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Assessing Avian Richness and Diversity in Different Regions of Oil Palm Plantation in Selangor, Malaysia

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ABSTRACT. Malaysia is characterized by a variety of habitats such as forests, clearings, thickets, and cropland that attract various species of birds. This study examined the bird community in terms of richness and diversity at oil palm plantations habitat. The abundance of birds was determined by using distance sampling point count method. A total of 2722 birds belonging to 38 families representing 86 species of birds were detected. Diversity analysis indicates that the species of birds in the oil palm plantation at Sungai Pelek is more diverse (Shannon-Wiener Diversity Index H; 3.52) and richness (Margalef's Richness Index R1; 10.2) than oil palm plantation in Teluk Panglima Garang-Pulau Carey and Banting-Jenjarum. However, the species of birds in the oil palm plantations at Teluk Panglima Garang-Pulau Carey and Banting-Jenjarum show higher evenness (Pielou's Evenness Index E; 0.82) compared with oil palm plantations in Sungai Pelek. The results of this study indicate that the species composition and distribution of the avian species in the oil palm plantations are affected by habitat characterization of that particular area and its vicinity.

1. INTRODUCTION

Malaysia bestowed with a variety of habitats such as forests, open spaces, shrublands, wetlands, lake, river, aquacultural ponds, agricultural lands, paddy fields, and waste water treatment areas [1], which is rich in diversity of birds, including 525 residents, 200 migrants, 92 vagrants, and 42 endemic bird species [2]. However, the conversion of tropical lowland forests on a large scale into oil palm plantations, especially in Southeast Asia, has led to a significant loss and fragmentation of once great and continuous tropical forest habitats [3]. Yet, many logged forests that are facing degradation are subjected to continuous pressure for conversion for agriculture, especially oil palm in Southeast Asia [4]. Forest clearings for new oil palm plantations usually results in many degraded and small patches of forest.

Felling of natural forests for agriculture has threatened the survival of many species of birds [5]. Changes in bird assemblages in undisturbed and human modified habitats have been studied in different parts of the world by several authors [6,7,8,9]. Approximately, 45 species of birds are endangered from loss and degradation of habitats in Malaysia [10]. Reducing the loss of habitat is more effective than trying to boost bird populations in their foraging areas and then restoring the habitat.

The retention of forest patches in oil palm plantations, especially those with High Conservation Value (HCV) has been promoted by the Roundtable on Sustainable Palm Oil (RSPO) certification program as a means to reduce the loss of biological diversity in and around oil palm plantations [11]. Despite, its overall effectiveness has not been widely demonstrated; such strategy is usually considered as a useful practice to improve biodiversity and is part of the "wildlife-friendly" management system in the oil palm plantations [12]. Only a few studies have specifically examined the value of forest patches in habitat matrix of oil palm for vertebrate conservation.

Therefore, conservation of natural habitats across the country is the most important factor in maintaining bird populations. It also has been suggested that the value of agricultural plantations for bird conservation can be enhanced by maintaining forest patches within or nearby plantation [13], although the results were not always consistent [14].

The main objective of this study was to investigate the contribution of biological diversity in human-modified habitats; using oil palm plantation as a model and by using birds as indicators. The main objective has been achieved by analysing the richness and diversity of bird species in each sites of the study area. Therefore, parameters such as relative abundance, composition, and diversity are expected to improve our understanding of the effects of habitat structure and its vicinity on bird species.

2. MATERIALS AND METHODS

Study Area. The study regions were located in the state of Selangor. The data was collected from three regions; Teluk Panglima Garang-Pulau Carey ($2^0$56.477'N, $101^0$25.261'E), Banting-Jenjarom ($2^0$50.767'N, $101^0$25.298'E), and Sungai Pelek (2°39.856'N, 101°44.521'E). Each study region is composed of oil palm plantation that is adjacent or continuous with the mangrove area (Fig.1).

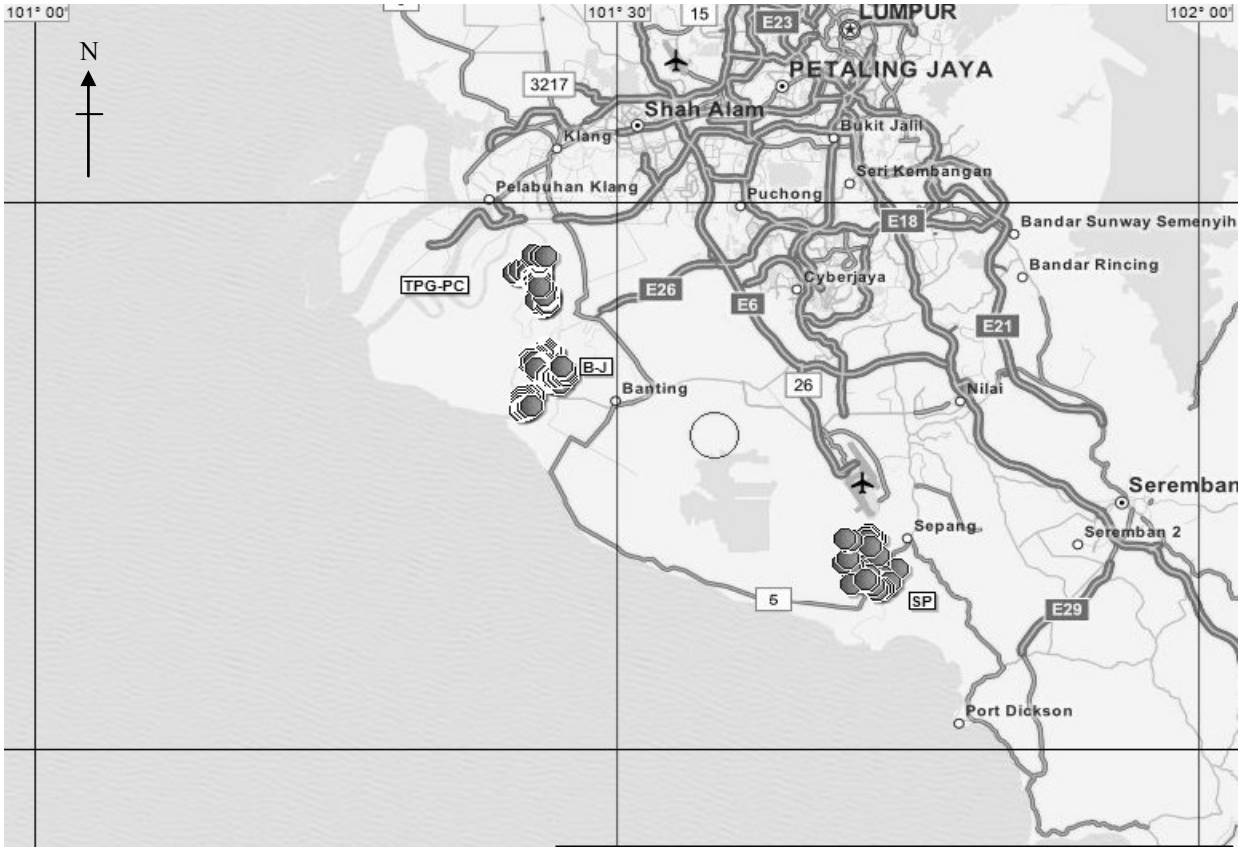

Fig. 1. Geographical locations and map of the study areas. Circles represent of the survey plots. TPG-PC is represent for Teluk Panglima Garang-Pulau Carey, B-J is for Banting-Jenjarom and SP is stand for Sungai Pelek.

Bird Surveys. To determine the richness and diversity of resident bird communities, bird surveys were conducted using the Point Count technique at each study sites from October 2012 to November 2013. Each sampling conducted at a particular site covered 80 point counts. All bird surveys were carried out by the same observer [15]. The sampling points were chosen randomly with the condition that they were at least 200 m apart [16]. During each survey, birds that were seen or heard during a 10 minutes period within 40m radius were recorded at each sampling point [17]. All surveys were conducted between 0700 and 1030h on days with no precipitation or strong wind [15]. If a bird was heard and could not be identified, the calls were documented using a voice recorder, and compared with local bird vocalization from a CD-ROM of Birds of Tropical Asia 3 [18].

3. DATA ANALYSIS

Relative Abundance (%). The relative abundance relates to the number of individuals of a particular species as a percent of total detection at each area. We estimate the relative abundance for each species detection by using average values which is calcualted by dividing the total number of species detected in each region. The relative abundance (%) of birds species have been estimated by the following expression:

$$\text{Relative abundance} = n/N \times 100 \quad (1)$$

Where:
n = The number of a particular detected bird species
N = The total number detected for overall species in each region

Bird Diversity Indices. Avian species diversity, species richness and species evenness in oil palm plantations at different regions were analysed by using Shannon-Wiener Diversity Index, Margalef's Richness Index, and Pielou's Evenness Index.

The Shannon-Wiener Diversity Index for each oil palm plantations was calculated by using the following equation:

$$H = -\sum[(p_i)*\ln(p_i)] \quad (2)$$

Where:
S = number of individuals of one species
N = total number of all individuals in the sample

Margalef's Richness Index was used as a simple measure of species richness.

$$R_1 = (S-1)/\ln(N) \quad (3)$$

Where:
S = total number of species
N = total number of individuals in the samples

For calculating the evenness of species, the Pielou's Evenness Index was used.

$$E = H/\ln(S) \quad (4)$$

Where:
H = Shannon-Wiener Diversity Index
S = total number of species in the sample

Significant Difference among Different Oil Palm Plantations. A One-Way Analysis of Variance (ANOVA) and Tukey's (HSD) test was conducted in order to investigate the difference in bird richness and oil palm plantations at different regions.

4. RESULTS

Bird Species Composition with Relative Abundance in Different Oil Palm Plantations. Generally, the point count method observed a number of 2722 bird individuals representing 86 species of birds and 38 families (i.e 60.53% families from Teluk Panglima Garang-Pulau Carey,

68.42% from Banting-Jenjarom, and 86.84% from Sungai Pelek). 37 species were observed from oil palm plantation in Teluk Panglima Garang-Pulau Carey while 41 species were observed in Banting-Jenjarom and 65 bird species were observed in Sungai Pelek.

Bird Species Composition with Relative Abundance in Teluk Panglima Garang-Pulau Carey Oil Palm Plantation. A total of 1134 individuals were observed (40.18%) from Teluk Panglima Garang-Pulau Carey representing 37 bird species and 23 families. Three bird species i.e., *Orthotomus sutorius* - Common Tailorbird (11.20%), *Acridotheres tristis* - Common Myna (11.11%), and *Spilopelia chinensis* - Spotted Dove (9.26%) were the most common bird species in the Teluk Panglima Garang-Pulau Carey oil palm plantation. Conversely, two bird species i.e., *Centropus bengalensis* - Lesser Coucal and *Prinia rufescens* - Rufescent Prinia were least abundant (each 0.18% - observed only twice) (Table 1).

Bird Species Composition with Relative Abundance in Banting-Jenjarom Oil Palm Plantation. In Banting-Jenjarom oil palm plantation, a total of 1057 individuals of 41 species of birds were observed representing 26 families. The results showed that *O. sutorius* - Common Tailorbird (12.77%), *Copsychus saularis* - Oriental Magpie-robin (11.92%), and *Geopelia striata* - Zebra Dove (9.84%) were the most abundant bird species in Banting-Jenjarom oil palm plantation. On the contrarily, one species namely *Pycnonotus brunneus* - Asian Red-eyed Bulbul were considered as the rarest (0.09%) (Table 1).

Bird Species Composition with Relative Abundance in Sungai Pelek Oil Palm Plantation. Similarly, a total of 530 individuals of birds belonging to 65 species and 33 families were observed from oil palm plantation in Sungai Pelek. Three bird species i.e.; *Halcyon smyrnensis* - White-throated Kingfisher (12.81%), *A. tristis* - Common Myna (9.04%), and *Pycnonotus goiavier* - Yellow-vented Bulbul (8.85%) were the most abundant birds species observed with higher number of individuals. In addition, 10 species of birds such as *Orthotomus ruficeps* – Ashy Tailorbird, *Aviceda leuphotes* – Black Baza, *Monticola solitarius* – Blue Rock Thrush, *Anthreptes malacensis* – Brown-throated Sunbird, *Orthotomus atrogularis* – Dark-necked Tailorbird, *Dicrurus paradiseus* – Greater Racket-tailed Drongo, *Aegithina viridissima* – Green Iora, *Pycnonotus eutilotus* – Puff-backed Bulbul, *Rhipidura albicollis* – White-throated Fantail, and *Ixobrychus sinensis* – Yellow Bittern were the birds that considered as rare in oil palm plantation in Sungai Pelek (0.19% each) (Table 1).

Comparison of Bird Species Composition in Oil Palm Plantations at Different Regions. 56 species of birds have been observed from oil palm plantations in Teluk Panglima Garang-Pulau Carey and Banting-Jenjarom. However, 15 species of birds were sampled only in oil palm plantations in Teluk Panglima Garang-Pulau Carey which were absent in oil palm plantations in Banting-Jenjarom. Reciprocally, 19 bird species were observed in oil palm plantations in Banting-Jenjarom, but absent in oil palm plantations in Teluk Panglima Garang-Pulau Carey. There were 21 bird species commonly detected in oil palm plantations in Teluk Panglima Garang-Pulau Carey and Banting Jenjarom (Table 1).

Comparing Teluk Panglima Garang-Pulau Carey and Sungai Pelek, 26 bird species were common in both habitats, 10 bird species were only found in the oil palm plantations at Teluk Panglima Garang-Pulau Carey; not found at all in the oil palm plantations at Sungai Pelek. Similarly, 38 species of birds were found in Sungai Pelek but were absent atTeluk Panglima Garang-Pulau Carey (Table 1).

Comparing oil palm plantations in Banting-Jenjarom and Sungai Pelek; 23 species were commonly found in both habitats. Only 17 species were detected in the oil palm plantations in Banting-Jenjarom but not found in oil palm plantations at Sungai Pelek. On the other hand, 41

species were found in oil palm at Sungai Pelek but absent in oil palm at Banting-Jenjarom (Table 1).

Comparing results of the One-way ANOVA test showed there was a statistically significant difference between the avian relative abundance of the different regions ($F_{2, 170}$=5.68, p=0.041). Tukey's (HSD) test revealed that the avian relative abundance in oil palm plantations was significantly higher in Teluk Panglima Garang-Pulau Carey (13.19±1.68 birds, p<0.05) and Banting-Jenjarom (12.29±1.65 birds, p<0.05) compared to Sungai Pelek (6.17±0.96 birds). However, there was no significant difference between Teluk Panglima Garang-Pulau Carey and Banting Jenjarom (p>0.05).

Table 1. Bird species composition with relative abundance in oil palm plantations at three different regions in Selangor, Malaysia.

			Teluk Panglima Garang-Pulau Carey		Banting-Jenjarom		Sungai Pelek	
Family	Scientific name	Common name	No. of captures	%	No. of captures	%	No. of captures	%
Cisticolidae	*Orthotomus sutorius*	Common Tailorbird	127	11.20	135	12.77	0	0.00
Sturnidae	*Acridotheres tristis*	Common Myna	126	11.11	87	8.23	48	9.04
Columbidae	*Spilopelia chinensis*	Spotted Dove	105	9.26	55	5.20	24	4.52
Accipitridae	*Spilornis cheela*	Crested Serpent Eagle	88	7.76	38	3.60	19	3.58
Sturnidae	*Acridotheres javanicus*	Javan Myna	80	7.05	51	4.82	0	0.00
Muscicapidae	*Copsychus saularis*	Oriental Magpie-robin	71	6.26	126	11.92	40	7.53
Halcyonidae	*Halcyon smyrnensis*	White-throated Kingfisher	69	6.08	46	4.35	68	12.81
Oriolidae	*Oriolus chinensis*	Black-naped Oriole	65	5.73	40	3.78	10	1.88
Pycnonotidae	*Pycnonotus goiavier*	Yellow-vented Bulbul	62	5.47	100	9.46	47	8.85
Cuculidae	*Eudynamys scolopaceus*	Asian Koel	57	5.03	0	0.00	4	0.75
Columbidae	*Geopelia striata*	Zebra Dove	56	4.94	104	9.84	18	3.39
Phasianidae	*Gallus gallus*	Red Junglefowl	42	3.70	15	1.42	6	1.13
Cisticolidae	*Orthotomus ruficeps*	Ashy Tailorbird	35	3.09	26	2.46	1	0.19
Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	19	1.68	15	1.42	19	3.58
Cisticolidae	*Orthotomus atrogularis*	Dark-necked Tailorbird	13	1.15	0	0.00	1	0.19
Cisticolidae	*Prinia flaviventris*	Yellow-bellied Prinia	10	0.88	0	0.00	4	0.75
Pycnonotidae	*Tricholestes criniger*	Hairy-backed Bulbul	8	0.71	0	0.00	0	0.00
Rhipiduridae	*Rhipidura albicollis*	White-throated Fantail	8	0.71	0	0.00	1	0.19
Nectariniidae	*Leptocoma calcostetha*	Copper-throated Sunbird	8	0.71	7	0.66	0	0.00
Ardeidae	*Ardea purpurea*	Purple Heron	8	0.71	0	0.00	9	1.69
Corvidae	*Corvus splendens*	House Crow	7	0.62	0	0.00	9	1.69
Coraciidae	*Eurystomus orientalis*	Dollarbird	7	0.62	7	0.66	8	1.51
Timaliidae	*Mixornis gularis*	Pin-striped Tit-babbler	7	0.62	11	1.04	0	0.00
Halcyonidae	*Todiramphus chloris*	Collared Kingfisher	6	0.53	17	1.61	2	0.38
Estrildidae	*Lonchura punctulata*	Scaly-breasted Munia	6	0.53	7	0.66	8	1.51
Corvidae	*Corvus macrorhynchos*	Large-billed Crow	5	0.44	11	1.04	0	0.00
Scolopacidae	*Gallinago stenura*	Pin-tailed Snipe	5	0.44	0	0.00	0	0.00
Rhipiduridae	*Rhipidura javanica*	Malaysian Pied Fantail	5	0.44	0	0.00	5	0.94
Muscicapidae	*Ficedula mugimaki*	Mugimaki Flycatcher	5	0.44	0	0.00	0	0.00
Laniidae	*Lanius cristatus*	Brown Shrike	4	0.35	0	0.00	8	1.51
Charadriidae	*Vanellus malabaricus*	Yellow-wattled Lapwing	4	0.35	0	0.00	5	0.94
Hirundinidae	*Hirundo rustica*	Barn Swallow	3	0.26	7	0.66	6	1.13
Meropidae	*Merops philippinus*	Blue-tailed Bee-eater	3	0.26	14	1.32	12	2.26
Scolopacidae	*Calidris alpina*	Dunlin	3	0.26	0	0.00	0	0.00
Charadriidae	*Charadrius dubius*	Little Ringed Plover	3	0.26	8	0.76	0	0.00
Cisticolidae	*Prinia rufescens*	Rufescent Prinia	2	0.18	0	0.00	3	0.56
Cuculidae	*Centropus bengalensis*	Lesser Coucal	2	0.18	0	0.00	5	0.94
Meropidae	*Merops viridis*	Blue-throated Bee-eater	0	0.00	14	1.32	0	0.00
Estrildidae	*Lonchura maja*	White-headed Munia	0	0.00	14	1.32	0	0.00
Estrildidae	*Lonchura atricapilla*	Chestnut Munia	0	0.00	14	1.32	2	0.38
Aegithinidae	*Aegithina viridissima*	Green Iora	0	0.00	10	0.95	1	0.19
Nectariniidae	*Anthreptes malacensis*	Brown-throated Sunbird	0	0.00	9	0.85	1	0.19

Dicaeidae	*Prionochilus thoracicus*	Scarlet-breasted Flowerpecker	0	0.00	9	0.85	0	0.00
Picidae	*Chrysocolaptes guttacristatus*	Greater Flameback	0	0.00	7	0.66	0	0.00
Cuculidae	*Phaenicophaeus diardi*	Black-bellied Malkoha	0	0.00	6	0.57	0	0.00
Accipitridae	*Nisaetus alboniger*	Blyth's Hawk-eagle	0	0.00	6	0.57	0	0.00
Accipitridae	*Haliastur indus*	Brahminy Kite	0	0.00	6	0.57	4	0.75
Megalaimidae	*Megalaima haemacephala*	Coppersmith Barbet	0	0.00	6	0.57	0	0.00
Campephagidae	*Pericrocotus divaricatus*	Ashy Minivet	0	0.00	5	0.47	4	0.75
Alcedinidae	*Alcedo atthis*	Common Kingfisher	0	0.00	5	0.47	0	0.00
Columbidae	*Columba livia*	Rock Pigeon	0	0.00	4	0.38	2	0.38
Accipitridae	*Butastur indicus*	Grey-faced Buzzard	0	0.00	5	0.47	0	0.00
Cuculidae	*Centropus sinensis*	Greater Coucal	0	0.00	4	0.38	6	1.13
Accipitridae	*Nisaetus cirrhatus*	Changeable Hawk Eagle	0	0.00	3	0.28	4	0.75
Pellorneidae	*Trichastoma rostratum*	White-chested Babbler	0	0.00	3	0.28	0	0.00
Pycnonotidae	*Pycnonotus brunneus*	Asian Red-eyed Bulbul	0	0.00	1	0.09	0	0.00
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	0	0.00	0	0.00	15	2.82
Ardeidae	*Ardea cinerea*	Grey Heron	0	0.00	0	0.00	10	1.88
Accipitridae	*Pernis ptilorhyncus*	Crested Honey Buzzard	0	0.00	0	0.00	9	1.69
Ardeidae	*Ixobrychus cinnamomeus*	Cinnamon Bittern	0	0.00	0	0.00	9	1.69
Picidae	*Dinopium javanense*	Common Flameback	0	0.00	0	0.00	6	1.13
Sturnidae	*Aplonis panayensis*	Asian Glossy Starling	0	0.00	0	0.00	5	0.94
Campephagidae	*Lalage nigra*	Pied Triller	0	0.00	0	0.00	5	0.94
Dicruridae	*Dicrurus leucophaeus*	Ashy Drongo	0	0.00	0	0.00	5	0.94
Columbidae	*Treron vernans*	Pink-necked Green Pigeon	0	0.00	0	0.00	5	0.94
Hemiprocnidae	*Hemiprocne comata*	Whiskered Treeswift	0	0.00	0	0.00	4	0.75
Charadriidae	*Vanellus indicus*	Red-wattled Lapwing	0	0.00	0	0.00	4	0.75
Anatidae	*Dendrocygna javanica*	Lesser Whistling-duck	0	0.00	0	0.00	3	0.56
Tytonidae	*Tyto alba*	Common Barn Owl	0	0.00	0	0.00	3	0.56
Corvidae	*Corvus enca*	Slender-billed Crow	0	0.00	0	0.00	3	0.56
Scolopacidae	*Philomachus pugnax*	Ruff	0	0.00	0	0.00	3	0.56
Pycnonotidae	*Ixos malaccensis*	Streaked Bulbul	0	0.00	0	0.00	3	0.56
Meropidae	*Merops orientalis*	Little Green Bee-eater	0	0.00	0	0.00	3	0.56
Ardeidae	*Egretta garzetta*	Little Egret	0	0.00	0	0.00	3	0.56
Apodidae	*Apus nipalensis*	House Swift	0	0.00	0	0.00	2	0.38
Ciconiidae	*Mycteria leucocephala*	Painted Stork	0	0.00	0	0.00	2	0.38
Picidae	*Micropternus brachyurus*	Rufous Woodpecker	0	0.00	0	0.00	2	0.38
Dicaeidae	*Dicaeum minullum*	Plain Flowerpecker	0	0.00	0	0.00	2	0.38
Ardeidae	*Butorides striata*	Little Heron	0	0.00	0	0.00	2	0.38
Strigidae	*Strix seloputo*	Spotted Wood Owl	0	0.00	0	0.00	2	0.38
Falconidae	*Microhierax fringillarius*	Black-thighed Falconet	0	0.00	0	0.00	2	0.38
Accipitridae	*Aviceda leuphotes*	Black Baza	0	0.00	0	0.00	1	0.19
Muscicapidae	*Monticola solitarius*	Blue Rock Thrush	0	0.00	0	0.00	1	0.19
Dicruridae	*Dicrurus paradiseus*	Greater Racket-tailed Drongo	0	0.00	0	0.00	1	0.19
Ardeidae	*Ixobrychus sinensis*	Yellow Bittern	0	0.00	0	0.00	1	0.19
Pycnonotidae	*Pycnonotus eutilotus*	Puff-backed Bulbul	0	0.00	0	0.00	1	0.19
		Total	1134		1057		531	

Comparison of Bird Diversity Indices in Oil Palm Plantations at Different Regions. Analysis showed that the diversity of bird species in oil palm plantations at Sungai Pelek is more diverse (Shannon-Wiener Diversity Index H; 3.52) and richest in avian species (Margalef's Richness Index R_1; 10.2) compared to both oil palm plantations in Teluk Panglima Garang-Pulau Carey and Banting-Jenajrom. However, avian species in both oil palm plantations in Teluk Panglima Garang-Pulau Carey and Banting-Jenjarom were most evenly distributed (Pielou's Evenness Index E; 0.82) compared to the oil palm plantations in Sungai Pelek (Table 2).

Table 2. Diversity indices of bird species in oil palm plantations at three different regions in Selangor, Malaysia

Habitat	Shannon-Wiener Diversity Index H	Margalef's Richness Index R_1	Pielou's Evenness Index E
Teluk Panglima Garang-Pulau Carey	2.96	5.12	0.82
Banting-Jenjarom	3.05	5.74	0.82
Sungai Pelek	3.52	10.2	0.84

5. DISCUSSION

Birds are bio-indicators of the health of ecosystems. They are more visible, easy to learn and are closely related to the vegetation structure. Birds often choose to utilize a variety of habitats and dependent on the quality and productivity of the habitat in terms of food availability, shelter, and breeding areas to maintain populations [19]. Monitoring bird association in monoculture plantations is important to understand the importance, productivity, and suitability of certain areas in influencing habitat selection and distribution of birds.

The number of bird species inventory in in the oil palm plantation at Teluk Panglima Garang-Pulau Carey, Banting-Jenjarom and Sungai Pelek was 37, 41 and 65 respectively. By referring to the result, Sungai Pelek has the highest species richness when compared to the other two areas. However, the total number of individuals at that area recorded a lowest at 531 compared to 1134 and 1057 in Teluk Panglima Garang-Pulau Carey and Banting-Jenjarom. Therefore, we can say that the vicinity of the oil palm plantations at the Sungai Pelek provide better habitats for birds. Apart from close to the mangroves and Bagan Lalang Beach, the location of oil palm plantations is also close to the edge of forest. Moreover, residents in Sungai Pelek are active in planting activity including vegetables, fruits, as well as cassava and sweet potatoes. The vegetables gardens and orchards are cultivated massively not far from the oil palm plantations. There are also abandoned plantations between the oil palm plantations. Some of the plantations also have pond and drains that flows clean water. Based on [20], the characteristics of the adjacent landscapes of the oil palm plantation such as mangroves, forests, and near water bodies can promote high diversity and species richness due to the wide diversity of habitat characteristics and increase in prey availability. However, the observations hint that most of the species recorded in Sungai Pelek showed the behaviour of movement in oil palm plantation instead of foraging and nesting. This is the factor that causes the number of individuals observed in oil palm plantation at Sungai Pelek is lower than the other two places.

Food sources may regulate population distribution of bird species [21], and fruits abundance may affect species composition and foraging behaviour of frugivorous birds [22]. Opening gaps will increase shrub that often leads in growth of variety of flowers and fruits, which is the main diet for bird species. Tree diversity and richness may also affect the provision and utilization of the food and ultimately affect the distribution and diversity of birds. Based on [23], different bird species would be attracted to the different vegetation structure such as large area of seedlings, regenerating or early successional plants for their food sources [24]. For example, frugivorous birds are always concentrated where fruits are abundance, as their diet consisted of more than 50% of fruits [25]. From the observation, 24.4% from the total of 86 species of birds are frugivorous. [26] stated that deforestation causes gaps that enhance the growth of shrubs that would attract understorey bird species such as Common Tailorbird and Common Myna.

The results of a larger number of tailorbird, myna, dove, robin, and bulbul in oil palm plantations in Teluk Panglima Garang-Pulau Carey and Banting-Jenjarom shows that forest logging is one of the key determinants of richness effects and the distribution of this bird species [27]. We also can assume that these species of birds are not affected by the disturbance. These avian species are considered as open country birds and utilized open area such as parks, gardens, and plantations.

[23] reported that the diversity of songbird species will increased in harvested area. They often choose internal edges, clearings, and forest logging areas [28]. 44.2% of bird species discovered at the oil palm plantation in Teluk Panglima Garang-Pulau Carey, Banting-Jenjarom, and Sungai Pelek were Passeriformes.

Contrarily, observation of several rarest species at oil palm plantation of Banting-Jenjarom and Sungai Pelek such as Asian Red-eyed Bulbul, Black Baza, Blue Rock Thrush, Greater Racket-tailed Drongo, Puff-backed Bulbul, and Yellow Bittern shows that these bird species are less resilience to disturbance and are habitat specialist.

Regarding the status of birds, there are 57 resident bird species, 15 resident and migratory bird species, 9 migratory bird species, 4 feral bird species, and 1 vagrant bird species observed at the oil palm plantations in Teluk Panglima Garang-Pulau Carey, Banting-Jenjarom, and Sungai Pelek. In the case of migratory birds, there are 5 species of migratory birds had been observed present at both oil palm plantations in Teluk Panglima Garang-Pulau Carey and Sungai Pelek, whereas 4 species of migratory birds had been observed at oil palm plantations in Banting-Jenjarom. This indicates that the numbers of bird species that benefit from the areas are almost the same.

Overall, these findings indicate that the bird community is dynamic and can change in relation to the deforestation, conversion from forest to monotonous plantation or the vicinity of the particular area. Deforestation creates canopy gaps by the removal of trees and the establishment of the plantation causes less plant diversity and hence influence the richness and diversity of birds through food sources, increased in nest predation, and brood parasitism [29]. Our result also suggest that, despite the relatively oil palm plantation is adjacent to the mangrove, oil palm plantations are relatively impermeable habitat for many species of birds, including species of high conservation value. For more effective conservation of birds in oil palm plantations, the larger forest patches are needed in the landscapes. Moreover, whenever possible, more oil palm plantations should be developed adjacent to one or more larger continuous areas of forest, which could be a source of habitat. This further indicates that in order to increase the value of forest patches for bird diversity and conservation in oil palm plantations, quality of habitat is one of the key factors that needed to be repaired.

6. CONCLUSION

The vegetation structure and the vicinity on that particular area may affect the distribution of bird species. There are bird species identified of which listed as Nearly Threatened (NT) at oil palm plantations in Banting-Jenjarom and Sungai Pelek based on [30]. The species are Green Iora (*Aegithina viridissima*), Scarlet-breasted Flowerpecker (*Prionochilus thoracicus*), Black-bellied Malkoha (*Phaenicophaeus diardi*), White-chested Babbler (*Trichastoma rostratum*), Streaked Bulbul (*Ixos malaccensis*), Painted Stork (*Mycteria leucocephala*), and Puff-backed Bulbul (*Pycnonotus eutilotus*). Those species should therefore have high priority for conservation and monitoring. The inventories of bird species in the oil palm plantation may be useful in predicting the bird changes under various human disturbances, and ultimately protecting the Malaysian avifauna.

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References

[1] Rajpar, M.N. and M. Zakaria. 2011. Bird species abundance and their correlationship with microclimate and habitat variables at natural wetland reserve, Peninsular Malaysia. International J. Zoology, Article ID 758573, 17 pages.

[2] Malaysian Nature Society. 2010. Checklist of the Malaysian birds with information about occurrence and status. URL: http://www.birdingmalaysia.com/lists.php. Retrieved on 23rd April 2015.

[3] Koh, L.P. and Wilcove, D. S. 2009. Oil palm: disinformation enables deforestation. Trends in Ecology and Evolution 24: 67-68.

[4] Koh, L.P. and Wilcove, D.S. 2008. Is oil palm agriculture really destroying tropical biodiversity? Conservation Letters 1: 60-64.

[5] Peh, K.S.H., Sodhi, N.S., Jong, J.D., Sekercioglu, C.H., Yap, C.A.M. and Lim, S.L.H. 2006. Conservation value of degraded habitats for forest birds in Southern Peninsular Malaysia. Diversity and Distribution 12: 572-581.

[6] White, J.G, Antos, M.J., Fitzsimons, J.A, Palmer, G.C. 2005. Non-uniform bird assemblages in urban environments: the influence of streetscape vegetation. Landscape and Urban Planning, 71: 123-135.

[7] Shahabuddin, G., Kumar, R. 2007. Effects of extractive disturbance on bird assemblages, vegetation structure and floristics in tropical scrub forest, Sariska Tiger Reserve, India. Forest Ecology and Management. 246 (2-3): 175-185.

[8] Tabarelli, M., Aguiar, A.V., Ribeiro, M.C., Metzger, J.P., Peres, C.A. 2010. Prospects for biodiversity conservation in the Atlantic Forest: Lessons from aging human-modified landscapes. Biological Conservation 143: 2328-2340.

[9] Kukreti, M. and Bhatt, D. 2014. Birds of Lansdowne forest division and adjacent suburban landscapes, Garhwal Himalayas, Uttarakhand, India: community structure and seasonal distribution. Biodiversitas 15: 80-88.

[10] World Bank Report. 2013. Bird species; threatened in Malaysia. Retrieved on 13th April 2015 at URL: http://ieconomics.com/bird-species-threatened-in-malaysia

[11] Yaap, B., Struebig, M., Paoli, G. and Koh, L. 2010. Mitigating the biodiversity impacts of oil palm development. CAB Reviewers: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 5: 1-11.

[12] RSPO. 2013. RSPO Principles and Criteria for Sustainable Palm Oil Production. 70 pp.

www.rspo.org/file/PnC_RSPO_Rev1.pdf. Accesssed on 27th March 2015.

[13] Azhar, B., Lindenmayer, D.B., Wood, J., Fischer, J., Manning, A., McElhinny, C. and Zakaria, M. 2011. The conservation value of oil palm plantation estates, small holdings and logged peat swamp forest for birds. Forest Ecology and Management 262: 2306-2315.

[14] Edwards, D.P., Hodgson, J.A., Hamer, K.C., Mitchell, S.L., Ahmad, A.H., Cornell, S.J. and Wilcove, D.S. 2010. Wildlife-friendly oil palm plantations fail to protect biodiversity effectively. Conservation Letters 3: 236-242.

[15] Peh, K.S.H., de Jong, J., Navjot, S.S., Susan, L.H.L., Charlotte, A.M.Y. 2005. Lowland rainforest avifauna and human disturbance: Persistence of primary forest birds in selectively logged forests and mixed-rura; habitats of southern Peninsular Malaysia. Biological Conservation, Elsevier.

[16] Rajpar, M.N., and Zakaria, M. 2010. Density and diversity of water birds and terrestrial birds at Paya Indah Wetland Reserve, Selangor, Peninsular Malaysia. Journal of Biological Science. Vol. 10, ed. 7, pp. 658-666.

[17] Kwok, H.K., Corlett, R.T. 2000. The bird community of a natural secondary forest and a *Lophostemon confertus* plantation in Hong Kong, South China. Forest Ecology and Management. Vol. 130,pp. 227-234.

[18] Scharringa, J. 2005. CD-ROM of birds of tropical Asia 3. Bird Song International. Netherland. 2005.

[19] Soderstrom, B. and T. Part. 2000. Influence of landscape scale on farmland birds in semi-natural pastures. Conser. Biol., 14: 522-533.

[20] Cintra, R. and L.N. Naka. 2012. Spatial variation in bird community composition in relation to topographic gradient and forest heterogeneity in a Central Amazonian Rainforest. Intl. J. Ecology.

[21] Johnson, M.D. and T.W. Sherry. 2001. Effects of food availability on the distribution of migratory warblers among habitats in Jamaica. J. Anim, Ecol., 70: 546-560.

[22] Moegenburg, S.M. and D.J. Levey. 2003. Do frugivore respond to fruit harvest? An experimental study of short-term response. Ecology, 84: 2600-2612.

[23] Campbell, S.P., J.W. Witham and M.L. Hunter Jr., 2007. Long-term effects of group selection timber harbesting on abundance of forest birds. Conserv. Biol., 21: 1218-1229.

[24] DeGraaf, R.M. and M. Yamasaki. 2003. Options for managing early successional forest and shrubland bird habitats in the north-eastern United States. Forest Ecol. Manage., 185: 179-191.

[25] Renton, K. 2001. Lilac-crowned Parrot diet and food resource availability: Resource tracking by a parrot seed predator. Condor, 103: 62-69.

[26] Doyon, F., D. Gagnon and J.F. Giroux. 2005. Effects of strip and single tree selection cutting on birds and their habitat in a South-Western Quebec Northern Hardwood forest. Forest Ecol. Manag., 209: 101-115.

[27] McShea, W.J. and J.H. Rappole. 2000. Managing the abundance and diversity of breeding bird populations through manipulation of deer populations. Conserv. Biol., 14: 1161-1170.

[28] King, D.I. and R.M. Degraff. 2004. Effects of group selection opening size on the distribution and reproductive success of an early-successional shrubland birds. Forest Ecol. Manage., 190: 179-185.

[29] Lemelin, L.V., L. Imbeau, M. Darveau, and D. Bordage. 2007. Local, short-term effects of forest harvesting on breeding waterfowl and Common Loon in forest-dominant landscapes of Quebec. Avian Conserv. Ecol. 2:pp. 10.

[30] IUCN 2014. The IUCN Red List of Threatened Species. Version 2014.3.