



Institute of Biodiversity and Environmental Conservation

**Effect of Longhouse Communities on Species Diversity and Diet of
Bulbul (Aves: Pycnonotidae) in Pelagus, Kapit, Sarawak**

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**Master of Science
2020**

Effect of Longhouse Communities on Species Diversity and Diet of Bulbul
(Aves: Pycnonotidae) in Pelagus, Kapit, Sarawak

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A thesis submitted

In fulfillment of the requirements for the degree of Master of Science

(Bird Ecology)

Institute of Biodiversity and Environmental Conservation

UNIVERSITI MALAYSIA SARAWAK

2020

DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ACKNOWLEDGEMENT

My special acknowledgement goes toward my supervisor and my co-supervisor, Prof. Dr. Andrew Alek Tuen and Prof. Dr. Gabriel Tonga Noweg for advice, support, strength and precious guidance throughout this research. I am thankful for all advice and guidance from all Institute of Biodiversity and Environmental Conservation (IBEC) lecturer and staff. A wholehearted appreciation goes to my fieldwork team Hasri Al-Hafiz bin Haba, Rahah Mohd binti Yakup, Isa Sait, Adi Shabrani bin Mohammad Ridzuan, Pui Yong Min, Pang Sing Tyan, Mohd Paisal bin Wahab, Attiqah Fadziliah binti Sopian and Melynda Cheok Ka Yi. I am grateful for the help, field assistantship and accommodation provided from local community namely John anak Asun (Headman of Rumah John), Ugak anak Ribat, Jawek anak Gagat, Nicholas Bantin anak John, Bonnyson anak Gon, Alistar Keyang anak John, Temenggong anak Kumap, Bujah anak Ijau (Headman of Rumah Bujah), Win anak Meluda, Umpik anak Bunsu, Richelles Seli anak Lasu and Laja anak Sandak (Headman of Rumah Laja). I also want to express my gratitude toward Sally Soo and Stephanie Judi for helping me.

I want to express my appreciation towards Sarawak Energy Berhad, through its Hydropower Environmental Sustainability Project research grant for financial support of my fieldwork; toward Ministry of Higher Education, Malaysia for My Brain 15 scholarships and Sarawak Forestry Department for research permit (NCCD.907.4.4(JLD.12)-109) and park permit (238/2015).

My innermost gratitude is for my mother, Rohana Binti Abdullah and my late father, Ismail bin Brahim and the rest of my family and friends for giving me strength, supported me, motivate and pray for me in completing this thesis. I am so grateful for all the support and

so thankful for even the smallest help. All of our hard work and experiences will always be remembered. Thank you all and really appreciate it.

ABSTRACT

Longhouse communities can be a significant source of disturbance to local fauna by their presence in the vicinity and through their activities such as farming, hunting and gathering of forest produce. The level of disturbance is likely to be highest at sites that are closest to the longhouse and lesser at sites further away from the longhouse. Whether different levels of anthropogenic disturbance affect avifauna community have not been studied in isolated longhouse communities in Sarawak. Hence a study was conducted in the forests behind three longhouses (Rumah Laja, Rumah Bujah and Rumah John) and in Pelagus National Park (PNP) to determine the effect of anthropogenic disturbance on the diversity and diet of bulbul. Sampling stations were located at 100 m, 500 m and 1000 m away from the longhouse, and inside PNP at location which is more than 1000 m from the longhouse and protected against anthropogenic disturbance by law. Eight sets of double-stacked mist nets were deployed at each station and checked every two hours from 8am to 6.30pm for four days. Insect and fruit traps were also set at the same station to sample the potential diet of bulbuls. These locations were sampled four times over a period of 12 months between December 2014 and November 2015. Captured bulbuls were identified, ringed, measured, and administered with emetic solution to obtain regurgitation samples for dietary studies and then released back to the forest. A total of 240 individuals comprising 12 species of bulbul was captured in this study. The dominant species caught was Spectacled bulbul (*Pycnonotus erythrophthalmos*) with 19% relative abundance and followed by Puff-backed bulbul (*Pycnonotus eutilotus*) with 16% relative abundance. Based on high diversity (Simpson index = 0.862; Shannon index = 2.145) and abundance (91 individuals), the site 500 m from the longhouse is the most preferred by bulbul and this site have a high similarity to 1000 m station and Pelagus National Park site based on Morista-horn index. A total of 24 families

of plant and 494 fruit sample weighing 1.4963 kg was collected from all stations. Distance from longhouses does not seem to affect yield of fruits collected but fruit yield was highest in March/April 2015. The total number of invertebrates collected was 20,037 individuals comprising four classes of potential preys, which are arachnida, chilopoda, gastropoda and insecta. Ivlev's electivity index (E) was used to measure a degree of selection of prey by the predator. Orthoptera with E value of +0.90 and hemiptera with E value of +0.80 are the main prey selected by bulbul. Bubluls also selected other insect orders which are coleoptera (E = +0.60), dictyoptera (E = +0.68) and isoptera (E = +0.68). The diet of bubluls has a positive relationship with fruit weight and invertebrates in environment based on linear regression. Different habitat also offered different types of food based on food resources collection conducted in this study. This study concluded that longhouse community have a significant effect on bulbul diversity, species evenness, number of species and abundance up to 100 m from longhouses. This supported the hypothesis of this study that the impact of anthropogenic disturbances is greatest in areas closest to human settlement and less in areas that are further away.

Keyword: Bulbul, diversity, diet, Iban longhouse, anthropogenic activity

Kesan Komuniti Rumah Panjang Terhadap Kepelbagaian Spesies dan Diet Bulbul

(Aves: Aves: Pycnonotidae) in Pelagus, Kapit, Sarawak

ABSTRAK

*Komuniti rumah panjang boleh menjadi punca utama gangguan terhadap fauna tempatan dengan kehadiran mereka di kawasan sekitar dan melalui aktiviti mereka seperti berkebun, memburu dan mengumpul hasil hutan. Tahap gangguan berkemungkinan tinggi di kawasan yang dekat dengan rumah panjang dan rendah di kawasan yang jauh dari ruman panjang. Perbezaan tahap gangguan antropogenik yang menjejaskan komuniti avifauna belum lagi dipelajari di komuniti rumah panjang terpencil di Sarawak. Oleh itu satu kajian dijalankan di hutan di belakang tiga rumah panjang (Rumah Laja, Rumah Bujah dan Rumah John) dan di Taman Negara Pelagus (PNP) untuk menentukan kesan gangguan antropogenik terhadap kepelbagaian dan diet bulbul. Stesen pensampelan terletak di 100 m, 500 m dan 1000 m dari rumah panjang, dan di dalam PNP di lokasi yang lebih daripada 1000 m dari rumah panjang dan dilindungi terhadap gangguan antropogenik oleh undang-undang. Lapan set jaring kabut berganda dilancarkan di setiap stesen dan diperiksa setiap dua jam dari pukul 8 pagi hingga 6.30 petang selama empat hari. Serangga dan perangkap buah juga ditetapkan di stesen yang sama untuk mengambil sampel makanan potensi bulbul. Lokasi-lokasi ini telah dilawat sebanyak empat kali dalam tempoh 12 bulan antara Disember 2014 dan November 2015. Bulbul yang ditangkap telah dikenalpasti, dicincin, diukur, dan diberikan cecair emetik untuk mendapatkan sampel regurgitasi untuk kajian diet dan kemudian dibebaskan kembali ke hutan. Sebanyak 240 individu terdiri daripada 12 jenis bulbul yang ditangkap dalam kajian ini. Spesies dominan yang ditangkap adalah Merbah mata merah kecil (*Pycnonotus erythrophthalmos*) dengan 19% kelimpahan relatif dan diikuti oleh Merbah coklat berjambul (*Pycnonotus eutilotus*) dengan kelimpahan relatif*

sebanyak 16%. Berdasarkan kepelbagaian yang tinggi (Indeks Simpson = 0.862; Shannon index = 2.145) dan kelimpahan (91 individu), stesen 500 m dari rumah panjang adalah stesen yang paling disukai oleh bulbul dan stesen ini mempunyai persamaan yang tinggi dengan stesen 1000 m dan Taman Negara Pelagus berdasarkan indeks Morista-horn. Sejumlah 24 keluarga tumbuhan dan 494 sampel buah seberat 1.4963 kg telah dikumpulkan dari semua stesen. Jarak dari rumah panjang seolah-olah tidak menjejaskan hasil buah-buahan yang dikumpulkan dan hasil buah yang tertinggi adalah pada bulan Mac/April 2015. Jumlah bilangan invertebrata yang dikumpulkan adalah 20,037 individu yang terdiri daripada empat kelas potensi mangsa, iaitu arachnida, chilopoda, gastropoda dan serangga. Indeks elektiviti Ivlev (E) digunakan untuk mengukur tahap pemilihan mangsa oleh pemangsa. Orthoptera dengan nilai $E +0.90$ dan hemiptera dengan nilai $E +0.80$ adalah mangsa utama yang dipilih oleh bulbul. Bulbul juga memilih serangga lain iaitu coleoptera ($E = + 0.60$), dictyoptera ($E = + 0.68$) dan isoptera ($E = + 0.68$). Pemakanan bulbul mempunyai hubungan positif dengan berat buah dan invertebrata dalam persekitaran berdasarkan regresi linear. Habitat yang berbeza juga menawarkan pelbagai jenis makanan berasaskan pengumpulan sumber makanan yang dijalankan dalam kajian ini. Kajian ini menyimpulkan bahawa komuniti rumah panjang mempunyai kesan yang signifikan terhadap kepelbagaian bulbul, kesamaan spesies, bilangan spesis dan kelimpahan sehingga 100 m dari rumah panjang. Ini menyokong hipotesis kajian ini bahawa kesan gangguan antropogenik adalah paling besar di kawasan-kawasan yang paling dekat dengan penempatan manusia dan kurang di kawasan-kawasan yang lebih jauh.

Kata kunci: Bulbul, kepelbagaian, diet, rumah panjang Iban, aktiviti antropogenik

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LIST OF ABBREVIATIONS

asl	Above sea level
Cm	Centimeter
FAO	Food and Agricultural and Organization of the United Nation
g	Gram
ha	Hectare
IBEC	Institute of Biodiversity and Environmental Conservation
km	Kilometer
m	Meter
mm	Milimeter
ml	Mililiter
PNP	Pelagus National Park
UNIMAS	Universiti Malaysia Sarawak

CHAPTER 1

INTRODUCTION

1.1 Indigenous Communities

Longhouses or rumah panjang is a type of traditional settlement for natives in Borneo Island (Cramb, 2007). Traditionally longhouse is an elevated wooden structure that is built near a river, which provided access to other areas and water for bathing, washing and drinking. Longhouses communities conducted many activities such as farming, fishing and collecting forest produce to support their livelihood. Shifting cultivation is the most common farming practices of the Iban longhouse communities (Cramb, 1993) and it is one of primary causes of degradation and loss of tropical rainforest in South East Asian because each year new areas are opened up for cultivation (Ichikawa, 2007). As a consequence, farms get further and further away from the original longhouse and eventually a new longhouse is built in the newly farmed area (Yea, 2002).

In the last 40 years however the Iban and other minority groups in Sarawak are encouraged by the government to adopted more sedentary lifestyle by building a permanent structure such as using concrete, corrugated iron and glass (Yea, 2002). Recently, tourism has become an alternative source of livelihood as shown by Longhouse tour and “River Safari” in area Batang Ai, Lemanak, Engkari and Ulu Ai river in Sri Aman division (Yea, 2002) and in Kelabit Highlands (Hitchner et al., 2009). Longhouse communities, especially the women, elderly and landless, can also generate income through production and sales of handicraft such as basket, mat plaiting, weaving pua (ceremonial blanket), weaving Kelambis (Jacket), making selampai (sashes), carving terabai (shields), kenyalang image and sungkup (funerary monument) (Berma, 2001).

This study focuses on the Iban community in Pelagus, located in central Sarawak, along the Rajang River. The Iban is the largest of indigenous people in Sarawak, numbering about 797,700 in 2016 (The Official Portal of Sarawak Data, 2018). They practiced shifting cultivation to plant paddy, and after harvesting the paddy they plant rubber and fruit trees on the fallow land thus creating an agroforestry system. They also hunt, collect forest produce from the communal forest surrounding their longhouse and fish in the major rivers (Rajang River, Pelagus River) which is also their main means of transport. The mechanism to create communal forest was by having an agreement or mutual understanding with logging companies, which limit logging activities to areas outside 1000 m radius from their longhouses.

Globally, indigenous people-inhabited areas occur simultaneously with world remaining major concentration of biodiversity, with an estimated 22% of the world land surface under traditional indigenous communities holding 80% of the planet's biodiversity (WRI, 2005). About 11% of the world forest land are legally owned by indigenous people and communities (White et al., 2004; Takeuchi et al., 2017). It is suggested that when indigenous communities are small in numbers, adhere to traditional systems and methods of resource exploitation and harvest only for self-consumption, their impact on ecosystem function and biodiversity is minimal. According to Persha et al. (2011), forest systems are more likely to have sustainable outcome (above average tree species richness and subsistence livelihoods) when local forest users participate in the forest rulemaking. A study by Takeuchi et al. (2017) showed that the tree diversity in communal reserve forest belonging to Iban and Penan community in Sarawak, Borneo, is similar to that of primary forest.

Globalization factors such as market assess, migration and technology network have implication toward household economics, social network and native biodiversity (Kramer et

al., 2009). This implication can be illustrated by the rising prices for local products that resulted in intensification of production or increases their land holding through deforestation that associated with habitat loss, nutrient runoff, pollution and species decline (Geist & Lambin, 2002). They may also shift from traditional produce crops to one better-suited for export (rubber, oil palm) that often comes with harmful ecological consequences (Amadi, 1988).

1.2 Disturbed Forest and Its Avifauna Community

The tropical forest is an important habitat due to its high diversity, ancient and unique ecology of land communities (Myers, 1984). Tropical forest is being threatened by deforestation and degradation caused mostly by settlement, logging and agricultural activities. Based on satellite imagery, it is estimated that by 2009 over 80% of Sarawak and Sabah forest is degraded (Bryan et al., 2013). Oil palm plantation in Sarawak has increased in size from 28,500 ha in 1985 to 744 372 ha in 2008 (Tsuyuki et al., 2011) and increases even more in the year 2018 with 1,572,477 ha (MPOB, 2019). Based on Global Witness (2012), only 5% of Sarawak forests remain in pristine state and degradation of virgin forest in Sarawak is surprisingly more than Sabah, Indonesia and Brunei combined. Increases proportion of disturbed forest has make it important to study the biodiversity of these areas and try to understand some of the factors that maintain diversity.

Disturbance towards the environment has a potentially damaging effect on wildlife (Hume, 1976). Disturbance is often label as event such as hurricane, forest fires or anthropogenic activities such as logging, land clearing and infrastructure development (McKelvey, 2015). Avian community has been affected widely by habitat modification caused by agriculture, settlement and logging activities. Oil palm plantation only retains about 20% of previous forest inhabitants of mammal, reptiles and birds (Laidlaw, 1998; Heang & Lim, 1998).

According to Gibson et al. (2011), bird is most sensitive to forest conversion into agriculture. In Ulu-Segama-Malua forest reserve in Sabah, the abundance of imperiled bird species in forest fragment is 60 times lower and in oil palm plantation 200 times lower than in contiguous forest (Edwards et al., 2010).

Forest disturbance has an impact on decreasing food supply that can affect bird diversity, abundance, breeding ecology, body condition, ranging and/or flocking behaviour (Sodhi, 2002). Wong (1986) studied the effect of food supply of understory bird in primary and disturbed forest in Pasoh Forest Reserve, Negeri Sembilan, Malaysia. Plant producing flowers or fruits used by birds in primary forest is higher than in disturbed forest; foliage arthropods abundance did not differ between two forest but low abundance period is four months longer in disturbed than in primary forest. Bird species richness and abundance were lower in disturbed than primary forest, and this is due to lower abundance of resource in disturbed forest than primary forest (Wong, 1986). Aratrakorn et al. (2006), compared the oil palm and rubber plantation versus lowland forest in Khao Pra-Bang Khram Wildlife Sanctuary and Bang Khram National Reserve Forest in Thailand and showed that species richness is lower in the plantation compared to lowland forest. Barbet, woodpecker and babbler are largely absent in the plantation and 15 out 16 globally threatened or near threatened species can be found only in lowland forest (Aratrakorn et al., 2006). The impact of habitat fragmentation on tropical bird community was also studied in Lake Kenyir, Malaysia by Ding et al. (2011). Based on the study, smaller islands have simpler bird communities and contains less functional group at feeding guilds level. Insectivorous and frugivorous birds are the most affected by forest fragmentation (Sodhi et al., 2004).

Bulbul (Family Pycnonotidae) comprised of 161 species worldwide (IUCN, 2019), 68 species in Southeast Asian (Avibase, 2019) and 27 species in Borneo (Avibase, 2019). Based

on Phillipps and Phillipps (2014), the Bornean Bulbul is endemic to Borneo Island. This species occurs in the south to Barito Ulu, Kalimantan and is locally common in some places such as Crocker Range, and scarce on Mount Kinabalu but not found on Gunung Penrissen and Gunung Pueh, Sarawak. Bulbuls do not migrate, and sexes are alike (Smythies, 1981).

Bulbul is a generalist frugivore that feeds on a broad type of fruits (Fukui, 1995; Corlett, 1998a). Frugivorous bird has dominant roles in mutualism as seed dispersal, which can be understood using diet studies (Corlett, 1998a; Wenny, 2000; Corlett, 2009). Bulbuls preferably feed on fruit and berries (Fogden, 1972) but flowers, buds and insects are also consumed when fruits and berries are scarce (Brooks, 2013). Black-crested Bulbul takes insect on wing regularly and Yellow-vented Bulbul regularly feeds from the ground on prey that included worms, scarabs, and crickets (Smythies, 1981). A study in Semengo Forest Reserve, Sarawak showed that fruit may be essential for a bulbul diet where they consumed them even when the insect is abundant (Fogden, 1972). More than 90% of bulbul dropping has plant material in them (Mandon-Dalger et al., 2004; Milla et al., 2005; Linnebjerg, 2010) and the rest are insects.

1.3 Problem Statement, Research Questions and Hypothesis

Globally, indigenous people-inhabited or controlled areas coincided with the world's remaining centres of biodiversity (WRI, 2005; Sobrevila, 2008). It is suggested that when indigenous communities are small in numbers, adhere to traditional culture and systems of resource exploitation and harvest only for self-consumption, their impact on ecosystem function and biodiversity would be minimal, hence the high biodiversity of indigenous people occupied areas. Applying this global view to the Iban in Pelagus, their impact on avifauna diversity in the surrounding forest is going to depend on whether the three assumptions holds true or not: (i) that their population remain small and isolated (ii) they

follow traditional system of land management and resource exploitation, (iii) they harvest resources only for their own consumption. Even if the assumptions hold true, their daily activities will be greatest closer to the longhouse, simply because of the greater effort required to venture further. Furthermore, the area beyond 1000 m was under logging concession and not accessible to those not connected with logging activities.

This study focuses on distances from a longhouse (100 m, 500 m and 1000 m from longhouse) as a factor and using bulbul as an ecological indicator to show the effect of longhouses community toward bulbul diversity and its diet. Bulbul was chosen because they can be found extensively in Borneo with over 27 species (Avibase, 2019), occupying a wide variety of habitats and therefore relatively easy to capture. Additionally, forest bulbuls are important small frugivores (Corlett, 1998a), feeding on figs and other sugar-rich fruit (Wells, 1975; Wong, 1986; Lambert, 1989) and lipid-rich capsular fruit (Pannell & Koziol, 1987).

Food resources are one of the environmental factors that maintain species diversity. This study also focuses on food resources as the parameter through which anthropogenic disturbance from longhouses community influenced diversity. This anthropogenic disturbance causes different forest structure in study area (logged forest, secondary forest and agroforest) and thus different site or distances will offer different food resources, which in turn influence the bulbul community.

The research question to be addressed in this study are:

- i. What bulbul species are found at different distance from longhouses (100 m, 500 m and 1000 m) and what to be found at totally protected area Pelagus National Park?
- ii. What are the food resources that attract bulbuls to a particular site?