COMPARING SOCIAL BEE AND WASP DIVERSITY IN DIFFERENT AGRICULTURAL LANDSCAPES USING PAN TRAPS

FATIN AFIQAH BINTI ROSLAN

Comparing Social Bee and Wasp Diversity in Different Agricultural Landscapes Using Pan Traps

By

FATIN AFIQAH BINTI ROSLAN

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DEDICATION

For my beloved family:

Roslan bin Sentol.

Rozita binti Ramli.

Also my siblings.

To all my friends,

Villages people in Kampung Sungai Lalah, Negeri Sembilan.

Thank you for your encouragements supports

And the sacrifices that you have given.

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

ABSTRACT

Forest conversion into agricultural lands has become a global concern due to habitat degradation that reduces overall biodiversity specifically insects. Insects responsed to agricultural land use, however, may vary between different management such as monoculture and polyculture systems. In this study, social bees and wasps (Insecta: Hymenoptera) were compared between different agricultural landscapes namely; polyculture orchard, monoculture rubber and monoculture oil palm plantations. The study was carried out in Kampung Sungai Lalah, Pedas, Negeri Sembilan for 28 days from January to February 2018. Social bees and wasps were sampled using yellow pan trap at all agricultural sites (total sampling point = 45). From the results, a total of 1045 individuals social bees and wasps belonging to eight families were recorded. Polyculture orchard showed the greatest abundance of social bees and wasps followed by monoculture oil palm and monoculture rubber plantations. Surprisingly, all agricultural sites recorded similar number of social bees and wasps family. However, family composition differed between polyculture and monoculture landscapes where Apidae was only recorded in orchard while Braconidae was only recorded in rubber and oil palm plantations. Polyculture orchard also showed significantly greater vegetation cover and relative humidity that may provide suitable habitat conditions for social bees and wasps. The findings proved that habitat heterogeneity in polyculture systems may support greater abundance of social bees and wasps compared to monoculture plantations. Social bee and wasp abundance and diversity of in agricultural landscape may indicate enhance local diversity as this particular insect group providing important ecosystem services such as pollination and biological control. Thus, polyculture systems should be established in agricultural landscape for improved insect conservation and ecosystem services.

ABSTRAK

Penukaran hutan ke tanah pertanian menjadi kebimbangan global disebabkan oleh degradasi habitat yang mengurangkan serangga biodiversiti secara keseluruhannya. Walau bagaimanapun, reaksi serangga terhadap penggunaan tanah pertanian mungkin berbeza antara pengurusan yang berbeza seperti sistem monokultur dan polikultur. Dalam kajian ini, lebah dan penyengat (Insecta: Hymenoptera) dibandingkan antara landskap pertanian yang berbeza iaitu; dusun polikultur, getah monokultur dan ladang kelapa sawit monokultur. Kajian ini dijalankan di Kampung Sungai Lalah, Pedas, Negeri Sembilan selama 28 hari dari Januari hingga Februari 2018. Sampel lebah dan penyengat diambil menggunakan perangkap dulang kuning di semua kawasan pertanian (jumlah titik pensampelan = 45). Dari hasilnya, sebanyak 1045 individu lebah dan penyengat yang terdiri daripada lapan famili telah direkodkan. Kebun polikultur menunjukan bilangan lebah dan penyengat yang paling banyak diikuti oleh ladang getah kelapa sawit dan monokultur monokultur. Hasil kajian ini menunjukkan bahawa semua tapak pertanian mencatatkan bilangan famili lebah dan penyengat yang sama. Walau bagaimanapun, komposisi famili yang berbeza di antara landskap polikultur dan monokultur di mana Apidae hanya direkodkan dalam kebun sementara Braconidae hanya direkodkan di ladang getah dan kelapa sawit. Dusun polikultur juga menunjukkan perlindungan tumbuhan yang ketara dan kelembapan relatif yang dapat memberikan kondisi habitat yang sesuai untuk lebah dan penyengat. Penemuan ini membuktikan bahawa habitat komplek dalam sistem polikultur dapat menyokong bilangan lebah dan penyengat yang lebih banyak berbanding ladang monokultur. Kelebihan lebah dan penyengat serta kepelbagaian landskap pertanian mungkin menunjukkan peningkatan kepelbagaian kumpulan serangga kerana ianya menyediakan perkhidmatan ekosistem yang penting seperti pendebungaan dan kawalan biologi. Oleh itu, sistem polikultur perlu diwujudkan dalam landskap pertanian untuk pemuliharaan serangga dan perkhidmatan ekosistem yang lebih baik.

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APPROVAL SHEET

I certify that this research project report entitled “Comparing Social Bee and Wasp Diversity In Different Agricultural Landscapes Using Pan Traps’’ by Fatin Afiqah binti Roslan 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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Dr. Norhisham bin Razi
Faculty of Forestry
Universiti Putra Malaysia
(Supervisor)

____

Prof. Dr. Mohamed Zakaria Bin Hussin
Dean
Faculty of Forestry
Universiti Putra Malaysia

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Forest degradation has become a major concern worldwide due to its negative impact on overall biodiversity (Wilcove & Koh, 2010). Tropical forests provide refuge for diverse insect communities and the impacts of human activity such as illegal logging and agricultural expansion has led to population declines in many tropical insect species (Cunha & Juen, 2017). Bees and solitary wasp (Insecta: Hymenoptera) are considered as an important component in ecosystem functioning (Matos et al., 2016). Bees provide important function for pollination while solitary wasp is an efficient predator for crop pest (Kevan, 1999; Urbini et al., 2006). In addition, these hymenopterans are also ideal biological indicators for ecosystem disturbance as they are sensitive to changes in environmental conditions (Hirsch & Wolters, 2003). Forest degradation has caused the loss of natural habitat leading to population decline in bees and wasps community. Changes in environmental biotic and abiotic factor may affect the distribution and abundance of bees and wasp due to loss in nesting and floral resources (Tylianakis et al., 2004)

Pollination is a biotic interaction between plant and its pollinators where pollen from anther is transferred to stigma in the same or to different flower.

Many insects are useful pollinators as observed in butterfly (Lepidoptera) but bees are the most important and effective pollinator (Kevan, 1999). Bees contribute to the overall reproductive fitness of diverse plant community (Rianti et al., 2010) and population decline can have negative impact on crop yields (Ricketts et al., 2008). In addition, social bees and wasps are also sensitive to environmental disturbance through changes in microclimatic conditions, plant community structure and topography (Loyola & Martins, 2008). Forest expansion into agricultural lands such as oil palm has become a major concern worldwide due to habitat degradation that contributes to decline in insects biodiversity (Turner & Foster, 2008). Changes in landscape heterogeneity may change bees and wasp species composition that influence the biotic pollination for many crops and wild plant species (Hirsch & Wolters, 2003).

Biodiversity conservation is important to maintain bees and wasps community in agroecosystems. The intensification of agricultural practices such as monoculture systems can have negative impacts on bees and wasp species composition due to lower habitat complexity compared to polyculture systems (Ghazali et al., 2016). Complex vegetation structure that consists of crops and wild plants may support bees and wasp community due to higher food resources and nesting sites. Thus, diverse plant community as seen in agroforestry systems may support different bees and wasps community. Moreover, crop production such as seeds and fruits in agroforestry or agricultural landscapes are highly dependent on bee's pollination. Meanwhile, wasps can become a useful predator to control crop pest population such as Lepidoptera larvae (Krewenka et al., 2011). Even though bees and wasp are known to play important role for agroecosystem functioning, information regarding species composition between different agricultural landscapes are still poor.

1.2 Problem Statement and Justification

In Malaysia, agricultural landscapes are mostly represented by monoculture and polyculture systems which are majorly consist of oil palm plantation, rubber plantation and fruit orchard. Landscape heterogeneity between agricultural landscapes may differ and influence the abundance of bees and wasps due to variation in fluoristic composition and nesting sites. Therefore, different agricultural management can have different impact on bees and wasp survival. Even though, pollination of some crops is not affected by bees such as oil palm that depends on weevil, *Elaeidobius kamerunicus* (Curculionidae), their presence in agricultural plantations is essential for wild plant pollination and also to assess the effects of pesticide and herbicides in agricultural landscapes. Meanwhile, the presence of wasps may indicate the degree of physical habitat complexity as their nesting sites can be found in tree trunks or branches of semi-natural habitats. Thus, the presence of bees and wasp can elucidate the effects of modification and intensification in different agricultural practices (Wang et al., 2017).

Apart from pollination, bees also support human wellbeing by honey productions. By maintaining diverse plant community in agricultural landscape, provide the opportunity for beekeeping as a value added product in food security other than crop production. Furthermore, in agricultural landscape, the pollination and pest control service provided by bees and wasps can significantly increase crop yields and reduced the application of agrochemicals. However, to fully utilized ecosystem functions provided by these hymenopterans, assessment on the effects of different agricultural systems is essential. Different vegetation structure and microclimatic conditions between monoculture and polyculture system can influence bees and wasps assemblages within an area (Klein et al., 2002). By understanding the important factors that support bees and wasps persistence within an agricultural landscape will help to improve conservation effort for a better agroecosystem services (Kremen, 2005). Thus, more information is required to understand the effects of agricultural intensification on the abundance of bees and wasps populations (Matos et al., 2016).

Bee and wasp diversity in agricultural landscapes is closely associated with plant community structure (Loyola & Martins, 2008). Increased in agricultural intensification by using a single crop species with frequent application of agrochemicals will significantly reduce bees and wasps diversity. Therefore, study comparing different agricultural practices will illustrate the effects of agricultural intensification on bees and wasps community. The diversity of bees and wasps is one of the important key for successful a successful agro ecosystem functioning (Liow et al., 2001). Therefore, the present study is set out to compare bees and wasps diversity in different agricultural practices between monoculture and polyculture systems.

1.3 Research Objectives and Questions

The present study aimed to evaluate the effects of different agricultural landscapes between monoculture and polyculture systems on bees and wasps communities. The specific objective was to compare the number of families and abundance of bees and wasps influence by vegetation structure and environmental variables under different agricultural landscapes.

1.4 Research Questions

In order to understand bees and wasps diversity and abundance in agricultural landscape, the present study asked the following question; (i) how changes in agricultural intensification affect bees and wasps diversity? And (ii) what are the important environmental variables that influence bees and wasps distribution?

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