

**THE DIVERSITY OF BIRDS IN  
GUNUNG RENG, JELI, KELANTAN**

**NUR AIMIE NADIAH BINTI MAZLAN**

**FACULTY OF EARTH SCIENCE  
UNIVERSITI MALAYSIA KELANTAN**

**2017**



# **THE DIVERSITY OF BIRDS IN GUNUNG RENG, JELI KELANTAN**

By

**NUR AIMIE NADIAH BINTI MAZLAN**

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

---

**FACULTY OF EARTH SCIENCE**

---

**UNIVERSITI MALAYSIA KELANTAN**

---

2017

## DECLARATION

I declare that this thesis entitled The Diversity of Birds in Gunung Reng, Jeli, Kelantan 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 : \_\_\_\_\_  
Name : \_\_\_\_\_  
Date : \_\_\_\_\_

UNIVERSITI  
MALAYSIA  
KELANTAN

## ACKNOWLEDGEMENT

First of all, I would like to express my sincere appreciation for the opportunity to complete the project. A special gratitude I give to my supervisor, Madam Aainaa Syazwani Bt Mohamad Amir Hamzah, whose guide me in stimulating suggestion and encouragement, always support and help me to complete my project especially in thesis writing. Then, I would like to thanks to Universiti Malaysia Kelantan, Jeli Campus, especially to the Faculty of Earth Science for the opportunity given to the final year students to do this project.

Next, special thanks go to my groupmate Norshabira, Nur Liyana, Nur Ain and Azfar Aizat for their kindness in helping me, collecting the data and giving inspiring encouragements. Futhermore, I like to thanks my supportive family, my father, Mazlan Bin Satar and my mother, Jamilah Binti Latiff who helped me in term of financial and also supported me until this project successful. Last but not least, I would like to thanks to my classmate who help me sincerely and support along this final project.

UNIVERSITI  
MALAYSIA  
KELANTAN

## The Diversity of Birds in Gunung Reng, Jeli, Kelantan

### ABSTRACT

A study of bird diversity was conducted in Gunung Reng, Jeli, Kelantan. This area was surrounded with secondary forest, rubber plantation, oil palm plantation, river and stream which help in contributes to the variety of bird species. The aim of the study was to estimate the diversity index of birds in Gunung Reng. Field study was conducted from July 2016 to September 2016. In bird sampling, due to the small area in Gunung Reng, one potential spot was taken to observe bird species and all the birds observed in range of 40 m from the observation spot were taken. The data recorded was analyzed by using Shannon-Wiener Index, Pielou's Evenness Index, and Margalef's Richness Index. A total frequency recorded in the study area was 56 with 17 species of birds from 16 families. The highest frequency recorded was Barn Swallow as there was caves in Gunung Reng that act as their home and nesting place. Then, the analysis illustrates that bird community in term of species diversity was 2.39, the evenness of bird species was 0.84 and the species richness was 3.97. This value shows low bird diversity and low species richness. However, the bird species in Gunung Reng was well distributed. As a conclusion, the diversity of bird in Gunung Reng was quiet low because of human disturbance of their habitat and it was recommended to make a further research of this study because there might be more bird species would be observed and identified in Gunung Reng.

UNIVERSITI  
MALAYSIA  
KELANTAN

## **Kepelbagaian Burung di Gunung Reng, Jeli, Kelantan**

### **ABSTRAK**

Satu kajian ke atas kepelbagaian spesies burung telah dijalankan di Gunung Reng, Jeli, Kelantan. Kawasan ini dikelilingi oleh hutan sekunder, ladang getah, ladang kelapa sawit, sungai dan anak sungai dimana ianya membantu dalam menyumbang kepada kepelbagaian spesies burung. Tujuan kajian ini adalah untuk menganggarkan indeks kepelbagaian burung di Gunung Reng. Kajian lapangan telah dijalankan dari bulan Julai 2016 sehingga September 2016. Dalam pensampelan burung, disebabkan kawasan Gunung Reng yang kecil, satu tempat yang berpotensi telah diambil untuk melihat spesies burung dan semua burung yang diperhatikan dalam lingkungan 40 m dari tempat pemerhatian telah diambil. Data yang dikumpulkan telah dianalisis dengan menggunakan Indeks Shannon Wiener, Indeks keserasian Pielou, dan Indeks kekayaan Margalef. Sebanyak 56 frekuensi burung dengan 17 spesies dari 16 famili telah direkodkan di kawasan kajian. Frekuensi yang tertinggi yang telah direkodkan adalah Burung Layang-layang Pekan kerana di Gunung Reng terdapat beberapa gua yang bertindak sebagai tempat tinggal dan tempat bersarang bagi spesies itu. Data yang telah dianalisis menunjukkan komuniti burung dari segi kepelbagaian spesies adalah 2.39, keserasian spesies burung adalah 0.84 dan kekayaan spesies burung adalah 3.97. Nilai-nilai ini menunjukkan bahawa kepelbagaian dan kekayaan spesies burung adalah rendah. Walaubagaimanapun penyebaran spesies burung di Gunung Reng adalah baik. Secara rumusnya, kepelbagaian burung di Gunung Reng agak rendah kerana terdapat gangguan daripada manusia terhadap habitat burung dan dicadangkan untuk meneruskan kajian ini kerana kerana mungkin ada lebih banyak spesies burung yang akan diperhatikan dan dikenal pasti di Gunung Reng.

UNIVERSITI  
MALAYSIA  
KELANTAN

## TABLE OF CONTENT

	<b>PAGE</b>
<b>TITLE</b>	<b>i</b>
<b>DECLARATION</b>	<b>ii</b>
<b>ACKNOWLEDGEMENT</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>ABSTRAK</b>	<b>v</b>
<b>TABLE OF CONTENTS</b>	<b>vii</b>
<b>LIST OF TABLES</b>	<b>viii</b>
<b>LIST OF FIGURES</b>	<b>ix</b>
<b>LIST OF ABBREVIATION</b>	<b>x</b>
<b>CHAPTER 1 INTRODUCTION</b>	
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Objectives	4
<b>CHAPTER 2 LITERATURE REVIEW</b>	
2.1 Birds	5
2.2 Birds Topography	6
2.3 The Study of Birds in Kelantan	7
2.4 Bird Habitat and Community	9

2.4.1	Mangroves and mudflats	10
2.4.2	Peat Swamp Forests	11
2.4.3	Mixed Dipterocarp Forest	12
2.4.4	Forest over Limestone	13
2.4.5	Open Country	13
2.4.6	Park and Garden	14
2.4.7	Freshwater, Lakes and Rivers	15
2.5	Biodiversity	
2.5.1	Biodiversity in Malaysia	16
2.5.2	Overview of Malaysian Birds	18
2.5.3	Bird as Indicators of Biodiversity	19
2.6	Threat to biodiversity	
2.6.1	Habitat loss	20
2.7	Migratory birds	20
2.8	Climate change	21
<b>CHAPTER 3 MATERIALS AND METHODS</b>		
3.1	Material	24
3.2	Methods	25
3.2.1	Study Site	25
3.2.2	Bird Sampling	26
3.2.3	Species Identification	27
3.2.4	Data Analysis	28

<b>CHAPTER 4 RESULTS AND DISCUSSION</b>	
4.1 Species Richness	30
4.2 Bird's Families	37
4.3 Bird Diversity index	39
<b>CHAPTER 5 CONCLUSION AND RECOMMENDATIONS</b>	
5.1 Conclusion	43
5.2 Recommendations	44
<b>REFERENCES</b>	45

## LIST OF TABLES

<b>Table</b>	<b>Title</b>	<b>Page</b>
2.1	Malaysia's known Fauna and Flora Species Diversity	17
3.1	The Reference Books for Species Identification	27
4.1	Bird species in Gunung Reng, Jeli, Kelantan	35

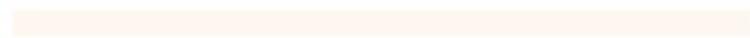
UNIVERSITI  
MALAYSIA  
KELANTAN

## LIST OF FIGURES

<b>Figure</b>	<b>Title</b>	<b>Page</b>
2.1	Bird Physiology	6
2.2	Head of Bird	7
2.3	Wing of bird	7
2.4	Blue-banded Kingfisher	9
2.5	Jambu Fruit Dove	9
2.6	Ruddy Kingfisher	9
2.7	Dusky eagle Owl	11
2.8	Straw-headed Bulbul	12
2.9	Blue Whistling Thrush	13
2.10	Bee-eater	14
2.11	Black-naped Oriole	15
2.12	Kingfisher	16
3.1	Binocular	24
3.2	GPS	25
3.3	Maps of Gunung Reng	26
4.1	Javan Myna	32
4.2	Zebra Dove	33
4.3	Eurasian Tree Sparrow	34
4.4	Oriental Magpie Robin	35
4.5	Green-billed Malkoha	36
4.6	Red Junglefowl	36
4.7	Percentage of the Bird's Families	39



UNIVERSITI



MALAYSIA



KELANTAN

## LIST OF ABBREVIATION

ESA	Environmentally Sensitive Area
NPP	National Physical Plan
GPS	Global Positioning System
UMK	Universiti Malaysia Kelantan
PM	Peninsular Malaysia
EM	East Malaysia (i.e. Sabah and Sarawak)
n.a	Not Available

UNIVERSITI  
MALAYSIA  
KELANTAN

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of the study

Species diversity is one of the basic aspects of biodiversity and birds are one of the best known for most highly valued group species compare to other species (BirdLife International, 2013). Birds can be classified as landbirds, migratory birds, breeding endemic, seabirds and waterbirds (BirdLife International, 2013).

Birds are one of the observable faunal groups that can be found in every habitat such as primary forest, secondary forest, urban gardens and lakes (Duncan et al., 2014). It is also can be found almost everywhere in the world even in a smallest group of birds since they have the ability to cross large area of open sea and conquer the lands surface (BirdLife International, 2013).

Birds can be assisted as dispersal agent in transporting nutrients and spores from one place to another during their migration and local movement (Niemi, 1985). Globally, the most noticeable aspect of this migration and movement is the far greater diversity of bird species in the tropics, compared to the temperate and polar regions. However, tropical birds also may have smaller ranges. Therefore, the actual birds species found is more various from place to place (BirdLife International, 2013).

Birds and their diversity constitute a main part of the natural environment and show a functional role as agents of flower pollination, seed dispersal, source of food chain and agents in breaking seed dormancy (Nason, 1992). Changes in bird populations can also generate a useful indication of broad environmental change (BirdLife International, 2013).

Birds compose nearly 10,000 living species since birds can be found everywhere. However, each species have unique features and behavior in its distribution and ecology (BirdLife International, 2013). Many of them have small ranges and most are controlled to distinct kinds of habitat. The diversity of birds provides a picture on how biodiversity is distributed, and assist as valuable indicators for global environmental change (BirdLife International, 2013).

Bird studies largely proved that vegetation habitat can positively influence species diversity (Wichmann et al., 2004). In forest, there are nesting sites and there are also have strong evidence that vertical partitioning of resources that facilitates the guild diversity of birds (Poulsen, 2002).

Detecting all the species in a bird community is usually a demanding task and bird studies in ecology invariably depends on sampling if they aim to estimate the number of species that occur in a given habitat or area (Ruiz et al., 2014). Thus, the purpose of this study is to establish baseline data on the presence of diversity, evenness and richness of various bird species in Gunung Reng, Jeli, Kelantan.

Gunung Reng is located near the East-West Highway at Jeli area in western Kelantan and is approximately thirty minutes from Universiti Malaysia Kelantan Kampus Jeli. Gunung Reng is a limestone hill with a few caves inside and

surrounded with secondary forest, rubber plantation, and oil palm plantation. There are also river and stream with clear and clean water.

The physical factor and geographic act as an important role in this study as there are rich with flora and fauna likes various types of fruits, flowers, butterflies, river, and consist of various habitat which help in contributes to the variety of bird species in Gunung Reng, Jeli.

Studies of the birds at caves area are particularly scarce (Bash, 2015). Studies of the bird diversity of the Gunung Reng area can make an important contribution by offering new knowledge about the area's biodiversity and nature environment. Therefore, all the information gathered in Gunung Reng is very useful for the conservation and management of biodiversity and may encourage the tourism industry in Gunung Reng, Jeli.

The data and information gathered and recorded was analyzed by using Shannon Index to determine the diversity of birds, Pielou's Evenness Index for species evenness of birds and Margalef's Index to estimate species richness of birds. All the data analyzed help to achieve the objectives and give better understanding for this study.

## **1.2 Problem Statement**

Gunung Reng is rich with flora and fauna as there are various type of habitat that can be found such as secondary forest, rubber plantation and oil palm plantation. Moreover, this limestone cave habitat has many beautiful fauna such as butterflies and dragonflies.

The study of diversity of birds is quite important since birds are good indicators of the ecosystem quality. There are lacks of data regarding the diversity of birds in Gunung Reng, Jeli. Thus, this study was carried out to focus on the diversity and abundance of various bird species occurring in Gunung Reng, Jeli, Kelantan.

### **1.3 Objectives**

- a) To estimate the diversity index of birds in Gunung Reng, Jeli, Kelantan.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Birds

Birds are bipedal, warm-blooded and egg-laying vertebrates. There are two kinds of birds which are flying and non-flying birds. For example, the birds that cannot fly are emu, ostrich, and kiwi because they are big and bulky. However, most birds are able to fly. Birds make up less than half per cent of global animal species diversity (Wichmann et al., 2004).

Birds are acknowledged to be ecosystems health indicators worldwide (Mahinya, 2005) and birds can accomplish many ecological functions in their habitats and it can be a good indicator to the environment and ecosystem. They also act as dispersal agents in transferring nutrients and spores from one place to another place during their migration and local movements (Niemi 1985).

Due to the important role that birds play in maintaining ecosystems and supporting biodiversity, many researchers look for their protection to manage biological threats and effortlessly protect the environment and biodiversity. Human population growth connect with the increases in demand for settlements, agricultural land and wood products for development of the wildlife habitats, bird diversity patterns and overall biodiversity around the world (Andrew et al., 2004).

## 2.2 Birds topography

Birds have various size, shapes, color pattern, behavior, and habitat that distinguish the species of birds and the main part of birds are head, bill, throat, breast, wings, tail and leg (Powell, 2015).

This birds topography can help in recognize birds and easier to notice the birds type or species. Picture in Figure 2.1, 2.2, and 2.3 below shows the birds topography in more detail.

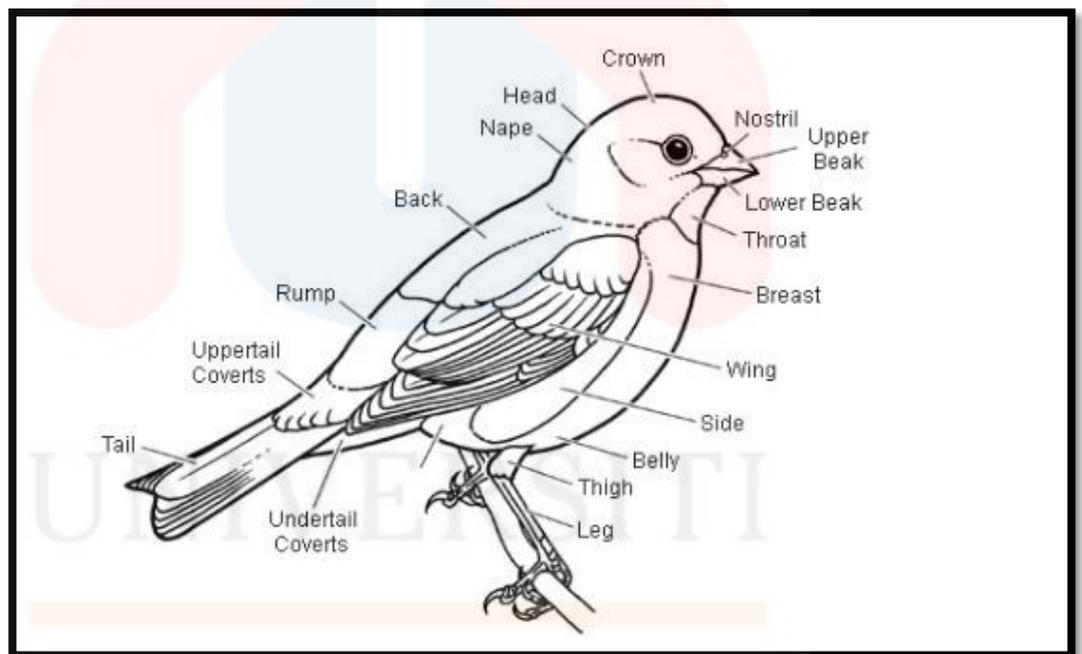


Figure 2.1: Bird physiology  
(Source: Schmitt, 2015a)

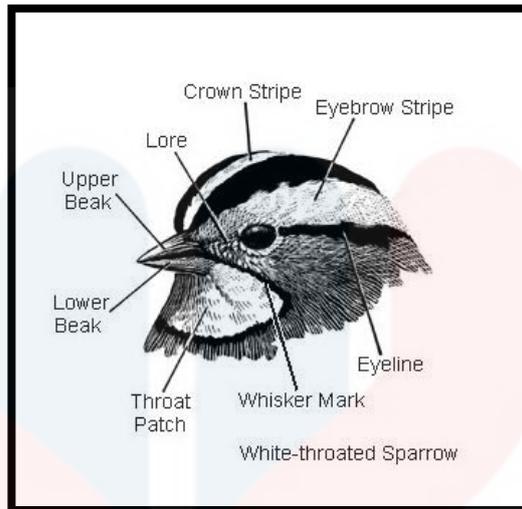


Figure 2.2: Head of bird  
(Source: Schmitt, 2015b)

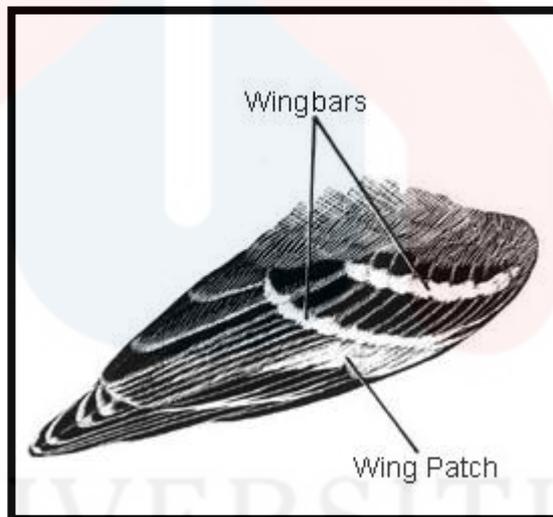


Figure 2.3: Wing of bird  
(Source: Schmitt, 2015c)

### 2.3 The Studies of Birds in Kelantan

Kelantan is situated in the North East of Peninsular Malaysia which is known as agrarian state with lush paddy field, unsophisticated fishing village and casuarina-lined beach. Kelantan also home to the most ancient archaeological discoveries in Malaysia including the prehistoric aboriginal settlement (Strange & Yong, 2006).

In Kelantan, the forest areas are known as the main of portion of Taman Negara National Park and it has been identified as an Environmentally Sensitive Area (ESA) rank one under Malaysia's National Physical Plan (NPP) due to a lack of baseline data (Zain et al., 2013). Moreover, Kelantan forest areas are divided into three portions which are lowland evergreen rain forest, lower mountain rain forest, and upper mountain rain forest that has been sort by general vegetation forms (Ghasemi, 2014).

There are total of 321 species of birds were recorded in Kelantan forest area. Out of the total number of recorded species, 220 species were falls under totally protected categories, 49 species were nearly threatened, seven species have been categorized in vulnerable and one species were critically in endangered categories (Ghasemi, 2014).

Besides that, out of the total recorded bird species in Kelantan forest area, 155 species were recorded in lowland evergreen rain forest reserves, 292 species of bird were recorded in lower mountain rain forest reserves and 128 species were recorded in upper Kelantan montain rain forest (Ghasemi, 2014).

Furthermore, there are 83 species that were observed frequently in three types of habitats and 20 species were recorded only in Kelantan lowland forest reserve and five species were recorded in upper montain rainforest (IUCN, 2012). Based on the list of Kelantan birds, the Blue-banded Kingfisher (Figure 2.4) is fall under nearly critically endangered in status while Jambu Fruit-Dove (Figure 2.5) is fall under nearly threatened status (Ghasemi, 2014).



Figure 2.4 Blue-banded Kingfisher

(Source: Chan, 2006)



Figure 2.5 Jambu Fruit Dove

(Source: Huat, 2002)

## 2.4 Bird habitat and community

Habitat has been used as a predictor of bird species abundance and variety of birds has spread different preferences for habitat (Huston, 1994). Generally, there are three types of habitats which are primary forest, secondary forest and lowland forest. Primary forest has less human disturbance while secondary forest has large

trees that has been cut down but there has been some regeneration. Habitat that has high human disturbance, supported less bird species richness and diversity because that disturbance of natural forest may cause destruction or loss habitat of bird species and the species that has high chances to survive is a generalist species (Green & Baker, 2003).

#### **2.4.1 Mangroves and mudflats**

Mangroves forests are located between land and sea and it is important barrier against the erosion and salt invasion. Mangroves are one of the ecosystem that is rich in biodiversity in the world, which providing shelter and feeding sites for many birds and animals species (Prabhakar, 2011).

Besides, mudflat is rich with marine life. So it has large number of shorebird feeding and these mudflats can be distinguished near the river mouth and off coastal mangrove (Malaysia Birding, 2015).

Examples of birds that can be found in mudflats are Mangrove Blue, Flycatcher, Mangrove Pitta, Milky Stork, Lesser Adjutant, Great-billed Heron, Great Tit, Mangrove Whistler, Greater Flameback, Ruddy Kingfisher, Chinese Egret and Asian Dowitcher. Figure 2.6 shows the Ruddy Kingfisher which is one of the birds of the mangroves and mudflats.



Figure 2.6 Ruddy Kingfisher

(Source: Yean, 2002)

#### 2.4.2 Peat swamp forests

Peat swamp forest is a significant component of forest and many of peat swamp forest have already been transformed to new land uses which are palm oil, housing and agriculture (Azmi et al., 2009). Peat swamp forest can be very attractive and have very typical vegetation that can attract various species of birds.

Peat swamp forest can be found in Peninsular Malaysia and it has been develop over nutrient lacking soil of decayed vegetation. The water is acidic with pH below four and severely varies (Malaysia Birding, 2015). Figure 2.7 shows one of the birds that can be found in peat swamp forest named Dusky Eagle Owl.



Figure 2.7 Dusky Eagle Owl

(Source: Sein, 2004)

### 2.4.3 Mixed Dipterocarp Forest

Dipterocarp forest namely because this area is dominated by trees from the Dipterocarpaceae family. These forests occur on dry land which above sea level to an altitude of about 900 meters (World Wild Fund for Nature, 2016).

This forest is home for various terrestrial species in the world such as Straw-headed Bulbul (Malaysia Birding, 2015) (Figure 2.8).



Figure 2.8 Straw-headed Bulbul

(Source: Jweeyh, 2007)

#### 2.4.4 Forest over Limestone

In forest over limestone, there are steep cliffs, jagged summits and caves characteristic limestone hills. These forests is creting micro habitat with harsh, dry and hot conditions which resulted various species diversity of large plants (Malaysia Birding, 2015).

There are also caves that act as home to swiftlets and bats which can attract the predators that prey on bat and small birds such as Blue Whistling Thrush (Malaysia Birding, 2015) as shown in Figure 2.9.



Figure 2.9 Blue Whistling Thrush

(Source: Neil, 2005)

#### 2.4.5 Open Country

Open country is when the land cleared by human activity and this natural states of the cities are different compared to the forest. This area created by tree cutting along roads, utility right-of-way, airport runways and railroads (Whitaker et al., 2012).

However, this open area with abandoned land and some vegetation are favored by certain birds for foraging and roosting (Malaysia Birding, 2015). The species of birds that can be found in this area are Bee-eater, Munia, Coucal and Shrike Territory (Strange, 2000). The Bee-eater bird is shown in Figure 2.10.



Figure 2.10 Bee-eater

(Source: Suleesia, 2006)

#### 2.4.6 Park and Garden

Garden and park are the most disturbed and artificial of all habitats. However it is highly productive if these park and garden are managed sensitively (Strange, 2000). There are a few large cities and towns that have recreational parks with some similarity of natural vegetation and this can attract various species of birds (Malaysia

Birding, 2015). Figure 2.11 shows the Black-naped Oriole that can be found in garden and park.



Figure 2.11 Black-naped Oriole

(Source: Loinaz, 2009)

#### **2.4.7 Freshwater, lakes and rivers**

Malaysia has very few natural lakes and other lakes are man-made lakes which formed by the flooding of former tin-mining pits with their aquatic vegetation and reed beds that can attract waterbird from various species (Malaysia Birding, 2015).

Besides, the bird fly low over the lake and river in searching for food are affected by the higher speed of water flow of freshwater habitat (Alderton, 2002). Usually, bird that can be found in this area is Kingfisher species (Figure 2.12).



Figure 2.12 Kingfisher

(Source: Gay, 2012)

## **2.5 Biodiversity**

### **2.5.1 Biodiversity in Malaysia**

Term of biodiversity comes from the word “biological diversity” that combines the concept of plant and animals as genetic resources and the diversity of species and their habitat in one term (Conservation and Environmental Management Division, 2006).

Biodiversity includes the diversity at the genetic level, the diversity of species and the diversity of ecosystem and habitat (Ghasemi, 2014). Genetic diversity refers to the variation of genes in the population of species while species diversity means the number of species of living organisms on earth. Besides, ecosystem diversity is about the variety of habitat, biotic communities and ecological process in particular area with interaction and process (Conservation and Environmental Management Division, 2006).

In Malaysia, genetic diversity is important for potential of a species to respond and adapt to environmental changes, to understand the organic evolution and population structure and it is can make better breeds of plants and animals. However, it is still in early stages even though the biotechnology in Malaysia is prioritized (Latiff, 2010).

Moreover, the numbers of species in Malaysia are more than 170 000 species (Ghasemi, 2014). The Table 2.1 shows the Malaysia's known fauna and flora species diversity.

Table 2.1 The Malaysia's Known Fauna and Flora Species Diversity

(Source: Ghasemi, 2014)

Organism	Endemic Species	Total Species
Mammals	27	286
Birds	11	736
Reptiles	69	268
Amphibians	57	158
Marine Fishes	n.a	4000
Freshwater Fishes	n.a	449
Invertebrates	n.a	150 000
Flowering Plants	n.a	15 000
Palms	n.a	195 (PM), 128 (Sabah), 213 (Sarawak)
Ferns and Fern Allies	n.a	1 159
Orchids	n.a	500 (PM), 2 500 (EM)
Fungi	n.a	400 (PM), 300 (EM)
Mosses	n.a	432 (WM), 400 (EM)

Furthermore, Malaysia has a great diversity of ecosystem as Malaysia was completely covered with forest for about hundred years ago and Malaysia also has freshwater aquatic ecosystem such as rivers, lakes and marine ecosystem with various species of plants and animals (Conservation and Environmental Management Division, 2006).

### **2.5.2 Overview of Malaysian Birds**

Malaysia is well known as the richest bird in the world. Bird species present in Malaysia for about 742 species whereas Peninsular Malaysia recorded 662 species and Borneo have been recorded 552 and 557 species of birds in Sabah and Sarawak respectively (Lang et al., 2014).

There are four species endemic in Peninsular Malaysia (MNS- Bird Conservation Council, 2010) while in Borneo, there are between 38 and 52 endemic species that depending on which taxonomic authority is consulted (Yeap et al., 2007).

The large distribution of species are known as forest dependent (Wells, 2007) which are in the lowland mixed dipterocarp forest, lowland evergreen forest and freshwater swamp forest, lower montane forest and upper montane forest (Duncan et al., 2014). In addition, lowland forests of Malaysia are home and main habitat to 311 species of birds (Peh et al., 2005).

### 2.5.3 Bird as Indicators of Biodiversity

Birds are very functional indicators of species richness and endemism pattern as bird record very highly of broad criteria in selecting the taxa for indicator (Pearson, 1995). The best indicators taxon is depends on whether the purpose is to track environmental change or clarify biodiversity pattern, regarding the scale involved and the type of habitat being looked at (Birdlife International, 2013).

Based on Birdlife International (2013), there are some reasons why birds are good indicators for biodiversity:

- i. Bird taxonomy is well known and relatively constant.
- ii. The distribution of birds, bird ecology and life history of bird are well understood.
- iii. Birds are generally easy to recognize, survey and monitor, and there are valuable historical data sets for a wide range of species.
- iv. Birds are diverse and can be found in nearly all habitats and occur across the world.
- v. Birds usually inhabit high trophic levels in food webs and are relatively sensitive to environmental change.
- vi. The distribution of birds are generally reflects that of many other wildlife groups.
- vii. Bird population trends often mirror those of other species.
- viii. Birds are economically important.

## **2.6 Threat to Biodiversity**

### **2.6.1 Habitat loss**

Malaysia is well known for its tropical rainforest that play a very functional role in maintaining various species of wildlife because of their diversity of habitat (Ghasemi, 2014). Unfortunately, Malaysia has record the highest rate of deforestation (Butler, 2013) and this can cause habitat loss and degradation (Shaw et al., 2013) which can affect the richness and diversity of birds.

Bird species are very sensitive to the change of ecological process and display a wide range of sensitivity to habitat modification and disturbances of the natural process (Chapman et al., 2010). Habitat loss is one of the main caused or threat of faunal species to be decrease (Duncan et al., 2014).

Although native habitat loss is the main cause of the loss of biodiversity of the world and decrease the diversity of bird species, some agro ecosystems can harbor a substantial portion of the biodiversity of the original land cover and can also buffer and complement the protected areas ( Peh et al., 2005).

## **2.7 Migratory birds**

Migration is a natural process, whereby different birds fly over distances of hundreds to thousands of kilometers in order to find the best ecological conditions and habitats for feeding, breeding and raising their young. For example, the birds may leave the forest and fly to adjacent areas to find food (Bash, 2015).

The migration of birds usually begins in September until March every year which they come in large number from Mongolia, Japan and Siberia that often flying solitary. Besides, to reach Indonesia and Australia, these birds will use Malayan Peninsula as their land bridge (Singh, 2009).

There are many different migration patterns. Most birds are migrating from northern breeding areas in the summer to southern wintering grounds. They involved in activities that afford them opportunity to store enough fats for the journey back to Europe (Manu, 2000). For most species of bird, their successful migration is dependent on the availability of suitable stopover sites where they can refuel to stock up their fat reserves (Fallis, 2013).

Migratory birds have the perfect morphology and physiology to fly fast and over long distances. However, they often experience an exhausting journey during which they go to their limits. Migratory birds therefore rarely fly to their destination nonstop but interrupt their journey frequently to rest and feed or to sit out a spell of bad weather (Fallis, 2013).

In addition, some birds are “escapees” as they are not native locally but have been adapt happily and breed in the wild for many years from released captive such as pretty Java sparrow (Singh, 2009).

## **2.8 Climate change**

Many migrating birds are very sensitive to environmental changes and are already being affected by climate change. Increasing temperatures, changing vegetation and extreme weather conditions lead to significant changes of the bird's

essential habitats can cause the decline of bird populations and changes in migration patterns (Parry, 2007).

Global climate change has already been shown to affect a wide spectrum of organisms, from plants to invertebrates and vertebrates, in their morphology, physiology, phenology, life history, abundance and distribution (Parmesan, 2006).

The ways in which migratory birds respond to these environmental changes differ by species. Generally, short and middle distance migrating birds can adapt to climate changes more easily compare to long distance migrants. Moreover, climate change may exacerbate further wetlands natural resources degradations (Parry, 2007), consequently affecting negatively the abundance, diversity and community composition of especially threatened bird species (Baker & Baker, 2002).

## **2.9 Vegetation**

In most vegetation, rainforest is covering various type of forest that growing in areas where rainfall is usually has high evapotranspiration for at least nine months of the year. The typical progression from the coast to inland is from mangroves to peat swamp forest, lower montane forest and upper montane forest (Davison & Yeap , 2010).

The distribution of bird species and the diversity of birds are depending on the vegetation at that area as the availability of resources for birds will be decline reflecting differences in forest stand structure, site productivity, distribution pattern, secondary biotic interactions, vegetation composition and available land area (Joshi et al., 2012).

The high distribution of birds and species diversity can be found at lowland which from the extreme lowlands up to about 900 m altitude and lowland forest also known as premier birding habitat (Davison & Yeap, 2010).



UNIVERSITI



MALAYSIA



KELANTAN

## CHAPTER 3

### MATERIALS AND METHODS

#### 3.1 Materials

The materials needed for this research was binocular (Figure 3.1) that had been used to observe and confirm the identification of the birds and Global Positioning System (GPS) (Figure 3.2) was used to record the coordinate of the point count surveys.



Figure 3.1 Binocular

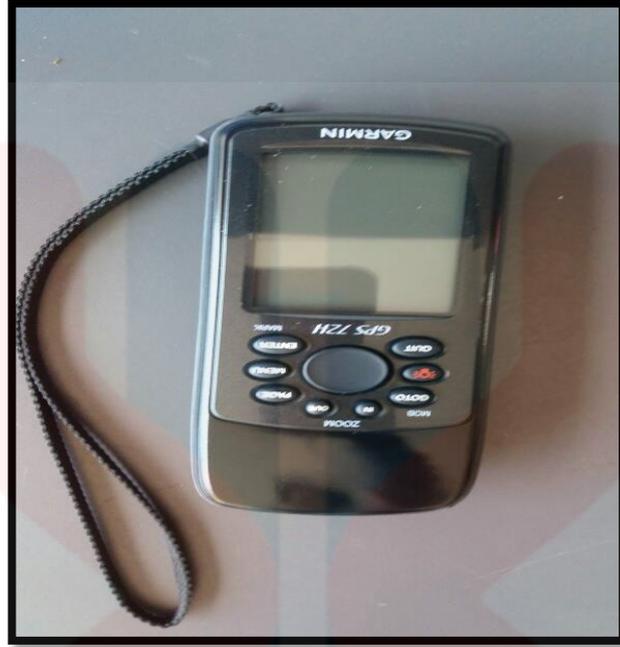


Figure 3.2 GPS

## 3.2 Methods

### 3.2.1 Study Site

The study was carried out at Gunung Reng, Jeli, Kelantan ( $05^{\circ}42'53''\text{N}$ ,  $101^{\circ}44'43.5''\text{E}$ ). Gunung Reng (Figure 3.3) is about fifteen km and approximately twenty minutes from Universiti Malaysia Kelantan (UMK), Jeli Campus. Gunung Reng can be seen as a huge rock because it exists in that area that has no continuous series of mountain. This area was surrounded with secondary forest, rubber plantation, and oil palm plantation. There was also a river and stream with clean water. The sampling had been conducted around Gunung Reng area.

This study had been conducted starting from July until August 2016 between 0700 h to 1000 h and 1800 h to 1900 h on days with no precipitation or strong wind (Peh et al., 2005).

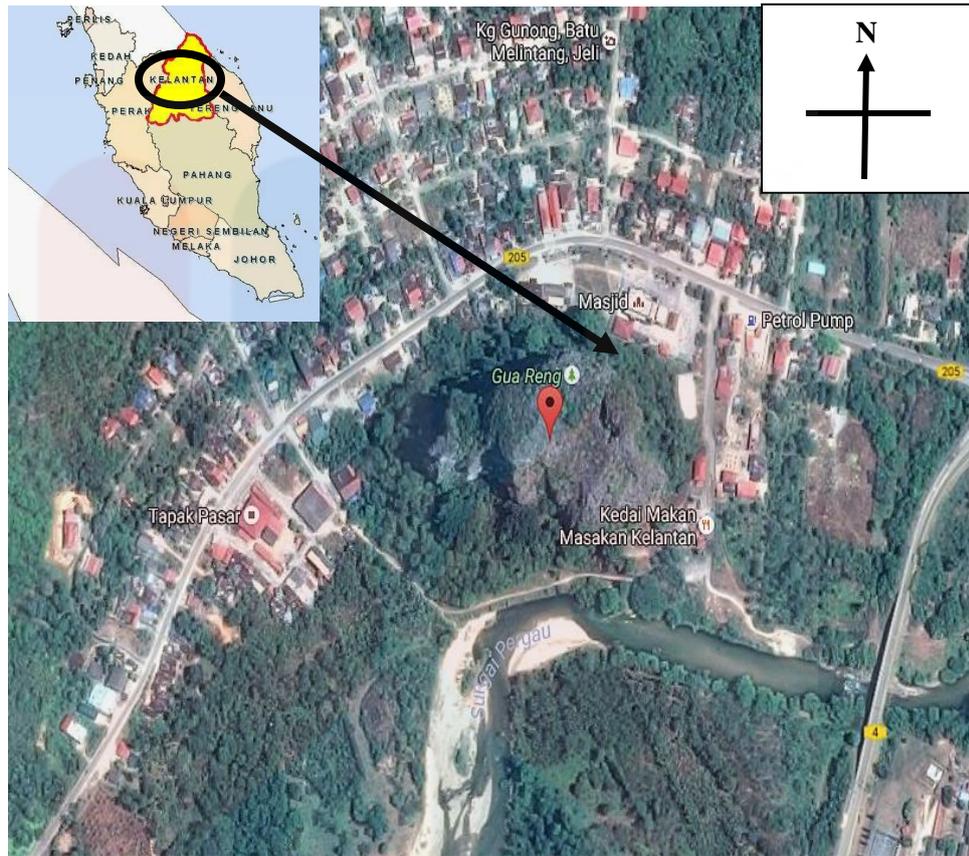


Figure 3.3 Map of Gunung Reng

( Source: Google Maps, 2016; Photobucket,2016)

### 3.2.2 Birds Sampling

To determine the richness and diversity of bird communities in Gunung Reng, bird survey was conducted by took one potential spot for bird observation. This bird survey had been carried out in the morning from 0700 h to 1000 h and evening from 1800 h to 1900 h and binocular had been used to observe and confirm the identification of the birds. All bird surveys were carried out by the same observer (Peh et al., 2005).

A researcher only took one potential spot for bird observation because of the limited and small area at Gunung Reng. All the birds observed in range of 40 m radius from the observation spot were taken (Amir et al., 2015).

Precaution had been taken to avoid the recounting of the same individuals at given point. First, try to avoid double counting of the same individual by using careful observation and common sense (Gregory et al., 2004) and when multiple sighting of same bird species, only count the first sighting (Hostetler & Main, 2001). Then, for each bird species, only the total number of birds with the highest frequency was taken throughout the observation period (Hernandes & Venancio, 2013).

### 3.2.3 Species Identification

All the species observed had been identified by referring to the reference books as in Table 3.1.

Table 3.1 The Reference Books for Species Identification

No.	Book Title	Source
1	A Photographic Guide to the Birds of Southeast Asia including the Philippines and Borneo	Strange (2000)
2	A Field Guide to the Bird of Peninsular Malaysia and Singapore	Jeyarajasingam & Pearson (2012)
3	A Naturalist's Guide to the Birds of Malaysia including Sabah and Sarawak	Davinson & Yeap (2012)

### 3.2.4 Data Analysis

The diversity of birds had been analyzed by using Shannon-Wiener Diversity Index ( $H'$ ). Shannon-Wiener Diversity Index assumes that all species are represented in a sample that is obtained.

a) The Shannon-Wiener Diversity Index ( $H'$ )

$$H' = - \sum_{i=1}^S (p_i \ln p_i) \quad \text{-----Equation 3.1}$$

Where :

$S$  = Number of species

$P_i$  = Total number of individuals in  $i^{\text{th}}$  species/ number of individual for all species

$\ln$  = Natural logarithm

The species evenness of birds had been analyzed by using Pielou's Evenness Index ( $J'$ ). Species evenness was a measure of relative abundance of the different species making up the richness of an area. This Pielou's Evenness was used where the number is derived from the Shannon Index. The evenness value constrained between 0 and 1 and the closer the number to one, the more even the distribution in abundance among species. Number one was considered as the maximum value of evenness, as  $H_{\text{max}}$  was the highest evenness possible in the population.

b) Pielou's Evenness Index ( $J'$ )

$$J' = \frac{H'}{H_{max}} \quad \text{----- Equation 3.2}$$

Where:

$$H_{max} = \ln S$$

Furthermore, the estimation of species richness of birds represented in Gunung Reng, Jeli had been analyzed by using Margalef's Richness Index.

c) The Margalef's Richness Index

$$D_{mg} = \frac{(S-1)}{\ln N} \quad \text{----- Equation 3.3}$$

Where:

S = Number of species

N = Total number of species in community

Next, species accumulation curve was graphed to evaluate inventory completeness. The accumulation curve was the collector curve. This curve was plot the cumulative number of species that had been recorded at Gunung Reng as a function of the number of samples. The curves generally grow rapidly at first, as the most common species are found. However, the curves bench was occur only when the rarest species remains to be sampled.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Species Richness

A total of 56 frequencies of birds were recorded in Gunung Reng, Jeli, Kelantan which belonging to 17 species and 16 families. The result shown that, *Hirundo rustica* - Barn Swallow was the most abundant bird species in Gunung Reng with the highest number of frequency recorded. Five bird species i.e., *Stachyris nigricollis* – Black-throated Babbler, *Eurystomus orientalis* - Asian Dollarbird, *Phaenicophaeus tristis* – Green-billed Malkoha, *Gallus gallus* - Red Junglefowl and *Garrulax lugubris* - Black Laughingthrush were the less abundant birds species observed with lower number of frequency. In addition, *Acridotheres javanicus* – Javan Myna, *Copsychus saularis* – Oriental Magpie Robin and *Geopelia striata* – Zebra Dove were the most common bird species that can be seen almost every day in Gunung Reng, Jeli.

The result of a highest frequency of Barn Swallow in Gunung Reng because it was sometimes gathers in large flocks and easy to identify by its appearance, tail shape and size (Davison & Yeap, 2010). Besides, Gunung Reng is a limestone hill with scarce caves inside that contribute to the presenting of barn swallow in this area. These caves could be act as a home and nesting place to this barn swallow. This area also surrounded with various vegetation which fit to their foraging activities as birds often choose to utilize a various type of habitat and reliant on the quality and productivity of the habitat for their food, shelter, and breeding areas to maintain their populations (Amir et al., 2015).

Food sources may regulate population distributions of bird species (Johnson & Sherry, 2001) as different birds species could be attracted to the different vegetation structure like large area of seedlings (Campbell, 2007). Based on the result, Common Tailorbird was ranked as the second highest frequency and followed by Dusky Munia. In Gunung Reng, open garden can be found near the caves and this habitat was preferred to Common Tailorbird as this little bird often foraging through the garden and looking for spiders, small insects and grubs (Singh, 2009).

In contrarily, Dusky Munia requires more severely vegetated habitats for their foraging from taking various grass seed and fragments from the ground including some from animal dung (Davinson & Yeap, 2010). Thus, we can say that food sources may affect the distribution of population of bird species and fruit abundance may affect species conformation and foraging behavior of birds (Amir et al., 2015).

Opening gaps will increase shrub that often leads the growth of various fruits and flower which benefit to main diet for bird species. The richness and diversity of plants may also affect the utilization and provision of the food and eventually affect the diversity and distributions of birds (Amir et al., 2015).

Javan Myna (Figure 4.1) was one of the common species of birds in Gunung Reng and it was recorded with frequency of 4. Javan Myna was one of the birds that can live by feeding off scavenging and at rubbish heaps (Davinson & Yeap, 2010). In Gunung Reng, there was laystall near the river for the use of resident there and this can be one of the factors for distribution of Javan Myna in this area.

The population of the Javan Myna also increases and distributes quickly in urban area especially in residential zone which has abundant supply of human food resources (Yap et al., 2002). Certainly, the Javan Myna is well adapted in urban area

because of the availability of food resources. Nest site of Javan Myna was usually includes a frond-axil in a palm-crown likes tall coconut, hole and crevices in limestone cliff, hole trunk of a dead tree and man-made structure such as roof space (Wells, 2010). The breeding accomplishment of the native birds was decrease because of the aggression and monopolization of the nest hole of Javan Myna (Yap et al, 2002).



Figure 4.1 Javan Myna

Furthermore, Zebra Dove and Eurasian Tree Sparrow as shown in Figure 4.2 and Figure 4.3 respectively also recorded with 4 frequency and ranked third highest number of individuals. Gunung Reng had one playground with open garden that were contribute the presenting of Zebra Dove and Eurasian Tree Sparrow in study area as they were the commoners birds life in garden and city.

Zebra Dove often looking for seed on the ground by wandering the garden while Eurasian Tree Sparrow particularly adapted with open ground for them to dig

around worms (Holmes & Phillipps, 1998). We can assume that these bird species were considered open country birds and utilized open area such as gardens, parks, and plantations.



Figure 4.2 Zebra Dove



Figure 4.3 Eurasian Tree Sparrow

Gunung Reng was surrounded with secondary forest with large trees that makes these birds comes often to the Gunung Reng because of their scampering behavior in trees. There was also river and stream at Gunung Reng which contributes the presenting of Oriental Magpie Robin (Figure 4.4) as a one of the resident birds in that area. Oriental Magpie Robin also one of the garden bird and it can conquer edges of heavily logged forest adjacent to cultivation and forested riverbanks and wandering the ground for worms and insects (Davinson & Yeap, 2010).

This characteristics of the adjacent landscapes of the oil palm plantation as well as forests and near water bodies includes stream can encourage the species richness and high diversity due to the wide diversity of habitat characteristics and growth in prey availability (Amir et al., 2015).



Figure 4.4 Oriental Magpie Robin

(Source : Pan, 2005)

Besides, *Stachyris nigricollis* – Black-throated babbler, *Eurystomus orientalis* – Asian Dollarbird, *Rhopodytes sumatranus* – Green-billed Malkoha (Figure 4.5), *Gallus gallus* – Red Junglefowl (Figure 4.6) and *Garrulax lugubris* – Black Laughingthrush recorded the least number of frequency in Gunung Reng. It may be because these species were residentially migrants.

Furthermore, bird species was very sensitive to many changes due to some of ecological process and it shows wide range of sensitivities to the habitat disturbance and alteration of natural process (Chapman et al., 2010). Since Gunung Reng had some disturbance from villagers near this study area and human activities, it may be considered that these species are affected from the disturbance occurs at Gunung Reng, Jeli.



Figure 4.5 Green-billed Malkoha



Figure 4.6 Red Junglefowl

Regarding to the data recorded in Table 4.1, *Stachyris nigricollis* – Black-throated Babbler was fall under near threatened based on IUCN Redlist 2016 status and it can be the reason why it was only one individual found in Gunung Reng. Black-Throated Babbler was highly sensitive to habitat adaptation and it seems to have caused moderately quick population decline in its range. Thus, the rapid development could be a contributing factor for this threatened.

However, this species had found in Gunung Reng, Jeli. This shows that the environments in Gunung Reng still support the ecological requirements for Black-throated Babbler. Further research is necessary to ensure that this bird does not extinct in Gunung Reng. Thus, it was possible that this bird species will continue to extinct if the disturbance occurs in Gunung Reng was remaining increase.

Table 4.1 Bird species in Gunung Reng, Jeli, Kelantan

No	Family	Scientific Name	Common Name	Frequency	Status
1	Pycnonotidae	<i>Pycnonotus goiavier</i>	Yellow- vented Bulbul	3	Least Concern
2	Aegithinidae	<i>Aegithina tiphia</i>	Common Iora	4	Least Concern
3	Sturnini	<i>Acridotheres javanicus</i>	Javan Myna	4	Least Concern
4	Nectariniini	<i>Arachnothera longirostra</i>	Little Spiderhunter	2	Least Concern
5	Saxicolini	<i>Copsychus saularis</i>	Oriental Magpie Robin	3	Least Concern
6	Oriolini	<i>Oriolus chinensis</i>	Black- naped Oriole	3	Least Concern
7	Columbidae	<i>Geopelia striata</i>	Zebra Dove	3	Least Concern
8	Hirundininae	<i>Hirundo rustica</i>	Barn Swallow	13	Least Concern
9	Acrocephalinae	<i>Orthotomus atrogularis</i>	Dark- necked Tailorbird	2	Least Concern
10	Timaliini	<i>Stachyris nigricollis</i>	Black- Throated babbler	1	Near threatened
11	Passerinae	<i>Passer moritanus</i>	Eurasian tree Sparrow	4	Least Concern
12	Acrocephalinae	<i>Orthotomus sutorius</i>	Common Tailorbird	6	Least Concern
13	Coraciidae	<i>Eurystomus orientalis</i>	Asian Dollardird	1	Least Concern
14	Estrildidae	<i>Lonchura fuscans</i>	Dusky Munia	4	Least Concern
15	Cuculidae	<i>Phaenicophaeus tristis</i>	Green- billed Malkoha	1	Least Concern
16	Phasianidae	<i>Gallus gallus</i>	Red Junglefowl	1	Least Concern
17	Garrulacinae	<i>Garrulax lugubris</i>	Black Langhingthrush	1	Least Concern
					<b>Total = 56</b>

#### 4.2 Bird's Families

A total of 16 families representing of 17 species were recorded in Gunung Reng, Jeli. By referring to the figure 4.7, the highest percentage of family recorded was Acrocephalinae with 12 %. Bird species that includes in family Acrocephalinae

were *Orthotomus sutorius* – Common Tailorbird and *Orthotomus atrogularis* – Dark-necked Tailorbird.

Although they were in same family but they were different species and features. Common Tailorbird was commonly seen in Gunung Reng compare to Dark-necked Tailorbird that can be seen once only. The appearances of Common Tailorbird were duller, chestnut cap darker and merging more smoothly into back compare to Dark-necked Tailorbird (Davinson & Yeap, 2010).

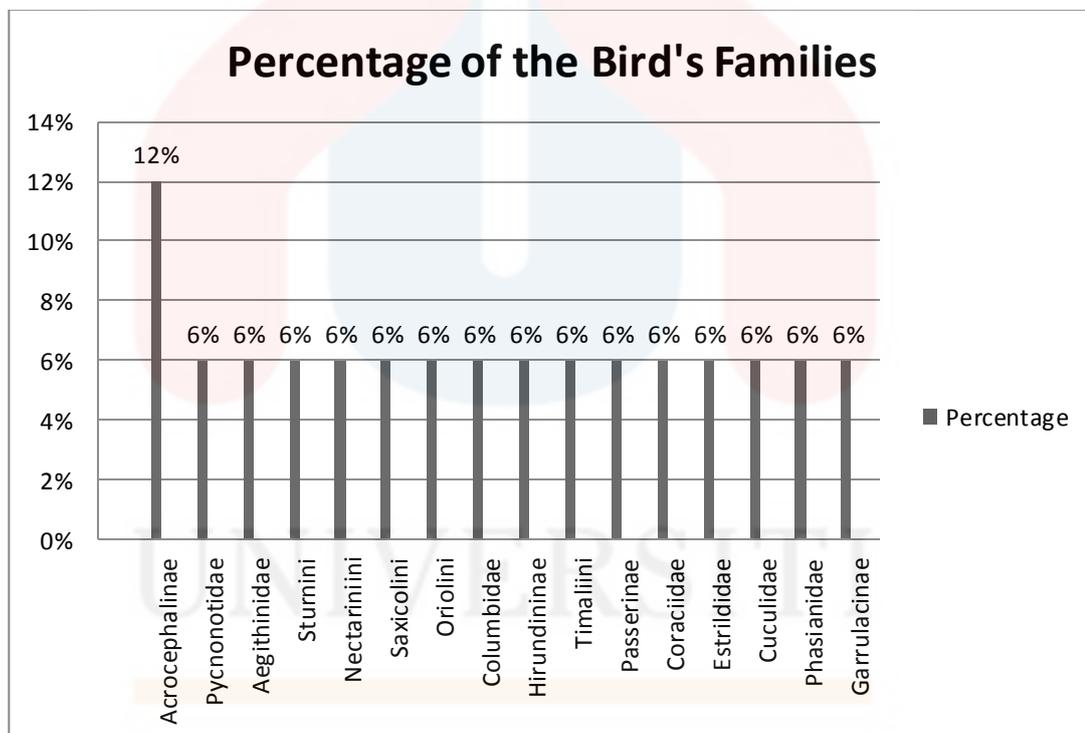


Figure 4.7 Percentage of the Bird's Families

The highest percentage of Acrocephalinae (Common Tailorbird and Dark-necked Tailorbird) was because these species have successfully adapted to human disturbances and the natural vegetation in Gunung Reng fits their diet well as

Common Tailorbird was insectivores which often foraging through garden to find small insect and grubs (Singh, 2009). The bird species like Common Tailorbird was well adapted to humans and urban areas which they are rapidly colonizing and use whatever resources available in their surrounding although that resource was not their main necessities (Ramli, 2004).

### 4.3 Bird Diversity Index

The Shannon-Wiener Index ( $H'$ ), Pielou's Evenness Index ( $J'$ ) and Margalef's Richness Index ( $M$ ) was used to measure the diversity index of birds. The Table 4.2 below shows the diversity index of birds in Gunung Reng, Jeli, Kelantan.

Table 4.2 Shannon-Wiener Index ( $H'$ ), Peilou's Evennes Index ( $J'$ ), Margalef's Richness Index (DMg)

Site	$H'$	$H'$ max	$J'$	DMg
Gunung Reng, Jeli, Kelantan	2.39	2.83	0.84	3.97

Based on the Table 4.2, The Shannon-Wiener Index value was 2.39 that represented all species of birds in Gunung Reng. The typical values of Shannon-Weiner Index are normally between 1.5 and 3.5 in most ecological studies, and this values index is rarely greater than 4 (Magurran, 2004). Thus, the value of Shannon-Wiener Index shown the diversity of bird species in Gunung Reng has quiet low

diversity between bird species. It may be because of human disturbance of bird habitat in Gunung Reng.

Gunung Reng was disturbed for being a park and attractions for residents there doing activities like jogging, playing and camping. There was also human alteration landscape in Gunung Reng that may contribute to the negative impacts to the bird diversity and this can be explained by the low diversity of birds in Gunung Reng.

Besides, the Pielou's Evenness Index was 0.84. The value for evenness was closer to the number one and it shows the more even of the quantities of the different species as number one was considered as the maximum value. The value of Pielou's Evenness Index revealed that the individuals in the community are well distributed among these bird species.

Moreover, the value Margalef's Richness Index was 3.97 which indicates the species richness and abundance represented in Gunung Reng, Jeli, Kelantan. Based on Table 4.1, the Barn Swallow was highly abundant with a frequency number of 13 recorded compared to Black-throated Babbler, Asian Dollarbird, Green-billed Malkoha, Red Junglefowl and Black Langkingthrush with only one frequency recorded.

Barn Swallow was highly abundant because of the existence of caves as their home for their nesting and foraging site while Black-throated Babbler, Asian Dollarbird, Green-billed Malkoha, Red Junglefowl and Black Langkingthrush recorded the least abundance may be caused by the different habitat preferred and features and they are threatened by human disturbance at Gunung Reng.

Furthermore, the Figure 4.8 shows the accumulation curve that represented the curve of rising biodiversity with days on x-axis and number of species richness on y-axis.

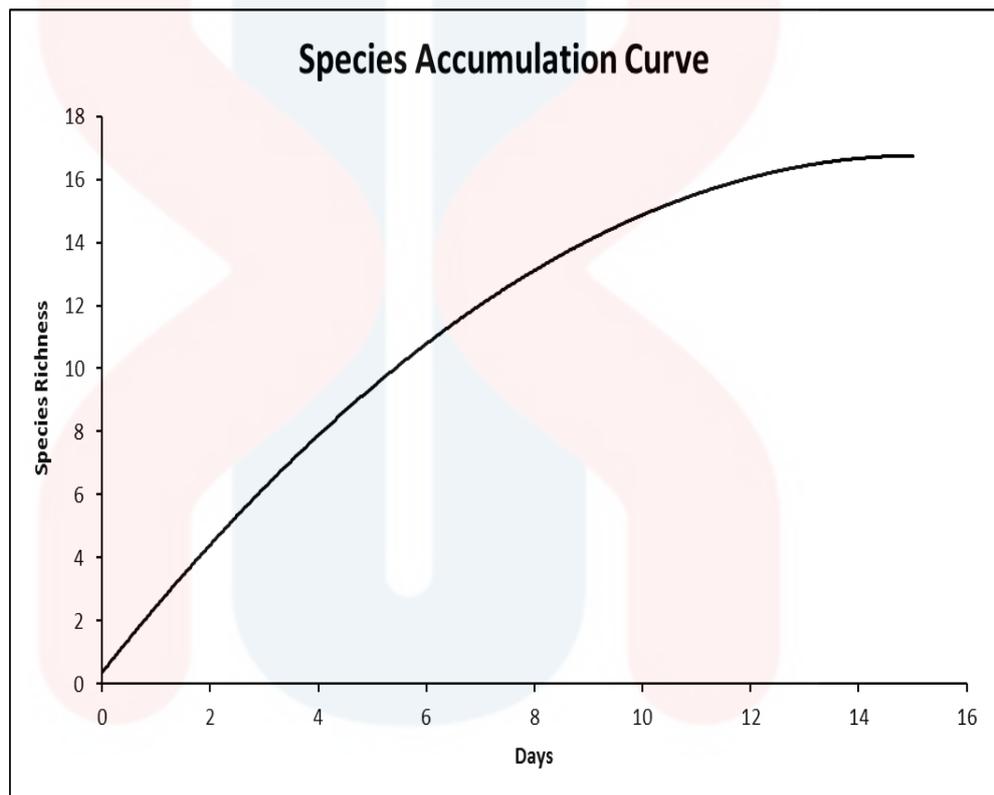


Figure 4.8 Species Accumulation Curve

The species accumulation curve was plotted based on the data recorded in this study. It shows the frequency at which new species are found within a community and can be used to provide the estimation of species richness. Based on the Figure 4.8, the graph was not reached their asymptotes due to lack of sampling period. This was because the weather conditions like rain and precipitation that affect the bird sampling. Even though the curve have reached their asymptotes, further

research is still necessary because there is more bird species await to be observed and identified.



UNIVERSITI  
MALAYSIA  
KELANTAN

## CHAPTER 5

### CONCLUSION AND RECOMMENDATIONS

#### 5.1 Conclusion

This study had recorded 56 frequencies of bird species at Gunung Reng, Jeli, Kelantan which representing of 17 species and 16 families. The highest family recorded in Gunung Reng was Acrocephalinae which were Common Tailorbird and Neck-Throated Tailorbird. Besides, the highest frequencies of recorded species were Barn Swallow followed by Common Tailorbird.

In addition, the distributions of bird species in Gunung Reng may due to the physical characteristics of this area. This area was surrounding by the secondary forest, oil palm plantation and rubber plantation. Gunung Reng was also near to the water bodies like river and stream with clean and fresh water and surrounded by forest garden and plant cultivation.

Other than that, the value of Shannon Weiner Index was 2.39, and the evenness value was 0.84. Thus, the diversity and richness of bird species in Gunung was quick low diversity. The value for evenness was closer to the number one and it is shows the more even of the quantities of the different species as one was considered as the maximum value. Therefore, it was indicate that the species of birds in Gunung Reng was well distributed.

## 5.2 Recommendations

The number of bird species in this area could be more various and increase if study was held for a long period. So, it is recommended to make a further research of this study in Gunung Reng because there might be more bird species would be observed and identified in the study area with a further sampling effort. The checklist of the bird in this area may be update and improve from time to time.

Gunung Reng was known as tourism attractions due to the beautiful geological features. Thus, this study also can provide an input for the activities of eco-tourism like bird seeing if the management of this area was taken care and the several of birds resulting in this area can contributes to the eco-tourism and economy.

## REFERENCES

- Alderton, D. (2002). *The World Encyclopedia of Birds & Birdwatching*, Academic Reading. London: Annes
- Amir, A., Noor, H. M., and Hambali, K. (2015). Assessing avian richness and diversity in different regions of oil palm plantation in Selangor, Malaysia. *International Letters of Natural Sciences*, 42.
- Andrew, S. M., Maliondo, S. M. S., Mtika, J., Msanga, H. P., and Nsolomo, V. R. (2004). Growth performance of *Azadirachta indica* provenances in Morogoro, Tanzania. *Journal of Tropical Forest Science*, 328-335.
- Azmi, M. M., Cullen, R., Bigsby, H. R., and Noor, A. A. (2009). The Existence Value of Peat Swamp Forest in Peninsular Malaysia.
- Baker, N.E. and Baker, E.M. (2002). Important bird area in Tanzania. *A first inventory*. Wildlife Society of Tanzania, Dar es salaam Tanzania.
- Bibby, Jones., M., and Marsden, S. (1998). Bird Surveys. *Expedition Field Techniques*
- Bash, E. (2015). Bird Species Diversity in the Padawan Limestone Area, Sarawak . *PhD Proposal*, 1(2), 65–80  
<http://doi.org/10.1017/CBO9781107415324.004>
- BirdLife International. (2013). *Birds are very useful indicators for other kinds of biodiversity*: <http://www.birdlife.org/datazone/sowb/casestudy/79>.
- Butler, R. (2013). *Malaysia has the world's highest deforestation rate*, reveals Google forest map. Retrieved May 20 from <http://news.mongabay.com/2013/1115-worlds-highest-deforestationrate.html>
- Chan, K.F. (2006). [Blue-banded Kingfisher]. *Birding Malaysia*. Retrieved May 22 from [http://www.birdinginmalaysia.com/details.php?bird\\_id=82](http://www.birdinginmalaysia.com/details.php?bird_id=82)
- Campbell, S.P., J.W. Witham and M.L. Hunter Jr., 2007. Long-term effects of group selection timber harvesting on abundance of forest birds. *Conservation Biology*, 21: 1218-1229.
- Chapman, C. A., Struhsaker, T. T., Skorupa, J. P., Snaith, T. V., and Rothman, J. M. (2010). Understanding long-term primate community dynamics: Implications of Forest Change. *Ecological Applications*, 20(1), 179-191.
- Conservation and Environmental Management Division. (2006). *Biodiversity in Malaysia*
- Davison, G.W.H. and Yeap, C.A. (2010). *A naturalist's guide to the birds of Malaysia including Sabah and Sarawak*. John Beaufoy Publishing. Oxford. UK

- Duncan, A.I.L., David. B., and Maketab.M. (2014). A National Red List for The Birds of Malaysia. *Journal of Wildlife and Parks*, 28: 41-49.
- Fallis, A. (2013). Bird Migration . *Journal of Chemical Information and Modeling*, 53(9), 1689–1699. <http://doi.org/10.1017/CBO9781107415324.004>
- Gay, G. (2012). [Kingfisher]. *Malaysia Wildlife Photography*. Retrieved May 20 from <http://malaysianwildlifephotography.blogspot.my/2012/07/hunting-white-throated-kingfishers.html>
- Ghasemi, S. (2014). A rapid assessment of logging effects on bird species in Kelantan Forests Areas, Malaysia. *PeerJ PrePints*, 1–20. <http://doi.org/http://dx.doi.org/10.7287/peerj.preprints.488v1>
- Google Maps. (2016). *Gunung Reng*. Retrieved October 6, from <https://www.google.com/maps/place/Gunung+Reng>
- Green, D.M. and Baker, M.G. (2003). Urbanization impacts on habitat and bird communities in a Sonoran desert ecosystem. *Landscape and Urban Planning*, 63, 225-239. [http://dx.doi.org/10.1016/S0169-2046\(02\)00195-0](http://dx.doi.org/10.1016/S0169-2046(02)00195-0)
- Gregory, R. D., Gibbons, D. W., and Donald, P. F. (2004). Bird census and survey techniques. *Bird ecology and conservation*, 17-56.
- Hernandes Volpato, G., and Venancio Martins, S. (2013). The bird community in naturally regenerating Myracrodruon urundeuva (Anacardiaceae) forest in Southeastern Brazil. *Revista de Biología Tropical*, 61(4), 1585-1595.
- Holmes, D. and Phillipps, K. (1998). *The Bird of Peninsular Malaysia*. Oxford University Press, New York.
- Hostetler, M. E., and Main, M. B. (2001). *Florida monitoring program: point count method to survey birds*. University of Florida Cooperative Extension Service, Institute of Food and Agriculture Sciences, EDIS.
- Huat, T.L. (2002) [Jambu Fruit Dove]. *Birding Malaysia*. Retrieved May 21 from [http://www.birdinginmalaysia.com/details.php?bird\\_id=325](http://www.birdinginmalaysia.com/details.php?bird_id=325)
- Huff, M. H., Bettinger, K. A., Ferguson, H. L., Brown, M. J., and Altman, B. (2000). A habitat-based point-count protocol for terrestrial birds, emphasizing Washington and Oregon. *United States Department Of Agriculture Forest Service General Technical Report Pnw*.
- Huston, M. A. (1994). Biological Diversity. *Cambridge University Press, Cambridge*. 3rd Edition., p. 78.
- IUCN. (2012). IUCN Red List categories and criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN.
- Jeyarajasingam, A. and Pearson, A. (2012). *A Field Guide to the Bird of Peninsular Malaysia and Singapore*. Oxford University Press. London. UK.

- Johnson, M.D. and T.W. Sherry. 2001. Effects of food availability on the distribution of migratory warblers among habitats in Jamaica. *J. Anim, Ecol.*, 70: 546-560.
- Joshi, K. K., Bhatt, D., and Thapliyal, A. (2012). Avian diversity and its association with vegetation structure in different elevational zones of Nainital district (Western Himalayan) of Uttarakhand. *International Journal of Biodiversity and Conservation*, 4(11), 364-370.
- Jweyeh. (2007). [Straw-headed Bulbul]. *BirdForum Ltd*. Retrieved May 20 from [http://www.birdforum.net/opus/Image:Straw-headed\\_Bulbul.jpg](http://www.birdforum.net/opus/Image:Straw-headed_Bulbul.jpg)
- Lang, D. A. I., D.Bakewel, and Mohamed, M. (2014). A National Red List for the Birds of Malaysia. *Journal of Wildlife and Parks*, 28, 41–49.
- Latiff, A. (2010). The Current Status of Biodiversity Conservation in Malaysia. *The Current Status of Biodiversity Conservation in Malaysia*, 1–24.
- Loinaz, A. (2009). [Black-naped Oriole]. *Wild Bird Club of the Philippines*. Retrieved May 21 from <http://www.birdwatch.ph/html/gallery/blacknapedoriole.html>
- Magurran, A.E. 2004. *Measuring Biological Diversity*. Blackwell.
- Mahinya, S.G. (2005). Assessment of ecological integrity of land use systems using birds as bioindicators in the Malagarasi-Muyovozi Ramsar site Western Tanzania: *M.Sc. Thesis*, Sokoine University of Agriculture, Tanzania
- Malaysia Birding. (2015). Birding in Malaysia. Retrieved May 21, 2016 from <http://malysiabirding.org/section.php?sid=10&pb=Tier>
- Manu, S. A. (2000). Effects of habitat fragmentation on the distribution of forest birds in south western Nigeria with particular reference to the Ibadan Malimbés and other Malimbés, *PhD thesis*. University of Oxford, p. 205.
- MNS-Bird Conservation Council. (2010). A checklist of the birds of the Peninsular Malaysia. Kuala Lumpur: Malaysian Nature Society. (MNS Conservation Publication No.10).
- Nason, I. (1992). *Discovering birds*. Pisces Publication, pp.67-69.
- Neil. (2005). [Blue Whistling Thrush]. *Birdforum Ltd*. Retrieved May 20 from [http://www.birdforum.net/opus/Blue\\_Whistling-Thrush](http://www.birdforum.net/opus/Blue_Whistling-Thrush)
- Niemi, G.J. (1985). Patterns of morphological evolution in bird genera of New World and Old World Peatland. *Ecology*, 66: 1215-1228.
- Pan, J. (2005). [ Oriental Magpie Robin]. *Birding Malaysia*. Retrieved October 6 from <http://birdinginmalaysia.com/image.php?picname=magpie-robin2710cs.jpg&specie=name=%20Oriental%20%20Magpie-robin>
- Parmesan, C. (2006) Ecological and evolutionary responses to recent climate change. *Annual Review of Ecology, Evolution and Systematics*, 37, 637–669.

- Parry, M.L. (2007). Climate change impacts, adaptation and vulnerability: Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change. Cambridge University, Cambridge
- Pearson, D. L. (1995). Pp. 75–80 in D. L. Hawksworth ed. Biodiversity: measurement and estimation. London: Chapman & Hall and the Royal Society
- Peh, K. S-H., De jong, J., Sodhi, N. S., Lim, S. L-H., and Yeap, C., A-M. (2005). Lowland rainforest avifauna and human disturbance: persistence of primary forest birds in selectively logged forests and mixed-rural habitat of Southern Peninsular Malaysia. *Biological conservation*, 123, 489-505
- Photobucket. (2016). *Peta Malaysia Negeri Kelantan*. Retrieved October 6 from [http://s306.photobucket.com/user/abg\\_utara881/media/kelantaaaann.jpg.html](http://s306.photobucket.com/user/abg_utara881/media/kelantaaaann.jpg.html)
- Poulsen, B.O. (2002). Avian richness and abundance in temperate Danish forests: tree variables important to birds and their conservation. *Biodiversity and Conservation*, 11, 1551–1566.
- Powell, H. (2015). *All About Birds*. Retrieved October 10 from <https://www.allaboutbirds.org/bird-id-skills-field-marks/>
- Prabhakar, R. P. (2011). Species diversity of birds in mangroves of Uran (Raigad), Navi Mumbai, Maharashtra, West coast of India. *Journal of Experimental Sciences*, 2 (10), 73-77.
- Ramchandra, A. M. (2013). Diversity and richness of bird species in newly formed habitats of Chandoli National Park in Western Ghats, Maharashtra State, India, 4(1), 235–242.
- Ramli, R. (2004). Green Areas and Avian Species Richness in University of Malaya Campus, Peninsular Malaysia. *Malaysian Journal of Science*, 23: 7- 13.
- Ruiz, M. D. M., Taylor, B., Cruz, J., Banos, B., Ciudad, M., Ángel, P. and Mixtepec, S. P. (2014). Estimating species richness and density of a bird community in a coastal lagoon on the Mexican Pacific, 15(2), 64–81.
- Sein, K.L. (2004). [Dusky Eagle Owl]. *Birding Malaysia*. Retrieved May 21 from [http://www.birdinginmalaysia.com/details.php?bird\\_id=210](http://www.birdinginmalaysia.com/details.php?bird_id=210)
- Singh, A. (2009). *A Freindship with Birds*. Dato' Dr. Amar- Singh HSS
- Schmitt, J. (2015a). [Bird Physiology]. *All About Birds*. Retrieved October 10 from <https://www.allaboutbirds.org/bird-id-skills-field-marks/>
- Schmitt, J. (2015b). [Head of Bird]. *All About Birds*. Retrieved October 10 from <https://www.allaboutbirds.org/bird-id-skills-field-marks/>

- Schmitt, J. (2015c). [Wing of Bird]. All About Birds. Retrieved October 10 from <https://www.allaboutbirds.org/bird-id-skills-field-marks/>
- Strange, M. (2000). *A photographic guide to the birds of South East Asia including the Philiphines and borneo*. Singapore: Periplus Editions (HK) Ltd.
- Suleesia (2006). [Blue-tailed Bee-eater]. *BirdForum Ltd*. Retrieved May 20 from [http://www.birdforum.net/opus/Blue-tailed\\_Bee-eater](http://www.birdforum.net/opus/Blue-tailed_Bee-eater)
- Strange, M., and Yong, D. (2006). *Malaysia Kelantan. Wildlife and Nature Development*. Retrieved May 20, 2016 from <http://www.wildlifenaturedestinations.com>
- Wells, D.R. (2007). *The birds of the Thai-Malay Peninsular Passerines*. A&C Black. London (Vol. 2).
- Wichmann, M. C., Schwager, M., and Jeltsch, F. (2004). Animal Species Diversity Driven By Habitat Heterogeneity / Diversity : The Importance Of Keystone Structures, 79-92.
- Whitaker, J. R., J. O., Amlaner J.R., C. J., Jackson, M.T., Parker, G.R., and Scott, P. E. (2012). *Habitat and Ecological Communities of Indiana: Presettlement to present*: Indiana University Press.
- World Wildlife Fund for Nature (2016). The Malaysian Rainforest. Retrieved May 21 from [http://www.wwf.org.my/about\\_wwf/what\\_we\\_do/forests\\_main/the\\_malaysian\\_rainforest/](http://www.wwf.org.my/about_wwf/what_we_do/forests_main/the_malaysian_rainforest/)
- Yap, A. M. C., Sodhi, N. S., and Brook, B. W. (2002). Roost Characteristics Of Invasive Mynas In Singapore. *The Journal of Wildlife Management*, Vol.66(4): 1118-1127.
- Yean, O.B. (2002). [Ruddy Kingfisher]. *Birding Malaysia*. Retrieved May 21 from [http://www.birdinginmalaysia.com/details.php?bird\\_id=513](http://www.birdinginmalaysia.com/details.php?bird_id=513)
- Yeap, C.A., Sebastian, A.C. and Davison, G.W.H. (2007). Directory Of Important Bird Areas In Malaysia: Key Sites For Conservation. Kuala Lumpur. *Malaysian Nature Society*. (MNS Conservation Publication No.8).
- Zain, R. M., Ismail, M. H., and Zaki, P. H. (2013). Classifying Forest Species Using Hyperspectral Data in Balah Forest Reserve, Kelantan, Peninsular Malaysia.. *Journal of Forest Science*, 29(2), 131-137.