Avifauna Community in Timber Production Area in Segaliud-Lokan Forest Reserve, Sabah

Woon-Jah Lee[1], Jephte Sompud[1#], Kurtis Jai-Chyi Pei[2], Mahmud Sudin[1], Collin Goh[3], Paul Liau[3], Fadzil Yahya[4], Abdul Jalal Sampurai Abdullah[3]

1 Forestry Complex, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, MALAYSIA.
2 Department of Natural Resources and Environmental Studies, National Dong Hwa University, 1,Sec. 2, Dahsueh Road, Shoufeng, Hualien 97401,TAIWAN.
3 KTS Plantation Sdn. Bhd., Lot 32, Bandar Pasaraya Commercial Complex, Mile 4, North Road, W.D.T.20, 90009 Sandakan, Sabah, MALAYSIA.
4 Sabah Forestry Department, Head Quarter of Forestry Department, Beg Berkunci 68, 90009 Sandakan, Sabah, MALAYSIA.
Corresponding author. E-Mail: jephte@ums.edu.my; Tel: +6088-320000; Fax: +6088-320769.

ABSTRACT Selective logging is one of the widespread human activities in tropical forest. It is a recommended forest operation method as opposed to clear-cut logging which has lower impact on environment. Timber production forests that are managed sustainably may acts as potential refuges for avian population. Therefore, the purpose of this study is to present the avifauna community in timber production area of a production forest. The study was conducted from October to December 2017 at Segaliud-Lokan Forest Reserve (SLFR). Two types of surveys were conducted, i.e. bird survey and vegetation survey. Standard point count method was used to conduct bird survey from 0700 hours to 1130 hours. For vegetation survey, 20m x 20 m plot was established on each point count stations. The data was analyzed by descriptive analysis and statistics analysis. Fisher's alpha diversity index was calculated for the bird species diversity. A total of 55 species with 27 families (228 individuals) were recorded. The value of Fisher's alpha index of diversity was 23.02. The results show that the avian community in SLFR was similar as compared to other past studies that were logged 20 years ago in Malaysia.

KEYWORDS: Selective logging; Production forest; North Borneo; Avian community; Point count

I Received 13 Jan 2018 **II Revised** 18 April 2018 **II Accepted** 1 Jun 2018 **II Online** 28 June 2018 **I**

INTRODUCTION

Anthropogenic activity particularly affects birds in tropical forest (Mammides *et al*., 2015). Bird is one of the taxa that can play role as biological indicators to evaluate the forest health (Barlow *et al*., 2007) and performs some important ecological functions such as pollinators and seed dispersers (Whitman *et al*., 1998). Selective logging is one of the widespread human activities in the tropic and is a recommended timber harvest method as opposed to clear-cut-logging which has low-impact on the environment (Sekercioglu, 2002). Logging activities may give uncertain effect on avian community (LaManna & Martin, 2016). Felton *et al*. (2008) reported that birds can be affected by the change on forest vegetation. Segaliud-Lokan Forest Reserve (SLFR) was gazetted as a timber production forest in 1955 and have been managed by few private companies until to date (Wilting & Azlan, 2010; Mohamed *et al*., 2013). However, the peer-viewed information of the bird status in active timber production forest such as SLFR is limited. Therefore, the objective of this study is to investigate the avifauna abundance and population diversity in timber production area of a production forest.

METHODOLOGY

Study Area

The study was located at the South Eastern part of Sabah in Sandakan district (5°20′-27′N; 117°23′-39′E). SLFR covered 57,247 hectares and was zoned into Natural Forest Management area and Industrial Tree Plantation area. SLFR has been logged by different selective logging technique repeatedly from 1950 to 1990 (Mohamed *et al*, 2013). Currently, SLFR is being managed by KTS

Plantation Sdn. Bhd. (KTSP) from 1998 to date. Two sites within the SLFR were selected for this study which was compartment 11 and 15 respectively (**Figure 1**). Both compartments comprised of Dipterocarps forest. The bird surveys were conducted from 11st October to 16th December 2017 at compartment 11 and 15.

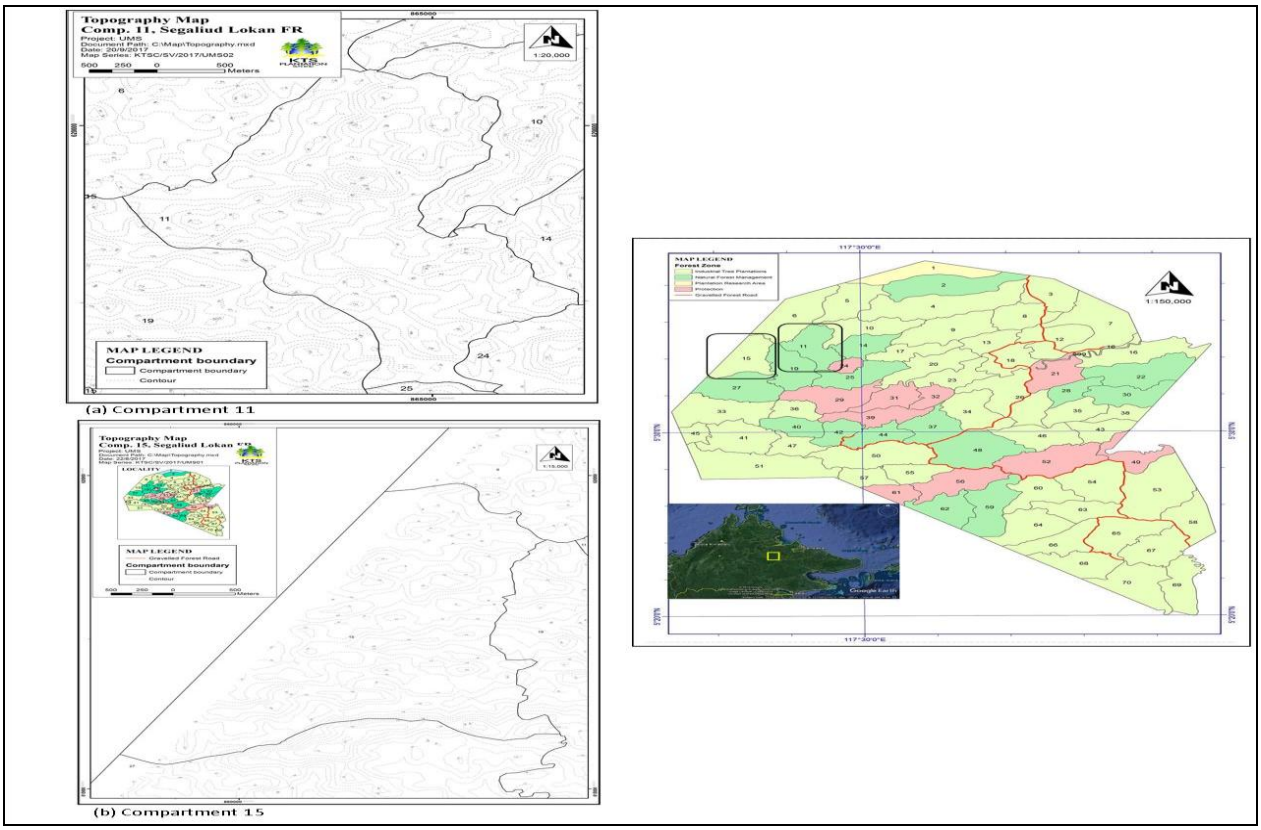

Figure 1. Location of (a) compartment 11 and (b) compartment 15 at SLFR, Sandakan, Sabah (KTS Plantation, 2017).

Data Collection

The data collection consisted of two surveys, of which were bird survey and vegetation surveys. Three transects lines of 1000 meters long were established at each of the compartment 11 and 15 which was timber production areas. Each transect line was at least 500 meters apart to avoid double counting as adapted from Bicknell *et al*. (2015). Six point counts stations were established on each of the 1000 meters transect and each point count stations was 200 meters interval in order to minimize the probability of double counting that can be consider to statistically independent (Whitman *et al*., 1998). The horizontal distance between observer and bird individual was recorded by using laser rangefinder (Owiunji & Plumptre, 1998). At least 2000 meters of bird survey was completed daily. Bird survey was conducted by standard point count survey between 0700 hours to 1130 hours which is the active time for bird (Sompud *et al*., 2016) in the absence of rain. The duration for bird observation at each point was 10 minutes (Bicknell *et al*., 2015). Birds were identified using "Field Guide to The Birds of Borneo" (Phillipps & Phillipps, 2014).

The vegetation survey was conducted using a plot of 20 meters x 20 meters that was established on each point count station to evaluate the vegetation cover (Chaves *et al*., 2017). Recorded tree data were tree diameter at the height of 1.3 meters above ground by using diameter tape (Pearman, 2002). Tree height was measured by the laser rangefinder Trimble (Sompud *et al*., 2016). Only tree with 10 centimeters and above was enumerated. The tree was identified up to species level by an experienced forester using "Preferred Check-list of Sabah Trees" (Lee, 2003). Shannon-Wiener Index, Simpson's Index of Diversity, Fisher's alpha Index of Diversity was used to measure the bird

population diversity in both compartments as follows Magurran (2004). Spearman correlation was used to evaluate the relationship between bird individual and vegetation parameters. The vegetation data were consisted of stem density, tree species, average tree height and basal area.

RESULT

A total of 55 species with 27 families (228 bird individuals) were recorded in compartment 11 and 15. Little spiderhunter (*Arachnothera longirostra*), Sooty-capped babbler (*Malacopteron affine*), Brown fulvetta (*Alcippe brunneicauda*), White-chested babbler (*Trichastoma rostratum*), Bornean black magpie (*Platysmurus aterrimus*), Ferruginous babbler (*Trichastoma bicolor*), Bornean Bristlehead (*Pityriasis gymnocephala*), Slender-billed crow (*Corvus enca*), Yellow-bellied bulbul (*Criniger phaeocephalus*) and Chestnut-winged babbler (*Stachyris erythroptera*) were the top ten bird species with highest relative abundance (**Table 1**).

Table 1. Top 10 bird species with relative abundance in compartment 11 and 15 at SLFR.

Family	Common name	Scientific name	Relative abundance (%)
Nectariniidae	Little spiderhunter	*Arachnothera longirostra*	10.53
Leiothrichidae	Brown fulvetta	*Alcippe brunneicauda*	7.46
Pellorneidae	Sooty-capped babbler	*Malacopteron affine*	7.46
Pellorneidae	White-chested babbler	*Trichastoma rostratum*	5.26
Corvidae	Bornean black magpie	*Platysmurus aterrimus*	4.82
Pellorneidae	Ferruginous babbler	*Trichastoma bicolor*	3.95
Pityriaseidae	Bornean Bristlehead	*Pityriasis gymnocephala*	3.95
Corvidae	Slender-billed crow	*Corvus enca*	3.51
Pycnonotidae	Yellow-bellied bulbul	*Criniger phaeocephalus*	3.51
Timaliidae	Chestnut-winged babbler	*Stachyris erythroptera*	3.51

The result of Spearman's rank correlation between bird individual and vegetation parameter shows that only stem density was significant correlation (P=0.024) while other parameters included tree species, average tree height and basal area shows no significant correlation (P>0.05) (**Table 2**). This indicated that bird individual was affected by the stem density in the timber production forest.

Table 2. The relationship between bird individuals and vegetation parameters in SLFR.

Spearman's rank correlation	N	Correlation coefficient	P-value
Bird individual and stem density	370	-0.117	0.024*
Bird individual and tree species	370	-0.096	0.065
Bird individual and average tree height	370	-0.043	0.414
Bird individual and basal area	370	0.041	0.427

* Correlation is significant at the 0.05 level (2-tailed).

Shannon-Wiener diversity index value in this timber production area was 3.569. This was supported also by the Simpson's diversity index value with 0.960. The results indicate that the bird in this timber production area was diverse. Fisher's alpha index of diversity in this timber production area was 23.02.

DISCUSSION

According to the results of Spearman's correlation, the bird abundance increases as stem density decrease. Most of the past studies showed that vegetation structure affected the abundance of bird positively (Owiunji & Plumptre, 1998; Sompud *et al*., 2016). Canopy cover is probably as one of the factor influences the bird abundance (Owiuniji & Plumptre, 1998). After several logging activities, residual trees may affect the ecological patterns on the sites such as amount of light intensity reaching the understory for regeneration (Stuart-Smith *et al*., 2006). Light penetrate through the canopy gaps to the forest ground and enhance the growth of understory vegetation. Understory vegetation provides habitat for insect breeding (Rajpar & Zakaria, 2015). It might attract insectivorous bird for foraging in the understory forest (Moorman *et al*., 2012).

The bird population diversity of this study was compared with other locations in Malaysia (**Table 3**). Our study area has similar avian diversity after with Kerian River Basin (KRB), Kedah which also survey 20 years after logging. Avian diversity was higher in the forest that 30 years after logging (**Table 3**), suggested the avian diversity will increase with the age of forest regeneration.

Table 3. Comparison of avian diversity at different logged forests in Malaysia.

Study site	Bird population diversity (Shannon index, H')	Logging method	Years after logging	Type of vegetation	Sampling method	Studies
SLFR, Sabah	3.569	Selective logging	20 years	Dipterocarps	Point count	This study
Kerian River Basin, Kedah (KRB)	3.561	Selective logging	20 years	Dipterocarps	Point count	Azman *et al*., 2011
Belumut , Johor	4.22	Selective logging	30 years	Dipterocarps	Point count	Peh *et al*., 2005
Bekok, Johor	4.30	Selective logging	30 years	Dipterocarps	Point count	Peh *et al*., 2005

The similarity of avian diversity index between SLFR and KRB suggested that the selectively logging in SLFR provide refuges for avian community in unlogged pockets of the area (John, 1996). These unlogged forest patches allows bird species to reside and thrive after timber harvesting (Edwards *et al*., 2014). In SLFR, secondary roads and skid trails in former timber production area were abandoned to enable the logged over forest to regenerate naturally (Ting, 2017, personal communication). The closing of the accessible road soon after the completion of logging operation benefits bird community by enhancing its survival rate, as recommended by Thiollay (1997). The undergoing forest recovery of regrowth of the vegetation provides availability of food and shelter for avian community. Mature plants bearing fruits and flowers attract different types of arthropod such as butterflies, moths, bees, spiders and wasps that serves as food for birds (Zakaria & Rajpar, 2015). In this study, 50% of the bird species belonged to insectivore bird and indicated that the food resources for insectivore bird was sufficient in this logged over forest.

CONCLUSION

The bird population diversity in SFLR was similar with past studies that were conducted in 20 years selectively logged over forest in Peninsular Malaysia. Timber production forest might act as

refuge for bird community if the forest is managed sustainably. A further study is recommended to investigate the rare bird species in the timber production forest.

ACKNOWLEDGEMENTS

This research was funded by National Geographical Society grant (WW-114ER-17) and KTSP. We would like to express our gratitude to KTSP's executives, officers and staffs, especially Mr Abdul Jalal Sampurai Abdullah, Mr Peter Tiong, Mr Ting Chung Kee, Mr Sanchez John, Miss Darrysie Salapan, Mr Wong Kee Min, Mr Haddi Baluan Musa, Mr Nordin Bin Piku, Johairul Wasing, Monloi Muroi and Mohamad Jefli Bin Jamal for their invaluable assistance that made this study possible.

REFERENCES

[1] Barlow, J., Gardner, T. A., Araujo, I. S., Ávila-Pires, T. C., Bonaldo, A. B., Costa, J. E., Esposito, M. C., Ferreira, L. V., Hawes, J., Hernandez, M. I. M., Hoogmoed, M. S., Leite, R. N., Lo-Man-Hung, N. F., Malcolm, J. R., Martins, M. B., Mestre., L. A. M., Miranda-Santos, R., Nunes-Gutjahr, A. L., Overal, W. L., Parry, L., Peters, S. L., Ribeiro-Junior, M. A., da Silva, M. N., F., da Silva Motta, C., & Peres, C. A. (2007). Quantifying the biodiversity value of tropical primary, secondary, and plantation forests. *Proceedings of the National Academy of Sciences*, **104**(47), 18555-18560.

[2] Bicknell, J. E., Struebig, M. J., & Davies, Z. G. (2015). Reconciling timber extraction with biodiversity conservation in tropical forests using reduced-impact logging. *Journal of Applied Ecology*, **52**(2), 379-388.

[3] Chaves, W. A., Sieving, K. E., & Fletcher, R. J. (2017). Avian responses to reduced-impact logging in the southwestern Brazilian Amazon. *Forest Ecology and Management*, **384**: 147-156.

[4] Edwards, D. P., Tobias, J. A., Sheil, D., Meijaard, E. & Laurance, W. (2014). Maintaining ecosystem function and services in logged tropical forests. *Trends in Ecology & Evolution*, **29**(9), 511-520.

[5] Felton, A., Wood, J., Felton, A. M., Hennessey, B. A. & Lindenmayer, D. B. (2008). A comparison of bird and communities in the anthropogenic and natural-tree fall gaps of a reduced-impact logging subtropical forest in Bolivia. *Bird Conservation International*, **18**, 129-143.

[6] John, A.G. (1996). Bird population persistence in sabahan logging concessions. *Biological Conservation*, **75**, 3-10.

[7] KTS Plantation. (2017).

[8] LaManna, J. A. & Martin, T. E. (2016). Logging impacts on avian species richness and composition differ across latitudes and foraging and breeding habitat preferences. *Biological Reviews*, **92**(2), 1657-1674.

[9] Lee, Y. F. (2003). *Preferred Check-list of Sabah Trees*. Natural History Publications (Borneo), Kota Kinabalu, Sabah.

[10] Magurran, A.E. (2004). *Measuring Biological Diversity*. Oxford: Blackwell Publishing .

[11] Mammides, C., Schleuning, M., Bohning-Gaese, K., Schaab, G., Farwig, N., Kadis, C. & Coulson, T. (2015). The indirect effects of habitat disturbance on the bird communities in a tropical African forest. *Biodiversity and Conservation*, **24**(12), 3083-3107.

[12] Mohamed, A., Sollmann, R., Bernard, H., Ambu, L. N., Lagan, P., Mannan, S., Hofer, H. & Wilting, A. (2013). Density and habitat use of the leopard cat (*Prionailurus bengalensis*) in three commercial forest reserves in Sabah. Malaysia Borneo. *Journal of Mammalogy*, **94** (1), 000-000.

[13] Moorman, C. E., Bowen, L. T., Kilgo, J. C., Hanula, J. L., Horn, S., & Ulyshen, M. D. (2012). Arthropod abundance and seasonal bird use of bottomland forest harvest gaps. *The Wilson Journal of Ornithology*, **124**(1), 31-39.

[14] Owiunji, I. & Plumptre, A. J. (1998).Bird communities in logged and unlogged compartments in Budongo Forest, Uganda. *Forest Ecology and Management*, **108**, 115-126.

[15] Pearman, P. B. (2002). The scale of community structure: habitat variation and avian guilds in tropical forest understory. *Ecological Monographs*, **72**(1), 19-39.

[16] Phillipps, Q. & Phillipps, K. (2014). *Phillipps' Field Guide to The Birds of Borneo*. United Kingdoms: John Beaufoy Publishing.

[17] Rajpar, M. N., & Zakaria, M. (2015). Bird abundance and its relationship with microclimate and habitat variables in open-area and shrub habitats in Selangor, Peninsular Malaysia. *The Journal of Animal & Plant Science*, **25**(1), 114-124.

[18] Sekercioglu, C. H. (2002). Effects of forestry practices on vegetation structure and bird community of Kibale National Park, Uganda. *Biological Conservation*, **107**, 229-240.

[19] Sompud, J., Kee, S. L., Sompud, C. B., Emily A. G. & Igau O. A. (2016). The correlations between bird relative abundance with the stem density in two years old *Acacia mangium* plantation at Sabah Forest Industries, Sipitang. *Transactions on Science and Technology*, **3**(1-2), 136- 142.

[20] Stuart-Smith, A. K., Hayes, J. P., & Schieck, J. (2006). The influence of wildfire, logging and residual tree density on bird communities in the northern Rocky Mountains. *Forest ecology and management*, **231**(1-3), 1-17.

[21] Thiollay, J-M. (1997). Disturbance, selective logging and bird diversity: a Neotropical forest study. *Biodiversity and Conservation*, **6**, 1155-1173.

[22] Ting, C.K.(2017). Personal Communication.

[23] Whitman, A. A., Hagan, J. M. & Brokaw,N. V. L. (1998). Effects of selection logging on birds in northern Belize. *Biotropica*, **30**, 449–457.

[24] Wilting, A. & Azlan M. (2010). *Wildlife Surveys in Segaliud Lokan Forest Reserve*. Sandakan, Sabah.

[25] Zakaria, M. H. & Rajpar, M. N. (2015). Effects of logging and recovery process on avian richness and diversity in hill dipterocarp tropical rainforest-Malaysia. *Journal of Environmental Biology*, **36**, 121-127.