UNIVERSITI PUTRA MALAYSIA

ESTIMATING NOCTURNAL BIRD DENSITIES IN OIL PALM AGROECOSYSTEM BASED ON DISTANCE SAMPLING

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By

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Thesis Submitted to School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements of the Degree of Master of Science (Wildlife Ecology and Conservation)

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the Degree of Master of Science

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April 2017

Chairman : Prof. Mohamed Zakaria Hussin, PhD

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Nocturnal birds play important role in oil palm agroecosystem especially with respect to controlling pest populations. However, only Barn Owl has been widely studied in oil palm plantations while other nocturnal species remain understudied. The surveys were conducted on nocturnal birds (Strigiformes and Caprimulgiformes) in oil palm smallholdings at Tanjung Karang, Kuala Selangor, from May to October 2013. Nocturnal bird sampling was carried out between 2000 hr to 0100 hr across 80 survey points spaced at least 800 m apart. Bird calls were listened both before and after broadcasting a 1-min recording of call for each of the seven species recorded on-site. Environmental factors including; number of crop species and average height of oil palm stands; distances to the nearest forest, river and road; number of houses in 100m radius, oil palms and other crops; width of drain and road, were also measured at each point. The results showed that the most abundant species was Large-tailed Nightjar (*Caprimulgus macrurus*; 273 encounters, 47.31% from total of 577 recorded encounters; mean of 3.425), followed with Spotted Wood Owl (*Strix seloputo*; 152 encounters, 26.30%; mean: 1.9), Sunda Scops Owl (*Otus lempiji*; 101 encounters; 17.47%; mean: 1.263) and Common Barn Owl (*Tyto alba*; 34 encounters, 5.89%; mean: 0.425). One species associated with wildlife habitat was also recorded during the study, i.e. Brown Wood Owl (*Strix leptogramica*; 7 encounters). The results of Generalised Linear Models (GLMs) showed that two predictor variables (i.e. distance to the nearest river with slope estimate = 0.0828 and average height of oil palm stands with slope estimate = 0.0417) influenced the nocturnal bird richness while number of houses in 100m radius (slope estimate = 0.0487), number of oil palm stand (slope estimate = 0.0351), distance to forest (slope estimation = -0.1164) and distance to the nearest road (slope estimate = 0.0328) were found to influence the relative abundance of the nocturnal bird species in oil palm smallholdings.

The presence of a high density of nocturnal birds in oil palm smallholdings may be associated with the availability of food resource and roosting structure as well as ecotone. The findings from this study suggest that maintaining certain habitat features while reducing human disturbances (such as houses and roads) may be beneficial to nocturnal bird species in the smallholdings.

Key words: nocturnal birds, oil palm smallholding, call playback, environmental factors, density, richness, abundance

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

ANGGARAN KEPADATAN BURUNG NOKTURNAL DI DALAM EKOSISTEM TANI KELAPA SAWIT BERDASARKAN KAEDAH PERSAMPELAN JARAK

Oleh

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Burung nokturnal memainkan peranan penting di dalam ekosistem tani kelapa sawit terutamanya dari segi pengawalan populasi perosak. Walau bagaimanapun, hanya Burung Jampuk Putih sahaja telah dikaji secara meluas di dalam ladang kelapa sawit, manakala spesies burung nokturnal lain masih belum dikaji dengan lebih mendalam. Survei ke atas burung-burung nokturnal (Strigiformes dan Caprimulgiformes) telah dijalankan di dalam kebun kelapa sawit kecil yang terletak di Tanjung Karang, Kuala Selangor, bermula dari Mei sehingga Oktober 2013. Pensampelan burung-burung nokturnal ini telah dijalankan antara jam 2000 sehingga jam 0100 melintasi 80 titik survei yang berjarak sekurang-kurangnya 800 m dari titik yang lain. Panggilan burung dicatatkan sebelum dan selepas penyiaran rakaman selama 1-min bagi setiap daripada tujuh spesies yang direkodkan. Faktor-faktor persekitaran termasuk; kekayaan tanaman dan purata tinggi dirian kelapa sawit; jarak ke hutan, sungai dan jalan yang berdekatan; bilangan rumah di dalam radius 100m, dirian kelapa sawit dan tanaman lain; kelebaran jalan dan parit, juga telah diukurkan di setiap titik survei. Keputusan menunjukkan bahawa spesies paling banyak ialah Burung Tukang Malas (*Caprimulgus macrurus;* 273 pertemuan, 47.31% daripada jumlah 577 pertemuan yang direkodkan; min 3.425), diikuti oleh Burung Hantu Berbintik (*Strix seluputo*; 152 pertemuan; 26.30%; min: 1.9), Burung Jampuk Kubur (*Otus lempiji*; 101 pertemuan; 17.47%; min: 1.263) dan Burung Jampuk Putih (*Tyto alba*; 34 pertemuan; 5.89%; min: 0.425). Keputusan daripada analisis *Generalised Linear Model* (GLMs) menunjukkan bahawa dua pembolehubah peramal (i.e. jarak sungai terdekat dengan anggaran nilai cerun = 0.0828 dan purata tinggi dirian kelapa sawit dengan anggaran cerun = and 0.0417) mempengaruhi kekayaan burung-burung nokturnal manakala bilangan rumah dalam 100 m radius (anggaran

cerun = 0.0487), bilangan dirian kelapa sawit (anggaran cerun = 0.0351), jarak ke hutan terdekat (anggaran cerun = -0.1164) dan jarak ke jalan utama terdekat (anggaran cerun = 0.0328) pula telah mempengaruhi kelimpahan relatif spesies burung nokturnal di dalam kebun kelapa sawit kecil. Kehadiran burung-burung nokturnal yang dengan kepadatan yang tinggi dalam persekitaran kelapa sawit ini mungkin disebabkan oleh adanya sumber makanan dan juga struktur bertengger serta kawasan ekoton. Penemuan daripada kajian ini mencadangkan supaya pengekalan ciri-ciri habitat tertentu dan pengurangan gangguan manusia (seperti rumah dan jalan) akan memberi kesan berfaedah terhadap populasi spesies burung-burung nokturnal di dalam kebun kelapa sawit kecil.

Kata kunci: burung nokturnal, kebun kelapa sawit kecil, panggilan semula, faktor- faktor persekitaran, ketumpatan, kekayaan, kelimpahan

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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

CBO	Common Barn Owl
CDS	Conventional Distance Sampling
DF	Distance to the nearest forest patch
DR	Distance to the nearest main road
DS	Distance to the nearest house
EDR	Effective detection radius
FAO	Food and Agriculture Organization of the United Nations
FDS	Forest Department Sarawak
FELDA	Federal Land Development Authority
GLMs	Generalized Linear Models
HP	Average height of oil palms
IUCN	International Union for Conservation of Nature
LTN	Large-tailed Nightjar
MET	Malaysian Meteorological Department
MNS	Malaysian Nature Society
MPOB	Malaysian Palm Oil Board
MPOC	Malaysian Palm Oil Council
NC	Number crop species
NP	Number of oil palms
NS	Number of human settlements
PERHILITAN	Department of Wildlife and National Parks
RL	Relative likelihoods
RSPO	Roundtable on Sustainable Palm Oil

SSO	Sunda Scops Owl
SWD	Sabah Wildlife Department
SWO	Spotted Wood Owl
USD	United State Dollar
WR	Average width of roads
WT	Average width of trenches

CHAPTER 1

INTRODUCTION

1.1 General Background

Palm oil is an essential ingredient in most of our daily use products (i.e. foods, cosmetics, etc.). Originated from the coastal swamplands and freshwater riverine habitats of Central and West Africa, oil palm (*Elaeis guineensis* Jacq.) was first introduced in Malaysia as an ornamental plant. After its economic viability was recognised, the first commercial oil palm cultivation in Malaysia was initiated and named as Tennamaran Estate at Batang Berjuntai (or currently known as Bestari Jaya) in the Selangor state. In year 1958, the first Federal Land Development Authority (FELDA) plantation was established at Lurah Bilut. Since then, a large tract of forested lands and other areas comprising commodity perennial crops (i.e. rubber) have been converted into oil palm cultivation to improve the socio-economy of the country. The total of palm oil per capita produced and exported has since become very encouraging, up to a stage that it has become among the top economic leverage for Malaysia.

Palm oil supply forms one third of global demand for vegetable oils (i.e. sunflower, canola, olive, etc.) or 29.78% of the world oil and fat productions (MPOB 2014). Malaysia currently accounts for 39% of the world's palm oil production and 44% of the global exports (MPOC 2013). Being one of the biggest producers and exporters of palm oil and palm oil based products, Malaysia plays an important role in fulfilling the ever growing need for these products (MPOC 2014). In order to achieve that, a total area of 5.3 million ha of land in the country has been converted to oil palm cultivation by year 2014 which has generated RM66.12 billion of exported revenue (MPOB 2014). Nowadays, the oil palm cultivations have become a typical landscape in Malaysia, as well as for other developing countries in the tropical regions (i.e. Indonesia and Brazil) (Donald 2004, Wilcove and Koh 2010, Jambari *et al.* 2012, Azhar *et al.* 2013).

Despite being a lucrative industry, the expansion of oil palm cultivation has been held responsible for biodiversity loss in the tropics as highlighted by environmental NGOs in their anti-oil palm campaigns (Rist *et al.* 2010). Due to that, various efforts have been made by oil palm stakeholders in order to turn the industry into an environmental-friendly agribusiness (e.g. palm oil certification and biofuel policy) (Fitzherbert *et al.* 2008, Danielsen *et al.* 2009, Koh *et al.* 2010, Jambari *et al.* 2012). Palm oil stakeholders were also being pressured to come out with better agricultural practices in their farmlands by taking into consideration the elements of biodiversity conservation (Jambari *et al.* 2012). However, the emphasis on oil palm cultivation as a biodiversity-

friendly commodity is still being disputed by many (Komar 2006, Fitzherbert *et al.* 2008, Jambari *et al*. 2012).

At present, the number of studies involving fauna in oil palm cultivation was relatively small as compared to those done in natural habitats (Fitzherbert *et al.* 2008). Jambari *et al*. (2012) indicated that oil palm cultivation was able to support considerable amount of bird species, both resident and migratory. Jambari *et al.* (2012) also suggested the potential of oil palm cultivation with biodiversity management approach could act as an alternative habitat for some species. Similarly, some studies acknowledged that some migratory birds used other crops cultivation (i.e. coffee) as a transit point during winter season in the Northern Hemisphere and this further aids to the understanding about the importance of these man-made habitats for biodiversity conservation such as in the case of birds (Greenberg *et al.* 1997, Reitsma *et al.* 2001, Jambari *et al*. 2012).

Beside birds, several studies on other taxa such as mammals (Azhar *et al.* 2014) and insects (Krooss & Schaefer 1998, Wickramasinghe *et al.* 2004, Koh 2008, Turner & Foster 2009) were also conducted in the oil palm cultivation which also further demonstrated that these man-made habitats are capable to function as an alternative habitat especially to adaptive species.

1.2 Problem Identification

The conversion of natural forests to oil palm cultivation is a major threat to biodiversity in Southeast Asia (Foster *et al.* 2011). Previous studies indicated that oil palm cultivation supports fewer species than natural habitats do (Appendix A). Biodiversity found in the former habitat may often be fewer than other tree crop commodities (Fitzherbert *et al.* 2008). However, the importance of conserving biodiversity within the oil palm cultivation itself should be prioritised (Foster *et al.* 2011). In return, the existence of such biodiversity in the oil palm cultivation could be beneficial in terms of providing ecological services (i.e. pollination, biological control, and biological indicator of environmental health).

Oil palm agroecosystem offers abundant oil-rich crop all year round which makes it a favourable habitat for rodent pest communities (Puan *et al.* 2010). With the growth of the rodent pest populations, Barn Owls (*Tyto alba*) have been introduced by the oil palm managers in order to suppress crop damage. In addition to Barn Owls which were widely studied as a biological control agent for rodents in oil palm plantations (Lenton 1984, Hafidzi *et al.* 2003, Puan *et al.* 2012), several owls, i.e. Spotted Wood Owl (*Strix seluputo*) and Sunda Scops Owl (*Otus lempiji*) were also found to be associated with this man-made habitat (Puan 2013). In addition, a preliminary study conducted in early 2013 in oil palm smallholdings also recorded several forest associated nocturnal birds (i.e. Brown Wood Owl (*Strix leptogrammica*) and Dusky Eagle Owl (*Bubo coromandus*) in the oil palm agroecosystem (Atikah *et al*. 2013).

Unfortunately, there is only little information available about the ecology and composition of nocturnal birds in oil palm cultivations. Therefore, further investigation is needed to find out how community structure of nocturnal birds is being affected by habitat complexity in oil palm agroecosystem and the significance of oil palm as a supplementary habitat for forest associated species. The density, abundance, and richness of nocturnal birds are expected to be influenced by local-level and landscape-level variables similar to findings on other taxa studied by Azhar *et al.* (2011). At the population level, seasonal factors may affect population dynamics (reproduction and/or behaviour in another) of the nocturnal birds, and these may be particularly important to understand at times of rapid habitat alteration (Greenberg & Marra 2005). In addition, this information is important for the development of a sound conservation strategy in the future.

1.3 Research Questions

This study intended to answer several research questions with respect to the density, abundance and richness of nocturnal birds in oil palm smallholdings. These questions were as follows:

(1) Which environmental factors affect the density of nocturnal birds within oil palm agroecosystem?

(2) Does the nocturnal bird density estimation differ during breeding and non-breeding seasons?

(3) What factors, at the landscape level and local level, influence the nocturnal bird species richness and abundance in oil palm cultivation?

1.4 Objectives

The main objective of this study was to estimate the density of nocturnal birds in oil palm agroecosystem by using distance sampling. The specific objectives were:

(1) To compare the density, as well as the abundance of nocturnal birds estimated using two survey methods, namely spontaneous call method and playback call method,

(2) To compare the density, as well as the abundance of nocturnal birds during breeding and non-breeding seasons, and

(3) To determine environmental variables at local-level and landscape-level which influence the nocturnal bird species richness and abundance in oil palm agroecosystem.

1.5 Organisation of Thesis

The thesis is organised into five chapters. Chapter Two provides an overview of oil palm agroecosystem in Peninsular Malaysia. The classification of oil palm cultivation and its environmental values were described. The nocturnal avian community in Peninsular Malaysia and their importance in oil palm agroecosystem were also discussed in the latter part. This is followed by information on the use of point count survey and call-playback method through the review of some previous studies. Chapter Three identifies the key elements in the study design, implementation and analysis of the data collected. This includes the report on nocturnal bird density along with significant environmental variables which include local habitat characteristics and landscape metric measurements through General Linear Models (GLMs) analysis. The empirical results were presented and discussed in Chapters Four and Five, respectively, which include the density, richness and abundance of nocturnal birds, followed by the most significant environmental variables in determining the density of the birds. The final chapter draws concluding remarks on the results and some recommendations for future study.

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