ASSESSING THE INFLUENCE OF MICROCLIMATE AND VEGETATION STRUCTURE ON HYMENOPTERA DIVERSITY AND ABUNDANCE

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By

NURUL IFFAH NADHIRAH BINTI AZLAN

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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 beloved family:

Azlan Bin Arshad, Norizah Binti Abdul Hamid

And also my siblings have always been my priority in life.

My supportive friends,

Thank you for all 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,

Zarulnizam Asyraf Bin Zamran

Who has always encouraged, helped and support me to conduct this research

and my study.

Thank you for everything. May Allah bless all of us

ABSTRACT

Hymenoptera is beneficial for ecosystem services such as natural predation and pollination. Due to high demand in agriculture, massive forest land has been converted into monoculture plantations affecting Hymenoptera assemblages. Moreover, different habitat quality characteristics due to land use changes influence Hymenoptera biodiversity. Thus, this study was conducted to determine Hymenoptera diversity and abundance in different habitat landscapes between polyculture (orchard) and monoculture system (oil palm and rubber plantation) and to investigate the influence of microclimate condition and vegetation structure on Hymenoptera assemblages. This study was conducted at Kampung Ulu Sepri, Kampung Empang Batu and Kampung Batang Sepri located in Pedas, Negeri Sembilan. Hymenoptera sampling was carried out using yellow pan trap in 30 sampling points with 100 meters distance between points in each plantation area (a total of 90 sampling points). Environmental data was collected vegetation structure and microclimate was collected during solar noon. Overall, 440 Hymenoptera individuals belonging to 7 families (Vespidae, Sphecidae, Crabonidae, Megachilidae, Pompilidae, Braconidae and Ichneumonidae) were collected. Hymenoptera family and abundance were higher in rubber plantations (7 family, 232 individuals) compared to oil palm plantations (6 family, 44 individuals) and orchards (5 family, 164 individuals). Hymenoptera family were dominated by Ichneumonidae in rubber plantations and orchards, whereas oil palm dominated by Braconidae family. These result provide clear evidence that landscapes surrounding rubber plantation with high vegetation structure affects the abundance and number of Hymenoptera family. Hence, vegetation structure plays an important role to maintain social bees and wasps abundance.

ABSTRAK

Hymenoptera bermanfaat untuk perkhidmatan ekosistem seperti pemangsa semula jadi dan pendebungaan. Oleh kerana permintaan tinggi dalam bidang pertanian, tanah hutan secara besar-besaran telah diubah menjadi ladang-ladang monokultur yang mempengaruhi perkumpulan Hymenoptera. Lebih-lebih lagi, ciri-ciri kualiti habitat yang berlainan akibat perubahan penggunaan tanah mempengaruhi biodiversiti Hymenoptera serta mengkaji pengaruh cuaca mikro dan struktur tumbuhan terhadap perkumpulan Hymenoptera. Oleh itu, kajian ini dijalankan untuk menentukan kepelbagaian dan kelimpahan Hymenoptera dalam landskap habitat yang berlainan antara polikultur (dusun) dan sistem monokultur (ladang kelapa sawit dan getah). Kajian ini dijalankan di Kampung Ulu Sepri, Kampung Empang Batu dan Kampung Batang Sepri yang terletak di Pedas, Negeri Sembilan. Pensampelan Hymenoptera dijalankan menggunakan perangkap dulang kuning dalam 30 titik pensampelan dengan jarak 100 meter antara titik di setiap kawasan perladangan (sejumlah 90 titik pensampelan). Data habitat iaitu struktur tumbuhan dan cuaca mikro yang diambil pada waktu tengah hari. Secara keseluruhannya, 440 individu Hymenoptera yang terdiri daripada 7 keluarga (Vespidae, Sphecidae, Crabonidae, Megachilidae, Pompilidae, Braconidae dan Ichneumonidae) dikumpulkan. Keluarga dan kelebihan Hymenoptera lebih tinggi di ladang getah (7 keluarga, 232 individu) berbanding ladang kelapa sawit (6 keluarga, 44 individu) dan kebun (5 keluarga, 164 individu). Keluarga Hymenoptera didominasi oleh Ichneumonidae dalam ladang getah dan dusun, sedangkan kelapa sawit didominasi oleh keluarga Braconidae. Hasil ini memberikan keterangan yang jelas bahawa kelainan lanskap sekitar ladang getah dengan struktur tumbuhan yang tinggi mempengaruhi kelimpahan dan kekayaan spesies keluarga Hymenoptera. Oleh itu, struktur tumbuh-tumbuhan memainkan peranan penting untuk mengekalkan kelimpahan Hymenoptera.

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APPROVAL SHEET

I certify that this research project report entitled “Assessing the Influence of Microclimate and Vegetation Structure on Hymenoptera Diversity and Abundance” by Nurul Iffah Nadhirah Binti Azlan 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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ANOVA	Analysis of Variance
FAO	Food and Agriculture Organization of the United Nations
HSD	Honestly Significant Difference

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Insects are among the most successful terrestrial arthropods that have survive major global challenges such as forest loss and environmental degradation (Jankielsohn, 2018). Other than being one of diverse taxon worldwide, insects also contribute to major ecological functions such as natural predation, predation and decomposition (Schuldt, 2011). Beneficial insects such as social bees and wasps (Insecta: Hymenoptera) regulate ecosystem services through pollination and natural regulation of plant pests (Ndakidemi *et al*., 2016). Their importance as beneficial insects have been highlighted in natural forest and human dominated landscapes such as agricultural land that help promote plant health (Jones & Snyder, 2018).

Among the major function of beneficial insects is pollination (Ndakidemi *et al*., 2016). Most insects forage flowering plants to obtain plant-provided food (nectar, pollen).Throughout this insect-plant relationship, flower-visiting insects can transfer male gametes which are contained in pollen to the female gametes while foraging, resulting in pollination. Honey bees (Apidea) is responsible for pollination services in majority of crops, while *non-Apis* bees are also important pollinators of crops, especially for crops in which honey bees are inefficient to pollinate (Getanjaly *et al.*, 2015).

Other than pollination, insects also provide natural predation that predate and feed on other insects, particularly insect pests. Their important function as natural predators or often refer as natural enemies contribute to natural pests' regulation land biological control (Shelton, n.d.).

Growing demands on agricultural land for food, fibre, and fuel are predicted to rapidly increase in coming decades with continued population growth (Bommarco *et al.*, 2013). Human population growth together with competitive land use causes land scarcity, conversion of wild lands to agriculture and other uses. Human influence on the land and other natural resources is accelerating because of rapid population growth and increasing food requirements (Kanianska, 2016).

The major constraints of food production and security nowadays are combating insect pest and climate change (FAO, 2016). Land use changes for agricultural food production affect large parts of terrestrial area, where contribution to biodiversity is relatively low (Jankielsohn, 2018). However, maintaining ecosystem services for biodiversity conservation specifically insects may promote sustainable forestry and agricultural production (FAO, 2016). Moreover, in most terrestrial ecosystems, insects play key ecological roles in diverse ecological processes such as nutrient cycling, seed dispersal, bioturbation, pollination, and pest control (Nichols *et al.*, 2008).

1.2 Problem Statement

In Malaysia, agricultural landscapes are mostly represented by monoculture and polyculture systems which are majorly consist of oil palm plantation, rubber plantation and orchard. The Food and Agriculture Organization of the United Nations (2010) estimates that in developing countries alone at least 13 million hectares of forest are lost to agricultural land each year. Westerkamp and Gottberge (2000) explained that natural pollination and predation of crops supported by landscape heterogeneity and surrounding natural habitats support greater insect biodiversity. Thus, different types of agricultural management system such as monoculture and polyculture may support different pollinators and insect predators. In addition, Patricio-Roberto and Campos (2014) reported that major decline of pollinator population is a consequence of landscape changes to agriculture. This indicate that less Hymenopterans community in pure agriculture landscape represent lower crop production and pest outbreak due to less natural pollination and predation.

1.3 Justification

Hymenoptera provide essential role for ecosystem services (pollination and predation) where greater Hymenopterans diversity support sustainable agroforestry system. Hymenoptera (social bees and wasps) are the most valuable pollinators and natural predator in agriculture and forestry landscape (Rader *et al*., 2015). The present study is important to highlight Hymenopterans community in different agricultural landscape and their potential as bio-indicator for biodiversity friendly management due to their sensitivity towards

agrochemical applications. According to Steffan-Dewenter et al. 2002 stated that habitat diversity effects the hymenoptera abundance because different habitat provides different food source, nest sites and nest materials for Hymenoptera family.

1.4 Research Objectives

The main objective of this study was to measure Hymenoptera diversity and abundance between habitat quality different agriculture landscapes (orchard, oil palm and rubber plantation). The specific objective were to; (i) determine Hymenoptera diversity between different habitat quality of monoculture and polyculture systems and (ii) investigate the influence of microclimate condition and vegetation structure on Hymenoptera assemblages.

1.5 Research Questions

The following research questions were used for the study to determine how different agricultural landscape influence Hymenoptera diversity; (i) do different agriculture management influence Hymenoptera diversity and abundance? (ii) what are the key variables of habitat quality (microclimatic condition, vegetation structure) that influence hymenoptera assemblages?

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