**	**II**	**III**
Adites curvata Holloway*			1
Adites hosei Holloway*	1		
"*Barsine*" *exclusa* Butler		1	4
Barsine lineatus Walker			1
"*Barsine*" *porphyrea* Snellen	1		
Barsine rubricostata Herrich-Schaffer	2		1
Brunia sarawaca Butler		1	1
Cyana costifimbria Walker		1	1
Cyana determinata Walker	1		2
Cyana inconclusa Walker			2
Cyana maiae Holloway*			1
Cyana malayensis Hampson		3	3
Cyana perornata Walker	2	2	1
Cyana pudens Walker		1	
Cyana selangorica Hampson	1	1	5
Cyana sp.		1	
"*Eilema*" *fasciculosa* Walker			1
"*Eilema*" ?*pulvereola* Hampson			1
Eugoa crassa Walker*		1	
Eugoa pseudarcuata Holloway*		1	

Eugoa tessellata Holloway*		1	1
Eugoa trifasciata Snellen	1		2
Eugoa uniformis Holloway*			1
Eugoa sp.		1	
Garudinia acornuta Holloway		1	
Lyclene biseriata Hampson*		1	
Macotasa biplagella Butler*	1	3	1
Nishada chilomorpha adunca Holloway		2	1
Nishada rotundipennis Walker	1		2
Oeonistis altica Linnaeus		1	1
Padenia duplicana Walker			1
Pseudoblabes oophora Zeller	1		
Teulisna nebulosa Walker		1	
Teulisna quadratella Holloway*			1
Teulisna tumida Walker			1
Thysanoptyx oblonga Butler	1		1
"*Tigrioides*" *leucanioides* Walker	1	5	5
Trischalis stomata Holloway			1

10. Family: Drepanidae			
i. Subfamily: Drepaninae	**I**	**II**	**III**
Albara hollowayi Watson		1	1
Callidrepana micacea Walker	1		
Callidrepana pulcherrima Hampson		1	
Callidrepana saucia sundobscura Holloway		1	
Canucha specularis Moore	1		
Gogana ?kerara Swinhoe	1		
Gogana sp. B	1		
Leucoblepsis renifera Warren	1		
Oreta bicolor Warren		1	
Oreta rubromarginata Swinhoe	1		
Paralbara perhamata Hampson			1
Strepsigonia affinis Warren		2	3
Strepsigonia robusta Holloway			1
Tridrepana albonotata Moore		1	
Tridrepana brunneilinea Holloway	1	2	1
Tridrepana flava Moore	2	1	1
Tridrepana fulvata Snellen		1	
Tridrepana microcrocea Gaede	1	1	3
Tridrepana subtusmaculata Gaede	1		

11. Family: Uraniidae			
i. Subfamily: Uraniinae	**I**	**II**	**III**
Lyssa menoetius Hopffer	3		
Urapteroides astheniata Guenee	1	1	3
ii. Subfamily: Epipleminae	**I**	**II**	**III**
Dysaethria quadricaudata Walker		2	
Dysaethria ?columba Holloway*		1	
Monobolodes yeni Holloway*		1	
Monobolodes undatifascia Holloway*		1	
Phazaca erosioides Walker		2	
12. Family: Geometridae			
i. Subfamily: Desmobathrinae	**I**	**II**	**III**
Noreia achloraria Warren			1
Noreia anacardium Holloway*		1	
Ozola pannosa Holloway			1
ii. Subfamily: Geometrinae	**I**	**II**	**III**
Agathia cristifera Walker	1		
Agathia sp. 17492		1	
Comibaena attenuata Warren	1		
Comibaena biplaga Walker	1		
Comostolodes dialitha West		1	1
Dindica olivacea Inoue	1		
Eucyclodes discipennata Walker			2
Herochroma orientalis Holloway	1		
Herochroma urapteraria Walker			2
Ornithospila bipunctata Prout	1	1	1
Ornithospila cincta Walker	1	2	
Ornithospila submonstrans Walker			1
Paramaxates polygrapharia Walker	1	1	
Pingasa rubicunda Warren			1
Pingasa ruginaria Guenee	1	2	
Spaniocentra lobata Holloway*			1
Spaniocentra megaspilaria Guenee*		1	
Tanaorhinus rafflesii Moore	4		
Tanaorhinus viridiluteata Walker	1		2
Thalassodes sp.			1
iii. Subfamily: Sterrhinae	**I**	**II**	**III**
Antitrygodes divisaria Walker		1	
Chrysocraspeda comptaria Swinhoe	1		

Chrysocraspeda dramaturgis Holloway*			1
Idaea vacillata Walker		1	
Scopula vacuata Guenee*		1	
Zythos turbata Walker	1		

iv. Subfamily: Ennominae	**I**	**II**	**III**
Achrosis lithosiaria Walker			2
Achrosis longifurca Holloway*	1		1
Alcis periphracta Prout		1	
Bracca georgiata Guenee	1		
Bracca maculosa Walker	1		
Cassyma quadrinata Guenee			1
Chorodna complicataria Walker			1
Cleora cucullata Fletcher			1
Cleora determinata Walker	2		
Cleora inoffensa Swinhoe		1	
Diplurodes inundata Prout			1
Diplurodes kerangatis Holloway	1		1
Diplurodes sugillata Prout		1	1
Fascellina meligerys Prout	1		
Fascellina pulchracoda Holloway			1
Godonela avitusaria Walker		1	
Heteralex rectilineata Guenee	1		
Hypephyra brunneiplaga Swinhoe			1
Hypochrosis binexata Walker	5	1	7
Hypochrosis cryptopyrrhata Walker	1		1
Hypochrosis pyrrhophaeata Walker	2	1	4
Hypomecis cineracea Moore	1		
Hypomecis costaria Guenee	1	1	1
Hypomecis lioptilaria Swinhoe	4	3	
Hypomecis separata Walker			1
Hypomecis subdetractaria Prout			1
Hypomecis tetragonata Walker	2		
Hyposidra apioleuca Prout	1		1
Hyposidra infixaria Walker	1		
Lomographa luciferata Walker	1		
Luxiaria acutaria Snellen		1	
Luxiaria emphatica Prout	1		1
Luxiaria subrasata Walker		1	
Monocerotesa strigata Warren		1	
Omiza lycoraria Guenee	2	1	1
Peratophyga trigonata Walker		1	
Plutodes malaysiana Holloway	1		

Pogonopygia nigralbata Warren	1		
Sysstema pauxilloides Holloway			1
Zamarada 15815		2	1

13. Family: Noctuidae

i. Subfamily: Aganainae	**I**	**II**	**III**
Asota egens Walker	2		
Asota heliconia Linnaeus	2	1	2
Asota producta Butler	1		

ii. Subfamily: Hadeninae	**I**	**II**	**III**
Tiracola plagiata Walker	2		1

iii. Subfamily: Amphipyrinae	**I**	**II**	**III**
Apsarasa radians Westwood		1	
Athetis bipuncta Snellen			1
Athetis nonagrica Walker			1
Corythurus nocturnus Hampson		1	
Iambia lyricalis Holloway		1	1
Lignispalta incertissima Bethune-Baker	1		
Mudaria major Warren			1

iv. Subfamily: Acronictinae	**I**	**II**	**III**
Acronicta rubiginosa Walker		1	

v. Subfamily: Agaristinae	**I**	**II**	**III**
Sarbanissa sundana Holloway		1	

vi. Subfamily: Aventiinae	**I**	**II**	**III**
Corgatha tornalis Wileman	1	1	
Metamaene atrigutta Walker			1
?*Oruza* sp.		1	

vii. Subfamily: Eublemminae	**I**	**II**	**III**
Eublemma quadripunctata Warren			2
Eublemma sp.			2

viii. Subfamily: Pantheinae			
Arcte modesta van der Hoeven	1		
Arcte sp.	1		

ix. Subfamily: Catocalinae	**I**	**II**	**III**
Amphigonia hepatizans Guenee		1	

"*Anomis*" *cupienda* Swinhoe		1	
Artena dotata Fabricius	4		
Artena inversa Walker	5	4	3
Attonda adspersa Felder & Rogenhofer		3	2
Bastilla vitiensis Butler	1		
Bocula bifaria Walker	4		
Bocula divergens Prout			1
Claterna cydonia Cramer			1
Daddala brevicauda Wileman & South	1		
Diascia hayesi Holloway			4
"*Egnasia*" *sundana* Kobes		1	
Episparis costistriga Walker	1		4
Ercheia cyllaria Cramer		3	
Ercheia multilinea Swinhoe			1
Ercheia pulchrivena Walker			1
Erebus caprimulgus Fabricius	1	1	
Erebus ephesperis Hubner	1		
Eubryopterella cinerea Holloway	3	2	
Eubryopterella triangulata Holloway			3
Homodes lassula Prout	1		
Hypopyra lactipex Hampson		1	
Hypopyra pudens Walker			1
Hyposemansis singha Guenee		1	1
Hypospila bolinoides Guenee		1	
Ischyja hageni Snellen	1		
Ischyja inferna Swinhoe	1	1	2
Ischyja manlia complex Cramer	1	3	
Ischyja manlioides Prout			1
Lacera nyarlathotepi Zilli & Holloway*		1	
Lineopalpa horsfieldi Guenee			3
Masca abactalis Walker	1		
Mecodina albodentata Swinhoe			1
Mecodina lanceola Guenee	2		1
Mecodina leucosticta Hampson			1
Mecodina praecipua Walker		1	
Oglasa costisignata Hampson*	1		
Ophisma pallescens Walker	1		
Oxyodes scrobiculata Fabricius		1	
Pangrapta metagona Walker	1		
Pantydia metaspila Walker	1		
Paranagia rufostrigata Bethune-Baker		1	
Phyllodes staudingeri Semper			1
Plecoptera recta Pagenstecher		1	

Poliofoca gebenna Swinhoe			1
Pseudathyrma tepescens Walker			1
Rectipalpula billeti de Joannis		3	6
Rema costimacula Guenee	1	1	
"*Saroba*" *maculicosta* Walker	1		
Sympis rufibasis Guenee	1		
Sypna martina Felder			1
Sypnoides infernalis Berio*	1		
Tamba capatra Swinhoe			1
Tamba cosmoloma Prout	1		
Tamba lala Swinhoe		1	
Tamba magniplaga Swinhoe		1	
Tamba mnionomera Hampson			1
Tamba ochra Prout			1
Tamsia hieroglyphica Swinhoe			2
Tochara creberrima Walker	1	2	
Tropidtamba lepraota Hampson			1
Ugia disjungens Walker*	1		2
Ugia serrilinea Hampson		1	
Ugia sundana Hampson			1
Ugia viridior Holloway		1	
Unidentified 1		1	
Unidentified 2		1	
Unidentified 3		1	

x. Subfamily: Stictopterinae (Plate 2)	**I**	**II**	**III**
Aegilia sundascribens Holloway		2	
Lophoptera acuda Swinhoe		1	
Lophoptera coangulata Warren		1	
Lophoptera gadirthoides Holloway*		1	
Lophoptera huma Swinhoe		3	4
Lophoptera ?*huma* Swinhoe		4	
Lophoptera illucida Walker		3	1
Lophoptera ?*leucostriga* Hampson		2	
Lophoptera olivascens Moore		2	1
Lophoptera pallibasis Holloway	2	9	7
Lophoptera ?*phaeobasis* Hampson		2	
Lophoptera purpuriridis Holloway*			2
Lophoptera submarginata Holloway	1		
Lophoptera trilobuncus Holloway		1	
Odontodes pallidifimbria Warren		1	
Odontodes seranensis Prout	6	5	1
Stictoptera signifera Walker		2	
Stictoptera terribilis Holloway*		1	

xi. Subfamily: Hypeninae	**I**	**II**	**III**
Hypena ischyra Prout		1	2
xii. Subfamily: Herminiinae	**I**	**II**	**III**
Adrapsa editha Swinhoe*		2	
Adrapsa ereboides Walker	1		1
Adrapsa geometroides Walker	1		
Bocana manifestalis Walker	1		
Hadennia mysalis Walker			2
Hepsidera lignea Swinhoe	1		
Hydrillodes ?*moloalis* Walker			1
Simplicia butesalis Walker			2
Simplicia robustalis Guenee		1	
14. Family: Nolidae			
i. Subfamily: Nolinae	**I**	**II**	**III**
"*Meganola*" *scriptoides* Holloway			1
ii. Subfamily: Chloephorinae	**I**	**II**	**III**
Asinduma exscripta Walker		1	8
Calymera metaphaca Hampson			2
Calymera sabulosa Warren		2	
Calymera translucens Holloway	1		
Chloroplaga nygmia Swinhoe		1	1
Didigua mixticolor Warren	1	1	
Gelastocera castanea Moore	1		
Maceda mansueta Walker	5	1	4
Siglophora bella Butler			1
Siglophora hayata Kobes			2
Tathothripa continua Walker	1		1
Xenochroa argentiviridis Holloway*		2	
Xenochroa costiplaga Swinhoe			1
Xenochroa mathilda Swinhoe			1
Xenochroa obvia Hampson			1
Xenochroa plesiogramma Prout			1
Xenochroa purpureolineata Hampson	1		
iii. Subfamily: Westermanniinae	**I**	**II**	**III**
Miaromima columbina Warren	2	1	2
Negeta contrariata Walker			1
Pterogonia cardinalis Holloway		1	

iv. Subfamily: Bleninae	**I**	**II**	**III**
Blenina chlorophila Hampson			1
Blenina lichenosa Moore	1		

#The species list is based on the nomenclature in Holloway (1983-2009), which is being brought up to date in the revised and annotated checklist planned for the final volume of 'The Moths of Borneo' series that is currently in preparation (J.D. Holloway, *pers. comm*.).

Appendix 2. Moths collected at Ginseng Camp on March 6-12, 2005. Outside the sampling period, not included in data analysis.

Family: Saturniidae	**N**
Antheraea helferi Moore	1
Archaeoattacus staudingeri Rothschild	1

Family: Brahmaeidae	
Brahmaea hearseyi White (Plate 4)	1

Plate 1. The light-trap used when sampling moths.

Plate 2. *Lophoptera* moths (Noctuidae: Stictopterinae).

Plate 3. Emperor moth *Antheraea diehli* Lemaire (Saturniidae).

Plate 4. *Brahmaea hearseyi* White (Brahmaeidae).