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Abstract. This study was conducted to determine the species diversity of birds and to establish a checklist of bird species in Lingai, Terengganu, Malaysia. Two different sampling stations were chosen; which was old growth vegetation and agriculture area. Mist netting was conducted for five consecutive days, monthly from November 2012 to April 2013. A total of 83 individuals belonging to 14 families were sampled and recorded. From 25 different species, 59 individuals (71.1%) were netted from old growth vegetation while another 24 (28.9%) were netted from agriculture area. From the study, the Shannon-Weiner index was calculated where old growth vegetation gave a higher value of H'=2.526, than that of agriculture area with a value of H'=2.126. The test shows no significant difference in terms of bird diversity (t= 0.0074, df = 81, P>0.05) between both sites. The dominant species caught was stripe-throated bulbul (*Pycnonotus fynlaysoni*) followed by collared scops owl (*Ottus bakkamoena*). As a conclusion, the result shows that Lingai has a diverse bird community that must be conserved and more studies should be made in order to understand better on the diversity of birds in Lingai.

1. Introduction

Some birds are considered keystone species as their presence in or disappearance from an ecosystem affects other species indirectly. They are an integral part of the ecosystem and serve many important purposes, including natural biological control and seed dispersal agents. The distribution of birds is largely governed by the availability of habitat. Usually, their habits and behaviour are closely linked to their habitat. Birds need for habitat depends on their species' food preferences, foraging strategies, and nest site requirements [2].

Old-growth vegetation supports diverse bird community more than mature stand. The abundant of coarse woody debris was the main structural feature affecting bird communities; tree-size variation was additionally important for species richness [17]. Diverse food supply and cover conditions produced by co-occurring tree species are probably a reason why mixed stands have a more abundant bird fauna [4].

While for birds in agricultural area, the different patterns of woody vegetation are likely to be beneficial in making the bird population abundant. The more native trees make it able to support more biodiversity thus, support more birds in that area. Habitats for birds vary with the structure and composition of the vegetation in a species-specific manner [6].

The study area, Lingai is chosen because it is adjacent to the Belara Forest Reserve. To date, there is no substantial study of birds being made in Belara Forest Reserve. Thus, as Lingai is near to Belara Forest, it is important to understand the diversity of birds there because it can reflects the diversity in Belara itself. The result gained from the study in Lingai can be a basic information and a benchmark for any upcoming researches. By having two sampling sites; agriculture area and old growth vegetation, the

comparison between two different habitats can be made and and the pattern of bird fauna, determined. Hence, this study contributes to the knowledge of the diversity and provides updated checklist of birds of Lingai.

2. Methodology

This study was done in the forest habitat of Lingai, (5° 25' North, 103° 0' East) which is situated at 30km northwest of Kuala Terengganu (Figure 1). This study was conducted for five days monthly from November 2012 to April 2013 in Lingai. The climate for this study area is of the tropical monsoon with the average temperature ranging between 23-29°C in a year 2012 and average rainfall between 104mm – 620.3mm monthly. The total days for the sampling recorded were 30.

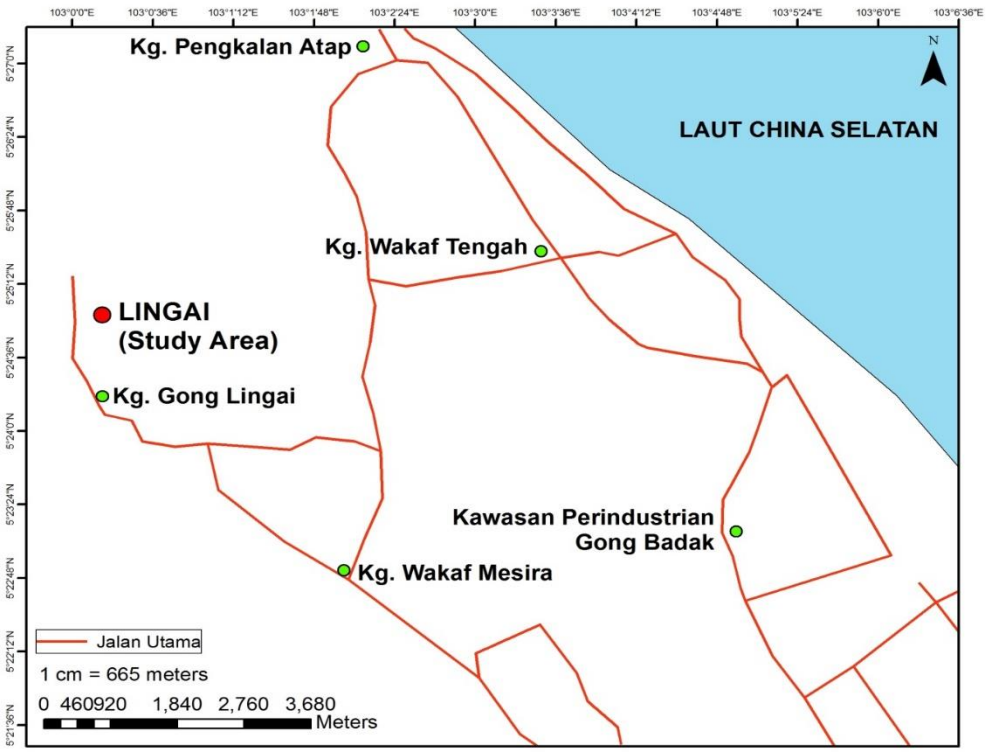

Figure 1. Map showing the study site, Lingai

2.1. Sampling site

Two different sites were chosen for the sampling, old growth vegetation and agricultural area. Old growth vegetation which was Station A (5° 25' North, 103° 0' East) is located adjacent to a secondary forest which is featured with native habitat. The common plants found in this area are fruit tree species including ciku (*Manilkara zapota*), jackfruit (*Artocarpus heterophyllus*) and forest tree species such as merbau (*Intsia palembanica).*

Agriculture area which was Station B (5° 25' North, 103° 0' East) which is a disturbed area. This station is dominated by vegetation such as *Durio zibethinus (*durian*), Nephelium Lappaceum* L (rambutan), *Parkia* spp.(petai*), Lansium Domesticum Correa* (langsat), *Garcinia Mangostama* L *(*mangosteen*), Artocarpus Heterophyllus* Lamk (Jackfruit) and *Hevea brasiliensis* (rubber) (Ong, 2011).

2.2. Mist netting

Mist netting was used to sample birds. The mist nets (2.5 m x 9 m x 4 m) were placed randomly across bird flyways such as trails or forest gaps. The nets were left open from 0700 till 1900 throughout the

five days of sampling. The mist nets were set loose so they would form pouches where the birds would usually end up. Eight mist nets were used for each station which made up a total of 16 nets for both sites. The mist nets were checked every four hours. The trapped birds were collected for identification process.

2.3. Birds handling

The netted birds were weighed and body measurements were taken for identification. The birds were identified following the guide book Birds of South- East Asia by Craig Robson (2000) and Birds of Peninsular Malaysia and Singapore by G.W. H Davison and Chew Yen Fook (2003). Each netted bird was marked with a unique red permanent ink (unipaint marker) before being released back at the same location where they were netted.

3. Result

3.1 Birds in Lingai

A total of 83 individuals belonging to 15 families were sampled throughout the study period. The birds comprised of 25 different species (Table 1). From these numbers, 59 individuals (71.1%) were netted from old growth vegetation (Station A) while another 24 individuals (28.9%) were netted from agriculture site (Station B) (Figure 2). The birds caught from Station A comprised of 12 families and 20 species while those from Station B belonged to seven families and ten species. This shows that a higher number of families and species were caught in Station A. As for bird species, the stripe-throated bulbul (*Pycnonotus fynlaysoni)* species was the most netted bird species during the study period for both stations.

Station A recorded a total of 17 of stripe-throated bulbul *(Pycnonotus fynlaysoni)* which is the highest number of birds netted followed by greater-racquet tailed drongo *(Dicrurus paradiseus)* with seven individuals and six individuals of puff-throated babbler (*Pellorneum ruficeps*). There were nine species recorded as the lowest number of birds netted. The species were yellow-bellied prinia (*Prinia flaviventris*), tiger shrike (*Lanius tigrinus*), plaintive cuckoo (*Cacomantis merulinus*), orange-bellied flowerpecker (*Dicaeum trigonostigma*), Asian brown flycatcher (*Muscicapa dauurica*), rufous-tailed tailorbird (*Orthotomus sericeus*), buff-rumped woodpecker (*Meiglyptes tristis*), black-headed bulbul (*Pycnonotus atriceps*) and Abbot's babbler (*Malacocincla abbotti*) with only one individual netted for each species.

Station B recorded collared-scops owl (*Ottus bakkamoena*), white-throated kingfisher (*Halcyon smymensis*) and green-winged pigeon (*Chalcophaps indica*) were the most abundant bird species with a total of four individuals respectively. The lowest catch were jambu fruit dove (*Ptilinopus jambu*), plaintive cuckoo (*Cacomantis merulinus*), purple-naped sunbird (*Hypogramma hypogrammicum*), buff-necked woodpecker (*Meiglyptes tukki*) and Abbot's babbler (*Malacocincla abbotti*) with only one individual respectively. From the study, the Shannon-Weiner index was calculated where old growth vegetation gave a higher value of H'=2.526, than that of agriculture area with a value of H'=2.126. The test shows no significant difference in terms of bird diversity ($t= 0.0074$, $df = 81$, $P>0.05$) between both sites (Figure 3).

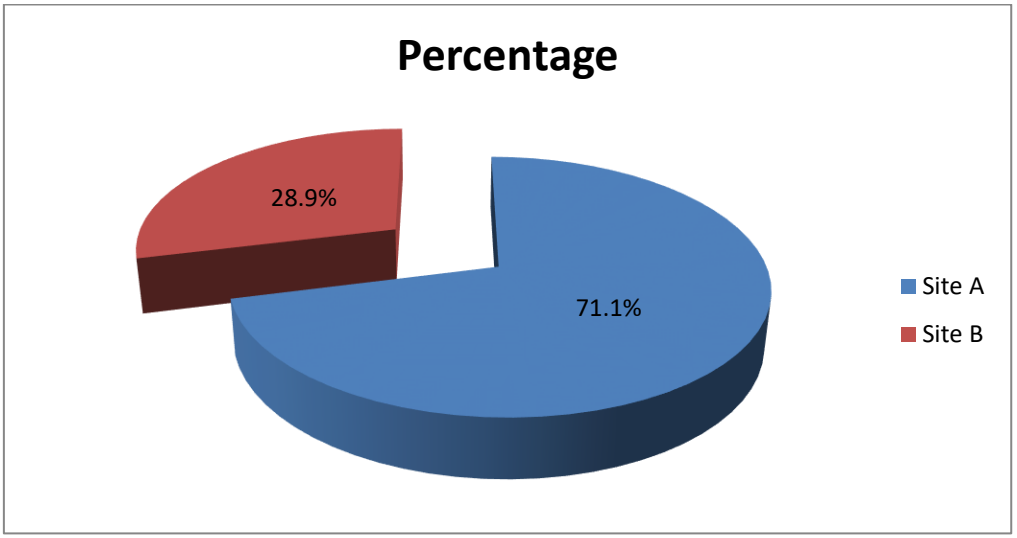

Figure 2. Percentage of birds netted based on site

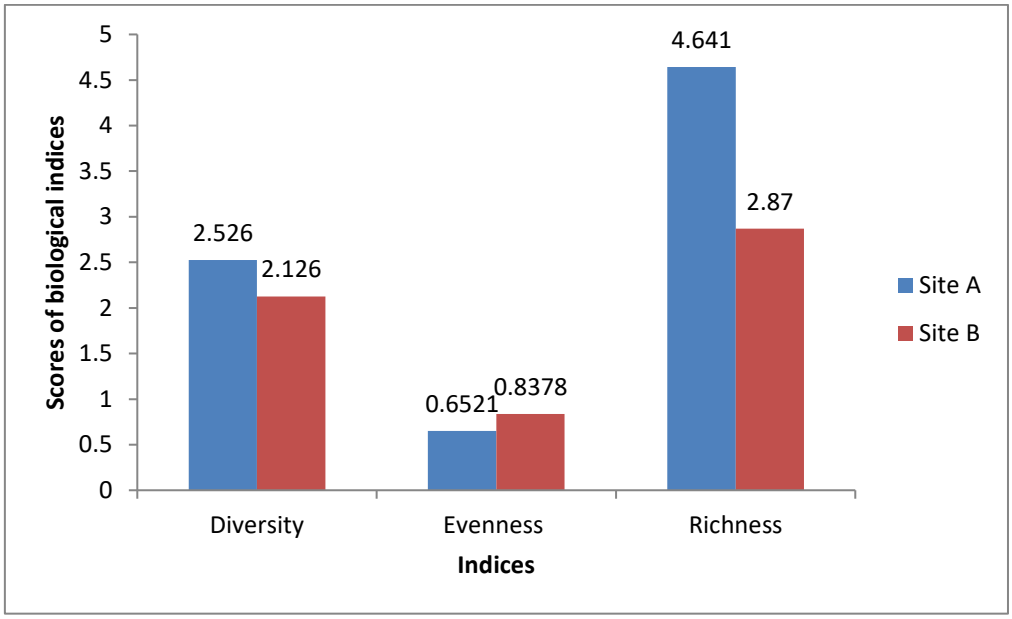

Figure 3. Comparison between diversity indices of birds for both station A and B in Lingai

Table 1. List of distribution status of birds in Lingai, Kuala Terengganu

Family	Common Name	Scientific Name	Status
Cisticolidae	Yellow-bellied prinia	*Prinia flaviventris*	R
Columbidae	Jambu fruit dove	*Ptilinopus jambu*	R
Columbidae	Green-winged pigeon	*Chalcophaps indica*	R
Corvidae; Cinclosomatinae	Tiger shrike	*Lanius tigrinus*	M
Corvidae; Dicrurinae	Greater racket-tailed drongo	*Dicrurus paradiseus*	R
Corvidae	Crested jay	*Platylophus galericulatus*	R
Cuculidae	Plaintive cuckoo	*Cacomantis merulinus*	R
Dicaeidae	Orange-bellied flowerpecker	*Dicaeum trigonostigma*	R
Halcyonidae	White-throated kingfisher	*Halcyon smymensis*	R
Meropidae	Chestnut-headed bee-eater	*Merops leschenaulti*	R
Muscicapidae; Muscicapinae	Asian brown flycatcher	*Muscicapa dauurica*	M
Muscicapidae	White-rumped shama	*Pcopsychus malabaricus*	R
Nectariniidae	Little spiderhunter	*Arachnothera longirostra*	R
Nectariniidae	Brown-throated sunbird	*Anthreptes malacensis*	R
Nectariniidae	Purple-naped sunbird	*Hypogramma hypogrammicum*	R
Pardalotidae	Rufous-tailed tailorbird	*Orthotomus sericeus*	R
Pellorneidae	Abbot's babbler	*Malacocincla abbotti*	R
Picidae	Buff-necked woodpecker	*Meiglyptes tukki*	R
Picidae	Rufous piculet	*Sasia abnormis*	R
Picidae	Buff-rumped woodpecker	*Meiglyptes tristis*	R
Pycnonotidae	Stripe-throated bulbul	*Pycnonotus fynlaysoni*	R
Pycnonotidae	Black-headed bulbul	*Pycnonotus atriceps*	R
Strigidae	Collared-scops owl	*Ottus bakkamoena*	R
Sylviidae; Sylviinae	Puff-throated babbler	*Pellorneum ruficeps*	R
Sylviidae; Sylviinae	Black-capped babbler	*Pellorneum capistratum*	R

4. Discussion

4.1 Diversity of birds in Lingai

Generally, stripe-throated bulbul (*Pycnonotus fynlaysoni)* was the most netted species throughout the sampling period in Lingai. This bird species is a common bird that can be found easily in forests in Terengganu [22]. Station A (Old Growth Vegetation) was recorded higher catch with 20 species than Station B (Agriculture Area) with ten species. This is related to the condition and vegetation type of both stations which are different. Station A was favoured by more birds to forage in its area and offered a better habitat selection for the birds. While Station B, it was a disturbed area. As reported by [11], the changes in surroundings will lead to the changes in the distribution of species inhabiting the area. So, this would make the birds more abundant in the area with better surroundings.

Stripe-throated bulbul was the most netted bird based on the number of individuals at Station A. This was due to the species having an extremely large range habitat and described as locally common. The

population trend appears to be stable throughout Peninsular Malaysia and was listed as a Least Concern species. The highest birds netted at Station B were collared-scops owl (*Ottus bakkamoena*), white-throated kingfisher (*Halcyon smymensis*) and green-winged pigeon (*Chalcophaps indica*) with a total of four individuals respectively. According to Sibley (1990), the collared-scops owl is a common breeding bird in forests and other well-wooded areas. It nests in a hole in a tree and usually makes it as a home. As the site is an agricultural area, there are many rodents and other small mammals living at the area. This is ample food for the birds to forage and the good habitats make the collared-scops owl species abundant. For green-winged pigeon, it is a widespread resident breeding bird in the tropical and sub-tropical parts of Malaysia. This is a common species in the rainforest and similar dense wet woodlands, farms, gardens and mangroves.

4.2 Diversity of birds in old growth vegetation

Birds have their own unique characteristics that enable them to be a well-known biodiversity and environmental quality indicator [8]. Their diversity could indicate the relation between the habitat and the species itself. High diversity of birds might be due to the high richness and diversity of vegetation such as old trees that enable the birds to adapt for living [15]. According to [17], old-growth hosted both more diverse and more abundant bird communities. Old growth vegetation consists of large trees and snags, multilayered canopy and old decaying woods [12]. Their variety, provide high quality habitat and foraging opportunities for a diverse array of bird species. Bird species in old growth vegetation are dependent on the structures found for their survival. Some bird species are highly mobile, utilizing old growth vegetation for every aspect of their life. This shows from the result that old growth vegetation holds more birds in terms of number of species and number of individuals than agricultural ecosystems. The high resource for food and availability of habitat for the birds to breed make old growth contain more birds.

4.3 Diversity of birds in agriculture area

[1] in their study conducted in agricultural landscapes south of the city of Santiago, Chile suggested that agricultural environment significantly provide habitat for a proportion of bird diversity of central Chile. From their study, it shows that agricultural land cover does affect bird composition which includes abundance and species. However, there are still various species that could persist within the agricultural environment. This is due to the ability of agricultural landscapes to provide some alternative feeding resources to the birds such as seeds and invertebrates [5]. [13] who conducted a comparative study of the relative conservation values of different land uses in southern Peninsular Malaysia for forest bird indicated that 30 years after selective logging, forests can recover 84% of their original forest bird community. This means that the conversion of forest to agricultural activities decreases the bird diversity by 77%. The findings suggested that the agricultural area has detrimental impacts to the biodiversity. However, contrary to their findings, the data collected from Lingai showed that there is no significant difference in terms of bird diversity ($t= 0.0074$, $df = 81$, $P>0.05$) between both sites; in old growth forest and in agriculture area. Thus, Lingai agricultural area still harbours diverse bird species and shows the birds' adaptability to their environment. Based on [14], agricultural landscape may increase local diversity of bird species due to the connection found between landscape and fragmentation of patches. The possibilities of different niches for species in the agriculture area will increase the number of habitats for the birds thus making it still a suitable habitat for the certain bird species.

4.4 Comparison between bird diversity in old growth vegetation and agriculture area in Lingai

A study by [14] in three degraded habitat types in southern Peninsular Malaysia concluded that these habitats harbored a moderate fraction of forest birds with an approximately of 46–76 species. They used the point count method to sample birds for five months. They chose 240 points arbitrarily from a map and aimed to sample habitats in proportion to their occurrence in the human-dominated landscape. Meanwhile in this study, there were 25 species of birds from 14 families recorded from both old growth vegetation and agriculture area of Lingai with a total of 83 individuals netted. Although methodologies

were different (point count and mist netting) the data gained from this study also showed a comprehensive result for both, old growth vegetation and agriculture area. Based on [23], using different methods would give varying results; species that mist netting failed to capture were usually large or those foraging on the wing, and species that point counts failed to detect were usually small, such as sparrows or rare species. Being adjacent to Belara Forest Reserve, Lingai could represent or reflect the forest in terms of vegetation and the animal diversity. Thus, the data collected from this study is a good indicator and could act as a benchmark for any upcoming research. These results could provide novel information useful for land use management and planning in a biodiversity hotspot.

4.5 Species associations of birds

[24] made a study to assess the impact of habitat fragmentation to the birds' community and to confirm that insectivorous bird is the most affected feeding guild. Their results suggested that the decrease in the habitat area had a stronger impact on insectivorous birds when compared to that of frugivores and omnivores. Their results were supported by many other findings including that of [19] and [21]. The result was also consistent with a study by [18] in Lenggong, Perak. They first classified the bird species into three feeding guilds: insectivores, frugivores and others (omnivores, carnivores, nectarivores and granivores). They found that insectivores were the most abundant group (52%), followed by frugivores (24%) and others (24%). However, the number of the insectivorous decreases at the forest edges compared to intermediate and interior forest.

From this study conducted in Lingai, 57.1% of the birds are insectivorous, followed by frugivores (21.4%), 14.2% are scavengers and carnivores (7.1%). The results are also consistent to research mentioned above by Saiful & Shahrul, 2012. According to [13], agricultural areas in Malaysia consisting of oil palm, rubber and fruit trees, frugivores and trunk-feeding insectivores tended to persist. The number of bird species in agriculture areas might be lesser than that in forest habitats, but the proportion of insectivores and frugivores did not differ between habitats [14]. Agriculture areas are also rich in tree cover that is essential for connecting isolated protected areas and their meta-populations. These landscapes will also support higher proportions of avian seed dispersers, pollinators, insect predators, and their valuable ecosystem services [3].

5. Conclusion

In conclusion, there were 25 species of birds from 14 families recorded at both old growth vegetation and agriculture area of Lingai with a total of 83 individuals netted. From this study, it showed that both old growth vegetation and agriculture area have diverse bird species with the value of Shannon-Wiener index 2.526 and 2.126 while the evenness value was 0.6251 and 0.8378. However, these values but were not significantly different between sites.

Based on the results, additional species could be found in Lingai if the time of sampling is longer and sampling effort is increased. As for recommendations, it would be useful to improve the sampling in terms of time and effort. The quality of degraded habitats could be improved by planting more shrubs and trees. Doing this, is also another way to improve water restoration process and increase the diversity of the vegetation.

6. References

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