THE EFFECTS OF FOREST PATCH SIZE ON BIRD BIODIVERSITY

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THE EFFECTS OF FOREST PATCH SIZE ON BIRD BIODIVERSITY

By

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ABSTRACT

In Malaysia, forest fragmentation has become a great concern as it causes environmental degradation. Forest fragmentation occurs when original large and continuous forest is divided into small patches of forest. Forest fragmentation affects the forest fauna diversity. This study was conducted to investigate the species richness and abundance of the forest birds within four fragmented forests in Selangor. The four fragmented forest reserves were located within urban landscape, these study sites were Sungai Lalang Forest Reserve (SLFR), Ayer Hitam Forest Reserve (AHFR), Bukit Cerakah Forest Reserve (BCFR) and Bangi Forest Reserve (BFR). Point transect survey was used as a method for this study. Thirty sampling points were prepared for all study sites. One-way ANOVA was used to compare the abundance and richness of forest bird species among study sites. The BFR was recorded as the highest species richness compared to other sites. The highest bird abundance was recorded at AHFR compared to the other fragmented forests. This result is somewhat contradictory with previous studies which suggested large forest supports a high number of bird abundance and species richness. Similarity Percentage analysis (SIMPER) was used to determine the species composition within each forest patches. The contributions from this study were to update the biodiversity information within each forest patch and made a management recommendation for stakeholder to protect the biodiversity.

ABSTRAK

Di Malaysia, pemecahan hutan telah menjadi kebimbangan besar yang menyebabkan kemusnahan alam sekitar. Pemecahan hutan berlaku apabila hutan besar dibahagikan kepada bahagian-bahagian hutan yang kecil. Pemecahan hutan memberi kesan kepada kepelbagaian fauna hutan. Kajian ini dijalankan untuk menyiasat kekayaan dan kelimpahan spesies burung hutan dalam empat hutan berpecah-belah di Selangor. Rizab hutan yang berpecah belah yang terletak dalam landskap bandar terpilih sebagai tapak kajian ialah Hutan Simpan Sungai Lalang (SLFR), Hutan Simpan Ayer Hitam (AHFR), Hutan Simpan Bukit Cerakah (BCFR) dan Hutan Simpan Bangi (BFR). Kaedah transek titik digunakan sebagai kaedah untuk menjalankan kajian ini. Tiga puluh pensampelan disediakan untuk semua tapak kajian. Satu arah ANOVA digunakan untuk membandingkan kelimpahan dan kekayaan spesies burung hutan di setiap tapak kajian. BFR telah direkodkan sebagai hutan yang mempunyai kekayaan spesies burung hutan yang paling banyak berbanding dengan tapak lain. Sementara itu, kelimpahan spesies burung hutan tertinggi dicatatkan di AHFR berbanding dengan hutan berpecah yang lain. Hasil ini agak bertentangan dengan kajian terdahulu yang mengatakan saiz hutan yang besar akan menyokong kelimpahan dan kekayaan spesies burung yang banyak. SIMPER analisis digunakan untuk menentukan komposisi spesies burung di setiap hutan. Sumbangan daripada kajian ini ialah untuk mengemaskini maklumat mengenai biodiversiti di setiap hutan dan membuat cadangan pengurusan kepada pihak yang bertanggungjawab untuk melindungi biodiversiti di setiap hutan.

DEDICATION

This thesis is especially dedicated to my beloved

For my beloved family:

Kadis Bin Sian (Father)

Zaleha Binti Jais (Mother)

For my siblings:

Mohd Haniff Bin Kadis

Mohd Shahrum Bin Kadis

Nadianty Binti Kadis

Izzayu Binti Kadis

Haslin Binti Kadis

Muhammad Afiq Aiman Bin Kadis

And all my friends

Thank you for all your encouragements supports

And the sacrifices that you have given.

Thank you for everything and may Allah bless all of us.

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APPROVAL SHEET

I certify that this research project report entitled **"The Effects of Forest Patch Size on Bird Biodiversity"** by Nur Faizza Binti Kadis 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, Universiti Putra Malaysia.

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

SLFR	Sungai Lalang Forest Reserve
AHFR	Ayer Hitam Forest Reserve
BCFR	Bukit Cerakah Forest Reserve
BFR	Bangi Forest Reserve
IUCN	International Union for Conservation of Nature

CHAPTER 1

INTRODUCTION

1.1. General Background

Forest fragmentation occur as forest is divided into a small patches which separated by development purposed. According to Rusak (2003), forest fragmentation occurs when large area of forest divided into smaller block for roads, agriculture, urbanization, or other development. This process intrudes the function of forest as a habitat for many plant and animal species. As well, it reduces the forest's effectiveness in order to play their roles in other functions, such as water and air purification. Fragmentation not only reduces the area as forest but also affects other biophysical aspects of the forest, such as forest structure, temperature, moisture and light regimes. It disturbs the habitat to which all forest animals and plants have been adapted over millennia.

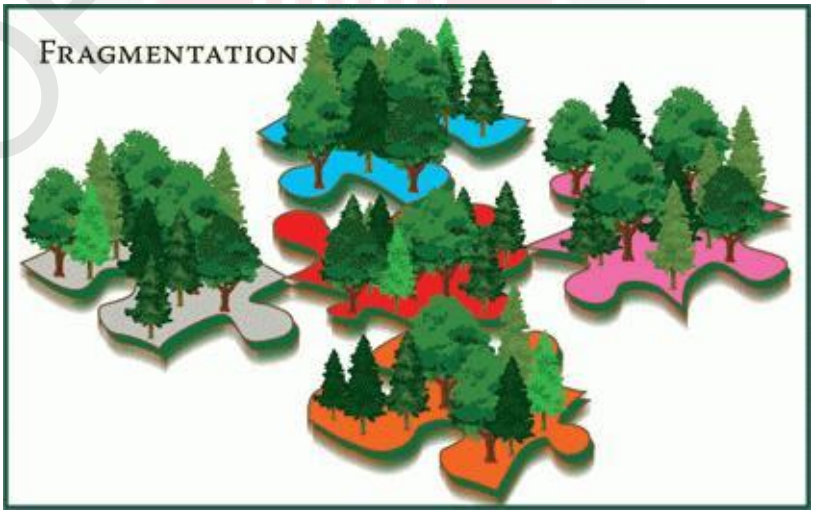

Figure 1.1: show how forest fragmentation occurs.

Forest fragmentation can give negative effect on environment and difficult to be restored, especially when associated with human development. When habitat is reduced to smaller and smaller patches, there will be less in diversity of habitat type. A reduced amount of habitat supports correspondingly smaller populations of wildlife, as well as fewer species. Debinski & Holt (2000) state that smaller patch of forest generally contain fewer species than larger patch. This fact can be support by saying that small patch can lead to population decline (Bender *et al.,* 1998). Small patch may limit in resources (Zanette *et al.,* 2000). When a habitat is fragmented, the amount of edge habitat increases by reducing interior habitat. As well as, it increasing the number of species that dependent on edge habitat and reducing the species dependent on interior habitat. Edge habitat gives greater influence by an increase in predator and invasive species, a reduction in biodiversity, and the degradation of vegetation (Lee, Kim, Choi, & Oh, 2010). Highly fragmented forests complicating interior forest species to find the food, cover, or reproduction needs. Predator and invasive species can find their requirements more easily in edge habitats. Woodland size is also important to be concern because smaller forests usually support a lower diversity of forest-dwelling species in which this species need large forest area to breed successfully and proportionally fewer numbers of each species due to edge effects. Woodland-dependent bird species, even though they are found in nearby woodland areas, often avoid smaller fragments (Rusak, 2003). Rusak (2003) states that patches of 200 hectares are considered the minimum size for a forest ecosystem to recover from disturbance events such as wind-throw, fires, or insect and disease infestations.

As a habitat becomes fragmented, patches become separated from one another by relatively inhospitable terrain. Wildlife attempting to cross between patches becomes temporarily vulnerable to predators, harsh environmental conditions, or simply to starvation (Rusak, 2003). Forest fragmentation gives unfavorable situation both plant and animal populations because they become isolated within a patch when surrounding patches of habitat are destroyed. It leads to difficulty of migration or movement of those species. This effect on population to be decline due to inbreeding, swings in numbers due to over-exploitation of habitat, and sudden removal from the patch due to disturbances such as fire, wind damage, or insect or disease infestations. Wildlife should be able to move freely from one forest patch to another. This movement allows for interbreeding, flowing of genetic materials within populations and ensuring that suitable habitats can be filled. In a fragmented forest landscape, large distances between woodlots may prevent this movement and are an impediment for migrating wildlife.

1.2. Problem statements

Urban forest can be described as a system of plant and animal communities, or as the woody and associated vegetation in and around human settlement areas. Miller (1997) define urban forest as all woody and associated vegetation in and around dense human colony, range from small communities in rural settings to capital city. Many of these studies found that urban development decreased bird diversity, composition, and richness; and increased density and biomass (Chace

& Walsh, 2006). The population of birds in urban forest indicated that these areas have low in number of species compared to rural habitat. They are also examples of extreme anthropogenic landscape transformations, with the great proportion of artificial and impermeable surfaces, the altered and maintained flora, high human densities and vast amount of garbage having significant impacts on biodiversity and ecosystems (Pickett et al. 2011). So from here, is the patch area affects species richness and abundance of birds? How patch area affects species richness, abundance and composition in forest patches?

1.3. Objectives

The objectives of this study were:

i. To determine the species richness and abundance of birds among different forest patches.
ii. To compare bird species richness and abundance among different forest patches.
iii. To determine the species composition for each forest patch.

1.4. Hypothesis

From this research, three hypotheses were constructed which are:

- Forest bird species richness was predicted to be greater in the largest patch compared to smaller patches.
- Abundance of forest bird species was predicted to be greater in the largest patch compared to smaller patches
- Species compositions in smaller patches is less diverse compared to the largest patch.

REFERENCES

Akbari, H., Pomerantz, M. and Taha, H. (2001). Cool Surfaces and Shade Trees to Reduce Energy Use and Improve Air Quality in Urban Areas. *Solar Energy,* 70, 295-310.

Amat, J. A. and Green, A. J. (2012). Waterbirds as Bioindicators of Environmental Conditions: C. Hurford et al. (eds.), *Conservation Monitoring in Freshwater Habitats*: Sevilla, Spain.

Anderson, D. R., Burnham, K., Laake, J. L., & Buckland, S. T. (1993). Distance Sampling, 446. https://doi.org/10.1002/0470011815.b2a16019.

Ational, E., & Nature, I. N. (1999). B i rds & Fore s t s A look at How Birds and Forests Live and Thrive Together. *E*, *2 wildlife*, 6.

Barraclough, R. K. (2000). Distance Sampling: A Discussion Document Produced for the Department of Conservation. In *Science & Research Internal Report 175. Department Of Conservation.*

Bender, D. J., Contreras, T. A., & Fahrig, L. (1998). Habitat Loss and Population Decline: A Meta-Analysis of The Patch Size Effect. *Ecology,* 79(2), 517–533.

Bolund, P. and Hunhammar, S. (1999) Ecosystem Services in Urban Areas. *Ecological Economics*, 29, 293-301.

Cadenasso, M. L., S. T. A. Pickett, K. C. Weathers, and C. G. Jones. (2003) A Framework for a Theory of Ecological Boundaries. *BioScience* , 53, 750–758.

Chace, J. F., & Walsh, J. J. (2006). Urban Effects on Native Avifauna: A Review. *Landscape and Urban Planning*, *74*(1), 46-69.

Dami, F. D., Mwansat, G. S., & Manu, S. A. (2013). The Effects of Forest Fragmentation on Species Richness on The Obudu Plateau, South-Eastern Nigeria. *African Journal of Ecology*, *51*(1), 32–36.

David, L. H. & Alan, T. Bull. (Eds).(2007). Vertebrate Conservation and Biodiversity. *Springer Science & Business Media.*

Debinski, D. M., & Holt, R. D. (2000). A Survey and Overview of Habitat Fragmentation Experiments. *Conservation Biology*, *14*(2), 342–355.

Dry, a D., In, F., & Brazil, C. (2011). 1121 Edge Effect on Tree Diversity , Composition and Structure in a Deciduous Dry Forest in Central Brazil. *Revista Árvore*, *35*(5),1121–1134.

Fernández-Juricic E (2004) Spatial and Temporal Analysis of The Distribution of Forest Specialists in an Urban Fragmented Landscape (Madrid, Spain): Implications for Local and Regional Bird Conservation. *Landscape and Urban Planning*, 69, 17–32.

Gonzalez-Gomez, P. L., C. F. Estades, and J. A. Simonetti. 2006. Strengthened Insectivory in a Temperate Fragment Forest. *Oecologia,* 148, 137–143.

Hashim, N., & Ezyan, N. (2013). *Comparative Study of Understorey Birds Inhabiting Selected Logged and Virgin Lowland Forests/Noorul Ezyan binti Nor Hashim* (Doctoral dissertation, University of Malaya).

Jones, G. A., Sieving, K. E., & Jacobson, S. K. (2005). Avian Diversity and Functional Insectivory on North-Central Florida Farmlands. *Conservation biology*, *19*(4), 1234-1245.

Kang, W., Minor, E. S., Park, C.-R., & Lee, D. (2015). Effects of Habitat Structure, Human Disturbance, and Habitat Connectivity on Urban Forest Bird Communities. Urban Ecosystems, 18(3), 857–870. https://doi.org/10.1007/s11252-014-0433-5.

Lee, D., Kim, E., Choi, J., & Oh, K. (2010). The Effects of Development on Forest-Patch Characteristics and Bird Diversity in Suji, South Korea. *Landscape and Ecological Engineering*, 6(2), 171–179.

Lopez de Casenave, J., Pelotto, J. P., Caziani, S. M., Mermoz, M., & Protomastro, J. (1998). Responses of Avian Assemblages to a Natural Edge in a Chaco Semiarid Forest in Argentina. *The Auk*, *115*(2), 425–435.

López-Barrera, F., Armesto, J. J., Williams-Linera, G., Smith-Ramírez, C., & Manson, R. H. (2007). *Fragmentation and Edge Effects on Plant Animal Interactions, Ecological Processes and Biodiversity* (Pp. 69-101). Biodiversity Loss and Conservation in Fragmented Forest Landscapes. The Forests of Montane Mexico and Temperate South America. CABI, Wallingford, Oxfordshire, UK.

Matthews, S. N., & Rodewald, P. G. (2010). Movement Behaviour of a Forest Songbird in an Urbanized Landscape: The Relative Importance of Patch-Level Effects and Body Condition During Migratory Stopover. *Landscape Ecology*, *25*(6), 955–965.

Mekonen, S. (2017). Birds as Biodiversity and Environmental Indicator, 61, 16–22.

McGarigal K, Romme WH, Crist M, Roworth E. (2001). Cumulative Effects of Roads and Logging on Landscape Structure in The San Juan Mountains, Colorado (USA). *Landscape Ecology*, 16, 327–349.

McCollin, D. (2017). Turnover Dynamics of Breeding Land Birds on Islands: is

Island Biogeographic Theory 'True but Trivial'over Decadal Time-Scales?. *Diversity*, *9*(1), 3.

Mohd-Taib, F. S., Md-Nor, S., & Abdullah, S. A. (2016). Implications of Patch Size and Landscape Matrix Towards Native-Forest Bird Species in Fragmented Forests. *Malaysian Applied Biology*, *45*(1), 55–63.

Murcia, C. (1995). Edge effects in fragmented forests: implications for conservation. *Trends in ecology & evolution*, 10(2), 58-62.

Nowak, D. J., Crane, D. E., Stevens, J. C., Hoehn, R. E., Walton, J. T. and Bond, J. (2008) A Ground-Based Method of Assessing Urban Forest Structure and Ecosystem Services. *Arboriculture and Urban Forestry*, 34, 347-358.

Osman, M. T. (2013). Green Educational Park, UPM. *Agrobiotech Agri Putra,* 5(1), 161 – 171.

Pickett, S. T., Cadenasso, M. L., Grove, J. M., Boone, C. G., Groffman, P. M., Irwin, E., ... & Pouyat, R. V. (2011). Urban Ecological Systems: Scientific Foundations and a Decade of Progress. *Journal of Environmental Management*, 92(3), 331-362.

Porensky, L. M., & Young, T. P. (2013). Edge-Effect Interactions in Fragmented and Patchy Landscapes. *Conservation Biology*, *27*(3), 509-519.

Press, A., Raven, P. H., Wu, J., Vankat, J. L., & Remarks, C. (1995). Island Biogeography: Theory and Applications. *System*, *2*(October), 371–379.

Rumble, H., Doick, K., Rogers, K., & Hutchings, T. (2015). Valuing Wrexham's Urban Forest: Assessing The Ecosystem Services of Wrexham's Urban Trees: A Technical Report.

Rusak, H. (2003). Forest Fragmentation. *Woodlands At Risk*, 4. https://doi.org/10.1016/0378-1127(85)90079-9.

Miller, R. W., Hauer, R. J., & Werner, L. P. (2015). *Urban Forestry: Planning and Managing Urban Greenspaces*. Waveland Press.

Rosli, Z., & Zakaria, M. (2011). Response of Upperstorey Bird Composition at Different Distances from Forest Edge to Interior Forest. *Journal of Natural & Environmental Sciences*, *2*(2), 12–18.

Seress, G., & Liker, A. (2015). Habitat Urbanization and Its Effects on Birds. *Acta Zoologica Academiae Scientiarum Hungaricae,* 61(4), 373-408.

Stenhouse, R. N., (2004) Fragmentation and Internal Disturbance of Native Vegetation Reserves in the Perth metropolitan area, Western Australia. *Landscape and Urban Planning*, 68,389–401.

Steidl, R. J., & Powell, B. F. (2006). Assessing the Effects of Human Activities

on Wildlife. *The George Wright Forum*, *23*(2), 50–58.

Suarez-Rubio, M., & Thomlinson, J. R. (2009). Landscape and Patch-Level Factors Influence Bird Communities in an Urbanized Tropical Island. *Biological Conservation*, *142*(7), 1311–1321.

Temple, S. A., & Wiens, J. A. (1989). Bird Populations and Environmental Changes: Can Birds be Bio-Indicators. *American Birds*, *43*(2), 260-270.

Terraube, J., Archaux, F., Deconchat, M., van Halder, I., Jactel, H., & Barbaro, L. (2016). Forest Edges have High Conservation Value for Bird Communities in Mosaic Landscapes. *Ecology and Evolution*, *6*(15), 5178–5189.

Ulrich, R. S. (1979) Visual Landscapes and Psychological Wellbeing. *Landscape Research*, 4, 17-23.

Weathers, K. C., Cadenasso, M. L., & Pickett, S. T. (2001). Forest Edges as Nutrient and Pollutant Concentrators: Potential Synergisms between Fragmentation, Forest Canopies, and The Atmosphere. *Conservation Biology*, *15*(6), 1506-1514.

Zanette, L., Doyle, P., & Trémont, S. M. (2000). Food Shortage in Small Fragments: Evidence from an Area-Sensitive Passerine. *Ecology*, *81*(6), 1654-1666.

Zakaria, M., Leong, P. C., & Yusuf, M. E. (2005). Comparison of Species Composition in Three Forest Types - Towards Using Bird as Indicator of Forest Ecosystem Health. *Journal of Biological Sciences*, *5*(6), 734–737.