



***COMPARING FRUGIVOROUS BUTTERFLY SPECIES UNDER DIFFERENT  
AGRICULTURAL LANDSCAPES***

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**FH 2018 127**

**COMPARING FRUGIVOROUS BUTTERFLY SPECIES UNDER  
DIFFERENT AGRICULTURAL LANDSCAPES**



By

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**A Project Report Submitted in Partial Fulfillment of the Requirements  
for the Degree of Bachelor of Forestry Science in the  
Faculty of Forestry  
Universiti Putra Malaysia**

**2018**

## DEDICATION

Every challenging work needs self efforts as well as guidance of elders especially those who are close to our hearts.

I dedicate this thesis to my parents, Zakaria bin Montil and Mashitah binti Ibrahim, whose love, unselfish support and example over many years laid the foundations for the discipline and application necessary to complete this work.

Thank you for everything. May Allah bless all of us.

## ABSTRACT

The conversion of native forests to monoculture plantation has taken a spotlight in biodiversity-rich countries in the tropics. This has led to biodiversity loss of insects that play important roles in ecosystem functioning. The present study investigates the effect of different vegetation structure and microclimatic conditions between monoculture and polyculture plantations on frugivorous butterfly diversity and abundance. The study was conducted in Kampung Sungai Lalah, Pedas, Negeri Sembilan. For the study, monoculture farming systems were conducted in oil palm and rubber plantations, while polyculture farming systems were conducted in orchards. Passive sampling was used to capture fruit-feeding butterflies at all study areas. A total of 15 sampling points were set up in each agricultural landscape, giving a total of 45 sampling points. Each sampling point was randomly selected with > 100 m distance. Butterflies were sampled in a 28-day period between January and February 2018, where five sampling points were completed for every three days. The results showed a total of 363 frugivorous butterflies belonging to 7 species were recorded under the subfamilies Satyrinae and Limenitidinae. The highest occurrence was recorded in orchards, followed by oil palm and rubber plantations. It is proven that fruit-feeding butterfly abundance and species richness were greater in polyculture (orchard) than monoculture plantations (oil palm and rubber plantations). The findings of this study suggest that spatial heterogeneity greatly influences patterns in butterfly species richness and abundance. Thus, polyculture farming should be explicitly considered in conservation and management actions.

## ABSTRAK

Penukaran hutan asli kepada perladangan monokultur telah mendapat tumpuan dalam negara yang kaya dengan biodiversiti di kawasan tropika. Hal yang demikian telah menjurus kepada penurunan biodiversiti serangga yang memainkan peranan penting dalam ekosistem. Kajian ini bertujuan untuk mengetahui bagaimana struktur tumbuh-tumbuhan yang berbeza dan keadaan mikroklimatik antara perladangan monokultur dan polikultur dapat mempengaruhi komposisi rama-rama pemakan buah. Kajian ini dijalankan di Kampung Sungai Lalah, Pedas, Negeri Sembilan. Untuk kajian ini, sistem pertanian monokultur dijalankan di ladang kelapa sawit dan getah, sementara sistem pertanian polikultur dijalankan di kebun buah. Persampelan pasif digunakan untuk mengambil sampel rama-rama pemakan buah di semua kawasan kajian. 15 titik pensampelan telah ditubuhkan di setiap landskap pertanian yang memberikan sejumlah 45 titik pensampelan. Setiap titik pensampelan dipilih secara rawak dengan jarak > 100 m. Kajian dijalankan dalam tempoh 28 hari antara Januari hingga Februari 2018 di mana lima titik pensampelan dipantau selama tiga hari. Hasilnya menunjukkan sejumlah 363 rama-rama yang berjalur dari 7 spesies telah direkodkan di bawah subfamili Satyrinae dan Limenitidinae. Kejadian tertinggi direkodkan dalam kebun, diikuti oleh ladang kelapa sawit dan getah. Kajian ini membuktikan bahawa bilangan dan kepelbagaian spesis rama-rama pemakan buah di perladangan polikultur lebih banyak berbanding di perladangan monokultur. Penemuan kajian ini juga menunjukkan bahawa kepelbagaian spatial sangat mempengaruhi corak dalam kekayaan spesies rama-rama, oleh itu pertanian polikultur harus dipertimbangkan dalam aspek pemuliharaan dan pengurusan.

## ACKNOWLEDGEMENTS

At the very onset, I surrender myself before the Almighty Lord for all the blessings. Be it this thesis or the outcome of this research pursuit, it is all His blessings and mercy.

It has been customary to thank my supervisor for his role in guiding a thesis. I wish to thank my supervisor, Dr Norhisham bin Ahmad Razi, not only for this thesis, but also for helping me develop some vital virtues within me. I consider my supervisor as a blessing bestowed upon me. His intuitively driven scientific ideas, consistent support, motivation and patience have been the driving force in this research pursuit. I am in deficit of words to describe how he has been a great motivator throughout my journey in completing my research writing. I thank him from the bottom of my heart for accepting me as his pupil and guiding me all through.

My greatest appreciation also goes to the people that have been involved directly or indirectly throughout the one-month data collection in Kg Sungai Lalah, the residents of Kampung Sg Lalah, Negeri Sembilan for being very warm and welcoming from the beginning.

Finally, I bow in ovation to my friends who are also better known as my team mates. They have not only supported me but have also shown the course of directions by righteously correcting me in many ways from time to time. Special thanks are given to them.

## APPROVAL SHEET

I certify that this research project report entitled “Comparing Frugivorous Butterfly Species Under Different Agricultural Landscapes” by Najihah Binti Zakaria has been examined and approved as a partial fulfillment of the requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry, Univeristi Putra Malaysia.

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Date: June 2018

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# CHAPTER 1

## INTRODUCTION

### 1.1 General Background

As part of the Sundaland biodiversity hotspot, Malaysia is home to some of the most complex and diverse forest ecosystems on Earth (Myers et al., 2000; Sodhi et al., 2004). Forests serve as a natural habitat for many living organisms including insects. Unfortunately, deforestation activity has been a major concern for biodiversity losses and continues to increase at an unprecedented rate worldwide (Green et al., 2005). Deforestation is defined as the conversion of natural forest area into an alternative permanent non-forested land use such as agriculture and urban development (Kooten & Bulte, 2000). Forest loss happens concurrently with the loss of tropical forest biodiversity which stems from forests conversion including monoculture practices (Sutrisno, 2010). In Peninsular Malaysia, the expansion of agricultural land particularly oil palm covers 5.2 million ha in 2012 (MPOB, 2013). This massive agricultural expansion will continue to increase with higher food demand (Clay, 2004) and Malaysia is known to be one of the largest producer for oil palm production (Brühl & Eltz, 2009). Thus, the rapid expansion of oil palm plantations in Malaysia may have negative impacts on the environment if biodiversity conservation is not given a priority in the long-term.

Forest degradation has a negative impact on overall biodiversity and ecosystem functioning (Schulze *et al.* 2004; Fitzherbert *et al.* 2008). While many studies have emphasized the effects of forest degradation on birds (Kaban *et al.*, 2017) and mammals (Kinnaird *et al.*, 2003), little information has been given on the effects on insects. Insects occupy various types of ecosystem and play a vital role in ecosystem stability as pollinators, decomposers and plant propagation (Ghazanfar *et al.*, 2016). The decline in important insect species due to forest degradation may occur due to loss of food availability and nesting places (Hoekstra *et al.* 2005; Cardillo 2006).

Tropical forests provide refuge for various insect species that play an important role in ecosystem functioning. Unfortunately, their importance in natural environment and agriculture landscapes remain unnoticed. Degradation of tropical forests reduces habitat quality for insects leading to population declines. Butterflies (Lepidoptera) play an important function as pollinators, and herbivores in a forest ecosystem (Miller, 1998). In addition, apart from being a biological pest control, butterflies function in ecosystem restoration as a source of food to other organisms, such as birds and reptiles (Ghazanfar *et al.*, 2016). Butterfly fauna is often correlated with the type of vegetation. Additionally, disturbance such as human activities has been proven to influence butterfly behavior, both in tropical (Ghazoul, 2002; Hamer *et al.*, 2003) and temperate areas (Kocher and Williams, 2000). Changes to the forest structure can influence butterfly communities due to their high sensitivity to environmental disturbance as their development are mostly dependent on environmental variables (e.g. temperature, humidity,

vegetation structure (Srygley & Chai 1990; Spitzer et al. 1997). Thus, butterflies represent one of the important ecological indicators for environmental disturbance.

## **1.2 Problem Statement**

Deforestation and land degradation are among the major threats to forest ecosystems globally (Terborgh, 1992). Humans have altered large areas of the Earth surface, altering most of the native vegetation into a variety of anthropogenic land-uses. Changes in tropical forest area are mostly represented by land conversion into agricultural landscape that leads to habitat fragmentation and biodiversity losses. Insects' survival depends on the types and degree of disturbances such as tree composition, canopy cover and log debris, which could affect their diversity and abundances (Kra et al., 2009).

Studies under different agricultural system (polyculture vs monoculture) may provide important information regarding insect persistence within their environment. Agricultural intensification that often leads to monoculture are most likely to support lower insect community compared to polyculture due to lower vegetation structural complexity and floristic diversity (Matson et al. 1997; Ghazali et al., 2016). Furthermore, in an observation-based study by Yahya et al. (2017), the findings have shown that it is vital to incorporate conservation plans onto agricultural systems to protect biodiversity. Biodiversity in a high vegetative complexity can be akin to nearby native forests ( Moguel & Toledo, 1999 ), facilitate between-fragment dispersal

(Vandermeer & Carvajal, 2001; Steffan-Dewenter, 2002 ), and may maintain long-term survival of forest species ( Vandermeer & Carvajal, 2001; Perfecto & Vandermeer, 2002).

The present study test the following predictions;

- (i) Frugivorous butterfly species is more diverse in polyculture compared to monoculture system and
- (ii) Greater habitat complexity such as vegetation composition under agricultural landscape supports diverse butterfly species.

### **1.3 Aim and Objectives**

The main objective of the study is to investigate frugivorous butterfly species composition under different agricultural system (monoculture vs polyculture).

Specific objectives:

To test these prediction, the study sets-out

1. To determine the effect of different vegetation structure and microclimatic condition between monoculture and polyculture plantations on frugivorous butterfly species richness and abundance.
2. To determine the composition of butterflies in three different landscapes.



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