AN ECOLOGICAL ASSESSMENT OF WETLAND HABITATS UTILIZED BY MIGRATORY SHOREBIRDS AT KAPAR, PANTAI REMIS AND KUALA SELANGOR NATURE PARK, MALAYSIA

By

KHALID MAROL RIAK

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

February 2004

DEDICATION

This thesis is Dedicated to

My wife,

Amal Ibrahim Khalifa

My Daughters,

Moun Khalid Marol

Awut Khalid Marol

& Son

Riak Khalid Marol

Your motivation, sacrifice, and support during the period of my academic mission are appreciated.

My parents, my brothers and sisters

Your prayers and encouragements

that made me whom I am today is very much acknowledge

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

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Chairman: **Associate Professor Ahmad Bin Ismail, Ph.D.**

Faculty: **Science and Environmental Studies**

The objective of this research was to study the ecology of migrant shorebirds with respect to abundance, migration chronology, behaviour, habitat use, and prey availability. Further investigation was also conducted on the quality of habitats in terms of heavy metals and estimation of plastic pellets distribution at the wetland of Kuala Selangor Nature Park (KSNP) and intertidal mudflats of Kapar and Pantai Remis on the west coast of Peninsular Malaysia during the southward and northward migration period of year 2000-2002. Total shorebird abundance, number of species and diversity index (Ĥ) were significantly higher in the intertidal mudflats ($F = 3843$, $df=2$, $P<0.01$, $F = 193.13$, $df = 2$ $P<0.01$ and $F = 59.75$, $df = 2$ $P<0.01$ respectively) as compared to the KSNP. Arranged in descending order of abundance; Common Redshanks, Mongolian Plovers, Black-tailed Godwits, Eurasian Curlews, Bar-tailed Godwits, Whimbrels, and Grey Plovers were the dominant shorebird. Endangered species like Asian Dowitchers, Little Stints, and Spoon-billed Sandpipers were also encountered. The results of migration chronologies for

shorebirds were distinct and peak abundances generally occurred in the second week of October. Migration chronologies of small sized shorebirds were different (year 2000: χ^2 = 116.39, P<0.001; year 2001: χ^2=112.92 P<0.001). In year 2000, the migration chronology pattern of medium size probers were different (χ^2=49.54 P<0.001), whereas, in year 2001, they were of similar pattern (χ^2= 7.35 P>0.05). Results of habitat use revealed that most species utilized intertidal mudflats that are characterized by moist mud, wet mud, and shallow water edge (≤4 cm depth). However, Plovers showed a high preference for dry mud and wet mud. Behavioural data (feeding, locomotion, resting, body maintenance and alertness of three shorebird species (Eurasian Curlews, Common Redshanks and Mongolian Plovers) was different (Wilk's λ= 0.102, P<0.001). Feeding was the most important activity indicating that, migratory shorebirds used the sites to replenish energy and nutrient reserves.

Eight taxa of macrobenthic fauna were encountered, viz Platyhelminthes, Annelida, Brachiopoda, Mollusca, Sipunculida, Arthropoda, Echinodermata, and Chordata. Gastropoda was the most diverse taxa with 16 species. Other diverse groups were the Crustacea (15 species), Polychaeta (14 species) and Bivalvia (10 species). The abundance of macrobenthic fauna was highest in Pantai Remis, followed by Kapar and finally the KSNP. Results of heavy metal (Zn, Cu, Cd and Pb) concentrations in the sediment were significantly different (F= 2.96; df, 2; P <0.05) between the study sites. Concentrations were higher at the KSNP with lower concentration in the mudflats of Pantai Remis. The results of the heavy metal concentration of the macrobenthic fauna ranged from 1.38-29.13 μg g^{-1} for Cu, 6-99.76 μg g^{-1} for Zn and 0.56-1.97 for Pb. A fluctuation in Cd

concentration in macrobenthic was at a relatively narrow range of 0.57-1.96 as compared to other metals. The results of plastic pellets indicated that the total frequency of occurrence was highly variable between the sites, being highly significant in Kapar ($P<0.05$).

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

PENILAIAN EKOLOGI HABITAT TANAH BASAH YANG DIGUNAKAN OLEH BURUNG-BURUNG PANTAI BERHIJRAH DI KAPAR, PANTAI REMIS DAN TAMAN ALAM KUALA SELANGOR, MALAYSIA

Oleh

KHALID MAROL RIAK

Februari 2004

Pengerusi: **Profesor Madya . Ahmad Bin Ismail, Ph.D.**

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Objektif kajian ini adalah untuk mengkaji ekologi burung berhijrah menerusi kehadiran, kronologi penghijrahan, perilaku, penggunaan habitat dan kehadiran sumber makanan. Kajian lanjutan juga dilakukan untuk menilai kualiti habitat dari aspek logam berat dan anggaran penyebaran pelet plastik di habitat tanah basah Taman Alam Kuala Selangor dan dataran lumpur pasang surut Kapar dan Pantai Remis di pantai barat Semenanjung Malaysia semasa musim penghijrahan ke selatan dan ke utara pada tahun 2000 – 2002. Jumlah kehadiran burung pantai, bilangan spesies dan indeks kepelbagaian ($\hat{H}$) didapati secara signifikan lebih tinggi di kawasan dataran lumpur pasang surut ($F=3843$, $df=2$, $P<0.01$, $F=193.13$, $df=2$, $P<0.01$ dan $F=59.75$, $df=2$, $P<0.01$ masing-masing) berbanding Taman Alam Kuala Selangor. Susunan secara menurun bagi kehadiran relatif; Kedidi Kaki Merah, Rapang Mongolia, Kedidi Ekor Hitam, Kedidi Kendi, Kedidi Berjalor, Kendi Pisau Raut, dan Rapang Kelabu adalah burung-burung pantai dominan di semua kawasan kajian. Spesies terancam seperti Kedidi Kerikil, Kedidi Kecil, dan Kedidi Paroh

Sudu juga ditemui. Keputusan bagi kronologi-kronologi penghijrahan untuk burung pantai adalah jelas dan kemuncak kehadiran secara umumnya adalah pada minggu kedua bulan Oktober. Kronologi penghijrahan bagi burung pantai bersaiz kecil adalah berbeza (tahun 2000: $\chi^2 = 116.39$, $P<0.001$; tahun 2001: $\chi^2 = 112.92$, $P < 0.001$). Pada tahun 2000, bentuk kronologi penghijrahan bagi yang bersaiz sederhana adalah berbeza ($\chi^2 = 49.54$, $P < 0.001$), tetapi, dalam tahun 2001, kronologi penghijrahan mereka mempunyai bentuk yang sama ($\chi^2 = 7.35$, $P > 0.05$). Keputusan mengenai penggunaan habitat menunjukkan bahawa hampir keseluruhan spesies menggunakan habitat dataran lumpur pasang surut yang mempunyai ciri lumpur lembap, lumpur basah, dan kedalaman air yang cetek (≤4 cm dalam). Namun begitu, burung-burung Rampang menunjukkan mereka lebih menggemari lumpur kering dan lumpur basah. Data perilaku (pemakanan, pergerakan, rehat, penjagaan badan dan kepekaan) bagi tiga spesies burung pantai (Kedidi Kendi, Kedidi Kaki Merah dan Rapang Mongolia) adalah berbeza (Wilk's $\lambda = 0.102$, $P<0.001$). Pemakanan adalah aktiviti utama yang menunjukkan burung-burung berhijrah menggunakan kawasan-kawasan tersebut untuk mengumpul tenaga dan simpanan nutrien.

Lapan taksa haiwan makrobentos telah dijumpai semasa tempoh kajian, iaitu Platyhelminthes, Annelida, Brachiopoda, Mollusca, Sipunculida, Arthropoda, Echinodermata dan Chordata. Gastropoda (Mollusca) adalah yang paling banyak ditemui iaitu sebanyak 16 spesies. Kumpulan spesies utama lain adalah Crustacea (15 spesies), Polychaeta (14 spesies) dan Bivalvia (10 spesies). Kehadiran haiwan makrobentos yang tertinggi adalah di Pantai Remis, diikuti Kapar dan terakhir adalah Taman Alam Kuala

Selangor. Keputusan bagi kepekatan logam berat (Zn, Cu, Cd dan Pb) di dalam sedimen menunjukkan perbezaan yang bererti ($F=2.96$; $df=2$; $P<0.05$) antara kawasan-kawasan kajian. Kepekatan adalah tinggi di Taman Alam Kuala Selangor manakala rendah di dataran lumpur Pantai Remis. Keputusan bagi kepekatan logam berat dalam haiwan makrobentik adalah antara 1.38-49.13 μg.g-1 untuk Cu, 6.00–171.76 $\mu g.g^{-1}$ untuk Zn dan 0.56–15.23 $\mu g.g^{-1}$ untuk Pb. Kepekatan Cd yang tidak menentu dalam haiwan makrobentos adalah pada julat yang kecil antara 0.57–3.96 $\mu g.g^{-1}$ berbanding logam lain. Keputusan bagi pelet plastik menunjukkan terdapat perbezaan yang ketara bagi jumlah frekuensi kehadiran antara kawasan kajian, dengan nilai bererti yang tinggi di pantai Kapar ($P<0.05$).

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I certify that an examination committee met on 24, February, 2004 to conduct the final examination of Khalid Marol Riak on his Doctor of Philosophy thesis entitled "An Ecological Assessment of Wetland Habitats Utilized by Migratory Shorebirds at Kapar, Pantai Remis and Kuala Selangor Nature Park, Malaysia" in accordance with the Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis 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 are as follows:

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DECLARATION

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

_____

Khalid Marol Riak

Date:

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