Avifauna Composition at Tenghilan Community Forest: A Preliminary Assessment

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ABSTRACT The avian community plays an important role in maintaining the ecosystem at Tenghilan Community Forest in equilibrium, and yet the existing condition of the local avifauna community has yet been investigated by the researchers at this moment. Henceforth, a preliminary mist-net survey was conducted for 6 days, to determine the species composition of avifauna presented at three different forest trails in this state land forest. A total of 48 individuals and 22 species of avian belonged to 13 different families were recorded in this research. The detected avian individuals were comprised mainly of the insectivorous (n=29 or 60.4 %) species, and followed by the omnivorous (n=7 or 14.6 %) species, and finally both the carnivorous species and frugivorous species (n=6 or 12.5 % respectively; X^2_{63}=144.0, p<0.001). There were no significant differences in the diversity richness and distribution evenness of avian species between the three selected forest trails (p>0.05), therefore indicating that the local avifauna species were rich in diversity (H' > 1.5) and evenly distributed (1-D>0.5) across the Tenghilan Community Forest. However, further study should be conducted at this state land forest by covering a wider sampling area, also a longer sampling period in future.

INTRODUCTION

Borneo is known to have a rich diversity of avian species, where a total of 669 species of resident and migratory species can be observed at Borneo (Phillips & Phillips, 2014). Then, rich diversity of avifauna species can be found across the different forest habitats of Sabah, Malaysia Borneo (Gilbert *et al.*, 2018; Lee *et al.*, 2018; Hasmat *et al.*, 2020). Since the frugivorous and herbivorous species assist in the seed dispersal, while the carnivorous and insectivorous species are crucial in regulating the population densities of certain smaller-sized wildlife (e.g.: insects, mammals, reptiles and birds) species, hence avian community is vital in maintaining the ecosystem of a particular forest habitat in equilibrium (Peh *et al.*, 2005; Lim & Mojiol, 2020a). However, the species composition of birds can be varied from one forest habitat to another, mainly because of the variation in forest type and management between different forest habitats (Lim & Mojiol, 2020b). The availabilities of favourable food and shelter for a certain avian species are defined by the vegetation composition and structure, which are varied across different forest types (Lerman *et al.*, 2014; and Lim & Mojiol, 2020a). At the same time, forest management is closely related with habitat degradation, which can further impact both the food and shelter availabilities, and resulting in the presence and absence of certain avifauna species at a given forest habitat (Lim *et al.*, 2019; and Lim & Mojiol, 2019). In summary, a forest with low diversity richness and distribution evenness of avian species is considered as a poor habitat for the local avifauna community (Lim & Mojiol, 2020b). At the Tuaran District of Sabah, the Tenghilan Community Forest is managed as a state land forest, where parts of the local natural lowland forest have been converted to the small-scale plantation areas by the local community. Presently, a similar study has yet to be conducted at this state land forest, thus a preliminary assessment was conducted to determine the local avifauna species composition.

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METHODOLOGY

Study Site

   Tenghilan Community Forest was a state land forest situated within the District of Tuaran at Sabah (6°16'58.00"N and 116°22'4.40"E). Three forest trails established by the local community across the local undulating terrain were selected as sampling areas of this study, in which both the Liposu Trail (302 m) and Bambangan Trail (199 m) were situated at the valley region, while the Tongkat Ali Trail (129 m) was located at the ridge region. These three selected trails were mainly surrounded by the regenerated lowland dipterocarp forest, although a segment of Liposu Trail was located within a local rubber plantation forest. Clear streams were presented alongside Liposu Trail and Bambangan Trail, where aquatic organisms could be found inhabiting the given streams. Then, several fruit tree species were identified along these trails, such as the Bambangan (*Mangifera pajang*), Durian (*Durio* sp.), Liposu (*Baccaurea lanceolata*), and Jackfruit (*Artocarpus* sp.). Along the given trails, a set of three sampling points with at least 50 m gap-interval were established, as shown in below Figure 1.
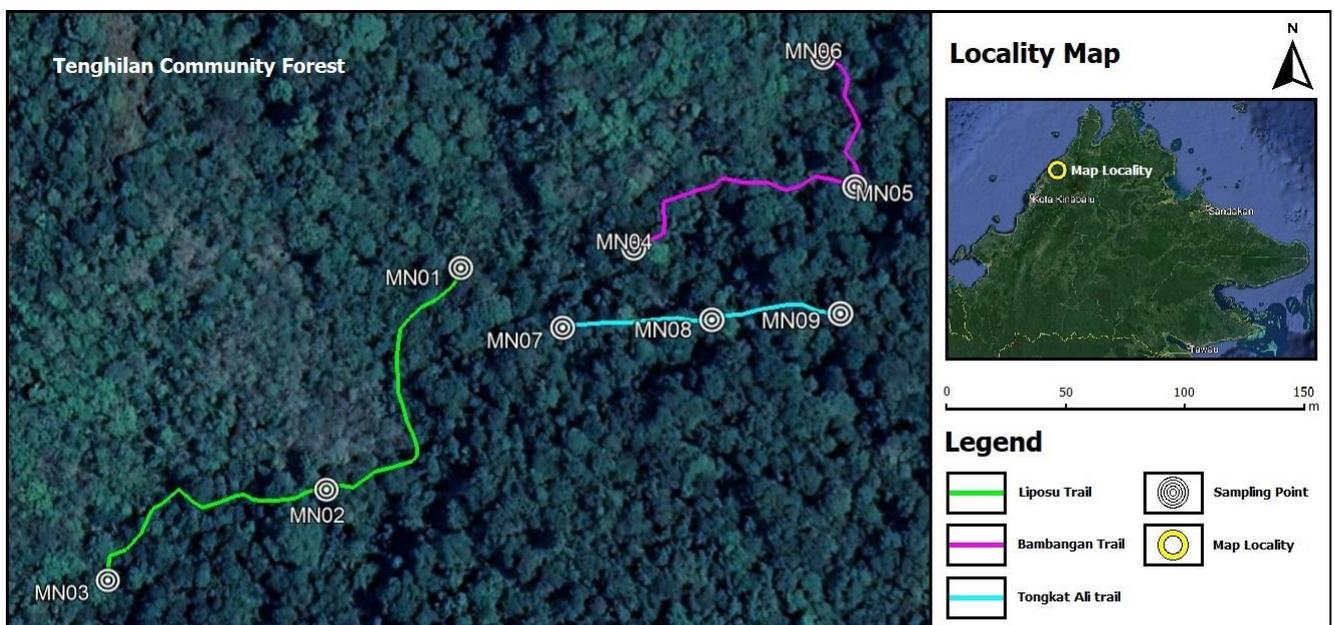
Figure 1. Locations of the nine established sampling points at the Liposu Trail, Bmabangan Trail and Tongkat Ali Trail in Tenghilan Community Forest, Tuaran, Sabah.

Mist Net Survey

   This study implemented the mist-net survey for six days (8/9/2020 to 10/9/2020 and 10/10/2020 to 12/10/2020) at the 9 established sampling points in Tenghilan Community Forest. At each sampling point, a unit of mist net (Width = 3.0 m) was set up at 1.0 m aboveground level and in perpendicular to the trail. Then, each mist net was opened and closed for trapping the avifauna individuals at 6.00 a.m. and 6.00 p.m. respectively (12 hours a day) throughout the entire sampling period. The mist nets were checked once every 2 hours, where the number of individuals and species of the trapped individuals were recorded directly on the spot, before released back to the wild (Hasmat *et al.*, 2020).

Data Analysis

   Species of the trapped avifauna individuals were identified by referring to the field guide written by and Phillipps and Phillipps (2014). Then, the feeding guild for each trapped species was verified by using the relevant secondary data (e.g.: Sheldon *et al.*, 2010; Styring *et al.*, 2011; and Phillipps & Phillipps, 2014). The Chi-Squared test was applied in determining the main composition of avifauna species presented at Tenghilan Community Forest, in terms of the feeding guild of trapped avifauna

species. Furthermore, the Shannon's (*H'*) and Simpson's (*1-D*) Diversity Indices were estimated, and then the Diversity t-test was applied, to assess the significance differences in the diversity richness and distribution evenness of avifauna species across the three selected trails in this state land forest. These statistical analyses were implemented using the statistical software PAST ver. 3.25 (Hammer *et al.*, 2001), at the confidence interval level of 95.0 % (*p*=0.05).

RESULT

A total of 48 individuals and 22 species of avian belonging to 13 different families were detected at Tenghilan Community Forest in this study, as shown in below Table 1. The Pellorneidae (Jungle Babblers) family was determined to have the highest number of recorded species (4 species or 18.2 %), and followed by the Pycnonotidae (Bulbuls) family with three recorded species (13.6 %) in this research. Four families were verified with two recorded species (9.09 %) each, while the remaining 7 families only had one avian species (4.55 %) each recorded. Among the 22 detected species, the Little Spiderhunter (*Arachnothera longirostra*) was trapped most frequently (n=12 or 25.0 %), and followed by the Rufous-backed Kingfisher (*Ceyx rufidorsa*: n=5 or 10.4 %), Rufous-fronted Babbler (*Cyanoderma rufifrons*: n=4 or 8.33 %), Olive-winged Bulbul (*Pycnonotus plumosus*) and Grey-capped Emerald Dove (*Chalcophaps indica*) (n=3 or 6.25 % each). Then, a majority of the detected individuals were identified to be insectivorous species (n=29 or 60.4 %), and followed by the omnivorous species (n=7 or 14.6 %), and finally both the carnivorous and frugivorous species (n=6 or 12.5 % each; X^2_{63}=144.0, *p*<0.001).

Table 1. A list of avifauna species detected at Tenghilan Community Forest in this study.

Family	Species	Common Name	Feeding Guild	n
Columbidae	*Chalcophaps indica*	Grey-capped Emerald Dove	Frugivore	3
	Ptilinopus jambu	Jambu Fruit-dove	Frugivore	1
Alcedinidae	*Alcedo meninting*	Blue-Eared Kingfisher	Carnivore	1
	Ceyx rufidorsa	Rufous Backed Kingsfisher	Carnivore	5
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	Insectivore	1
Calyptomenidae	*Calyptomena viridis*	Green Broadbill	Frugivore	1
Dicaeidae	*Prionochilus percussus*	Crimson-Breasted Flowerpecker	Omnivore	1
Monarchidae	*Hypothymis azurea*	Black-naped Monarch	Insectivore	1
	Terpsiphone paradisi	Indian Paradise-flycatcher	Insectivore	1
Muscicapidae	*Cyornis olivaceus*	Fulvous-chested Jungle-flycatcher	Insectivore	2
	Cyornis umbratilis	Grey-chested Jungle-flycatcher	Insectivore	2
Nectariniidae	*Arachnothera longirostra*	Little Spiderhunter	Insectivore	12
Pellorneidae	*Trichastoma bicolor*	Ferruginous Babbler	Insectivore	2
	Malacopteron albogulare	Grey-Breasted Babbler	Insectivore	1
	Trichastoma abbotti	Horsfield's Babbler	Insectivore	1
	Trichastoma malaccense	Short-Tailed Babbler	Insectivore	1
Pycnonotidae	*Pycnonotus simplex*	Cream-Vented Bulbul	Omnivore	2
	Pycnonotus plumosus	Olive-Winged Bulbul	Omnivore	3
	Pycnonotus brunneus	Red-Eyed Bulbul	Omnivore	1
Sturnidae	*Gracula religiosa*	Common Hill Myna	Frugivore	1
Timaliidae	*Cyanoderma rufifrons*	Rufous-fronted Babbler	Insectivore	4
Trogonidae	*Harpactes duvaucelii*	Scarlet-Rumped Trogon	Insectivore	1

*Note: n = Number of Individual.

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High diversity richness (*H'*>1.5) and distribution evenness (*1-D*>0.5) of avian species were found across the three selected forest trails at Tenghilan Community Forest in this research. At the same time, the differences in both the diversity richness and distribution evenness of avifauna species between the given trails were confirmed to be insignificant (*p*>0.05). Generally, Liposu Trail was determined with the highest number of recorded avian species (11 species or 50.0 %), while the Tongkat Ali Trail was confirmed with the highest number of detected avian individuals (n=22 or 45.8 %). The lowest number of species (7 or 31.8 %) and individual (n=10 or 20.8 %) of bird were obtained at the Bambangan Trail in this research. In summary, the highest diversity richness and distribution evenness of avian species were obtained at Liposu Trail (*H'*=2.253; *1-D*=0.875). Likewise, Tongkat Ali Trail possessed less evenly-distributed (*1-D*=0.814) and more diverse (*H'*=1.996) species of avifauan than those of Bambangan Trail (*H'*=1.834; *1-D*=0.820) at this state land forest.

DISCUSSION

The species composition of avian individuals detected at the Tenghilan Community Forest in this study was similar to those of the Kawang Forest Reserve (7 species) reported by Hasmat *et al.* (2020), and also those of Gaya Island (6 species) recorded by Gilbert *et al.* (2018). This is because these study sites were comprised mainly of regenerated lowland forest, thus certain common bird species were presence at these three forest habitats, liked the Cream-vented Bulbul (*Pycnonotus simplex*), Olive-winged Bulbul (*Pycnonotus plumosus*), Red-eyed Bulbul (*Pycnonotus brunneus*), Grey-chested Jungle-flycatcher, and Grey-capped Emerald Dove. Moreover, the high numbers of recorded avian species for both the Pellornidae and Pycnonotidae families in this study were related to their capabilities to survive at both the natural forest and human-modified habitats (Hasmat *et al.*, 2020).

However, the Litter Spiderhunter was detected most frequently at Tenghilan Community Forest in this study, and followed by the Rufous-backed Kingfisher, Rufous-fronted Babbler, Grey-capped Emerald Dove, and Olive-winged Bulbul. Lee *et al.* (2018) emphasized that a forest habitat with high food availability, in term of the food variety and abundance, dictated the local avifauna abundance. Understory vegetation functioned as the favorable habitat for insects to breed, and coincidentally the understory vegetation at Tenghilan Community Forest was dense, thus indicating a high abundance of insects present at this forest habitat (Zakaria & Rajpar, 2015). At the same time, high abundances of fruit trees and aquatic organisms were presented along the forest trails and in the clear streams of this community forest respectively. Therefore, the high detection frequencies of the given five avian species were likely for prey-hunting and fruit consumption at the study site of this research (Lerman *et al.*, 2014). Then, both the Black-naped Monarch (*Hypothymis azurea*) and Indian Paradise-flycatcher were observed only once in this study. These two Monarch Flycatcher (Monarchidae) species were known to exhibit higher preferences in inhabiting the open-understory area of an old-growth forest (Sheldon *et al.*, 2010; and Styring *et al.*, 2011), mostly because of the presence of high availability of insects at the open-understory area of the given forest habitat (Lerman *et al.*, 2014).

Actually, the avian composition is dictated by the existing vegetation composition and structure, as well as the level of habitat degradation, since these variables define the availabilities of favorable food and shelter for the avian community that inhabit a certain forest habitat (Lim & Mojiol, 2020b). Since the study site of this research was comprised majorly of the regenerated lowland dipterocarp forest with high density of understory vegetation, where high abundance of insect could be detected at this area (Zakaria & Rajpar, 2015), hence a wide range of insectivorous birds were attracted to visit the Tenghilan Community Forest. The omnivorous, frugivorous and carnivorous birds, on the other hand, comprised only 39.6 % of the trapped avifauna individuals in this study (n=19), indicating that only selected avian species were attracted to the fruit trees (e.g., Jackfruit, Bambangan, Durian, and

Liposu) and aquatic organism presented in this forest habitat (Styring *et al.*, 2011). This phenomenon can be resulted from the fact that certain avian species can only survive at a forest habitat that have aged or recovered from timber harvesting activity, deforestation or land cover change, since both the favorable food and shelter availabilities are higher for these species at this type of forest habitat (Lim *et al.*, 2019; Lim & Mojiol, 2019). In a nutshell, the Tenghilan Community Forest was vital to the survival of these 22 trapped avian species, not only as a feeding ground, but also as a roosting site and breeding site for the given species (Hasmat *et al.*, 2020).

The differences in both the diversity richness and distribution evenness of avifauna species were confirmed as insignificant (p>0.05) across the three forest trails in Tenghilan Community Forest. This phenomenon can be resulted from the fact that the given trails are all located in regenerated lowland dipterocarp forest, where similar avifauna species composition could be found across forest habitats with similar conditions (Lim & Mojiol, 2020b). Although the Tongkat Ali Trail is situated far from a stream, and also the Liposu Trail is partially disturbed by the rubber plantation forest, still both the availabilities of food and shelter are generally similar between these trails. Henceforth, various avian species could be found distributed evenly across the given three forest trails in this state land forest, as suggested by Lerman *et al.* (2014) and Lim & Mojiol (2019).

However, a forested area with low stem density has a high detection rate of bird individuals, and vice versa for a forest habitat with high stem density, due to the fact that the bird individuals prefer to travel through wide-gap regions than narrow-gap regions (Lee *et al.*, 2018). Tongkat Ali Trail is located along the ridge, therefore the stem density of this trail was lower than those of Liposu Trail and Bambangan Trail, which could result in the local avian individuals to travel through Tongkat Ali Trail, and subsequently resulted in the highest recorded individual number was obtained at this particular trail (n = 22 or 45.8 %) in this study. The Liposu Trail, on the other hand, possessed high food availability, in terms of the abundances of fruit and insects, which could result in obtaining the highest number of species for Liposu trail in this study (Lim & Mojiol, 2019). Additionally, both the variation and abundance of food could be the leading factors behind the lowest numbers of species and individuals recorded at Bambangan Trail in this study as well (Lerman *et al.*, 2014). Then again, the diversity indices obtained for the three selected trails in this study suggested that this state land forest was generally inhabited by the avifauna community that was rich in species diversity (H'>1.5) and evenly-distributed (1-D>0.5), thus crucial towards the survival of the local avifauna community (Magurran, 2002; and Lim & Mojiol, 2019).

CONCLUSION

The avifauna community that inhabits Tenghilan Community Forest is comprised mainly of the non-endemic, non-threatened, resident, and insectivorous species that can be found at the terrestrial forest ecosystem of Sabah, Malaysia Borneo. However, the migratory Indian Paradise-flycatcher, as well as several near-threatened avian species, can be found in this forest habitat, indicating that this state land forest plays an important role in providing foods and shelters for these avifauna species. Although human activities have been conducted here for many years, still the diversity richness and distribution evenness of bird species remain high and non-significantly different across the different regions of this state land forest. Henceforth, further land cover change from the regenerated lowland dipterocarp forest to plantation forest should be avoided, to help conserving the local avian species, and also to ensure their survival at Tenghilan Community Forest in future. However, this research has evaluated only a portion of this state land forest and under a short duration of time, henceforth further study should be conducted onto the given matter here in future.

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