UNIVERSITI PUTRA MALAYSIA

VOCAL INDIVIDUALITY OF SUNDA SCOPS OWL (Otus lempiji Horsfield, 1821), BROWN BOOBOOK (Ninox scutulata Raffles, 1822) AND SPOTTED WOOD OWL (Strix seloputo Horsfield, 1871) IN PENINSULAR MALAYSIA

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FH 2016 37

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By

YEE SIEW ANN

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

December 2016

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

VOCAL INDIVIDUALITY OF SUNDA SCOPS OWL (*Otus lempiji* Horsfield, 1821), BROWN BOOBOOK (*Ninox scutulata* Raffles, 1822) AND SPOTTED WOOD OWL (*Strix seloputo* Horsfield, 1871) IN PENINSULAR MALAYSIA

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Sunda Scops Owl (*Otus lempiji* Horsfield, 1821), Brown Boobook (*Ninox scutulata* Raffles, 1822) and Spotted Wood Owl (*Strix seloputo* Horsfield, 1871) are commonly found in semi-open as well as forested habitats in Peninsular Malaysia yet they remain understudied. Nocturnal habit, secretive nature and cryptic coloration of these birds cause difficulties in their monitoring using traditional survey techniques. Individual variations in vocalisation can potentially be used to distinguish different individuals of an owl species as being demonstrated for many bird species. The objectives of this study were (1) to describe the territorial call of these three owls; (2) to determine whether their calls can be distinguished individually; (3) to examine whether the calls from the same individuals were stable over time; and (4) to examine whether there were differences in the calls of the same species between two habitat types. In total, 75 recordings from 12 Sunda Scops Owls, 16 recordings from four Brown Boobooks, and 14 recordings from three Spotted Wood Owls were collected from June 2014 to June 2015 in a lowland forest and the oil palm smallholdings in Selangor, Peninsular Malaysia. From spectrograms produced using Raven Pro 1.5, two temporal parameters were measured for all the three owl species. Five frequency parameters were measured for the Sunda Scops Owl whereas it was six for Brown Boobook, and only three for Spotted Wood Owl. Kruskal-Wallis tests found significant individual differences ($P < 0.001$) in each parameter measured for each species. Discriminant function analysis (DFA) achieved 96.8% classification success for the Sunda Scops Owl, and it was 100% for the other two owl species. Based on Wilcoxon signed ranks tests, most of the measured vocal parameters from the Sunda Scops Owls did not vary significantly ($P > 0.05$) between two pre-determined survey periods. The sample size of the other two owl species was too small to allow temporal comparison. Based on scatterplot derived from DFA, intraspecific difference with respect to two different habitats was found for the Sunda Scops Owl. Overall, this study

suggested that the territorial calls of the three Malaysian owl species differed individually and this will aid in the survey and monitoring of these birds at night based on their vocalisations. Such method can be further tested for other little known owl species in the tropics.

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

PERBEZAAN VOKAL SECARA INDIVIDU DALAM JAMPUK KUBUR (*Otus lempiji* Horsfield, 1821), PUNGGUK (*Ninox scutulata* Raffles, 1822) DAN BURUNG HANTU BERBINTIK (*Strix seloputo* Horsfield, 1871) DI SEMENANJUNG MALAYSIA

Oleh

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Jampuk Kubur (*Otus lempiji* Horsfield, 1821), Pungguk (*Ninox scutulata* Raffles, 1822) dan Burung Hantu Berbintik (*Strix seloputo* Horsfield, 1871) merupakan spesies burung hantu yang boleh dijumpai di habitat semi-terbuka dan berhutan di Semenanjung Malaysia, tetapi tiada kajian yang teliti telah dijalankan ke atas ketiga-tiga spesies tersebut. Tabiat nokturnal dan sifat suka bersembunyi serta warna yang sukar dikesan telah menyebabkan kesukaran dalam kerja pemantauan untuk spesies tersebut melalui teknik penyelidikan tradisional. Seperti yang telah ditunjukkan oleh pelbagai spesies burung, variasi individu dari segi vokal adalah berpotensi untuk digunakan untuk mengenalpasti individu burung hantu untuk spesies yang sama. Objektif kajian ini adalah (1) untuk menghuraikan bunyi pertahanan wilayah bagi ketiga-tiga spesies burung hantu ini; (2) untuk mengenalpasti sama ada bunyi tersebut boleh dibezakan secara individu; (3) untuk menentukan sama ada bunyi daripada individu yang sama adalah stabil sepanjang masa; dan (4) untuk mengenalpasti sama ada bunyi daripada spesies yang sama adalah berbeza antara dua jenis habitat. Sejumlah 75 rakaman bunyi daripada 12 ekor Jampuk Kubur, 16 rakaman daripada empat ekor Pungguk dan 14 rakaman daripada tiga ekor Burung Hantu Berbintik telah dikumpulkan daripada Jun 2014 hingga Jun 2015 di dalam kawasan hutan tanah pamah dan kebun kecil kelapa sawit yang berada di Selangor, Semenanjung Malaysia. Daripada spektogram yang dihasilkan dengan menggunakan *Raven Pro* 1.5, dua parameter berdasarkan masa telah diukur untuk ketiga-tiga spesies burung hantu. Sebanyak lima parameter berdasarkan frekuensi telah diukur untuk Jampuk Kubur manakala enam parameter frekuensi telah diukur untuk Pungguk dan hanya tiga parameter frekuensi telah diukur untuk Burung Hantu Berbintik. Keputusan ujian *Kruskal-Wallis* menunjukkan bahawa terdapat perbezaan yang ketara ($P < 0.001$) antara individu untuk setiap parameter yang diukur daripada setiap species. Keputusan *Discriminant function analysis* (DFA)

mencapai ketepatan sebanyak 96.8% dalam mengklasifikasikan vokal untuk individu Jampuk Kubur dan 100% untuk dua spesies burung hantu yang lain. Berdasarkan ujian *Wilcoxon signed ranks*, kebanyakan parameter vokal yang diambil daripada Jampuk Kubur tidak mempunyai perbezaan yang ketara ($P > 0.05$) antara dua tempoh pensampelan. Saiz sampel untuk Pungguk dan Burung Hantu Berbintik adalah terlalu kecil untuk membuat perbandingan antara tempoh pensampelan. Berdasarkan *Scatterplot* yang dihasilkan daripada DFA, perbezaan intraspesies antara dua habitat telah dijumpai untuk Jampuk Kubur. Secara keseluruhan, kajian ini menunjukkan bahawa bunyi pertahanan wilayah bagi tiga spesies burung hantu di Malaysia adalah berbeza secara individual dan ini akan memudahkan kerja penyelidikan dan pemantauan ke atas burung hantu ini. Kaedah ini boleh diuji ke atas spesies burung hantu lain yang masih kurang diketahui di kawasan tropika.

ACKNOWLEDGEMENTS

First of all, I would like to give my sincere gratitude to my supervisor, Dr. Puan Chong Leong for his guidance, support and enthusiasm throughout this project. His patience and attentive have greatly guided me through this project whenever I encountered difficulties. Next, I would like to thank my co-supervisor, Dr. Badrul Azhar for his valuable comments and suggestions in improving my works.

My appreciation is also extended to the Ministry of Higher Education Malaysia for granting the research through the Fundamental Research Grant Scheme (Project No. 07-01-13-1184FR). I would also like to acknowledge the Forest and Plantation Section, Sultan Idris Shah Forestry Education Centre (SISFEC), Universiti Putra Malaysia for giving the permission to conduct the research and access to the AHFR.

Special thanks to Chang Phooi Kuan for her help and assistance in the field throughout the whole study period. I would also like to thank Muhammad Syafiq Yahya, Muhamad Syafiq Che Shaffine, and Sasidhran Selvadurai for their kind assistance during fieldwork. Without their support and help, this research would not have been completed. I am also thankful to Wak Jupri for providing accommodation during the survey at Tanjung Karang.

Likewise, I am grateful to my friends, Yap Mei Ling, Koh Hui Sin, Wong Pei Ying, Asma Widad Muhammad, Ng Sheng Jie, Ng Kang Yew and Tan Teik Kiat for their constant support and encouragement. Their companion has helped me went through the tough times.

Last but not least, I would like to give my warmest appreciation to my beloved family for their unconditional love, support and caring throughout this long process. This accomplishment would not have been possible without them. Thank you.

I certify that a Thesis Examination Committee has met on 27 December 2016 to conduct the final examination of Yee Siew Ann on her thesis entitled "Vocal Individuality of Sunda Scops Owl (*Otus lempiji* Horsfield, 1821), Brown Boobook (*Ninox scutulata* Raffles, 1822) and Spotted Wood Owl (*Strix seloputo* Horsfield, 1871) in Peninsular 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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1st SF	Start frequency of first note
1st LF	Lowest frequency of first note
1st HF	Highest frequency of first note
2nd EF	End frequency of second note
2nd LF	Lowest frequency of second note
2nd HF	Highest frequency of second note
AHFR	Ayer Hitam Forest Reserve
CV	Coefficients of variation
CV_i	Within individual CV
CV_b	Between individual CV
DFA	Discriminant function analysis
EF	End frequency
ha	Hectare
HF	Highest frequency
Hz	Hertz
INTD	Internote duration
km	Kilometer
LF	Lowest frequency
m	Meter
MF	Maximum frequency
ND	Note duration
s	Second
SF	Start frequency
TND	Total note duration
PIC	Proportion for individuality coding

CHAPTER 1

INTRODUCTION

1.1 General background

With the increase in taxonomic revision and discoveries of new owl species, a total of 241 owl species have been identified in the world to date (Clements *et al*., 2015; Gill & Donsker, 2015). Unfortunately, five owl species have gone extinct since the early 17th century (i.e. Bermuda Saw-whet Owl *Aegolius gradyi*, Reunion Owl *Mascarenotus grucheti*, Rodrigues Owl *Mascarenotus murivorus*, Mauritius Owl *Mascarenotus sauzieri*, and Laughing Owl *Sceloglaux albifacies*), as a result of habitat loss, hunting or predation by invasive species (IUCN Red List, 2015). The International Union for Conservation of Nature (IUCN) has listed 43 owl species as Vulnerable to Critically Endangered and another 27 owl species are Near Threatened (IUCN Red List, 2015). Habitat destruction is a major threat to most owls, besides pesticide poisoning and vehicle collisions (Sergio *et al*., 2004; Romulo, 2012). Many species are also being heavily targeted for illegal trade in South Asia such as India and Nepal (Acharya *et al*., 2009; Ahmed, 2010).

Owls play important ecological roles in forest ecosystems. They are nocturnal counterpart of diurnal raptors (e.g. eagles, falcons and hawks) and they occupy different trophic levels of a food pyramid (Roots, 2006). Different owl species have different diets, e.g. invertebrates, fish, reptiles, amphibians, birds and small mammals. As many owls are apex predators, changes in their populations may inadvertently affect their prey populations and *vice versa* (Southern, 1970; Norrdahl & Korpimäki, 1995). Recognising their ecological role, Barn Owl (*Tyto alba*) has been introduced as a biological control agent for rodent species (Puan *et al*., 2011; Tillmann, 2012) in the agricultural sector in many countries.

Many owls are forest-dependent species, particularly for owls in the tropics (Marcot, 1995; König & Weick, 2008). These species rely on forests or wooded habitats for nesting or roosting. Although certain owls can adapt to some environmental changes, declining populations of many owl species is an indication of problems or changes in an ecosystem (Movalli *et al*., 2008, Romulo, 2012). As such, owls can serve as indicator species, umbrella species or flagship species to represent the overall status of an ecosystem and facilitate its conservation (Caro & O'Doherty, 1999; Sergio *et al*., 2004; Sergio *et al*., 2006; Movalli *et al*., 2008). For example, the Blakiston's Fish Owls (*Bubo blakistoni*) have been suggested as a key indicator of ecosystem health in Russia, as they rely on old-growth forests and require large trees for breeding cavities. They are linked to the health condition of the forests, rivers and salmon populations, where salmon is their favourite prey (Slaght *et al*., 2013). In the Klamath-Siskiyou forests of northern California, the conservation plan proposed for the Northern Spotted Owl (*Strix occidentalis caurina*) has made it

an umbrella species for conservation hotspots of mollusc and salamander richness and for species representation (Dunk *et al*., 2006). In Australia, large forest owls such as Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) are of great scientific and community interest as flagship species for the conservation and management of mature forest ecosystems (Department of Environment and Conservation (NSW), 2006).

Conservation efforts that target on owl species may help protect many other species, habitats and ecological functions within the same ecosystem (Romulo, 2012). In the Pacific Northwest, the monitoring of the population size and reproductive rate of the Spotted Owl (*Strix occidentalis*) has been used as an ecological indicator of the effect of old-growth logging on small mammals and on lower trophic levels (Dawson *et al*., 1987). In New South Wales, Australia, four threatened large forest owls - Powerful Owl, Sooty Owl, Masked Owl and Barking Owl (*Ninox connivens*) have played a vital role in regional forest management plans. They are top predators and require large territories, thus their breeding within an area often indicates the health and viability of the broader ecosystem (Lake Macquarie City Council, 2014). In relation, these four owls have been given the priority for any decision making in future land use planning and management of some regions (Lake Macquarie City Council, 2014). Since owls are very important in ecosystem and conserving them can achieve biodiversity conservation goals, there is a need for a better understanding of these birds including their biology, evolutionary history, taxonomy, distribution and habitat which still remain incompletely known for many species.

Malaysia has a total of 20 owl species, three from Tytonidae family (Barn Owl *Tyto alba*, Grass Owl *Tyto capensis*, Oriental Bay Owl *Phodilus badius*) and 17 from Strigidae family (Short-eared Owl *Asio flammeus*, Dusky Eagle Owl *Bubo coromandus*, Barred Eagle Owl *Bubo sumatranus*, Collared Owlet *Glaucidium brodiei*, Buffy Fish Owl *Ketupa ketupu*, Brown Fish Owl *Ketupa zeylonensis*, Brown Boobook *Ninox scutulata*, Rajah's Scops Owl *Otus brookei*, Sunda Scops Owl *Otus lempiji*, Mantanani Scops Owl *Otus mantananensis*, Reddish Scops Owl *Otus rufescens*, White-fronted Scops Owl *Otus sagittatus*, Mountain Scops Owl *Otus spilocephalus*, Oriental Scops Owl *Otus sunia*, Brown Wood Owl *Strix leptogrammica* and Spotted Wood Owl *Strix seloputo*) (Puan & Zakaria, 2007; König & Weick, 2008). Although Malaysia, as part of the Oriental region, has a high diversity of owl species (Duncan, 2003), most species remain poorly documented. There are only limited published works on owl species in Malaysia, with most studies concentrated on Barn Owl (e.g. Lenton, 1984; Lenton, 1985; Duckett, 1991; Hafidzi *et al*., 2003; Puan *et al*., 2011), and only a few studies focused on forest owl species (e.g. Marshall, 1978; Wells, 1986; Najmi-Hanis *et al*., 2016).

Sunda Scops Owl (Fig. 1), Brown Boobook (Fig. 2) and Spotted Wood Owl (Fig. 3) are three owl species that belong to the Strigidae family. These three species are resident species that are fairly common in Malaysia (König &

Weick, 2008). They can be found in forests, plantations, wooded gardens, suburban and/or urban areas. Sunda Scops Owl and Spotted Wood Owl are known to be able to tolerate to some levels of human development to a certain extent (König & Weick, 2008). Despite being common, little information is available on their biology, behaviour, habitat requirements, distribution and also vocalisation.

Figure 1: Sunda Scops Owl (*Otus lempiji* Horsfield, 1821).

Figure 2: Brown Boobook (*Ninox scutulata* Raffles, 1822).
(Photo credit: Kironvijay)

Figure 3: Spotted Wood Owl (*Strix seloputo* Horsfield, 1871).
(Photo credit: Muhammad Syafiq Yahya)

Wildlife ecological studies, wildlife conservation and management practices often require reliable identification of individual animals (Pollard *et al*., 2010). Identifying individuals within a population can produce highly accurate estimation of population size and abundance (e.g. Pradel *et al*., 1997; Hines *et al*., 2003; Manning & Goldberg, 2010; Peele *et al*., 2015) and generate useful ecological data such as information on life history parameters or input data for conservation models (McGregor & Peake, 1998). Site fidelity (Delport *et al*., 2002), territories turnover (Galeotti & Sacchi, 2001), mortality and survival (Terry *et al*., 2005) of a population can be estimated with identification of individual animals. For example, by identifying individual Eurasian Scops Owls (*Otus scops*) and monitoring their population, Galeotti and Sacchi (2001) managed to track the site fidelity and territories turnover of the species, and found that the owl might actually suffer a higher mortality than other owl species due to their migratory habits. In some cases, identifying individual animals was able to highlight behavioural traits that may affect the conservation value of different subsections of a population (Terry *et al*., 2005).

1.2 Problem statement

Unlike owl species in temperate regions, tropical owls are difficult to study due to their elusive behaviour and the difficulties in accessing most tropical forest types. Such limitations have led to a lack of information on many owl species based on ecology studies (Puan & Zakaria, 2007). The shortage of information available on most owls in Malaysia indicates the need of more research (Puan & Zakaria, 2007) particularly through improving survey methods. Information such as habitat requirements, behaviour, location and vocalisations may help improve the understanding of owl species and their conservation status (Puan & Zakaria, 2007).

Identifying individuals within a population is fundamental for ecological studies and it can generate many useful data (Terry *et al*., 2005). In field research on birds, traditional techniques of differentiating individuals usually involve assessing intraspecific differences such as colour or pattern, or capturing and marking individuals with visual tags or radio-transmitter (Baptista & Gaunt, 1997; Bibby *et al*., 2000; McGregor *et al*., 2000; Rognan *et al*., 2009). However, the cryptic plumage and possibly sexual monomorphism of many owl species such as Sunda Scops Owl, and Brown Boobook have posed difficulties in visual identification of captured individuals as well as birds sighted from a distance. Visual recognition may be impractical for these owls. In addition, nocturnal habits, inconspicuous behaviour coupled with difficult field conditions have also made capturing and monitoring individual owls by conventional methods harder.

On the other hand, studies involving capturing and marking techniques are often laborious and require intensive works and may directly or indirectly cause certain negative impacts to the study subjects (e.g. stress, behaviour alteration, adverse effects on survival or reproduction, etc.) (Baptista & Gaunt, 1997; Terry *et al*., 2005). Some species may also be difficult to mark-recapture and it may be desirable to avoid any disturbance associated with capture, especially for threatened species (McGregor *et al*., 2000; Laiolo *et al*., 2007). In the case of radio-transmitter, it is often considered the most productive monitoring technique, as the bird can be re-detected and the radio-transmitter can show precise location of the bird (Terry *et al*., 2005). However, aside from concerns on stress associated with catching individuals, radio-transmitter is costly and has a limited operation life (Terry *et al*., 2005). As such, alternative non-invasive techniques to identify individual animals such as those based on vocalisation may be feasible especially in field studies of elusive species when traditional techniques are impractical.

Like many other owl species, Sunda Scops Owl, Brown Boobook and Spotted Wood Owl are highly vocal and their calls can be heard throughout the year, especially during the breeding season (König & Weick, 2008). They use vocalisations to attract mates and also to advertise their territories, and thus they may be located through vocalisations. Their vocalisations pose a better condition to be used for their monitoring as compared with vision identification. Analysis of their calls can potentially be used to identify individuals and monitor their populations, and this can also contribute to a better understanding of these three species, particularly on their vocalisations.

Vocal individuality allows recognition of individuals by voice, thus avoiding the need for capture or recapture causing stress and disturbance to the birds (Baptista & Gaunt, 1997). It has been successfully applied to many bird species. Many owl species have been demonstrated to show sufficient individual variations in their vocalisations allowing their identification at individual level. Moreover, several studies have also demonstrated advantages of assessing vocal individuality in birds. Vocal individuality has been found to increase census accuracy (Peake & McGregor, 2001; Gilbert *et al*., 2002) and

help in taxonomic separation (Eisermann & Howell, 2011). In the case when vocal characteristics remain constant over the years, vocal individuality can be used in estimating territory turnover and the levels of site fidelity (Galeotti & Sacchi, 2001; Delport *et al*., 2002; Grava *et al*., 2008), and also monitoring habitat quality (Holschuh, 2004).

Vocal individuality has not previously been undertaken in any owl species in Malaysia. With the study of vocal individuality on owls in Malaysia, it may improve understanding of their acoustic activities and behaviour contributing to an improved field monitoring method. Since commonly used techniques of differentiating individuals are impractical on many owl species, vocal individuality can be applied on the study of owls. Sunda Scops Owl, Brown Boobook and Spotted Wood Owl are suitable for investigating vocal individuality as they are vocal and fairly common in Peninsular Malaysia. The vocalisations of these owls have not previously been examined, except for Brown Boobook (King, 2002). Their call types, calling behaviour, call function and intersexual call differences, are still largely unexplored.

The usefulness of vocal individuality largely depends on whether the calls of an individual can be distinguished and also whether the calls of the bird remain relatively constant over time. Therefore, my study was to increase the understanding of their vocalisations by describing the calls, and investigate if any acoustic features vary among and within individual owls in order to assess vocal individuality in these owls. As geographic variations in vocalisations have also been reported for a few owl species (Galeotti *et al*., 1996; Appleby & Redpath, 1997), this study also examined intraspecific differences in vocalisations between two habitat types. I hypothesised that individual owls differ significantly from others in their territorial calls and thus may be recognized on the basic of quantitative analysis of the spectrograms of recorded calls.

1.3 Objectives

The main objective was to examine vocal individuality of Sunda Scops Owl, Brown Boobook and Spotted Wood Owl found in Peninsular Malaysia based on surveys conducted in two habitat types, i.e. a lowland forest, namely Ayer Hitam Forest Reserve located in Puchong and oil palm smallholdings in Tanjung Karang, Selangor.

The specific objectives were:

i) To describe the territorial call of Sunda Scops Owl, Brown Boobook and Spotted Wood Owl;
ii) To determine vocal variability within individual birds, if any, for the three owl species;
iii) To assess vocal stability of individual birds over sampling period; and
iv) To examine if intraspecific difference in vocalisations was present from birds recorded from two habitat types.

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