THE RAFFLES BULLETIN OF ZOOLOGY 2007 **55**(1): 175-178
Date of Publication: 28 Feb.2007

BUTTERFLY (LEPIDOPTERA: RHOPALOCERA) DISTRIBUTION ALONG AN ALTITUDINAL GRADIENT ON MOUNT TANGKUBAN PARAHU, WEST JAVA, INDONESIA

S.S. Tati-Subahar, Anzilni F. Amasya and **Devi N. Choesin**
Ecology & Biosystematic Group, School of Life Sciences & Technology
Institut Teknologi Bandung, Jalan Ganeca 10, Bandung 40132, Indonesia
Email: tati@sith.itb.ac.id (TS; Corresponding author); devi@sith.itb.ac.id (DC)

ABSTRACT. **–** The distribution of butterflies (Lepidoptera: Rhopalocera) along an altitudinal gradient on Mount Tangkuban Parahu (MTP) forest in West Java, Indonesia, was studied using the 'standard walk' method. Observations were conducted beginning from the peak of the mountain following a foot track from Upas Crater (2,080 meters a.s.l.) through montane forest to Situ Lembang (1,600 meters a.s.l.). From 12 different locations, 23 species of butterflies were recorded and noted as a new record of butterflies from MTP. *Mycalesis sudra* and *Ypthima pandocus* were observed consistently at all altitudes. *Kaniska canace* appears to be a unique species only observed at 2,080 meters a.s.l., while *Lampides boeticus* and *Leptosia nina malayana* were characteristic of lower mountain species which were never found above 1,600 meters a.s.l. *Lantana camara* was the plant species most frequently visited by butterflies.

KEY WORDS. **–** altitudinal gradient, butterfly, distribution, Tangkuban Parahu.

INTRODUCTION

The area of Mount Tangkuban Parahu (MTP) is a remnant natural forest and biodiversity refuge within a region dominated by human activity. Anthropogenic activities resulting in the conversion of natural forest into other land uses have greatly affected the biological diversity of this area. Between 1994 and 2001, there has been an estimated 648 hectare reduction in forest area, or approximately 80 hectares of deforestation per year (Choesin et al., 2003). Tati-Subahar et al. (2003) found that forest conversion into agricultural land has resulted in a decline in arthropod diversity. In addition to the threat of forest reduction, biotic components of this site also experience disturbances related to tourism activities around the MTP volcanic craters, which are designated tourist attractions.

Butterflies (Lepidoptera: Rhophalocera) form an easily recognizable biotic component of the ecosystem, as they are visibly attractive and colorful. The ecological role of butterflies in an ecosystem is not only as herbivores, but also as important pollinators. Besides their attractiveness, butterflies are of interest because they can also be used to monitor environmental conditions. Change in butterfly abundance may indicate change in habitat conditions (Pollard 1992, in Goldsmith, 1992).

The objective of this study was to investigate the distribution of butterfly species along an altitudinal gradient on MTP, beginning from the peak at Upas Crater (approximately 2,080 m above sea level) towards Situ Lembang (1,600 m a.s.l.). It is hoped that results of this study can contribute to the biodiversity database of MTP; which can thereafter be used for monitoring of environmental change, in order to conserve the biotic components of this site, as well as increase the local people's awareness of biodiversity issues, so that conservation objectives may be achieved.

MATERIAL AND METHODS

Study site **–** Mount Tangkuban Parahu (MTP), at 2,081 m above sea level (a.s.l.) is a volcanic mountain located on Java Island, Indonesia (at 6°40'00"S 107°37'00"E, approximately 20 km north of Bandung, the provincial capital of West Java). The area is currently protected because of its geological, ecological, hydrological and cultural importance. Part of MTP functions as a nature tourism park (370 hectares), while the remaining 1,290 hectares has been designated as nature preserve (by Decree of the Minister of Agriculture No. 528/ Kpts/Um/9/74, dated 3 September 1974). Vegetation of MTP varies along the altitudinal gradient of the mountain. Specifically, Choesin et al. (2004) described the area between 1,980 and 2,080 m a.s.l. as being dominated by the genera *Neolitsea* and *Astronia*, and considered it as Upper Montane Zone. The area between 1,600 and 1,930 m a.s.l.,

characterized by *Quercus* sp. and *Schima wallichii*, was considered as Midmontane Slope Zone.

Our study site was located within the protected forest and its surroundings, following a foot track transect measuring approximately four kilometers long, beginning from the peak of MTP at Upas Crater (2,080 m a.s.l.) towards Situ Lembang area (1,600 m a.s.l.). This particular area in the western part of MTP was selected because the intensity of anthropogenic disturbance there is lower than in areas around the main volcanic crater (Ratu Crater) where tourism activity is very high. Previous biological studies of MTP have mostly been conducted to the east of Ratu Crater. However, information on the flora and fauna in the western area of MTP is still limited, or almost nonexistent. This is mostly due to the relatively difficult access to Ratu Crater from Situ Lembang.

Butterfly sampling was conducted along a relatively undisturbed, altitudinal gradient beginning from the peak of MTP at Upas Crater, in the same sampling area where vegetation studies were being conducted (Choesin et al., 2004). Eleven observation plots were set along the foot track (as a line transect) at every 50 m altitudinal difference. Upas Crater (2,080 m a.s.l.), situated on the mountain peak, was designated as plot 1, while the lowest point (Situ Lembang, at 1,600 m a.s.l.) was designated as plot 11. Observations in each plot followed the "standard walk" method from Pollard (in Goldsmith, 1992) and Pollard & Yates (1995), i.e., walking along the plot while counting and recording the number of butterflies seen or encountered. The observation width was limited to about 5 m. The presence and number of known butterflies in each plot were directly recorded. After being examined and recorded morphologically by photograph, we released the butterfly into its natural habitat. No individual marking was conducted. Unidentified butterflies were collected using an insect net for later identification. We also recorded the specific locations in which butterflies were observed, e.g., on flowers, other plant parts, or on the ground.

Six full day observations were made on October 2002, i.e., on October 4, 5, 6, 12, 13 and 20. In each observation plot, the surveyor spent 20 minutes. Due to the relatively difficult access between Ratu Crater and Situ Lembang, observation started from 0600 hours and finished around 1800 hours.

Species identifications were conducted at the Biology Department of Institut Teknologi Bandung using Lewis (1973), Fleming (1991), Neo (1996), Landman (1999), and Fetwell (2001) as references. Verification of samples was made by comparison to the insect collection of the Zoology Section, Biology Research Center of LIPI (the Indonesian Institute of Science) in Cibinong - Bogor. Specimens collected were deposit at Zoological Museum at ITB Bandung.

RESULTS AND DISCUSSION

Twenty-three butterfly species were recorded along the observation track between the peak of MTP and Situ Lembang, i.e., *Abisara savitri, Celastrina camenae, Celastrina ceyx, Chilades pandava, Cynthia cardui, Danaus melaneus, Eurema andersonii, Faunis canens, Graphium sarpedon, Heliophorus moorei, Jamides abdul, Kaniska canace perakana, Lampides boeticus, Leptosia nina malayana, Mycalesis sudra, Neptis mahendra, Pantoporia selenophora, Papilio memnon, Potanthus omaha, Pyrameis dejeani, Ypthima pandocus, Symbrenthia hyplesis,* and *Zemeros flegyas*. Among butterfly species sampled, none was Javan or Indonesian endemic species. This list forms a new record of butterfly species from MTP, as there has not been any previous documentation.

Butterfly species richness varied among locations (Fig. 1); the highest number of species (16) was found in plot 11 at Situ Lembang (1,600 m a.s.l.), i.e., *Mycalesis sudra, Ypthima pandocus, Eurema andersonii, Cynthia cardui, Neptis mahendra, Chilades pandava, Lampides boeticus, Potanthus omaha, Leptosa alcesta, Jamides abdul, Pyrameis dejeani, Symbrenthia hyplesis, Pantoporia selenophora, Zemeros flegyas, Celastrina camenae,* and *Celastrina ceyx*. Compared to most plots, species richness was lower in plots 3 to 6, i.e., between 1,830 and 1,980 m a.s.l.

Along the observation track, *Mycalesis sudra* and *Ypthima pandocus* were two species that were consistently found at all altitudes. *Pyrameis dejeani* was consistently found in all plots, except plot 5 (1,880 m a.s.l.), with more than an 80% frequency of occurrence, followed by *Faunis canens* (73%) which was not found at 2,080 m, 1,980 m, or 1,600 m a.s.l.. *Danaus melaneus* was found in plot 7 (1,730 m a.s.l.), while *Pantoporia selenophora* was always found from plot 2 (1,780 m a.s.l.) to plot 11 (1,600 m a.s.l.) with a frequency of 64%. Frequency of occurrence for both *Celastrina ceyx* and *Neptis mahendra* along the observation track was 54%. Finally, occurrence of *Celastrina camenae, Cynthia cardui, Papilio memnon* and *Symbrenthia hyplesis* was 45% for all four species.

The occurrence of other species such as *Eurema andersonii, Graphium sarpedon* and *Heliophorus moorei,* with lower frequencies did not show any consistent pattern (Fig. 2). However, *Kaniska canace perakana* was observed only at plot 1 around the mountain peak (altitude 2,080 m a.s.l.) and not in other plots. *Potanthus omaha* and *Zemeros flegyas* were observed at 1,780 m a.s.l. and lower; *Lampides boeticus* and

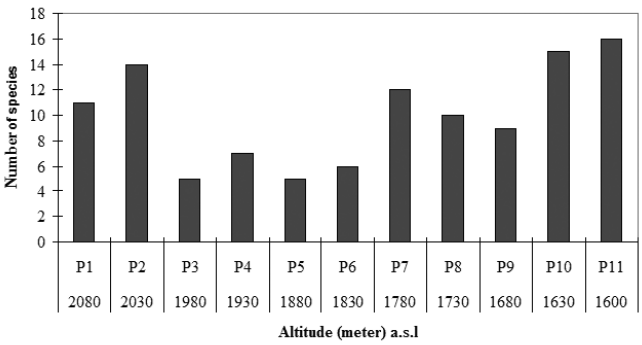

Fig. 1. Number of butterfly species at different altitudes along the track from the peak of MTP at Upas Crater (2,080 m a.s.l.) to Situ Lembang (1,600 m a.s.l.). P1 to P11 = plot of samplings.

Table 1. The occurrence of butterfly on each site visited along the foot track from Upas Crater to Situ Lembang at MTP on October 2002.

No	Butterfly species	Site of butterfly occurrence*										
		1	2	3	4	5	6	7	8	9	10	11
1	*Abisara savitri*								M			
2	*Celastrina camenae*			M							L	
3	*Celastrina ceyx*	H						L			M	
4	*Chilades pandava*		H	M								
5	*Cynthia cardui*			H								
6	*Danaus melaneus*				M							
7	*Eurema andersonii*			H				L				
8	*Faunis canens*	H			M							L
9	*Graphium sarpedon*									M		
10	*Heliophorus moorei*				M						M	
11	*Jamides abdul*	H		M								
12	*Kaniska canace perakana*										M	
13	*Lampides boeticus*	M										
14	*Leptosia nina malayana*	H										L
15	*Mycalesis sudra*	H	H						M			L
16	*Neptis mahendra*			H								
17	*Pantoporia selenophora*							M				
18	*Papilio memnon*			H				H		M		
19	*Potanthus omaha*	M	M	M								
20	*Pyrameis dejeani*										M	M
21	*Symbrenthia hyplesis*										M	
22	*Ypthima pandocus*	H	H	M		H	H					
23	*Zemeros flegyas*			M								

Note:
Butterfly occurrence at each site: L (low) = 1-5 individuals; M (medium) = 6-10 individuals; H (high) > 11 individuals
*Number corresponds to observed butterfly site, i.e., 1 = on the ground; 2 = on the grass; 3 = *Lantana camara*; 4 = *Impatiens sp*; 5 = *Ageratum conyzoides*; 6 = *Eupatorium inuliifolium*; 7 = *Caliandra sp*; 8 = *Dicranopteris linearis*; 9 = *Schima walichii*; 10 = herbs; 11 = Malvaceae.

Leptosia nina malayana were observed only at 1,600 m a.s.l. and not at higher altitudes. Similarly, and *Chilades pandava* and *Jamides abdul* were observed only at 1,630 m a.s.l. and not at higher altitudes. Finally, *Abisara savitri* was observed only at 1,930 m a.s.l. There was no correlation between butterfly distribution and habitat variables (e.g. tree density and light intensity). However, this result is unlike the results of Koh & Sodhi (2004) where butterfly distribution correlated with environmental factors (canopy cover, light intensity).

According to the specific habitat location in which they were encountered, most butterflies were found active on the ground (8 species) and visited several kinds of plants. We observed seven plant species that were intensively visited by butterflies, i.e., *Lantana camara*, *Impatiens* sp.; *Ageratum conyzoides, Eupatorium inuliifolium*, *Caliandra* sp., *Dicranopteris linearis, Schima wallichii*, and several other Malvaceae species, grasses, and other herbaceous species (Table 1). Most butterflies were found in interaction with herbaceous plants.

Studies on plant species in the same location found that

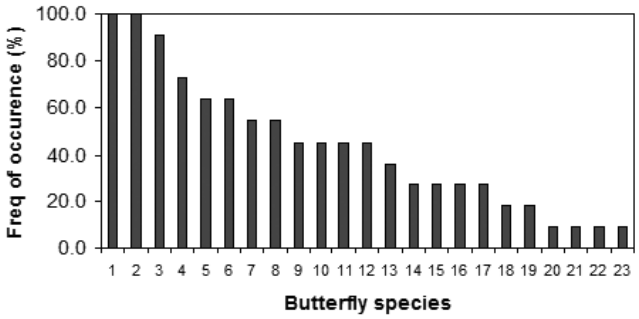

Fig. 2. Frequency of butterfly occurrence along the observation track from Upas Crater to Situ Lembang at MTP during October 2002. 1 = *Mycalesis sudra*; 2 = *Ypthima pandocus*; 3 = *Pyrameis dejeani*; 4 = *Faunis canens*; 5 = *Danaus melaneus*; 6 = *Pantoporia selenophora*; 7 = *Neptis mahendra*; 8 = *Celastrina ceyx*; 9 = *Cynthia cardui*; 10 = *Papilio memnon*; 11 = *Symbrenthia hyplesis*; 12 = *Celastrina camenae*; 13 = *Potanthus omaha*; 14 = *Graphium sarpedon*; 15 = *Eurema andersonii*; 16 = *Heliophorus moorei*; 17 = *Zemeros flegyas*; 18 = *Chilades pandava*; 19 = *Jamides abdul*; 20 = *Abisara savitri*; 21 = *Lampides boeticus*; 22 = *Leptosia nina malayana*; 23 = *Kaniska canace perakana*

Elastoma eurhyncum (herb) was found in abundance along the observation track. *Strobilanthes imbricata* (Acanthaceae) was the dominant plant species found between 1,680 and 1,780 m a.s.l., while *Eupatorium riparium* dominated between 1,600 and 1,630 m a.s.l. (Susanti, 2004). During the observation period, 11 sites were continuously visited by butterflies. However, these plants could not as yet be concluded as being their specific habitat, since butterfly habitat is defined as a place where both the adult butterfly and its larvae are found living (Dennis, 2003). During observation, a species often visited by butterflies was *Lantana camara*, an herbaceous plant growing along the edges of the observation track, particularly in open areas with high light intensity. Ten butterfly species were recorded visiting the flowers of *Lantana camara*, i.e., *Ypthima pandocus, Eurema andersonii, Cynthia cardui, Neptis mahendra, Papilio memnon, Chilades pandava, Potanthus omaha, Jamides abdul, Zemeros flegyas* and *Celastrina camenae*. Flowers of *L. camara* are often visited by butterflies because of its color, aroma, nectar, and proximity to the ground (Fetwell, 2001).

Results from this study showed that food plant diversity for the butterfly varied according to altitude. The herbaceous *Impatiens* sp. was found between 1,880 and 1,980 m a.s.l., but was absent between 1,600 and 1,830 m a.s.l... *Lantana camara* was absent between 1,680 and 1,830 m a.s.l., but found in the other plots. Such variation and heterogeneity in vegetation cover are expected to affect butterfly presence and diversity (Kerr, 2001).

Specifically, along the track from Upas Crater to Situ Lembang, most butterflies observed are inhabitants of marginal secondary forests: *Mycalesis sudra* and *Ypthima pandocus* were distributed between 1,600 and 2,080 m a.s.l. However, *Lampides boeticus* and *Leptosia nina malayana* were found only at 1,600 m a.s.l. *Kaniska canace perakana* could be considered as a characteristic species found only at 2,080 m a.s.l.

As previously mentioned, *Lantana camara* was the plant species most frequently visited. It is clear that butterfly distribution and population abundance can be related to food plant availability and scarcity, which may be affected by habitat alteration. A more intensive investigation is required to enable monitoring of environmental conditions at MTP, and in order to better manage the forest area at this site.

ACKNOWLEDGMENTS

We thank the ASEAN Regional Center for Biodiversity Conservation (ARCBC) and the European Union for their funding support (Project RE-IDN-003) and BKSDA for field site access. Special thanks to Dr. Lian Pin Koh for his suggestion in reviewing the manuscript, to C. Yanto for help in specimen processing, to Dr. Woro and Dr. Peggy from the Biology Research Center of LIPI for assistance in verifying the specimen collections, to Prof Soelaksono and Dr. Herawati for references, and all other parties involved in the project.

LITERATURE CITED

Choesin, D. N., A.Sjarmidi, D. T. Iskandar, E. Sulistyawati, T. S. Subahar, Taufikurahman, U.A. Dasuki & A. D. Permana., 2004. *Biodiversity Conservation in a Highland Ecosystem in Western Java, Indonesia: Ecological, Economic & Socio-Cultural Perspectives*. ARCBC Final Project Report. 41 pp.

Dennis, R. L. H., 2003. Towards a functional resource-based concept for habitat: a butterfly biology viewpoint. *Oikos* **102**(2): 417-426.

Fetwell, J., 2001. *The Illustrated Encyclopedia of Butterflies*. Grange Books. London. 288 pp.

Fleming, W. A., 1991. *Butterflies of West Malaysia and Singapore*. 2nd ed. Longman Malaysia SDN BHD. 148 pp.

Goldsmith, F. B. 1992. *Monitoring for Conservation and Ecology*. Chapman & Hall. Pp. 87-111

Kerr, J. T., 2001. Butterfly species richness patterns in Canada: energy, heterogeneity, and the potential consequences of climate change. *Conservation Ecology* **5**(1): 10, 1-14.

Koh, L. P., & N. S. Sodhi, 2004. Importance of reserves, fragments, and parks for butterfly conservation in a tropical urban landscape. *Ecological Applications*, **14**(6): 1695-1708.

Landman, W., 1999. *The Complete Encyclopedia of Butterflies*. Grange Books, The Netherlands. 272 pp.

Lewis, H. L., 1973. *Butterflies of the world*. Harrap London. 312 pp.

Neo, S. H. S., 1996. *A guide to Common Butterflies of Singapore*. Singapore Science Centre. Singapore. 168 pp.

Pollard, E. & T. J. Yates, 1995. *Monitoring Butterflies for Ecology and Conservation*: The British Butterfly Monitoring Scheme. Chapman and Hall. Suffolk. 274 pp.

Susanti, R., 2004. *Vegetation composition at different altitudes at Gunung Tangkuban Parahu.* Master Degree Thesis. Department of Biology, Institut Teknologi Bandung. 121 pp. (In Indonesian).

Tati-Subahar, S. S., M.L. Ilhamdi, R. D Sebayang, P. Prastowo & Adianto., 2003. The dynamics of change in land use function and its consequence to the diversity of arthropods at Tangkuban Parahu, West Java. *Ekologi & Biodiversitas Tropika*. **1**(1): 49-52. (In Indonesian).