ASSESSMENT OF DIURNAL BIRD SPECIES DISTRIBUTION BASED ON MICROCLIMATE FACTORS IN A FRAGMENTED FOREST IN SELANGOR, MALAYSIA

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By

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Malaysia is among mega-diversity countries in the world. It has a lot species of flora and fauna. These flora and fauna species can be found in many type of forest area. Most wildlife in the tropics especially birds' species depends on the forest for cover, food resources and breeding. However, the diversity of bird species are depends on the environment of the area. Forest fragmentations affect the distribution of bird and can cause the changes, reduction or increasing of bird's species. Sam (2014) indicates that forest fragments may cause changing in microclimate and microenvironment of habitat that may make unsuitable for sensitive bird's species. Microclimate and microenvironment factors have a great influenced on the status of bird composition. The relationship of the birds within the fragmented forest areas is difference in terms of microclimate and microenvironment factors (Noss & Cooperrider 1994; Harris 1984). Since forest become under the threats of fragmentation, it may have dire consequence to the diurnal bird's assemblage. Every species of diurnal birds may have different microclimate and microenvironment requirements. Logging and deforestation will disrupt the equilibrium and species richness as it radically alters the microclimate and microenvironment regime of the habitat. Thus, it is important to measure the microclimate and microenvironment features of the bird's habitat as a means of how the disruptions of these parameters affect the distribution of diurnal bird's species in the long run. The study of the assessment of diurnal bird's species distribution based on microclimate and microenvironment factors was conducted in Sungai Chongkak Recreational Forest, Selangor. The objectives of the study are (1) to assess the distribution of diurnal bird's species in Sungai Chongkak Recreational Forest, Selangor. (2) to examine the relationships between diurnal bird's species with microclimate and microenvironment factors at Sungai Chongkak Recreational Forest, Selangor. Transect line and point sampling methodology was used during the study. A multivariate statistic technique of a Canonical Correlation Analysis (CANOCO) was used to examine the relationship between the diurnal bird species with the microclimate and microenvironment factors. The results of the study indicate that there are 41 species of diurnal birds and 524 birds was observed and recorded. It showed that the

relationship between diurnal bird's species was highly correlated with the microclimate and microenvironment factors. The correlation was relatively high that scored between 82.4% – 94.5% (see Table 2 and 3). The CANOCO Diagram showed that every diurnal bird's species has their own relationship in microclimate and microenvironment factors (Figure 6 and Figure 7). This study found that the changes of microclimate (such as the increase or decrease of temperature, light intensity and humidity) and microenvironment (such as changes in size of canopy trees, DBH size of trees and number of shrub) influence the distribution of diurnal bird's species. In term of foraging strata, diurnal birds species at study area have their own foraging strata starting from the forest floor to upper canopy. In term of feeding guild, almost all species of diurnal birds observed at study area are insectivore (which is 40 species) except Yellow-breasted Flowerpecker (*Prionochilus maculates*), 19 species of diurnal birds are frugivore, 11 species of diurnal birds are nectarivore, 7 species of diurnal birds are granivore, 4 species of diurnal birds are carnivore and 2 species of diurnal birds are piscivore. The species of insectivores and frugivores birds are higher in the study area. As conclusion, this research found that microclimate and microenvironment factors may influence the distribution of diurnal bird's species. The changes of microclimate and microenvironment factors also affect the distribution of diurnal bird's species include changes in bird's distribution, bird's assemblage and bird's composition.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

PENTAFSIRAN TABURAN SPESIES BURUNG SIANG BERDASARKAN FAKTOR IKLIM MIKRO DAN PERSEKITARAN MIKRO DI HUTAN TERPISAH DI SELANGOR, MALAYSIA

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Malaysia merupakan antara Negara mega-diversiti di dunia. Ia memiliki pelbagai spesies flora dan fauna. Spesies-spesies flora dan fauna tersebut boleh dijumpai di banyak jenis hutan. Kebanyakan hidupan liar terutamanya spesies burung adalah bergantung dengan hutan untuk berlindung, sumber makanan dan pembiakan. Walaubagaimanapun, kepelbagaian spesies burung adalah bergantung kepada persekitaran sesuatu kawasan. Pemecahan hutan memberi kesan kepada taburan spesies burung dan menyebabkan perubahan, pengurangan atau peningkatan spesies burung. Menurut Sam (2014) perubahan iklim mikro dan persekitaran mikro mungkin menyebabkan pemecahan hutan tidak sesuai untuk spesies yang sensitif. Faktor iklim mikro dan persekitaran mikro merupakan faktor yang sangat mempengaruhi status komposisi burung. Menurut Noss & Cooperrider (1994), hubungan taburan burung adalah berbeza dari segi faktor iklim mikro dan persekitaran mikro yang wujud dalam kawasan hutan yang berpecah. Semenjak hutan berada dibawah ancaman pemecahan, ia mungkin memberi kesan buruk kepada himpunan burung siang. Setiap spesies burung siang mungkin mempunyai keperluan iklim mikro dan persekitran mikro yang berbeza. Pembalakan dan penebangan hutan akan mengganggu keseimbangan dan kekayaan spesies kerana ia secara radikal mengubah iklim mikro dan persekitaran mikro di habitat tersebut. Oleh itu, pengukururan ciri-ciri iklim mikro dan persekitaran mikro adalah penting sebagai salah satu cara untuk mengetahui bagaimana parameter ini memberi kesan kepada taburan spesies burung siang dalam jangka masa panjang. Kajian mengenai pentafsiran spesies burung siang berdasarkan faktor iklim mikro dan persekitaran mikro telah dijalankan di Hutan Lipur Sungai Chongkak, Selangor. Objektif kajian tersebut adalah (1) untuk mentafsir taburan spesies burung siang di Hutan Lipur Sungai Chongkak, Selangor. (2) untuk memeriksa hubungan antara spesies burung siang dengan faktor iklim mikro dan persekitaran mikro di Hutan Lipur Sungai Chongkak, Selangor. Kaedah garis transek dan persampelan titik telah digunakan semasa kajian. Teknik statistik multivariat daripada "Canonical Correlation Analysis" (CANOCO) telah digunakan untuk memeriksa hubungan antara spesies burung siang dengan faktor iklim mikro dan persekitaran mikro. Daripada hasil kajian,

terdapat sebanyak 41 spesies burung siang dan 524 ekor burung telah diperhatikan dan direkodkan. Hubungan antara spesies burung siang dengan faktor iklim mikro dan persekitaran mikro pula adalah agak tinggi. Hubungan tersebut adalah agak tinggi iaitu antara 82.4% – 94.5% (lihat Table 2 dan Table 3). Diagram CANOCO menunjukkan setiap spesies burung siang mempunyai hubungan mereka yang tersendiri dengan faktor iklim mikro dan persekitaran mikro (Figure 6 dan Figure 7). Kajian ini mendapati bahawa perubahan iklim mikro (seperti peningkatan atau penurunan suhu, keamatan cahaya dan kelembapan) dan persekitaran mikro (seperti perubahan saiz kanopi pokok, saiz DBH pokok dan bilangan pokok renek) mempengaruhi taburan spesies burung siang. Dari segi "Foraging Strata", spesies burung siang di kawasan kajian mempunyai "Foraging Strata" mereka yang tertentu bermula daripada lantai hutan hingga ke kanopi atas. Dari segi bentuk pemakanan pula, hampir keseluruhan spesies burung siang yang diperhatikan di kawasan kajian adalah "Insectivore" (iaitu sebanyak 40 spesies) kecuali "Yellow-breasted Flowerpecker (*Prionochilus maculates*)", 19 spesies burung siang adalah "Frugivore", 11 spesies burung siang adalah " Nectarivore ", 7 spesies burung siang adalah "Granivore", 4 spesies burung siang adalah "Carnivore" dan 2 spesies burung siang adalah "Piscivore". Kawasan kajian tersebut banyak didiami oleh burung pemakan serangga dan burung pemakan buah. Secara keseluruhan, kajian ini mendapati bahawa faktor iklim mikro dan persekitaran mikro mempengaruhi taburan spesies burung siang. Perubahan iklim mikro dan persekitaran mikro juga memberi kesan kepada taburan spesies burung siang seperti mengubah taburan spesies burung, taburan burung, himpunan burung, dan komposisi burung.

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LIST OF ABBRIVIATION AND SYMBLOS

%	Percentage
ABF	Asian Brown Flycatcher
APF	Asian Paradise Flycatcher
AST	Ashy Tailorbird
BBK	Black Backed Kingfisher
BNWP	Buff-Necked Woodpecker
BWLB	Blue-Winged Leafbird
CBM	Chestnut Breasted Malkoha
cm	Centimeter
CNF	Chestnut-NapedForktail
CT	Common Tailorbird
DNT	Dark Necked Tailorbird
DTO	Dark Throated Oriole
ED	Emerald Dove
FM	Fiery Minivet
GBB	Grey-Bellied Bulbul
GBS	Grey-Breasted Spiderhunter
GBW	Grey and Buff Woodpecker
GHB	Grey-Headed Babbler
GHCF	Grey-Headed Canary-Flycatcher
GRTD	Greater Racket-Tailed Drongo
GW	Grey Wagtail
HBB	Hairy-Backed Bulbul
HFB	Horsfield'S Babbler
km	Kilometer
LGLB	Lesser GreanLeafbird
LSH	Little Spiderhunter
m	Meter
MW	Maroon Woodpecker
OBFP	Orange-Bellied Flowerpecker
OMR	Oriental Magpie-Robin
PNSB	Purple-Naped Sunbird
PSTB	Pin-Striped Tit-Babbler
RCKF	Rufous-Collared Kingfisher
RTTB	Rufous-Tailed Tailorbird
RWP	Rufous Woodpecker

SBB	Spectacled Bulbul
SBR	Siberian Blue Robin
SCRF	Sungai Congkak Recreational Forest
STB	Stripe Throated Bulbul
TS	Tiger Shrike
WBW	White-Breasted Waterhen
WCF	White-Crowned Forktail
WRM	White-RumpedMunia
YBB	Yellow Bellied Bulbul
YBF	Yellow-Breasted Flowerpecker

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CHAPTER 1

INTRODUCTION

1.1 Background

The Malaysian tropical rainforest is one of the most complex ecosystems in the world. It has unique natural heritage, which has evolved over millions of years and is rich and varied in plant and animal life. Most wildlife in the tropics especially bird's species depends on the forest for cover, food resources and breeding.

The tropical rainforests, seas and freshwater ecosystems of Malaysia support a rich and diverse array of both flora and fauna species (WWF Malaysia, 2013). Malaysia has more than 170 000 of flora and fauna species with unequal density (Climate Avenue, 2011).

There are approximately 10,000 bird species in the world. This number varies by a few hundred of birds, depending on which classification system we use. Clements (2014) (now run by Cornell University) lists about 9,800 bird species whereas Sibley and IOU list over 10,000 species. As with most animal groupings, species are being redefined and what was considered to be one species may be split into two or more species, and in other cases. Two species may be combined into one species.

Splits and groupings of bird species happen regularly. In the United States (including Hawaii) there are about 980 bird species, depending on the listing source (Sibley, 2014). Birds are part of wildlife. In the global, there are many species of bird. Every country may have different own species of birds. This is because the species of bird usually different in different environment. The diversity of bird species are depends on the environment of the area.

With its rich bio-diversity, there are more than 742 species of the birds of Malaysia, belonging to 85 families. They range from the endemic and resident to migratory and vagrants. Peninsular Malaysia has a total of 644 species with 4 endemics, while Sabah has 568 species with 4 endemics, and Sarawak with 550 species, with 3 endemics. In fact Malaysia ranks among the 17 diverse countries which contain about 70% of the world's species (Bird of Malaysia, 2014).

The diversity in flora and fauna has enabled Malaysia to earn a prestigious spot as one of the 17 mega biodiversity countries in the world. The country was endowed with over 15,000 species of flowering plants, 1,500 species of terrestrial vertebrates and about 150,000 species of invertebrates (WWF Malaysia, 2015). The critical factor that has contributed to this rich biological diversity is our ability to protect our forests; in fact, it has been our policy all along to maintain our forests at 50 percent of the total land area.

At the moment about 60 per cent our land area is covered by forests, totally protected forests areas account for 16 per cent of the land area in Malaysia (Conservation International, 2008). With a high proportion of endemic species, Malaysian forests serve as a nature gene bank of biological diversity and played an important role in stabilizing the ecosystem (Conservation International, 2008).

Apart from its contribution to biological diversity, forests also play a crucial role in mitigating the effects of climate change. As important storehouse of carbon, forests take in and store large quantities of carbon, making them excellent natural carbon sinks, however once disturbed or degraded, due to unsustainable use, these forests will instead become a significant source of carbon, releasing large quantities of carbon dioxide into the atmosphere resulting in higher global temperatures (Flint Hughes, 2014).

There are two main types of birds of prey: diurnal (active during the day) and nocturnal (active at night). However, the study focused mainly for diurnal bird species. Diurnal birds are defined as the birds that are principally active during the day with all major life activities, including courtship, nesting and feeding, preening and other behaviors. Most species of birds, including songbirds, hummingbirds, waterfowl and raptors other than owls are considered diurnal. Diurnal birds roost and sleep at night and become active again when the sun rises.

Diurnal bird is part of biodiversity. This species play important roles in the natural ecosystem. For example, there are some plants in the ecosystems which cannot spread their own seed and need help from other element (such as wind, animals and birds) (Detheridge, 2006). There are some species of diurnal bird that can help on dispersal of seed. The examples of seed dispersing birds are such as hornbill, Asian barbets and some species of parrots (Kricher, 2011; Chang *et al.*, 2012; Trounov, 2012). This mean some diurnal bird is important to maintain the plant species in the natural forest.

Diurnal birds have aesthetic values. These values come in many interesting form, color, voice and behavior. There are some species of diurnal birds that has their own interesting characteristic and behavior that can make the surrounding area more interesting. The aesthetic values of the species of diurnal bird are useful for the nature lover such as bird lover.

Besides, diurnal birds are also the sensitive environmental changes which lead to population declining or extinct if not conserve.

In the recreation area, diurnal bird is one of the most attractiveness things to the visitors who love the Birding activities. Birding or bird watching is the observation of bird's label. It can be done with the naked eye, through a visual enhancement device like binoculars and telescopes, or by listening for bird sounds (Dunne, 2003). Nowadays, a bird watching is among popular recreation activities in Klang Valley.

There are many recreation parks in Malaysia but not all recreation parks have higher diversity of bird species.

1.2 Problem Statement

Forest fragmentations affect the distribution of bird. The effect of habitat fragmentation on the distribution of organisms is a key issue in conservation biology. Fragmentation implies that the originally continuous habitat transforms into several isolated remnant patches, and the area of the original habitat decreases (Raphael, 2010). In addition, the original habitat contracts even more than the topographic area of the remnant patches, because of the deforestation (Murcia, 1995). This effect means that vegetation and the related species of organisms occurs within the habitat patches may differ from those in the interior habitats owing to micro environmental gradients. Therefore, the final extent of the original habitat strongly depends on the composition of the species of flora and fauna present.

According to Manu (2015), forest fragmentations reduce the diversity of bird's species. Species show many kinds of responses to habitat fragmentation: some are advantaged and increase in abundance, while others decline and become locally extinct (Andrew, 2010). In general, forest specialist birds showed stronger responses to landscape characteristics than generalist species, particularly to variations in landscape composition (Emilia, 2015). The loss of forest cover represented the main threat to forest specialist birds, with a negative impact on diversity richness (Emilia, 2015). In contrast, at the two spatial scales generalist birds seemed to be favored by forest loss, as diversity richness of these birds increased in landscapes with lower forest cover and higher number of forest patches (Emilia, 2015). If current deforestation rates continue, several forest specialists are likely to disappear (Emilia, 2015).

According to Haile (2014), there are strong impacts of forest loss and fragmentation on forest specialists, insectivores, frugivores, open nesters, understory nesters and resident birds. Protection and restoration of the remnant forest patches may help mitigate the negative effects of fragmentation on such specialist bird functional groups (Haile, 2014). According to Esa (2015), the landscape fragmentation affected the structure of bird assemblages inhabiting forest stands and that the effect was a species guild-specific. Virgin forest bird species suffer more from the landscape fragmentation than do managed forest bird species (Esa, 2015). Habitat disturbance, caused by logging, had a weak positive direct effect on the bird communities, but also had a strong detrimental indirect effect, particularly on the total abundance and species richness of forests specialists and insectivores (Christos, 2015). According to Robert (2015), tree cutting and clearing for agriculture are the causes to habitat disturbance and species loss. It is also the major challenge in the management of sensitive wildlife species such as forest specialist birds (Robert, 2015).

Fragmented forest ecosystems change through time as a result of their isolation as well as other human and natural disturbances. A reduction of species may occur in fragments that are too small to support their original flora and fauna (Yan, 2007).

While the reduction in species may result directly from a decrease in forest area, it is more likely due to the increased perimeter (edge species): area (total area) ratio that results from fragmentation and the modification of abiotic and biotic factors of the habitat (Gehlhausen, 2000).

As a whole, forest fragmentation affects the species of birds such as to the bird's distribution, bird's assemblage, bird's composition, and can cause the reduction or increasing of species. This is because it is influenced by the factor of microclimate and microenvironment. The relationship of the bird's distribution is differences in microclimate and microenvironment factors that exist within the fragmented forest areas (Noss & Cooperrider, 1994; Harris, 1984).

Microclimate and microenvironment factors have a great influenced on the status of bird composition. Changes in microclimate and microenvironment may make forest fragments unsuitable for sensitive species (Sam, 2014). This shows that microclimate and microenvironment factor have correlation with the species of birds.

Since forest become under the threats of fragmentation, it may have dire consequence to the bird assemblage. Every species may have different microclimate and microenvironment requirements. Logging and deforestation will disrupt the equilibrium and species richness as it radically alters the microclimate and microenvironment regime of the habitat. Thus, it is important to measure the microclimate and microenvironment features of the bird's habitat as a means of how the disruptions of these parameters affect the distribution of species in the long run.

In order to understand the relationship between diurnal bird's species with microclimate and microenvironment, ideally, we need to know how both the microclimate and the microenvironment vary with composition of the diurnal bird's species.

The study has been conducted in Sungai Chongkak Recreational Forest, Selangor. It is located in Hulu Langat, Selangor with 2800 hectares. According to information obtained from Forest Department Peninsular Malaysia, this area is a protected area. Since this area is a protected area, our study is limited only on diurnal bird species. Although the area receive high amount of visitors, the research on biodiversity get low priority in term of fauna study. According to information obtained from Department of Wildlife and National Park Malaysia, there is no research on birds has been conducted at the area. Bird Watching is the main activities occurred in Sungai Chongkak Recreational Forest. This activity involve with the species of diurnal birds. In order to manage diurnal bird's species at Sungai Chongkak Recreational Forest, the distribution of species need to be known.

1.3 Objectives

1.3.1 Main Objectives are:-

The main objective of this study is to assess the diurnal bird's species distribution based on microclimate and microenvironment factor at Sungai Chongkak Recreational Forest, Selangor.

1.3.2 Specific Objectives are :-

1. To determine diurnal bird's species richness and abundance at Sungai Chongkak Recreational Forest, Selangor.
2. To determine microclimate and microenvironment factor reported to influence habitat use by birds at Sungai Chongkak Recreational Forest, Selangor.

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