E-1.4 Study on Community Dynamics of insects in Tropical Rain forest

Contact Person Kenji Fukuyama
Chief of Entomology Laboratory
Hokkaido Research Center, For. & For. Prod. Res. Inst.
7 Hitsujigaoka, Toyohira-ku, Sapporo 062, Japan
Phone +81-11-851-4131 (Ext. 284), Fax +81-11+851-4167
E-mail fukuchan@ffpri-hkd.affrc.go.jp

Total Budget for FY1993-FY1995 23,972,000 Yen (FY1995; 7,413,000 Yen)

Abstract

Spatial distributions of decomposing beetles and of pollinating beetles were investigated using attractant traps in the Pasoh Forest Reserved in West Malaysia. 1) The balloon-suspended trap system developed in this study was effective to collect canopy insects. 2) Diverse flower visitors were trapped with various floral chemical attractants, among which linalool and methyl benzoate have been recommended for a general survey of flower-visiting insects. 3) Wood-boring beetles (Scolytidae) were abundant and rich in species just above the ground and in the upper layer of the canopy, perhaps reflecting the distribution of weakened or fresh fallen branches, on which they feed and breed. 4) Most of the flower-visiting beetles (Scarabaeidae) were mainly trapped from 10 m to 25 m above the ground, indicating that they are active in the continuous middle layer of the canopy, where most trees and climbers bear flowers. *Mecinonota regia* were distributed in the relatively low layer, while *Dasyvalgus dohlni* was in the upper part of the canopy. 5) No distinct changes in species richness of wood borers was detected perceived among trap sites, but the abundance of a dominant species increased consistently from the core to the boundary in the forest. The beetle was also abundant in the oil-palm plantation surrounding the forest, where it was observed to breed and multiply on leaf stalks of oil palm. It is most likely that there is a large flux of the beetle from the oil-palm plantation into the forest. The population level or dominance of the ambrosia beetles would be a good indicator for the degree of artificial disturbance on primary forests. 6) Ambrosia beetles frequently attacked on the basal area of dead branches on the canopy. They can should accelerate to fall the dead branches down on the forest floor.

Key Words canopy fauna, Coleoptera, pollinator, decomposer, fragmentaion, spatial distribution

1. Introduction

Recent fragmentation of natural forests threatens the persistence of biodiversity and rudimental ecological processes, but empirical data are too limited to understand and assess the impacts of logging and other forestry treatments on organic communities of forests, especially tropical rain forests (Whitmore & Sayer, 1992). Our ultimate objective is to elucidate human impacts on arthropod diversity in tropical forests. Before we can appraise such impacts in fragmented primary or managed secondary forests, however, we need to understand the pattern of spatial structure of arthropod communities in a primary rain forest reserve (Sutton, 1989).

The purpose of our recent study was to develop sampling techniques for important groups of arthropods and to clarify the spatial structure of their communities in a primary forest. We focused our attention on three major groups of forest insects, i.e., flower-visiting beetles (pollinators), wood-boring beetles (wood decomposers), and parasitic wasps (predators of

various arthropods). These insects are all active flyers and occasionally inhabit only upper layers of the canopy, thus, we have developed a sampling system using a balloon in order to investigate insects in the canopy.

2. Materials and Methods

A system of suspending insect traps from a movable balloon was developed and tested. It comprised a spherical helium balloon (2.1 - 2.5 m in diameter and made of white colored vinyl chloride film 0.12 mm in thickness) and one or two water- or sticky-traps with chemical attractants (Fig. 1). The balloon was moored with three pieces of thin rope in three different directions to prevent the traps from swaying.

Field tests and investigations were mostly conducted in Pasoh Forest Reserve, Negeri Sembilan, which is about 6000 ha in area and consists of a primary forest and a peripheral secondary forest adjacent to oil-palm plantations. Some field experiments were also carried out in a secondary forest, that is, Air Hitam Forest Reserve, near UPM.

Quantitative sampling of flower visitors and wood borers was carried out using collision traps provided with floral fragrance chemicals and ethanol, respectively. Parasitic wasps and other flying insects were trapped in an intercept trap (Townes Style Malaise trap).
Vertical distribution of the insects was investigated using attractant or non- attractant traps suspended from the balloon or attached on the canopy towers (32 m) at Pasoh.

In order to assess changes in insect community structure along a gradient from the core to the boundary of Pasoh Forest Reserve, sampling of insects was carried out at several census sites along the gradient . The forest of Pasoh is adjacent to oil-palm plantations established in the 1970's.

To estimate a role of scolytid beetles on falling dead branches from forest canopy, we surveyed the injury ratio of scolytid beetles on the fallen dead branches and dead branches on the canopy in Pasoh Forest Reserve.

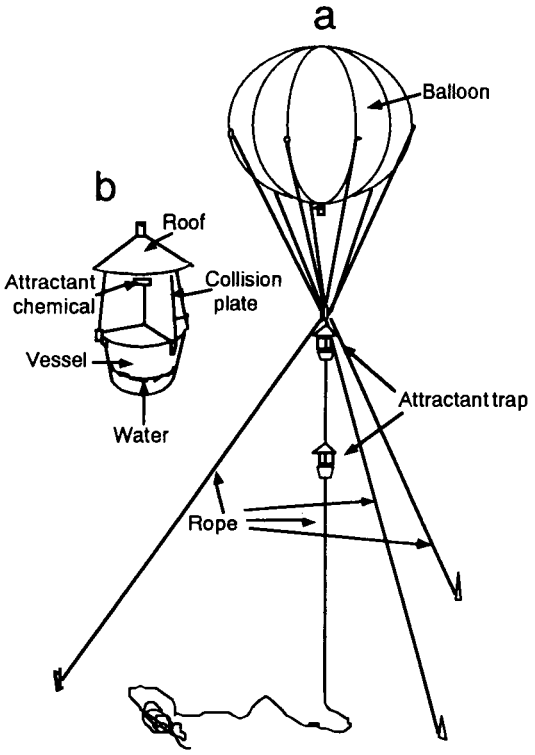

Figure 1. Balloon trap system

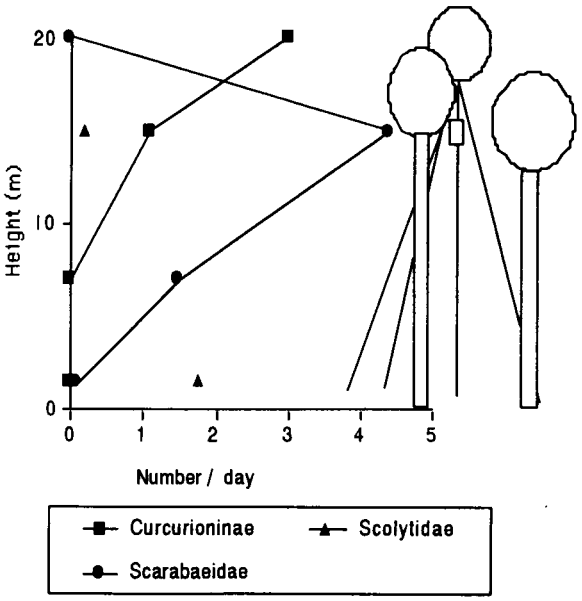

Figure 2. Vertical distribution caught by the balloon trap system

3. Results and Discussion

1) Development of balloon-suspended trap system for sampling insects in the canopy

The balloon-suspended trap system developed in this study (Fig. 1) remained effective suspending insect traps for at least 3 weeks. Mooring the balloon with three cords was necessary and enabled it to remain stable. With floral attractants attached to the suspended trap, various flower-visiting beetles (e.g., Scarabaeidae, Mordellidae, Curculionidae) were successfully trapped in the canopy (Fig. 2). It was confirmed to be a practical for studying canopy insects on a spatial and temporal scale. Diverse flower visitors were trapped with various floral chemical attractants, among which linalool and methyl benzoate have been recommended for a general survey of flower-visiting insects.

2) Selective attraction of flower- visiting beetles (Coleoptera) to floral fragrance chemicals

Our preliminary field trial shows that fragrance chemicals are useful for sampling flower-visiting beetles in tropical rain forests. The collected beetles included pollen or nectar feeders (Scarabaeidae, Mordellidae, Cerambycidae) and certain groups of Curculionidae which probably lay eggs in flower-buds or ovaries. They all are expected to play some roles in pollinating flowers.

Four floral fragrance chemicals, eugenol, benzyl acetate, methyl benzoate and linalool, were compared as regard to their possible attraction of flower-visiting Coleoptera in the field, the Air Hitam Forest Reserve, Selangor, Peninsular Malaysia. Scarabaeids, including *Dasyvalgus*, *Callistethus* and *Mecinonota*, were caught in the traps with eugenol, methyl benzoate or linalool (Fig. 3). A large number of mordellids, mostly of Glipostenoda, were collected with linalool. Certain species of Curculionidae (*Amorphoides*, *Endaenidius*, and *Mecysmoderes*), which probably lay eggs in flower-buds or ovaries, were caught in the traps with benzyl acetate, methyl benzoate or linalool. Most Cerambycinae including Longipalpus were collected with methyl benzoate while Lamiinae were chiefly caught in eugenol traps. Methyl benzoate and linalool were likely to attract a wide range of flower-visiting beetles, though some curculionids were exclusively caught in the traps with benzyl acetate.

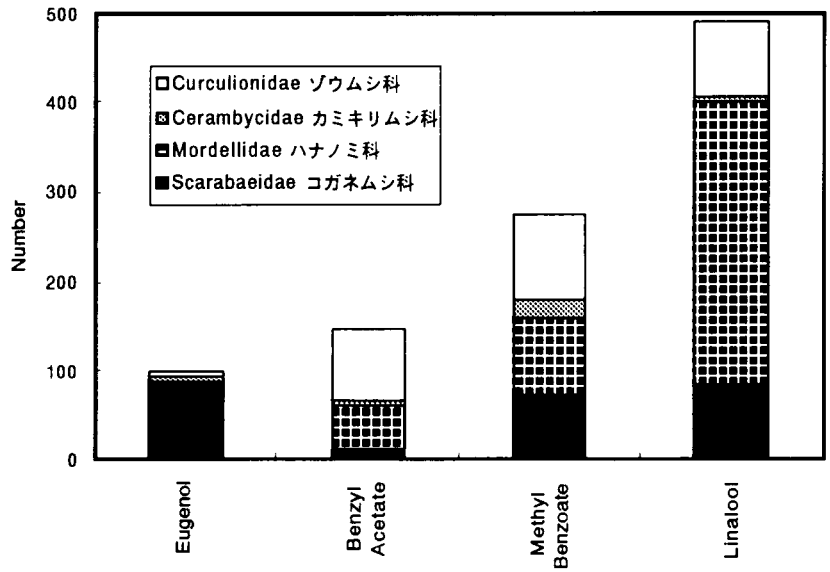

Figure 3. Beetles attracted by four floral fragrances

3) Vertical distribution of flying insects in the canopy

Flower-visiting beetles (Scarabaeidae) were mainly trapped from 10 m to 25 m above the ground, indicating that they are active in the continuous middle layer of the canopy, where most trees and climbers flower (Fig. 4). Wood-boring beetles (Scolytidae) were abundant and rich in species just above the ground and in the upper layer of the canopy, perhaps reflecting the distribution of weakened or fresh fallen branches, on which they feed and propagate (Fig. 5). Parasitic wasps were mostly captured at ground level as suggested by Ng (1978), but this may be due to the structure of the intercept trap and thus other methods of sampling should be tested for the canopy.

Ground level sampling will certainly be applicable to the survey of some groups of flying insects, but others, such as flower-visiting Scarabaeidae, are best sampled in the canopy with the aid of a balloon system, towers or other tools.

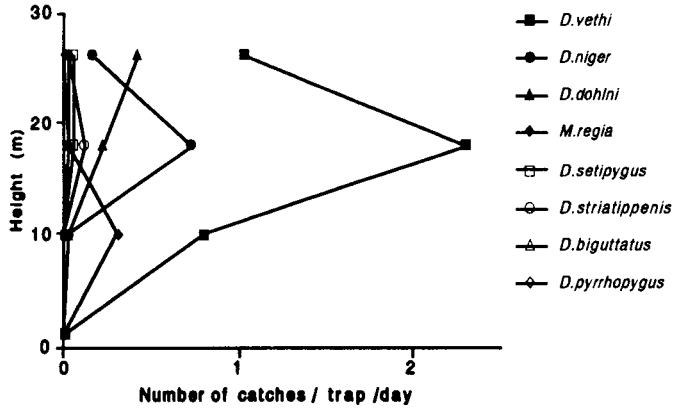

Figure 4. Flower-visiting beetles (Scarabaeidae) caught by the Attractant trap

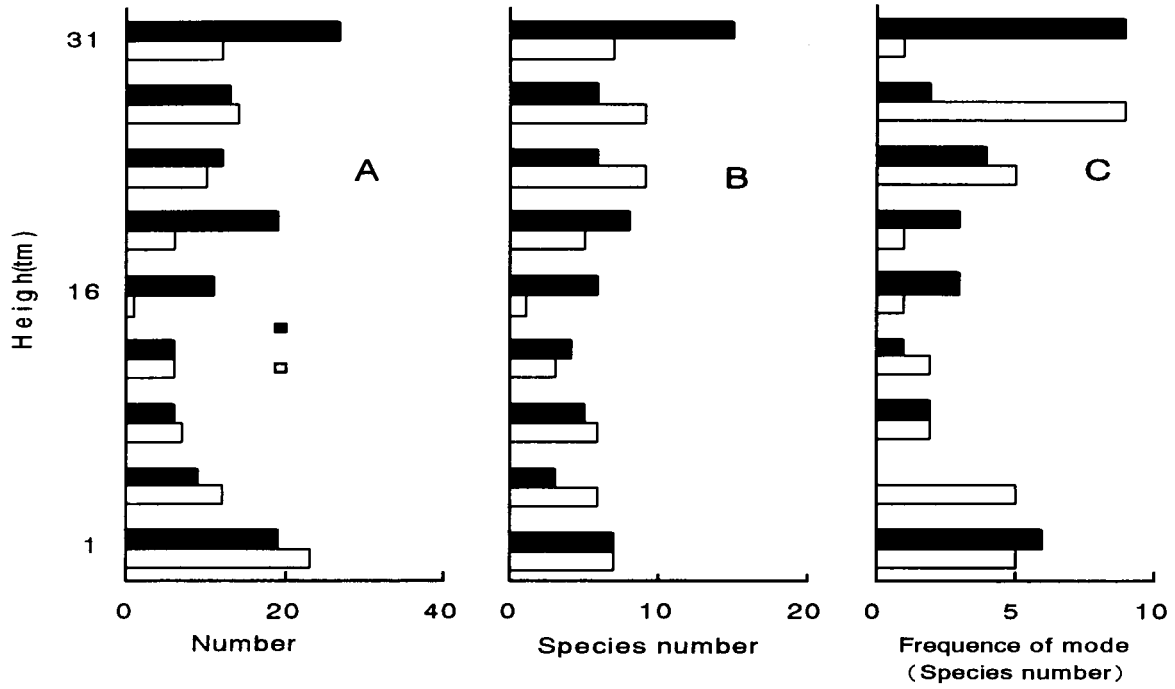

Figure 5. Vertical distribution wood boring beetles (Scolytidae and Platypodidae)
White bar: Nov.-Dec. 1993 Black bar: July-Aug. 1995

4) Edge effects on communities and populations of forest insects

No distinct changes in species richness of wood borers (ambrosia beetles of the family Scolytidae) was perceived among trap sites in Pasoh Forest Reserve, but the abundance of a dominant species increased consistently from the core to the boundary in the forest (Fig. 6). The beetle was also abundant in the oil-palm plantation, where it was observed to breed and multiply (Fig. 7). It is most likely that there is a large flux of the beetle from the oil-palm plantation into the forest. It is possible that the beetles carry exotic micro-organisms into the core area.

Such edge-effects or external influences should be carefully considered in conservation management of remnant areas of native vegetation surrounded by a matrix of developed land. Also, the population level or dominance of the ambrosia beetles would be a good indicator of artificial disturbance on primary forests.

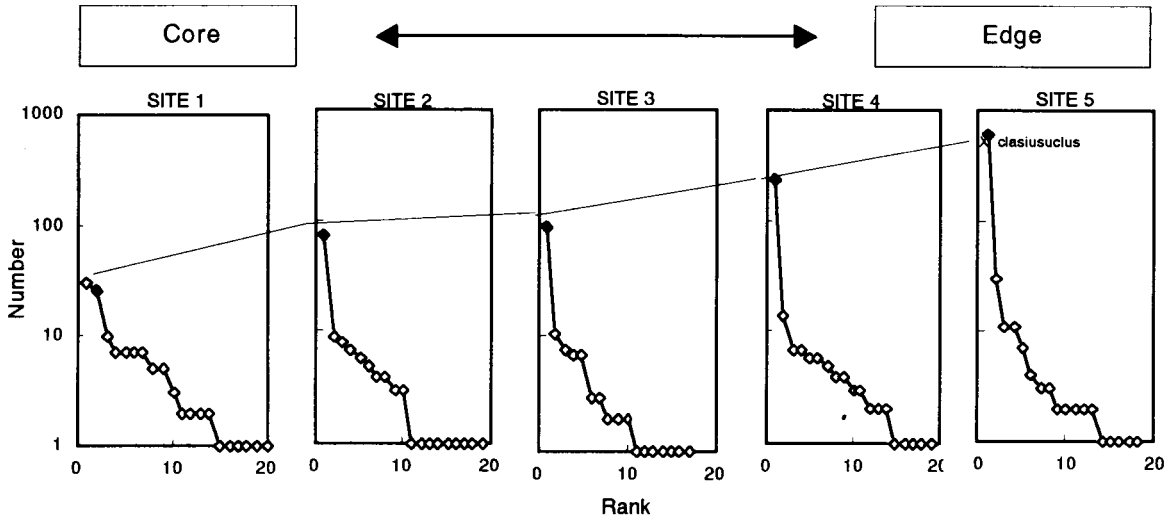

Figure 6. Species rank of scolytid beetles number on each site

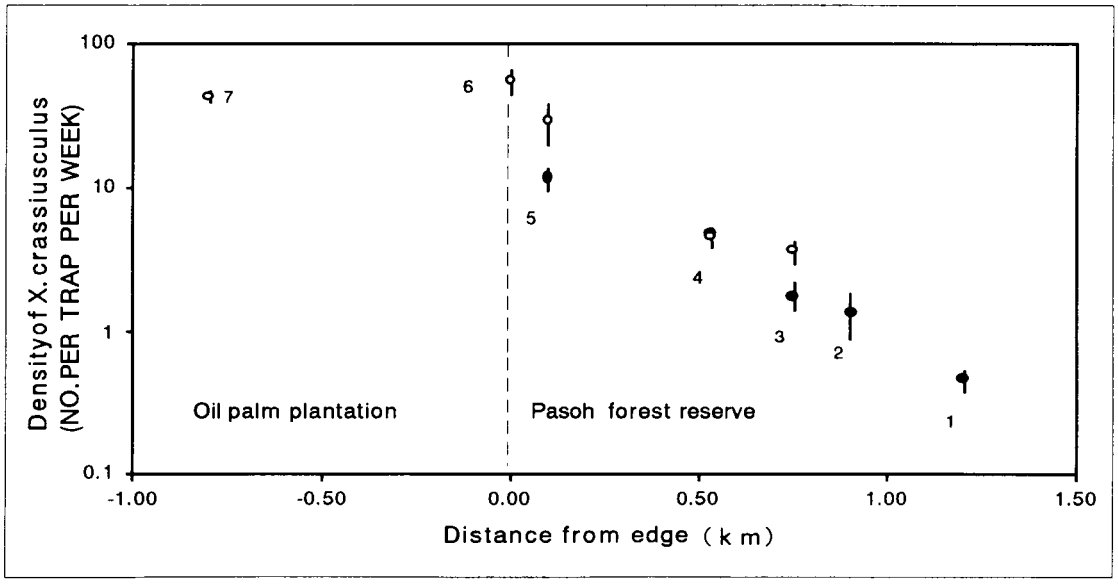

Figure 7. Distribution of X. crassiusculus from oil palm to core area