THE DIVERSITY AND ABUNDANCE OF BIRDS AT GUA SETIR COMPLEX USING MIST NET AND VISUAL OBSERVATION

By

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A report submitted in fulfillment of the requirement for the degree of Bachelor of Applied Science (Natural Resources Science) with Honors

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DECLARATION

I declare that this thesis entitled “The Diversity and Abundance of Birds at Gua Setir Complex using Mist Net and Visual Observation” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : _____

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Date : _____

APPROVAL

"I hereby declare that I have read this thesis and in our opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Applied Science (Natural Resources Science) with Honors"

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Date : ……..

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The Diversity and Abundance of Birds at Gua Setir Complex Using Mist Net and Visual Observation

ABSRACT

A field study on bird diversity and abundance was conducted at Gua Setir, Jeli, Kelantan. This area was surrounding with secondary forest, rubber plantation, fruit orchard and river that contributes to the variety of bird species. The aim of the study was to identify birds' species diversity and abundance in the proposed site. A total of 60 species from 28 family were recorded from July 2018 to August 2018 using line transect method. The mist-netting and visual observation techniques were applied to record bird species. Of this, 50 species were recorded as resident, eight species were migration and two were recorded as altitudinal migration and Barn Swallow *(Hirundo rustica)* was recorded as the highest frequency in the study area because of the presence of lime stone area. In term of conservation status, seven species are classified as Near Threatened by the IUCN Red List include Buff-vented Bulbul (*Iole crypta)*, Grey-bellied Bulbul (*Pycnonotus cyaniventris*), Chestnut-bellied Malkoha (*Phaenicophaeus sumatranus*), Black-bellied Malkoha (*Phaenicophaeus diardi*), Fluffy-backed Tit-babbler (*Macronus ptilosus*), Green Iora (*Aegithina viridissima*) and Black Hornbill (*Anthracoceros malayanus*). The data recorded was analysed by using Shannon-Wienner Index and Pielou's Evenness Index. The analysis of the bird study area illustrated that the bird community in term of species diversity was 2.36, and the evenness of bird's species 0.58 indicated that the bird's diversity in the study area is highly disturbed. Generally, Gua Setir district possess a wide variety of birds and can contribute significantly towards biodiversity management and conservation.

Kepelbagaian dan Kelimpahan Burung Di Kompleks Gua Setir Menggunakan Jaring Kabut dan Pemerhatian Visual

ABSTRAK

Kajian lapangan mengenai kepelbagaian dan kelimpahan burung dilakukan di Gua Setir, Jeli, Kelantan. Kawasan ini bersebelahan dengan hutan sekunder, ladang getah, kebun buah dan sungai yang menyumbang kepada pelbagai spesies burung. Tujuan kajian ini adalah untuk mengenal pasti kepelbagaian spesies burung dan kelimpahannya di tapak yang dicadangkan. Sebanyak 60 spesies dari 28 keluarga telah direkodkan dari Julai 2018 hingga Ogos 2018 menggunakan kaedah garisan transek. Teknik jaring kabut dan teknik pemerhatian visual telah digunakan untuk merekodkan spesies burung. Dari jumlah ini, 50 spesies telah direkodkan sebagai pemastautin, lapan spesies adalah penghijrahan dan dua direkodkan sebagai migrasi ketinggian dan Layang-layang Hijrah (*Hirundo rustica*) dicatatkan sebagai frekuensi tertinggi di kawasan kajian kerana kehadiran kawasan batu kapur. Dari segi status pemuliharaan, tujuh spesies diklasifikasikan sebagai hampir terancam oleh Senarai Merah IUCN termasuk Merbah-riang Biasa (*Iole crypta*), Burung Merbah Dada Kelabu (*Pycnonotus cyaniventris*), Cenuk Perut Coklat (*Phaenicophaeus sumatranus*), Cenuk Perut Hitam (*Phaenicophaeus diardi*), Burung Rimba Pong-pong (*Macronus ptilosus*), Burung Kunyit Hijau (*Aegithina viridissima*) dan Kelingking Hitam (*Anthracoceros malayanus*). Data yang direkodkan dianalisis dengan menggunakan Indeks Shannon-Wienner dan Indeks Kesamarataan Pielou. Analisis kawasan kajian burung menggambarkan bahawa komuniti burung dari segi kepelbagaian spesies adalah 2.36, dan kesamaan spesies burung 0.58 menunjukkan bahawa kepelbagaian burung di kawasan kajian sangat terganggu. Umumnya, daerah Gua Setir mempunyai pelbagai jenis burung dan boleh menyumbang dengan ketara ke arah pengurusan biodiversiti dan pemuliharaan.

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LIST OF ABBREVIATIONS

KM	Kilometre
m	Meter
h	Hour
5^{th}	Fifth
e.g.	Example gratis
i.e.	Example gratis
sp.	Species
IUCN	International Union for Conservation of Nature

LIST OF SYMBOLS

=	Equal to
/	Division slash
%	Percent
&	And
∑	Total all
−	Subtraction
°	Degree
( )	Parentheses
>	More than

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Birds exist worldwide and easily recognized with its feathers, toothless beak jaws, hard-shelled eggs, and four-chambered hearts. Several studies have found that based on fossil evidence, birds had appeared dramatically during 66 million years ago around the period time of the Cretaceous-Palaeogene. Every bird has wings but which are more or less developing, depending on the species. Wing transform from forelimbs make the birds' capability to fly, but with further evolution have led some species of birds to the loss of flight such as emu, ostrich, and kiwi (Eduardo et al., 2010).

There are studies that have discovered on some tropical countries have higher secondary forest. Some of them have a large fraction region's native bird species, but because of lack resources it will not be able to support larger birds' species. Whereas the remaining forest in Malaysia mostly has been gazetted as forest reserves or national parks and normally are left untouched and some areas that are closely located are connected by established as forest corridors to give high mobility of forest animals (Ramli, Ya'cob & Hashim, 2009).

Jeli is well known as high content of diversity due to most of the land (80%) covered by forest. Thus, Gua Setir is the possible place contains high diversity of

birds due to a tropical region that gives high availability of food resources for birds. The physical factor and geographic also one of the greatest impacts on the diversity and abundance of flora and fauna in an area that indirectly contributed to the diversity of birds species in Gua Setir limestone hill.

The objective of this study is to determine on bird species of diversity and abundance of birds' species in Gua Setir. This study is a part of an effort to assist the authorities in conserving the bird's population. The study conducted by using mist-net and visual observation methods.

1.2 Problem Statement

There is no data on diversity and abundance of birds collected in Gua Setir limestone hill, the urge of this study needs to be done to learn the pattern of diversity in birds population and the information will be provided to general management as a guidelines to make sure where future habitat can be conserved. There were several places have been collected the data of birds in Kelantan. For instance 17 species and 16 families were recorded in Gunung Reng, Kelantan (Mazlan, 2017) while 20 species and 15 families were recorded in Kampung Baung Bayam, Kelantan (Fong & Jayaraj, 2017).

1.3 Objective

The objective of this study is:

1. To determine the species diversity and abundance of birds in Gua Setir, Jeli, Kelantan.

1.4 Scope of Study

The scope of study is focusing on bird diversity in Gua Setir complex. Birds is the vertebrates relatively well presented around karst known to use limestone crags as breeding grounds and refugia (Sutherland, Newton & Green, 2004). This research determined with two methods which are mist net and observation method.

1.5 Significant of Study

Cave, one of the areas contains high biodiversity, from flora to fauna. Thus, this study needs to be done to a relevant representative of all major birds' species in the study area. Besides, this research provided information on diversity and abundance of birds in the study area to the public to create awareness and appreciation in an individual towards the bird, as a valuable indicator for stabilizing the environment. In addition, the data obtained will help future researchers as references to study more closely about birds. Besides, baseline data on diversity and abundance of birds in Gua Setir limestone area will help local authorities in conserving birds in Kelantan.

CHAPTER 2

LITERATURE REVIEW

2.1 Birds

Birds are the vertebrates group truly special in many ways. Even though mammals are often thought as dominant vertebrate's species, birds occur more over the earth's surface. Birds are warm-blooded vertebrates that have full of a feather that forelimbs modified into wings, a toothless and pointed beak and laying an egg.

Birds play important roles as pollinator especially during rainy season for flowered-plants at the high elevation with good flight conditions (Cruden, 1972). Birds may possible provides services for pollination, but they may also protect the plant from an herbivorous insect (Ford et al., 1979). It essential to improve knowledge about birds considered it excellent bio-indicator that stabilizing environment (Bicudo et al., 2010). According to previous studies, it is importance to study on avifauna diversity which acts as indicator to evaluate different habitat through qualitative and quantitatively and also can fulfils many ecology functions like disease regulation, seed dispersal, pollination and biomass recycling (Herrera, 2009).

2.2 Limestone Outcrops

In Peninsular Malaysia, the vegetation type of landscape is unique with many endemics like clusters of woolly plants, *Paraboea* sp. that grow only on limestone area. Also include *Buxus malayan*, *Vitex samica*, and epiphyte (*Schefflera musangenesis*). Limestone areas commonly found with very thin soil cover that can support stunted trees except Nakawan range. According to Jeyarajasingam (2012), for the birdlife, limestone outcrop can support a few species like cliff nesting birds (resident peregrine falcon and dusky crag martin). The caves provide nesting site to swiftlet, Striated Swallow and Blue Whistling-thrush at the cave mouths and foraging site especially for the Blue Rock-thrush on limestone cliffs (Jeyarajasingam, 2012).

2.3 Diversity and Abundance of Birds

Diversity and abundance of birds occur due to many years of evolution. Through a long period of time, birds dispersed to various places in the whole world. However, the pattern of birds' diversity and distributions are strongly related to environment factors (topography, habitats and climate condition) and human interventions and certain species of birds can only exist in the certain area (Rodríguez-Estrella, 2007; Jankowiski et al., 2009). Before twentieth-century, total 693 avifauna in Malay Peninsular naturally occurring species distributed in the various habitat type and due to forest disturbance, total 673 species have been recorded in 2010 (Jeyarajasigam, 2012). In Kelantan, total 321 species have been recorded and 220 species (protected), 49 species (nearly threatened), seven species (vulnerable) and one species (critically endangered) (Ghasemi, 2015).

2.4 Anthropogenic Activities

The area covered by tropical forests has now been cleared approximately 50%, and much of what remains is being rapidly degraded (Wright, 2005). Fragmentation, habitat destruction and loss have been observed due to increase of human population (Manhães & Ribeiro, 2005). Forests have been converted to agricultural field, urban settlement, sometime to open land give impact on bird species diversity, abundance, distribution due to fragmentation and isolation (Westphal et al., 2006). Loss of species and decline in abundance of birds are due to human activities have been observed in the tropics (Cordeiro, 2002). This proved with studies of Ramli et al., (2009), Khan et al., (2008) and Ghasemi (2015) on Niah National Park, Kenaboi Forest Reserve and Kelantan Forests Areas. The results indicated that diversity and abundance of birds are affected by human interference in these areas.

2.5 Diversity Indices

Many researchers normally were measured the richness and evenness of the species in a community. According to Striling and Wilsey (2001), diversity is typically measured by species richness and evenness index, sometimes it may also be measured by a proportional statistic that combines with both measured (e.g., Shannon-Weiner index). As illustrated by Tramer (1969), the index resolved into its components like species richness and relative abundance, to identify which components played a big role in determined by diversity pattern. There was a studied from Padawan, Sarawak used Shannon diversity indices to calculated values for

Giam and Danu and stated that diversity index from both site differed due to disturbed and undisturbed (Rahman, 2002).

2.6 Mist Net

There are several techniques can identify the species diversity and abundance of birds. But, many researchers prefer to use the mist net as a tool to capture birds as a stated by Remsen & Good (1996). Remsen and Good (1996) assumed that, 95% of the flight with a mean of 2m would fall between 0 and 4m and 95% of those with a mean of 10m would fall between 0 and 20m. This evidence shows the efficiency of mist net to get the data somewhat easy than the other methods.

However, according to Ramli et al., (2009), further analysis discovers that mist netting was conducted for much longer (860 netting hours) than direct observation (96 observation hours). Thus, direct observation is effective methods in sampling forest birds when study effort and success rate were taken into consideration. The success rate for direct observation was 5.02 than mist-netting at 1.35.

2.7 Visual Observation

Visual observation is an absorbing pastime and interesting activity that requiring skill and patience to get the maximum benefit. A pair of binoculars is the most significant tool in a bird's watcher in magnifies objects and ascertains positive identification (Jeyarajasingam, 2012). Observer must highly trained bird-watcher because sometimes there are only brief opportunity in identify birds species and it

behaviour (Ramli et al., 2009). Direct observation has been used in many birds studies in Malaysia such as in Kampong Baung Bayam, Kelantan (Fong & Jayaraj, 2017), Penang National Park, Penang (Biun et al., 2014), Padawan, Sarawak (Rahman, 2002) and Keneboi Forest Reserve, Jelebu Negeri Sembilan (Ramli et al., 2009).

2.8 Birds Call

Birds are groups of organisms that are easy to survey with a multispecies approach, even if this group cannot always be seen they can often be heard (Bibbly, 1999). Birds sound range from simple calls to beauty and complexity. Birds normally produced two types of sound, alarm calls and danger to make sure that birds remain in the group and it normally short and simple (Burnie, 2007). It is important for the student of birds sound to recognize the species pronunciation of birds in the fields (Rowan, 1924). There was a studied in Selangor State, recorded that only six individual birds with calls were recorded and assumed that each was the same individual due to the distance between birds only (>3m) (Yee et al.,2016). This shows that birds call need highly experienced people to do the survey in the field.

CHAPTER 3

MATERIAL AND METHODS

3.1 Materials

The materials needed are mist net used to capture birds as it is the safest methods to use in capturing birds. Pole used to deploy the mist net to make easier to capture birds. Birds that captured weighed with a Pesola spring balance. The external morphological characters measured using Mitutoyo electronic digital calipers (Mitutoyo Corporation) and a steel ruler. Binoculars used for direct observation and identification.

3.2 Methods

3.2.1 Study Area

The study was carried out at Gua Setir, Jeli, Kelantan (Figure 3.1) is within the extent of the northern part of Kelantan that covers the range of 25km^2 of area. The research area located nearby to Gua Maka and 5km from Kampung Pasir Dusun. Besides, the area also surrounded by secondary forest and located near several rivers and cleans water. The sampling conducted around Gua Setir. The research conducted starting from May to July 2018 between 0600h to 0900h and 1600h to 1700h.

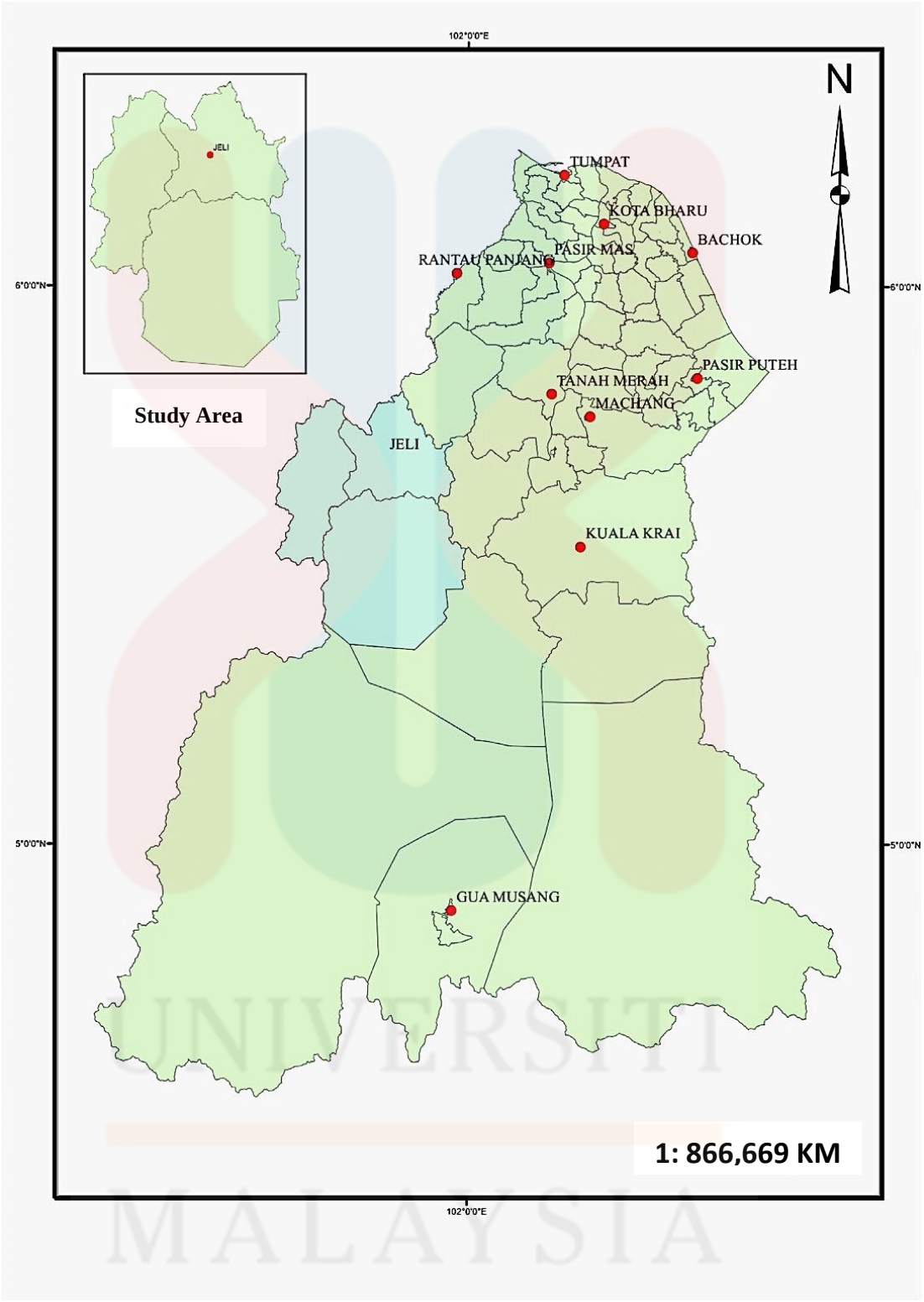

Figure 3.1 Map of Jeli (Source: Arc Map, 2018)

3.2.2 Mist Net

A total of 10 mist nets were deployed at several locations presumed potential birds to be flyways like a small stream, river, and trails. Mist nest were deployed before sunrise and were unwrapped after sundown and checked every one hour approximately from 0600 hours to 1700 hours. The mist net should have sufficient vertical slack in it to form a pocket between self-strings (Sutherland et al., 2004).

During the examination, when birds entangled in the net, birds were collected and kept in cloth bags then taken for identification. All captured birds were identified with the aid of Jeyarajasingam (2012) and Robson (2000). Every bird were weighed with Pesola spring balance and its morphological characters were measured by using Mitutoyo electronic digital calipers (Mitutoyo Corporation) include (wingspan, total length, tail length, wing length, bill width, bill depth, bill length and tarsus length) and subsequently released.

3.2.3 Visual Observation

Two transects of one kilometer (km) each were established and divided into 5 stop points with 200 meter (m) apart. Each point was surveyed for 10 to 15 minutes. Visual observation was conducted in early morning by using binoculars from (0730 to 1200 hours) and late afternoon (1700 to 1900 hours) and was identified using Jeyarajasingam (2012) and Robson (2000). Within this period, birds active and easier for data collection and identification (Ramli et al., 2009). The available trail in the forest used as transect for bird observation. Observation was conducted at the different study site from mist net to avoid duplication (Ramli et al., 2009).

3.3 Data Analysis

3.3.1 Accummulative Graph

Cummulative graph is used to determine the number of diversity of birds were recorded. The graph were plot based on data recorded in study area. Which was constructed based on the cummulative number of bird were count based on the the bird count each day. Cummulative graph is the kind of graph that commonly used for displaying a group or population in such a graphical manner to produces a variation of the frequency distribution graphs presented in the preceding para-graph. This graph was used in scientific and statistical work because the slope, position and overal shape of the data curve easily the number of values classes in a group or diversity of size, as different to the possible confusion among the numerical entries in a table. When the data line from to right shows an incresing accumulation of the dependent variable, the last data value to the right is a accummulative total (Richardson, 1985).

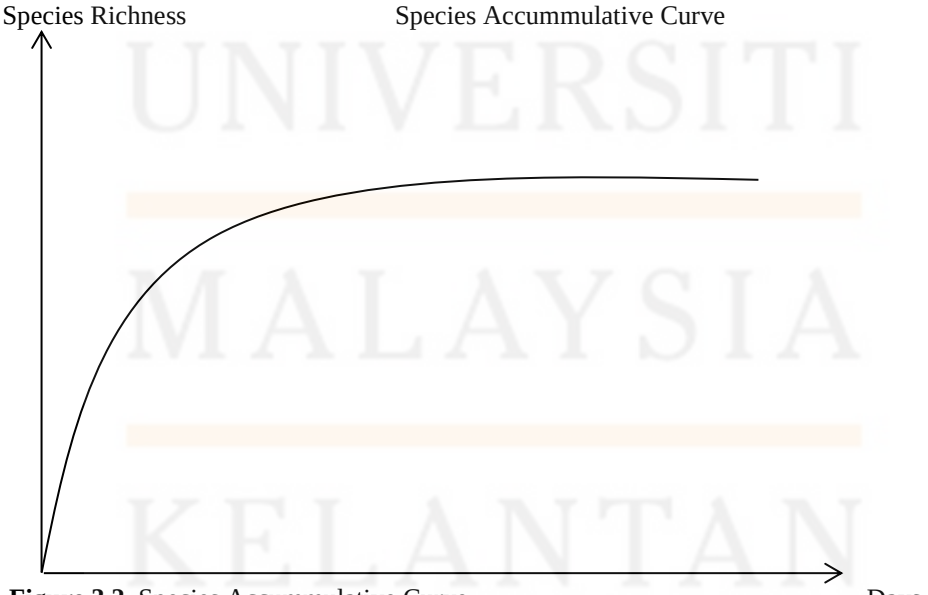

Figure 3.2 Species Accummulative Curve.

3.3.2 Shannon-Wiener Diversity Index

The methods used to calculate the diversity of the birds. It was statistics that summarise that which each member belongs to a unique group in diversity of a population. Shannon-Wiener index commonly used even many indices of diversity have been proposed.

The equation of this calculation:

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$ ……Equation 3.1

where :

H'= Diversity index

pi = The proportion of individuals found in the i^{th} species.

S= Species count

Ln= Natural logarithm

3.3.3 Pielou's Evenness index

This calculation showed how frequent (in number) each species found in an area. There are several equations have been suggested to calculate evenness from diversity measures (Sarma & Das, 2015). Evenness value (E) is always constrained between 0 and 1. The lower evenness value, the less evenness in communities between species.

The equation of this calculation:

$$E = \frac{H'}{H_{max}}$$

……..Equation 3.2

H'= Value Shannon index for certain population

H_{max}= Maximum value of Shannon index with same species and a total number of individuals sampled.

Several assumption were identified in measurind diversity, all birds species are equal which mean that no distinctions among species by richness measurement and threat exceptionally abundance in the same ways as well as rare birds species. Next, all individuals of birds are equal, where no distinction between both largest and smallest individual. Then, there is a population size of birds from which can draw an infinite number of birds replacement and these birds can represent random samples of the population.

CHAPTER 4

RESULT AND DISCUSSION

4.1 Species Richness

A total of 60 species of birds from 29 families were recorded in Gua Setir, Jeli, Kelantan with 21 species were mist-netted while the rest were recorded through incidental observation. The number bird species composition probably more than what was recorded in here due to their shyness and secretive birds perhaps hiding in dense bushes and the undergrowth out of sight of the observer (Fong & Jayaraj, 2017). Out of total recorded species, a total of seven species were recorded under Near Threatened in IUCN Red List included Buff-vented Bulbul (*Iole crypta),* Grey-bellied Bulbul (*Pycnonotus cyaniventris*), Chestnut-bellied Malkoha (*Phaenicophaeus sumatranus*), Black-bellied Malkoha (*Phaenicophaeus diardi*), Fluffy-backed Tit-babbler (*Macronus ptilosus*), Green Iora (*Aegithina viridissima*) and Black Hornbill (*Anthracoceros malayanus*) while the rest were categories as Least Concern (Table 4.1). Therefore, for species is Near Threatened should be a review on the occurrence of these species within and outside of protected areas in Malaysia in order to protect and conserved these species from extinct.

Among the identified bird species in Gua Setir, the result shown that, Rufous-bellied Swallow (*Cecropis badia*) was the most abundant bird species in Gua Setir with the highest number of frequency recorded followed by Barn Swallow (*Hirundo*

rustica) and Glossy Swiftlet (*Collocalia esculenta*). These species need to carefully identify as most are very similar and hard to identify from distance. According to Rahman & Abdullah (2002), the presence of caves and cliffs were influenced the abundance of swiftlets by serving their major roosting site. These swiftlet mostly active in the morning and evening as early as 0600 hours and returning at 1600 hours to the fact that they hunt and feeding during daytime (Khan et al., 2008).

On the other hand, Oriental Magpie-robin (*Copsychus saularis*), Red Junglefowl (*Gallus gallus*), Little Spiderhunter (*Arachnothera longirostra)*, Jungle Myna (*Arachnothera longirostra*), Emerald Dove (*Chalcophaps indica*) were commonly caught and observed through the sampling. These species are very resilient and widely distributed in anthropogenic landscapes (Fong & Jayaraj, 2017) perhaps due to suitable habitat and availability food resources in the area.

The present of Black Hornbill (*Anthracoceros malayanus*) were also sight in this study. Consider this species is the major seed disperser for a species of durian, *Durio graveolens* (Nakashima, Lagan & Kitayama, 2008) which coincides with the sampling of this study due to Gua Setir area covered with secondary forest that full with plantation particularly durian plantation. Several Malaysian states that Johor, Pahang and Kelantan are possess huge plantation areas, where typically the durian season occurs from July to September (Jabatan Pertanian Malaysia, 2012).

Nocturnal bird in this study which were Collared Scops-owls (*Otus lettia)* were captured during night time indicated that emergence of these avian reinforcing the idea that using mist nets and other methods would be effective. It is expected that these species were recorded in the area due to owls were spotted flying along across the stream occasionally during the full moon nights.

Table 4.1 Birds species in Gua Setir, Jeli Kelantan.

Species	Frequency	Distribution Status	Status
Hirundinidae			
Barn Swallow (*Hirundo rustica*)	160	M	LC
Rufous-bellied Swallow (*Cecropis badia*)	250	R	LC
Apodidae			
Glossy Swiftlet (*Collocalia esculenta*)	50	R	LC
Columbidae			
Emerald Dove (*Chalcophaps indica*)	6	R	LC
Spotted Dove (*Streptopelia chinensis*)	5	M	LC
Zebra Dove (*Geopelia striata*)	3	R	LC
Little Green-pigeon (*Treron olax*)	3	M	LC
Pycnonotidae			
Red-eyed Bulbul (*Pycnonotus brunneus*)	2	R	LC
Buff-vented Bulbul (*Iole olivacea*)	1	R	NT
Olive-winged Bulbul (*Pycnonotus plumosus*)	2	R	LC
Yellow-vented Bulbul (*Pycnonotus goiavier*)	1		LC
Grey-bellied Bulbul (*Pycnonotus squamantus*)	1	R	NT
Finsch's Bulbul (*Alophoixus finschii*)	1	R	LC
Cream-vented Bulbul (*Pycnonotus simplex*)	1	R	LC
Spectacled Bulbul (*Pycnonotus erythropthalmos*)	2	R	LC
Cisticolidae			
Common Tailorbird (*Orthotomus sutorius*)	2	R	LC
Dark-necked Tailorbird (*Orthotomus atrogularis*)	2	R	LC
Musicapidae			
Oriental Magpie-robin (*Copsychus saularis*)	20	R	LC
Blue Whistling-thrush (*Myophonus caeruleus*)	4	AM	LC

Species	Frequency	Distribution Status	Status
Phasianidae			
Red Junglefowl (*Gallus gallus*)	7	R	LC
Campephagadae			
Scarlet Minivet (*Pericrocotus speciosus*)	2	R	LC
Picidae			
Buff-rumped Woodpecker (*Meiglyptes tristis*)	2	R	LC
Banded Woodpecker (*Picus miniaceus*)	3	R	LC
Rufous Piculet (*Sasia abnormis*)	1	R	LC
Nectariniidae			
Little Spiderhunter (*Arachnothera longirostra*)	15	R	LC
Thick-billed Spiderhunter (*Arachnothera longirostra*)	2	R	LC
Grey-breasted Spiderhunter (*Arachnothera modesta*)	1	R	LC
Crimson Sunbird (*Aethopyga siparaja*)	1	R	LC
Olive-backed Sunbird (*Cinnyris jugularis*)	1	R	LC
Purple-naped Sunbird (*Hypogramma hypogrammicum*)	1	R	LC
Alcedinidae			
White-throated Kingfisher (*Halcyon gularis*)	2	R	LC
Blue-eared Kingfisher (*Alcedo meninting)*	3	R	LC
Corvidae			
Large-billed Crow (*Corvus macrorhynchos*)	2	R	LC
Accipitridae			
Black Baza (*Aviceda leuphotes*)	1	M	LC
Black Eagle (*Ictinaetus malaiensis*)	2	R	LC

Species	Frequency	Distribution Status	Status
Cuculidae			
Plaintive Cuckoo (*Cacomantis merulinus*)	5	M	LC
Chestnut-bellied Malkoha (*Phaenicophaeus sumatranus*)	3	R	NT
Raffles's Malkoha (*Phaenicophaeus chlorophaeus*)	1	R	LC
Black-bellied Malkoha (*Phaenicophaeus diardi*)	1	R	NT
Chestnut-breasted Malkoha (*Phaenicophaeus curvirostris*)	2	R	LC
Greater Coucal (*Centropus sinensis*)	1	R	LC
Lesser Coucal (*Centropus bengalensis*)	3	R	LC
Common Asian koel (*Eudynamys scolopaceus)*	1	M	LC
Black Magpie (*Platysmurus leucopterus*)	1	R	LC
Sturnidae			
Jungle Myna (*Acridotheres fuscus*)	20	R	LC
Timaliidae			
Fluffy-backed Tit-babbler (*Macronus ptilosus*)	2	R	NT
Dicaeidae			
Scarlet-backed Flowerpecker (*Dicaeum cruentatum*)	2	R	LC
Crimson-breasted Flowerpecker (*Prionochilus percussus*)	1	R	LC
Aegithinidae			
Common Iora (*Aegithina tiphia*)	15	R	LC
Green Iora (*Aegithina viridissima)*	5	R	NT
Bucerotidae			
Black Hornbill (*Anthracoceros malayanus*)	3	R	NT
Strigidae			
Collared Scops-owl (*Otus lettia*)	2	AM	LC
Turnicidae			
Barred Buttonquail (*Turnix suscitator*)	5	R	LC

Species	Frequency	Distribution Status	Status
Dicruridae			
Greater Racket-tailed Drongo (*Dicrurus paradiseus*)	2	R	LC
Vangidae			
Black-winged Flycatcher-shrike (*Hemipus hirundinaceus*)	3	R	LC
Zosteropidae			
Oriental White-eye (*Zosterops palpebrosus*)	4	M	LC
Passeridae			
Eurasian Tree Sparrow (*Passer montanus*)	10	R	LC
Estrildidae			
White-bellied Munia (*Lonchura leucogastra*)	3	R	LC
Meropidae			
Blue-throated Bee-eater (*Merops viridis*)	4	M	LC
Pellorneidae			
Puff-throated Babbler (*Pellorneum ruficeps*)	1	R	LC
Total Number of Individual	**662**		
Total Number of Species	**60**		
Total Number of Family	**28**		

Legend: Distribution Status (R= Resident, M= Migrant, AM= Altitudinal Migration); Status IUCN (LC= Least Concern, NR= Near Threatened).

Migratory birds normally start to arrive as early as July and August in peninsular Malaysia, and then the large numbers of birds were arrived from September until November (Zahidin, 2017). According to Medway (1973), Barn Swallow is non-breeding winter visitor is migrate in to west Malaysia from late July to peak November which coincides with the sampling period of the study. However,

there were also nationally common species such as Plaintive Cuckoo (*Cacomantis merulinus*), Common Asian koel (*Eudynamys scolopaceus*), Black Baza (*Aviceda leuphotes*), Oriental White-eye (*Zosterops palpebrosa*) and Blue-throated Bee-eater (*Merops viridis*) were recorded present in the site perhaps either distributed as resident in the area or migrates during migratory seasons.

On the other hand, two species were recorded as altitudinal migration, Collard Scops-owl (*Otus lettia)* and Blue-whistling Thrush (*Myophonus caeruleus*). Altitudinal migration occurs due to food availability and climate changes as well as destructions of anthropogenic influence (Hobson et al., 2003). However, it is obvious that the migratory bird in this study were minimally recorded perhaps it can be attributed in two factors. Firstly, most migratory birds not fully migrate, as they will migrate from mid-October until May that not coincides with the sampling period in this study. Therefore, any visit not falling within this period will see less migratory species than local species. Secondly, the reserve does not have ample resources to attract migratory species perhaps due to forest disturbance that lead to resources depletion.

There were two raptor species presented in the study area, Black Eagle (*Milvus migrans*) and Black Baza (*Aviceda leuphotes*). Due to, the variation of habitat as well as species distributed in the area especially near the cave that rich with reptile species small mammals or large insects, it is not surprisingly expected the present of these two species sighted foraging or flying on top of tree crown or tree trunks to catch their prey (Robinson & Holmes, 1982). However, both species have rarely spotted in the study area and more active late evening and dusk compare to morning to afternoon.

4.2 Bird's Family

A total 28 family represented 60 species were recorded in Gua Setir, Jeli. Referring to Figure 4.1, Cuculidae family was also most dominant species for this study with total 9 species spotted during this study. Most species of Cuculidae family were sedentary and were found mainly in river habitats and open areas (Khan et al., 2008).

Bulbuls from Pycnonotidae family were second most abundant species caught in this study as it is thrive well in disturbed forests due to modification of habitat structure and common found in the lowland rainforest (Ghasemi, 2015) and occasionally sighted forages on small parties either single or sometimes together with other birds to feed in fruiting trees (Jeyarajasingam, 2012). Bulbuls which are insectivore-frugivorous avian species is a group that can adapt to the seasonal fruit availability (Azman et al., 2011) and some species are considered as crop pests, particularly in orchards (Fox, 2011) which are explain why Pycnonotidae are the family with total nine species of Bulbul caught from sampling (Table 4.1) the most number of species as Gua Setir is well known secondary forest full covered with plantation.

Meanwhile, Sunbirds and Spiderhunters of family Nectariniidae were recorded with a total of six species as the second highest number of species. These birds can be found in various types of habitats such as primary forest, secondary forest, peat swamp forest, plantation and gardens (Phillipps, 2014). These habitats can provide large range of food availability, protection from predators and microhabitats (Khan et al., 2008). With being both insectivorous and nectarivorous, these birds can mostly found feed in area abundant with ginger and wild bananas and

also occasionally feed on insects around the area (Strange & Jeyarajasingam, 1993). All these species are commensal species and normally associated with human settlement. This is show that study area is heavily disturbed and in process of regenerating (Dent & Wright, 2009).

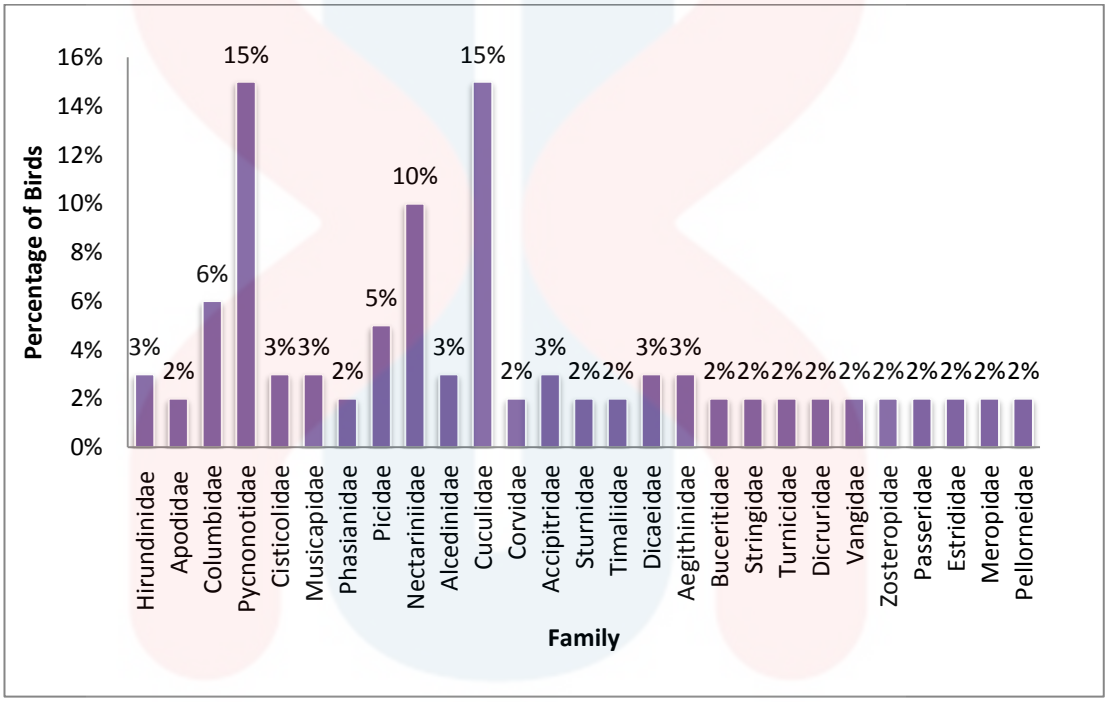

Figure 4.1 Percentage of family of birds at Gua Setir, Jeli Kelantan

The forth dominant family present was Columbidae with 6% (4 species). This family occasionally sight feeding on seeds, fruits and plant whether on the ground (granivorous species) or on the tree (frugivorous species) (Corlett, 2017). However, without any conservation, this family can be extinct as they have been used as the source of food (Eastman & John, 2000) and the game bird (Goodwin & Gillmor, 1983) in local communities. The dominant family after Columbidae family was Picidae. This family normally sighted foraging, breeding involve with drumming and hammering using bill (Gibson, 2006). They usually feed on other invertebrates or

insects living under bark and in wood and with the hole-making abilities act importance roles for various mammals, innervates and bird species that unable to make their own hole as breeding and roosting places (Sangster et al., 2016).

The least with 2% (1 species) dominant families were Apodidae, Phasionidae, Corvidae, Sturnidae, Timaliidae, Buceritidae, Stringidae, Turnicidae, Dicruridae, Vangidae, Zosteropidae, Passeridae, Estrididae, Meropidae and Pellorneidae. The least present of these families perhaps attributed with badly affected by forest disturbance like hunting, agriculture, and encroachment of land near the sanctuary area that gave great threat for survival of birds' species (Brooks et al., 1999).

Approximately half of the total recorded (60 species) were successfully detected by both techniques while the remaining was recorded only by either mist-net. A total 39 species were detected by direct observation only while 21 species were recorded by mist-net. Previous studies seemingly suggested that mist netting is the most efficient technique in sampling birds. But, furthers analysis discover that direct observation is more effective when success rate and study effort were taken into consideration (Ramli et al., 2009).

Figure 4.2 shows the curve represented rising biodiversity of birds with number of species richness on y-axis and days on x-axis.

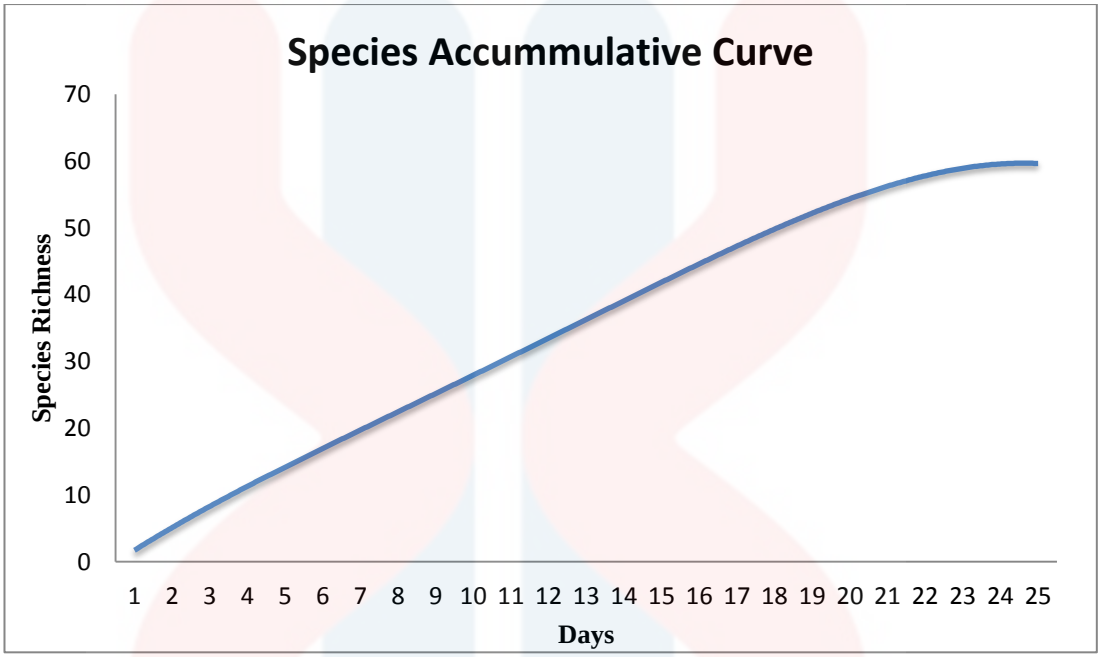

Figure 4.2 Species accumulative curve.

This curve was plotted based on data collected in this study. This curve showed that the species richness increase along with the days were count. However, the graph not complete reached their asymptotes perhaps contribute with these two factors there were the lack of sampling period and unpredictable of weather condition like rain. The wet-dry seasons was indirectly affected on food resources and suitability of habitat in bird population (Beerens et al., 2015). It is suggesting additional surveys and researches can be done to produce comprehensive bird list for the study area because there were more bird species wait to be explore, observed and identified.

4.3 Bird Diversity Index

The diversity indexes ware used Shannon-Wiener Index (H') and Pielou's Evenness Index (J'). The table 4.3 below shows the diversity indexes of birds in Gua Setir, Jeli, Kelantan.

Table 4.3 Shannon-Wiener Index (H') and Pielou's Evenness Index (J')

Species	Frequency	pi	H'	Hmax	Eveness
Barn Swallow (*Hirundo rustica*)	160	1.42	0.343	4.094	0.083
Rufous-bellied Swallow (*Cecropis badia*)	250	0.974	0.368	4.094	0.089
Glossy Swiftlet (*Collocalia esculenta*)	50	2.583	0.195	4.094	0.047
Emerald Dove (*Chalcophaps indica*)	6	4.703	0.042	4.094	0.010
Spotted Dove (*Streptopelia chinensis*)	5	4.885	0.036	4.094	0.009
Zebra Dove (*Geopelia striata*)	3	5.396	4.094	4.094	0.005
Little Green-pigeon (*Treron olax*)	3	5.396	0.024	4.094	0.005
Red-eyed Bulbul (*Pycnonotus brunneus*)	2	5.802	0.004	4.094	0.004
Buff-vented Bulbul (*Iole olivacea*)	1	6.495	0.009	4.094	0.002
Olive-winged Bulbul (*Pycnonotus plumosus*)	2	5.802	0.017	4.094	0.004
Yellow-vented Bulbul (*Pycnonotus goiavier*)	1	6.495	0.009	4.094	0.002
Grey-bellied Bulbul (*Pycnonotus squamantus*)	1	6.495	0.009	4.094	0.002
Finsch's Bulbul (*Alophoixus finschii*)	1	6.495	0.009	4.094	0.002
Cream-vented Bulbul (*Pycnonotus simplex*)	1	6.495	0.009	4.094	0.002
Spectacled Bulbul (*Pycnonotus erythropthalmos*)	2	5.802	0.017	4.094	0.004
Common Tailorbird (*Orthotomus sutorius*)	2	5.802	0.017	4.094	0.004
Dark-necked Tailorbird (*Orthotomus atrogularis*)	2	5.802	0.017	4.094	0.004
Scarlet Minivet (*Pericrocotus speciosus*)	2	5.802	0.017	4.094	0.004
Oriental Magpie-robin (*Copsychus saularis*)	20	3.499	0.105	4.094	0.025
Blue Whistling-thrush (*Myophonus caeruleus*)	4	5.108	0.03	4.094	0.007
Red Junglefowl (*Gallus gallus*)	7	4.543	0.011	4.094	0.011
Buff-rumped Woodpecker (*Meiglyptes tristis*)	2	5.802	0.017	4.094	0.004
Banded Woodpecker (*Picus miniaceus*)	3	5.396	0.024	4.094	0.005
Rufous Piculet (*Sasia abnormis*)	1	6.495	0.009	4.094	0.002
Little Spiderhunter (*Arachnothera longirostra*)	15	3.787	0.085	4.094	0.020
Thick-billed Spiderhunter (*Arachnothera* longirostra)	2	5.800	0.017	4.094	0.004
Grey-breasted Spiderhunter (*Arachnothera modesta*)	1	6.495	0.009	4.094	0.002
Crimson Sunbird (*Aethopyga siparaja*)	1	6.495	0.009	4.094	0.002
Olive-backed Sunbird (*Cinnyris jugularis*)	1	6.495	0.009	4.094	0.002
Purple-naped Sunbird (*Hypogramma hypogrammic*)	1	6.495	0.009	4.094	0.002
White-throated Kingfisher (*Halcyon gularis*)	2	5.802	0.017	4.094	0.004
Blue-eared Kingfisher (*Alcedo meninting)*	3	5.396	0.024	4.094	0.005
Plaintive Cuckoo (*Cacomantis merulinus*)	5	4.885	0.036	4.094	0.009
Chestnut-bellied Malkoha (*Phaenicophaeus sumatranus*)	3	5.396	0.024	4.094	0.005

Raffles's Malkoha (*Phaenicophaeus* chlorophaeus)	1	6.495	0.009	4.094	0.002
Black-bellied Malkoha (*Phaenicophaeus diardi*)	1	6.495	0.009	4.094	0.002
Chestnut-breasted Malkoha (*Phaenicophaeus curvirostris*)	2	5.802	0.017	4.094	0.004
Greater Coucal (*Centropus sinensis*)	1	6.495	0.009	4.094	0.002
Lesser Coucal (*Centropus bengalensis*)	3	5.396	0.024	4.094	0.005
Common Asian koel (*Eudynamys scolopaceus*)	1	6.495	0.009	4.094	0.002
Black Magpie (*Platysmurus leucopterus*)	1	6.495	0.009	4.094	0.002
Large-billed Crow (*Corvus macrorhynchos*)	2	5.802	0.017	4.094	0.004
Black Baza (*Aviceda leuphotes*)	1	6.495	0.009	4.094	0.002
Black Eagle (*Ictinaetus malaiensis)*	2	5.802	0.017	4.094	0.004
Jungle Myna (*Acridotheres fuscus*)	20	3.499	0.105	4.094	0.025
Fluffy-backed Tit- babbler (*Macronus ptilosus)*	2	5.802	0.017	4.094	0.004
Scarlet-backed Flowerpecker (*Dicaeum cruentatum*)	2	5.802	0.017	4.094	0.004
Crimson-breasted Flowerpecker (*Prionochilus percussus*)	1	6.495	0.009	4.094	0.002
Common Iora (*Aegithina tiphia)*	15	3.787	0.085	4.094	0.002
Green Iora (*Aegithina viridissima*)	5	4.885	0.036	4.094	0.009
Black Hornbill (*Anthracoceros malayanus*)	3	5.396	0.024	4.094	0.005
Collared Scops-owl (*Otus lettia*)	2	5.802	0.017	4.094	0.004
Barred Buttonquail (*Turnix suscitator*)	5	4.885	0.036	4.094	0.009
Greater Racket-tailed Drongo (*Dicrurus paradiseus*)	2	5.802	0.017	4.094	0.004
Black-winged Flycatcher-shrike (*Hemipus hirundinaceus*)	3	5.396	0.024	4.094	0.005
Oriental White-eye (*Zosterops palpebrosus*)	4	5.108	0.03	4.094	0.007
TOTAL	**662**	**-**	**2.36**	**4.094**	**0.576**

Shannon-Wiener index assumes that all species are represented in the sample are the individuals are randomly sample from a large population (Shannon & Weaver, 1949). The value of Shannon-Wiener diversity index normally falls between 1.5 and 3.5, and rarely surpasses 4.5 and the value near 4.6 indicated that the numbers of individual of species are evenly distributed between all of the species (Bibi & Ali, 2013). Table 4.3 shows that 2.36 value of Shannon-Wiener index that represented all avian species in Gua Setir indicated that highly biased composition and diversity of birds in study area perhaps due to habitat destruction from anthropogenic activities.

As for the Pielou's Eveness index, was to measure of relative abundance of differences species making up the richness of an area. Equitability assumes a value between 0 and 1 with 1 being complete evenness. The evenness of study area was 0.58; the value was quit far to the number one. This is indicated that the individuals in the community are distributed unequitable among species and it could be suggests that the study area has been dominated by some bird species like swiftlet and swallow count than any other species in this study which recorded of less than half of the swiftlet and swallow count perhaps due to the present of caves.

The richness of avifauna from (Table 4.3) show was 4.16 represented species richness and abundance in study area. It is importance to know species richness in some habitat where it can use for indicator of community properties such as resources availability. Therefore, the disturbance of the anthropogenic activities is one of main causes of destruction of resources availability in habitat (Schelle, Collier & Pittock, 2004).

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CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

Overall, the study plots and direct observation carried out have achieved the objectives that have been state in the study which was to determine the species diversity and abundance of study area. Diversity and abundance of birds in study area depend greatly influenced on several of factors like food availability, migratory and disturbance. The divergent seasonality of rainfall, seasonal variation in the plenty of food resources and forest vegetation end result the species abundances of birds (Gaston et al., 2000; Hurlbert, 1971).

Based on result that recorded in this study it is obvious that direct observation is more efficient technique compared to mist-netting in documenting bird diversity in study area. However, each method had advantage and disadvantages although direct observation enjoy success rate than mist-netting technique (Ramli et al., 2009).

In this study, the presented of Bulbul and Spiderhunter family indicated that the study area is in the process of regenerating and heavily disturbed. This is because; these species were commensal species that associated with human settlement (Ramli et al., 2009). In some studies state that logged forest reserve that left untouched in longed period of time can play essential role in conserving widely

distributed primary forest species and in conserving biodiversity particularly when old growth forest are nearby (Dent et al., 2009).

Based on the observation, most of the environmental degradation and species extinction is caused by the anthropogenic activities. From previous study stated that the major declined to bird diversity were from destruction, over grazing, habitat destruction and unawareness (Bibi & Ali, 2013). Species richness and composition essential to ecosystem stability, therefore a massive decline of bird's diversity will lead to successive changes in properties of natural environment (Murphy & Romanuk, 2014).

5.2 Recommendation

This birds lists compiled in this study can be improved by increasing survey period of samplings to ensure the consistency of data in providing the best interpretation of diversity, richness and evenness of studies avifauna at particular area. Therefore, it is suggested that additional surveys could be done to produce comprehensive bird list for the study area. In other hands, as this study was done early August, the present migratory of birds quite low. Perhaps any further research can be done about the diversity of migratory of birds in the study area in the future.

The rich vegetation is the main role for existence of many species. Therefore, ecosystem management need to improve understanding of consequences of existence in avian diversity and the urgent needed to safeguard avian diversity by protecting natural habitat of protected area. In other words, these actions were improved bird diversity in the study area and also indirectly improve the quality of human and wildlife (Clergeau et al., 2001).

Besides, due to high illiteracy rate and lack of exposure about importance avifauna species the local community in Gua Setir were unaware about the importance of these species by killing as for food or hunting as game bird and have no idea about sustainable management. Therefore, campaigns or events should be organized which involve the community in all age. The community can be sensitized by celebrating special days like Bird Days that held every 5th January and World Migratory Bird Day to assist them in practicing sustainable in their daily life.

Thus, cooperation among different stakeholders like land surveyors, ecologies, social scientists, environmentalists, communities and birds watchers groups is needed to make sure birds diversity are conserved. Ultimately, it is hope that such work may lead to the development of standard monitoring procedure which could value in assessing the environmental stability of the area and prediction of the effect on structure of avifauna population of tropical forest destruction.

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APPENDIX A

Figure of Final Years Project

Figure A.1: The view of Gua Setir**.**

Figure A.2: The entrance to the cave.

Figure A.3: Mist-net was deployed along the road.

Figure A.4: Collared Scops-owl *(Otus lettia).*

APPENDIX B

Table of Final Year Project Planning

Date	Activity
FYP I	
2/3/2018-15/4/ 2018	Selection of Project Title Writing Research Proposal Completing (Chapter 1,2,3)
20/4/ 2018	Research Proposal Presentation
5 /7/2018	Final Draft Proposal Submission (Chapter 1,2,3)
FYP II	
19/7/2018- 20/7/2018	Preparing materials for sampling Mist-net and binocular
21/7 2018 -15/8/ 2018	Conducting Research Work Identification species of birds
10/ 12/ 2018	Final Report Writing submission (Chapter 4,5)
18-19/10/2018	Final Presentation FYP II
18/1/2019	Hardbound submission