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Study on Diversity of Insect Communities at Different Altitudes of Gunung Nuang in Selangor, Malaysia

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Abstract: A total of six insect Orders comprising 2139 individual were collected for this study. The Hymenopterans had the highest individuals followed by Orthopterans, Coleopterans, Diptyopterans, Hemipterans and Dipterans. There was no specific pattern of abundant for the Hemipteran and Dipteran individuals collected except for Diptyoptera that was more abundant at 800 m altitude than at other altitudes. However, the Hymenopterans were found to higher at the lower altitudes than at the higher altitudes. There was a significant different ($P < 0.05$) in diversity of insect communities among the altitudes as indicated by the values of Shannon Weiner-Index (H') with the highest and lowest H' values were at 500 (1.89) and 1100 m (1.33) altitudes respectively. The species richness was relatively highest and lowest at 800 and 500 m altitudes respectively. The Jaccard's Similarity Index indicated that the insect communities similarity was highest between altitudes 800 and 1100 m (0.467) and lowest between 300 and 1100 m (0.176). There seemed to be two altitudinally associated insect faunas, one in higher altitudes and another one in the lower altitudes. The transition between the two assemblages is between 500 and 800 m altitudes.

Key words: Diversity, insect communities, Gunung Nuang Shannon Weiner-Index (H')

Introduction

The insects and other related arthropods are a dynamic group of organisms with a long evolutionary history. Appearing first in the Devonian (400 million years ago), the insects have successfully diversified throughout geological history (Gray and Shear, 1992). It is believed that this is the main attribute to a broad genetic adaptability that insects have to resist different environmental changes and to adapt to changing environmental condition (Hoffmann and Parsons, 1991). They are now found throughout the world in all biogeographical regions and ecological zones (Romoser and Stoffolano, 1998), from the Arctic Circle (Danks, 1981) to Antarctica (Block, 1992) to the tropics (e.g. Jazen, 1983 and 1976). The highest species richness of insects is found in the tropics (Groombridge, 1992). As such, it is not surprising that insects are the most dominant species (estimated 1 million species) of living organisms on the earth (Kim, 1993). The high number of insect species compared to other living organisms also indicates that they are the most successful living things that ever live on earth.

Ecologically, insects are occupying diverse niches (found in every conceivable habitat) and play many different functional roles important in sustaining the dynamics of ecosystem process (Walker, 1992). They could be herbivores (some of them are pests), predators and parasites/parasitoid (maintaining the population dynamic of herbivore insects), pollinators (such as bees), decomposers (such as termites) and scavengers (beetles and flies)–each group or species within groups have distinct feeding habit (Miller, 1993; Kim, 1993). As such, they are closely associated with the habitat and factors within it. Any change within habitat they are occupying would certainly affect their present. As such insect has been considered as one of most important biological indicators used to monitor environment changes. This is true as 22% of the 69 papers presented during 'The 9th International Symposium on Bioindicators' held in 1997 in Kuala Lumpur, Malaysia were related to use of insects for monitoring environmental changes and pollutants. Other organisms used or studied were plants (18%), bacteria (10%), arthropod other than insects (10%), fungus (5%), snail (5%) and other (birds, rodents, crustaceans, fishes and etc) (30%).

Insect abundance and diversity are also affected by the latitude and altitude of their habitat (LaSalle and Gauld, 1993; Price, 1991; Martin-Pierra and Lobo, 1993; Gauld, 1987; Lawton *et al.*, 1987; Janzen, 1976). Gunung Nuang is the only mountain forest left in Hulu Langat District in the State of Selangor. Because of rapid land development for industry and urbanization of the surrounding area since 1990 it is hypothesized that they would be a changing in biological diversity of this mountain forests now and in the future. This study was aimed to investigate the change of insect community in different altitudes of Gunung Nuang in Selangor, Malaysia. Results of this study are expected to provide baseline data for future study and monitoring of insect community changes in this mountain habitat as affected by the development of its surrounding area.

Materials and Methods

A study on diversity of insect communities at different altitudes of Gunung Nuang Selangor, Malaysia was conducted in the year of 2002 using pitfall trap. The Gunung Nuang is situated at 101°50 east and 3°14' north, in state of Selangor, Malaysia and bordering Pahang state. It was selected for the study because of the possibility of human interferences as a consequence of land development activities in the surrounding area. In addition, this mountain is also forest reserve and watershed for the most Hulu Langat District. Up to date there has been no related study conducted in Malaysia.

Experimental layout: Five elevations were selected namely 300, 500, 800, 1100 and 1350 m above sea level. There were some differences in term of sign of illegal logging activities, land surface characters, tree height and percent canopy cover, dominant plants present and as well as the thickness of dead leaves on the ground among these elevations. Three sampling points or plots (300 m a part, 150 x 150m^2 per sampling point) were selected per altitude. Ten transect lines were established across the plot parallel to each other at 15 m a part. Each transect line was installed with two pitfall traps following Maryati (1992) and this means that there were 20 traps per plot or 60 traps per treatment (altitude). However, the location of the traps per transect were not similar as they were installed randomly and independent of location of other traps in other transects. Traps were left in the field for 24 h for 3 days in which insects were collected daily, brought back to laboratory, sorted and identified to order and morphospecies. Number of individual morphopspecies per insect Order per altitude was recorded. The abiotic factors (temperatures and relative humidity) were also recorded daily during the study period.

Data analysis: The different in insect diversity, richness and

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abundance among altitudes was analyzed using Shannon-Weiner Indexes (Robinson, 1991). Cluster analysis was used to analyze the species similarity index among altitudes (MVSP, 1999). The two-way analysis of variance (ANOVA) was used to analyze the differences in distribution pattern of insect communities among altitudes (MINTAB statistical analysis, Version 13).

Results and Discussion

Abundance and distribution pattern: A total of six insect orders comprising 2139 individual were collected from all altitudes of Gunung Nuang (Table 1). The Hymenopterans had the highest individuals followed by Orthopterans, Coleopterans, Diptyopterans, Hemipterans and Dipterans, indicating that the Hymenopterans is the most abundant of all insect at Gunung Nuang forest. Interestingly, the ant groups (Formicidae) comprising 85% of the total Hymenopterans caught by the traps. This probably due to more ant tribe at the forest floor habitat and that the pitfall trap method may be better to collect ants that other insects (Maryati, 1992; Disney, 1994).

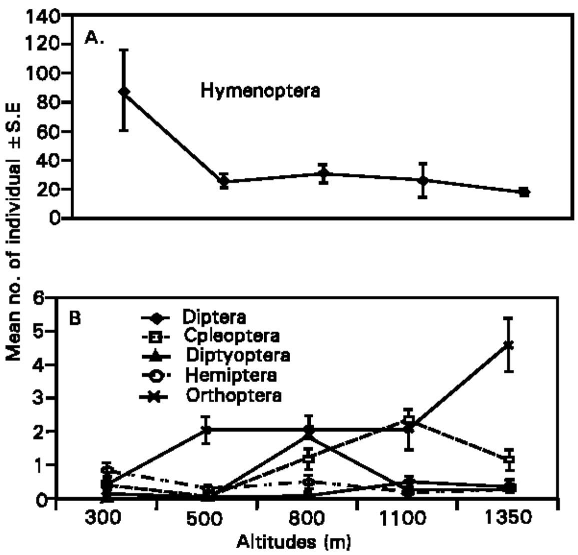

Fig. 1: Mean total number of individual insect per order, (A Hymenoptera; B) other insect order) collected at different altitudes of Gunung Nuang using pitfall traps

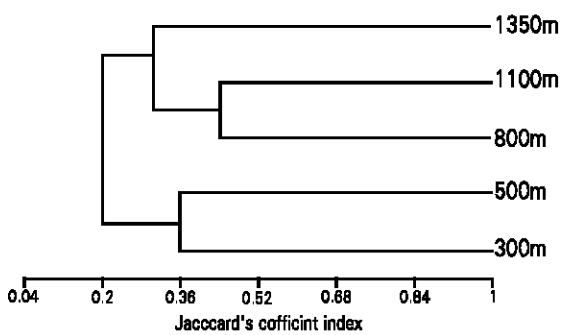

Fig. 2: Dendogram of grouping insect communities at Gunung Nuang in Selangor, Malaysia utilizing the Jaccard's Coefficient Index and the unweighted-pair groups method (UPGMA).

The mean total numbers of insect individual collected per Order per altitude were significantly influenced ($F = 4.0$; $df = 20$; $P < 0.05$) by the interaction between insect Order and altitudes. This indicates that the distribution patterns and population abundance of insect communities at Gunung Nuang varies with altitudes and in which Order of particular insects are in. The mean total number of Hymenopterans collected was significantly more ($F=34.4$; $df=5$; $P < 0.05$) than the other insects in all altitudes ($F=3.5$; $df=4$; $P < 0.05$) (Fig. 1A, B). There was a significantly ($P < 0.05$) more Hymenopteran individuals collected at the lower altitudes than at the higher altitudes (Fig. 1A). In contrast, the Orthopteran and Coleopteran individuals collected seemed to increase with the altitudes (Fig. 1B). There was no specific pattern of abundant for the Hemipteran and Dipteran individuals collected except for Diptyoptera that was more abundant at 800 m altitude than at other altitudes. There was a lack of report on differential abundant or distribution pattern of insect at different altitudes or elevations as compared to at different latitudes. However, the abundance of Hymenopterans especially the Ichneumonidae and other parasitic wasps was reported to be more at the middle elevation (1300–1700 m) than at the lower or higher elevations (Gauld, 1987; Noyes, 1989).

Insect diversity: There was a significant different ($P < 0.05$) in diversity of insect communities among the altitudes of Gunung Nuang as indicated by the values of Shannon Weiner-Index (H') (Table 2). However, the H' value (1.33) was significantly lower ($P < 0.05$) at the 1100 altitudes as compared to H' values at other altitudes. This is tends to disagree with earlier report that insect species was relatively higher at the middle altitudes of selected forest of Sulawesi, Indonesia (Noyes, 1989), and the small mammals diversity at the Mount Kinabalu, Sabah, Malaysia (Md. Nor, 2001). This probably due to it has a combination of low E' and R' values that are two components important in determining

Table 1: Total number of insect individual collected per insect Order at different altitudes of Gunung Nuang, Selangor, Malaysia using pitfall trap

	Altitude (m)					
Order	300	500	800	1100	1350	Total
Hymenoptera	880	251	318	271	192	1912
Orthoptera	4	21	21	21	47	114
Coleoptera	4	1	12	24	12	53
Diptyoptera	0	0	19	3	3	25
Hemiptera	8	3	5	2	4	22
Diptera	2	1	1	1	5	13
Total	898	277	376	326	262	2139

Table 2: The Shannon-Weiner Diversity Index (H'), Evenness (E') and Richness (R') for insect species (morphospecies) at different altitudes of the Gunung Nuang, Selangor, Malaysia collected using pitfall trap

Altitudes (m)	Shannon-Weiner Index (H')	Evenness (E')	Richness (R')
300	1.73a	0.57	2.94
500	1.89a	0.68	2.48
800	1.87a	0.58	4.05
1100	1.33b	0.45	3.11
1350	1.79a	0.62	3.05

In H' column, values with the same letter were not significantly different at $P < 0.05$ (paired t-test)

Table 3: Similarity in insect communities (Jaccard's coefficient Index) at Gunung Nuang, Selangor, Malaysia

Altitude (m)	300	500	800	1100	1350
300	1.000	0.385	0.211	0.176	0.258
500	0.385	1.000	0.323	0.296	0.259
800	0.211	0.323	1.000	0.467	0.344
1100	0.176	0.296	0.467	1.000	0.370
1350	0.258	0.259	0.344	0.370	1.000

value of diversity. The relatively low E' and R' of insect communities at an altitude of 1100 m may be associated with Myrtaceace, Rubiaceace and Lauraceace plants that is most abundant at this altitudes. These plant groups may be able to serve (as food or shelter) to less number of insect species or communities at 1100 m altitude as compared to plant groups at other altitudes.

Insect communities similarity: Result also indicates that the E' is important than R' in determining H' value as indicated by low R' with relatively high E' value produced the highest H' value for altitude 500 m. The species richness seemed to increase with altitudes, peak at 800 m and declined as the altitude increased (Table 2). This probably the reason why H' value for an altitude 800 m was somewhat similar to that of 500 m altitudes even though the E' value at 800 m is much lower than that at 500 m altitude.

Insect Communities similarity Result of cluster analysis based on the UMPGA (unweighted-pair groups method) and Jaccard's Coefficient (Jaccard's Similarity Index) indicated that the insect community similarity was highest between altitudes 800 and 1100 m (0.467) and lowest between 300 and 1100 m (0.176). This indicated that 46.7% of the insect communities at 800 and 1100 m altitudes were similar while only 17.6% of the insect communities at 300 and 1100 m altitudes were the same. The similarity of insect communities between 300 and 500 m altitudes is also high (38.5%). Because the relative humidity was not significantly correlated with altitudes, the insect communities similarity among altitudes may be influenced by the temperature ($r=0.97$; $f=53.4$; $df=1, 3$, $p< 0.005$) or plant diversity or majority of plant present at each altitudes.

There seemed to be two altitudinally associated insect faunas, one in higher altitudes and another one in the lower altitudes (Fig. 2). The transition between these two assemblages is between 500 and 800 m altitudes. The lowland faunal assemblage has the highest number of species, with maximum species richness at about 500 m altitude. At about 800 m altitude the species richness and diversity were the highest (Table 3) and this may be the areas where overlapping of insect species occur. This area may also the altitude where climate and vegetation rapidly from lowland to mountain types (ecotone) as reported by Md. Nor (2001) for small mammals in the Mountain Kinabalu, Sabah, Malaysia.

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References

Block, W., 1992. An annotated bibliography of Antarctic Invertebrates (Terresterial and Fresh water). Cambridge, UK. British Antarctic Survey. National Environmental Research Council.

Danks, H.V., 1981. Arctic Arthropods. A review of systematics and ecology with particular reference to the North American Fauna. Ottawa, Canada: Entomol. Soc. Canada.

Disney, R.H.L., 1994. Scuttle flies. The Phoridae. Chapman and Hall. London, pp: 467.

Gauld, I.D., 1987. Some factors affecting the composition of tropical Ichneumonids faunas. Biol. J. Linnean Soc., 30: 299–312.

Gray, J. and W. Shear, 1992. Early life on land. Am. Sci., 80: 444-456.

Groombridge, B., 1992. Global Biodiversity. Status of the earth's living resources to agrochemicals: From Fundamental Research to Practical Strategies. Washington, DC: Am. Chem. Soc.

Hoffmann, A.A. and P. A. Parsons, 1991. Evolutionary genetics and Environmental Stress, Oxford: Oxford University Press.

Janzen, D.H., 1976. Changes in the arthropod community along of seasons, vegetation types, elevational, time of day and insularity. Ecol., 54: 687-708.

Janzen, D.H., ed. 1983. Costa Rican Natural History. Chicago: University of Chicago Press.

Kim, K.C., 1993. Biodiversity, conservation and inventory: why insects matter. Biodiversity and Conservation, 2: 191–214.

Lawton, J.H., M. MacGarvin and P.A. Heads, 1987. Effects of altitude on the abundance and species richness of insect herbivores on bracken. J. Ani. Ecol., 56: 147-160.

La Salle, J. and I.D. Gauld, 1993. Hymenoptera and Biodiversity. C.A.B. International, pp: 384.

MVSP, 1999. Multivariate Statistical package (VSP), Version 3.11c, 1999.

Md. Nor, S., 2001. Elevational diversity patterns of small mammals on Mount Kinabalu, Sabah, Malaysia. Global Ecology and Biogeography, 10: 41–62.

Martin-Pierra, F. and J.M. Lobo, 1993. Altitudinal distribution patterns of coprenecphage Scarabaeoidae in Veracruz, Mexico. Coleoptera Bulletin, 47: 321-334.

Maryati, M., 1992. Penggunaan kaedah yang sesuai bagi pengumpulan semut. Prosiding Simposium Sumber Alam Kebangsaan Pertama., pp: 182-192.

Miller, J.C., 1993. Insect Natural History, multi-species interactions, and biodiversity in ecosystems. Biodiversity and Conservation, 2: 233-244.

Noyes, J.S., 1989. A study of five methods of sampling Hymenoptera (Insecta) in a tropical rainforest, with special reference to the Parasitica. J. Natural History, 13: 285-298.

Price, P.W., 1991. Pattern in communities along latitudinal gradients. pp: 51-69. In Price, P.W., Lewinsohn, T.M., Fernandes, G.W. and Benson, W.W. (eds.), Plant-animal interaction: Evolutionary ecology in tropical and temperate regions. John and Wiley, New York.

Robinson, G.S., 1991. Aplha, PC Version GW Basic. Natural History Museum, London.

Romoser, W.S. and J.G. Stoffolano, 1998. The Science of Entomology. McGraw-Hill Companies.

Walker, B.H., 1992. Biodiversity and ecological redundancy. Conservation Biol., 5: 18–23.