UNIVERSITI PUTRA MALAYSIA

AVIFAUNA COMPOSITION AND HABITAT IN THE PAYA INDAH FRESHWATER WETLAND ECOSYSTEM, MALAYSIA

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By

MUHAMMAD NAWAZ RAJPAR

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

August 2010

DEDICATION

Specially dedicated to:

My Beloved Family

My Wife and Daughter

My Mother and My Late Father

Your Love Has Made Me a Better and Stronger

Throughout My Study

You Are Always in My Heart

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

AVIFAUNA COMPOSITION AND HABITAT IN THE PAYA INDAH FRESHWATER WETLAND ECOSYSTEM, MALAYSIA

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Chairman   :   Associate Professor Mohamed Zakaria Hussin, PhD

Faculty   :   Forestry

Birds are the most conspicuous and significant components of freshwater wetland ecosystem and their presence or absence may indicate the ecological conditions of the wetland area. The objectives of this study were to determine species composition, diversity, density, feeding guilds and correlation of birds with microclimate and microhabitat conditions. The study was conducted using distance sampling point count and mist-netting methods at Paya Indah Wetland Reserve, Peninsular Malaysia. A total of 122 bird species and 42 families (including 12 opportunistic observations) were recorded during 15 consecutive months of the study period, from November 2007 to January 2009. The point count method detected 100 species of birds (25 waterbird species and 75 terrestrial bird species) belonging to 38 families. Meanwhile, the mist-netting method captured 65 bird species (18 waterbird species and 47 terrestrial bird

species) belonging to 33 families. The bird density of the wetland reserve was 83.92 ± 4.53 birds/ha which ranged from 75.40 – 93.41 birds/ha (95% confidence interval). The density of the terrestrial birds was higher (70.26 ± 4.48 birds/ha) than the waterbirds (13.09 ± 1.78 birds/ha). Furthermore, the resident birds showed the highest bird density (72.17 ± 3.77 birds/ha) compared to the resident and migratory birds (8.86 ± 0.86 birds/ha), migratory birds (3.77 ± 0.50 birds/ha) and vagrant birds (0.13 ± 0.08 birds/ha). In addition, the highest density was recorded in Marsh Swamp (136.55 ± 21.21 birds/ha) as compared to Lotus Swamp (95.42 ± 6.96 birds/ha), Shrub Patches (86.47 ±8.36 birds/ha), Dryland (75.22 ± 7.09 birds/ha) and Open Water Body (70.40 ± 11.14 birds/ha). White-throated Kingfisher (*Halcyon smyrensis*; 66 captures; 32.84%) for waterbirds and Yellow-vented Bulbul (*Pycnonotus goiavier*; 379 captures; 29.68%) for terrestrial birds were the most abundant species based on mist-netting captured. In addition, eight waterbird species (0.49% each) and nine terrestrial bird species were the rarest species (0.08% each). The *Pycnonotidae* was the most dominant family (385 individuals; 26.05%) whereas the *Phasianidae, Coraciidae* and *Muscicapidae* were the rarest families with only one individual captured each (0.07%) based on mist-netting. Meanwhile, the point count results showed that *Carnivore/Piscivore/Insectivore* was the most dominant guilds (1.48 ± 0.13 birds/ha) and *Insectivore* was the rarest guild (0.42 ± 0.27 birds/ha) for waterbirds. In addition, the *Granivore* was most abundant guild (2.81 ± 0.38 birds/ha) while the *Carnivore* was the rarest guild (0.46 ± 0.22 birds/ha) for terrestrial birds. Furthermore, the mist-netting method indicated that *Carnivore/Piscivore/Insectivore* was the most dominant guilds (81.89%), while

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Omnivore was the rarest guild (18.41%) for waterbirds. The *Frugivore/Insectivore* was the most abundant guild (38.06%) and the *Carnivore* was the rarest guild (0.55%) for terrestrial birds. Both the point count and the mist-netting methods showed that terrestrial birds have higher species diversities, i.e. Shannon's index (point count; N_1 = 20.83 and mist-netting; N_1 = 14.97), species richness, i.e. Margalef's index (point count; R_1 = 7.97 and mist-netting; R_1 = 6.43) and species evenness, i.e. McIntosh's index (point count; E = 0.73 and mist-netting; E = 0.66) as compared to waterbirds, i.e. Shannon's index (point count; N_1 = 9.56 and mist-netting; N_1 = 7.23) and species richness, i.e. Margalef's index (point count; R_1 = 2.99 and mist-netting; R_1 = 3.21) and species evenness, i.e. McIntosh's index (point count; E = 0.62 and mist-netting; E = 0.60). Moreover, the point count method indicated that Marsh Swamp had a higher species diversity (Shannon index; N_1 = 27.16), species richness (Margalef's index; R_1 = 9.52) and species evenness (Pielou's J Evenness; E = 0.71) as compared to Lotus Swamp, Open Water Body, Dryland and Shrub Patches. The Canonical Correspondence Analysis revealed that the microhabitat characteristics such as vegetation composition (i.e. emergent and submerged vegetations, grasses, shrubs and trees), vegetation structures (tree diameter and height), vegetation layers (ground vegetation, shrubs and tree layers), microclimate variables (temperature, relative humidity and light intensity) and water level were the key factors that influenced the distribution, diversity and density of the wetland avian species. This study also revealed that the wetland bird species have adapted a fairly unique set of microhabitat and microclimate conditions. Therefore, this study showed that the distance

sampling point count method was more efficient and produced better results than the mist-netting method particularly in terms of species composition, diversity and feeding guilds. Moreover, mist-netting should be applied as a supplement method to the point count in obtaining accurate estimates because mist-netting is more effective to record small, highly cryptic and shy bird species with secretive behaviour. The results also indicated that marsh swamp and open water body have "Class II A" water quality, while lotus swamp has "Class III" water quality. The results of this study clearly indicated that Paya Indah Wetland Reserve is a highly important area in providing diverse food resources, shelter, nesting and roosting sites for a wide range of bird species, particularly for the waterbird and terrestrial species. Therefore, the wetland area should be protected and declared as another Ramsar site for the country.

Abstrak tesis yang dikemukakan kepada senate Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KOMPOSISI DAN HABITAT FAUNA BURUNG DI EKOSISTEM TANAH
LEMBAB AIR TAWAR PAYA INDAH, MALAYSIA**

Oleh

MUHAMMAD NAWAZ RAJPAR

Ogos 2010

Pengerusi   :   Profesor Madya Mohamed Zakaria Hussin, PhD

Fakulti   :   Perhutanan

Burung adalah yang paling ketara dilihat dan merupakan komponen yang
signifikan di ekosistem tanah lembap air tawar dan kehadiran atau ketiadaannya
menunjukkan keadaan ekologi kawasan tanah lembap tersebut. Objektif kajian
ini adalah untuk menentukan komposisi spesies, kepelbagaian, kepadatan,
tahap pemakanan dan hubung kait burung dengan keadaan mikroiklim dan
mikrohabitat. Kajian telah dijalankan menggunakan kaedah pensampelan jarak
bilangan titik dan jaring kabut di Rezab Tanah Lembap Paya Indah,
Semenanjung Malaysia. Sejumlah 122 spesies dan 42 famili burung (termasuk
12 pemerhatian oportunistik) telah direkodkan dalam 15 bulan berturutan iaitu
jangka masa kajian dari November, 2007 hingga Januari, 2009. Penggunaan
kaedah bilang titik dapat mengesan 100 spesies burung (25 spesies burung air
dan 75 spesies burung daratan) yang terdiri daripada 38 famili. Manakala,

dengan menggunakan kaedah jaring kabut, 65 spesies burung dapat ditangkap (18 spesies burung air dan 47 spesies burung daratan) tergolong dalam 33 famili. Kepadatan burung pada kawasan rizab tanah lembap ialah 83.92 ± 4.53 ekor burung/ha dalam julat antara 75.40 - 93.41 ekor burung/ha (95% sela keyakinan). Kepadatan bagi burung daratan adalah lebih tinggi (70.26 ± 4.48 ekor burung/ha) daripada burung air (13.09 ± 1.78 ekor burung/ha). Tambahan pula, burung residen menunjukkan kepadatan tertinggi (72.17 ± 3.77 ekor burung/ha) berbanding dengan burung residen dan migrasi (8.86 ± 0.86 ekor burung/ha), burung migrasi (3.77 ± 0.50 ekor burung/ha) dan burung '*vagrant*' (0.13 ± 0.08 ekor burung/ha). Sebagai tambahan, kepadatan tertinggi telah dicatatkan bagi Paya *'Marsh Swamp'* (136.55 ± 21.21 ekor burung/ha) berbanding dengan Paya Lotus '*Lotus Swamp'* (95.42 ± 6.96 ekor burung/ha), Tompok Belukar **'***Shrub Patches'* (86.47 ±8.36 burung-burung/ha), Daratan '*Dryland'* (75.22 ± 7.09 ekor burung/ha) dan Kawasan Air Terbuka '*Open Water Body'* (70.40 ± 11.14 ekor burung/ha). Pekaka Dada Putih (*Halcyon smyrensis*; 66 penangkapan; 32.84%) bagi burung air dan Merbah Berjambul (*Pycnonotus goiavier*; 379 penangkapan; 29.68%) bagi burung daratan merupakan kelimpahan tertinggi berdasarkan penangkapan jaring kabut.. Sebagai tambahan, 8 spesies burung air (0.49% setiap satu) dan 9 spesies burung daratan juga direkod sebagai spesies paling jarang ditemui (0.08% setiap satu). Pycnonotidae ialah famili burung yang paling dominan (385 individu; 26.05%) dan Phasianidae, Coraciidae dan Muscicapidae ialah famili-famili paling jarang ditemui iaitu dengan satu individu ditangkap (0.07% setiap satu) menggunakan kaedah jaring kabut. Keputusan bilang titik menunjukkan

Karnivor/Piskivor/Insektivor ialah kumpulan yang paling dominan (1.48 ± 0.13 ekor burung/ha) dan Insektivor ialah kumpulan paling jarang ditemui (0.42 ± 0.27 ekor burung/ha) untuk burung air. Sebagai tambahan juga, Granivor ialah kumpulan yang paling banyak (2.81 ± 0.38 ekor burung/ha) dan Karnivor ialah kumpulan paling jarang ditemui (0.46 ± 0.22 ekor burung/ha) untuk burung daratan. Tambahan pula, dengan menggunakan kaedah jaring kabut menunjukkan bahawa Karnivor/Piskivor/Insektivor ialah kumpulan yang paling dominan (81.89%) dan Omnivor ialah kumpulan yang jarang ditemui (18.41%) untuk burung air. Frugivor/Insektivor ialah kumpulan yang paling banyak ditemui (38.06%) dan Karnivor ialah kumpulan yang paling jarang ditemui (0.55%) untuk burung daratan. Kedua-dua kaedah bilangan titik dan kaedah jaring kabut menunjukkan burung daratan mempunyai kepelbagaian spesies lebih tinggi i.e. Indeks Shannon (bilang titik; N1 = 20.83 dan jaring kabut; N1 = 14.97) dan kekayaan spesies i.e. Indeks Margalef (bilang titik; R1 = 7.97 dan jaring kabut; R1 = 6.43) dan keserataan spesies i.e. Indeks McIntosh (bilangan titik; E = 0.73 dan jaring kabut; E = 0.66) berbanding dengan burung air i.e. Indeks Shannon (bilangan titik; N1 = 9.56 dan jaring kabut; N1 = 7.23) dan kekayaan spesies i.e. Indeks Margalef (bilang titik; R1 = 2.99 dan jaring kabut; R1 dan kekerapan spesies i.e. Indeks McIntosh (bilang titik; E = 0.62 dan jaring kabut; E = 0.60). Sebagai tambahan, kaedah bilang titik menunjukkan yang Paya '*Marsh Swamp*' mempunyai kepelbagaian spesies (Indeks Shannon; N1 = 27.16), kekayaan spesies (Indeks Margalef; R1 = 9.52) dan kekerapan spesies (J Pielou; E = 0.71) lebih tinggi berbanding dengan Paya Lotus, Kawasan Air Terbuka, Daratan dan Tompok Belukar. '*Canonical Correspondence Analysis*'

mendedahkan ciri-ciri mikrohabitat seperti komposisi vegetasi (cth. tumbuhan permukaan dan tenggelam, rumput semak dan pokok), struktur vegetasi (diameter dan ketinggian pokok), lapisan vegetasi (vegetasi bawah, tumbuhan renek dan lapisan-lapisan pokok), pembolehubah mikroiklim (suhu, kelembapan dan keamatan cahaya) dan paras air merupakan faktor utama yang mempengaruhi taburan, kepelbagaian dan kepadatan spesies burung air. Kajian ini menunjukkan spesies burung tanah lembap telah beradaptasi dengan keadaan mikrohabitat dan mikroiklim. Oleh yang demikian, kajian ini menunjukkan kaedah pensampelan jarak bilang titik adalah lebih cekap dan efisien dengan menghasilkan keputusan yang lebih baik daripada kaedah menggunakan jaring kabut terutama dari segi komposisi spesies, kepelbagaian kumpulan dan tahap permakanan. Tambahan lagi, menggunakan kaedah penjaringan sesuai diaplikasikan sebagai penambahan kepada kaedah bilang titik agar mendapatkan jangkaan yang lebih tepat kerana menggunakan jaring kabut lebih berkesan dan efektif dalam merekodkan burung kecil, sukar ditemui dan pemalu yang mempunyai perilaku berahsia. Keputusan juga menunjukkan kawasan paya dan air terbuka mempunyai kualiti air Kelas IIA, manakala paya lotus mempunyai kualiti air Kelas III. Keputusan kajian ini dengan jelas menunjukkan kawasan Rezab Tanah Lembap Paya Indah adalah kawasan amat penting dalam menyediakan kepelbagaian sumber makanan, tempat perlindungan, tempat sarang dan pertenggekkan untuk pelbagai spesies burung terutamanya spesies burung air dan burung daratan. Oleh itu, kawasan tanah lembap ini harus dilindungi dan diisytiharkan sebagai satu lagi kawasan Ramsar untuk negara.

ACKNOWLEDGEMENT

First of all, My gratitude to Almighty "ALLAH" for His blessings who gave me strength and encouragement to conduct this valuable research.

I would like to be highly thankful to the Chairman of my Supervisory Committee, Assoc. Prof. Dr. Mohamed Zakaria Hussin for his valuable assistance to complete this research. He provided me tremendous amount of knowledge related to wildlife research and management and gave me freedom to discover new things at my own. I am also thankful to my supervisory committee members; Prof. Ahmad Said Sajap, Dr. Ebil Yusof and Dr. Kamziah Kudus for their valuable comments and guidance for completion of this thesis.

I am grateful to Department of Wildlife and National Parks, Peninsular Malaysia to allow conducting this research study at Paya Indah wetland Reserve.

Special thanks to Zamri, Hossein, Sabir, Zul and Nurul for helping me during the research. Finally, I am highly thankful to my beloved wife for her cooperation, patience and support to complete this research.

APPROVAL

I certify that an Examination Committee meeting will be held in June 2010 to conduct the final examination of Muhammad Nawaz Rajpar on his Doctor of Philosophy thesis entitled "Avifauna Composition and its habitat in Freshwater Wetland Ecosystem" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981.

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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 Doctor of Philosophy. The members of the Supervisory Committee were as Follows:

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Date: 25 November 2010

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DECLARIATION

I hereby declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently submitted for any other degree at UPM or other institutions.

Muhammad Nawaz Rajpar
Date: 13th August, 2010

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