



***COMPARING NECTARIVOROUS BUTTERFLY SPECIES UNDER
DIFFERENT AGRICULTURAL LANDSCAPE***

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Comparing Nectarivorous Butterfly Species under Different Agricultural Landscape



By

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DEDICATION

For my beloved family

Abdul Aziz Bin Badu

Saedah Binti Abas

Also my siblings

To all my friends,

Thank you for your encouragements supports

And the sacrifices that you have given.

Thank you for everything. May Allah Bless All of us.

ABSTRACT

Conversion of forest areas for agricultural purposes has contributed to the decline of overall biodiversity. Among the major organism being affected, insects provide substantial evidence on the impact of conversion of forest areas. The present study was set out to investigate the abundance and species richness of butterflies (Insecta:Lepidoptera) in three different agricultural landscapes namely; orchard (polyculture systems), oil palm and rubber plantations (monoculture systems) in Kampung Sungai Lalah, Pedas, Negeri Sembilan. In this study, butterflies were sampled using active sampling methods (visual observations) in all study sites (a total of 45 sampling points). Throughout the study, orchard (polyculture systems) represent a significantly greater butterfly abundance (276) and species richness (14) followed by oil palm and rubber plantations. The findings suggest that polyculture systems in orchard can provide refuge for diverse butterfly community due to greater habitat heterogeneity compared to oil palm and rubber plantations. In addition, vegetation cover and height showed a positive relationship on butterfly abundance and richness showing their importance at all agricultural landscapes. The present study suggest that polyculture systems in agricultural landscapes is essential to improve insects biodiversity especially butterflies. Hence, more studies are required to assess the impacts of polyculture and monoculture practices in different agricultural areas in Malaysia.



ABSTRAK

Penukaran kawasan hutan untuk tujuan pertanian telah menyumbang kepada penurunan biodiversiti keseluruhan. Antara organisma utama yang terjejas, serangga memberi bukti ketara mengenai kesan perubahan kawasan hutan. Kajian ini bertujuan untuk mengkaji kelimpahan dan kekayaan spesies rama-rama (Serangga: Lepidoptera) dalam tiga landskap pertanian yang berbeza iaitu; kebun buah (sistem polikultur), ladang kelapa sawit dan getah (sistem monokultur) di Kampung Sungai Laloh, Pedas, Negeri Sembilan. Dalam kajian ini, rama-rama disampel menggunakan kaedah pensampelan aktif (pemerhatian visual) di semua tapak kajian (berjumlah 45 titik pensampelan). Sepanjang kajian, kebun buah (sistem polikultur) mewakili kelebihan rama-rama yang besar (276) dan kekayaan spesies (14) diikuti ladang kelapa sawit dan getah. Penemuan ini menunjukkan bahawa sistem polikultur di kebun buah boleh memberi perlindungan kepada rama-rama kerana kepelbagaian habitat yang lebih besar berbanding ladang kelapa sawit dan getah. Di samping itu, litupan tumbuhan dan ketinggian menunjukkan hubungan positif dengan kelimpahan rama-rama dan kekayaan yang menunjukkan kepentingan mereka di semua landskap pertanian. Kajian ini mencadangkan sistem polikultur dalam landskap pertanian adalah penting untuk meningkatkan biodiversiti serangga terutamanya rama-rama. Oleh itu, lebih banyak kajian diperlukan untuk menilai impak amalan polikultur dan monokultur di kawasan pertanian yang berbeza di Malaysia.

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APPROVAL SHEET

I certify that this research project report entitled “**Comparing Nectarivorous Butterfly Species under Different Agricultural Landscape**” by Nurul Amalina Binti Abdul Aziz has been examined and approved as a partial fulfilment of the requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry, Universiti Putra Malaysia.

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CHAPTER 1

INTRODUCTION

1.1 General Background

The rapid growth of human population represented an increased industrialization and urbanization development worldwide. In Malaysia, recent statistics shows a total of 32 million human populations (Department of Statistics Malaysia, 2017) indicating an increased demand over food supply that mostly depends on agricultural products. Agricultural land is estimated to cover 23.86% of Malaysia total land area (World Development Indicator, 2014) with oil palm plantation representing at least 1,040,000 ha (FAO, 2009). Due to this, Malaysia has now become one of the largest producers of palm oil with total production of 42% from the global palm oil industry (FAOSTAT, 2007). Agricultural expansion known as one of the major driver of forest loss in the tropics (Voigt, 2016; Kissinger et al., 2012). This has contribute to the substantial decline in overall biodiversity and insects are among the major organism being affected by agricultural expansions (Green et al., 2005; Koh, 2007).

Butterflies (Insecta: Lepidoptera) are among the ideal model organisms for ecological studies (Koh & Sodhi, 2004; Koh, 2007). They have been used as biological indicator to assess forest degradations due to their sensitivity to changes in vegetation structure and composition (Bonebreak et al., 2010).

In addition, they also provide crucial ecosystem services within a forest ecosystems (Nyafwono et al., 2014). Adult butterflies pollinates plant through pollen transfer during foraging for nectar resources.

Meanwhile, butterflies larva plays an important function for plant propagation as most larva are herbivorous. Adults and larva butterflies also serve as major component in natural food webs providing food resources to many birds and animals. Due to this, many ecological studies has highlight the importance of butterfly to assess the impact of land use changes especially in the tropics (Devries et al., 1997; Koh, 2007; Asmah et al., 2017).

Previous studies has shown rapid decline of butterfly species richness and diversity due to habitat loss from logging and agricultural activities (Spitzer et al., 1993; Willott et al., 2000). This is explained by butterfly needs for diverse food resources and favourable environmental conditions (i.e. temperature, relative humidity, floristic compositions and vegetation cover), which is mostly met under natural forest conditions (Bonebreak et al., 2010). Interestingly, butterfly response to land use change may also represent both positive and negative response. For example, a study by Horner-Devine et al. (2003) showed an increase of butterfly species richness in coffee plantations indicating a positive response under human-dominated landscapes. Generally, the conversion of natural forest into agricultural land decreases butterfly presence due to loss of habitat and food.

Biodiversity friendly agriculture practices is the agricultural landscape that support both agricultural production and biodiversity conservation, however, may present significant opportunities to provide refuge for butterfly communities (Horner-Devine et al., 2003; Asmah et al., 2016). This, however, is largely influence by landscape heterogeneity within an agricultural land such as vegetation compositions and the availability of natural habitats (Lucey and Hill, 2012).

Understanding the effects of agricultural expansion on butterfly biodiversity requires an assessments of community response to different agricultural practices. In Malaysia, agricultural land are well represented by rubber, oil palm and fruit orchard which are manage between mono- and polyculture practices. These different agricultural practice may support different insect communities due to its variation in vegetation structure and compositions (Amal et al., 2016; Asmah et al., 2017). Thus, the present study is important to address how agricultural intensifications between a mono- and polyculture practices can influence insects diversity specifically butterflies.

1.2 Justification/ Problem Statement

Forest conversion into agricultural land has led to the major decline of many insect species including butterflies. Despite the major finding of forest loss to butterfly communities (Cleary et al., 2009), few studies have emphasized on the potential conservation efforts to help mitigate this problem. Biodiversity friendly approach in agricultural practices has a significant role to help insect conservation efforts.

Such an example shown in polyculture practice where diverse crop types can support higher biodiversity when compared to single monoculture landscapes (Tschamntke et al., 2005; Vasconcelos et al., 2015). The structural complexity and floristic diversity in polyculture practice represent the important components for insect conservation strategy in agricultural landscapes (Ghazali et al., 2016). Moreover, multifunctional agriculture that integrates food security and insect conservation will contribute to sustainable practice where ecosystem services such as natural pollination is maintained within agricultural landscape.

Thus, the present study is important to address how different agricultural practice (monoculture vs polyculture) in rubber, oil palm and orchard affect butterfly communities. The study is also essential to assess the potential of orchard as butterfly refuge due to its higher habitat complexity in terms of vegetation compositions.

1.3 Objective

The overall aim of the study was to investigate nectarivorous butterfly communities between three different agricultural landscapes. The specific objectives were; (i) to compare nectarivorous butterfly species richness and abundance between polyculture and monoculture system and (ii) to determine microclimatic condition and vegetation structure that influence butterfly species distribution. The study predicted that higher habitat complexity in polyculture landscapes may support higher butterfly communities.



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