2011 2nd International Conference on Environmental Science and Technology
IPCBEE vol.6 (2011) © (2011) IACSIT Press, Singapore

Species Composition and Feeding Guilds of Birds Utilizing Palm Oil Mill Effluent (POME) Area in Carey Island, Malaysia

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***Abstract*—A study was conducted in Carey Island, Peninsular Malaysia to determine species composition and feeding guilds of birds that utilized Palm Oil Mill Effluent (POME) ponds. The presence of birds in the area was recorded by a direct observation technique (using binoculars and video camera) from January to December 2009. A total of 31 species of birds which can be classified into 11 families were recorded. Egrets and herons are the most abundant birds, while other waterbirds such as sandpipers, snipes, lapwings, and grebe are presence only in a small number either occasionally or throughout the year. In term of feeding guild, most birds belong to Piscivore/Insectivore (57.14%) and only few species are Insectivore (4.76%). Presence of many bird species with variety of feeding guilds indicated that POME ponds are indeed providing an attractive habitat or foraging site for birds.**

Keywords-component; Waterbirds; POME; feeding guild; wetland; foraging ecology

I. INTRODUCTION

Oil palm (*Elaeis guineensis*) is vastly cultivated in Malaysia and enjoys rapid growth over the years. It covers more than 3.8 million hectares or 11% of the land area and occupying more than one-third of the total cultivated area in Malaysia [1]. The crop has significantly contributed to the economic growth of the country as Malaysia is currently the second world's largest producer and exporter of palm oil products [2].

The rapid development of palm oil industry in Malaysia had produced enormous amount of palm oil mill effluent (POME). It is estimated that there are 400 palm oil mills throughout the nation which generated 30 million tons of POME annually. POME is a yellowish acidic wastewater with fairly high polluting properties, with an average of 25,000 mg/l biochemical oxygen demand, 55,250 mg/l chemical oxygen demand, and 19,610 mg/l suspended solid [3]. This colloidal suspension usually contains 95–96% of water, 0.6–0.7% of oil and grease, and 4–5% of total solids [4, 5, 6]. Generally between 5 – 7.5 tons of water is requires to process one ton of crude palm oil but more than half of the water will end up as palm oil mill effluent [7].

The effluent is highly organic and acidic in nature [8] and can easily pollute the water system. Therefore it has been considered as the largest pollution load into the rivers throughout the country. Since the effluent is detrimental to the water quality it needs to be properly treated before being discharged into the environment. Therefore, series of ponds were constructed to trap the chemical and sediment contain in POME. These ponds are small and shallow water bodies that can be considered as a type of wetland. It acts as a retention system to minimize the impact of pollution by oil mill effluent into the river system.

POME contains lot of nutrients because it is highly organic. The nutrients are useful for the survival of plant and wildlife. Therefore POME pond always attracted many species of birds especially waterbirds such as egrets, herons, bitterns, ducks, plovers and grebes. However, the diversity and composition of waterbirds vary from one area to another depending on the location and size of the pond. Larger and more complex pond usually supports more species of waterbirds than small and simple pond [9]. Although it is well known that waterbirds are foraging in the wetlands area, study on species composition and feeding guilds of bird in POME area is undoubtedly lacking. The aim of this study is to determine bird species that are frequently visiting POME area and identify which feeding guild is commonly used by each bird species. Then the information is used to associate between roles of POME ponds in providing suitable foraging habitat for birds.

II. MATERIALS AND METHODS

Study Site

Carey Island is located south to Port Klang and north to Klang River in Kuala Langat District of Selangor, Peninsular Malaysia (101°22′ E and 2°52′ N; Figure 1). It is separated from mainland by the Langat River but is connected by a bridge at Chondoi near Banting. The island is located two meters below sea level during high tide. Therefore bund was constructed throughout the island to prevent sea-water from invading the land area. Of 15,000 hectares of island land area, 75% are planted with oil palm plantation, own by Sime Darby Berhad.

The island has two mills (east and west) to process oil palm products. Although each mill have POME retention ponds, west oil mill ponds are more pronounce and easily accessible. It is located nearby to Langat River where all the effluents will be discharged after undergoing treatment processes. These ponds are also located closer to Straits of Malacca which will attract more shorebirds and migratory

birds. Based on these reasons, the west oil mill POME area was chosen for this study.

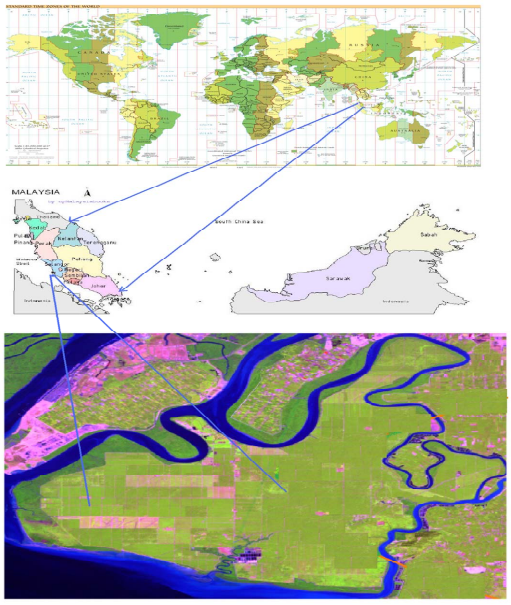

Figure 1. Location of study site in Carey Island, Selangor, Peninsular Malaysia

Birds Survey

The presence of birds in west oil mill POME area was surveyed once a week from January to December 2009 (Table 1). Direct observation technique (using binoculars and video camera) was used in documenting bird species and their foraging behavior. Observation session began at 0900 hours until 1200 noon at selected sampling station. To reduce disturbance to bird's daily activity and for ease of study, the observation was conducted inside mobile bird-hide (makeshift tent) that was strategically setup along the pond bank. Details of the methodology were described by Richardson *et al.* [10] and Yu-Seong *et al.* [11].

TABLE I. THE SCHEDULE OF WEEKLY BIRD SURVEYS

Months	Date	No. of days	Observations hours
January	2, 9, 16, 23, 30	5	36
February	6, 13, 20, 27	4	31
March	5, 12, 19, 26	4	34
April	2, 9, 16, 23, 30	5	35
May	7, 14, 21, 28	4	28
June	4, 11, 18, 25	4	33
July	2, 9, 16, 23	4	35
August	6, 13, 20, 27	4	34
September	3, 10, 17, 24	4	28
October	1, 8, 15, 22	4	32
November	5, 13, 20, 27	4	28
December	3, 10, 17, 24	4	31
Total		50	385

Since it is impossible to capture and marked the birds (except sandpipers, snipe and kingfishers that were mist-netted few times), bird counting was not conducted to avoid multiple counting. Therefore, population size of each species cannot be ascertained. The species will be considered abundantly presence in the study area if they were regularly sighted in big numbers (although it can be same individual detected repeatedly) or rare if it was observed either occasionally or regularly but in small number (although it can be different individuals recorded at different times).

III. RESULTS

Species Composition

A total of 31 species of birds that belong to 11 families were recorded frequenting POME area (Table 2). Most of these birds (18 species of 58%) are waterbirds (such as herons, egrets, bitterns, lapwings, grebe, waterhen and moorhen), while some (6 species or 19%) are shorebirds (such as sandpipers, snipes, and plover) which are migrants that can be recorded in larger number during migratory seasons. The remaining species are opportunist birds that usually found closely associated with human settlements such as kingfishers, myna, swallow, and wagtail.

Overall, egrets and herons were the most abundant waterbirds species in both ponds. Other birds such as ducks, lapwings, grebe, sandpipers and kingfishers were recorded regularly but only presence in small number. On the other hand, species such as sandpipers and plover which are migratory birds are presence in big number but only during migratory season.

Although there are four ponds available in the area, only two were regularly visited by birds. Frequency of bird visitation to POME area is greatly affected by pond characteristics such as percentage of water covers, water quality, existent of perching site or dead wood, and thickness of effluent crust. The number and species of birds that are frequently forage in these two ponds varies either daily or monthly. More birds were observed frequenting the ponds from 0800 hours until 1100 hours, markedly decreased toward midday and early afternoon before peak again at late afternoon. Birds show different daily foraging activities and this is mainly due to the variation in heat intensity, weather condition, and migration season.

Feeding Guilds

Result shows that birds frequenting POME ponds were utilizing four different types of feeding guilds (Figure 2). Among these types, Piscivore/Insectivore was the most preferable feeding guild (52%), followed by omnivore (22%), insectivore (16%), and piscivore (10%). Both ponds that were regularly visited by birds have shallow water level and lots of insects (judging from the water bubble created by insects). The presence of many aquatic insects in the ponds had attracted insectivorous birds to forage in the area.

TABLE II. LIST OF BIRD SPECIES RECORDED UTILIZING POME PONDS OF CAREY ISLAND, PENINSULAR MALAYSIA

Family	Common Name	Scientific Name	Feeding Guild
Alcedinidae	Common Kingfisher	*Alcedo atthis*	Piscivore
Alcedinidae	White-throated Kingfisher	*Halcyon smyrnensis*	Piscivore/Insectivore
Alcedinidae	Collared Kingfisher	*Todiramphus chloris*	Piscivore/ Insectivore
Anatidae	Lesser Whistling Duck	*Dendrocygna javanica*	Omnivore
Ardeidae	Grey Heron	*Ardea cinerea*	Piscivore/Insectivore
Ardeidae	Purple Heron	*Ardea purpurea*	Piscivore/Insectivore
Ardeidae	Chinese Pond Heron	*Ardeola bacchus*	Piscivore/Insectivore
Ardeidae	Javan Pond Heron	*Ardeola speciosa*	Piscivore/Insectivore
Ardeidae	Eastern Cattle Egret	*Bubulcus coromandus*	Piscivore/Insectivore
Ardeidae	Little Heron	*Butorides striata*	Piscivore/Insectivore
Ardeidae	Great Egret	*Ardea alba*	Piscivore/Insectivore
Ardeidae	Chinese Egret	*Egretta eulophotes*	Piscivore/Insectivore
Ardeidae	Little Egret	*Egretta garzetta*	Piscivore/Insectivore
Ardeidae	Intermediate Egret	*Mesophyx intermedia*	Piscivore/Insectivore
Ardeidae	Cinnamon Bittern	*Ixobrychus cinnamomeus*	Piscivore/Insectivore
Ardeidae	Yellow Bittern	*Ixobrychus sinensis*	Piscivore/Insectivore
Ardeidae	Black-crowned Night-heron	*Nycticorax nycticorax*	Piscivore/Insectivore
Charadriidae	Little-ringed Plover	*Charadrius dubius*	Insectivore
Hirundinidae	House Swallow	*Hirundo tahitica*	Insectivore
Motacillidae	Western Yellow Wagtail	*Motacilla flava*	Insectivore
Podicipedidae	Little Grebe	*Tachybaptus ruficollis*	Piscivore/Insectivore
Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*	Omnivore
Rallidae	Common Moorhen	*Gallinula chloropus*	Omnivore
Scolopacidae	Common Sandpiper	*Actitis hypoleucos*	Insectivore
Scolopacidae	Common Snipe	*Gallinago gallinago*	Omnivore
Scolopacidae	Swinhoe's Snipe	*Gallinago megala*	Omnivore
Scolopacidae	Pintail Snipe	*Gallinago stenura*	Omnivore
Scolopacidae	Wood Sandpiper	*Tringa glareola*	Insectivore
Sturnidae	Common Myna	*Acridotheres tristis*	Omnivore
Vanellidae	Grey-headed Lapwing	*Vanellus cinereus*	Piscivore/Insectivore
Vanellidae	Red-wattled Lapwing	*Vanellus indicus*	Piscivore/Insectivore

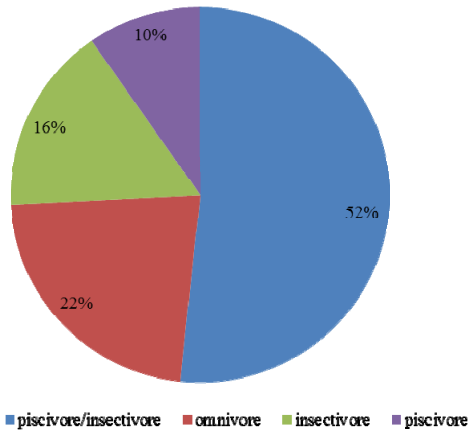

Figure 2. List of feeding guilds with number of species recorded in POME ponds

DISCUSSION

It is highly important to monitor the birds species composition and feeding guilds to understand the importance of POME ponds for birds species. The gradual losses of wetlands due to habitat loss or degradation have caused population decline in many waterbirds species around the world [12]. Many waterbirds species are under heavy pressure and at risk of extinction due to degradation and habitat loss that caused the degradation of breeding and feeding sites. They are the most threatened species as compared to terrestrial birds. It has been estimated that around 41% of waterbirds population had declined.

The recording of 31 species of birds indicated that POME ponds are attractive habitat and suitable foraging site for wide array of bird species. Plentiful food resources and nutrients area available in POME ponds but require birds to utilize different strategies to extract these resources. To ensure their survival and optimize food resources, birds show various foraging behaviors to exploit diverse food resources in POME ponds at different depths. This may be due to differences in bill shape and tarsus length that allow them to prey at various water depths. The presence of food resources is a key factor in regulating waterbirds diversity

and abundance [13]. Common Moorhen (*Gallinula chloropus*) for example prefers pond edges to feed on soft shoots, stems, herbs, and seed of reeds, rushes and invertebrates such as larvae of insects, snails and worms [13]. Other waterbird such as Little Egret (*Egretta garzetta*), Great Egret (*Ardea alba*), Intermediate Egret (*Mesophyx intermedia*), Eastern Cattle Egret (*Bubulcus coromandus*) and Chinese Egret (*Egretta eulophotes*) forage in shallow waters along the edges and on compacted waste material but employ various tactics such as stand and wait, walking slowly or run quickly, wing flick and foot shuffling. Lapwings, plover, and sandpipers preferred wet moist soils in shallow water such as ditches and edges of water bodies to probe in mud on variety of food items such as worms, snails and insects. This may be due to edges might have high level of prey availability and easy to catch due to shallow water [14]. White-breasted Waterhen (*Amaurornis phoenicurus*) prefer adjacent terrestrial areas covered with grasses to forage on seeds, vegetable matter and invertebrates such as worms and insects. Kingfishers often perched on mangrove trees and oil palm plants and caught insects through sallying and consumed on trees especially dead branches.

IV. CONCLUSION

The results of this study highlighted that POME ponds are productive habitat and had successfully attracted a wide range of bird species. In addition, the findings also indicated that distribution and relative abundance of birds is closely associated with aquatic vegetation, prey distribution and foraging success.

ACKNOWLEDGMENT

We thank Sime Darby Plantation Berhad for allowing us to conduct this study in their estate. Field assistance from Sime Darby Berhad and Institute of Biological Sciences staffs is highly appreciated. This study is funded by Sime Darby Plantation Berhad (55-02-03-1034) and University of Malaya Research Grant.

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