Volume 18, Nomor 2, Nopember 2009 ISSN 0215-191X

ZOO INDONESIA

Jurnal Fauna Tropika

Akreditasi : 119/AKRED/LIPI/P2MBI/06/2008.

Zoo Indonesia	Volume 18 (2)	45-103	2009	ISSN 0215-191X

Alamat Redaksi
Zoo Indonesia
Bidang Zoologi, Puslit Biologi LIPI
Gd. Widyasatwaloka
Jl. Raya Bogor-Jakarta KM. 46
Cibinong 16911

Telp. (021) 8765056
Fax. (021) 8765068
zooindonesia@yahoo.com (www.biologi.lipi.go.id)
Akreditasi: 119/AKRED/LIPI/P2MBI/06/2008

Masyarakat Zoologi Indonesia (MZI) adalah suatu organisasi profesi dengan anggota terdiri dari peneliti, pengajar, pemerhati dan simpatisan kehidupan fauna tropika, khususnya fauna Indonesia. Kegiatan utama MZI adalah pemasyarakatan tentang ilmu kehidupan fauna tropika Indonesia, dalam segala aspeknya, baik dalam bentuk publikasi ilmiah, publikasi popular, pendidikan, penelitian, pameran ataupun pemantauan.

Zoo Indonesia adalah sebuah jurnal ilmiah di bidang fauna tropika yang diterbitkan oleh organisasi profesi keilmiahan Masyarakat Zoologi Indonesia (MZI) sejak tahun 1983. Terbit satu tahun satu volume dengan dua nomor (Juni & Nopember). Memuat tulisan hasil penelitian dan tinjauan ilmiah yang berhubungan dengan aspek fauna, khususnya wilayah Indonesia dan Asia. Publikasi ilmiah lain adalah Monograph Zoo Indonesia - Seri Publikasi Ilmiah, terbit tidak menentu.

PETUNJUK PENULISAN

Zoo Indonesia merupakan jurnal ilmiah di bidang zoologi yang diterbitkan oleh organisasi profesi Masyarakat Zoologi Indonesia (MZI) sejak tahun 1983. Terbit setiap tahun satu volume dengan dua nomor (Juni & Nopember). Bentuk naskah terbagi atas naskah utama, berupa hasil penelitian yang utuh dan belum diterbitkan; naskah penunjang, berupa catatan pendek dari hasil penelitian yang dirasakan perlu cepat untuk diinformasikan; dan review, suatu kajian ilmiah yang menyeluruh, lengkap dan cukup mendalam tentang suatu topik berdasarkan rangkuman hasil penelitian beberapa peneliti. Bidang pembahasan dalam Zoo Indonesia meliputi fauna, pada semua aspek keilmuan seperti Biosistimatik, Fisiologi, Ekologi, Molekuler, Pemanfaatan, Pengelolaan, Budidaya dll. Tata cara penulisan adalah:

1. Naskah ditulis dalam bahasa Indonesia atau Inggris. Diketik pada format kertas A-4 dengan jarak spasi 1.5, Arial, font 10. Ukuran margin atas & bawah 2.54 cm, kanan & kiri 3.00 cm.
2. Sistematik penulisan :
   - **a.** **Judul**, singkat dan jelas, penyertaan anak judul sebaiknya dihindari. Diketik dengan huruf besar, dihitamkan, terkecuali pada nama Latin, dengan huruf miring.
   - **b.** **Nama dan alamat penulis** beserta alamat elektronik, ditulis lengkap tanpa ada singkatan, ditempatkan di bawah judul.
   - **c.** **Abstrak**, merupakan intisari naskah, ditulis tidak lebih dari 200 kata dan dituangkan dalam satu paragraf. Dibawah abstrak dicantumkan kata kunci maksimal lima kata. Berbahasa Indonesia dan Inggris.
   - **d.** **Pendahuluan**, ditulis singkat mengenai latar belakang penelitian, permasalahan, hal-hal yang telah diketahui, pendekatan yang dikembangkan dalam memecahkan masalah dan pencapaian tujuan penelitian.
   - **e.** **Materi & Metode**, menerangkan secara jelas tata cara penelitian, waktu dan tempat penelitian, metode yang digunakan, analisa statistik, sehingga mampu diulang kembali oleh pihak lain atau mengkaji ulang runtutan tata cara penelitian. Data mengenai nomor aksesi spesimen, asal-usul spesimen, lokasi atau hal lain yand dirasa perlu untuk penelusuran kembali, ditempatkan sebagai Lampiran, setelah Daftar Pustaka.
   - **f.** **Hasil & Pembahasan**, menyajikan hasil penelitian yang diperoleh, sekaligus mengupas dan membahas hasil penelitian, membandingkannya dengan hasil temuan peneliti lain dan penjabaran implikasi dari penelitian yang diperoleh. Penyertaan ilustrasi dalam bentuk Tabel, Gambar atau Sketsa hendaknya berwarna hitam putih. Khusus foto dapat hitam putih atau berwarna, format JPEG. Sitiran untuk menghubungkan nama penulis dan tahun terbitan tidak menggunakan tanda koma. Bila ada beberapa tahun penulisan yang berbeda untuk satu penulis yang sama digunakan tanda penghubung koma, serta tanda gabung bentuk titik koma pada kumpulan sitiran yang mengelompok tetapi berbeda penulis (Hasyim 2005, 2006; Gunawan 2004). Nama penulis yang lebih dari dua orang ditulis *et al*. (jurnal terbitan asing) atau dkk. (jurnal terbitan lokal). Kata penghubung diantara dua penulis menggunakan tanda &.
   - **g.** **Kesimpulan**, merupakan rangkuman dari keseluruhan hasil penulisan.
   - **h.** **Daftar Pustaka**, menyajikan semua pustaka yang dipergunakan dalam naskah.

Flannery, T. 1990. Mammals of New Guinea. Robert Brown & Associates. New York.

Nelson, M.E & L.D Mech. 1987. Demes with a Northeastern Minesota Deer Population. In: B.D Chepko-Sade & Z Tanghapin (edits.) Mammalian Dispersal Pattern-The Effect of Social Structure on Population Genetics. University of Chicago Press. 230-243.

Youngson, R.W. 1970. Rearing red deer calves. Journal of Wildlife Management 34:467-470.

1. **Ucapan Terima Kasih**, sebagai penghargaan atas pihak-pihak yang dirasa layak diberikan.

2. Naskah lengkap dapat dikirim melalui alamat elektronik atau pos. Bila melalui pos dikirim dua rangkap, satu diantaranya tanpa nama dan alamat penulis, disertai compact disk.

Redaksi Zoo Indonesia
d/a Bidang Zoologi - Puslit Biologi LIPI
Jl. Raya Bogor-Jakarta Km. 46
Cibinong 16911
zooindonesia@yahoo.com

MONOGRAPH ZOO INDONESIA adalah publikasi ilmiah lainnya yang terbit tidak menentu. Berisi bahasan yang sangat mendalam dan holistik mengenai satu aspek pada tingkat jenis (species) ataupun permasalahan.

Terakreditasi berdasarkan SK Kepala LIPI no. 683/D/2008
No. Akreditasi: 119/AKRED/ LIPI/P2MBI/06/2008, periode Juni 2008-2011

Akses online di www.biologi.lipi.go.id/publikasi/jurnal


Masyarakat Zoologi Indonesia
MZI

MOTH (INSECTA : LEPIDOPTERA) DIVERSITY IN MONTANE GUNUNG PATUHA PROTECTED FOREST, WEST JAVA, INDONESIA

Hari Sutrisno

Laboratory of Entomology, Research Center for Biology,
Jl. Raya Bogor-Jakarta Km. 46, Cibinong 16911
e-mail: *hari.sutrisno@lipi.go.id*

Received 14 February 2009; Accepted 24 August 2009

ABSTRACT

Sutrisno, H. 2009. Moth (Insecta : Lepidoptera) Diversity in montane Gunung Patuha protected forest, West Java, Indonesia. Zoo Indonesia 18(2): 69-78. *A study on montane moth diversity was conducted at Gunung Patuha protected fores, West Javat. The aim of the study was to evaluate the biodiversity of this montane protected forest using moths as an indicator. For comparison, biodiversity data of other submontane forests (G. Kendeng & G. Botol, Halimun National Park, West Java) and a low land forest (Giam Siak Kecil Nature Reserve, Sumatra) were used. The results of Fisher á diversity indexes across all sites of Gunung Patuha, showed that the second site (1,900 m asl.) was the highest (85.48). On the other hand, the third site (2,250 m asl.) was the lowest (45.70). The species composition of those sites were also different. At the first site, Pyralid and Noctuid moths were dominant, while at the second and the third sites, Geometrid and Noctuid moths were dominant. Moreover, pyralid moths increase gradually along with the decrease of gradient altitude at this forest. Compared with other data, the diversity of macro-moths at Gunung Patuha was slightly lower than those of the two submontane forests, Gunung Botol and Gunung Kendeng but higher than that of Giam Siak Kecil, they were 117.26, 179, 117.4 and 47.68, respectively.*

Keywords: *biodiversity, Gunung Botol, Gunung Patuha, Gunung Kendeng, moths.*

ABSTRAK

Sutrisno, H. 2009. Kajian biodiversitas ngengat dataran tinggi: Hutan Lindung Gunung Patuha, Jawa Barat. Zoo Indonesia 18(2): 69-78. *Kajian biodiversitas ngengat hutan dataran tinggi telah dilakukan di Hutan lindung Gunung Patuha. Tujuan dari penelitian ini adalah untuk mengevaluasi biodiversitas kawasan ini dengan menggunakan ngengat sebagai indikator lingkungan. Untuk pembanding, data dari hutan dataran tinggi G. Kendeng dan Gunung Botol (Taman Nasional Gunung Halimun-Salak) serta hutan dataran rendah Suaka Margasatwa Giam Siak Kecil digunakan dalam analisa. Di Gunung Patuha, index Fisher's á pada titik koleksi yang ke-dua (1.900 m dpl.) adalah yang tertinggi (85,48). Sebaliknya, pada titik koleksi yang ke tiga (2.250 m dpl.) adalah yang paling rendah (45,70). Komposisi jenis setiap titik koleksi menunjukan perbedaan. Pada titik koleksi yang pertama (1.700 m dpl.) pyralid dan noctuid adalah yang paling dominan sedangkan pada titik yang kedua (1.900 m dpl.) dan ketiga (2.250 m dpl.) adalah geometrid dan noctuid. Jenis pyralid jumlahnya bertambah seiring dengan turunnya ketinggian tempat. Dibandingkan dengan dataran*

tinggi yang lain (Gunung Kendeng & Gunung Botol) Gunung Patuha mempunyai index diveristas yang sedikit lebih rendah tetapi lebih tinggi bila dibandingkan dengan hutan dataran rendah Giam Siak Kecil, secara berurutan adalah 117,26; 179; 117,4 dan 47,68.

Kata kunci: *biodiversitas, Gunung Botol, Gunung Patuha, Gunung Kendeng, ngengat.*

INTRODUCTION

As of other conservation areas in Indonesia, Gunung Patuha protected forest (2,343 m asl.; Bandung) has a serious potential degradation, due to the pressure of human population growth, the change on land use and the conflict of ownership. The decrease of the roles of this forest as the protection of ecosystem, hydrology, and land conservation can be measured by comparing with other forest using bio-indicators.

Among bio-indicators, moths (Insect: Lepidoptera) is one of the most popular to be used as bio-indicator since most of the species have a specific host-plant, easy to collect in a large number that making easy to do a statistical analysis, and most of them are readily to be identified using field guide books.

In recent years several field studies have been conducted to access the diversity of Lepidoptera in Indonesia. Those studies concentrated on Borneo (Holloway 1984, Robinson & Tuck 1993, 1996, Seram (Holloway 1993), Sulawesi (Heppner 1989, Holloway et al. 1990). Other studies were conducted at low land areas at Nusa Barong Nature reserve and peat swamp forest in Central Kalimantan (Sutrisno, 2006; 2007). To improve the knowledge on Lepidoptera diversity especially at high altitude, study on biodiversity at Gunung Patuha protected forest with focus on macro-moths (>20 mm in wingspan) was conducted. For comparison, data of macro-moths from a moderate altitude forest of Gunung Kendeng (950 m asl.) and Gunung Botol (1,500 m asl.), Halimun National Park and from the low land forest of the Giam Siak Kecil Nature Reserve, Riau (< 20 m asl.) were used in this study.

The objective of this research was to obtain numbers of species, their abundance and frequencies occurring in this area. Which may can be used for management of the Montane biodiversity.

MATERIALS & METHODS

Locations

Gunung Patuha. This protected forest is located at about 46 km southwest of Bandung. The top of the mountain is located at about 2,434 m asl. Sampling was conducted for three nights (17-20 July 2007) at three different altitudes (1,700 m; 1,900 m & 2,250 m asl.).
Gunung Botol, Halimun National Park. This site is located at altitude of approximately 1,500 m asl, around 10 km from the Cikaniki research Station. This area was classified as montane zone and dominated by Fagaceae (*Castanopsis* spp, *Lithocarpus* spp and *Quercus* spp)**.** In this site the sampling was conducted for three nights (20-23 August 2007).

Gunung Kendeng, Halimun National Park. This site was near Cikaniki research station at altitude of approximately 950 m asl. and classified as Zona Colline of Primary forest. The vegetation was dominated by *Altingia exelsa*. In this site the sampling was conducted for three nights (3-6 September 2007)**.**

Suaka Margasatwa Giam Siak Kecil. This Natural forest is located on the

eastern side of Sumatra, approximately 45 km south west of Selat Bengkalis. The site is located along and southwest of a 50 km section of Sungai Siak Kecil. The northern boundary is approximately 40 km from Dumai. The area consists of swamp forest, peat swamp forest and floodplain lakes. North and northeast lies a large peat dome with reportedly some of the deepest peat in Sumatra. Along the river numerous shallow floodplain lakes occur that are connected to the Siak Kecil by narrow streams. Much of the forest is secondary, having been selectively logged prior to gazettal. This natural forest covers about 100,000 ha, almost 30% of the total area is peat swamp forest. Sampling was conducted for four nights (24-28 October 2007).

Collections

Field work was performed using a night collecting light. All groups of Lepidoptera, which are attracted by light, were sampled. Thus butterflies and day flying moth were not captured by this method. They were excluded from the sampling programme and from the analysis.

Collection began at dusk and was completed after six hours. The moths were picked from a white sheet that was hung vertically and was illuminated by a 160 W lamp powered from portable generator. The capture of all species of macro-moth was attempted and macro-moths was stored in paper bags. Shortly before the end of night collection, all remaining specimens on the sheet were countered. This counting ensured that all attracted species were indeed registered. This count was summarized with the number of collected specimens to give the total number of specimens N, which was used in the statistical analysis. Usually, a large fraction of the order is covered. The numbers were used to calculate various indices, which describe and elucidate features of the local or regional Lepidoptera community. By comparing these numbers and indices, it should be possible to recognize areas of high or low diversity. Furthermore, quantitative measures of species and individual abundance provide comparative values for the evaluation of different habitats, biomes or ecosystem. These comparisons can be used in making conservation and management decision. Since the field work on all sites was performed with the same methods and sampling protocol this study was able to compare the results in order to see whether the diversity data can contribute to quantification and better understanding of the faunal differences between Gunung Patuha protected natural forest and other regions.

Data analysis

The diversity measure for species-richness used throughout this discussion is the á–statistic of Fisher *et al.* (1943). Fisher's alpha diversity index, defined implicitly by the formula:

$S=a\ ln(1+n/a),$

where *S* is number of taxa, *n* is number of individuals and *a* is the Fisher's alpha. Justification for this on grounds of the frequent approximation of light-trap moth samples to a log-series distribution of abundance among the species is given by Taylor *et al*. (1976) and, within a South East Asian context, by Barlow & Woiwod (1989). Wolda (1983) also demonstrated that this statistic was the most sample-size independent of a number of frequently used diversity measure. For comparison among two sites, Jaccard index of similarity is used. This is a robust measure of beta diversity and widely used in biodiversity research.

In addition, extrapolation method, which gives an estimate of the total number species from empirical samples was

$$E(S_n) = \sum_{i=1}^{s} \left[1 - \frac{\binom{N-N_i}{n}}{\binom{N}{n}} \right]$$

$$V(S_n) = \sum_{i=1}^{s} \left[\frac{\binom{N-N_i}{n}}{\binom{N}{n}} \left(1 - \frac{\binom{N-N_i}{n}}{\binom{N}{n}} \right) \right] + 2 \sum_{j=2}^{s} \sum_{i=1}^{j-1} \left[\frac{\binom{N-N_i-N_j}{n}}{\binom{N}{n}} - \frac{\binom{N-N_i}{n}\binom{N-N_j}{n}}{\binom{N}{n}\binom{N}{n}} \right]$$

(Source: Krebs 1998).

used. Let *N* be the total number of individuals in the sample, *s* the total number of species, and *Ni* the number of individuals of species number *i*. The expected number of species $E(S_n)$ in a sample of size *n* and the variance $V(S_n)$ were then given:

The value of light collection

A correct statistical analysis first requires a certain number of replicate samples, which, secondly, have to be drawn randomly. Both conditions are not met in the present study. They are hardly achievable in these kinds of studies at all, because the use of light or light trap is a selective method and the number of replicate usually remains low. Nonetheless, the use of light in collecting Lepidoptera yields the highest proportion of the total species spectrum at a given locality. It is nearly impossible to get similar part of taxocenosis by applying other methods.

RESULTS & DISCUSSION

The record of the species collected in this study was available on request and all the specimens were deposited at Museum Zoologicum Bogoriense. (MZB) Cibinong. Table 1 showed that the short collecting time spent across all sites in this forest made the results only a fragment of the actual existing Lepidoptera fauna which was only 168 of 194 species or about 86%. In addition, the number of families recorded from this park was low, 14 families, about one fourth of the families of moth that occur in Indo-Malayan region (Holloway *et al*. 2001).

The collected species at the second site (1,900 m asl.) was the highest among other sites while the lowest was the third site (2,250 m asl.) (Table 2). The Fisher's alpha index also showed a similar phenomenon. Moreover, the short collecting time resulted more than 90% of the total estimated species occur on the first and the second sites and only about 86% on the third site. Among of all sites, the three big families, Geometridae, Pyralidae and Noctuidae were the most dominant among other families. However, there was slightly different in species composition across all sites at Gunung Patuha. The proportion of pyralid moths decreased along with the increase of gradient altitude but the proportion of large moths (Geometridae & Noctuidae) increased.

The number of collected species at G. Kendeng was the highest than those of G. Botol and Giam Siak Kecil, they were 183, 214 and 81, respectively (Table 3). The results also showed that the

Table 1. Species richness of macro-moth collected at Gunung Patuha protected natural forest (S= Species number).

	Taxa	S	%	Species with 1 individual	Species with ≥ 2 individuals	Estimate
1	Arctiidae	16	9.5	10	6	194
2	Bombicidae	2	1.1	1	1	
3	Drepanidae	1	0.5	1	0	
4	Eupterpotidae	1	0.5	1	0	
5	Geometridae	31	18.5	17	14	
6	Herminiidae	2	1.1	1	1	
7	Lasiocampidae	2	1.1	0	2	
8	Lymantridae	7	4.1	3	4	
9	Nolidae	4	2.4	4	0	
10	Notodontidae	1	0.5	1	0	
11	Thyatiridae	3	1.7	1	2	
12	Sphingidae	5	2.9	3	2	
13	Pyralidae	28	16.6	18	10	
14	Noctuidae	65	38.6	43	22	
Total		168	100	104	270	

number of family has a similar phenomenon, G. Kendeng was the highest (21 families) and Giam Siak Kecil was the lowest (12 families). More over, the proportion of species was different, Noctuid moths were dominant at G. Botol and G. Kendeng. On the other hand, pyralid moths were dominant at Giam Siak Kecil.

In general, a floral diversity will determine the composition and diversity of macro-moths because their larvae of moths indeed often show great specificity to hostplants even though their adults can use many kinds of flowers as sources of their nutrition. The larvae are mainly defoliator, but there are also leaf miners (several micro-moth families such as Nepticulidae and Gracillaridae), stem borers (for instances in Noctuidae and Pyralidae), flower feeders (Noctuidae & Geometridae), and timber borers (Cossidae & Hepialidae) (Robinson 1975; Holloway 1976; Hebert 1980; Inoue *et al.* 1982; Common 1990; Robinson *et al*. 1994). Therefore, there is no doubt that more varies vegetations resulted more divers on moth fauna as indicated by the result of this study. Among of the three sites, the vegetation at the second sites (1,900 m asl.) was the most varies. This site was dominated by *Litsea* sp, *Scima walichii*, *Querqus*, *Podocarpus imbricatus*, *Castanopsis argentea*, *Maglitia galauca*, and *altingia excelsa*. On the other hand, the vegetation at the first site (1,700 m asl.) and the third sites (2,300 m asl.) were less varied. The first site is a border or a transition area between the protected forest and the wood plantation belongs to PT. Inhutani.Those the vegetation was dominated by *Altingia excelsa*, *Castanopsis argentea*, and grasses (shrub) at the open areas. The third site (2,300 m asl.) was the most closest to the Kawah Putih (2,345 m asl.), therefore only certain plants that can well-adapt to the sulfuric condition such as *Selliguea feci*, *Vaccinium vargineafolium* and *Rhododendron retusum*.

In addition, the increase on altitude up to a certain level brings consequence in the decrease of plant species, even at the highest altitude the vegetation become homogeneous. Thus, it causes not many choices for moths that have a specific–host relationship to be able to survive at >1,500 m asl. since

Tabel 2. Species richness of macro-moth collected on each site at different altitude on Gunung Patuha protected natural forest (S= Species number).

Locality	No	Taxa	S	%	Species with 1 individual	Species with ≥ 2 individuals	Estimate
Site 1 (1,700 m asl.)	1	Arctiidae	8	10.8	5	3	
	2	Bombycidae	2	2.7	1	1	
	3	Eupterpotidae	1	1.3	1	0	
	4	Geometridae	13	17.5	5	8	81
	5	Herminiidae	2	2.7	1	1	
	7	Lymantridae	3	4.0	3	0	
	8	Nolidae	1	1.3	1	0	
	9	Notodontidae	1	1.3	1	0	
	10	Sphingidae	2	2.7	2	0	
	11	Pyralidae	20	27.0	13	7	
	12	Noctuidae	21	28.3	15	6	
Total			74	100	48	26	
Site 2 (1,900 m asl.)	1	Arctiidae	9	11.0	6	3	
	2	Geometridae	15	18.5	11	4	
	3	Lasiocampidae	2	2.4	2	0	88
	4	Lymantridae	2	2.4	2	0	
	5	Nolidae	1	1.2	1	0	
	6	Thyatiridae	1	1.2	0	1	
	7	Sphingidae	3	3.7	2	1	
	8	Pyralidae	11	13.5	8	3	
	9	Noctuidae	37	45.6	27	10	
Total			81	100	59	21	
Site 3 (2,250 m asl.)	1	Arctiidae	5	9.4	3	2	
	2	Drepanidae	1	1.8	1	0	
	3	Geometridae	11	20.7	7	4	62
	4	Lasiocampidae	2	1.8	1	1	
	5	Lymantridae	5	9.4	2	3	
	6	Nolidae	2	3.7	2	0	
	7	Thyatiridae	2	3.7	1	1	
	8	Sphingidae	1	1.8	1	0	
	9	Pyralidae	1	1.8	0	1	
	10	Noctuidae	24	45.2	19	6	
Total			53	100	37	16	

the vegetation at this altitude is dominated by Fagaceae. Therefore, the whole diversity index of Gunung Patuha was slightly lower than other regions except compared with Giam Siak Kecil Nature Reserve. However, it is well-known that peat swamp forest has low diversity both flora and fauna as has been repeatedly reported by many authors (Sutrisno 2005). The characteristic of the peat swamp: unfertile soil, acid and un-degradable organic maters cause only a certain plant such as Euphorbiacea, Dipterocarpaceae, Rubiaceae, Myristicaceae, Lauraceae dan Sapotacae that can inhabit this peat swamp forest. Thus, the low diversity

Table 3. Species richness of Lepidoptera moth collected at Gunung Botol (GBTL), Gunung Kendeng (GKD), Giam Siak Kecil (GSK) Nature Reserves (S= Species number).

Locality	No	Taxa	S	%	Species with 1 individual	Species with ≥ 2 individuals	Estimate
GBTL	1	Aganidae	3	1.6	1	2	
	2	Arctiidae	9	4.9	4	5	
	3	Bombycidae	2	1.1	1	1	
	4	Cossidae	2	1.1	2	0	
	5	Drepanidae	5	2.7	4	1	
	6	Geometridae	50	32.7	35	15	
	7	Lasiocampidae	3	1.6	1	2	
	8	Limacodidae	4	2.1	3	1	197
	9	Lymantridae	8	4.3	7	1	
	10	Noctuidae	62	33.8	42	20	
	11	Notodontidae	4	2.1	3	1	
	12	Pyralidae	18	9.8	11	7	
	13	Saturnidae	1	1.1	1	0	
	14	Sphingidae	10	5.4	7	3	
	15	Thyatiridae	1	1.1	0	1	
	17	Thyrididae	1	1.1	0	1	
	18	Uranidae	1	1.1	1	0	
		Total	183	100	122	61	
GKD	1	Aganidae	3	1.2	1	2	
	2	Arctiidae	15	7.0	2	13	
	3	Bombycidae	2	0.9	2	0	
	4	Cossidae	4	2.1	4	0	
	5	Drepanidae	8	3.7	4	4	
	6	Ethmiidae	1	0.4	0	1	264
	7	Eupteroptidae	1	0.4	1	0	
	8	Geometridae	43	20.09	27	16	
	9	Herminiidae	1	0.4	0	1	
	10	Lasiocampidae	7	3.2	1	6	
	11	Limacodidae	4	2.1	3	1	
	12	Lymantridae	4	2.1	3	1	
	13	Noctuidae	76	35.5	58	18	
	14	Nolidae	4	2.1	4	0	
	15	Notodontidae	8	3.7	7	1	
	16	Physichidae	1	0.4	1	0	
	17	Pyralidae	22	10.2	13	9	
	18	Saturniidae	1	0.4	1	0	
	19	Sphingidae	6	2.8	1	5	
	20	Thyrididae	1	0.4	0	1	
	21	Uraniidae	1	0.4	1	0	
		Total	214	100	134	80	
GSK	1	Arctiidae	4	4.93	0	4	
	2	Aganidae	1	1.23	1	0	
	3	Cossidae	2	2.47	2	0	
	4	Geometridae	17	21	8	9	
	5	Lasiocampidae	4	4.93	2	2	
	6	Limacodidae	3	3.7	0	3	
	7	Noctuidae	14	16.47	9	5	92
	8	Nolidae	4	4.93	2	2	
	9	Notodontidae	1	1.23	1	0	
	10	Pyralidae	25	30.86	15	10	
	11	Sphingidae	5	6.17	2	3	
	12	Thyrididae	1	1.23	1	0	
		Total	81	100			

Table 4. Index diversity Fisher's Alpha of Gunung Patuha, Gunung Botol, Gunung Kendeng and Giam Siak Kecil.

Locality	S	N	Alpha	Variance of alpha	Standard Error
G. Patuha	168	374	117.26	3182.2	56.41
Site 1	74	139	64.24	854.79	29.23
Site 2	81	135	85.48	200.9	14.17
Site 3	54	100	45.70	672.0	25.9
G. Botol	183	323	179	810.9	28.4
G. Kendeng	214	609	117.4	194.7	13.9
Giam Siak Kecil	81	212	47.68	139.2	11.8

Table 5. Index similarity across all localities based on Jaccard and Sorensen Coeficient.

	G. Patuha	G. Botol	G. Kendeng	Giam Siak
G. Patuha	-			
G. Botol	0.087/0.167	-		
G. Kendeng	0.075/0.139	0.209/0.345	-	
Giam Siak	0.024/0.046	0.019/0.036	0.043/0.082	-

of the moth of this peat swamp forest is caused by availability of their host plants at this area.

Gunung Kendeng site has the most diverse both in family and species numbers and there is still more species remind uncollected during this study as indicated by a low proportion between collected species and estimated species (86%). Compared with other sites, floral fauna at Gunung Kendeng is more heterogeneous and its position which is located at middle of this park and far from the local settlement has made this site is more conserve.

Some species apparently restricted by geographical boundaries and some others may be restricted to particular forest types associated with a particular climatic regime and may well reflect distribution of their host plants. In addition, there is distinct altitudinal zonation in the Lepidoptera of SE Asia i.e. the fauna of lowland and hill dipterocarp forest of Borneo has few species in common with that the montane forest 1,000 m or more asl. (Holloway 1976; Holloway *et al*. 1990; Robinson & Tuck 1993, Murphy 1990; Mey & Speidel 2003). This result also shows that G. Patuha, G. Botol, G. Kendeng and Giam Siak Kecil have a few species in common since these four sites have a significant difference on altitude. Only a certain group which is able to adapt at the low temperature (high altitudes), especially species which has very dense scales such as large Geometrids and Noctuids. They are able to survive at the high altitude (>1,500 m asl.) with temperature vary from 15 to 20°C.

Based on these results, Gunung Patuha protected forest can be categorized almost as good as Gunung Botol and Gunung Kendeng, Halimun National Park, but this forest still need to be continuously maintained to keep the role of the forest as a conservation area.

ACKNOWLEDGMENT

Grateful thanks are due to the Head of Protected Forest Gunung Patuha, the Head of Gunung Halimun National Park, and the Head of Suaka Margasatwa Giam Siak Kecil Nature reserve for their permission to access their forest. Many thanks also go Cholik and Darmawan for helping me in collecting the materials. This research is partly

supported by Nagao Foundation and DIPA - LIPI 2007, without this grant it is impossible to conduct this research successfully.

REFERENCES

Barlow, H.S. & I.P. Woiwod. 1989. Moth diversity of a tropical forest in Peninsular Malaysia. Journal of Tropical Ecology 5: 37-50.

Fisher, R.A., A.S. Cobert & C.B. William. 1943. The relation between the number of species and the number of individuals in a random samples of animal population. Journal of Animal Ecology 12: 42-58.

Hebert, P.D.N. 1980. Moth communities in montane Papua New Guinea. Journal of Animal Ecology. 49: 593-602.

Heppner, J.B. 1989. Lepidoptera diversity in North Sulawesi. Oriental Insects 23: 349-364.

Holloway, J.D., G. Kibby & D. Peggie. 2001. The families of Malesian moths and butterflies. Fauna Malesiana Handbook 3. Brill. Leiden

Holloway, J.D., G.S. Robinson & K.R. Tuck. 1990. Zonation in the Lepidoptera of Northern Sulawesi. –*In*: Knight, W. J & J. D. Holloway (edits) Insects and the rain forest of South East Asia. Royal Entomological Society London.153-166.

Holloway, J.D. 1976. A survey of the Lepidoptera, biogeography and ecology of New Caledonia. Seri Entomology 15:1-50.

Holloway, J.D. 1984. The larger moths of the Gunung Mulu National Park: a preliminary assessment of their distribution. Sarawak Museum Journal 30: 149-190.

Holloway, J.D. 1993. Aspects of the biogeography and ecology of the Seram moth fauna. *In*: Edwards, I. D., Macdonald, AA & J. Proctor (edits) Natural History of Seram, Maluku, Indonesia. Intercept Ltd. Andover. 91-114.

Inoue, H., S. Sugi, H. Kuroko, S. Moriuti & A. Kawabe. 1982. Moths of Japan. Kodansha Co. Ltd. Tokyo

Krebs, C.J. 1998. Software program for ecological methodology, 2nd Edition, ver.5.1.

Mey, W. & W. Speidel. 2003. Lepidoptera diversity at high and low altitudes in Taiwan and Luzon – a comparison. Journal of Zoological Society Wallacea 1: 29-42.

Murphy, D.H. 1990. The natural history of insect herbivory on mangrove trees in and near Singapore. Raffless Bulletin of Zoology 38: 119-203.

Robinson, G.S., P.R. Ackery, I.J. Kitching, G.W. Beccalony & L.M. Hernández. 2001. Hostplants of the moths and butterfly caterpillars of the Oriental Region. Southdene and The Natural History Museum. Kuala Lumpur

Robinson, G.S., K.R. Tuck & M. Shaffer. 1994. A field Guide to the smaller moths of South East Asia. Malaysian Nature Society. Kuala Lumpur.

Robinson, G.S. & K.R. Tuck. 1993. Diversity and faunistics of small moths (Microlepidoptera) in Bornean rainforest. Ecological Entomology 18: 385-393.

Robinson, G.S. & K.R. Tuck. 1996. Describing and comparing high invertebrate diversity in tropical forest- a cast study of small moths in Borneo. In: Edwards, DS. (edit.): Tropical Rainforest Research - Current Issues. Kluwer Academic Publisher. 29-42.

Robinson,G.S. 1975. Macrolepidoptera of Fiji and Rotuma, a taxonomic and geographic study. E.W. Classsey. Faringdon

Sutrisno, H. 2005. Moth Diversity at Sebangau Peat Swamp and Busang River Secondary Rain Forest, Central Kalimantan. Hayati (Journal of Biological Researches) 12: 121-126.

Sutrisno, H. 2007. Rapid assessment on macromoth faunas at Nusa

Barong Nature Reserve: a low diversity. Hayati (Journal of Biological Researches). 12: 1-7.

Taylor, L.R., R.A. Kempton & I.P. Woiwod. 1976. Diversity statistics and the log-series model. Journal of Animal Ecology 45: 255-271.

Wolda, H. 1983. Diversity, diversity indices and tropical cockroaches. Oecologia 58: 290-298.

DAFTAR INDEKS
Zoo Indonesia 2009, Volume 18, Nomor 1 & 2