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A PRELIMINARY STUDY ON MACRO-MOTH DIVERSITY AT THE BASE OF FOJA MOUNTAIN NATURE RESERVE: KWERBA VILLAGE, MEMBRAMO RAYA, PAPUA

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ABSTRAK

Sutrisno, H. 2012. Kajian awal diversitas ngengat di kaki suaka Margasatwa Pegunungan Foja, Desa Kwerba, Membramo Raya, Papua. ***Zoo Indonesia*** **21(1) 1-7.** *Kajian awal ngengat berukuran besar telah dilakukan di desa Kwerba, Kaki Pegunungan Foja, Membramo Raya tanggal 1 sd. 29 November 2008 (10 malam). Tujuan dari kajian ini adalah untuk mengumpulkan informasi tentang keragaman ngengat dan juga untuk mengetahui komposisi jenis ngengat di kawasan ini. Hasil penelitian menunjukan bahwa dalam waktu yang singkat hanya diperoleh sekitar 83% dari total yang ada atau sekitar 178 dari total perkiraan 214 jenis. Indeks diversitas Fisher's α relatif rendah yaitu 83,17. Demikian juga jumlah famili yang ditemukan di kawasan ini juga rendah hanya 19 famili atau sekitar 1/3 dari total famili yang ada di Indo-Malaya. Secara umum, Pyralidae, Geometridae, dan Noctuidae mendominasi kawasan tersebut. Rendahnya diversitas di kawasan ini berhubungan dengan jenis tanaman yang ada. Pembukaan lahan dan pembalakan liar telah menyebabkan turunnya jumlah jenis pohon tetapi di sisi yang lain kerapatan tumbuhan muda dan jumlah tumbuhhan merambat meningkat. Hanya terdapat sekitar 300 species tumbuhan dikawasan ini. Tentu saja kalau menuju ketinggian yang lebih tinggi dari kawasan kaki gunung ini kemungkinan jenisnya tumbuhan akan lebih banyak karena lebih jauh dari jangkauan penduduk. Sehingga diversitas ngengat di kawasan ini belum dapat digunakan untuk menyimpulkan keragaman ngengat di Pegunungan Foja. Kajian yang lebih intensif yang meliputi seluruh lokasi pegunungan dari dataran rendah sampai puncak masih perlu dilakukan.*

Kata Kunci: *diversitas, Pegunungan Foja, Kwerba, Ngengat besar*

ABSTRACT

Sutrisno, H. 2012. A preliminary study on macro-moth diversity at the base of Foja mountain nature reserve: Kwerba village, Membramo Raya, Papua. ***Zoo Indonesia*** **21(1) 1-7.** *A preliminary study on moth diversity with focus on macro-moths was conducted at Kwerba, the base of Foja mountain, Membramo Raya from 1st to 29th November, 2008 (10 night effectives). The aims of the study were to acquire information of macro-moth diversity and to access the composition of the species at this area. The result showed that a short collecting time records (10 nights) only about 83% of estimated value in this area (178 of 214 species). Index diversity based on Fisher's α was low, 83.17. In addition, the number of families recorded from this forest was also low, 19 families, or about one third of the moth families that occur in Indo-Malayan region. In general, Pyralidae, Geometridae, and Noctuidae dominated at this area. This low diversity correlates with plant species in this area. Land clearing and illegal logging have caused the decrease on species tree but increase on its density since young trees and liana trees grow everywhere. Only about 300 species trees were recorded in this area. Off course, there are more species of plants if we go up to the Foja mountain since there are more conserved area and less disturbed area at the higher altitude due to its geographical position, and its access limitation. So, this diversity of this area should not be used to conclude the moth diversity on the Foja mountain area. More study is needed to cover all the whole Foja mountain from the lowest up to the top forest of the mountain.*

Keywords: *diversity, Foja Mountain, Kwerba, macro-moths*

INTRODUCTION

The change of habitat due to human activity such as land clearing, illegal logging change of land use is one of the factors that directly influent to the ecosystem. But, this impact is not always easy to be measured, even to determine clearly what level of

the degradation occurs in a certain area needs a comprehensive study based on a certain taxon that its response can representatively indicate to any environmental changes. Among them, moths is one of the best candidate bio-indicator which fulfill all requirements such as ease and objective in sampling, taxonomic tractability, ecological generality combined with fine-grained habitat fidelity (including low blurring of pattern through mobility and rapid response to disturbance). In addition, they can be collected in a large number by using a light trap and also can be found in numbers in most vegetation types. So, it is possible to quantitatively calculate any statistical analysis to measure various parameters. Moreover, the larvae indeed often show a great specifity to host plants (Holloway 1976, 1984; Hebert 1980; Heppner 1989). Thus, this group is more suitable than other insects or vertebrate as indicator of the forest ecosystem and for monitoring the impact of changes. The importance of moths and their value as indicators is discussed by Brown (1991), and Holloway & Stork (1991).

The data of the base line study is very important to evaluate any impact of human activity to the natural reserve/conservation area. The impact of human activity to the ecosystem can be evaluated by comparing the data of the biodiversity before and after human activity occurring in the conservation area. Thus, without these data, it is impossible to measure any change of the ecosystem. But collecting those data is very hard, almost impossible to be conducted within a large nature reserve or a remote area in one time. It needs efforts continuously to inventory and populate the data of the biodiversity in that area.

The moth diversity in different habitat has been repeatedly reportedly by numerous authors (Holloway 1998; Beck *et al.* 2002; Fielder & Schulze 2004; Sukara 2005; Sutrisno 2010). However, most studies were conducted in Kalimantan, Sumatra, Sulawesi and Java. To complete the data on moth diversity in Indonesia, therefore, we conducted a preliminary study with focused on macro-moths at Kwerba Village (base of Nature Reserve of Foja

Table 1. Species richness of Lepidoptera collected at Kwerba village, Foja Mountain Nature Reserve from 1 to 23 November 2008 (S= Species number of taxa)

No	Taxa	S	%	Species with 1 individual	Species with > 2 individual	Species Estimated	Fisher Alpha index
1	Aganaidae	2	1.12	2	0		
2	Arctiidae	5	2.80	3	2		
3	Cossidae	4	2.24	1	3		
4	Drepanidae	3	1.68	2	1		
5	Dudgeoneidae	1	0.56	0	1		
6	Eupteroptidae	2	1.12	2	0		
7	Geometridae	34	19.10	22	12		
8	Hepialidae	2	1.12	2	0		
9	Herminiidae	2	1.12	0	2		
10	Lasiocampidae	4	2.24	3	1		
11	Lymacodidae	6	3.37	2	4		
12	Lymantriidae	9	5.0	7	2		
13	Noctuidae	23	12.92	21	2		
14	Nolidae	2	1.12	1	1		
15	Notodontidae	2	1.12	1	1		
16	Pyralidae	60	33.70	16	44	214	86.35
17	Sphingidae	11	6.79	4	7		
18	Thyrididae	6	3.37	3	3		
19	Uraniidae	1	0.56	1	0		
				93	85		

Mountain) during a month (1st to 29th November 2008).

RESEARCH METHODS

The research was conducted at the base of the Foja mountain, Kwerba village, which is located on a sharp of the Wiri, a tributary of the Membarmo (Fig.1). This is a mountainous region and the village at 80 m a.s.l. Along one side of the village, is a small and usually clear stream (the kali Buerat). The area is a part of a large complex of nature reserve, together with the Mamberamo and Rouffaer Reserves. Samplings were conducted at 10 sites in Kwerba village. The positions of the ten sites in Kwerba are near to the CI's base camp at S. 02° 38. 822´ E. 138° 24 981´.

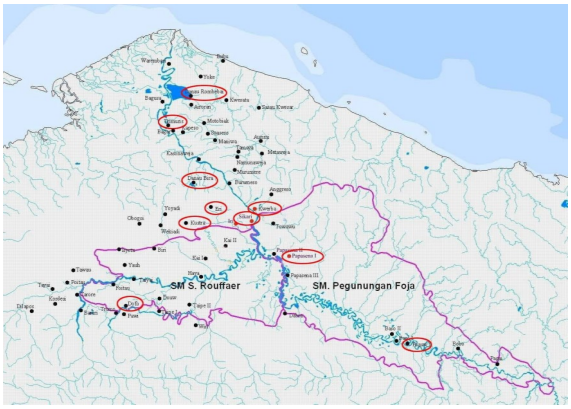

Figure 1. Site of study: Kwerba Village at base of Foja Mountain (indicated by a red arrow)

Directly surrounding the village are garden (cultivated: sweet potato, cassava, sugar cane, coconut, banana and other cultivated crops) or (temporarily) abandoned (bekas kebun). Otherwise Kwerba is surrounded by forest with several trees that are very common such as *Licuala* spp, *Pandanus conoideus*, *Hopea novoguineensis*, *Anisoptera thurifera* and *vatica rassak*. More over, Zingeberaceae, Orchidaceae, *Begonia* spp, and *Pandanus* spp are also very common in this forest.

Sampling has been conducted using light traps equipped with a 160 watt mercury vapor light and a 2 X 2.5 m white screen from 18.00 to 24.00 during 10 nights at 10 sites. The light trap is set up at the open area within this forest. Moths attracted to the light trap and lied at the white screen were collected into an ethyl acetate-killing bottle. For the large moths (wing span > 5 cm) were collected by using an insect net and then injected at the thorax with a small amount of absolute ammonia. All specimens collected at the night and then were pined using insect pins no. 3 and 4 at the next morning, while the specimens are still in fresh condition.

Preservation of the specimens was conducted at the laboratory of Entomology, Division of Zoology, Research Center for Biology, Cibinong. All moth specimens were labeled based on the field collection data. Their wings were spread and then dried up using oven at 45-50°C for 3-5 days, depends on the condition of specimens. All the materials were deposited at the Museum of Zoologicum Bogoriense, the Indonesian Institute of Sciences, Cibinong.

Measuring the diversity for species-richness based on α –statistic of Fisher (Fisher *et al*. 1943). Fisher's alpha diversity index, defined implicitly by the formula: $S=a \ln(1+n/a)$ where S is the number of taxa, n is the 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, Kempton and Woiwod (1976) and, within a South East Asian context is given by Barlow and Woiwod (1989). Wolda (1983) demonstrated that this statistic was the most sample-size independent of a number of frequently used of diversity measure

In addition, I have chosen an extrapolation method, which given an estimate of the total number species from empirical samples. N: the total number of individuals in the sample, s: the total number of species, and Ni: the number of individuals of

species *i*. The expected number of species $E(S_n)$ in a sample of size *n* and the variance $V(S_n)$ are then given:

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

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

All this methods were implemented in "methodological ecology" software (Krebs, 1998).

RESULTS AND DISCUSSION

The record of species collected of the study is available on request and all specimens are deposited at Museum of Zoologicum Bogoriense. These results in Table 1 showed that the short collecting time spent across all sites in this forest makes the results only a fragment of the actual existing Lepidoptera fauna. We do not know after what time the diversity values stabilizes. However, there is a statistical procedure which estimates the actual number of a community or taxocenosis from empirical samples (Krebs 1998). Based on this method, only about 83% of the existing moth fauna has been collected in this study (only 178 of 214 species). Based on the scatter plot between the species accumulation versus sampling efforts showed that after 10 nights, the species accumulation is still gradually increase (Figure 2). This result was lower compared with the previous study that was conducted in Dabra area by Mastrigt & Rosariyanto (2002). They collected about 480 species in over 112 genera.

Family Pyralidae, Geometridae and Noctuidae were dominant among other families in this area, they were 60 species (33.70 %), 34 species (19.10 %) and 23 species (12.92 %), respectively. It is not surprising since the same phenomenon has been repeatedly reported by numerous researchers. These three families are the most divers in Papua

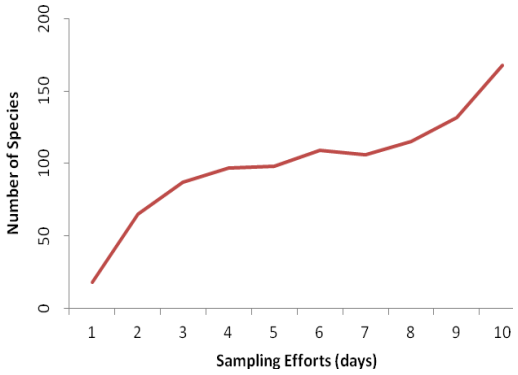

Figure 2. Graph of species accumulation versus sampling efforts (day)

region with the number species are 2764, 2520, 1641 species, respectively (Holloway et al. 2001).

The results also showed that family number found in this site is very low, less than half of the total families on this region (19 of 45), even some families that have been reported to divers in this region was not collected such as family Saturnidae and Notodontidae. The previous study in Dabra area also resulted no single sphingid has been collected (Mastrigt & Rosariyanto 2002). It has been reported that there were about 28 and 155 of these families to occur in Australian region (Holloway *et al.* 2001). On the other hand, some families which have a small number of species to distribute in this region were found in this study such as Hepialidae and Dudgeoneidae. The second family only contains a single genus *Dudgeonea* but they distribute from Africa, Madagaskar, India, South East Asia, New Guinea and Australia. There are about six described species of *Dudgeonea* (Zborowski & Edwards 2007; Edwards 1996).

The results showed that the index diversity based on Fisher's alpha is very low, 86.35. In addition the number of species with more than two individuals was slightly lower than the number of species with 1 individual, they were 85 (47.75%) and 93 (52.24%). Compared with montane forest such as in Gunung Halimun-Salak National Park

(West Java) and in Gunung Patuha Protected forest (West Java), the value of index diversity in Kwerba village was lower. But, if we compare with other low land ecosystem such as in Nusa Barong Nature Reserve (East Java), and in Giam Siak Nature Reserve (peat swamp forest) Riau, Kwerba was slightly higher (Sutrisno 2005; 2007; 2009). There are many factors that determined the diversity of macro-moths in a certain region, such as a floral diversity, altitudes, and seasons.

A floral diversity will determine the composition and diversity of macro-moths because their larvae of moths indeed often show great specificity to host plants 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 and Geometridae), and timber borers (Cossidae and Hepialidae). Therefore, there is no doubt that more varies vegetations resulted more divers on moth fauna as has been reported on the study of Pyraloid and Sphingid moth diversity (Beck *et al*. 2002; Fiedler & Schulze 2004).

Kwerba has a lot of disturbed area as results of land clearings or illegal loggings as of other low land areas in Indonesia. Even though hunting and fishing is the main way to fulfill their food but there is a tradition in general society in Kwerba village, each family to have farming area of cassava, sweet potato and sugar cane to support their food. They do land clearings by rotation from one area to another area to open a new farming area to get the most fertilized soil. Land clearing and illegal logging have caused the decrease on species tree but increase on its density since young trees and liana trees grow everywhere. So it is not surprising that number of plant species at this low land area is low, only about 300 species (Wayne. pers.comm). Off course, there are more species of plants if we go up to the Foja mountain since there are more conserved area and less disturbed area at the higher altitude due to its geographical position, and its access limitation. In general, an accumulation curve of plant species will increase along with gradient altitude and it will reach an asymptote after reaching a certain altitude (normally after 2000 m a.s.l. the vegetation becomes homogeneous). This phenomenon is also occurred at Gunung Halimun-Salak National Park in Java. Its position at high altitude has made Gunung Halimun-Salak National park is undisturbed or less disturbed compare to other low land areas in Java. The ecosystem of this park is also more complete than other parks because this park occupies various altitudes from 500 to 2000 m a.s.l. More than 700 species of floral plants and more than 850 of macro-moths has been discovered at this park (Sutrisno 2008).

The results showed that family Pyralidae is the most dominant among other groups. The similar phenomenon also has been reported from the previous study in Dabra Area, Membramo basin by Mastrigt & Rosariyanto (2000). They reported that about 30% of them was Pyralidae (145 of 480 species). Pyralidae is mostly medium size moths which its larvae has various behaviors such as stem borer, leaf roller and leaf eater. These larvae frequently occur in open habitat areas (grasses or Poaceae). It seems that the vegetation at Kwerba village which has a lot of open area is more suitable for this group than geometrid. Most Geometrid are phytophagus that inhabit the green canopy of the trees at primer forest. Thus, this group is lower than pyralids in this area. This phenomenon also has been reported by Sutrisno (2009) at the study a comparison on macro-moths diversity at the low land forest between Nature reserve forest Giam Siak Kecil and a private conservation forest in Riau, Sumatra. The study showed that Pyralids was dominant at Nature reserve forest Giam Siak Kecil in where this forest

has been illegal logged for a long time. On the other hand Geometridae was dominant at private conservation forest. The vegetation at this second forest was less disturbed and relatively more conserved as indicated by domination of large tree Dipteropcarpaceae. This group is as the main supporting component of the vegetation at the peat swamp forest in Sumatra. There is no doubt that some species of moths 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 (Beck & Kitching 2007; Sutrisno 2010). 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 1000 meters or more. Large Geometrids and Noctuids are more common to be found at high altitude. They are able to survive at the high altitude (>1500 m a.s.l.) with temperature vary from 15 to 20°C (Holloway 1976; Robinson & Tuck 1993; Mey & Speidel 2003). Indeed, moth composition can tell us the natural condition of vegetation of a certain area and can be used to evaluate the change of forest vegetation (Beck *et al.* 2002).

Thought the Foja mountain is a huge nature reserve covering area about 2 million Ha ranging from low land up to about 2193 m a.s.l., this study on moth diversity at Kwerba at the base of the Foja mountain, Membramo, Papua within 10 nights through a rapid assessment presented in this report should be regarded as a preliminary work. To get more comprehensive results, more sampling sites need to be established to represent the gradient altitudes and varies of the vegetation types in the future study.

CONCLUSION

Based on our finding, we concluded that the diversity of macro-moths at the base of Foja Mountain Nature Reserve is low. Land clearings by rotation from one area to another area to open a new farming area to get the most fertilized soil caused in decreasing of plant diversity. It is one of the main reasons for way the macro-moth diversity in a low land of Foja Mountain Nature Reserve is low since most of macro-moths have specific host-plants.

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