Coleopteran Assemblages at Four Different Habitats in the Mount Tangkuban Parahu Area, West Java-Indonesia

Christopher Y. Barsulo[1,2,*] and Tati S. S. Subahar[1]

[1]*Ecology and Biosystematic Research Group, School of Life Science and Technology, Institut Teknologi Bandung, Ganesa No. 10 Bandung 40132, Indonesia*
[2]*Laboratory of Ecology, Faculty of Science, Kanazawa University, Kanazawa 920, Japan*

ABSTRACT

Coleoptera assemblages at four different habitats of Mount Tangkuban Parahu, West Java - Indonesia were investigated from April to September 2004. Sampling was carried out at four different types of habitat represented by several dominant types, i.e. Vaccinium forest, mixed forest, pine forest, and post-agricultural area, of plant community. Specimens were collected using four different kinds of traps following sampling methods of DIWPA (Diversitas for Western Pacific Area) for IBOY (International Biodiversity Observation Year) program and analyzed down to the morphospecies level. The results showed that species composition of coleoptera differed at each habitat. Mixed forest was the most diverse with 252 species, followed by pine forest (178 species), Vaccinium forest (90 species) and post-agricultural area (76 species). In addition, many singleton species were found at each sampling site.

Keywords: Coleoptera, Diversity, Singleton species, Mount Tangkuban Parahu, Java, Indonesia

INTRODUCTION

Habitat modification has been a common problem these days especially in developing countries such as Indonesia, where habitat modification from natural forest to production forest or to agriculture area is common. Habitat modification can alter species composition and community structure including insect groups. Such modification also occurs in Mount Tangkuban Parahu (MTP) area, one of the natural reserves and active volcanic mountain in West Java, Indonesia.

Coleoptera is often considered as an ecological indicator for habitat modification both in tropical and temperate area. Coleoptera mostly from Carabidae family has been used as ecological indicator in temperate area; however, it is still difficult to decide the most appropriate group of Coleoptera that serves as a potential ecological indicator in tropical region [1–7].

The main objective of this research was to find out the influence of habitat modification to biodiversity by comparing the diversity and distribution of Coleoptera assemblages in each type of habitat, which represents a different type of land management (natural and managed habitats).

METHODS

Study site

Mount Tangkuban Parahu (MTP), with its peak at 2,081 meters above sea level (masl) is a volcanic

*Corresponding author, e-mail: chriswebyan@gmail.com
Information for use in citing this article: Okada, H., Mawatari, S.F., Suzuki, N. and Gautam, P. (eds.), *Origin and Evolution of Natural Diversity*, Proceedings of International Symposium "The Origin and Evolution of Natural Diversity", 1–5 October 2007, Sapporo, pp. 251–255.

mountain located on Java Island, Indonesia. It is located near 6°40′00″ south latitude and 107°37′00″ east longitude, approximately 20 km north of Bandung, the provincial capital of West Java (Fig. 1). Vegetation of MTP varies along the altitudinal gradient of the mountain. Specifically, Choesin et al. [8] described the area between 1,980 and 2,080 masl as Upper Montane Zone. The area between 1,600 and 1,930 masl was considered as Mid Montane Slope Zone.

Our study sites were located within the Upper Montane Zone (protected forest) and its surroundings – in the Mid Montane Zone. The first site was *Vaccinium* forest (1,900 masl, 06°45′40″ S & 107°37′07″ E) in an area near the crater, which is dominated by *Vaccinium varingiaefolium* tree, but some other trees such as *Ficus diversifolia, Melastoma malabathricum, and Embelia coriacea* do occur. The forest floor is dominated by *Polypodium feei*. The second site is a natural mixed forest (1,775 masl, at 06°46′00″ S and 107°37′08″ E). Forest tree in this area dominated by *Schima wallichii*, *Astronia spectabilis* but *Castanopsis argenta, Quercus* spp., *Syzygium* spp., *Litsea* spp., *Vernonia arborea, Polyosma integrifolia and Omalanthus populneus* are present. At forest floor we could find *Cyathea* spp., *Hedychium roxburghii, Lasianthus* sp., *Pinanga kuhlii, Piper* spp. The first two locations are considered as natural habitats. The third site was pine forest (1,722 masl, at 06°46′33″ S 107°37′24″ E), which was dominated by *Pinus merkusii and Pinus montezumae*. At the forest floor we found *Caliandra callothyrsus, Eupatorium* spp., *Melastoma malabathricum*, and *Molineria capitulata*. The fourth site considered as agriculture area (1621 masl; 06°46′45″ S & 107°37′40″ E) with vegetable crops. Since the year of 2001, the latter was the site of multicropping system, which consists of growing vegetables along with plantation of young pine trees (*Pinus merkusii*). During sampling periods, floor vegetation was rep-

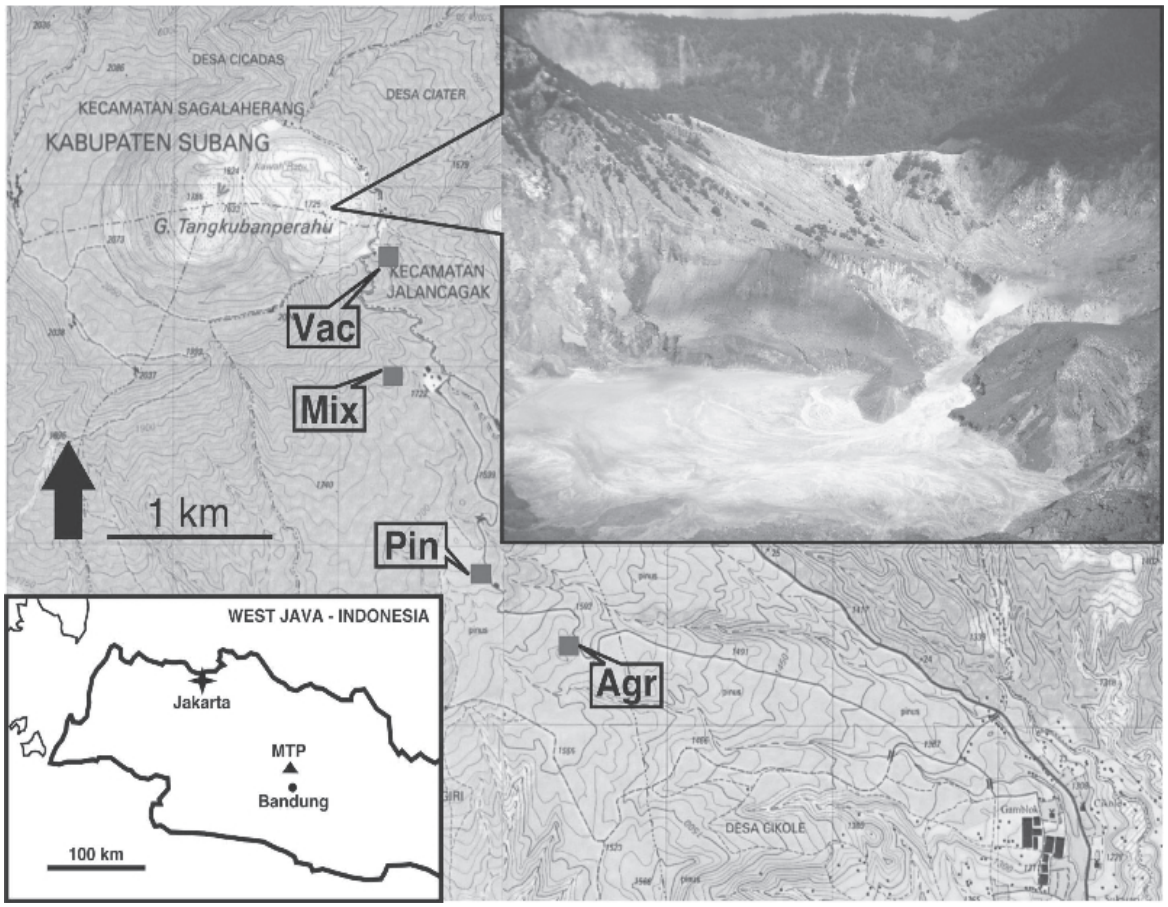

Fig. 1 A part of the topographic map with the sampling sites (Vac = Vaccinium forest; Mix = Mixed forest; Pin = Pine forest; Agr = Agriculture area). Index map in the lower left corner shows the location of Mount Tangkuban Parahu (MTP) in West Java. The photograph in the upper right corner shows the "Kawah Ratu"- main crater Tangkuban Parahu.

resented by *Penisetum purpureum*. The third and fourth sites are considered as managed habitats.

Sampling method

Samples were taken using light traps, window traps, malaise traps, and pitfall traps during three sampling periods from April to September 2004: I (April-May), II (June-July), and III (August to September). The first sampling was done during wet season, the second sampling was done between wet season and dry season, and the third sampling was done in dry season. Standard methods of DIWPA (Diversitas for Western Pacific Area) for IBOY (International Biodiversity Observation Year) were adapted [9]. Each sample was sorted and identified to the family and morphospecies level using references [10–11]. Samples are deposited in Zoological Museum Bogoriense of Indonesia Research Institute-LIPI Indonesia. They were verified by Coleopteran experts during the first and second IBOY-Parataxonomist Training courses conducted in 2004 and 2005.

RESULTS AND DISCUSSION

In total, the collection of Coleoptera consisted of 6,016 individual specimens represented by 56 families and 370 species. Analysis showed that the largest number of Coleoptera species is found in mixed forest (251 species), followed by the pine forest (178 species), Vaccinium forest (90 species) and agriculture area (77 species) (Fig. 2). Similar tendency is evident in the Shannon Diversity Index for each sampling period; the mixed forest has the highest diversity index followed by the pine forest, Vaccinium forest and agricultural area (Table 1).

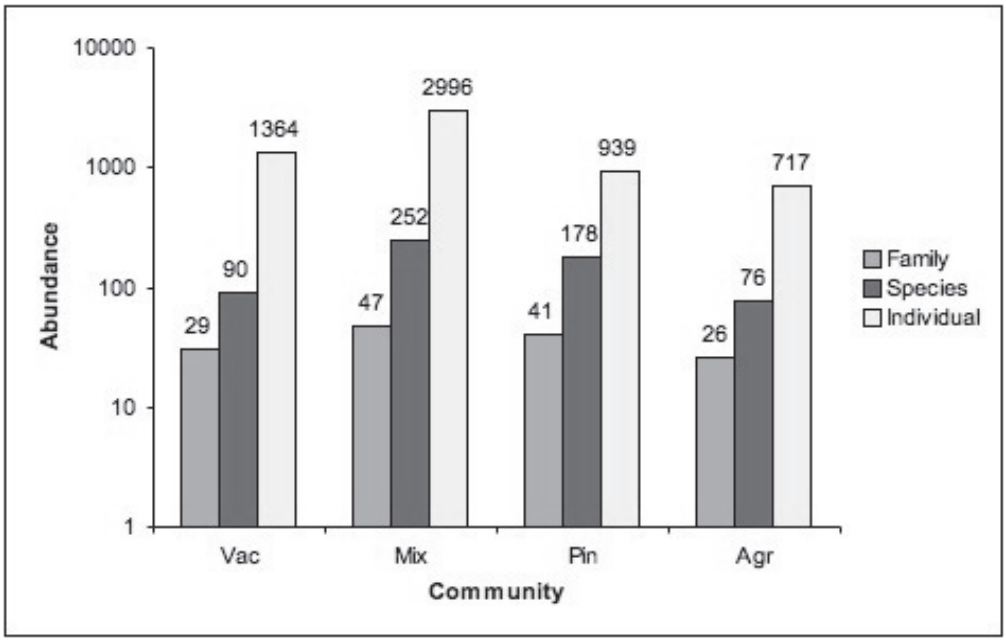

Fig. 2 Total no. of Coleoptera specimens captured during three sampling periods in four different habitats. Note: Vac = Vaccinium Forest, Cam = Mixed Forest, Pin = Pine Forest, Agr = Agricultural Area

Table 1 Coleopteran diversity index calculated for each sampling period and sampling habitat in Mount Tangkuban Parahu.

Period	Diversity Index H' by location			
	Vac	Mix	Pin	Agr
1	3,627	4,903	4,646	Not sampled
2	3,785	4,687	3,879	3,628
3	3,719	4,287	3,897	3,787

Note: Vac = Vaccinium Forest; Mix = Mixed Forest; Pin = Pine Forest; and Agr = Agriculture Area.

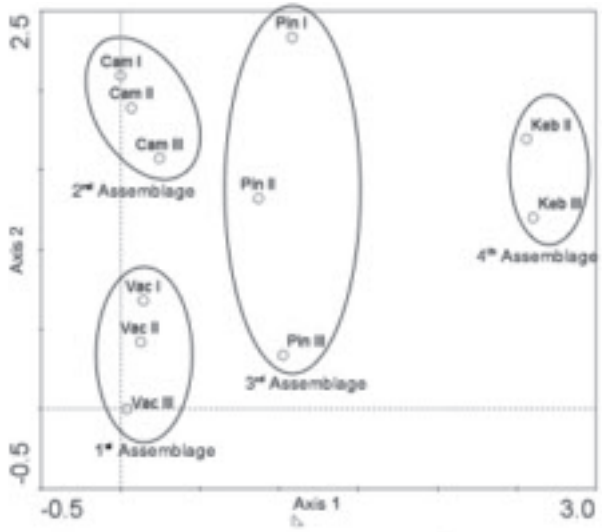

Fig. 3 Coleoptera assemblages in Mount Tangkuban Parahu by DCA analysis (percentage of cumulative variance from species data = 33.7; axis 1 = 20.1 with eigenvalue = 0.468; axis 2 = 13.6 with eigenvalue = 0.319). Vac = Vaccinium Forest, Cam = Mix Forest, Pin = Pine Forest, Keb = Agriculture Area. I, II, and III = sampling period.

Analysis of similarity using detrended correspondence analysis (DCA) for Coleoptera showed four coleoptera assemblages (Fig. 3). Each sample taken at the same habitat but during differing period of sampling is characterized by a distinct assemblage that is significantly separated from other assemblages. Statistically, these assemblages differ significantly as shown by the sum of both axis with eigenvalue exceeding 0.5 [12]. This may indicate that each habitat sampled in MTP area has a characteristic and unique Coleoptera assemblage.

The most important finding of this research is the existence of singleton species restricted to each of the sampling periods and sites. Actually, the proportion of singleton species in each sampling site was: 47.8% in Vaccinium forest (90 species), 46.4% in mixed forest (252 species), 49.4% in pine forest (178 species) and 50.6% in agriculture area (76 species). The number of singleton species in the mixed forest type was higher than at all other sites (Fig. 4).

Although the existence and diversity of Coleoptera in the Vaccinium forest was found to be always lower than in the pine forest, this phenomenon seems not related with the human intervention. It probably results from the type of substratum or physico-chemical conditions of the habitat (e.g., the area close to crater has high sulfur concentration). Comparison between managed habitat (pine forest, and agricultural area) to natural habitat (mixed forest) in term of species diversity shows that natural habitat has the highest species diversity but the abundance of each species is rather low. As a consequence, the natural habitat seems to be more sensitive to habitat modification. Research by Floren and Linsenmair on the response of Coleoptera community to anthropogenic disturbance in Kinabalu National Park Malaysia has shown that the lowness of vegetation diversity in disturbed forest is the cause of the changes in the distribution pattern of Coleoptera species inside it [13].

The existence of natural forest in MTP as the source of biodiversity (in this case Coleoptera diversity) is very important showed by it large potential species diversity which supposedly have important role in stability of ecology functional on MTP area. Based on a similar study in the Malaysia Kinabalu National Park, Floren and Linsenmair have recommended that it is vital to take action to conserve

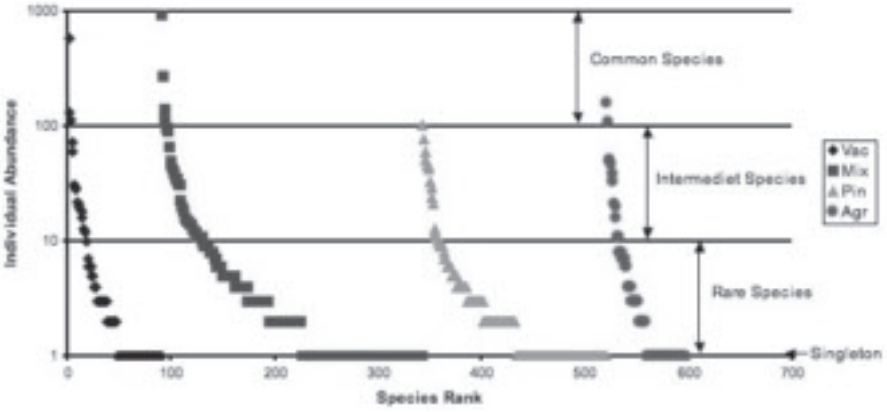

Fig. 4 Rank abundance plot showing the distribution of Coleoptera species in each habitat. Vac = Vaccinium Forest; Mix = Mixed forest; Pin = Pine forest; and Agr = Agriculture area.

natural area by maintaining the areas characterized by high biodiversity [13].

CONCLUDING REMARKS

Study on coleoptera diversity at different habitats by comparing the species richness is useful for determining ecological indicators at each habitat. Lesson learned from sampling differing habitats in MTP implies that natural habitat represented by mixed forest has higher diversity of coleoptera compared to the managed habitats. However, high number of singleton species in mixed forest indicated that this habitat is more sensitive to habitat modification. The forest in MTP is a remnant forest, which has a high anthropogenic pressure; therefore conservation of this natural forest requires a high priority.

ACKNOWLEDGMENTS

We thank Professors K. Nakamura, M. Toda, H. Katakura and K. Kitayama from the 21st Center of Excellence programs at Kanazawa University, Hokkaido University and Kyoto University for the support during DIWPA IBOY program. Our special thanks go to to the Indonesian Forestry Department especially Tangkuban Parahu Management. We thank Drs. N.A. Woro & S. Kahono from Zoological Museum of LIPI-Indonesia Research Institute, Cibinong Bogor for their help as well as access to the specimens. We also thank all Coleopteran experts – participants of the first and second IBOY Parataxonomist Training Courses conducted in 2004 and 2005 at LIPI under the sponsorship of the aforementioned COE programs for their help for specimen identification and verification.

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