

**INSECT COMMUNITIES IN THE THREE DIFFERENT FOREST  
HABITATS OF SUNGAI LALANG FOREST RESERVE WITH EMPHASIS  
ON SELECTED ORDERS OF INSECTS**

**By**

**NOOR FARIKHAH HANEDA**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra  
Malaysia, in Fulfilment of the Requirements for the  
Degree of Doctor of Philosophy**

**October 2004**

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Doctor of Philosophy

**INSECT COMMUNITIES IN THE THREE DIFFERENT FOREST HABITATS OF SUNGAI LALANG FOREST RESERVE WITH EMPHASIS ON SELECTED ORDERS OF INSECTS**

By

**NOOR FARIKHAH HANEDA**

**October 2004**

**Chairman: Professor Ahmad Said Sajap, Ph.D.**

**Faculty: Forestry**

A study to investigate the abundance and diversity of insects in forest habitat of different age after logging was conducted in the Sungai Lalang Forest Reserve, Selangor, Malaysia. The main objectives of the study were to determine (i) the dominant insect in different forest habitats, (ii) the biodiversity of insects, and (iii) the assemblage of insects that can be used as bioindicator. Three different forest habitats were selected, namely: Primary forest, Five-year-old logged forest and Ten-year-old logged forest.

Various trapping methods were used to collect insects, namely: pitfall trap, yellow-pan trap, malaise trap, window trap, and sticky trap. A total of 269,547 individuals comprising of 17 orders and 361 morphospecies were collected. Four majors order represented by Diptera, Hymenoptera,

Collembola and Coleoptera were recorded. The number of Diptera and Coleoptera was higher in five-year old logged forest than ten-year old logged and primary forests. The abundance of Hymenoptera was high in ten-year old logged forest, while Collembola was abundant in primary forest. These results suggest that Diptera, Hymenoptera and Coleoptera could adapt to the logged forests and they were able to utilize available resources from those forests. The richness and diversity of Hymenoptera and Coleoptera were higher in primary forest compared to both logged forests. Moreover, Collembola and Diptera had high richness and diversity index in logged forests, however the abundance, richness and diversity of insects differ among forest habitats.

At the family level, Formicidae was the most dominant insect in the three forest habitats. In addition to Formicidae, Ichneumonidae, Braconidae, Phoridae, and Chrysopidae were also found in high number. The abundance of Formicidae and Ichneumonidae was higher in primary forest than in both logged forests, while Phoridae, Braconidae and Chrysopidae was higher in ten-year old logged forest than in primary and five-year old logged forests. Formicidae and Phoridae diversity and richness was higher in primary forest than both logged forests, while Braconidae and Ichneumonidae were higher in five-year old logged forest than in primary and ten-year old logged forests.

Composition of Formicidae was dominated by *Pheidole* sp and *Odontomachus* sp in logged forest, while in primary forest was dominated by *Camponotus* sp. Microgastrinae sub-family (Braconidae) and Cryptinae sub-family (Ichneumonidae) was abundant in logged forest, while Orthocentrinae sub-family (Ichneumonidae) was numerous in primary forest. The phorid in the logged forest was abundantly represented by *Megaselia*, *Woodiphora* and *Puliciphora*.

Of the measured habitat variables, relative humidity and litter layer were important factors affecting the abundance of Diptera, Hymenoptera, Collembola and Coleoptera in five-year old logged forest. In primary forest, litter layer was the most important factor affecting Collembola, Diptera and Hymneoptera, while canopy cover was important for Coleoptera and Collembola. Environmental factors, litter layer, relative humidity, canopy cover and understorey plant could be use as potential predictor for Diptera, Hymenoptera, Collembola and Coleoptera. Those variables, as well temperature, light intensity and rainfall, were also significant factors for Formicidae, Phoridae, Braconidae, Ichneumonidae and Chrysopidae.

The composition of insects was found to be different in the three study areas. The relatively high number of insect biodiversity in the logged forest was due

to the differences in habitat condition between logged and primary forest. The number of trees and understorey plants were significantly different among habitats. Apparently, after forest logging, some undisturbed forest fragment patches contribute to the higher number of species in the logged forest. This difference was also evident in species richness, abundance, composition and diversity that corresponded to the intensity level of logging, age of the logged forest, proximity of other forest habitats and the insects' adaptability in the logged habitats.

The results presented in this study show that surveys of insect should be conducted using as wide a variety of methods as possible because every method undoubtedly has at least one advantage over the other. Pitfall and yellow-pan traps had collected ground insects, such as Collembola and Coleoptera while malaise trap and window trap collected had flying insect, particularly Hymenoptera, Diptera and Coleoptera.

Moreover, the high abundance of Phoridae, Formicidae, Ichneumonidae and Braconidae, and Chysopidae in all habitats, suggested that further studies should be concentrated on this group for possible useful indicators of forest condition.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KOMUNITI SERANGGA DI TIGA HABITAT HUTAN YANG BERBEZA  
DI HUTAN SIMPAN SUNGAI LALANG DENGAN PENEKANAN PADA  
ORDER SERANGGA TERPILIH**

Oleh

**NOOR FARIKHAH HANEDA**

**October 2004**

**Pengerusi: Profesor Ahmad Said Sajap, Ph.D.**

**Fakulti: Perhutanan**

Satu kajian tentang kelimpahan dan kepelbagaian serangga di habitat hutan yang berbeza umur pembalakan telah dijalankan di Hutan Simpan Sungai Lalang, Selangor, Malaysia. Tujuan utama kajian ini adalah untuk menentukan: (1) serangga dominan di habitat hutan yang berbeza, (2) kepelbagaian biologi serangga dan (3) kumpulan serangga yang boleh digunakan sebagai petunjuk biologi. Tiga habitat yang berbeza telah dipilih iaitu hutan primer (VJR), lima-tahun selepas dibalak dan hutan sepuluh-tahun selepas dibalak.

Serangga telah dikumpulkan dengan kaedah perangkap iaitu perangkap lubang, perangkap dulang kuning, perangkap malaise, perangkap jendela

dan perangkap perekat. Sejumlah 269,547 individu serangga yang terdiri daripada 17 order dan 361 morfospecies telah berjaya dikumpulkan. Empat order yang paling dominan adalah Diptera, Hymenoptera, Collembola dan Coleoptera. Kelimpahan serangga dari order Diptera dan Coleoptera di hutan lima tahun selepas dibalak adalah paling tinggi berbanding dengan hutan sepuluh tahun selepas balak dan hutan primer. Kelimpahan order Hymenoptera paling tinggi di hutan sepuluh tahun selepas dibalak, manakala hutan primer merekodkan jumlah serangga Collembola paling tinggi. Keputusan menunjukkan bahawa order Diptera, Hymenoptera dan Coleoptera dapat beradaptasi dengan hutan yang sudah dibalak dan dapat memanfaatkan sumber daripada hutan tersebut. Kekayaan dan kepelbagaian dari order Hymenoptera dan Coleoptera di hutan primer adalah lebih tinggi berbanding dengan habitat hutan yang sudah dibalak, manakala order Collembola dan Diptera menunjukkan kekayaan dan kelimpahan yang tinggi di hutan yang telah dibalak.

Pada peringkat famili, Formicidae adalah serangga paling dominan di semua habitat hutan. Selain Formicidae, Ichneumonidae, Braconidae, Phoridae dan Chrysopidae juga dijumpai melimpah di semua habitat hutan. Kelimpahan famili Formicidae dan Ichneumonidae adalah tinggi di hutan primer berbanding hutan balak, manakala famili Phoridae, Braconidae dan

Chrysopidae melimpah di hutan sepuluh tahun selepas di balak. Kekayaan dan kepelbagaian famili Formicidae dan Phoridae adalah tinggi di hutan primer berbanding di hutan balak, manakala famili Braconidae dan Ichneumonidae lebih tinggi di hutan lima tahun selepas di balak. Kelimpahan, kekayaan dan kepelbagaian serangga berbeza-beza pada habitat hutan yang berbeza.

Komposisi famili Formicidae di hutan balak didominasi oleh *Pheidole* sp. dan *Odontomachus* sp., manakala di hutan primer didominasi oleh *Camponotus* sp. Sub-famili Microgastrinae (Braconidae) dan Cryptinae (Ichneumonidae) adalah melimpah di hutan selepas dibalak, manakala sub-famili Orthocentrinae (Ichneumonidae) banyak dijumpai di hutan primer. Di hutan selepas balak. Famili Phoridae di hutan selepas di balak adalah tinggi dan diwakili oleh genus *Megaselia*, *Woodiphora* dan *Puliciphora*.

Pembolehubah habitat, kelembapan dan serasah di lantai hutan adalah factor yang penting yang mempengaruhi kelimpahan bagi order Diptera, Hymenoptera, Collembola dan Coleoptera di hutan lima tahun selepas di balak. Pokok bawah kanopi dan serasah di lantai hutan juga adalah faktor yang penting kepada kelimpahan serangga di hutan sepuluh tahun selepas di balak. Di hutan primer, serasah di lantai hutan adalah faktor paling penting

yang mempengaruhi Collembola, Diptera dan Hymenoptera, manakala litupan silara adalah faktor penting kepada Coleoptera dan Collembola. Pengukuran serasah, kelembapan, litupan silara dan tumbuhan bawah kanopi dapat digunakan sebagai petunjuk yang penting untuk Diptera, Hymenoptera, Collembola dan Coleoptera. Faktor-faktor tersebut dan juga suhu, keamatan cahaya dan curahan hujan adalah faktor yang ketara untuk famili Formicidae, Phoridae, Braconidae, Ichneumonidae dan Chrysopidae.

Komposisi serangga di tiga tempat kajian adalah berbeza. Kepelbagaian serangga yang tinggi di hutan selepas dibalak adalah disebabkan oleh perbezaan keadaan habitat antara hutan selepas dibalak dan hutan primer. Bilangan pokok dan tumbuhan bawah kanopi adalah berbeza secara bererti diantara habitat. Pada kebiasaannya setelah hutan dibalak akan wujud beberapa kawasan kecil yang tidak terganggu. Kawasan inilah yang memberikan nilai kepelbagaian yang tinggi di hutan balak. Perbezaan juga ditunjukkan pada kekayaan species, kelimpahan, dan kepelbagaian. Hal ini berkaitan dengan tahap intensiti pembalakan, umur hutan yang sudah balak, kawasan berhampiran habitat-habitat hutan yang lain dan keupayaan adaptasi serangga di habitat hutan sudah balak.

Keputusan kajian ini juga menunjukkan bahwa penyelidikan serangga sepatutnya menggunakan pelbagai kaedah kerana setiap kaedah mempunyai sekurang-kurangnya satu kelebihan dari kaedah yang lain. Perangkap pitfall dan yellow-pan adalah sesuai digunakan untuk mengumpulkan serangga merayap di lantai hutan, misalnya Collembola dan Coleoptera, manakala perangkap malaise dan window adalah untuk mengumpulkan serangga yang terbang, terutamanya Hymenoptera, Diptera dan Coleoptera.

Kelimpahan Phoridae, Formicidae, Ichneumonidae, Braconidae dan Chrysopidae di semua habitat hutan menunjukkan bahawa kajian pada masa akan datang perlu ditumpukan kepada kumpulan ini yang kemungkinan menjadi petunjuk keadaan hutan.

## ACKNOWLEDGEMENTS

My gratitude.....

- to the Chairman of my Supervisory Committee, Prof. Dr. Ahmad Said Sajap; and also to the Supervisory Committee members, Prof. Dr. Syed Tajuddin Syed Hassan, Assoc. Prof. Dr. Mohamed Zakaria Hussin, and Assoc. Prof. Dr. Idris Abdul Ghani, for their precious support and guidance during the course of the research and preparation of the thesis.
- to the UPM staff in the Entomology and Wildlife laboratories; namely, Mr. Yacoob Abd. Wahab and Mr. Abdul Rahim Mudin. My thanks are due to Wilder friends and UKM staff in the Entomology laboratory for sincere assistance, support and encouragement.
- to Bogor Agricultural University (Institut Pertanian Bogor) Indonesia for granting the study leave and to my Colleagues at the Faculty of Forestry who took over the academic responsibility in my absence.
- to the Malaysian Government (IRPA Project: 08-02-04-0051), South East Asia Research Center for Agriculture (SEARCA), International Tropical Timber Organization (ITTO) and Ms. Noor Farikhah Haneda for providing and sponsorship throughout the study.
- to the friends in Persatuan Pelajar Indonesia (PPI-UPM), Muhrizal Sarwani family and Forgrad-UPM friends, who were there for letting their hands and time in one way.
- To my family for their patient, understanding and faith on me.
- Above all, to God Almighty for His blessed and Will.

To all of them, I give my utmost gratitude and due indebtedness for the success of this thesis. Alhamdulillah.

I certify that an Examination Committee met on 14<sup>th</sup> October 2004 to conduct the final examination of Noor Farikhah Haneda on her Doctor of Philosophy thesis entitled "Insect communities in Three Different Forest Habitats of Sungai Lalang Forest Reserve with Emphasis on Selected Orders of Insects" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

**Abdullah Mohd, Ph.D.**

Associate Professor  
Faculty of Forestry  
Universiti Putra Malaysia  
(Chairman)

**Rohani Ibrahim, Ph.D.**

Associate Professor  
Faculty of Agriculture  
Universiti Putra Malaysia  
(Member)

**Faizah Abood Haris, Ph.D.**

Faculty of Forestry  
Universiti Putra Malaysia  
(Member)

**Abu Hassan Ahmad, Ph.D.**

Professor  
School of Biological Sciences  
Universiti Sains Malaysia  
(Independent Examiner)

---

**GULAM RUSUL RAHMAT ALI, Ph.D.**

Professor/Deputy Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date :

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirements for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follows:

**Ahmad Said Sajap, Ph.D.**

Professor  
Faculty of Forestry  
Universiti Putra Malaysia  
(Chairman)

**Syed Tajuddin Syed Hassan, Ph.D.**

Professor  
Faculty of Environmental Science  
Universiti Putra Malaysia  
(Member)

**Mohd. Zakaria Hussin, Ph.D.**

Associate Professor  
Faculty of Forestry  
Universiti Putra Malaysia  
(Member)

**Idris Ab. Ghani, Ph.D.**

Associate Professor  
Faculty of Science and Technology  
Universiti Kebangsaan Malaysia  
(Member)

---

**AINI IDERIS, Ph.D.**

Professor/Dean  
School of Graduate Studies  
Universiti Putra Malaysia

Date :

## DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

---

**NOOR FARIKHAH HANEDA**

Date :

## TABLE OF CONTENTS

	<b>Page</b>
ABSTRACT	ii
ABSTRAK	vi
ACKNOWLEDGMENTS	xi
APPROVAL	xii
DECLARATION	xiv
LIST OF TABLES	xviii
LIST OF FIGURES	xxv
LIST OF ABBREVIATIONS/GLOSSARY OF TERMS	xxxiv
 CHAPTER	
1 INTRODUCTION	1.1
2 LITERATURE REVIEW	2.1
2.1 The Tropical Rainforest Biodiversity	2.1
2.1.1 Flora and Fauna Diversity	2.4
2.1.2 Insect Diversity and Its Significance	2.7
2.2 Forest Disturbance	2.10
2.2.1 Wind	2.10
2.2.2 Floodwater	2.11
2.2.3 Fire	2.11
2.2.4 Drought	2.13
2.2.5 Fragmentation	2.13
2.2.6 Forest Logging	2.14
2.3 Effect of Forest Logging on Diversity	2.15
2.3.1 Effect on Flora and Fauna	2.15
2.3.2 Effect of Forest Disturbance on Insect	2.19
2.4 Insect Sampling	2.22
2.4.1 Purpose of Sampling	2.22
2.4.2 Types of Sampling	2.24
2.5 Statistical Analysis for Biodiversity	2.27
3 MATERIALS AND METHODS	3.1
3.1 Study Area	3.1
3.2 Insect Sampling Method	3.9
3.3 Microhabitat and Microclimate Sampling	3.14

3.4	Identification	3.16
3.5	Data Analysis	3.17
4	RESULTS	4.1
4.1	Pitfall	4.1
4.1.1	Composition and Abundance of insect taxa in different forest habitats	4.1
4.1.2	Composition and Abundance of insects taxa within forest habitats	4.12
4.1.3	Diversity among the forest habitats	4.28
4.1.4	Similarity among the forest habitat	4.30
4.1.5	Effects of environmental factors (microhabitat and microclimate)	4.32
4.2	Yellow-pan	4.37
4.2.1	Composition and Abundance of insect taxa in different forest habitats	4.37
4.2.2	Composition and Abundance of insects taxa within forest habitats	4.46
4.2.3	Diversity among the forest habitats	4.61
4.2.4	Similarity among the forest habitat	4.61
4.2.5	Effects of environmental factors (microhabitat and microclimate)	4.63
4.3	Malaise	4.69
4.3.1	Composition and Abundance of insect taxa in different forest habitats	4.69
4.3.2	Composition and Abundance of insects taxa within forest habitats	4.77
4.3.3	Diversity among the forest habitats	4.87
4.3.4	Similarity among the forest habitat	4.89
4.3.5	Effects of environmental factors (microhabitat and microclimate)	4.90
4.4	Window	4.96
4.4.1	Composition and Abundance of insect taxa in different forest habitats	4.96
4.4.2	Composition and Abundance of insects taxa within forest habitats	4.103
4.4.3	Diversity among the forest habitats	4.118
4.4.4	Similarity among the forest habitat	4.118
4.4.5	Effects of environmental factors (microhabitat and microclimate)	4.121

4.5	Sticky trap	4.126
4.5.1	Comparison of abundance of lacewing ( <i>Glenochrysa</i> sp.) among forest habitats	4.126
4.5.2	Effect of environmental factors on the abundance of lacewing within forest habitats in varied over the year	4.127
4.6	Total insects from all traps	4.132
4.6.1	Composition and abundance of insects taxa in different forest habitats obtained from all traps	4.132
4.6.2	Insect diversity among the forest habitats	4.135
4.6.3	Similarity among the forest habitats	4.139
4.6.4	Effects of environmental factors (microhabitat and microclimate)	4.141
5	DISCUSSION	5.1
5.1	Effect of habitat types on the ground dwelling insect community	5.1
5.1.1	Insect abundance, richness and diversity	5.2
5.1.2	Insect composition	5.14
5.1.3	Temporal factors affecting insect abundance	5.21
5.2	Effect of habitat types on the flying insect community	5.24
5.2.1	Insect abundance, richness and diversity	5.25
5.2.2	Insect composition	5.32
5.2.3	Temporal factors affecting insect abundance	5.38
5.3	Population of <i>Glenochrysa</i> sp. (green lacewing)	5.42
6	GENERAL DISCUSSION	6.1
7	CONCLUSION	7.1
	REFERENCES	R
	APPENDICES	A
	BIODATA OF THE AUTHOR	B