## E-2.2 Effects of forest fragmentation and degradation on insect species diversity

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**Abstract** Number and species richness of the understory butterflies (Lepidoptera, Nymphalidae), flower visiting beetles, bees and soil micro arthropoda were compared between neighboring primary forest and secondary forest in the Pasoh Forest Reserve, Peninsular Malaysia. The secondary forest had been naturally regenerated after selective logging in the 1960s. It was found that butterfly fauna of the regenerated forest has not been recovered after about 30 years of natural regeneration. Number of the flower visiting beetles (Scarabaeidae and Mordellidae) does not seem to be different between natural and regenerated forests. To examine the seasonal variation and community structure of tropical pollinators, honey traps were set in every 10 m on a Pasho tower (50m in height) from 0 m to 40 m. Bee communiy structure was strongly influenced by the dipterocarp mass flowering which occured in 1996. Numbers of Collembola, Pseudscorpion and Schizomida were fewer in the oil palm and the rubber plantation than in the primary forest. Community structures of the oribatid mites were similar among study site except for oil palm plantation.

**Key Words** tropical forest, fragmentation, degradation, insect, species diversity

### (1) Diversity and dynamics of insect communities between regenerated and natural forests

### 1. Introduction

Lowland tropical forests should be preserved because of the importance of genetic resources for future human beings. On the other hand most of all tropical lowland forests have already been developed. Therefore, one of the best ways to preserve bio-diversity in tropical forests is to practice sustainable use of secondary forests based on thoughtful consideration for bio-diversity. Though selective logging is the most typical forest treatment in tropical forests, there is little data on the effects of the treatment on bio-diversity in tropical rain forests, especially a long time after logging. Therefore, we attempted to estimate effects of selective logging on bio-diversity of forest arthropods 30 years or more after selective logging.

## 2. Methods

We established a line transect study plot from the edge to the core area along a path in Pasoh Forest Reserve and set 10 pairs of flower fragrance attractant traps on forest canopies at 2 different heights. We established research plots (100m X 100m) in secondary forests selectively logged 30 years ago (S1, S2) and in a primary forest (P1, P2). We set flower fragrance attractant traps on forest canopies in plot S1, S2 and P1, P2 for flower visiting beetles. By the use of fruit-bait traps, we sampled understory butterflies at the P1, P2 and S1, S2 in 1997. Twenty soil samples were collected from the primary (P1) and selective logged forest 30 years ago (S1), 10 samples from clear cut forest 30 years ago (CL), primary area neighbouring of (CL), oil palm plantation (OP) and rubber plantation (R) in 1996 and 20 samples from P1, P2, S1, S2 in 1997. Soil micro-arthropods were extracted by the Tullgren funnel in the laboratory on the sampling day.

## 3. Results and discussion

### *Flower-visiting beetles in the buffer zone and primary zone*

The number of *Dasyvalgus* spp., one of the main flower visiting groups, in the core area (primary forest) was significantly greater than that in buffer area (secondary forest) (t-test, N = 5, p= 0.015), whilst *Mecinonota,* another dominant flower visitor, showed no difference (t-test, N=5, p=0.134). Species structures of *Dasyvalgus* were different from each other.

### *Under story butterflies*

Twenty-two species of nymphalids were captured, with 0.65 individuals per day per trap. The similarity in species composition was very high between the two secondary plots, though they were most distant from each other. On the other hand, it was very low between the primary plots, thus the total number of species captured in the primary plots was about

1.5 times that in the secondary plots. It is most likely that the assembly of understorey butterflies has not completely recovered after selective loggging about 30 years ago. Understorey butterflies can be quantitatively sampled with the traps and are rather easily identified by non-specialists, thus they should be counted as one of high priority indicator groups for the monitoring of protected or disturbed forests, in additon to birds and mammals.

*Soil micro-arthropoda*

Number of soil micro-arthropods in order level was not different between the primary and the secondary forest. Numbers of oribatid mites in the rubber plantation (R) was significantly lower than the other sites. Numbers of collembolan insects were significantly higher in the primary (P1) and the selective logged forest (S1) and lower in the clear cut forest (CL), the oil palm (OP) and the rubber plantation (R). Species diversities of oribatid mites in the primary forests were higher than the secondary forest, and lowest in the clear cut forest. Community structures of the oribatid mites were similar among study site except for the oil palm plantation. These results show that 30 years is enough to recover the density of soil micro-arthropoda but not enough the diversity of soil faua in tropical forests after selective logging or clear cutting. The species composition in the rubber plantation was relatively similar to the primary forests. This fact suggests that a rubber plantation has an certain role to keep biodiversity in lowland area in tropical rain forests concerned with soil micro-arthropoda.

(2) The impact of general flowering on the community structure of tropical pollinators in a lowland dipterocarp forest

1. Introduction

Lowland forest in the Peninsula Malaysia is much characterized by the mixed dipterocarp forest. Most of tropical tree species, especially the family Dipterocarpaceae, have general flowering at intervals 2-10 years. After the general flowering, the tree has a large amount of fruits. The adaptive significance of the general flowering is thought to be that the resulting mass fruits after flowering escape the predation [1].

The tropical forests have much diversity in tree species, suggesting that a few individual of the same species exists in the same area and the distance among the same species individuals is much larger. Furthermore, many dipterocarp trees are thought to be out breeding species. Therefore, effective pollination for the tree spices plays an important role on the regeneration of the plants. Thus, general flowering in a dipterocarp tropical rain forest attracts a plenty of pollinators, which results mass fruiting.

Roubik [2] suggested that a tree in south east Asia have a partnership with a number of bees in a manner that niche differentiation in time and space. Only a few study [2] in pollination has been performed in tropical rain forest, especially from the side of its community structure in time and space. Furthermore, no study clarify the impact of general flowering on a community structure of pollinators.

In this study, we study the impact of general flowering on a community structure of pollinators in a low land dipterocarp forest by using an artificial diet.

## 2. Materials and Methods

### *Field Research*

All the research was done at the Pasho Forest Reserve in Negri Sembiran State, Peninsular Malaysia (2°59'N and 102°18'E). The reserve forest is typical lowland dipterocarp forest in the Peninsula Malaysia. Two petri dishes were set at the tower (50 m in height) from 0 m to 40 m high in every 10m. A sponge was set in the petri dish and it was fulled with 50 cc honey (50%). After setting the dishes, 50% honey was sprayed near the petri dishes for 3 seconds to attract bees. Three and 6 hours later, the petri dishes were covered with the caps and all the attracted bees were collected. General flowering occurred during April to July 97. The census was performed from May 95 to November 97.

### *Analysis of biodiversity of pollinators*

Morisita's b [6] (1967) was used for an analysis of biodiversity of pollinators. When $n_i$ is the total number of species *i* and N is total number of the population, β is given by the following equation,

$$\beta = \frac{N(N-1)}{\sum_i n_i(n_i-1)}$$

## 3. Results & Discussion

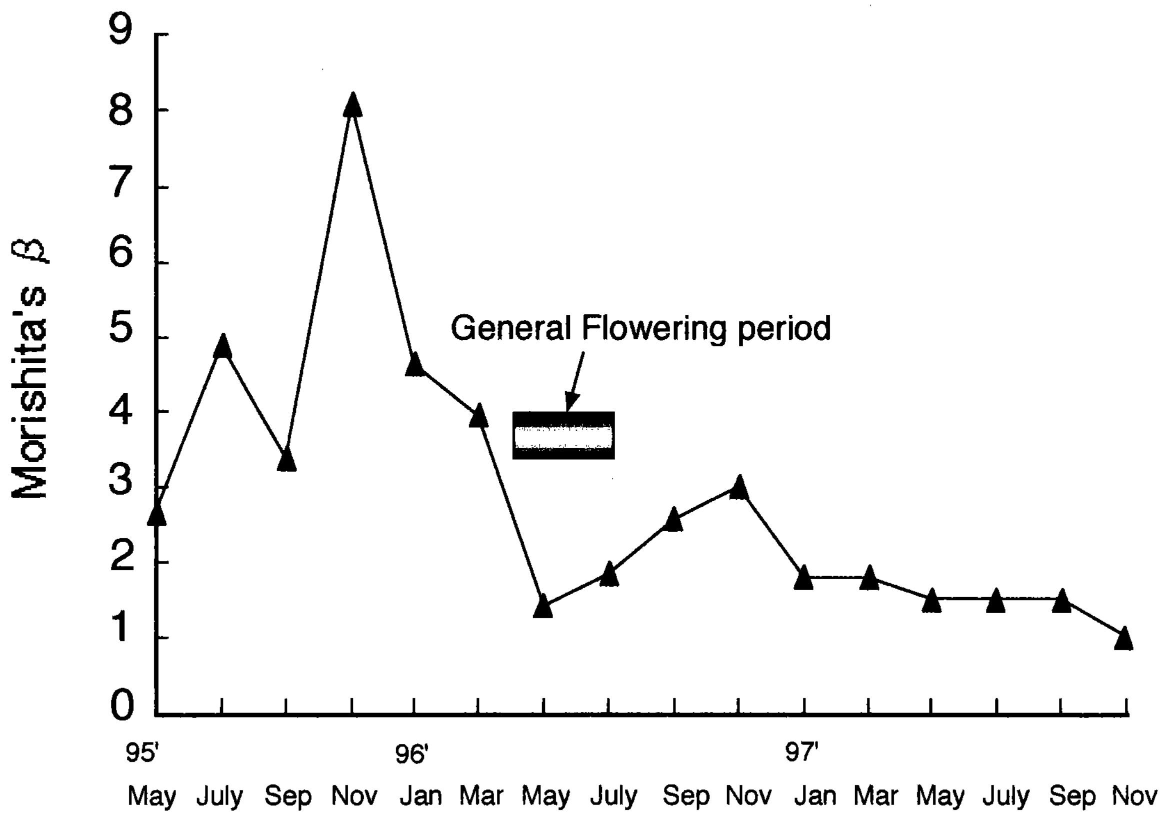


Fig. 1 The seasonal change of Morishita's B of pollinators at Pasho forest Reserve.

Figure 1 shows the seasonal change of Morisita's β at Pasoh Forest Reserve. Before the general flowering, the value of b is rather high (~4). However, during the general flowering, that drastically decreased (~2) and it has not recovered for a year and half. Figure 2 shows the insect pollinators in each height 4 month intervals before, during, and after general flowering. Before the general flowering 10 species of bees was collected. However, during general flowering only 2 species (96.9% of them were *Apis cerana*) were trapped and six species (91.6% of them were *Trigona peninsularis*) were trapped 4 months after general flowering.

These results indicate that general flowering decreased the biodiversity of pollinators and the influence continued at least one and half years. Furthermore, this study clarify that a large bee (eg. *A.cerana and T. peninsularis*) was a dominant species during and after general flowering. Thus, A large amount of supply of nectar and pollen in general flowering disturbed and changed the community structure of pollinators in the forest.

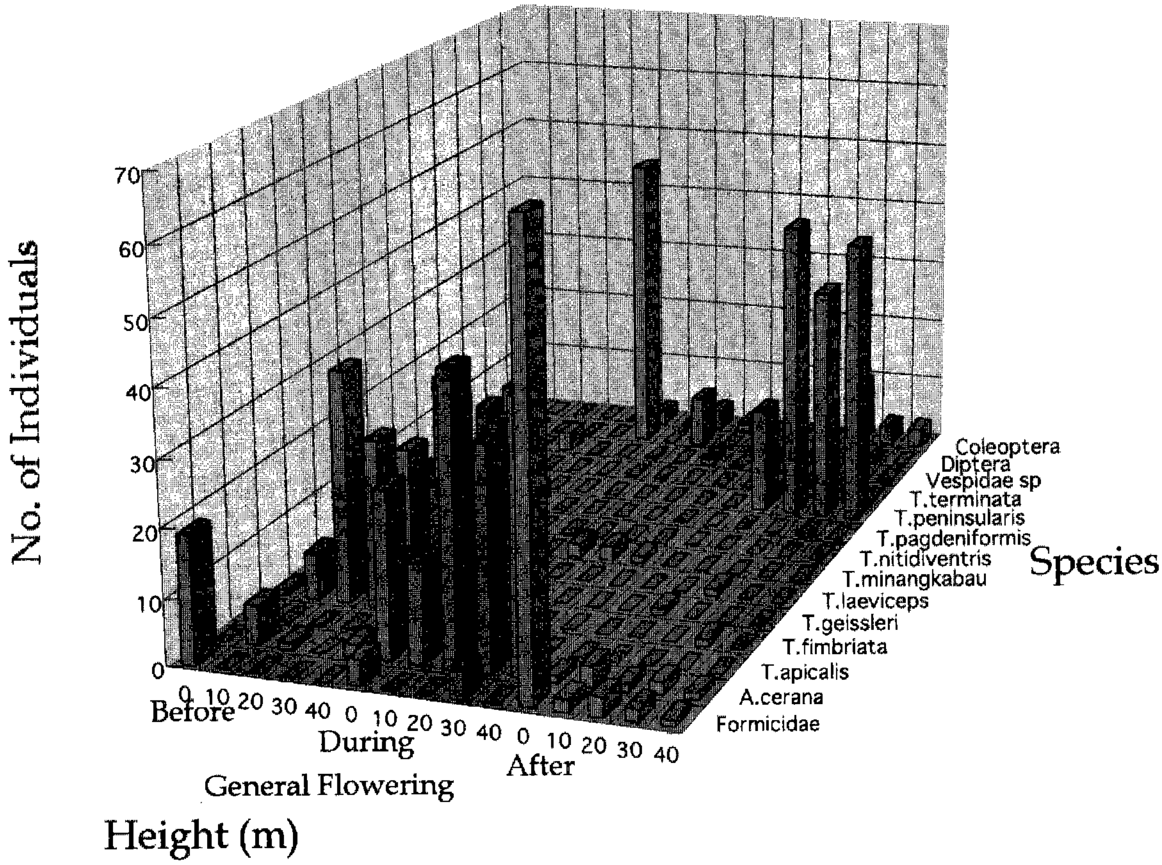


Fig. 2 The insect pollinators in each height 4 month intervals before, during and after general flowering.

4. Refernces

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