UNIVERSITI PUTRA MALAYSIA

HABITAT, INSECT COMPOSITION AND ENVIROMENTAL PARAMETERS THAT INFLUENCE ON RANGING BEHAVIOUR OF AERODRAMUS FUCIPHAGUS THUNBERG AT KUALA LANGAT DISTRICT, SELANGOR, MALAYSIA

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HABITAT, INSECT COMPOSITION AND ENVIROMENTAL FACTORS THAT INFLUENCE ON RANGING BEHAVIOUR OF *Aerodramus fuciphagus* Thunberg AT KUALA LANGAT DISTRICT, SELANGOR, MALAYSIA

By

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Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Science Vertebrate Pest

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the Degree of Science Vertebrate Pest

HABITAT, INSECT COMPOSITION AND ENVIROMENTAL PARAMETERS THAT INFLUENCE RANGING BEHAVIOUR OF *Aerodramus fuciphagus* Thunberg IN KUALA LANGAT DISTRICT, SELANGOR, MALAYSIA

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Edible nest (EN) swiftlets are widely known for their unique edible nest, however, their ecology and behavior are still largely undiscovered. This research has attempted to understand the ecology and the ranging behavior of *Aerodramus* spp, by mapping out favorable feeding spots and identifying insect's species and diversity therein. The study site was located in the Kuala Langat district, Selangor, Malaysia, over a two year duration I.e. from March 2013 to March 2015. The en swiftlets successfully captured, tagged with transmitters and radio-tracked on a 4-wheel drive vehicle. Within the traceable range, based on the kernel analysis method, seven sampled swiftlets had an average home range size of 6437.47 ha. A corresponding average core area size of 1687.06 ha, and average furthest flying distance flown from the swiftlet range of 11.78 km. They were mostly found roaming and foraging in riverbanks area; which was the preferred habitat based on the Jacob index value of 0.3439. Within these areas, insect trappings yielded predominantly high numbers of hymenopterans (41.78%) followed by almost equal distributions of dipterans (33.34%). Other habitats such as residential area, oil palm older than 5 years old, oil palm younger than 5 years old and grassland also shows high number of hymenopterans and dipterans. Pearson correlation shows both the 50% core area size and the 95% foraging area size was negatively correlated to the wind velocity with values of $r = 0.8067$, $p= 0.9854$ and $r=0.8205$, $p=0.9883$, respectively. The average flying velocity was positively correlated to the wind speed ($r=0.8423$, $p<0.05$). This suggest that swiftlet fly in the downwind direction and the higher wind velocity aid in the foraging effort of the EBN swiftlet thereby reducing their measurable foraging/home range size. All other parameters tested I.e. light intensity ($r = 0.7286$, $p = 0.9682$), temperature ($r = 0.0522$, $p = 0.5443$), humidity ($r = 0.1062$, $p = 0.4104$) and API ($r = 0.0245$, $p = 0.4784$) (atmospheric particle index - a quantitative measure of haze) have no influence on the flying speed of the swiftlet. This is an indication that apart from wind speed all other environmental factors measured in this study will not impede on the movement of the swiftlet. This was also substantiated by the lack of correlation between light intensity, temperature, humidity and API on both the home range and core area size of the EBN swiftlets. We can conclude that EBN swiftlets are designed to

hunt in all weather conditions and they take advantage of wind conditions to facilitate aerial hunting of insect prey.

Abstrak tesis yang di kemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains (Perosak Vertebrata)

HABITAT, KOMPOSISI SERANGGA DAN FAKTOR ALAM SEMULAJADI YANG MEMPENGARUHI TABIAT SEMULAJADI *Aerodramus fuciphagus Thumberg* DI DAERAH KUALA LANGAT, SELANGOR, MALAYSIA

Oleh

MAISARAH BINTI BURHANUDDIN

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Burung walit di kenali dengan kebolehannya untuk membina sarang yang boleh di makan oleh manusia. Meskipun begitu, masih banyak persoalan yang belum terjawab terutamanya mengenai ekologi burung tersebut. Oleh sebab itu, kami menjalankan kajian ini untuk memahami ekologi burung walit dengan memetakan kawasan pemburuan mereka dan mengenalpasti serangga di dalamnya. Kajian ini telah di jalankan di sekitar daerah Kuala Langat, Selangor bermula Mac 2013 sehingga Mac 2015. Burung walit liar di tangkap di kawasan lading kelapa sawit dan kemudiannya di letakkan alat pengesan sebelum kami jejaki semula dengan menggunakan pacuan empat roda. Dalam jarak penjejakan yang boleh di jejaki, ketujuh-tujuh burung walit mempunyai purata kawasan perumah sebesar 637.47Ha dan luas teras sebesar 1697.06 Ha. Burung walit didapati banyak menghabiskan masa di sekirn pinggir sungai menurut Index Jacob's dengan nilai sebanyak 0.3439. Habitat ini, penangkapan serangga didapati order hymenoptera sebanyak (71.43%) diikuti jumlah diptera sebanyak (11.78%). Korelasi Pearson menunjukkan 50% luas teras kawasan legar burung walit dan 95% luas kawasan legar burung walit berkait secara negatif dengan kelajuan angin, dan nilai r. r=0.8067, p=0.9854 dan nilai r=0.8254, p=0.9883. Purata halaju penerbangan burung walit berkait dengan halaju angin (r=0.8423, p<0.05). Ini mencadangkan bahawaburung walit terbang dengan bantuan angin untuk mencari makan. Parameter lain yang di uji termasuklah cahaya (r = 0.7286, p = 0.9682), suhu (r = 0.0522, p = 0.5443), kelembapan (r = 0.1062, p = 0.4104) and API (r = 0.0245, p = 0.4784)(Indeks pencemaran udara-mengukur tahap jerebu) tidak mempunyai sebarang hubungan dengan halaju penerbangan urung walit. Ini menjelaskan bahawa cuaca tidak akan menjejaskan penerbangan burung walit. Parameter alam semulajadi juga tidak menunjukkan sebarang hubungan dengan luas kawasan dan luas teras kawsan penerbanga burung walit. Kesimpulannya, burung walit di cipta untuk memburu dalam pelbagai cuaca dan situasi dan mereka memanipulasikan kelajuan angin dari alam semulajadi untuk membantu dalam penerbangan mereka.

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For science and humanity

I certify that a Thesis Examination Committee has met on (28th July 2016) to conduct the final examination of Maisarah binti Burhanuddin on her thesis entitled "Habitat, Insect Composition And Environmental Factors That Influence On Ranging Behaviour Of *Aerodramus Fuciphagus* Thunberg At Kuala Langat District, Selangor, Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U. (A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

A.	Aerodramus
°	Degree
°C	Degree Celsius
DNA	Deoxy Ribonucleic Acid
E	East
EBN	Edible nest swiftlet
GPS	Global positioning system
Ha	Hectare
HF	High frequency
Km	Kilometer
Km/h	Kilometer per hour
lux	Luminance
M	Mean
Mhz	Megahertz
m	Meter
Mph	Meter per hour
N	North
%	Percentage
P	p-value
R	r-value
RF	Radio frequency
SD	Standard deviation
Sp.	Species
Spp	Subspecies
USD	US Dollar
VHF	Very high frequency

CHAPTER 1

INTRODUCTION

The edible bird nest (EBN) is well known as a curable delicacy for ages (Brungraber, 1972; Lim, 2009, Looi & Omar, 2016,). It's also has been consumed traditionally and widely used in cosmetic industry. The market for the edible bird nests is rapidly growing because the nest is considered as a status symbol, ensured well living as there are believes that the saliva of the swiftlet contain element that called (bǔ pǐn) which has the properties to boosts immunity system, aiding in digestion, and sharpen focus (Lim and Cranbrook, 2002; Marcone, 2005 Hobbs, 2004; Chua, 2014; Thorburn, 2015).

In Malaysia there are two main species of birds that produce edible nests: *Aerodramus fuciphagus* that produce the highly valued white nests) and *Aerodramus maximus* that produce black nests (Lim & Cranbrook, 2002). They inhabit limestone caves, such as the Niah caves. After the nests being harvested and cleaned, EBN will be traded, especially to China (Lau, and Melville, 1994) and other demanding countries. It was already in existence when Dutch merchants began operating in the Malaysian and Indonesian region (Medway, 1963, Lindblant, 1988; Lim & Cranbrook, 2002). Swiftlets tends to select hollows, rock-shelters or caves as nest sites (Sankaran,2001) This includes similar man-made structures, such as culverts, multi-storey car-parks, houses, barns or other buildings. The buildings involved as a swiftlet's shelter after modified from existing structures or purpose-built, are known as 'house-farms', and the management of the swiftlet colonies within them as 'house-farming' (Nugroho & Whendatro 1994). The swiftlets occupying house-farms are normally allowed free exiting to forage for food and water (Marzuki, 1994).

The earliest EBN swiftlet farm arose in Java, with the first reported in 1880 at Sedayu, East Java (Lim & Cranbrook 2002) and western Java, in 1900 (Medway, 1961). Trailing the process in Indonesia, the great expansion of swiftlet house-farming in Peninsular Malaysia was a phenomenon of the last decade of the twentieth century. In Peninsular Malaysia, an early house-farm colony in Penang was studied by Langham (1980).

The international trade in EBN birds' nests is currently estimated to worth nearly US$1.6 billion (Runckel 2010). Most of them exported from Indonesia, followed by Malaysia. Others from Thailand, Philippines, Cambodia, Vietnam and Myanmar.(Cohen and Redeb 1999). With the flow of large amount of value and money, encourages banks and governments to enhance the industry. Agrobank Malaysia for instance, provides RM 67.7 million in 2010 to support local entrepreneurs in this industry. Rm10 000 to RM 20 000 will be given to build up basic small bird house as a start-up. This encourages many entrepreneurs to involve in the industry and indirectly strengthen the local economy (Zainab, 2010)

The rise of swiftlet population in a habitat will also increase prey option for predators within the area causing the birdhouse being targeted especially by owls, civets, eagles and wild cats. Swiftlet ranchers usually take control measures to contain the predators and one of the methods is to trap and kill the pest. The balance within the nature that usually has been established for long time can be compromised. For example, barn owls (*Tyto alba*) that has played an important role as biological control for mice in rice field and oil palm plantation since the 80's in Malaysia (Hafidzi, 20013). Killing owls might save the swiftlet business but not saving other oil palm entrepreneurs or nearby farmers, and even from the increasing rat numbers. Therefore, there's an urge to regulate rules and guidance towards the standard protocol regarding swiftlet farming management. The first step to do that is by conducting ecological research to understand the basic needs of the target species, so that both party can harmoniously emerge as one unit for a common future benefits.

Many birdhouses were built without considering the ecological suitability and the ecosystem balance. As a result many birdhouses were built close to the residential area or too close to other birdhouses. Building birdhouse close to residential area caused anxiety towards local citizens since birds have the potential of becoming vectors for spreading diseases such as avian influenza (bird flu), salmonellosis and other zoonotic diseases transmisible to human. Law enforcement on removal of birdhouses in urban areas cannot be enforced since there is no proper information to justify their actions. Building birdhouses too close for each other may cause competition among ranchers.

An updated guideline in managing and building EBN swiftlet birdhouses is required for a sustainable management of EBN swiftlet's birdhouse and to do so, it should be started by understanding their natural ecology and behaviour. It will not only benefits EBN swiftlets ranchers and local citizen, but also assists city councils for a better urban managements, entrepreneurs in expanding their business and strengthen the industry as a whole.

Understanding the animal ecology and behaviour will give a better insight towards the needs of the species. The basic philosophy is to study living animals in their natural state outside the laboratory as distinct from taking measurements from restrained or captive specimens. One of the methods to achieve this is by using wildlife telemetry. Wildlife telemetry has been used widely by biologists for many purposes. Information such as movements, feeding locations, activity patterns, dispersal, and relationship with other subjects, feeding and social behavior can be obtained towards a wide range of species. Most studies have show interest on the vulnerable and endangered animals. The EBN swiftlet forging area and ranging are to a large extent are unknown since there is no attempt to study in the area. However it depends on the budget, costs and species of animal subject to decide which method is the best for the researcher to use.

Therefore, in pursuit of understand is more about the ecology and behavior of this bird, this research has been conducted to investigate the home range and core area within a detectable ranging area using radio telemetry. It would be the first of its kind in Malaysia since a minute tracking technology is usually exharbitant. The study use a basic radio telemetry equipment that works on radiowaves and integrated with a mobile vehicle unit. The method has been selected since several trials using conventional tracking method by foot fails as there is limitation to keep up with the swiftlets flying speed.

After producing a ranging map, we conduct a habitat selection study and insect assessment within the area preferred by EBN swiftlet. This will answer questions such as where do they go or why the area attractive to the EBN swiftlet. This study also seeks to understand any associated relationship between a number of environmental parameters with measurable home range size of EBN swiftlet for a better insight on how EBN swiftlet move, exploit nature and the utilization of nature resources for survival.

Thus, objectives of the study is to:

I. Investigate the home range and core area within a detectable ranging area using radio telemetry.

II. mapped out their most favorable feeding spots and identify insects species an diversity in the favorable feeding spot.

III. Understand any associated relationship between a number of environmental parameters with measurable home range size of EBN swiftlet

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APPENDIX 1

1. Experiment: determining receiving range from transmitter

x	y	x-xmean		y-ymean	$(x\text{-xmean})^2$ $(y\text{-ymean})^2$
630	359	-52.7	-95.9	2777.29	9196.81
712	401	29.3	-53.9	858.49	2905.21
689	541	6.3	86.1	39.69	7413.21
654	368	-28.7	-86.9	823.69	7551.61
661	420	-21.7	-34.9	470.89	1218.01
550	526	-132.7	71.1	17609.29	5055.21
671	415	-11.7	-39.9	136.89	1592.01