A COMPARISON OF PATTERNS OF AVIFAUNA COMMUNITY STRUCTURE BETWEEN FORESTED AND OPEN AREA IN JAMBUSAN, BAU, SARAWAK

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A comparison of patterns of avifauna community structure between forested and open area in Jambusan, Bau, Sarawak

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ABSTRACT

A study of avifauna community structure was conducted in Jambusan, Bau, Sarawak for six days continuously from 7 August 2004 to 12 August 2004. The aim of the study is to compare the patterns of avian community structure (species diversity, capture rate, composition, and temporal patterns) between forested area and open area in Jambusan, Bau. Forested areas are described as areas with scattered trees and without any mark of agriculture activities. Open areas are described as areas in which plantation activities were conducted and areas whereby some parts of the site have been logged. A total of 20 mist-nets were deployed in each of the sampling site with 10 mist-nets in the forested area and another 10 mist-nets in the open area. A total of 94 birds comprising 31 species from 14 families were recorded in the area. The analysis of Shannon-Weiner Index, $H'$ comparing the indices of the forested and open areas show no significant different between the two areas. Family Ploceidae contribute the highest relative abundance with 20 birds and the relative abundance of 21.3%. The most dominant species was mossy-nest swiftlet (Aerodramus salanganus) with 13 birds have been captured. In forested area, a total of 20 species from 11 families were recorded while 22 species from 13 families were recorded in open area. Eleven species and nine families were recorded in both forested and open areas. The overall capture rate for this study was 37 birds/1000 net-hours. Throughout the study period, birds were most captured during the morning and evening with 39 birds.

Key words: avian community structure, species diversity, capture rate, composition, temporal separation.

ABSTRAK


Kata kunci: komuniti struktur avifauna, kepelbagaian spesies, kadar tangkapan, komposisi, corak komuniti.
1.0 Introduction

Birds are interesting and fascinating group of animals. Many people like birds because of their beautiful appearance with variety of colours and distinctive voices (Mawek, 2002). Birds live in a wide variety of habitats and locality. They can be found in all over the place including the terrestrial land, islands and even in the open sea. There are about 9000 species of birds have been described and were classified into 27 orders (Solomon and Berg, 1995).

Ecologically, birds are considered as important seed dispersers due to their frugivorous and nectarivorous diets. Apart from that, they serve as a form of pests control by acting as predators for rodents and other prey animals. According to Dowsett (1985), migratory birds for instance play the most important role in the ecosystem services by acting as long-distance dispersers.

The trade of edible birds’ nests has become a valuable industry that has become one of the important economical activities to the country. In Sarawak, the main harvesting regions of these edible-nest caves swiftlets species include the caves in Niah National Park, Mulu National Park and Bau district (MacKinnon and Phillipps, 1993). Smythies (1981) mentioned that nests produced by white-nest swiftlet (Aerodramus fuciphagus) and black-nest swiftlet (A. maximus) are fetch higher price compared to mossy-nest swiftlet (A. salanganus). The edible-birds nest is highly demanded internationally and it contains nutritious elements.

Birds are studied because of their contributions to many important roles in the ecosystems by local researchers and also researchers from other countries. Most of the studies were extensively carried out in protected areas such as national parks, wildlife sanctuaries and forest reserves. This is due to the fact that protected areas in Malaysia offer a very high diversity of avifauna and some of them are endemic species (Jawi et al., 2005).
The patterns of birds' community can be determined as the species composition of the community, the distribution, abundance, morphological and behavioural attributes are related to the environment (Wiens, 1989).

This study is important as part of contributions towards studying the various aspects of bird ecology in Sarawak. The previous researches on bird's ecology have provided very useful information and knowledge particularly on the distribution and behaviour of birdlife in Sarawak forests areas. This study provides new information and data that can be used for future studies. The knowledge and information generated from this study can be utilized for conservation and management of avifauna communities particularly in the study areas and Sarawak in general.

1.1 Objective

The objective of this study is to compare the patterns of avian community structure between forested and open areas in Jambusan, Bau limestone forests. For the purpose of this study, the avian community structure include species diversity, capture rates, composition and temporal patterns.

1.2 Hypothesis

H_0: There is no difference in the patterns of avifauna community (species diversity, capture rate, composition, and temporal patterns) between forested and open areas.

H_a: There is a difference in the patterns of avifauna community (species diversity, capture rate, composition, and temporal patterns) between forested and open areas.
2.0 Literature Review

Studies on bird communities' have been conducted by many researchers (Wells, 1985). Their distribution, natural history, and systematic are generally well known. According to Rahman et al. (2002) on their study on the avifauna in Upper Rejang, Sarawak stated that the birds sample collections and surveys in Sarawak started as early as in the 1800’s. Wallace had been collecting samples of animals including birds in Sarawak and the rest of Southeast Asia in the middle of the 1800’s. Wells (1985) stated that the mist-nets had been used to study bird in Malaysia in significant numbers in 1958 and 1959 hence, the start of formal birds population and migration studies. He added that the annual or biennial bird reports have been published in the Malayan Nature Journal since 1962.

Duckett (1985) described Sarawak as a vast area within has a very wide variation of habitats. Sarawak has an amazing wealth of bird’s species that attracts many observers to report and publish their observations which contributes to the increase in the overall knowledge on distribution and habitats of the birdlife in Sarawak. MacKinnon and Phillipps (1993) recorded Borneo has 358 species of birds comprising 66% occurring in islands of the Sunda Region. Of these, 37 species are endemic to Borneo. Sarawak has approximately 350 species of birds to date (Payne, 1995). Smythies (1981) listed 19 orders of birds that occur in Borneo, which include Podicipidoiformes, Procellariiformes, Pelecaniformes, Ardeiformes, Anseriformes, Falconiformes, Galliformes, Ralliformes, Charadriiformes, Columbiformes, Psittaciformes, Cuculiformes, Strigiformes, Caprimulgiformes, Apodiformes, Trogoniformes, Coraciiformes, Piciformes and Passeriformes.

The patterns of community structure can be termed as the species composition of the community, the distribution, abundance, morphological and behavioural attributes that are related to the environment. The most appropriate and efficient way to determine patterns was
through comparisons of the variation that occurs naturally in the environment. The variation is reflected in the differences or similarities between islands and mainland, between different elevational zones on a mountain or even between habitats at different latitudes (Wiens, 1989).

The research conducted in Jambusan, Bau had provided information particularly on the ecology of birds communities in the habitat of limestone forests. According to MacKinnon and Phillipps (1993), the limestone forest areas are totally riddles with caves and they are covered with less tall forests of specialized trees but still manage to support distinctive species of birds. In the interior part of the limestone forest, the undergrowth species and shrubs comprise of large ros palms, such as *Salacca* sp., rattans (*Calamus* sp. and *Daemonorops* sp.), *Caryota mitis*, and *Arenga* sp. Other undergrowth plant species include *Kopsia* sp., *Psychotria* sp., *Atalantia* sp., *Glycosmis* sp., and *Pandanus occultus* (Wells, 1977).

A study was conducted by Rahman *et al.* (2004) focuses on the diversity and abundance of understorey avifauna in limestone forest, Wind Cave and Fairy Cave, Bau. Sampling period for this study was six days. An overall total of 20 mist-nets were deployed within the study sites, with 10 mist-nets were deployed in the disturbed area and another 10 mist-nets were deployed in the less disturbed area. From the study, a total of 101 birds comprising 33 species from 15 families were recorded in the area. The families recorded in the study include *Columbidae*, *Cuculidae*, *Apodidae*, *Alcedinidae*, *Capitonidae*, *Eurylaimidae*, *Pycnonotidae*, *Turdidae*, *Timalidae*, *Sylviidae*, *Muscicapidae*, *Dicaeidae*, *Nectariniidae*, *Estrildidae* and *Oriolidae*.

Another study was conducted by Mawek (2002) in mixed dipterocarp forest of Gunung Pueh, Sematan. The study focused on the diversity and abundance of understorey birds in disturbed and less disturbed area. The sampling period of the study was 10 days. A
total of 20 mist-nets were deployed within the study sites, with 10 mist-nets were deployed in the disturbed area and another 10 mist-nets were deployed in the less disturbed area. From the study, a total of 205 birds representing 46 species from 20 families were recorded in the area. The families recorded include Columbidae, Cuculidae, Tytonidae, Strigidae, Trogonidae, Alcedinidae, Capitonidae, Picidae, Eurylaimidae, Hirundinidae, Pycnonotidae, Turdidae, Timaliidae, Sylviidae, Muscicapidae, Dicaeidae, Nectariniidae, Estrildidae, Dicruridae and Corvidae.

A study was conducted by Rahman et al. (2002) on the avifauna in Upper Rejang, Sarawak. The study was carried out in two periods. The first period was six days and the second period was 10 days. The survey was conducted by using the mist-netting technique and visual observation along the marked transects. From the study, a total of 175 species from 39 families of birds were recorded. Among the commonly observed birds were from the families of Hirunidinidae, Pycnonotidae, Timaliidae, and Nectariniidae.
3.0 Study Area

The study area was conducted in Jambusan (01°40.7'56" N and 110°11.8'542" E) (Figure 1), Bau district. It is situated about 3 kilometres from Bau main road before Jalan Merembeh junction. Bau district is about 35 kilometres and it takes less than one hour to travel by road from Kuching to Bau. Two routes to get there from Kuching are by using the old Bau-Kuching Road via Kota Sentosa or using the Kuching-Bau-Lundu Road via Batu Kawa (Anon, 2005).

Jambusan forest areas are largely covered with limestone, secondary forests and kerangas forests. The secondary forest consists of ferns, Ficus sp., Macaranga sp., Shorea sp., Endospermum sp., and Artocarpus sp. while kerangas forest consists of ferns, Ficus sp., Eleocarpus sp., Vaccinium sp., Melastoma sp., Scheffera sp., and Timonius sp. (Tuen et al., 2000).

The study sites were divided into two areas, namely forested and open areas. The range of study areas covered for about 1 km². Forested areas are described as areas with scattered trees and without any mark of agriculture activities. This area comprise of secondary forests along the limestone cliff. Open areas are described as areas in which plantation activities were conducted and areas whereby some parts of the site have been logged. This area has been planted with paddy, corn and cocoa plant.

During the study period, logging was still in progress in some parts of the study area. The existence of paddy field, cornfield and cocoa plot near and within the study sites indicated that most of the local people living nearby or within the study area are mostly farmers.
Figure 1: Map showing location of the study area in Jambusan, Bau (Wilford, 1964).
4.0 Materials And Method

4.1 Field Materials

Mist-nets with four shelves (2.5 m×12 m, 36 mm mesh) were used to capture the birds. Cloth bags were used to keep the captured birds before identification and measurement were made. Pesola spring scale was used to measure the weight of each bird. Electronic digital caliper or manual caliper (inc/mm), steel ruler and plyer were used for measuring the bird’s morphological characters. All of the captured birds were tagged with numbered rings before released. The bird’s field data book was used to record all the birds’ important data including their species name, morphological measurement, ring’s number, time, date and the areas of where the birds were captured. Field guides book such as The Birds of Borneo by Smythies (1981) and A Field Guide to The Birds of Borneo, Sumatra, Java and Bali by MacKinnon & Phillipps (1993) were used for the bird’s identification.

4.2 Field Methods

Twenty mist-nets with four shelves (2.5 m×12 mm, 36 mm mesh) were set at ground level of the study areas. The mist-nets were deployed in forested (10) and open areas (10) with 10 m apart from one mist-net to another. Mist-nets were checked everyday at two-hourly intervals and all captured birds were collected. The checking of the mist-nets was conducted from 0600 hours until 2200 hours. The time of each captured bird was recorded. All the birds were immediately identified soon after each and every collection of the bird was done.

Pesola spring scale was used to measure the weight of each captured bird. An electronic digital caliper or a stainless steel ruler was used to measure the external
morphological characters. The measurements include tarsus length, bill length, bill depth, bill width, wing length, tail length, total length, and wingspan. Moulting and brood patches of captured birds were examined as well. The birds were tagged with numbered metal rings. Each ring has a unique number bearing University Malaysia Sarawak (UNIMAS) address. The date and time of the captured birds were recorded before releasing the birds (Rahman et al., 2004).

4.3 Statistical Analysis

Shannon-Wiener Index and Zar t-test statistics were used for the statistical analysis. According to Wiens (1989), Shannon-Wiener Index is the most widely used diversity index. Program DIVERS (Appendix 10.5) was used to calculate the Shannon-Wiener function for species abundance data (Krebs, 1989). Shannon-Wiener Index was calculated using the formula, \( H' = -\sum p_i \ln p_i \) (Zar, 1996).

Program Divers Version 1.2, a modified programme of Program DIVERS (Laman, 2002) was used to calculate the species diversity in this study. According to Hutcheson (1970), t-test statistics can be used to test the null hypothesis that the measurement of species diversity is the same between open and forested areas. It was calculated using the formula:

\[
t = \frac{H'_1 - H'_2}{S_{H'_1,H'_2}}
\]

Where \( H'_1 = \frac{n(\log(n) - \sum f_i \log(f_i))}{n} \)
and $S_{H_1-H_2} = \sqrt{S_{H_1}^2 + S_{H_2}^2}$

Variance, $S_{H_i}^2 = \frac{\sum f_i \log^2 f_i - (\sum f_i \log (f_i))^2}{n^2}$

Degrees of freedom, $\nu = \frac{(S_{H_1}^2 + S_{H_2}^2)^2}{\frac{(S_{H_1}^2)}{n_1} + \frac{(S_{H_2}^2)}{n_2}}$
5.0 Results

A total of 94 individuals comprising 31 species from 14 families were recorded in the study area. The families include Columbidae, Cuculidae, Strigidae, Apodidae, Alcedinidae, Picidae, Pycnonotidae, Corvidae, Timaliidae, Sylviidae, Muscicapidae, Nectariniidae, Dicaeidae and Ploceidae. In forested area, 48 individuals were captured representing 20 species from 11 families. In open area, 46 individuals were recorded representing 22 species from 13 families. The number of individuals captured in the forested area was higher than the number of individuals captured in the open area. However, the number of species and families were higher in the open area compare to the forested area.

5.1 Cumulative Number Of Individuals

The graph (Figure 2) shows cumulative number of individuals throughout the study period. Based on the graph, the cumulative graph of individuals captured in the study areas was generally increasing from day one until the end of the sampling period. The highest number of individuals was captured on the fourth day with 24 individuals while the lowest number of individuals was captured on the last day of sampling period with eight individuals. This graph had indicated that more individuals could have been captured if the nets were deployed for a longer period.
5.2 Cumulative Number Of Species

The cumulative graph of species captured in the study areas was generally increasing from day one until the end of the sampling period (Figure 3). In general, the graph has not reached the asymptote, which means that more species could have been captured if the nets were deployed for a longer period (Rahman et al., 2004). However, the cumulative curve of species in forested area had reached the asymptote point, which means that probably there would no more species captured if the study was continued in the area. Generally, the highest numbers of species were captured on the first and second day, both with eight species. The lowest numbers of species captured was recorded on the fifth and the last day of sampling period, both with only two species.
5.3 Cumulative Number Of Families

The graph (Figure 4) shows the cumulative number of families captured in the study area had reached the asymptote point. This means that no more families would be captured if the nets were deployed for a longer period. Based on the graph, the highest numbers of families were captured on the first day in forested and open areas with four families in each area. Both of the study areas consist of an overall total of 14 families. The number of families was recorded with 11 families in forested area and 13 families in open area. The highest number of families captured was recorded on the forth day with 10 families and the lowest number of families was recorded on the last day with five families.
5.4 Relative Species Abundance

Family Ploceidae contributes the highest relative abundance with 20 individuals (21.3%). Family Nectarinaidae contributes the second highest of relative abundance with 15 individuals (16.0%) followed by Apodidae with 13 individuals (13.8%). The most dominant species was mossy-nest swiftlet (A. salanganus) with 13 birds (relative abundance = 13.8%). Eurasian tree sparrow (Passer montanus) contributes the second highest number of captured birds with 12 birds (relative abundance = 12.8%) followed by dusky munia (Lonchura fuscans) with eight birds (relative abundance = 8.5%).

In the forested area, mossy-nest swiftlet from the family of Apodidae contributes the most dominant species with 12 individuals (relative abundance = 13%). The little spiderhunter (Arachnothera longirostra) from the family of Nectariniidae contributes the second most abundance species within this area with six individuals (relative abundance =
Following this species was rufous-tailed tailorbird (*Orthotomus sericeus*) from the family of Sylviidae with four individuals (relative abundance = 4%).

In the open area, eurasian tree sparrow from the family of Ploceidae contributes the highest relative abundance with 12 individuals (relative abundance = 13%). Dusky munia that belongs to the same family was the second most dominant species within the area with seven individuals (relative abundance = 7%). Following this species was orange-bellied flowerpecker (*Dicaeum trigonostigma*) from the family of Dicaeidae with four individuals (relative abundance = 4%). The relative species abundance was calculated by using the formula below (Mawek, 2002):

\[
\text{Relative species abundance} = \frac{\text{Total number of individual for each species}}{\text{Total number of individual}} \times 100
\]