THE IMPACT OF DIFFERENT URBAN PARKS ON VEGETATION STRUCTURE, MICROCLIMATE AND INSECT COMMUNITIES

MOHAMAD AMEERUL BIN ISHAK

FH 2019 10

THE IMPACT OF DIFFERENT URBAN PARKS ON VEGETATION STRUCTURE, MICROCLIMATE AND INSECT COMMUNITIES

By

MOHAMAD AMEERUL BIN ISHAK

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

2019

DEDICATION

For my beloved family:

Ishak bin Agil

Siti Zahrah bte Hj Sohod

Also my siblings.

To all my friends, Faiz, Hafizul, Liyana, Fatin Asyilah, Fatin Afiqah, Meon

and Siti Wahdaniyah

Thank you for your encouragement support

And the sacrifices that you have given.

This project report is dedicated to my late grandmother who has been the strength for my struggle in completing this degree. Indeed, only god can repay all your kindness and sacrifices. I will always love you *Atok.*

Thank you for everything. May Allah Bless us all.

ABSTRACT

The opening of new areas for urban development has led to an increase of threatened habitat of insects due to changes of vegetation and thus introducing climate issues. The urban green spaces such as parks can provide ecosystem services such as microclimate mitigation and enhances the insect biodiversity. However, different types of urban park may have different vegetation structure and microclimatic condition thus may have different influence on the insect communities. Therefore, this study aimed to determine the influence of vegetation structure, microclimate and insect communities at different types of urban park. This study was conducted at three different park types of Taman Rimba Alam (Forest-based Park), Taman Saujana Hijau (Recreation-based Park) and Taman Warisan Pertanian (Orchard-based Park) in Putrajaya. Insect sampling was done using yellow pan trap at 20 points for two weeks for each park. Vegetation structure of number of trees, number of shrubs, percentage canopy cover, percentage land cover and microclimate parameters of air temperature, relative humidty, solar radiation and wind speed were measured at each park. The findings showed that Taman Warisan Pertanian was significantly greater in insect abundance and richness implying that insect communities were more attracted due to the variety of fuiting trees (fruiting season), low in temperature and wind speed. However, Taman Rimba Alam showed significantly lower air temperature (up to 1.3°C) and solar radiation and higher relative humidity due to significantly greater canopy coverage compared to the other two parks. This study shows that types of park have influence on the vegetation structure, microclimate and insect communities. This study assists the urban forest managers and planners in the future planning in optimizing the ecosystem services of each park.

ABSTRAK

Pembukaan kawasan baru untuk pembangunan bandar telah membawa kepada habitat serangga yang semakin terancam kerana perubahan tumbuh-tumbuhan dan dengan itu memperkenalkan isu-isu iklim. Kawasan hijau di bandar seperti taman boleh menyediakan perkhidmatan ekosistem seperti pengurangan iklim mikro dan meningkatkan biodiversiti serangga. Walau bagaimanapun, jenis taman bandar yang berbeza mungkin mempunyai struktur tumbuh-tumbuhan yang berbeza dan keadaan iklim mikro mungkin mempunyai pengaruh yang berbeza terhadap komuniti serangga. Oleh itu, kajian ini bertujuan untuk menentukan pengaruh struktur tumbuhan, iklim mikro dan komuniti serangga di taman bandar yang berbeza. Kajian ini dilakukan di tiga taman jenis Taman Rimba Alam, Taman Saujana Hijau dan Taman Warisan Pertanian di Putrajaya. Pensampelan serangga dilakukan menggunakan perangkap dulang kuning pada 20 mata selama dua minggu untuk setiap taman. Struktur tumbuhan iaitu bilangan pokok, bilangan pokok renek, peratusan kanopi, peratusan penutupan tanah dan parameter iklim mikro, suhu udara, kelembapan, radiasi matahari dan kelajuan angin diukur di setiap taman. Penemuan menunjukkan bahawa Taman Warisan Pertanian adalah lebih setara dalam kehadiran banyak serangga dan kekayaan yang menunjukkan masyarakat serangga lebih tertarik disebabkan oleh pelbagai pokok buah-buahan (musim buah), suhu dan kelajuan angina yang rendah. Walau bagaimanapun, Taman Rimba Alam menunjukkan suhu udara yang lebih rendah (sehingga 1.3 ° C) dan sinaran matahari dan kelembapan relatif yang lebih tinggi kerana liputan kanopi yang lebih besar berbanding dua taman yang lain. Kajian ini menunjukkan bahawa jenis taman mempunyai pengaruh terhadap struktur tumbuhan, iklim mikro dan komuniti serangga. Kajian ini membantu para pengurus dan perancang hutan bandar dalam perancangan masa depan dalam mengoptimumkan perkhidmatan ekosistem di setiap taman.

ACKNOWLEDGEMENTS

Alhamdulillah and thank to Allah S.W.T with all His Gracious and His Merciful for giving me strength and the ability to accomplish this project successfully. I would like to take the utmost opportunity to express my sincere and gratitude to my supervisor Dr. Ruzana Adibah Mohd Sanusi and co-supervisor Dr. Norhisham Razi, who are always giving me supports and guidance.

APPROVAL SHEET

I certify that this research project report entitled “The Impact Of Different Urban Parks on Vegetation Structure, Microclimate and Insect Communities” by Mohamad Ameerul bin Ishak 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.

_____

Dr. Ruzana Adibah Mohd Sanusi
Faculty of Forestry
Universiti Putra Malaysia
(Supervisor)

_____

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

Date: January 2019

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

TRA	Taman Rimba Alam
TSH	Taman Saujana Hijau
TWP	Taman Warisan Pertanian
NOT	Number of Trees
NOS	Number of Shrub
UHI	Urban Heat Island

CHAPTER 1

INTRODUCTION

1.1 General Backgroud

Tropical deforestation continues to rise at an alarming rate worldwide due to its negative impact on overall biodiversity (Wilcove & Koh, 2010). Tropical forest provide refuge for diverse insect communities and the impacts of human activity such as illegal logging, agricultural expansion and development of residences has led to population declines in many tropical insect spesies (Cunha & Juen, 2017). The net loss of forest area has reduced between 2000 to 2010 due to increase global effort in reforestation and afforestation (Achard et al., 2002). In Malaysia alone, at least 1.04 million ha of forest were converted into agriculture plantation from 1990 to 2005 (Wilcove & Koh, 2010). Insect species are considered as an important component in ecosystem functioning (Matos et al., 2016). Insect can plays as a role for pollination agent and as a predator for crop pest (Urbini et al., 2006). Insect also suitable for biological indicators for ecosystem disturbance as they are sensitive to changes in environmental conditions (Hirsh & Wolters, 2003). Most insects and other living organisms are influenced by natural changes in ecosystem environments.

Changes in environmental biotic and abiotic factor may affect the distribution and abundance of insects due to habitat loss (Tylianakis et al., 2004). Biodiversity conservation is a key mechanism in ecosystems for diversity of species or functional groups (Spehn et al., 2005). The intensification of urban area system can have negative impacts on insect composition due to lower

habitat complexity compared to nature forest area. Event though, habitat heterogeneity in urban area is lower compared forest area, urban area supports few insect communities for nesting and food resource such as at urban park areas. Thus, diverse plant community in urban area may support the life cycle of insect communities. Moreover, crop production such as seeds and fruits in orchard urban area are highly dependent on insect as their agent for pollination.

1.2 Justification

Land use and occupation by human populations can cause many environmental changes in insect communities, which affect not only the number and abundance of species but also the biological characteristics or functional traits of the individuals (Barbara et al., 2017). Different functions of land use may indicate the differences of insect communities (Barbara et al., 2017). Putrajaya is an example of planned city included of federal administrative centre of Malaysia. 38 % of planned garden and intelligent city of Putrajaya are reserved for green spaces in which natural landscape is enhanced. With 90,000 human population in this city (Department of Information, Ministry of Communications and Multimedia, Malaysia, 2017), competition of living spaces between human and other organism such as insect must be high. One of the objectives of having an urban forest in Putrajaya is to provide green areas that serve as habitat for birds, insects and others wildlife (Zhang & Wang, 2006). Generally, influence on land use changes on urban insect communities depends on management and plant

structure in the area. The diversity of insect communities with good conservation is important to ensure the survival of insect populations. The number of insect captured will reassamble the biodiversity of insect in the urban parks. Thus, this case study was conducted in order to investigate how do the differences affect the insect communities and its relation to the vegetation structure and microclimate conditions.

1.3 Objectives

The overarching aim of this study was to investigate the influence of different types urban park on habitat quality (vegetation stucture and microclimate) and insect communities. Specificilly, the objectives were to:

1. compare the vegetation stucture, microclimate and insect communities of different urban parks
2. determine the relationship between habitat quality and insect communities of different urban parks.

REFERENCES

Altieri, M. A. (2002). Agroecology: The science of natural resourcemanagement for poor farmers in marginal environments. *Agriculture, Ecosystems and Environment*, 93, 1-24.

Ashraf, M., Zulki, R., Sanusi, R., Tohiran, K.A., & Terhem, R. (2018). Alley- cropping system can boost arthropod biodiversity and ecosystem functions in oil palm plantations. Agriculture, *Ecosystems and Environment*, 260, 19-26.

Buschini, M.L.T & Woiski, T.D., 2008. Alpha-beta diversity in trap-nesting wasps (Hymenoptera: Aculeata) in Southern Brazil. *Acta Zoologica*, 89, 351-358.

Bengtsson, J., Ahnstrom, J. & Weibull, A.C. (2005). The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Applied Ecology*, 42, 261-269.

Bartlett-Healy, K., I. Unlu, P. Obenauer, T. Hughes, S. Healy, T. Crepeau, A. Farajollahi, B. Kesavaraju, D. Fonseca, G. Schoeler, et al. 2012. Larval mosquito habitat utilization and community dynamics of *Aedes albopictus* and *Aedes japonicus* (Diptera: Culicidae). *Journal of Medical Entomology*, 49, 813-824.

Briant, G., V. Gond, & S.G. W. Laurance. (2010). Habitat gragmentation and the desiccation of forest canopies: A case study from eastern Amazonia. *Biological Conservation,* 143, 2763-2769.

Carlson, T. N., & Arthur, S. T. (2000). The impact of land use — land cover changes due to urbanization on surface microclimate and hydrology: a satellite perspective. *Global and Planetary Change*, 25, 49-65.

Chen, J. Qin, Z., Chend, F., & Liang, B. (2014). Landscape and Urban Planning Influence of canopy structural characteristics on cooling and humidifying effects of Populus tomentosa community on calm sunny summer days. *Landscape and Urban Planning,* 127, 75-82.

Crowder, D. W., & Carri, Y. (2009). Comparing the refuge strategy for managing the evolution of insect resistance under different reproductive strategies. *Journal of Theoretical Biology*, 261, 423-430.

Diamond et al. (2015). Shared and unique responses of insects to the interaction of urbanization and background climate. *Current Opinion in Insect Science*, 11, 71-77.

DAVIS, A.L.V., & Philips, T. K. (2005). Effect of Deforestation on a Southwest Ghana Dung Bettle Assemblage (Coleoptera: Scarabaeidae) at the Periphery of Ankasa Conservation Area. *Environmental Entomology*, 34(5), 1070-1090.

Didham, R. K., Stork, N. E., & Davis, A. J. (1996). Insect in fragmented forest: a functional approach. *Trends in Ecology & Entomology*, 11(6), 250-265.

Fetridge, E. D., Asher, J. S., & Langellotto, G. A. (2008). The bee fauna of residential gardens in s suburb of New York City (Hymenoptera: Apoidea). *Annals of the Entomological Society of America,* 101(6*),* 1067-1077.

Gilbert, F., & Jervis, M. A. (1998). Functional, evolutionary and ecological aspects of feeding-related mouthpart speclizations in parasitoid flies. *Biological journal of the Linnean Society, 63*, 495-535.

Huang HX, Li JL, Huang LM (2008). Diurnal variation patterns of microclimate and their effects on human comfort degree in Nanjing City. *Chinese Journal of Ecology*, 27, 601-606

Horak, J., Peltanova, A., Podavkova, A., Safarova, L., Bogusch, P., Romportl, D., & Zasadil, P. (2013). Agriculture, Ecosystems and Environment Biodiversity responses to land use in traditional fruit orchards of a rural agricultural landscape. *Agriculture, Ecosystems and Environment*, 178, 71–77.

Kimberling, D. N., Karr, J. R., & Fore, L. S. (2001). Measuring human disturbance using terrestrial invertebrates in the shrub – steppe of eastern Washington (USA). *Ecological Indicators*, 1(2), 63-81.

Koh, L. P. (2008). Can oil palm plantations be made more hospitable for forest butterflies and birds? *Applied Ecology*, 45, 1002–1009.

Koivula M. (2011). Useful model organisms, indicators, or both? Ground beetles (Coleoptera, Carabidae) reflecting environmental conditions. *ZooKeys*, 100, 287- 317.

Liow, L. H., Sodhi, N. S. & Elmqvist, T. (2001). Bee diversity along a disturbance gradient in tropical lowland forests of South-East Asia. *Journal of Applied Ecology*, 38,180–192.

McGeoch, M. A. (1998). The selection, testing and application of terrestrial insects as bioindicators. *Cambridge Journals: Practice and Research*, 73, 181- 201.

Meyfroidt, P., & Lambin, E. F. (2011). Global forest transition: prospects for an end to deforestation. Annual Review of Environment and Resources, 36, 343– 371.

Nair, P. (1993). An introduction to agroforestry. Kluwer Academic Publishers. Pant, M., Negi, G. C. S., & Kumar, P. (2017). Macrofauna contributes to organic matter decomposition and soil quality in Himalayan agroecosystems, India. *Applied Soil Ecology*, 120, 20–29.

Peerawat, M., Blaud, A., Trap, J., Chevallier, T., Alonso, P., Gay, F. & Brauman, A. (2018). Rubber plantation ageing controls soil biodiversity after land conversion from cassava. *Agriculture, Ecosystems and Environment*, 257, 92–102.

Peterson, H. Strand, T., Lamb, B., Thistle, H., & Allwine, E. (2009). A simple model for simulation of insect pheromone dispersion within forest canopies. *Ecological Modelling*, 220, 640–656.

Pytrik Reidsma, Tonie Tekelenburg, Mauriys van den Berg & Rob Alkemade (2006). Impacts of land-use change on biodiversity: An assessment of agricultural biodiversity in the European Union. *Agriculture, Ecosystems & Environment*, 114, 86-102.

Schmidt M. (2005). The heat repeat protein blm10 regulates the yeast proteasome by capping the core particle. *Nature Structural & Molecular Biology,* 12(4), 294-303.

Schweiger, H. F., & Peschl, G. M. (2005). Reliability analysis in geotechnics with the random set finite element method. *Georisk Assessment and Management of Risk for Engineered Systems and Geohazards*, 32, 422–435.

Sodhi, N. S., Posa, M. R. C., Lee, T. M., Bickford, D., Koh, L. P., & Brook, B. W. (2010). The state and conservation of Southeast Asian biodiversity. *Biodiversity and Conservation*, 19(2), 317–328.

Sunderland, K. D. (1996). Ecology And Behavior Of Ground Beetles, *European Journal of Entomology*, 41, 23-56.

Sunderland, T., Abdoulaye, R., Ahammad, R., Asaha, S., Baudron, F., Deakin, E., Vianen, J. Van. (2017). Forest Policy and Economics A methodological approach for assessing cross-site landscape change : Understanding socioecological systems. *Forest Policy and Economics*, 84, 83–91.

Threlfall CG, Ossola A, Hahs AK, Williams NSG, Wilson L & Livesley SJ (2016). Variation in Vegetation Structure and Composition across Urban Green Space Types. *Landscape and Urban Planning*, 4, 66.

Threlfall CG, Williams NSG, Hahs AK., & Livesley, SJ (2016). Approaches to urban vegetation management and the impacts on urban bird and bat assemblages. *Landscape and Urban Planning*, 153, 28-39.

Thomas, R. S., Glen, D. M., & Symondson, W. O. C. (2008). Prey detection through olfaction by the soil-dwelling larvae of the carabid predator *Pterostichus melanarius*, *Soil biology & Biochemistry*, 40, 207–216.

Tscharntke, T., Tylianakis, J., Rand, T., Didham, R., Fahrig, L., Batáry, P., Bengtsson, J., Clough, Y., Crist, T., Dormann, C., Ewers, R., Fründ, J., Holt, R., Holzschuh, A., Klein, A., Kleijn, D., Kremen, C., Landis, D., Laurance, W., Lindenmayer, D., Scherber, C., Sodhi, N., Steffan-Dewenter, I., Thies, C., van der Putten, W. & Westphal, C. (2018). Landscape moderation of biodiversity patterns and processes – eight hypotheses. *Biology Review*, 87, 661–685.

Utomo, B., Prawoto, A. A., Bonnet, S., Bangviwat, A. & Gheewala, S. H. (2016). Environmental performance of cocoa production from monoculture and agroforestry systems in Indonesia. *Cleaner Production*, 134, 583-591.

Watson, D.M. (2002). A conceptual framework for studying species composition in fragments, islands and other patchy ecosystems. *Journal of Biogeography*, 29, 823–834.

Weibull, Ann-Christin & Östman, Örjan. (2003). Species composition in agroecosystems: The effect of landscape, habitat, and farm management. *Basic and Applied Ecology,* 4, 349-361.

Wilcove, D. S., & Koh, L. P. (2010). Addressing the threats to biodiversity from oil-palm agriculture. *Biodiversity and Conservation*, 19(4), 999–1007.

Zhang, W., Ricketts, T. H., Kremen, C., Carney, K., & Swinton, S. M. (2007). Ecosystem services and dis-services to agriculture. *Ecological Economics*, 64(2), 253–260.

Zhong D, Wang X, Xu T, Zhou G, Wang Y, Lee et al., (2016). Effects of microclimate condition changes due to land use and land cover changes on the survivorship of Malaria Vectors in China-Myanmar border region. *PLoS ONE,* 11(5).