ODONATA AS POTENTIAL BIOINDICATOR TO ASSESS DIFFERENT HABITAT QUALITY IN TERRESTRIAL LANDSCAPE

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ODONATA AS POTENTIAL BIOINDICATOR TO ASSESS DIFFERENT HABITAT QUALITY IN TERRESTRIAL LANDSCAPE

By

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DEDICATION

Thanks and Praise to Allah S.W.T for giving me better life and these chances.

Dedicate this thesis to:

My lovely family:

Yahya Bin Ishak, Milah Binti Mat

and also my siblings has always been my priority in life.

My supportive friends,

Thank you for your encouragements supports

and the sacrifices that all of you have given.

My great supervisor,

Dr. Norhisham Razi

Who always support and guide me to complete this study.

Last but not least,

Muhammad Fahmi Aizat bin Abdul Aziz

Who has encouraged me, helped me and always support me to conducting this research and in my study.

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

ABSTRACT

Monoculture practice is increasing rapidly in Malaysia due to massive expansion of oil palm and rubber plantations. Due to this, massive forests have been converted into agricultural land. This resulted to major changes in landscape structure that causes overall biodiversity decline particularly insects. The present study was conducted to measure habitat quality of different agricultural systems in orchard, oil palm, and rubber plantations and its impact on dragonfly and damselfly (Insecta: Odonata) abundance and species richness. The study was conducted at Kampung Ulu Sepri, Kampung Empang Batu and Kampung Batang Sepri located in Pedas, Negeri Sembilan. Odonata sampling was carried out using visual observation in 30 sampling points for each agricultural landscape (a total of 90 sampling points). In overall, 1,375 Odonata individuals belonging to 55 species and 8 families were recorded. In this study, orchards recorded the highest Odonata abundance with 41% followed by rubber plantations and oil palm plantations with 36% and 23% respectively. Rubber plantations recorded the highest species richness with 44% followed by orchards and oil palm plantations with 33% and 23% respectively. The findings showed that Odonata abundance in orchard was greater than monoculture plantation due to better habitat quality. While, greater Odonata species richness in rubber plantations was due to species spill over from adjacent forest area. In conclusion, Odonata from the family Calopterygidae and Chlorocyphidae can provide suitable biological indicator for habitat disturbance. Odonata occurence in both monoculture and polyculture systems require paramount importance for insect conservation.

ABSTRAK

Amalan monokultur semakin meningkat di Malaysia berikutan pengembangan ladang kelapa sawit dan getah secara besar-besaran. Oleh itu, kawasan hutan yang besar telah diubah menjadi tanah pertanian. Ini mengakibatkan perubahan besar dalam struktur landskap yang menyebabkan kemerosotan kepelbagaian biodiversiti keseluruhan terutamanya serangga. Kajian ini dijalankan untuk mengukur kualiti habitat dalam sistem pertanian yang berlainan di dusun, ladang kelapa sawit, dan ladang getah serta kesannya terhadap kelimpahan dan kekayaan spesies pepatung dan pepatung jarum (Insecta: Odonata). Kajian ini dijalankan di Kampung Ulu Sepri, Kampung Empang Batu dan Kampung Batang Sepri yang terletak di Pedas, Negeri Sembilan. Pensampelan Odonata dijalankan menggunakan pemerhatian visual dalam 30 titik pensampelan untuk setiap landskap pertanian (sejumlah 90 titik pensampelan). Secara keseluruhan, 1,375 individu Odonata yang terdiri daripada 55 spesies dan 8 keluarga telah direkodkan. Dalam kajian ini, dusun telah mencatatkan kelimpahan Odonata tertinggi dengan 41% diikuti oleh ladang getah dan ladang kelapa sawit dengan 36% dan 23% masing-masing. Ladang getah mencatatkan kekayaan spesies tertinggi dengan 44% diikuti oleh dusun dan ladang kelapa sawit dengan 33% dan 23% masing-masing. Penemuan menunjukkan bahawa kelimpahan Odonata di dusun adalah lebih besar daripada perladangan monokultur kerana kualiti habitat yang lebih baik. Walaupun, kekayaan spesies Odonata yang lebih besar dalam ladang getah disebabkan oleh limpahan spesies dari kawasan hutan berdekatan. Sebagai kesimpulan, Odonata dari keluarga Calopterygidae dan Chlorocyphidae dapat memberikan petunjuk biologi yang sesuai untuk gangguan habitat. Kehadiran Odonata dalam sistem monokultur dan polikultur menunjukkan pentingnya usaha pemuliharaan serangga.

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APPROVAL SHEET

I certify that this research project report entitled **“**Odonata as Potential Bioindicator to Assess Different Habitat Quality in Terrestrial Landscape” by Nor Afifah Binti Yahya 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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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
CR	Chloroprene Rubber
FAO	Food and Agriculture Organization of the United Nations
HA	Hectare
HSD	Honestly Significant Difference
IUCN	International Union for Conservation of Nature
KKK	Kuala Lumpur Kepong Berhad Company
PNG	Papua New Guinea
UNEP	United Nations Environment Programme
U.S.A	United States of America

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Habitat degradation is among the major cause of rapid biodiversity decline. Land use conversion from forest areas into agricultural land has increased in the past decade to meet global economic and society demand for various agricultural products (FAO, 2016). These land use changes has dramatically changed the landscape composition, structure and function affecting overall biodiversity specifically insects (Matson et al., 1997; Tilman & Polasky, 2002; Butchart et al., 2010). Due to land use change effects on biodiversity and ecosystem services, maintaining landscape heterogeneity in agricultural expansion area is important for conservation effort. Intensive agriculture practise such as monoculture has greater threat on overall biodiversity due to massive land clearing (Asmah et al., 2017).

Biodiversity decline can be measured based on the loss of individual species, species abundance or decrease in species richness. Urbanisation and agriculture expansion is identified as a main threat to 85% of all species described in the IUCN Red List (Craig & David, 2000). Specifically, agriculture expansion has led to an overall approximately 80% of deforestation worldwide (FAO, 2016). In developing regions, natural forest cover has declined from 31.6% to 30.6% between 1990 and 2015 (FAO, 2018). Both terrestrial and aquatic biodiversity are influenced by agricultural expansions due to the wide application of chemical fertilizers and pesticides,

tillage and crop rotation (Tilman, 1999; Beringer, 2000; Tilman et al., 2002; Ross et al., 2002).

Changes in land characteristics from natural forest into agricultural landscape are affecting dragonflies and damselflies (Insecta: Odonata) composition and distribution (Luke et al., 2017). Odonata life cycle require both aquatic and terrestrial landscapes making them more sensitive to environmental disturbance. Due to their sensitivity to environmental disturbance, dragonflies and damselflies can become potential bioindicator to address biodiversity loss within an ecosystem. Previous studies have addressed environmental changes in aquatic and terrestrial ecosystem using Odonata and highlight them as an effective bioindicators (Carvalho et al., 2013; Monteiro-Júnior et al., 2013; Oliveira Junior et al., 2015). Thus, Odonata can become a suitable tool to assess biodiversity friendly management in different agricultural management.

The present study aims to determine how different agricultural landscape (monoculture and polyculture) can influence Odonata species richness and abundance. The present study was conducted in Negeri Sembilan (Kampung Ulu Sepri, Kampung Empang Batu and Kampung Batang Sepri, Pedas) that comprised of different agricultural landscapes with monoculture (oil palm and rubber plantation) and polyculture (orchard plantations).

1.2 Problem Statement

Odonata response towards habitat degradation may vary with species (Luke et al., 2017). There are Odonata species that can adapted to environmental disturbance. For example, Odonata species such as *Neurothemis fluctuans* is well adapted to human modified landscapes thus provide indicator for disturbed habitat (Norma-Rashid et al., 2001). While species such as *Heliocypha biforata* only lives in forest can become indicator for undisturbed habitat (Ahmad & Husna, 2014). Different agricultural landscape between monoculture and polyculture practise may harbour different Odonata community due to different vegetation structure and environmental conditions. Thus, the present study is important to highlight key habitat characteristics in agricultural landscape that can provide refuge for diverse Odonata community.

1.3 Justification

Odonata provide suitable model organism to assess habitat degradation due to its sensitivity to environmental disturbance. However, there is a lack of information on how habitat degradation can influence Odonata abundance and species richness. The information on the impacts of agricultural management between monoculture and polyculture may have different results on Odonata abundance and diversity depending on vegetation structure and microclimate conditions.

1.4 Research Objectives

The main objective of this study is to assess changes in Odonata community between different agricultural landscapes. The specific objective are to (i) compare Odonata abundance and species richness between different agricultural landscapes, (ii) determine the relationship between microclimatic conditions and vegetation structure on Odonata assemblages and (iii) identify Odonata community that well represent each agricultural landscape (orchard, oil palm and rubber plantations).

1.5 Research Questions

The following research questions are used to determine the effects of different agricultural landscape on Odonata community; (i) is there any difference between Odonata abundance and species richness between mono- and polyculture agricultural management?, (ii) can Odonata become potential bioindicator to reflect different agricultural management between mono- and polyculture systems?

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