UNIVERSITI PUTRA MALAYSIA

FEEDING ECOLOGY AND ABUNDANCE OF LESSER WHISTLING DUCK (Dendrocygna javanica HORSFIELD) IN PAYA INDAH WETLANDS, MALAYSIA

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By

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

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

FEEDING ECOLOGY AND ABUNDANCE OF LESSER WHISTLING DUCK (*Dendrocygna javanica* HORSFIELD) IN PAYA INDAH WETLANDS, MALAYSIA

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April 2017

Chairman : Professor Mohamed Zakaria B Husin, PhD
Faculty : Forestry

To ascertain the food types, abundance and habitat selection of Lesser Whistling Duck (*Dendrocygna javanica*) is highly crucial for conservation and future management activities. There is little or no study on the food type selection and population of *D. javanica*. In this study, habitat selection of *D. javanica* in 14 heterogeneous lakes (direct visual observation & point sampling technique) and feeding ecology (scan through method) were investigated from April-September, 2016. Other ecological parameters such as water temperature, pH, Water Quality Index (WQI), Water Level Fluctuation (WLF), lake size were also taken. It was observed that Belibis Lake was heavily preferred by *D. javanica* (i.e., 166.16 ducks individuals). However, three lakes i.e., Seroja, Telipok and Drift Wood were completely avoided by *D. javanica* (i.e., no individual was observed) during the study period. The highest pH value was observed in Grebe Lake (September 2016; pH-8.9) and the lowest one in Seroja Lake (May 2016; pH-6.3). Likewise, the highest mean water temperature was recorded in Senduduk Lake (June 2016; 32.9°C) and the lowest one was determined in Grebe Lake (July 2016; 20.7 °C). Multivariate analysis i.e., correlation matrix identified multi-collinearity relationship between relative abundance of Lesser Whistling Duck with Water Level Fluctuation (WLF),Water Quality Index (WQI), Lake Size (LS) and Normalized Dorminant Vegetation Index (NDVI). Inter-specific variation analysis showed that habitat selection by *D. javanica* occurs at a species-specific level in responses to changes in environmental factors. *D. javanica* preferred Belibis lake (Mean abundance = 27 individuals/month, lake size =50939.5m^2, water depth = 3.38m, slope ± SE = -0.004 ± 0.309; P<0.001).Therefore, this study showed that the quality of the lakes, vegetation type and food richness/availability (i.e aquatic plants and invertebrates) were responsible for *D. javanica* abundance in Belibis lake compared to every other lake. In conclusion, this study indicates that in order for the population to strive well, the wetland habitats especially water depth and food type richness should be the priority in managing *D. javanica.*

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

EKOLOGI PEMAKANAN DAN KELIMPAHAN ITIK BELIBIS (*Dendrocygna javanica* HORSFIELD) DI PAYA INDAH WETLANDS, MALAYSIA

Oleh

ONWUKA MARTINS CHUKWUEMEKA

April 2017

Pengerusi : Profesor Mohamed Zakaria B Husin, PhD
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Penentuan jenis makanan, kelimpahan dan pemilihan habitat Itik Belibis (*Dendrocygna javanica*) adalah amat penting bagi pemuliharaan dan pengurusan masa depan. Terdapat sedikit atau tiada kajian mengenai pemilihan jenis makanan dan populasi *D. javanica*. Dalam kajian ini, pemilihan habitat *D. javanica* di 14 tasik heterogen (secora visual pemerhatian & teknik persampelan titik secora langsung) dan ekologi pemakanan (melalui kaedah imbasan) telah disiasat dari April-September, 2016. Parameter ekologi lain seperti suhu air, pH Indeks Kualiti Air (WQI), Aras Turun Naik Air (WLF), saiz tasik telah juga diambil. Diperhatikan bahawa Tasik Belibis amat disukai oleh *D. javanica* (iaitu, 166.16 individu itik). Walau bagaimanapun, tiga tasik iaitu, Seroja, Telipok dan Drift Wood telah dielakkan oleh *D. javanica* (iaitu, tiada individu diperhatikan) dalam tempoh kajian. Nilai pH tertinggi diperhatikan dalam Tasik Grebe (September 2016; pH 8.9) dan yang paling rendah hanya di Tasik Seroja (Mei 2016; pH 6.3). Begitu juga, suhu air min tertinggi dicatatkan pada Tasik Senduduk (Jun 2016; 32.9 ° C) dan yang rendah telah ditentukan dalam Tasik Grebe (Julai 2016; 20.7 ° C). Analisis multivariat iaitu, hubungan korelasi matriks dikenal pasti mempunyai pelbagai kolineariti antara kelimpahan relatif Itik Belibis dengan Level Turun Naik Air (WLF), Indeks Kualiti Air (WQI),Saiz Tasik (LS) dan Indeks "Vegetation Dorminant Normalized" (NDVI). Analisis variasi inter spesifik menunjukkan bahawa pemilihan habitat oleh *D. javanica* berlaku pada tahap yang khusus spesies dalam respons kepada perubahan faktor-faktor alam sekitar. *D. javanica* memilih tasik Belibis (Kelipahan pavata / bulan = 27, saiz tasik=509395m^2,kedalaman air = 3.38m, cerun ± SE = -0,004 ± 0,309; P <0.001) . Oleh itu, kajian ini menunjukkan bahawa kualiti tasik dan kekayaan makanan (iaitu tumbuhan akuatik dan invertebrata) di Tasik Belibis bertanggungjawab terhadap populasi *D. javanica*. Kesimpulannya, kajian ini menunjukkan bahawa habitat tanah lembap terutamanya dari segi kedalaman air dan ketersediaan makanan seharusnya menjadi keutamaan dalam pengurusan itik liar.

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I certify that a Thesis Examination Committee has met on 12 April 2017 to conduct the final examination of Onwuka Martins Chukwuemeka on his thesis entitled "Feeding Ecology and Abundance of Lesser Whistling Duck (*Dendrocygna javanica* Horsfield) in Paya Indah Wetlands, 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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Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

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CHAPTER 1

INTRODUCTION

Lesser Whistling Duck (*Dendrocygna javanica)* is waterbird with squarish head, pale buff face with a narrow yellow eye-rings, round & broader wings, dark gray bill, leg, and feet. Body generally pale brown and chestnut; under parts of the body are light rufous cinnamon that lack breast spotting, inconspicuous whitish flank feathers. They mostly occur in flocks and inhabit in freshwater wetlands such as ponds, reservoirs, lakes, and marshes dominated with aquatic vegetation. They foraged on a variety of food resources i.e., aquatic plants (seed, shoots, tuber and leaves), vertebrates (fishes and amphibians) and invertebrates etc. They often preferred thick vegetation to hide-in, nest in grasses adjacent to water bodies and (Tellkamp, 2004; Zakaria and Rajpar, 2014). This species has an extremely diverse home range i.e., they prefer to use variety of aquatic habitats for their survival and reproduction. The population is quite abundant, but the fact is that the population trend appears to be decreasing (BLI, 2016).

The Anatidae (ducks, geese and swans) comprised of 49 genera, 5 sub-families (i.e., Anatinae, Anserinae, Dendrocygninae, Stictonettinae, and Tadorninae) and encompass of 148 species (Andy, 1996; Howard, 2003). Out of total, 48 taxa are globally threatened such as 27 vulnerable, 12 endangered, 9 critically endangered and 7 have gone extinct. Currently, Anatidae is facing various threats and an overwhelming pressure that has abruptly the decline their population. For example;, habitat loss 73% (i.e., rapid increased in urbanization and agriculture expansion), illegal hunting for sport or market 48%, and introduction exotic species 31% (Asmawi et al., 2007; Thiel et al., 2007; Pauk, 2010). Furthermore, the habitat loss and degradation is major driven factor which has excreted immense pressure on population and survival rate (Gillespie, 2007; Shuford and Gardali, 2008). This could be that, habitat loss and degradation may cause escape movements to unsuitable and less productive areas that might be no suitable for them in order to fulfil their daily requirements for their survival (Thiel et al., 2008). Birds may spent more time vigilant to detriment on foraging (Casas et al., 2009; Wang et al., 2011) and impoverish individual condition or physiological status (Strasser and Heath, 2013; Rehnus et al. 2014).

However, relatively little research has been conducted to examine the habitat selection and foraging ecology of *D. javanica*. Thus, determining the habitat selection and foraging ecology of Anatidae is essential tool to understanding habitat preference and consequences of foraging ecology for future management. This will helps to examine the trends in Anatidae populations' fluctuation from time to time in order to reduce the threats in future. The objectives of the study was to ascertain the habitat preference and foraging ecology of Lesser Whistling Duck (*Dendrocygna javanica*) among 14 heterogeneous lakes of Malaysia for better conservation and future management activities.

Wetlands are standing water bodies for some part of the year that produce different varieties of hydrophytes such as caltrops, cat-tails, mosses, lotus, bulrushes, lilies, etc. Water in wetlands are made up of underground and atmospheric water. The plants that grow there have well adaptive features that help them survive under water logged conditions. Wetlands can be seen along the edges of streams, rivers, lakes or ponds, and between dry land and deep water. The global wetland size ranges between 5.3 to 12.8 million km (Mitsch & Gosselink, 2000). It has been estimated that about 86% of the total world's wetland areas are found in tropical, subtropical and boreal regions, while the remaining 14% are found in temperate zones (Fig 1.1).

Davidson (2014) provided the most updated picture of historical wetland losses. After studying 189 wetlands, he was able to show that wetland dissappearances in the 20th century were 64-71%, "and for some regions, notably Asia, even higher." He found that "losses of natural inland wetlands have been consistently greater, and have occurred at faster rate, than those of natural coastal wetlands." His study found out that the extent of inland wetlands losses were 69-75% during the 20th century, while coastal wetlands reduced 62-63%. Dissapearance in natural wetlands linger in the 21st century. The GBO-4 (Global Biodiversity Outlook 4) provides a mid-term evaluation of progress towards the Aichi Biodiversity Targets (Secretariat of the Convention on Biological Diversity 2014). Target 5 calls for habitat deterioration and displacement to be reduced, and similarly Target 14 calls for ecosystems that provide basic services, including those related to water, to be restored and safeguarded. The GBO-4 found out that wetlands including river systems, continue to deteriorate.e.g. Wetlands, including coral reefs, are still reducing.

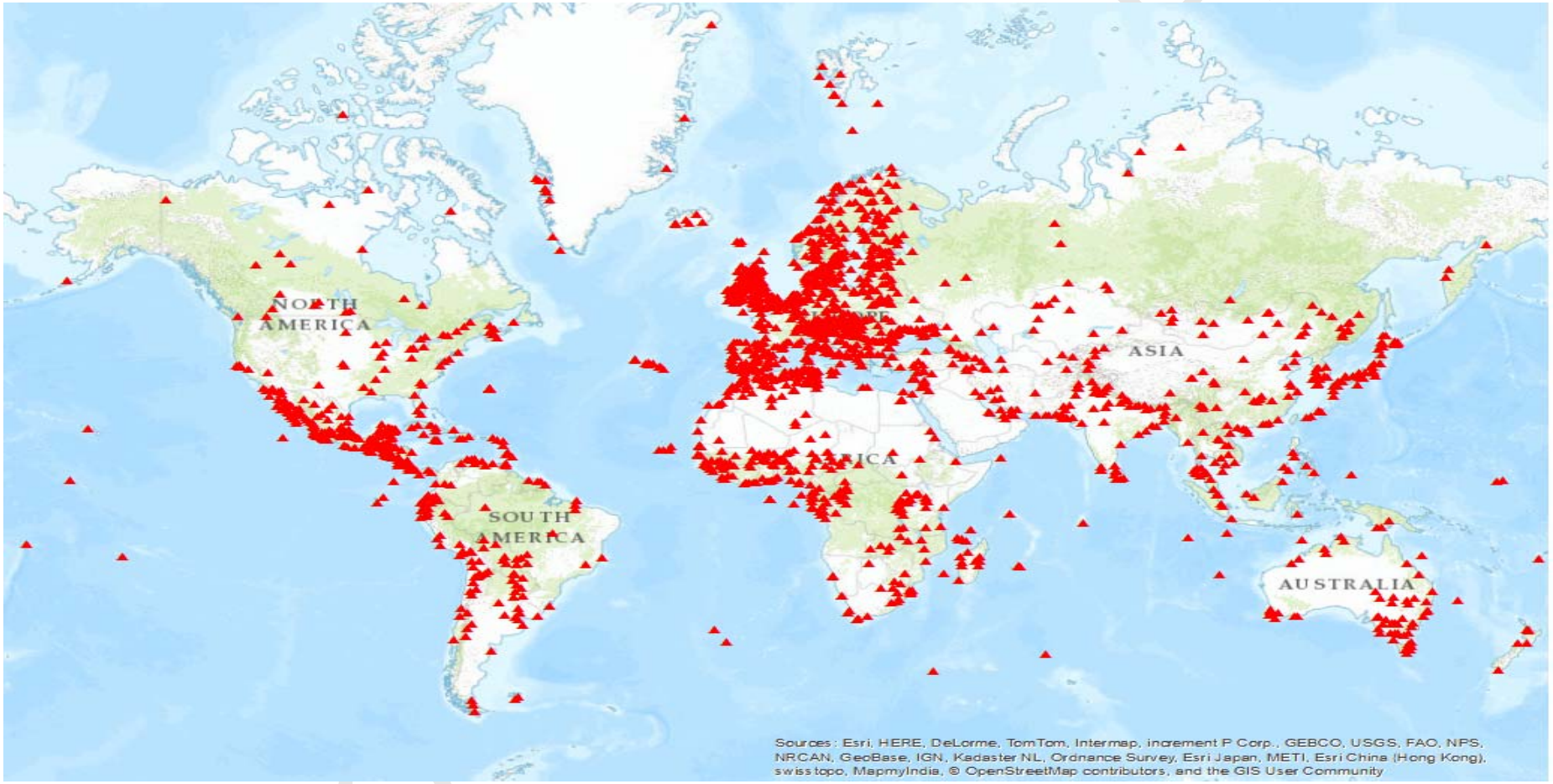

Figure 1.1 : Distribution of Wetland in the world (Source: Ramsar, 2014. Basemap: Esri et al.)

1.1 Wetland Areas in Malaysia

Malaysia has a large area of wetlands. The Malaysian Wetland Directory has listed 105 wetland sites (Fig 1.2). These include river systems, mangroves, mudflats, tropical peat swamp forests which constitute the major wetlands ecosystems which are found in Malaysia. The following are examples of Merits of wetlands in Malaysia (Wetland International Malaysia 2015):

- Peat swamp forests: North and South Selangor Peat Swamp Forest, South-east Pahang Peat Swamp Forest, Ayer Hitam Forest Reserve Johor, Klias Peninsula and Loagan Bunut.
- Mangroves and mudflats: Tanjung Piai, Pulau Kukup, Sungai Pulai, Matang, Kuala Gula, Kuala Selangor, Klang Islands (Pulau Ketam), Klias Peninsula, Bako National Park.
- Rivers: Sungai Pahang, Sungai Perak, Sungai Sedili Kecil and Sedili Besar, Sungai Setiu, Sungai Kinabatangan and Sungai Rejang.
- Lakes: Tasek Bera and Tasek Chini.
- Lagoons: Setiu Lagoon and Merang Lagoon.

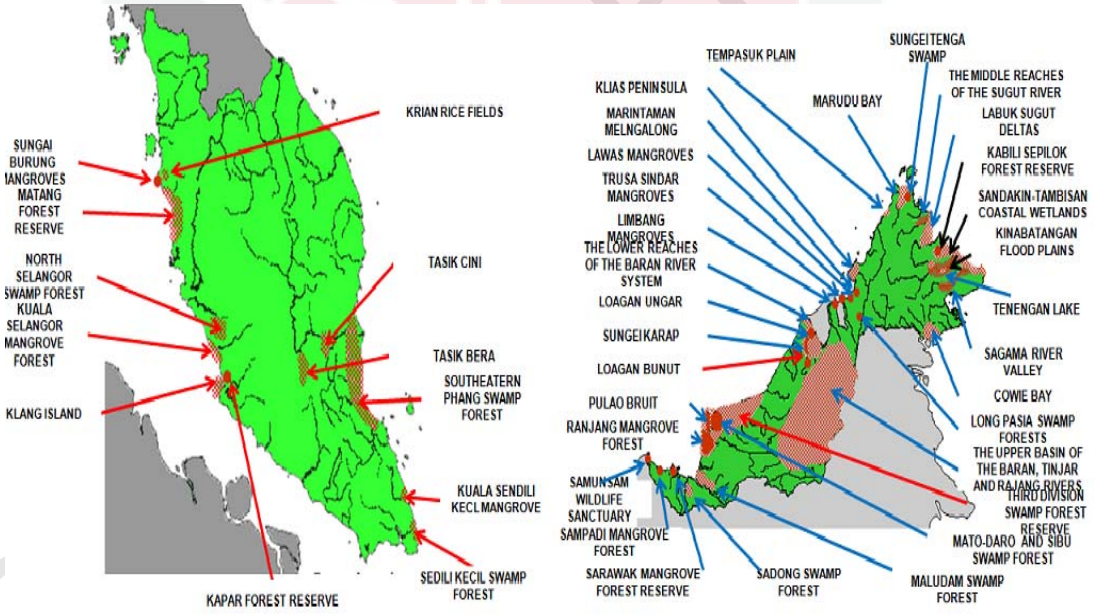

Figure 1.2 : Map of Malaysia's wetland areas (Malaysian Wetland Directory 2014)

1.2 General Background of *Dendrocygna javanica*

The lesser whistling duck also called Indian whistling duck or lesser whistling teal, is one of the species of duck that breeds in the Indian Subcontinent and Southeast Asia (Fig 1.3). They are always found flocking around lakes and wet paddy fields (Zakaria *et al.,* 2009; Heinroth 1911). They are often found perching on trees and may lay their eggs in the conclaves of trees. This long-necked duck has characterized features such as broad wings that may be visible when flying and produces a "wheezing call" sound.

It has a chestnut rump, differentiating it from its larger relative, the fulvous whistling duck (*D. bicolor*), which has a creamy white butt.

Figure 1.3 : Lesser Whistling Duck (*D. javanica*)

This chestnut brown duck is usually mistaken for fulvous whistling duck (*D. bicolor*) (Fig 1.4), but has chestnut upper-tail coverts which are different from the creamy white in the latter. When flying straight, their head is held below the level of the body as in other *Dendrocygna* species (Bolen *et al.,* 1975). The crown looks like dark and the sexes are usually difficult to differentiate. They fly slowly with rapid wing-flapping and also often produce a wheezy call as they orbit above.

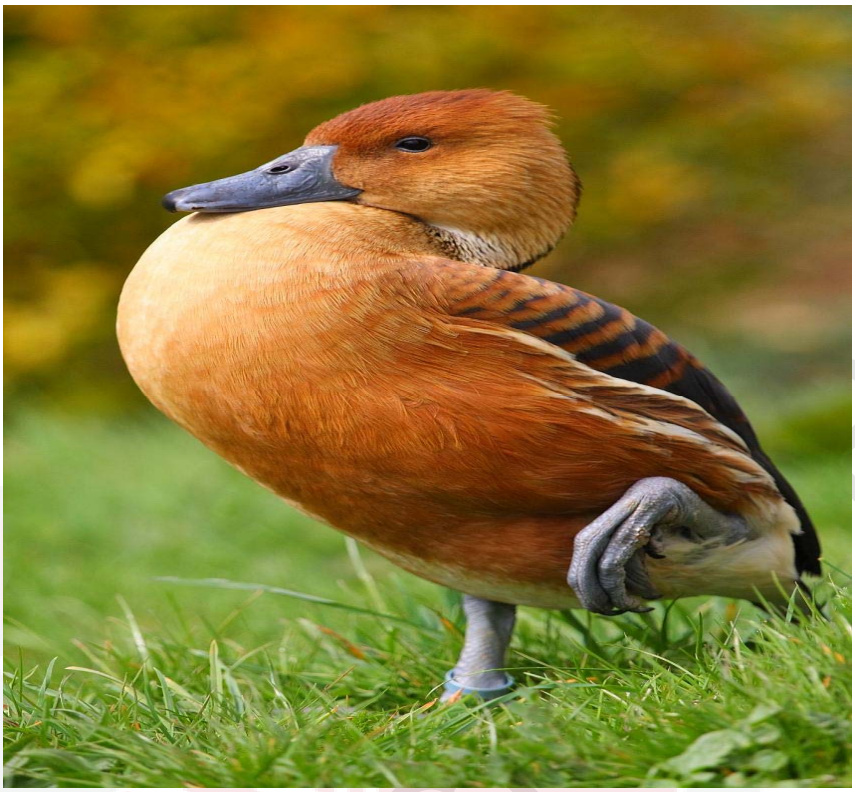

Figure 1.4 : Fulvous Whistling-Duck

According to Birdlife International (2015), *D. javanica* has an exceptionally large range, and consequently does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km^2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). Despite the fact that the population trend appears to be on the decline, the decrease is not seen to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is considered very large under the population size criterion (<10,000 mature individuals with a continuing decrease estimated to be >10% in 10 years or 3 generations, or with a specified population strategy). For these reasons the species is evaluated as Least Concern.

1.3 Importance of Wetlands of *D. javanica*

Wetlands are haven for biological diversity, such as *D. javanica*, fish, amphibians, reptiles, mammals and aquatic invertebrates, depending on them for their survival. Dawson (1988) and Wiegleb (1988), said wetlands are critical habitats for diverse avian species and their importance depends on the size, vegetation composition, vegetation structure, water quality, soil conditions and topography. Particularly, freshwater wetlands are the greatest productive ecosystem in the world and comparable with other ecosystems (Whittaker & Likens, 1973; Gibbs, 1993; Casado & Montes, 1995). Wetlands, as compared to other dry lands, represent a wider variety of natural resources with environmental, social, and scientific values and play a

remarkable role in the sustainance of biological diversity (Williams, 1999). Despite their great challenges, these ecosystems have undergone an increase in human influence (Naveh & Lieberman, 1994), and are overwhelmed by an increasing process of deterioration leading to the loss of many of them (Hollis, 1995; Brinson & Mclvarez, 2002).

Wetlands are known for their exclusive functions; they provide habitats for *D. javanica*, fish, amphibians, reptiles, mammals and aquatic invertebrates; they are good source of food for humans, i.e. fish, fruits and grains, water for family use, farming and industrial uses, fibre and fuel (logs, fuel wood, peat and fodder), supplies for biochemical (i.e. the removal of medicines and other materials from biota), supplies for genetic materials (i.e. genes for resistance to plant pathogens, ornamental species and others), regulating climate (i.e. source and sink for greenhouse gases).They may influence temperature, precipitation, and other climatic factors. Wetlands are good water regulators (i.e. ground water recycle-hydrological movements) and good hydro pacificators (i.e. reservation, restoration and discharge of excess nutrients and other pollutants). Wetlands control erosion (i.e. sustainance of soil sediments and building up of organic matter). Schooling (i.e. creates formal and informal teaching and training), nutrients cycling (i.e. storage, processing, recycling, and acquisition of nutrients) (Pethick, 1984; Constanza et al., 1997; Nakamura et al., 1997; Stumpf & Haines, 1998; Dierschke et al., 1999; Ishikawa et al., 2003).

1.4 Importance of the study

This study was to findout the population of *D. javanica* population, preferred food type and habitat selection (preferred lake) in Paya Indah wetlands Malaysia. Understand the preferred food types and habitat choice of *D. javanica* is very crusial to ecologist and conseravationist. This will help them solve the food type requirements and provide suitable habitat for the ducks and other water fowls that use the wetlands.Due to the general decrease in *D. javanica* abundance, this study was carriedout to acertain the population and also understand the feeding ecology (food type) of *D. javanica*.This study provides useful recommendation and habitat guidelines and manipulative techniques for ecologist and conservationist.

1.5 Problem statement

D. javanica are one of the most important species in the ecosystem of wetlands. Anatidae which includes ducks and duck-like waterfowl, such as swans and geese are modified to an aquatic existence with webbed feet, flattened bills, and feathers that are excellent at shedding water due to an oily coating. There are about 131 species in the world and basically 11 species in Malaysia (James & Thomson 2001).

Malaysia is blessed with extensive wetland areas. Information about relative abundance, population of *D. javanica,* habitat preference, choice of food type and the relationship between habitat characteristics and microclimate variables for various wetlands is lacking (M. N. Rajpar and M. Zakaria 2010). This knowledge is necessary

for conservational purpose on the particular choice of food, type of habitat and lake quality necessary to grow the population of *D. javanica*. Long-term population trends of *D. javanica*, habitat and microclimate characteristics, as well as correlationship between *D. javanica* and habitat characteristics have not been studied. In fact, very little is known on the ecological roles *D. javanica* in relation to habitat and habitat disturbances. Hence, it is important to understand the factors that encourages the population, relative abundance, food type preference, habitat preference, and correlationship of *D. javanica* between habitat characteristics and microclimate variables. *D. javanica* is a hunted species, and if studies are not carried out on its substance and conservation, it may go into extinction or migrate. The habitat loss and degradation have caused the decline of many bird species around the world (Altman & Bar, 2001; Taylor & Pollard, 2008).

Generally, Malaysian wetlands are facing an overwhelming pressure from rapid development and urbanization (Asmawi, 2007). Anthropogenic activities have altered the wetland habitats in a variety of ways that consequently cause great threats to wetland birds (Gillespie, 2007). Following this, the future challenges for wetland conservation and management are in estimating the wetland resources and monitoring the trends in wildlife populations, particularly wetland birds where further decline may cause extinction of wetland birds (Lawton & May 1995; Caughley & Gunn, 1996). Hence, this study seeks to find lasting solution to *D. javanica* decline in population by understanding the best food type preferred and habitat preference.

1.6 Research Hypothesis

The reseach hypothesis are as follows:

H_0: There is no relationship between the abundance and the habitat quality of *D. javanica* in Paya Indah wetlands

H_1: There is a relationship between the abundance and the habitat quality of *D. javanica* in Paya Indah wetlands

1.7 Research Objectives

The research objectives are as follows:

1. To examine types of food eaten by *D.javanica*.
2. To determine population size of Lesser Whistling Duck (*D. javanica*) in Paya Indah Wetlands.
3. To identify factors that affect population size of *D. javanica* in Paya Indah Wetlands.

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