



**Faculty of Resources Science and Technology**

**SPECIES DIVERSITY OF BUTTERFLY (LEPIDOPTERA: RHOPALOCERA) IN  
PERLIS STATE PARK, KEDAWI REGION OF MALAYSIA**

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Species Diversity of Butterfly (Lepidoptera: Rhopalocera) In Perlis State Park, Kedawi  
Region of Malaysia

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## **Declarations**

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree qualification of this or any other university or institution of higher learning.

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## **LIST OF ABBREVIATIONS**

EstimateS

EstimateS Version 9.1.0

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**SPECIES DIVERSITY OF BUTTERFLY (LEPIDOPTERA: RHOPALOCERA) IN  
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**ABSTRACT**

This study focused on the diversity of butterfly species at Perlis State Park which is also part of Kedawi Region. Aerial net and baited traps were used within the ten days of sampling from 17<sup>th</sup> April 2015 to 21<sup>st</sup> April 2015 and 12<sup>th</sup> November 2015 and 16<sup>th</sup> November 2015. A total of 99 individuals from 42 species had been obtained comprises of five families; Papilionidae, Nymphalidae, Lycaenidae, Pieridae and Hesperidae. Family Nymphalidae had been found as the most abundant family with 30 species and 78 individuals. *Bassarona teuta rayana* from family Nymphalidae had been listed as the most abundant species from this study with 15 individuals. Whereas the least abundant was family Hesperidae with one individual for each of two species that had been found. The Shannon index for the diversity of the butterflies was 3.41.

Keywords: diversity, butterfly, Perlis State Park, diversity index

**ABSTRAK**

*Kajian ini memberi tumpuan kepada kepelbagaian spesies rama-rama di Taman Negeri Perlis yang merupakan sebahagian daripada Kawasan Kedawi. Jaring aerial dan perangkap berumpan telah digunakan sepanjang sepuluh hari tempoh pengumpulan iaitu dari 17 April 2015 hingga 21 April 2015 dan 12 November 2015 hingga 18 November 2015. Sebanyak 99 individu dan 42 spesies telah diperolehi dari lima keluarga; Papilionidae, Nymphalidae, Lycaenidae, Pieridae dan Hesperidae. Keluarga Nymphalidae merupakan keluarga yang terbanyak dengan jumlah 30 spesies dan 78 individu. *Bassarona teuta rayana* dari keluarga Nymphalidae telah disenaraikan sebagai spesies terbanyak dari kajian ini dengan 15 individu. Manakala keluarga yang paling sedikit adalah keluarga Hesperidae dengan satu individu dari dua spesies yang ditemui. Indeks Shannon untuk pengagihan rama-rama adalah 3.41.*

*Kata kunci: kepelbagaian, rama-rama, Taman Negeri Perlis, indeks kepelbagaian*

## **1.0 INTRODUCTION**

### **1.1 Background study**

Insects have always been chosen as a research subject because of its complex life cycle, diverse habitat and its economic importance to human especially as pollinators and pests. Butterfly are the well-known pest, especially in their larvae stage. Up to date, 29 orders of insects were recorded (Hill & Abang, 2005). The butterfly is defined under the class of insecta in order Lepidoptera along with moth. Lepidoptera is one of the largest group of insects (Pathani & Kumari, 2009). Lepidoptera can be distinguished according to their four scale-covered wings. Adult butterfly has large and bright coloured wings. Wings pattern and colours made up of thousands of scales. The pattern and colours of the wings involve in defence mechanism and absorb heat from sunlight as energy. Butterfly will rest with wing open towards sunlight which also known as basking. Nearly all butterfly species are diurnal.

The butterfly is well distributed worldwide except for cold places. Commonly, butterfly distributed in the warmer region. Approximately, 90% of butterfly species live in the tropics (Bonebrake & Ponisio, 2010). According to New (2014), about 20,000 species of butterflies had been described. Approximately, 1,030 species of 21 endemics butterflies recorded in Peninsular Malaysia, whereas 1003 species of butterflies were discovered from Malaysian Borneo (Corbet & Pendlebury, 1992). High diversity of butterfly is associated with the resource-rich environment within the climate region (Walpole & Sheldon, 1998). Butterfly consist of two superfamilies which are Papilionoidea and Hesperoidea. Family Papilionidae, Pieridae, Nymphalidae and Lycaenidae categorized under Papilionoidea whereas Hesperidae is under Hesperoidea.

The butterfly is a good bio-indicator as they are sensitive towards temperature, weather and vegetation changes. Different butterfly species often occupy different type of vegetation because of their preference of host plants. Due to its ecologically isolated dietary habits, any human disturbance on vegetation will potentially lead to vulnerability (New,2014). Furthermore, butterfly plays an important role in ecology as they act as plant pollinators, seed disperser and become food source to other animals such as birds, bats and amphibians. Butterfly categorized as important plant pollinators due to their nectar-feeding mode (Abang, 2006). In the meantime, they also help disperse the seed each time they feed on the nectar of its host plant. Being a primary consumer, butterfly helps in balancing the ecosystem by involves in the food chain of certain habitats.

Perlis State Park had been chosen as study site due to its unique characteristics. It have semi deciduous forest that will defoliates on dry season. This type of forest specialized for certain species especially insects. The forest continuous with Thaleban National Park, Thailand. Both forest consist of limestone hills and caves which act as water catchment areas for Timah Tasoh Reservoir and nearby areas.

Thus, this study was conducted due to the incomplete data on the butterfly for biodiversity and ecology conservation. Besides, the information on the diversity of butterfly in Perlis State Park is still lacking. It is the only semi-deciduous forest in Malaysia which held many unique species of flora and fauna compared to other forests in Malaysia. The last study was conducted by Zaidi *et. al.* (2001). He found a total of 25 species of butterfly consist of four families which is Papilionidae, Pieridae, Nymphalidae and Hesperidae.

## **1.2 Objectives**

The objectives of this study are:

1. To determine the butterfly diversity and abundance at Perlis State Park.
2. To study the species distribution of butterfly at Perlis State Park.
3. To update the data on butterfly diversity at Perlis State Park.

## **2.0 LITERATURE REVIEW**

### **2.1 Taxonomy classification of butterfly**

Taxonomy classification are based on theories of the evolutionary lineage of species and derived from taxonomist analysis of characteristics. Analyses of morphological characters and gene sequences produce branching tree-like diagrams called phylogenetic trees that display relationship of species and their descent from common ancestor (Kirton, 2014). Standard classification of an organism is listed as kingdom, phylum, class, order, family, genus and species sometimes up to the subspecies level. Lepidoptera is categorised under the class of insecta, becoming the largest order in the class. It is then divided into two main suborders which are Rhopalocera (butterfly) and Heterocera (moth). These two suborders are being distinguished by several unique characteristics. Rhopalocera is then divided into two major superfamilies which are Papilionoidea and Hesperioidea. Superfamily Papilionoidea (true butterfly) consist of Papilionidae, Pieridae, Nymphalidae and Lycaenidae. While superfamily Hesperioidea (skippers) consist of Hesperidae.

### **2.2 Morphological characteristics of butterfly**

Butterfly and moth are basically differentiate using their antenna. Butterfly usually have filiform, clubbed or thickened towards the tip of the antenna while moths vary in antenna form. Both butterfly and moth used proboscis to reach nectar in flower. This slender and tubular feeding structure function as straw which they mainly drink their foods as they do not possess any chewing mouth part. It will keep curl until they ready to use it and uncurl it to reach inner part of the flower. During rest condition, the butterfly will uphold their wings and exposed underside of their wings except during basking. Different behaviour showed by moth, the moth will open their wings during the rest state.

Butterfly have two sets of wings which known as forewings and hind wings. The wings full of tiny scales covering it that express beautiful coloration of the wings. The scales also aid in camouflage, scare away the predator, regulate body temperature and attract mates. Butterfly's wings are made of thin, tough, transparent membrane supported by rigid veins. The colouration also influences by the chemical such as melanin for black and brown, uric acid and flavoners for yellow. Study on wing coloration is important as the differences can be used to distinguish them among different species. Butterfly are also polymorphic which mean the coloration not just differentiate species but also sexes. Based on the observation by Abang (2006) and Corbett and Pendlebury (1992), male coloration is more vibrant compare to female. The butterfly can be classified as holometabola which means they undergo 4 different phases throughout their life cycle begin with egg, larva, pupa and adult. Usually, the female will lay the egg on the host plant so that the larva can survive after hatched. The larva or caterpillars come in many form and colours depending on their species. Pupa phase is one of the most important phases that can take from a week to forth night, then the pupa will split along the dorsal surface and work their way out (Corbett & Pendlebury, 1992).

### **2.3 Distribution and diversity of butterfly**

Distribution of butterfly is influenced by geographical boundaries of certain habitat. Since ice age, Sundaland or Sundanian region used to be one huge connected landmass and the sea level are low. This landmass including Peninsula Malaysia, Borneo, Sumatera, Java, Bali and Palawan. Whereas Peninsula Malaysia, Singapore and Thailand known as the heart of Oriental Realm that extended from east of Pakistan through India, to South China and southeast Asia going far east as Philippines, Sulawesi and Timor (Kirton, 2014). According to (New, 2014), there are about 20,000 of butterfly species had been described worldwide. Many species are shared in common by these regions as they migrate along the connection. Corbet &



Pendlebury, (1992) studied had shown that about 88% of Malayan butterfly exist on the neighbouring island of Sumatera or Borneo or both. Small minority come to Peninsular Malaysia through Sri Lanka and India to Philippines and Sulawesi.

Species diversity can be defined as species variety which is measured by species richness and species composition which correlate with the number of species present in a certain habitat. Diversity also acts as an important element that involves in conservation and biodiversity (Voigt & Wurster, 2014). Butterfly play important role in conserving ecology as they act as pollinators and bio-indicator. The diversify of the butterfly species help in various functions of ecology that suitable with the conditions of environment. There are several factors that can affect diversity of species such as climate including annual rainfall, precipitation of the driest month, annual range temperature and maximum temperature on warmest month (Cabrera & Espinosa, 2010).

#### **2.4 Kedawi Region and Perlis State Park**

Kedawi region comprises the small northern state of Perlis, north of the Kedah River, and the Langkawi Islands, which are situated 14 miles from the Kedah coast (Corbet, 1941). Approximately, 20 species cannot be found at another place in Malaysia but can only found in Kedawi Region and less than one-third of the 20 species were found in Sumatera or Borneo (Corbet & Pendlebury, 1992). Some species found in this area resembles with the Thailand subspecies due to the same vegetation type of forest. This shows that the species distribution of butterfly species in Perlis is unique from the other parts of Malaysia.

Perlis is located at the most northern part of Malaysia and shares border with Thailand at the northern part while the southern part is Kedah. It is categorized under Kedawi Region

(Corbet & Pendlebury, 1992). Perlis State Park (6° 41' 51.7" N, 100° 11' 29.3" E) is the first State Park being gazetted for conservation purposes and involved 5,015.2 hectares of forest. Perlis State Park has a monsoon climate with a dry season between three to four months every year with an average of 1,789.4 mm annual rainfall (Forestry Department & DANIDA, 2005). Its semi-deciduous forest can be differentiated from other forests in the southern part of Malaysia according to the white "Meranti-Gerutu" forest. Its characteristics are identical with those found in Burma-Thailand forests including their ecosystem features, flora and fauna species. During the dry season, a portion of the trees of the forest will encounter falling leaves called defoliating.

### 3.0 MATERIALS AND METHODS

#### 3.1 Study area

This research was conducted at Perlis State Park ( $6^{\circ} 41' 51.7''$  N,  $100^{\circ} 11' 29.3''$  E) on 17<sup>th</sup> April 2015 until 21<sup>st</sup> April and 12<sup>th</sup> until 16<sup>th</sup> November 2015. This region located in the most northern part of Malaysia and its forest resembles Thailand type of vegetation. It is semi-deciduous forest which means some of the trees will be defoliating during the dry season (Hanum *et. al.*, 2002).



Figure 1: Maps of Perlis (Source: edited from Google maps)

#### 3.2 Sample Collection

##### 3.2.1 Aerial net

Aerial net is one of the active methods to capture flying insects especially butterfly during the day. The collectors were waiting and chased the butterflies and quickly catch and trapped it in the aerial net. Once the butterfly was inside the net, the net was flipped so that

the butterfly cannot fly out from the net. Net material is soft and light for easy swing and not harm the butterfly especially the wings. The net use from 0700 to 1900 and this method equals to 240 man powers (2 person x 12 hours x 10 days).

### 3.2.2 Baited trap

Baited trap was used basically to trap fruit-feeding butterfly. This passive method trap was made up from mosquito netting complete with the plastic plate as the place to put bait. Some part at the bottom of the trap was left open as an entry for the butterflies. As the butterflies will take off straight above, it will be trapped inside trap after it layover on the bait. Rotten pineapples and bananas were used as bait as the smell will attract butterflies effectively. The traps were set up vertically at ground level between to two meters and canopy level at 20 meters from the forest floor. Traps were set up by hoisting it over branches and adjusted to its desired height. Each spot of traps were approximately 10 meter part so that bigger area was covered. According to (Hughes *et. al.*, 1998) many butterflies arrived at the traps during the day (between morning mid-day and midday-afternoon checks) than at dusk or dawn (between the afternoon and morning checked up). This method equals to 1,200 trap-days (10units x 12hours x 10 days).



**Figure 2 :** Baited trap

### **3.3 Process of sample preservation**

The killing process involved pinching of the thorax that will paralyze the butterfly and then it was kept straight into the triangular envelope. During pinning process, the pin size was chosen according to the size of the butterfly. The butterfly specimen will be pinned at the thorax before the specimen dry.

Butterfly easily gets dry and the spreading process will be difficult. The butterfly's wings need to be relaxed by using relaxing chamber so that the spreading will be easier. It needs to be spread carefully as the wings are fragile and the colors from scaly-wings can be damaged easily. The specimen that had been pinned to the polystyrene board will be spread by pulling the fore wings carefully using forceps until the bottom of fore wings reach 90° and next the hind wings. Wax paper will be used to hold the wings properly on the polystyrene board and leave it to dry. References for identification involved *The Butterflies of the Malay Peninsula*, *Butterflies of Malaysian Borneo* and *Butterflies of peninsula Malaysia, Singapore and Thailand*.

### **3.4 Statistical analysis**

Microsoft Excel 2010 was used to plot graph. Several figures such as family bar chart, family cumulative graph, species accumulation graph, the relative abundance of species bar chart and species rank abundance bar chart been created using Microsoft Excel.

Shannon index, singleton and doubleton value were computed using EstimateS Win 9.1.0. Shannon index defined as a diversity index, taking into account the number of individuals as well as number of species. Shannon index is a diversity index taking into account the number of individuals as well as the number of species. Shannon diversity divided by the logarithm of the number of species. This measures the evenness of which individuals are divided among the species present (Hammer *et. al.*, 2005).

$$H = - \sum \frac{n_i}{n} \ln \left( \frac{n_i}{n} \right)$$

$N$  = number of individuals sampled,  $n_i$  = number of individuals belonging to the  $i$ th species.

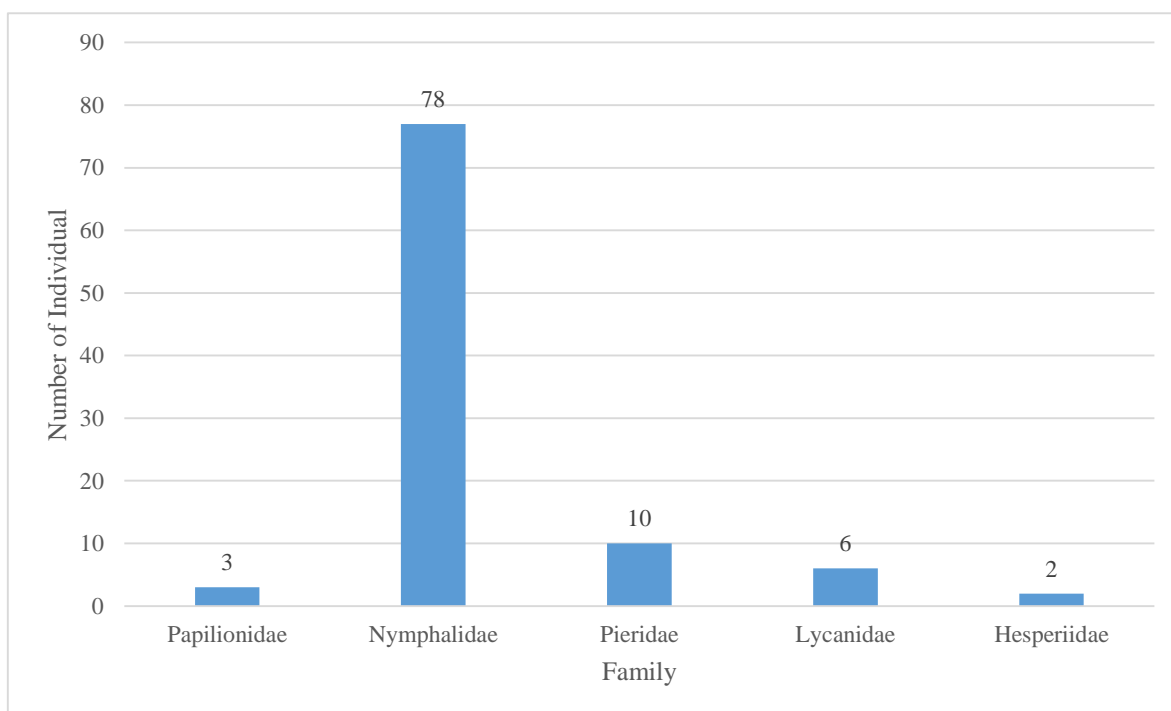
## **4.0 RESULTS**

### **4.1 Overall diversity**

During the five days of sampling, each on April and November 2015, a total of 99 individuals representing 42 species were collected from Perlis State Park. Table 1 shows the records of five families consist of Papilionidae, Nymphalidae, Pieridae, Lycaenidae and Hesperidae collected from the study area whereas Figure 3 shows the number of individual represented each family. Family Nymphalidae is the most abundant family with 78 individuals representing 30 species from five subfamilies which are Nymphalinae (16 species, 49 individuals), Danainae (five species, nine individuals), Morphinae (four species, 10 individuals), Satyrinae (three species, five individuals) and Charaxinae (one species, five individuals). Whereas Papilionidae, three species were recorded with three individuals from subfamily Papilioninae. Family Pieridae was recorded with two subfamilies that are Coliadinae (four species, nine individuals) and Pierinae (one species, one individual). As for another family such as Lycaeninae with three species six individuals from subfamily Lycaeninae while family Hesperidae from subfamily Hesperinae with two species, two individuals.

**Table 1:** The total number of species and individual collected from Perlis State Park

Family	Subfamily	No of Species	No of Individuals
Papilionidae	Papilioninae	3	3
Nymphalidae	Nymphalinae	16	49
	Danainae	5	9
	Morphinae	4	10
	Satyrinae	3	5
	Charaxinae	1	5
Pieridae	Coliadinae	4	9
	Pierinae	1	1
Lycaenidae	Lycaeninae	3	6
Hesperiidae	Hesperiinae	2	2
TOTAL		42	99



**Figure 3:** The number of individual representing the five families of butterfly caught at Perlis State Park