

BIRD POPULATION IN TWO-YEAR OLD *Acacia mangium* PLANTATION, SABAH FOREST INDUSTRIES SDN BHD

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ABSTRACT. *Large areas of tropical forest worldwide have been converted rapidly into forest plantation. Plantation can play an important role in restoring productivity, ecosystem stability, and biological diversity to degraded tropical lands. However, the conversion of forest areas to plantation rapidly resulting birds to lose their natural habitat. Therefore, Acacia mangium plantations have the potential as the refuges for birds. As such, this study was conducted to investigate the bird population in a 2-year Acacia mangium plantation, Sabah Forest Industries (SFI), Sabah to determine the bird population density and diversity of 2-year mangium plantation in SFI. There is no published information of the detailed status of birds in SFI yet. Bird survey was done by using point count method. The bird population density was analyzed by using distance 6.2 and bird diversity was calculated by using Shannon-Wiener diversity index. A total of 343 birds belong to 53 species from 21 families were detected. The bird population in this 2-year mangium plantation was 17.71 individuals per hectare, and Shannon-Wiener diversity index for bird diversity was 3.24. This study shows that the bird population density and diversity in SFI were higher as compared to other past studies in Borneo plantation areas.*

KEYWORDS. Forest plantation, population density, bird diversity, Acacia mangium, Sabah

INTRODUCTION

Birds are classified into Aves class, sub Phylum Vertebrata and Phylum chordate (Pettingill, 1985). Birds can act as biological indicators to measure forest health and environmental condition (Gregory & Strien, 2010). Malaysia is rich in biodiversity which contain more than 815 species of birds including water birds and terrestrial birds (Zakaria & Rajpar, 2013). There are about 643 species of bird and 53 of endemic recorded in Borneo, Sabah (Wong, 2012).

The driving force of the world deforestation trend is the conversion of tropical forests to agricultural land that has increased over the past ten years, resulting in birds losing their habitat. Due to increasing world population, the demand for natural resources have become increasingly high, most tropical forest were converted to farmland or plantation (Morelli, 2013). The reason for the conversion of forested areas to plantations was to provide steady and sustainable stream of raw timber material for industries, such as pulp and paper, furniture and construction.

Therefore, industrial plantation was the key to produce timber supply quickly via fast growing tree species (Styring *et al.*, 2011). *Acacia mangium* grows well in Sabah and is recommended for planting in a plantation.

Plantations play an important role in restoring productivity, ecosystem stability, and biological diversity to degraded tropical lands (Parrotta, 1992). *Acacia mangium* plantations can act as secondary habitat or refuges for tropical organisms and aid in the conservation of biodiversity (Lindell *et al.*, 2003). However, there is unpublished information of the status of birds in Sabah Forest Industry (SFI) plantation. Published information regarding bird community in plantation is very scarce. Limited past studies will result poor management plan in plantation and less concern to the environmental impact. Considering the potential of a plantation as an alternative habitat to decreasing areas of natural habitat, the aim of this study is to determine bird population and species in two-year old *Acacia mangium* plantation in SFI is clearly of importance for better management in following age.

METHODOLOGY

Study site

The study site was in Mendulong region, Sabah Forest Industries (4° 54' 56.5'' N; 115° 42' 27.6'' E) in the compartment L41 with elevation 342 which is located in the Sipitang district of south-western part Sabah (Figure 1). The area covers 183,316 ha and including Mendulong plantation area. Mendulong Estate of two-year old *Acacia mangium* plantations cover 617.11 ha and two-year old *Acacia mangium* plantation in compartment L41 is covering about 44.18 ha (SFI, 2015). The elevation of compartment L41 Mendulong approximately 415 m above from the sea level. The annual rainfall was approximately 3,757 mm (SFI, 2015). The maximum and minimum temperatures in July to August 2014 are 30°C and 19°C respectively (SFI, 2015).

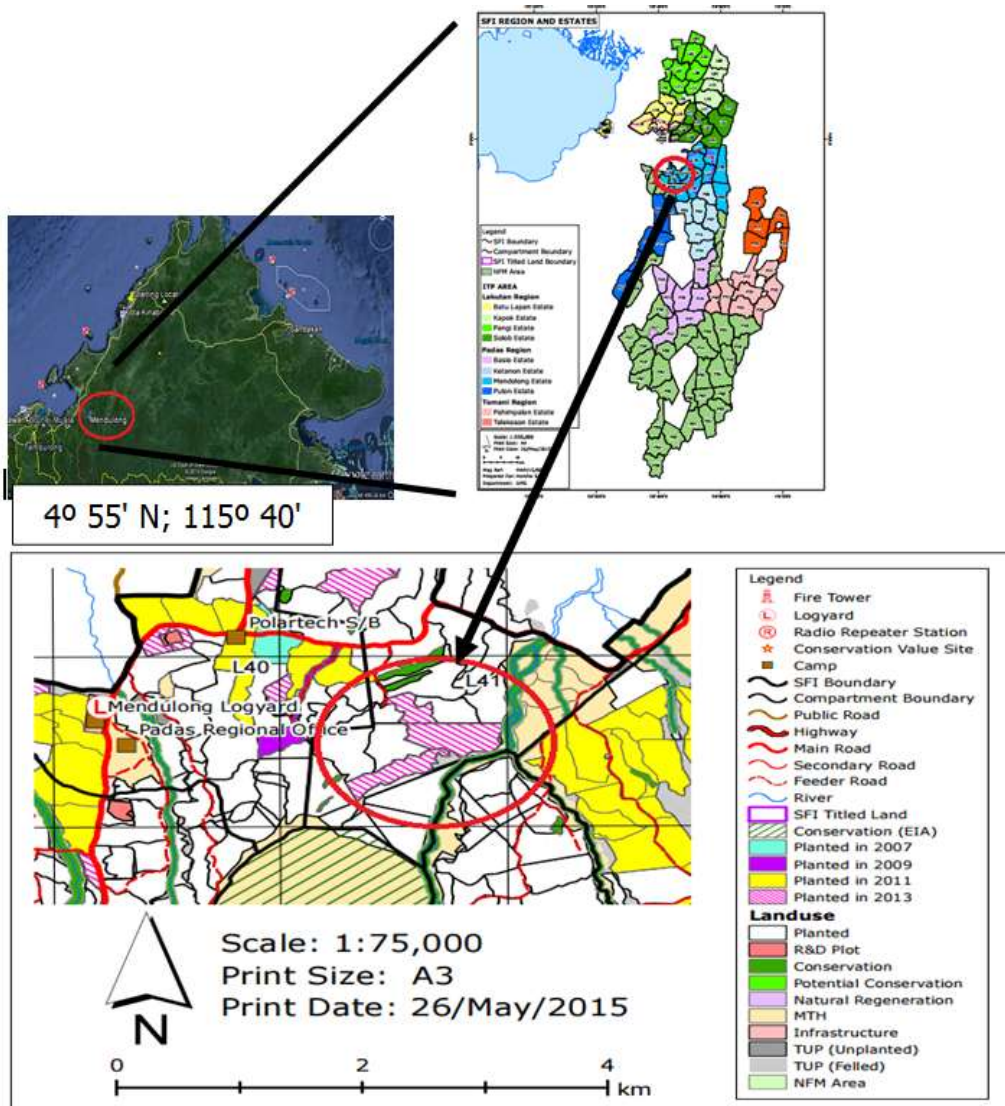


Figure 1: The location of the study site in compartment L41 (Source: SFI, 2015).

Data Collection

Twenty-one days were spent in the two-year old *Acacia mangium* plantation, Mendulong from 1st August to 21st August 2015 to obtain reliable estimates and increased precision of result data (Rajpar & Zakaria, 2010). Standard point count method was carried out and species of birds were identified through direct observation from 0630 hr to 1130 hr by using a pair of binoculars (10 X 40) because the best time for the bird observation was morning (Zakaria *et al.*, 2009). When it was raining, birds were not to be surveyed because cold weather shut down bird activity (Ralph *et al.*, 1993). During each point count survey, each individual of bird detected by sighting were recorded in point count data form and identified on the spot

using field guide “Birds of Borneo” (Wong, 2012) and “Field Guide to The Birds of Borneo” (Phillipps & Phillipps, 2014). Only birds that perched in a tree were recorded for standard survey and birds on flight were recorded as opportunities survey (Zakaria & Rajpar, 2010).

A total of 25 point count stations were established for bird survey in two-year old *Acacia mangium* plantation, Mendulong. Five point counts were set in one transect line with five replicates. The length of transect line was set as 250 m. A 20 m distance was established before start the first point count station to avoid forest edge. Transect lines were parallel to each other, which were established using mapping compass. The interval between points counts stations were 50 m. The distance between the transect line was 50 m. Points were spaced closely together to provide a comprehensive inventory (Styring *et al.*, 2011). At least four transect lines or 1000 m was done by a day. The observation last exactly for 5 minutes at each point count station (Mojiol *et al.*, 2008). Five minute observation in each point count enables to record sufficient number of individuals with minimal efforts and disturbance (Rajpar & Zakaria, 2010).

Data Analyses

Distance 6.2 software was used to estimate the population density of bird (Buckland *et al.*, 2009). All data were truncated at 20 m to remove any outlying records and also improve model fit (Mallari *et al.*, 2011).

The Shannon’s Index of Diversity (H’) is a mathematical statistic index to determine the evenness and species richness in a region. The value of Shannon’s Index of Diversity (H’) normally falls between 1.5 and 3.5, and it is only rarely over 4.5. A value near 4.6 would indicate that the numbers of individuals are evenly distributed between all the species (Bibi & Ali, 2013).

$$\text{Shannon's Index of Diversity (H)} = - \sum_{i=1}^s p_i \ln p_i$$

Where n_i = The individual in species i

N = Total number of individual

Σ = Summation

P_i = proportion (n/N) of individual of one particular species

Simpson’s Index of Diversity (1-D) is a tool to measure the diversity of the birds and used to quantify the biodiversity of a habitat. The Simpson’s Index of Diversity (1-D) was be used as desirable statistical properties (Wilsey & Stirling, 2007). The range value of Simpson’s Index of Diversity (1-D) is 0 when there is no diversity in the sample area whereas 1 is indicated the sample area is diverse.

$$\text{Simpson's Index of Diversity (1-D)} = 1 - \sum p^2$$

Where, P = Proportion (n/N) of individual of one particular species

RESULTS

There were 480 point counts of bird surveys that were conducted for this study. A total of 53 species with 21 families (343 individuals) were recorded in the 2-year mangium plantation L41. Some of the bird families were observed only once as shown in Table 1. The family of Pycnonotidae and Dicaeidae was found to form a considerable proportion of bird species in 2-year mangium plantation. They were almost 50% of the total species observed in the 2-year mangium plantation (Figure 2). The results indicated that the family Pycnonotidae, Dicaeidae and Timaliidae were mainly comprised of this species such as Yellow-Vented Bulbul (*Pycnonotus goiavier*), Bold-striped tit-babbler (*Macronous bornensis montanus*) and Orange-Bellied Flowerpecker (*Dicaeum trigonostigma*). However, the top five highest numbers of bird species were Yellow-vented bulbul (*Pycnonotus goiavier*), Orange-bellied flowerpecker (*Dicaeum trigonostigma*), Pied fantail (*Rhipidura javanica*), Black-headed bulbul (*Pycnonotus atriceps atriceps*) and Chestnut-munia (*Lonchura atricapilla*). This is because they are either omnivores or insectivores which can survive with wide range of habitat and favour in open area and forest edges (Styring *et al.*, 2011; Fujita *et al.*, 2014). There were several families that were observed by only single species or individuals including Ciconidae, Strigidae, Campephagidae, Rallidae, and Culicicapa. These groups either belonged to the migratory species or their natural habitats were not in plantation (Zakaria *et al.*, 2005).

Table 1: Number of species and individuals by family in 2-year mangium plantation (L41) recorded in 21 days continuously.

Family	L41
Accipitridae	1 (3)
Aegithinidae	3 (11)
Alcedinidae	2 (6)
Campephagidae	1 (2)
Ciconidae	1 (4)
Columbidae	2 (9)
Cuculidae	2 (2)
Culicicapa	1 (1)
Dicaeidae	3 (43)
Estrildidae	3 (24)
Cisticolidae	3 (12)
Monarchidae	1 (32)
Muscicapidae	2 (2)
Nectarinidae	6 (14)
Oriolidae	1 (6)
Psittacidae	1 (13)
Pycnonotidae	10 (117)
Rallidae	1 (1)
Strigidae	1 (3)
Timaliidae	7 (32)
Turdidae	1 (6)

Note: The first number refer to the number of species; the one number in bracket refer to the number of individual

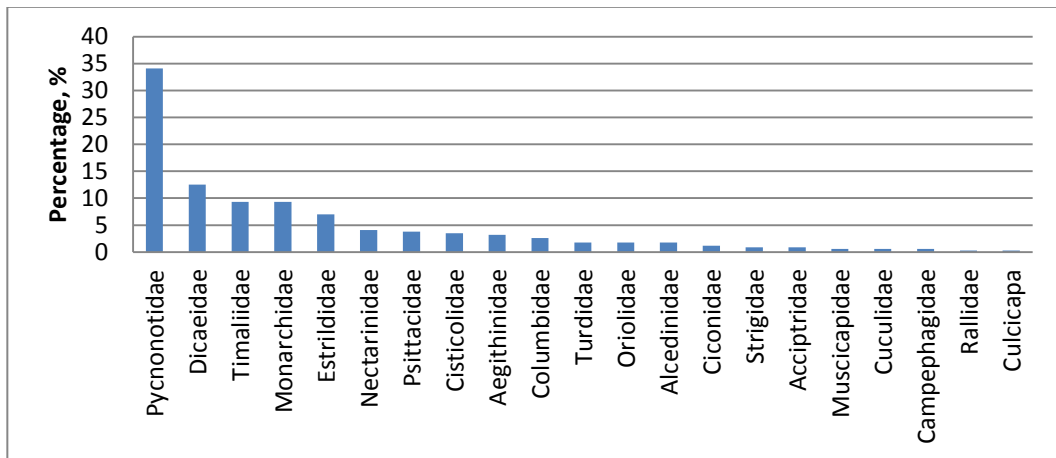


Figure 2: Relative abundance of bird families in 2-year mangium plantation L41, SFI.

The Shannon’s diversity index value (H') is 3.24. This result shows that the bird in the 2-year mangium plantation L41 was diversified. The Simpson’s diversity index value was estimated at 0.94, indicating that the bird species were equally diversified. The Simpson’s diversity index hence fully supported Shannon’s diversity index.

Point estimate population density is 17.71 individuals per hectare (SE=1.63; % of CV=9.25%; D LCL=14.76; D UCL=21.23) in the 2-year mangium plantation.

DISCUSSION

The bird population density and diversity in this study was compared with other past studies as shown in Table 2 and Table 3. Sabah Forest Industries (SFI) shows the highest bird population density and diversity that is 17.71 individuals per hectare and 3.24 respectively compared to Sabah Softwood Berhad (SSB) and Sarawak Planted Forest (SPF).

Table 2: Comparison of bird population density of bird in SFI, SSB and SPF.

Study Site	Bird Population Density (individual/ha)	Age Group	Type of Vegetation	Studies
SFI	17.71	2-years	<i>Acacia mangium</i>	This study
SSB	15.9	2-years	<i>Acacia mangium</i>	Sheldon & Styring (2011)
SPF	9.3	2-years	<i>Acacia mangium</i>	Sheldon & Styring (2011)

Table 3: Comparison of diversity of bird in SFI, SSB and SPF.

Study Site	Diversity of bird (Shannon's Diversity Index)	Age Group	Type of Vegetation	Studies
SFI	3.24	2-year	<i>Acacia mangium</i>	This study
SSB	1.48	2-year	<i>Acacia mangium</i>	Sheldon & Styring (2011)
SPF	1.29	2-year	<i>Acacia mangium</i>	Sheldon & Styring (2011)

The 2-year old *Acacia mangium* plantation in SSB was surrounded by logged native forest and the area had left uninhabited 45 years ago (Sheldon & Styring, 2011). But, the remaining stands of logged forest at SSB are managed for sustained use and retained as original tree diversity until 25 years ago (Sheldon & Styring, 2011). In contrast, the 2-year old *Acacia mangium* plantation of SFI is surrounded by conservation forest, stream and timber harvest. These varieties of habitats promote diversity and density of bird population (Sheldon and Styring, 2011). According to the Sheldon and Styring (2010), human disturbance is one of the factors that affect the bird population density and diversity in the region. The bird population density and diversity in SFI is higher than SSB due to the undisturbed conservation forest in SFI. In addition, the 2-years mangium plantations of SFI might provide adequate food source that draws the movements of the birds from the surrounding habitats to the plantation area.

Sarawak Planted Forest (SPF) has the lowest bird population density and diversity as compared to others. This is because the logged native forest nearby the SPF is poor in soil conditions that resulted in low food sources productivity, such as lack of fruiting season (Sheldon & Styring, 2011). Besides that, the forest near to the SPF has been disturbed for much longer time which caused the loss of variety of food source (Sheldon & Styring, 2011). The study site in SFI was located nearby two conservation areas and several riparian conservation areas as shown in Figure 1. There were also many conservation areas that exist as small forest islands. These conservation areas may be the factor that causes higher population density and diversity observed in the study site.

The top five dominant bird species of this study were compared to the past study of Sheldon and Styring (2011) as shown in Table 4. Both of the dominant bird species of Sabah Forest Industries (SFI) and Sabah Softwood Berhad (SSB) is Yellow-vented bulbul while the dominant bird species at Sarawak Planted Forest (SPF) is Bold-stripes tit-babbler.

Table 4: Comparison of top five bird species in SFI, SSB and SPF of 2-year mangium plantation

	SFI (This Study)	SSB (Sheldon & Styring, 2011)	SPF (Sheldon & Styring, 2011)
1	Yellow-vented bulbul	Yellow-vented bulbul	Bold-striped tit-babbler
2	Orange-bellied flowerpecker	Bold-striped tit-babbler	Rufous-tailed tailorbird
3	Pied fantail	Yellow-bellied prinia	Fluffy-backed tit-babbler
4	Black-headed bulbul	Rufous-tailed tailorbird	Little spiderhunter
5	Chestnut munia	Ashy tailorbird	Yellow-vented bulbul

Exotic plantation tree species generally suffer lower pest damage compared to indigenous plantation tree species because the planted environment is different and native pests were not present. However, exotic plantation tree species do not resist pests for long period due to the attracting of indigenous pests as new food sources such as termite, bagworms, caterpillar plusia, grasshopper, mosquito bug, pinhole borers, and stem borer. Therefore, these pests attracted the insectivorous or omnivorous birds to feed on them such as Yellow-vented bulbul, Orange-bellied flowerpecker, Pied fantail, Black-headed bulbul, Bold-striped tit-babbler, Yellow-bellied prinia, Rufous-tailed tailorbird, Ashy tailorbird, Fluffy-backed tit-babbler and Little spiderhunter (Wee, 2009; Sodhi *et al.*, 2005; Phillipps & Phillipps 2014).

Yellow-vented bulbul was the only one of the dominant bird species that can be found in all three studies. This species was well adapted to human creation habitat, such as cultivated areas, plantation and open woods and less found in deep forests (Wee, 2009). Yellow-vented bulbul is generalist in term of food, taking flowers, nectar, fruits, insects, and even carrion (Wells, 2007; Wee, 2009). Chestnut munia was not the dominant bird species in SSB and SPF but it was the top five dominant bird species in SFI. The favourable habitat for chestnut munia is grassy area, field, paddy land and rice agriculture (Well, 2009; Phillipps & Phillipps, 2014). This bird species was dominant in 2-year mangium plantation in SFI due to the bushy and grassy bund condition of study site.

The top five dominant bird species in SFI is different from SSB and SPF may be due to the differences of environment condition. Based on the value of bird diversity and bird population density, SFI has the highest value of bird diversity and bird population density. SFI contributes a comparative different plantation environment condition with the existence numerous conservation areas distributed throughout the plantation. This may this influence the observed bird species difference recorded in top five dominant bird species.

In short, the main factor that influenced the observed high bird population density and diversity in SFI, as compared to other 2-year mangium plantations may be due to the high availability of food source that was supported by the presence of nearby conservation areas. It is as expected since the bird diversity in Primary Forest and Steep Forest were higher as compared to SFI due to the pristine habitat that provide abundant food sources and the varieties of habitat. Food sources may be the key factor that influenced the dominant bird species observed in this study.

CONCLUSION

The bird population density and diversity in two-year old mangium plantations in SFI were higher as compared to those reported in past studies in SSB and SPF. This observed result may be due to the existence of numerous adjacent conservation areas and several riparian reserves that provides habitats and food sources, influencing the bird population found in the adjacent 2-year mangium plantation. A further study is recommended to be conducted in the adjacent conservation area with the mangium plantation at SFI to examine the mutual influence of adjacent plantation with the conservation area.

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