TRANSACTIONS ON SCIENCE AND TECHNOLOGY

The Comparison of Birds Population in Two Years and Eight Years Old *Acacia mangium* Plantation at Sabah Forest Industries (SFI), Sipitang

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Abstract

Forest plantation and plantation plays an important role to provide secondary habitat for wildlife, including birds. One of the factors that might influence the avian population is different age or vegetation structure. The purpose of this research is to compare the bird population density and diversity in 2-year and 8-year mangium plantation. The study was conducted from 1st - 21st August 2015 at SFI in Mendulong and Lakutan Estate. Two types of surveys were conducted, i.e., bird surveys and *A. mangium* vegetation surveys. Bird survey and vegetation survey were conducted using point count method. For *A. mangium* surveys, five plots of 10 x 100 metres were established at each age class. Shannon-Weiner (H') and Simpson diversity index (1-D) were used to calculate the bird species diversity. The Population density of bird was estimated by using software Distance 6.2. The results shows that there was a very significant difference between the bird species diversity between the population at 2-year (H'= 3.24) and 8-year (H'= 2.93) mangium plantation (T-test, p=0.001). Bird population density in 8-year mangium plantation (40.37 indv/ha) has a prominently higher density compared to 2-year mangium plantation (17.71 indv/ha). The stem density, basal area and average tree height in 8-year mangium plantation was higher as compared to the 2-year mangium. Avian population density at older age class mangium plantation was significantly higher as compared to the younger age class due to the more complex vegetation in older age class mangium plantation. The avian species diversity at 2-year was higher than the 8-year due to the higher ground elevation, wider range of habitat variability and the closer proximity to the conservation SFI area. A further study is recommended to investigate the ecological interactions, between the conservation areas with the forest plantation areas.

Keywords:
Birds population; *Acacia mangium*; forest plantation; Borneo; vegetation

Introduction

Many tropical forests have been converted into plantation or agricultural land due to the demand of raw materials. The conversion of forest into agricultural land and forest plantation has led to the shrinking of natural habitat in Malaysia. In Sabah, many private sectors are involved in forest plantation to support the demand of wood materials in the sustainable way such as Sabah Forest Industries (SFI), Sabah Softwood Berhad, Sabah Forest Department Authority for industries uses (Food and Agriculture Organization, 2002). In order to sustain the wood material demand, fast

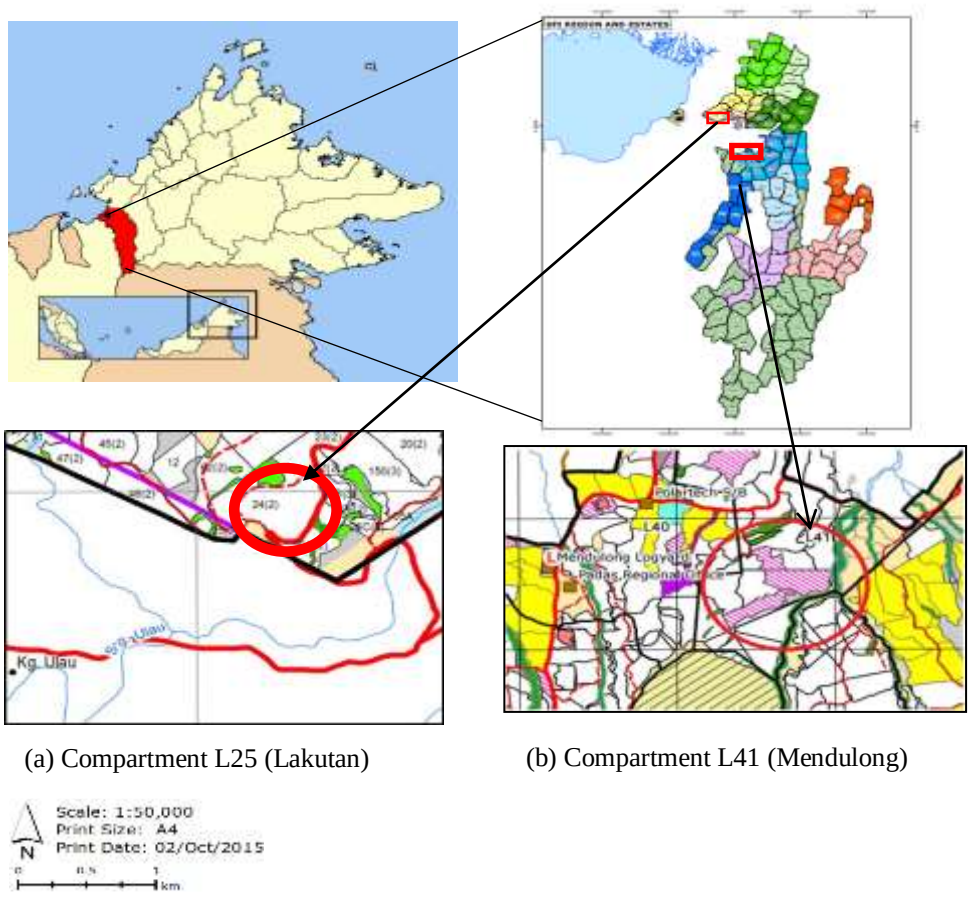
growing species of trees such as *Acacia mangium* were recommended to contribute for the wood production in Malaysia.

Forest plantation and plantation plays an important role to provide secondary habitat for wildlife, including birds. One of the factors that might influence the avian population is the different age or vegetation structure (Sheldon *et al*., 2010; Sheldon & Styring, 2011). Although forest plantation has similar management practice, however the differences of ages in the forest plantations may probably be a factor that influences the avian population. The purpose of this research is to compare the bird population in 2-year and 8-year mangium plantation in SFI.

Methods

Background Information

The study was conducted at the southwestern part Sabah in Sipitang district. (4º 54' 56.5'' N; 115º 42' 27.6" E). SFI Concession Area covers 183,316 hectares included Mendulong and Lakutan Estates (Figure 1).



(a) Compartment L25 (Lakutan) (b) Compartment L41 (Mendulong)

Figure 1. Location of study sites in Mendulong and Lakutan Estates at SFI, Sipitang (Sabah Forest Industries, 2015)

Two sites within the SFI licensed area were selected for this study. These study sites were at the 2-years old and 8-years old *A. mangium* plantation. The 2-years old *A. mangium* was situated at

Mendulong Estate and the 8-years old A. mangium was at Lakutan Estate. The Mendulong study site was at compartment L41 with the elevation of 342 metres above sea level. At Lakutan Estate, the study was conducted at compartment L25 that has the elevation of 261 metres above sea level. Both study sites were *A. mangium* plantation and were comparatively near to conservation areas that were designated by SFI. The surveys at Mendulong and Lakutan Estates were conducted from 1st August to 21st August 2015.

Data Collection

The data collection consisted of two surveys, of which were bird surveys and *A. mangium* vegetation surveys. A standard point count method was used for bird observation (Sheldon *et. al.*, 2010; Sheldon & Styring, 2011). Five transect lines were established at each of the study sites in 2-years and 8-years plantation. Each transect line was at least 50 meters apart to avoid double counting (Zakaria *et al.*, 2009). Six point counts were established on a 250 metres transect line and each point was 50 metres interval from each other (Styring *et al.*, 2011) to minimize the probability of double-counted individual birds (Sheldon *et al.*, 2010). The radius for each point was 20m and the horizontal distance was recorded by using the laser rangefinder (Sheldon *et al.*, 2010; Fujita *et al.*, 2014). At least four transect lines or 1000 m was completed daily.

Bird observation was conducted from 0630 hours to 1130 hours of which were the most active time period for birds (Fujita *et al.*, 2014) with binoculars 10 x 40 (Mansor *et al.*, 2011). Time interval for bird observation in each point was 5 minutes (Mojiol *et al.*, 2008). Birds were identified using "Birds of Borneo" (Wong, 2012) and "Field Guide to The Birds of Borneo" (Phillipps & Phillipps, 2014).

The *Acacia mangium* survey was also conducted at those two age class plantation. A plot of 10 x 100 metres was established along each transect line to acquire 0.1 hectare of *A. mangium* tree stand sample. According to Newton (2007), 0.1 hectare for total area is sufficient to represent the vegetation. Data that was recorded were the measurements of tree diameter at the breast height (approximate 1.3m) by using diameter tape (International Tropical Timber Organization, 2007; Sodhi *et al*., 2004) and tree height by using the laser rangefinder Trimble.

Data Analysis

Shannon-Wiener Index and Simpson's Index of diversity (Magurran, 2004) was used to measure the bird population diversity in both plantations. The population densities of bird were estimated by using software Distance 6.2 (Ross & Reeve, 2003; Thomas *et al.*, 2010). The *Acacia mangium* data was analysed by calculating the stem density and also basal area. Kerle (2005) stated that the stem density defined as the number of tree stems per unit of area. The unit of area is expressed as hectare or square metres. Basal area was calculated by using DBH of tree stand. Basal area refers as the cross sectional area of a tree at breast height (Torres & Lovett, 2012). Basal area indicates the stocking of a tree stand (Pérez & Kanninen, 2005).

Result and discussion

A total of 53 species with 21 families (343 individuals) were recorded in 2-year mangium plantation whereas a total of 38 species with 17 families (680 individuals) were recorded in 8-year mangium plantation. Pycnonotidae was the most dominant family at 2-year mangium plantation that represents 34% of the existing families. In 8-year, the Nectariniidae was the most dominant that represented 40% of the total families. Yellow-vented bulbul (*Pycnonotus goiavier*), Orange-bellied flowerpecker (*Dicaeum trigonostigma*) and Pied fantail (*Rhipidura javanica*) were the top five highest number of bird species in 2-years and 8-years *A. mangium* plantation. Those bird species were insectivores or omnivores that can adapt in wide range of habitat from open area to forest edge (Styring *et al*., 2011; Fujita *et al*., 2014; Zakaria *et al*., 2005). Avian families that have low abundance recorded in both age classes Rallidae, Culcicapa, Apodidae and Ramphasidae.

Shannon-Weiner for 2-years and 8-year mangium plantation were 3.24 and 2.93, respectively. Simpson's Index of Diversity value for 2-years and 8-year were 0.94 and 0.93, respectively. The diversity indices indicates that the bird population diversity in the younger class of plantation were more as opposed to the older class. Further analysis using T-test revealed that the difference was very significant (p=0.001).

The result of the bird population density for 2-years mangium and 8-years mangium plantation is shown at Table 1. The bird population density at the older age class was prominently higher (40.37 indv/ha) as compared to the younger age class (17.71 indv/ha).

Table 1. The result of bird population density by using Distance 6.2

Vegetation	Indv/ha	Standard Error	Percent Coefficient of Variation	95% Percent Confidence Interval	
				D LCL	D UCL
2-years mangium plantation	17.71	1.63	9.25	14.76	21.23
8-years mangium plantation	40.37	2.54	6.29	35.68	45.68

Note: D LCL= Density of Individual analytic Lower Confidence Limit; D UCL= Density of Individual analytic upper Confidence Limit.

The results for stem density, basal area and tree height in two age class of mangium plantation is presented in Table 2. The result shows that average stem density in 8-year mangium plantation was higher (760 trees/ha) as compared to the 2-year mangium plantation (610 tree/ha). Average for basal area and tree height for 8-year mangium plantation were also higher as compared to 2-year mangium plantation.

Table 2. Stem density, basal area and tree height of 2-year and 8-year mangium plantation

	2-year mangium plantation	8-year mangium plantation
Stem density (tree/ha)	610	760
Average of basal area per tree (cm^2)	125.38	306.1
Average of tree height (m)	8.65	15.01

The overall results of this study shows that older age class of mangium plantation supports more population density of birds. This observed increased in population density may be due to the higher stem density, basal area and tree height in older age class mangium plantation. Sheldon *et al*., (2010) and Styring *et al*., (2011) in their studies at Bornean forest plantation also shows that high stem density creates small canopy gap and complex vegetation that provide favorable habitat for birds. The complexities of mangium plantation also promote great insect species and mangium seeds that can be the food source for the bird species (Sheldon *et al*., 2010; Lindenmayer & Hobbs, 2007).

The bird species diversity were very significantly lower in 8-year than 2-year. This observed difference may be due to the fact that 2-year mangium plantation has a wider variability of habitat, higher ground elevation and a closer proximity to the conservation area. Sheldon & Styring (2011) stated that the surrounding habitats in forest plantations affect bird population. The 2-year mangium plantation has wider variability of habitat as oppose to 8-year due to the existing river at 2-year with the close proximity of the conservation area. Ground elevation affects bird species availability (Phillips & Phillips, 2014). The ground elevation at 2-year was higher than 8-year, of which attracts higher elevations bird species as compared to the 8-year.

Conclusion

Avian population density at older age class mangium plantation was significantly higher as compared to the younger age class due to the complex vegetation in older age class mangium plantation. The bird species diversity was higher at younger age class due to the higher habitat variability as opposed to the older age class. We recommend a further study to be conducted to obtain better understandings of the ecological interactions, through avian population, between the conservation areas with the forest plantation areas. This insight can be very useful for the best management practices of forest plantations in Sabah.

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