UNIVERSITI PUTRA MALAYSIA

A STUDY OF WILDLIFE IN THE FOREST PARK, UPM BINTULU CAMPUS

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A STUDY OF WILDLIFE IN THE FOREST PARK, UPM BINTULU CAMPUS

By

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A Project Report Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Bioindustry Science in the Faculty of Agriculture and Food Sciences Universiti Putra Malaysia Bintulu Campus

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DEDICATION

Especially to my lovely family, Samsudin bin Ismail and mom Ramlah binti Abdullah. all your hard work will not be forgotten. May all of you be blessed by Allah.

ABSTRACT

A study was conducted to identify the wildlife species of fishes, frogs and small mammals in the Forest Park in Universiti Putra Malaysia Bintulu Campus. The study was carried out to provide information and knowledge about the existence of wildlife in the Forest Park, UPM Bintulu Campus. Every species that had been observed was described based on their respective morphology, habitats and locations. The study of wildlife was conducted in three locations available in the Forest Park which are the Agro-Tourism Zone, Wildlife Zone, and also the Main Zone. The study was conducted according to zone; each zone was observed for a month starting November 2007 until January 2008. There were 5 species of small mammals (*Sundamys infraluteus*, *Callosciurus notatus*, *Callosciurus prevostii caroli*, *Tupaia tana nitidus* and *Maxomys alticola*), 15 species of fishes (*Anabas testudineus*, *Betta pugnax*, *Chana striata*, *Clarias batrachus*, *Clarias teysmanni*, *Cyclocheilichthys apogon*, *Glossogobius giuris*, *Nandus nebulosus*, *Ophicephalus melanosoma*, *Puntius binotatus*, *Puntius orphoides*, *Rasbora einthovenii*, *Rasbora sumatrana*, *Tilapia mossambica* and *Trichogaster trichopterus*) and 10 species of frogs (*Bufo melanostictus*, *Megophrys nasuta* *Rana limnocharis*, *Rana erythraea*, *Rana cancrivora*, *Rana ingeri*, *Rana signata*, *Rana nicobariensis*, *Rana glandulosa* and *Meristogenys phaeomerus*) found in the Forest Park.

ABSTRAK

Kajian dijalankan adalah untuk mengenal pasti spesis hidupan liar iaitu ikan, katak dan mamalia kecil di dalam Taman Hutan Universiti Putra Malaysia Kampus Bintulu. Kajian yang dijalankan adalah untuk memberikan pengetahuan dan maklumat tentang hidupan liar yang terdapat di dalam Taman Hutan UPM Kampus Bintulu. Setiap spesis yang dijumpai dihuraikan ciri-ciri rupa bentuk, habitat dan lokasi setiap spesis. Kajian hidupan liar ini dibahagikan kepada tiga lokasi yang terdapat dalam Taman Hutan tersebut iaitu Zon Agro-Tourism, Zon Hidupan Liar dan juga Zon Utama. Kajian ini dijalankan mengikut zon, setiap zon dijalankan selama sebulan bermula bulan November 2007 hingga Januari 2008. Terdapat 5 spesis mamalia kecil (*Sundamys infraluteus*, *Callosciurus natotus*, *Callosciurus prevostii caroli*, *Tupaia tana nitidus* dan *Maxomys alticola*), 15 spesis ikan (*Anabas testudineus*, *Betta pugnax*, *Chana striata*, *Clarias batrachus*, *Clarias teysmanni*, *Cyclocheilichthys apogon*, *Glossogobius giuris*, *Nandus nebulosus*, *Ophicephalus melanosoma*, *Puntius binotatus*, *Puntius orphoides*, *Rasbora einthovenii*, *Rasbora sumatrana*, *Tilapia mossambica* dan *Trichogaster trichopterus*) dan 10 spesis katak (*Bufo melanostictus*, *Megophrys nasuta*, *Rana limnocharis*, *Rana erythraea*, *Rana cancrivora*, *Rana ingeri*, *Rana signata*, *Rana nicobariensis*, *Rana glandulosa* dan *Meristogenys phaeomerus*), yang ditemui di dalam Taman Hutan tersebut.

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Lastly and most of all I am especially thank for to my lovely family and grateful to my love and source of inspiration; Marnizah binti Mohd yassin for her extraordinary sacrifice, patience, understanding and love.

APPROVAL SHEET

I certify that this research project report entitled "A study of Wildlife in the Forest Park, UPM Bintulu Campus" has been examined and approved as a partial fulfillment of the requirements for the Degree of Bachelor of Bioindustry Science in the Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Campus.

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LIST OF ABBREVIATIONS

SL	Standard Length
TL	Total Length
Sg.	River
mm	millimeter
cm	centimeter
m	meter
g	gram
kg	kilogram
UPMKB	Universiti Putra Malaysia Bintulu Campus
Dorsal	Dorsal fin counts
Pectoral	Pectoral fin counts
Ventral	Ventral fin counts
Anal	Anal fin counts

CHAPTER 1

INTRODUCTION

1.1 Background

Universiti Putra Malaysia Bintulu Campus is situated 13 km from Bintulu town, in the State of Sarawak and surrounded by a lush environment rich in flora and fauna. This campus covers about 715.16 hectares and 40 hectares is part of a Forest Park.

According to Jerry *et al.* (2004) wildlife means all non-domesticated animals which live outdoors, including mammals, birds, and fishes, which may be hunted as controlled by law. Some wildlife never was seen by man in their entire life. Wildlife populations are regulated by the availability of food, water, and cover that make the basic components of wildlife habitats.

Mammals are warm-blooded, vertebrate animals characterized by the presence of sweat glands, including those that produce milk, and by the presence of hair, three middle ear bones used in hearing, and a neocortex region in the brain. Most mammals also possess specialized teeth and utilize a placenta in the ontogeny. The mammalian brain regulates endothermic and circulatory systems, including a four-chambered heart (Tweedie, 1978). Mammals encompass approximately 5,400 species (including humans), distributed in about 1,200 genera, 153 families, and 29 orders, though this varies by classification schemes (Junaidi *et al.*, 1985).

The frog is a type of amphibian in the order Anura, formerly referred to as *Salientia*. Adult frogs are characterized by long hind legs, a short body, webbed digits, protruding eyes and the absence of a tail (Inger *et al*., 1995). Most frogs have a semi-aquatic lifestyle, but move easily on land by jumping or climbing. They typically lay their eggs in puddles, ponds or lakes; and their larvae, called tadpoles, have gills and developed in water. Adult frogs followed a carnivorous diet, mostly of arthropods, annelids and gastropods. Frogs are most noticeable by their calls, which can be widely heard during the night or day, mainly in their mating seasons (Robert, 1990).

Fishes are vertebrates (animals with backbones). They are poikilothermic or cold blooded as their body temperature changes depending on the external environment. The diversity of fishes is high. There are more fishes than any other vertebrate class. Among the total of 22,000 fishes in the world, 40% of them are freshwater fishes. Malaysia has 300 species of freshwater fishes (Sim, 2002). To date, 254 freshwater fish species have been recorded from Sarawak. According to Watson and Balon (1984) found 57 species in the Baram area and Lee Nyanti *et al*. (1999) found 24 species (7 families comprising 19 genera) in the Bario area.

1.2 Justification of Study

A study of wildlife species of mammals, fishes and frogs in the Forest Park is interesting because no such information is known for this site. This study described the habitats where the wildlife can be found in the Forest Park and show the locations of the existing wildlife species.

Besides that it helps to protect this wildlife species from extinction. From this study it can help to understand more about the habits and habitats of the wildlife; the morphology, characteristics, and more. This study could benefit further researches on the wildlife and also for educational purposes.

1.3 Framework of Study

The significance of the study of wildlife in the Forest Park can be seen from five broad inter-related components as shown below in Figure 1.

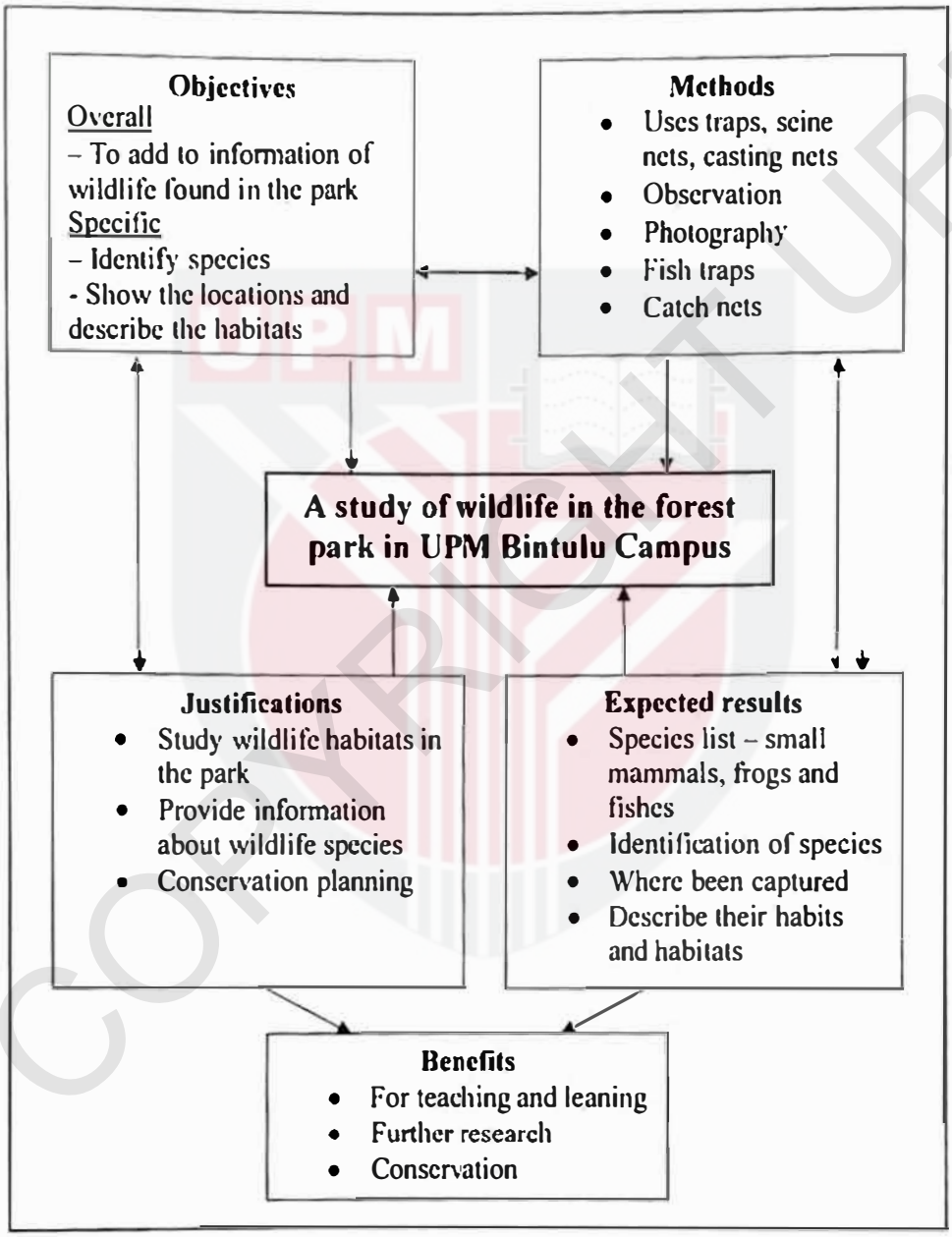

Figure 1: Study Framework

1.4 Objectives of Study

Overall objective:

1. To add to the wildlife information found in the Forest Park.

Specific objectives:

1. To identify species of small mammals, frogs and fishes in the Forest Park.
2. To show their locations and describe the habitats of the wildlife found.

CHAPTER 2

LITERATURE REVIEW

2.1 Wildlife

2.1.1 Wildlife

According to Hunter (1990) etymological narration about wildlife, ostensibly prior to 1913, people were simply concerned with Life, namely according to Type I meaning. There was little distinction if any between life in general and wildlife in particular. The dichotomy was between what was considered living and what was considered not living. This largely depended on a number of factors, including fundamental social and religious values that one held. Many of these factors still condition the way we value things. Nowhere is this more noticeable than when we look at how people relate to wildlife. By 1913 a qualifier in the form of an adjective was used to describe wildlife as Wild Life, i.e. of Type II category. This qualifier was first found in a book by William Hornaday entitled "Our Vanishing Wild Life". The notion here was to acknowledge that life in wilderness had a value and that was related with game birds, mammals, and fishes. The value of wildlife therefore depended largely on its usefulness.

It was in 1937 that "the term wildlife had been contracted into one word and expanded in scope" to become Type III categorization and it "replaced game". Wildlife became a noun. What it embraces depended on where the funding was coming from and what the funding was meant for. To a large extent these

different meanings still continue to persist. Adopting discipline orientations further complicates these meanings. For example, systems ecologists approach wildlife "as all forms of life that are wild." Because of such a conceptualization of wildlife they emphasize processes (Hunter, 1990).

2.1.2 The Importance of wildlife

Wildlife has the ability to increase its numbers. However, this growth usually is limited by one or more habitat factors, usually food, water, or cover (Howell and Webb, 2007). In the spring when habitat is at its best, most wildlife begins having young. Habitats are very important in wildlife survival. Building homes, growing food, and draining marshes destroys habitats that wildlife requires (Kurta, 1995). The main purpose of managing habitats is to prevent food, water, and plants from being destroyed. Habitats in poor condition can be improved or new habitats can be created. Since habitats factors can change from year to year, wildlife management programmes must stay flexible. Laws benefit wildlife by providing for habitats improvements, for example. Habitats are an environment that supplies everything wildlife needs; food, cover, water, space, and arrangement (Hunter, 1990)

2.1.3 Wildlife observation tips

According to Garbutt and Prudente (2006) wildlife observation gives the opportunity to appreciate all walks of life and to learn about different plants and animals. Wildlife observation doesn't have to be a scheduled activity or even a focused learning experience; simply sitting outside with a glass of iced tea gives a chance to observe the wildlife in our own neighborhood. A few tips for wildlife observation are clothing, movement, equipment, patience and flexibility.

2.2 Mammals

2.2.1 Mammals

Mammals are vertebrate animals with hair. Vertebrates are animals with backbones. Other vertebrate animals are bony fish, sharks, amphibians, reptiles and birds. Like birds, mammals are warm-blooded. Their hearts have four chambers (Kurta, 1995). This allows one channel to carry oxygen-rich blood to their brains, muscles and tissues, and a separate channel to carry oxygen-poor blood back to the lungs for more oxygen. Mammals are warm-blooded animals. That means they maintain a high, constant body temperature even though the outside temperatures change (Junaidi *et al.*, 1985).

Small mammals are important components of many terrestrial ecosystems. They are major consumers of primary productivity as well as being an important food base for many vertebrate predators. Thus, factors affecting the abundance and

diversity of small mammals affect the abundance and diversity of species throughout the food chain (Junaidi *et al.*, 1985).

2.2.2 Habitats of mammals

On land, mammals live in many different habitats, and at a wide range of altitudes. Many mammals dig burrows as refuges or as places to raise their youngs, but some have developed a largely subterranean lifestyle, feeding on small animals or plant roots beneath the soil's surface (Medway, 1969). These animals, including moles and mole-rats, dig through the ground either with spade like front paws or with their teeth, and they detect danger by being highly sensitive to vibrations transmitted through the soil (Howell and Webb, 2007).

According to Junaidi *et al.* (1985) mammal species occurred in lowland dipterocarp rainforest, with somewhat fewer species in swamp forest. Many species appear to survive in altered habitats, and often can be most easily seen in freshly logged and secondary forest or even plantations, where the vegetation is less dense and provides better visibility.

2.2.3 Areas and sites for trapping mammals

According to Bautz (1999) trapping locations were selected based on number of criteria such as (i) habitat fragmentation, area land use and elapsed time since last major disturbance, plant community type, and in some cases the probability of

human vandalism (ii) access, the natural plant community type, size and age structure, area land use, and unique geographical features.

2.2.4 Methodology to trap small mammals

According to Marvin (2002) two grids were set up to sample for small mammal density and microhabitat variables. The animals that were captured were evaluated, tagged to identify re-captures and released.

According to Bautz (1999) survey is done to gather baseline data on nonviolent small mammal populations across a variety of natural plant community. There are three survey methods for small mammal biodiversity; area site selection, data management, equipment and techniques. The traps were baited with banana and papaya and set out in pairs at intervals of about 15 metres. Each site was trapped for one night. GPS coordinates were taken at all collection locations as well as being noted.

2.3 Fishes

2.3.1 External anatomy of fishes

Fish breathe using their gills. Gills are made up of many layers of thin-walled filaments attached to the gill arches, and it has a great number of blood vessels. These gill filaments have a very large surface area for oxygen absorption. Most fishes are protected by their scales (Sim, 2002). Fish scales are made up of chitinous materials which also help in osmoregulation where entry of water into

their bodies and loss of salt are controlled. Fish have several sets of swimming fins. Fish fins vary in sizes, positions, numbers and forms (Zakaria, 1997). Fins are used mainly for fish movement, but many may also be used as an attractive display during courtship and breeding. Some fins are used for defence and even as a means of injecting venomous substances into would-be predators (Ng and Tan, 1997).

2.3.2 Habitats of fishes

According to Robert and Chin (2002) fish habitats characteristics and the natural productivity of fishes, develop habitat supply-driven population models for key fish species, evaluate and standardize field methods for assessing fish. Their habitat, develop practical tools and procedures for quantifying the effects of habitat loss and alteration, and devise methods for integrating fish habitat are the major concerns for resource management plans for whole ecosystems.

Habitat preferences have been inferred from morphological features or from anecdotal evidence during collection for taxonomic purposes. Estimates of fish abundance along with details of habitat structure are largely absent. The island of Borneo has an estimated 440 freshwater fish species (Kottelat and Whitten, 1996), but there are no quantitative accounts of species assemblages related to habitat variables. In their comprehensive monograph on the fishes of Sabah, Inger and Chin (1962) give descriptions of assemblages at different locations but no correlations with physical habitat data.

The fishes live in water, but most fishes are very particular about the water they live in. They need clean, healthy habitats where they can live and find good food, shelter and places to reproduce (Gerking, 1978). Fish habitat is any area in an aquatic ecosystem that provides something important that fishes need to live. This includes food, shelter, migration routes, places to reproduce, water quality, freshwater river and streams (Finger, 1982).

2.3.3 Methodology of catching fishes

Fishing using nets is non-selective and it could be considered as a destructive method in some areas (Sim, 2002). Wide ranges of mesh sizes are used for gill nets. The length of the nets varies depending on the habitats. It is used in open water areas. Nets are usually used only for a short period. They are left unattended for an average period of 3 hours. Unattended gill nets could be destructive to the fish population. If a catch is left uncollected for too long it could rot, leading to unnecessary wastage (Mizuno and Furtado, 1982).

According to Sim (2002) "Bubu" are used to catch small fishes that are normally found in the shallow parts of the streams and lakes. It is set in the water by putting the opening of the "bubu" against the water current, at shallower water areas. It has a funnel-like opening to trap and capture fish such as "Haruan" *Chana striata* and prevented them from escaping.

2.4 Frogs

2.4.1 Frogs

Frogs are small, tailless animal with a squat body and long, powerful hind legs adapted for jumping. Frogs have large, bulging eyes and moist skin. They typically live on land but spend part of their time in the water. Most frogs develop from small, fishlike larvae called tadpoles or pollywogs that live in water (Berry, 1975).

The life of frogs is divided between water and land showed a typical type of amphibians, a group of related animals that includes toads, newts, and salamanders as well as frogs. Frogs and toads are very similar animals that together make up a group of amphibians called anurans. Many species of frogs have smooth skin and live near water, while toads typically have rough, warty skin and often live in drier habitats (Ramlah and Zainudin, 1998).

2.4.2 Range and habitats of frogs

A few frog species live in moist forest areas near small bodies of water, a habitat that provides a favourable temperature and keeps the frogs from dehydration. Some frogs spend much or all of their time in water (Inger, 1966). Frogs species typically have webbed feet that help them swim. Their skills at jumping and climbing enable frogs to exploit habitats that other groups of amphibians cannot reach especially trees and bushes (Wong and Anna, 1994). Frogs that live in these habitats usually have expanded disks on the ends of their fingers and toes. The

feet and hands of most species provide clues to their habits and habitats (Inger and Stuebing, 1999).

2.4.3 Methodology of catching frogs

Frog or toad trapping can be done in an area where both of the species cannot escape. An approached is avoided because the action will scare the frog and make it attempt to escape during the catch (Inger and Stuebing, 1989).

Quickly grab the frog or toad and it is advisable to put the frog or toad into a high container because they can cling onto many surfaces and may "wall jump" out. Shine a bright light at a frog or toad in the middle of the night. This process is called spotlighting; the frog or toad had been liked a deer caught in headlights, and enabled to move (Vogt, 1981).

Frogs can also be captured manually by hands but some maybe poisonous. Things needed when catching the frog are container with water (water optional), food for the frog or toad, some habitat (i.e. grass, a rock maybe, sticks) and lid with holes so that the catches of frog or toad are able to breathe (Bickford *at el.*, 1995).

CHAPTER 3

METHODOLOGY

3.1 Study Areas and Site Selection

Sampling sites for wildlife study were identified within the Forest Park at UPM Bintulu Campus (Figure 2).

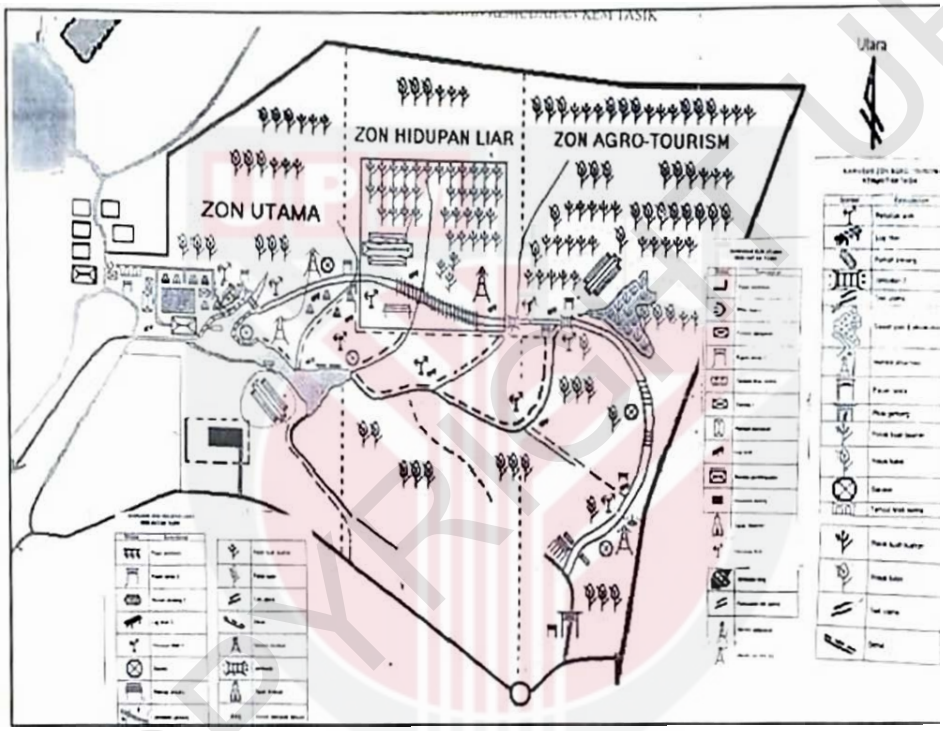

Figure 2: Forest Park (Source; Forest Park Development Plan, Department of Forest Science, UPMKB, 2007).

3.2 Experimental set-up

Samples of small mammals, fishes and frogs were collected from the sites within the Forest Park in each selected locality and were pooled together to make duplicate sets of each sample for each locality. Sampling was carried out weekly for a period of one month in one specific zone (Figure 3).

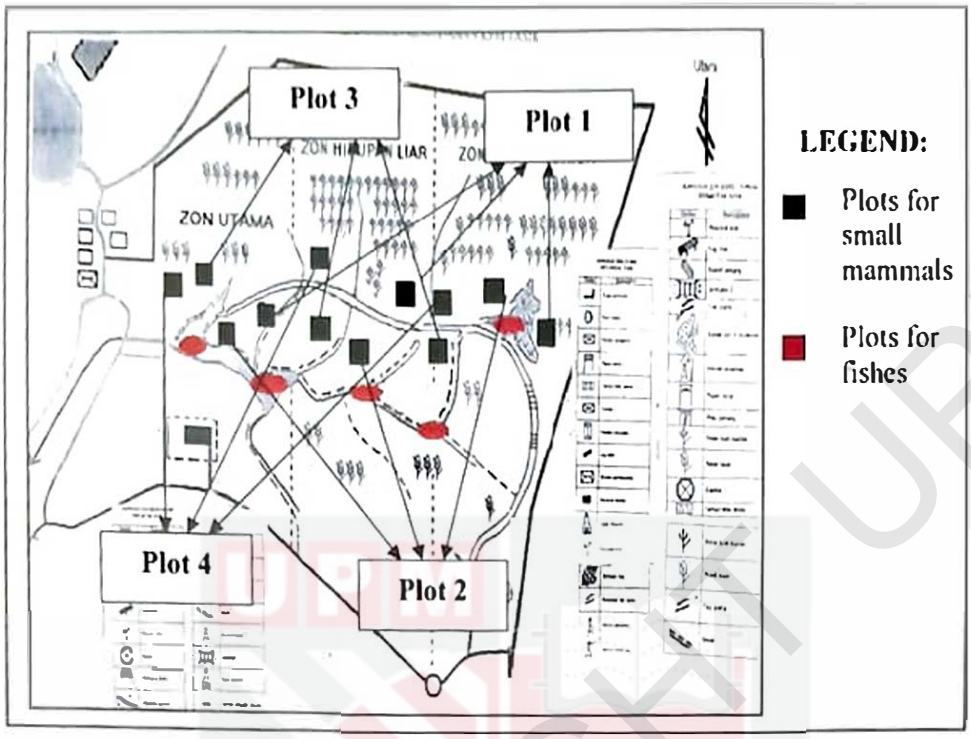

Figure 3: Plots for trapping small mammals and catching fishes

3.2.1 Trapping small mammals

Five small and two medium live traps was set up at 4 plots in every zone. Each grid was 25 m X 25 m consisting of 12 trapping plots. Traps was baited with fruits and positioned on level with dry ground at the base of large trees and along fallen trees. Small traps were placed at high up tree branches and dry ground (Marvin, 2002). Each trap was opened 8 nights per month. Photographs were taken at every collection of species of small mammals. Marked traps are – ST1P1, ST2P1, ST3P1, ST4P1 and ST5P1 (small traps) (Figure 4A) and MT1P1 and MT2P1 (medium traps) (Figure 4B).

Figure 4: Small trap (A) and Medium trap (B)

The areas for trapping were chosen and placing traps in areas which are in an opened or exposed position were avoided. Small mammals tend to avoid open spaces, preferring to go round the edge of a clearing rather than across it (Allen, 1995). Marking the traps with brightly colored tapes can help but making them too obvious in certain areas to avoid disturbance from people damaging the traps or its catch. Traps baits used different kind of baits such as fruits for examples banana, papaya and pineapple (Harrison, 1974).

One of the most commonly used traps for small mammals such as rats, squirrels and treeshrews, are the cage traps (Junaidi *et al.*, 1985) (Figure 5). This can be set on the ground or tied to fallen trees and branches. Many different foods are suitable for bait, including fruits and salt fish. Small ripe bananas are one of the easiest to obtain and the most effective baits (Kurta, 1995).

Figure 5: Cage trap for catching small mammals

3.1.2 Catching fishes

The fish was caught with variety types of fishing equipments such as fish-hook, casting net, fish traps and seine nets. After fish are caught, they are put in a pail to let them live because if the fish are dead, their body structure will also slowly get damaged (Watson and Balon, 1984).

In the lake area, using casting net is good to catch fish. A casting net is a special kind of net that only catches fish at or just below the surface of the water (Figure 6). When thrown into the air, the casting net opens wide into the shape of a circle. After it hits the water, weights drag it down and the attached drawstring was pulled to draw the net into a purse and caught the fish inside. A cast net was handy because no other nets allow us to sample right at the surface, or seconds after seeing birds feeding on fish schools (Kottelat and Whitten, 1996). The samples captured were released at their habitats after their images and measurements were taken.

Figure 6: Catching fish using casting net

3.1.3 Catching Frogs

Work was done along a baseline and the baseline was also used as a transect line which was laid out in the 3 main zones. The transect length in the Agro-Tourism Zone is about 400m, Wildlife Zone is about 500m and Main Zone is about 600m. An interval between each transect is a space about 50 m long (Figure 7).

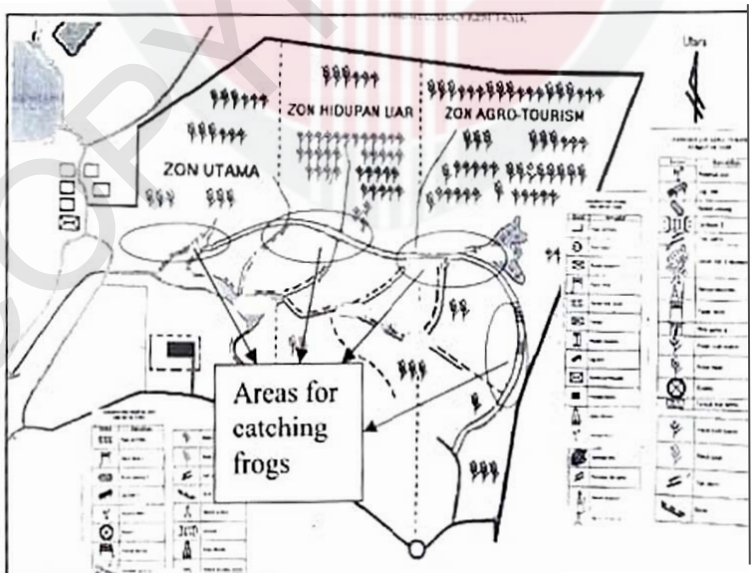

Figure 7: Areas for catching frogs following a baseline

The transects were followed at night to catch all the frogs (Figure 8). The position of each specimen on the transects were recorded (e.g., on ground, under leaves, on shrub, on tree branch etc.). Transects were visited three times per month but not on consecutive nights.

Figure 8: Searching for frogs following the streams

3.4 Data Analysis

The data analysis refers to the identification of species of small mammals, fishes and frogs in the Forest Park. Comparisons were made among different habitats where the species were found in the Forest Park.

CHAPTER 4

RESULTS

4.1 Small Mammals

There are three families (Sciurinae, Tupaiinae, and Muridae) and five species (*Tupaia tana nitidus*, *Sundamys infraluteus*, *Callosciurus notatus*, *Sundamys infraluteus* and *Callosciurus prevostii caroli*) of small mammals found in the Forest Park. Three species are present in the Agro-Tourism Zone which includes the Large Treeshrew (*Tupaia tana nitidus*), Mountain Giant Rat (*Sundamys infraluteus*) and Plantain Squirrel (*Callosciurus notatus*).

In the Wildlife Zone, four species are present which include the Mountain Giant Rat (*Sundamys infraluteus*), Plantain Squirrel (*Callosciurus natotus*), Prevost's Squirrel (*Callosciurus prevostii caroli*), and Mountain Spiny Rat (*Maxomys alticola*). However, in the Main Zone two species are commonly found which include the Mountain Giant Rat (*Sundamys infraluteus*) and the Plantain Squirrel (*Callosciurus notatus*). The Mountain Giant Rat (*Sundamys infraluteus*) and the Plantain Squirrel (*Callosciurus natotus*) are commonly found in every zone at the Forest Park (Table 1, 2 and 3).

Table 1: Species trapped in the Agro-Tourism Zone

Species	Family	Plots 1	2	3	4	Total
Callosciurus notatus	Sciurinae	3	1	3	2	9
Tupaia tana nitidus	Tupaiinae	0	0	1	0	1
Sundamys infraluteus	Muridae	5	0	0	1	6
Total		8	1	4	3	16

Table 2: Species trapped in the Wildlife Zone

Species	Family	Plots 1	2	3	4	Total
Callosciurus notatus	Sciurinae	3	1	6	3	13
Callosciurus prevostii caroli	Sciurinae	1	0	0	0	1
Sundamys infraluteus	Muridae	0	0	3	3	6
Maxomys alticola	Muridae	0	0	1	0	1
Total		4	1	10	6	21

Table 3: Species trapped in the Main Zone

Species	Family	Plots 1	2	3	4	Total
Callosciurus notatus	Sciurinae	0	0	1	4	5
Sundamys infraluteus	Muridae	3	3	0	3	9
Total		3	3	1	7	14

4.1.1 Descriptions of small mammals

Tupaia tana nitidus (Large Treeshrew) (weight = 226.0g)

Description: This species has paler upperparts towards front of the body, but with a darker midline, and blacker towards the rump (Junaidi *et al.*, 1985) (Figure 8).

Figure 8: *Tupaia tana nitidus*

Habits and Habitats: This species is mostly diurnal and adjacent small terrestrial. This species diets on arthropods and earthworms with some fruits and rarely found outside of tall forest or dense, shaded areas in secondary forests (Junaidi *et al.*, 1985).

Location: The species of *T. t. nitidus* was recorded at Agro-Tourism Zone within coordinates N 03° 12' 622" and E 113° 05' 963".

Maxomys alticola (Mountain Spiny Rat) (weight = 160.1g)

Description: This species is dark grey-brown along the midline of upperparts and paler along the sides of the body; Underparts whitish to creamy-buff. The entire upper and upperparts covered with numerous stiff spines giving a flecked appearance below and has a tail with dark on above and pale on below (Junaidi *et al.*, 1985) (Figure 9).

Figure 9: *Maxomys alticola*

Habits and Habitat: This species usually live in secondary forest and diet includes ants, other insects and fruits (Junaidi *et al.*, 1985).

Location: There was only one specimen found at the Wildlife Zone in the Forest Park at Plot 3 within coordinates N 03°12.574" and E 113°05.933".

Sundamys infraluteus (Moutain Giant Rat) (weight = 205.1 - 392.9g)

Description: This species has upperparts dark brown with long hair and longer black guard hairs. It has grey underparts with a strong orange tinge and tail entirely and dark brown (Tweedie, 1978.) (Figure 10).

Figure 10: *Sundamys infraluteus*

Habits and Habitats: This species is usually predominantly terrestrial and diet includes plants and animal matters (Tweedie, 1978).

Location: This species was commonly found in every zone in the Forest Park. There are 6 specimens found in the Agro-Tourism Zone, 6 specimens found in the Wildlife Zone and 9 specimens found in the Main Zone.

Callosciurus notatus (Plantain Squirrel) (Weight = 138.7 - 273.3g)

Description: This species has upperparts finely brownish, side-stripes white and black. Underparts vary from dark to light, but always reddish or orange (Tweedie, 1978) (Figure 11).

Figure 11: *Callosciurus notatus*

Habits and Habitats: This species is usually active early mornings and late afternoons. It travels and feeds mainly in small trees and diet includes a wide variety of fruits and insects, mostly ants. This species can live and breed entirely in plantations (Tweedie, 1978).

Location: The Plantain Squirrel was almost abundant in the Forest Park. There were 9 specimens found in the Agro-Tourism, 13 specimens found in the Wildlife Zone and 5 specimens found in the Main zone.

Callosciurus prevostii caroli (Prevost's Squirrel) (Weight 347.6g)

Description: This species has upperparts and tail dark grey, face and front parts of body with a white and orange below eyes and ears. This species usually has a white side-stripe with an orange stripe below it's legs (Junaidi *et al.*, 1985).

Figure 12: *Callosciurus prevostii caroli*

Habits and Habitats: This species active in the early mornings and late afternoons. Diet includes fruits, especially those with a sweet or oily flesh, and insects, notably ants, termites and beetle larvae which are gnawed out of dying wood (Junaidi *et al.*, 1985).

Location: The Prevost's Squirrel (*Callosciurus prevostii caroli*) was present in Plot 1 at the Wildlife Zone within coordinates N 03°12.582" and E113°05.942".

4.2 Species of Frog

Bufo melanostictus Schneider (Common Sunda Toad)

Description: This species is stocky, medium-sized to large toad with a relatively small head and short hind limbs. Long dark crests border the eyelids and run down on either side of the eye. The general colour is grayish or reddish brown, usually without markings except for the warty areas (Bickford *et al.*, 1995) (Figure 13).

Figure 13: *Bufo melanostictus* Schneider.

Habits and habitats: This species had adapted to the environmental disturbances created by mankind and occurs throughout tropical Asia in villages and towns. Adults are usually found either at temporary rain pools or drains or under street lamps where they feed on the insects dropping from the lights (Bickford *et al.*, 1995)

Location: *B. melanostictus* was found in the Forest Park, having caught at the Agro-Tourism and the Main Zone.

Rana limnocharis boie (Grass Frog)

Description: This species is a small frog with a long narrow head, and a slender, oval body. The fingers are also pointed, with no webbing at all. It is skin is finely pebbled, with a series of low interrupted ridges running down the back, becoming a line of bumps both on the rump and the sides. These frogs are rusty brown to brownish gray above, with darker blotches on the back (Wong and Anna, 1994) (Figure 14).

Figure 14: *Rana limnocharis* Boie

Habits and habitats: This frog prefers disturbed habitats and gathers in large groups around standing water and choruses are often heard well into the morning after a night of heavy rains. This frog eats invertebrates of grassy areas, including small beetles, ants, millipedes, and occasionally snails (Wong and Anna, 1994).

Location: This species was usually found at the Main Zone areas behind the Dean's house in the Forest Park.

Rana erythraea Schlegel (Green Paddy Frog)

Description: This species is small to medium-sized frog with muscular hind legs. Their tips are also sharply pointed and eardrum is prominent. It is texture is smooth and wide ridge on each side of back and bright to dark green from the top of the head, down the back, and along the sides. The entire underside is pearly white, occasionally with slight dark mottling towards the outer edges (Inger and Stuebing, 1989) (Figure 15).

Figure 15: *Rana erythraea* Schlegel

Habits and habitats: This is a frog of disturbed freshwater habitats such as irrigation ditches. They perch in low vegetation, while females are more often found on banks or bunds. *Rana erythraea* eats small terrestrial arthropods such as millipedes, crickets, and ants. Tadpoles are green or brown with dark specklings (Inger and Stuebing, 1989).

Location: It was commonly found in the large lake in the Main Zone at the Forest Park.

Rana cancrivora Gravenhorst (Mangrove Frog)

Description: This species is a medium sized frog with a long snout and well-muscled hind legs. The fingers are more pointed, and have no webbing and eardrum is conspicuous. It skin is smooth, with occasional scattered small bumps or a series of low, interrupted ridges down the back and with rows of bumps along the sides. These frogs are brown to gray on the back and legs, with dark markings (Berry, 1975) (Figure 16).

Figure 16: *Rana cancrivora* Gravenhorst

Habits and habitats: It is the only Bornean frog that tolerates saline habitats. Males do not form breeding groups, but call singly from vegetation on a river bank, irrigation ditch, or other coastal waterway. Stomach contents indicate a highly varied diet of small invertebrates (Berry, 1975).

Location: In the Forest Park, this species was found both at the Agro-Tourism Zone and the Main zone.

Rana ingeri Kiew (Greater Swamp Frog)

Description: This species is the large heavy-bodied frog, with heavily muscled hind legs. The eardrum is very distinct, and the toes are fully webbed, with slightly swollen tips. It skin is relatively smooth, except for a few scattered bumps on the sides and some short ridges on the back. There is a conspicuous fold from the eye to the arm, over the eardrum. The colour is reddish brown to dark brown and the underside of the head is gray-brown (Inger and Stuebing, 1999) (Figure 17).

Figure 17: *Rana ingeri* Kiew

Habits and habitats: This species lives in both primary and disturbed forests. It is often encountered in swampy areas and along muddy streams. Males have no vocal sacs and are not known to call. Adults feed on large prey, including crabs, other frogs, and even small snakes (Inger and Stuebing, 1999).

Location: *Rana ingeri* occurs mainly in the clear sandy rivers and streams with running water at the Agro-Tourism and Wildlife Zone.

Megophrys nasuta Schlegel (Bornean Horned Frog)

Description: This species is a stocky frog with a very wide head, and short, relatively thin hind legs. Eyelids are elongated into pointed projections, with a similar projection on the snout. The skin above is smooth, with two long, narrow ridges on each side of the back. Generally reddish brown or tan on back, often with one or two small dark spots. The shape, texture, and colours combined to give this frog a resemblance to dead leaves on the forest floor (Inger and Stuebing, 1999) (Figure 18).

Figure 18: *Megophrys nasuta* Schlegel

Habits and habitats: It lives in the leaf litter emerging at night to feed. The breeding site is on the banks of clear streams with sand or gravel bottoms and moderate current. Calling males are solitary and no breeding groups are formed (Inger and Stuebing, 1999).

Location: A forest frog that was occasionally found in the Wildlife Zone at the Forest Park.

Rana glandulosa Boulenger (Rough-Sided frog)

Description: This species is a medium-sized frog with a broad head and prominent eyes. The fingers are long and have pads at their tips like host the toes and large eardrum. The skin is covered by slightly raised, round bumps that are most prominent along the side of the body and the tops of the legs. These frogs are brown to dark brown which dark spot on the back. The sides are lighter brown and have large dark blotches (Bickford *et al.*, 1995) (Figure 19).

Figure 19: *Rana glandulosa* Boulenger.

Habits and habitats: This frog lives mainly in swampy forest. These species lives on the forest floor. Little is known of its breeding behaviour but males call singly. Adults eat insects and other invertebrates (Bickford *et al.*, 1995).

Location: Recorded from Wildlife Zone and was rarely found in the Forest Park. This species have been found within coordinates N 03°12.574" and E 113°05.933".

Rana nicobariensis Stoliczka (Cricket Frog)

Description: This species is a small to medium-sized frog with a long, narrow, pointed head. The legs are slender, and the fingers and toes extremely long with slightly swollen tips. The skin of the back is finely pebbled, and there is a distinct thin ridge or fold of skin along each side. The back is brown, with dark sports. The entire upper lip is pearly white. The underside is dirty white with gray mottling (Bickford *et al.*, 1995) (Figure 20).

Figure 20: *Rana nicobariensis* Stoliczka

Habits and habitats: These species harsh call of males is one of the characteristic sounds of wet grassy areas and roadside ditches. Males are often very abundant, but do not appear to call in groups (Bickford *et al.*, 1995).

Location: Rarely found species but found both along base line in the Forest Park. Only one specimen was found in the area.

Meristogenys phaeomerus Inger & Gritis (Brown Torrent Frog)

Description: This species is a medium-sized frog with long, slender legs and a triangular head. The eye is large. The upper surfaces are medium to dark brown, often with small darker spots on the back and the undersides are white (Inger and Stuebing, 1999) (Figure 21).

Figure 21: *Meristogenys phaeomerus* (Inger and Gritis)

Habits and habitats: These species are sometimes found far from streams, but usually they stay close to the banks of medium-sized, clear, rocky streams. Almost every night a few calling males are scattered along the bank, with an occasional night in which they are present in large numbers (Inger and Stuebing, 1999).

Location: This frog was common in hilly lowland forest and was found in the Wildlife Zone at the Forest Park.

Rana signata Guenther (Spotted Stream Frog)

Description: This species is a small, well-proportioned frog with a triangular head about the same width as the body. The eardrum is visible. Both fingers and toes have slightly swollen tips and the toes are slightly more than half-webbed. The skin of the back is very finely pebbled, while the upper surfaces of the legs are almost smooth. The frogs are black, with the back heavily spotted yellow (Figure 22), orange (Figure 23) or red (Inger, 1966).

Figure 22: *Rana signata* Guenther (yellow)

Habits and habitats: These species are almost found every night with a few solitary males calling, while at odd intervals sometimes a large calling aggregation will formed. They perch on low vegetation, logs, or irregularities of banks. Adult eat scorpions, beetles, spiders, ants, termites, crickets, wasps, in other words, almost any kinds of invertebrates in the size range 0.5-2.0 cm (Inger, 1966).

Figure 23: *Rana signata* Guenther (orange)

Location: This species was found in the clean streams in every zone in the Forest Park.

4.3 Species of Fishes

Clarias teysmanni (Bleeker, 1857) (Lelch Kembang)

TL = 30 cm

Description: This species has a slate brown colour above and on sides, whitish below; small white spots arranged in vertical rows above mid-lateral line; spots arranged in longitudinal rows below mid-lateral line; fins colored as adjacent parts of body (Inger and Chin, 2002) (Figure 24).

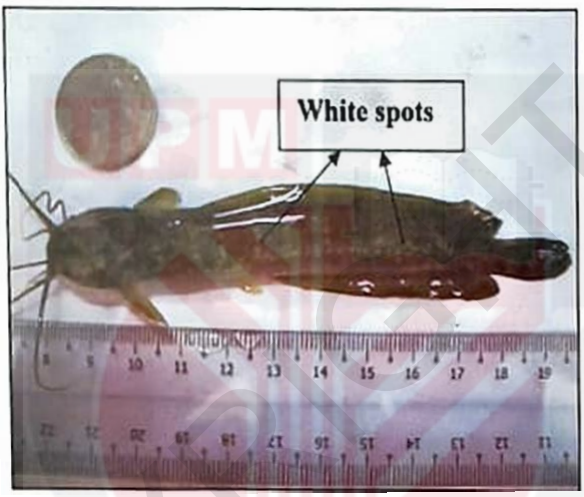

Figure 24: *Clarias teysmanni*

Dorsal – 67, Pectoral – 7, Ventral – 5, Anal – 63

Habits and habitats: It was probably more abundant in clear than in muddy water. The food consists primarily of aquatic insects and crustaceans, which appeared in 10 of 13 stomachs examined (Inger and Chin, 2002).

Location: *Clarias teysmanni* was captured in the clear and smooth stream water of the Wildlife Zone at the Forest Park.

Trichogaster trichopterus (Pallas, 1770) (Two Spot Gouramy)

TL = 9 cm

Description: This species has a dorsal fin with short spines and long soft rays. Colour is pale blue and white with two black spots, one on the centre of body and one of base of caudal; vertical fins spotted with dark pigment (Zakaria, 1997) (Figure 25).

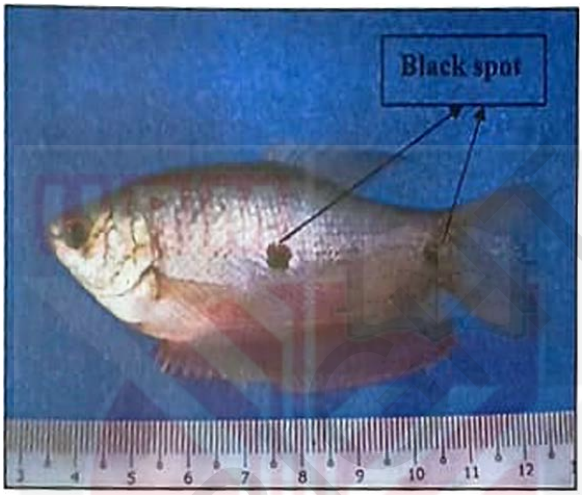

Figure 25: *Trichogaster trichopterus*

Dorsal – 9, Pectoral – 8, Ventral – 3, Anal – 35

Habits and habitats: It lives in lakes, ponds and still sluggish waters and generally feeds on aquatic plants. It can breathe air directly, as well as absorb oxygen from water through its gills (Zakaria, 1997).

Location: These species was found abundantly in the drainage ditches of the lake behind the Dean's house at the Forest Park within coordinates N 03°12.554" and E 113°05.62".

Tilapia mosambicca (Bleeker, 1857) (Mozambique Tilapia)

11. 25 cm

Description: This species have one spot on the back of the dorsal. It has truncate tail, terminal (trout) mouth and stenoid scales (Atack, 2006) (Figure 26).

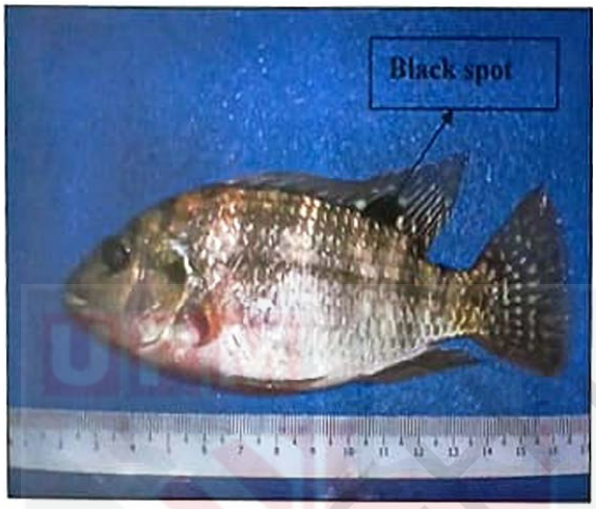

Figure 26: *Tilapia mosambicca*

Dorsal – 28, Pectoral – 12, Ventral – 6, Anal – 14

Habits and habitats: These species are found in revering habitats following through lowland areas in slow or standing waters, among river bank vegetation. It feeds on filamentous algae, submerged terrestrial plants, fruits and seeds, aquatic insects and crustaceans (Atack, 2006).

Location: These species was common species in muddy water habitats behind the Dean's house in the Main Zone.

Puntius binotatus (Valenciennes, 1842) (Three Spot Barb)

TL = 16 cm

Description: This species has variable coloration; usually a series of dark, round spots, two to four in numbers, along mid-lateral line; all these spots may be lacking, though a predorsal spot is almost invariably present; a small, dark spot at anterior base of dorsal (Inger and Chin, 2002) (Figure 27).

Figure 27: *Puntius binotatus*

Dorsal – 8, Pectoral – 15, Ventral – 8, Anal- 5

Habits and habitats: These species was conspicuously spotted specimens found in the Forest Park in the Main Zone. This species feed on insects and plants (Inger and Chin, 2002).

Location: These specimens were collected in small streams in quiet still water in the Main Zone at the Forest Park.

Ophicephalus melanosoma (Bleeker, 1851) (Black Snakehead)

TL = 35.5 cm

Description: This species is dark brown above, lighter below; many of the lateral scales with dark central spots; all fins dusky or dark, the caudal usually barred (Inger and Chin, 1962) (Figure 28).

Figure 28: *Ophicephalus melanosoma*

Dorsal – 39, Pectoral – 16, Ventral – 5, Anal – 24

Habits and habitats: This fish was collected in small to moderate sized streams. This species usually lives below rocks and leaves in slowly moving water. Their diets include insects, small fishes and plants (Inger and Chin, 1962).

Location: It was found in a clear or turbid water in stream flows at the Wildlife Zone within coordinates N 03°12.562" and E 113°05.825".

Rasbora eithovenii (Long-band Rasbora) (Bleeker, 1851)

SL 5.5 cm

Description: This species has one black stripe from tip of snout to end of middle caudal ray. The scales in upper half of body densely pigmented; scales in lower third of body with a few fine dots; conspicuous and broad. This species has a red line above the black band (Atack, 2006) (Figure 29).

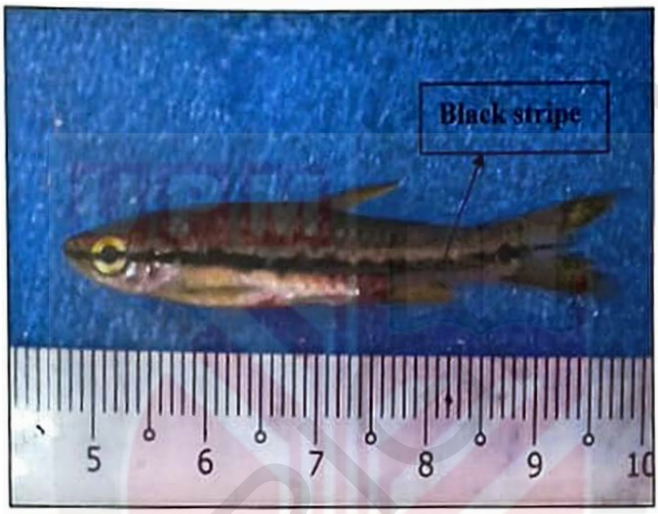

Figure 29: *Rasbora eithovenii*

Dorsal – 10, Pectoral – 13, Ventral – 7, Anal – 5

Habits and habitats: This species inhabits forest streams. They consume insects, worms, and small crustaceans and thrive on a high quality protein diet, supplemented with vegetable matters (Atack, 2006).

Location: This species lives in small and mud-bottomed streams in the Agro-Tourism Zone and Wildlife Zone.

Nandus nebulosus (Gray, 1834) (Bornean Leaf Fish/Malayan Leaf Fish)

TL – 10.5 cm

Description: This species has a body mottled with light and dark shades of brown; dorsal and ventral fins heavily marked with dark brown; soft dorsal, anal, and caudal with paler dark spots (Roberts, 1989) (Figure 30).

Figure 30: *Nandus nebulosus*

Dorsal – 11, Pectoral – 13, Ventral 5, Anal – 6

Habits and habitats: This species is usually found in clear water and found hiding in dead leaves that covered the bottom. The digestive tracts of the fishes contained aquatic organisms: dipterous larvae, Plecoptera nymphs, Psephenidae larvae, and one unidentified fish (Roberts, 1989).

Location: There were two specimens caught in very slowly moving water of shallow streams in swampy forested area in the Wildlife Zone at the Forest Park.

Glossogobius giuris (Hamilton, 1822) (Tank Goby)

TL = 22 cm

Description: This species is sandy brown above, yellowish below; a mid lateral row of squarish or oblong black spots, the one at the base of the caudal fin darkest; first dorsal dusky, with or without dark squares; second dorsal with 4 or 5 rows of blackish spots; caudal with vertical rows of black spots; other fins colorless (Inger and Chin, 2002) (Figure 31).

Figure 31: *Glossogobius giuris*

Dorsal – 8, Pectoral – 19, Ventral – 5, Anal – 8

Habits and habitats: This species was found in muddy areas and feeds on insects and vegetations (Inger and Chin, 2002).

Location: One specimen found in the Forest Park at the Main Zone behind the Dean's house within coordinates N 03°12.554" and E 113°05.62"

Rasbora sumatrana (Bleeker, 1852) (Sumatran Rasbora)

TL 13.0 cm

Description: This species has one lateral black stripe reaching the caudal peduncle. It's colour is silvery, darker above; a black mid-lateral line extending from behind operculum to base of caudal; a black mid-dorsal line, caudal orange or yellow; dorsal yellow and ventrals yellow or clear (Inger and Chin, 1962) (Figure 32).

Figure 32: *Rasbora sumatrana*

Dorsal – 6, Pectoral – 13, Ventral – 5, Anal – 5

Habits and habitats: This species occurs in clear-water in relatively fast-flowing and highly oxygenated streams. It is also present in freshwater and black-water swamps (Inger, and Chin, 1962).

Location: It was recorded at every lake and streams in the Forest Park except in the Wildlife Zone.

Cyclocheilichthys apogon (Valenciennes, 1842) (Red Eyed Barb/Beardless Barb)

Tl. = 25 cm

Description: This species have 7 to10 very conspicuous longitudinal spotted stripes from behind the head to caudal base and has a black spot at caudal peduncle (Roberts, 1989) (Figure 33).

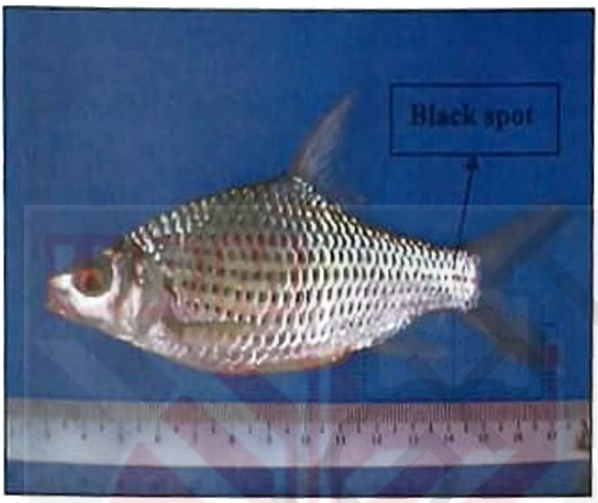

Figure 33: *Cyclocheilichthys apogon*

Dorsal – 8, Pectoral – 16, Ventral – 9, Anal – 6

Habits and Habitats: This species inhabits small streams, reservoirs, lakes, canals, and ditches. It is typically found on submerged surfaces of plants, on leaves, branches and tree roots where it browses for small planktons and crustaceans (Roberts, 1989).

Location: It was abundant in the Forest Park at the Main Zone. Specimens were collected in a small forest stream in the Forest Park having a bottom of sand and gravel.

Betta pugnax (Forest Fighting Fish / Perang Betta / Forest Betta)

TL = 12 cm

Description: This species has one or two dark stripes from eye to caudal peduncle. Dorsal side of the body is dark red and ventral and ventral side light red (Ng and Tan, 1997) (Figure 34).

Figure 34: *Betta pugnax*

Dorsal – 7, Pectoral – 13, Ventral – 3, Anal – 29

Habits and habitats: It occurs in small fast flowing forest streams. It inhabits overhanging bank vegetation, submerged leaf litters and roots of bank vegetation. The male brood the eggs in its mouth until the fry hatch (Ng and Tan, 1997).

Location: In the Forest Park, it was found in the Wildlife Zone. It was usually found in most of the streams at the Wildlife Zone where it lives below the rocks and leaves.

Channa striata (Common Snakehead)

Sl. = 100 cm

Description: This species has a black or brown body colour; no barbells; torpedo-shaped body; large scale-plated head; rounded tail; head is depressed and caudal fin is rounded (Mizuno and Furtado, 1982) (Figure 35).

Figure 35: *Channa striata*

Dorsal – 39, Pectoral – 18, Ventral – 5, Anal – 25

Habits and habitats: This species inhabits sluggish or standing water and is found mainly in swamps, but also occurs in the lowland river. It survives the dry season by burrowing in the muddy bottom of lakes and swamps. It feeds on fishes, frogs, snakes, insects, earthworms, tadpoles and crustaceans. This is a very hardy species that can inhabit polluted waters (Mizuno and Furtado, 1982).

Location: It was the most common *Channa* in the Forest Park at the Main Zone. At night, large numbers of juveniles can be observed hiding and resting in the muddy substrate of shallow parts of the lake behind the Dean's house.

Puntius orphoides (Valenciennes, 1842) (Javean Barb)

Sl. = 25 cm

Description: This species has conspicuous black blotch on caudal peduncle; black spot below dorsal origin; red spot on its cheek; silvery; underparts pale then upperparts; caudal fin orange red with a conspicuous broad black marginal stripe on each lobe; usually longitudinal rows of black spots along scale rows (Inger and Chin, 2002) (Figure 36).

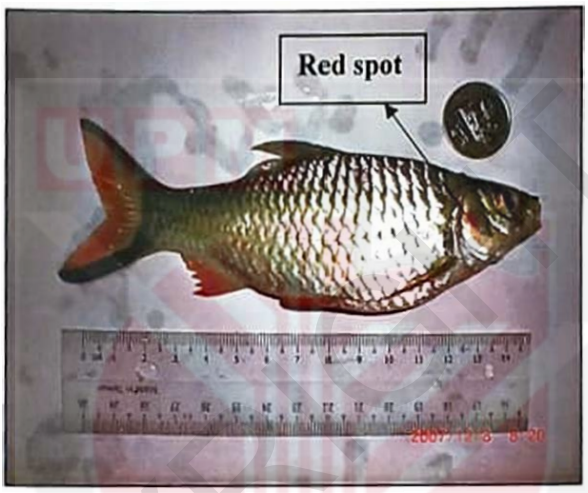

Figure 36: *Puntius orphoides*

Dorsal – 8, Pectoral – 14, Ventral -8, Anal – 5

Habits and habitats: Occurs in rivers of all sizes, but mainly in smaller streams, canals and on floodplains. Occasionally found in impoundments, but usually stays in the flowing streams leading to the impoundment (Inger and Chin, 2002).

Location: Specimens were colleted in small and medium-sized streams in quiet water over silt, sand, gravel or rock bottoms in every zone in the Forest Park but this species is usually common in the Main Zone.

Anabas testudineus (Climbing Perch)

TL = 25 cm

Description: The colour of this species is dark pale and yellow greenish below the body. There are longitudinal stripes which run ventrally across the head, a posterior margin of operculum with a dark spot and golden reddish iris. It has a scaled head (Lim and Wong, 1994) (Figure 37).

Figure 37: *Anabas testudineus*

Dorsal – 27, Pectoral – 19, Ventral – 6, Anal – 19

Habits and Habitats: Its body form is varied, affected by its age and the amount of food consumed. It feeds on macrophytic vegetation, shrimps and fish fry. It is able to survive for several days or weeks out of water if the air breathing organs can be kept moist. This fish is famous for its ability to walk with its spiky gill covers propped by its pectoral fins (Lim and Wong, 1994).

Location: These species had been found in the muddy lake in the Main Zone at the Forest Park.

Clarias batrachus (Common Walking Catfish)

SL 40 cm

Description: These species have the body that of compressed posterior with a slightly protruding upper jaw. The spine of its pectoral fins is sharp-pointed and serrated on its inner edge (Sim, 2002) (Figure 38).

Figure 38: *Clarias batrachus*

Dorsal – 82, Pectoral – 8, Ventral – 5, Anal – 73

Habits and habitats: These species usually live in swamps, ponds, ditches, rice paddies, and pools left in low spots after rivers have been flooded. It is common in swampy areas and lakes, which is normally lacking of dissolved oxygen. It breathes via skin and using arborescent organs to migrate to other water bodies. It feeds on insect larvae, earthworms, shells, shrimps, small fishes, aquatic plants and debris (Sim, 2002)

Location: These species had been found behind the Dean's house lake at the Main Zone of the Forest Park.

CHAPTER 5

DISCUSSION

Wildlife in the Forest Park such as small mammals, frogs and fishes has the ability to increase its numbers (Garbutt and Prudente, 2006). However, this growth is limited by one or more habitat factors, usually food, water, or cover. Habitats are very important to wildlife survival in the Forest Park because crops planting and draining marshes destroys habitat that wildlife requires. According to Howell and Webb (2007) habitat is an environment that supplies everything wildlife needs: food, cover, water, space, and arrangement. When these habitat factors are in good supply, they contribute to the well being of wildlife. If any one of the habitat factors is in short supply, it limits the number and locations of the wildlife.

5.1 Abundance of small mammals

There were five species of small mammals trapped in the Forest Park during the period from November 2007 to January 2008. Two species are present in every zone in the Forest Park which include Mountain Giant Rat (*Sundamys infraluteus*) and Plantain Squirrel (*Callosciurus natotus*). The Plantain Squirrel was almost abundant and often the only squirrel species in gardens, plantations and secondary forest. These species can live and breed entirely in monoculture plantations.

Only one specimen of Prevost's Squirrel (*Callosciurus prevostii caroli*) was found in the Forest Park because this species was rare and a protected species in

Sarawak. According to Junaidi *et al.* (1985) if populations of a species in different geographical areas can be consistently distinguished from each other by measurements or colours, then they are given subspecies names. For example, *Callosciurus* was the genus name for several species of similar medium-sized squirrels. *Callosciurus prevosti* refer specifically to the Prevost's Squirrel.

The Large Treeshrew (*Tupiana tana nitidus*) was found at the Agro-Tourism Zone and rarely found outside dense forest, shaded areas in secondary forests in the Forest Park. Another species found was the Mountain Spiny Rat (*Maxomys alticola*), only one specimen was found in the Wildlife Zone.

5.2 Abundance of frogs

During the period of study, 10 species of frogs were captured and identified in the Forest Park. They fall into three families that are widely distributed in Forest Park; Bufonidae, Megophryidae and Ranidae. According to Inger and Stuebing (1989) some books refer to Ranidae as "true frog". The only thing making them "true" is that they are the only family including the three frogs that occur in Borneo which is a strange definition. The Bufonidae are often called "true toads" for the same odd reason.

There are two major groups of frogs in the Forest Park according to their general habits and habitats. One group, the smaller, consists of species very closely associated with man, frogs that live in paddy fields or other types of cultivations.

villages, town gardens and roadside ditches (Inger and Stuebing, 1999). Four species fall into this category in the Forest Park which are the Green Paddy Frog (*Rana erythrea*), Mangrove Frog (*R. Cancrivora*), Grass Frog (*R. limnocharis*), and Cricket Frog (*R. nicobariensis*).

In the Forest Park, the Bornean Horned Frog (*Megophrys nasuta*) which was only one captured in the Wildlife Zone lives closely in matter resembling dead leaves. Many people in Malaysian Borneo will remark that frogs can call rain, and this notion was not without foundation (Inger, 1990). Though the frogs obviously do not bring rain, many species, include horned frogs (*Megophrys nasuta*) certainly sense the decrease in barometric pressure that precedes a heavy rain storm (Ramlah and Zainudin, 1998).

Frogs occupy a wide variety of habitats. No species actually lives in the sea, although one of the frogs (*Rana cancrivora*) found can tolerate saline waters; one was actually found swimming in the surf at the water's edge (Vogt, 1981). The species of frogs sought after are large species of river and swamp for the tables menu includes the *Rana ingeri*. There are said to be a delicacy among the Sarawak people (Inger and Stuebing, 1989).

The frog species that live in the Forest Park are found within the three different zones. There are six species recorded in the Agro-Tourism Zone, four species in the Wildlife Zone and five species in the Main Zone. In the Agro-Tourism Zone,

the species recorded are *Bufo melanostictus, Rana limnocharis, Rana cancrivora, Rana ingeri, Rana signata,* and *Meristogenys phaeomerus.* However, in the Wildlife Zone four species which are *Megophrys nasuta, Rana ingeri, Rana signata,* and *Rana glandulosa* were recorded. The Main Zone area had five species which include the *Bufo melanostictus, Rana limnocharis, Rana erythraea, Rana cancrivora,* and *Rana nicobariensis.* The species of *Rana erythraea,* a common species was found in the Main Zone because in the Main Zone there are one big lake their habitats in disturbed freshwater and feeding small terrestrial arthropods such as millipedes, crickets, and ants (Berry, 1975).

5.3 Abundance of fishes

There are 15 species of fishes found in the Forest Park. Out of these 15 fish species, five species were members of Cyprinidae, two species are members of Clariidae, Belontiidae, Channidae and one species member of Anabantidae, Cichlidae, Nandidae and Gobiidae.

From these 15 species, 11 species were present in the Agro-Tourism Zone (*Anabas testudineus, Betta pugnax, Chana striata, Clarias teysmanni, Cyclocheilichthys apogon, Ophicephalus melanosoma, Puntius binotatus, Puntius orphoides, Rasbora einthovenii, Rasbora sumatrana,* and *Trichogaster trichopterus*, 10 species in the Wildlife Zone (*Betta pugnax, Chana striata, Clarias teysmanni, Cyclocheilichthys apogon, Nandus nebulosus, Ophicephalus melanosoma, Puntius binotatus, Puntius orphoides, Rasbora einthovenii,* and

Rasbora sumatrana) and 10 species were found in the Main Zone (*Anabas testudineus*, *Chana striata*, *Clarias batrachus*, *Cyclocheilichthys apogon*, *Glossogobius giuris*, *Puntius binotatus*, *Puntius orphoides*, *Rasbora sumatrana*, *Tilapia mossambica* and *Trichogaster trichopterus*). The five species were found in every zone which includes the Red Eyed Barb (*Cyclocheilichthys apogon*), Two Spots Barb (*Puntius binotatus*), Javaen Barb (*Puntius orphoides*), Sumatran Rasbora (*Rasbora sumatrana*), and the Common Snakehead (*Chana striata*).

There were seven air breathers belonging to the family Clariidae (*Clarias batrachus*, *C. teysmanni*), Channidae (*Chana striata*, *Ophicephalus melanosoma*), Anabantidae (*Anabas testudineus*), and Belontiidae (*Trichogaster trichopterus*, *Betta pugnax*) in the Forest Park. These species can tolerate low dissolved oxygen conditions and were normally larger in size (Inger and Chin, 1962). However, surface fish species such as *Rasbora spp.* were abundant in open waters in the Forest Park.

In the Agro-Tourism Zone, Cyprinidae comprised of fishes sampled, with "Ikan Temperas" *Cyclocheilichthys apogon* and "Ikan Tebal Sisik" *Puntius binotatus* being the dominant species. "Ikan Seluang Sumatra" *Rasbora sumatrana* was abundant. In the Wildlife Zone, "Ikan Seluang" *Rasbora einthovenii*, and "Ikan Tebal Sisik" *Puntius binotatus* was abundant together with "Ikan Pelaga" *Betta pugnax*. In the Main Zone, the dominant species was the Cyprinidae (*Cyclocheilichthys apogon*) and Cichlidae (*Tilapia mossambica*), locally knowns

as "Ikan Temperas" and "Ikan Tilapia Hitam". "Ikan Daun Kering" *Nandus nebulosus* was caught only in the Wildlife Zone and "Ikan Bekut" *Glossogobius giuris* in only caught in the Main Zone, Forest Park and considered as a rare species.

CHAPTER 6

CONCLUSION

Through the study, 30 species of wildlife in the Forest Park had been identified from three families of small mammals (Muridae, Sciurinae and Tupaiidae) three of frogs (Megophryidae, Bufonidae and Ranidae) and eight families of fishes (Anabantidae, Belontiidae, Cichlidae, Channidae, Clariidae, Cyprinidae, Nandidae and Gobiidae).

There were five species of small mammals (*Sundamys infraluteus*, *Callosciurus notatus*, *Callosciurus prevostii caroli*, *Tupaia tana nitidus* and *Maxomys alticola*) ten species of frogs (*Bufo melanostictus*, *Megophrys nasuta*, *Rana limnocharis*, *Rana erythraea*, *Rana cancrivora*, *Rana ingeri*, *Rana signata*, *Rana nicobariensis*, *Rana glandulosa* and *Meristogenys phaeomerus*) and 15 species of fishes (*Anabas testudineus*, *Betta pugnax*, *Chana striata*, *Clarias batrachus*, *Clarias teysmanni*, *Cyclocheilichthys apogon*, *Glossogobius giuris*, *Nandus nebulosus*, *Ophicephalus melanosoma*, *Puntius binotatus*, *Puntius orphoides*, *Rasbora einthovenii*, *Rasbora sumatrana*, *Tilapia mossambica* and *Trichogaster trichopterus*).

In general, wildlife observations for the study took three months and were divided to three locations available in the Forest Park. The characteristics of the wildlife studied are very interesting and wildlife information found can be used for

education futher research, eco-tourism, future assesment and development of the Forest Park.

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APPENDICES

Appendix A (i)

Table 4: Checklist of small mammal species in the Forest Park.

Family name	Scientific name	Common name	Vernacular name	Conservation status in Forest Park
Muridae	*Sundamys infraluteus*	Mountain Giant Rat	Tikus Bukit Besar	Common
	Maxomys alticola	Mountain Spiny Rat	Tikus Duri Bukit	Rare
Sciurinae	*Callosciurus prevostii caroli*	Prevost's Squirrel	Tupai Gading	Rare
	Callosciurus notatus	Plantain Squirrel	Tupai Pinang or Tupai Merah	Common
Tupaiidae	*Tupaia tana nitidus*	Large Treeshrew	Tupai Muncung Besar	Rare

Notes

Rare – populations that are not presently 'endangered' but are at risk.

Uncommon – only recorded in a few areas in small numbers.

Common – frequently occurring in abundance in many areas.

Appendix A (ii)

Table 5: Checklist of frog species in the Forest Park

Family name	Scientific name	Common name	Vernacular name	Conservation status in Forest Park
Megophryidae	*Megophrys nasuta* Schlegel	Borneaun Horned Frog	Katak Bertanduk, Takang	Rare
Bufonidae	*Bufo melanostictus* Schneider	Common Sunda Toad	Katak Puru Sunda	Uncommon
Ranidae	*Rana limnocharis* Boie	Grass Frog	Katak Rumput or Katak Kampung	Uncommon
	Rana erthraea Schlegel	Green Paddy Frog	Katak Sawah Hijau	Common
	Rana cancrivora Gravenhorst	Mangrove Frog	Katak Paya Bakau	Uncommon
	Rana ingeri Kiew	Greater Swamp Frog	Katak Paya Besar	Common
	Rana signata Guenther	Spotted Stream Frog	Katak Sungai Berjalur and Berbintik	Common
	Rana nicobariensis Stoliczka	Cricket Frog	Katak Cengkerik	Rare
	Rana glandulosa Boulenger	Rough-Sided Frog	Katak Sisi Kasar	Rare
	Meristogenys phaeomerus Inger & Gritis	Brown Torrent Frog	Katak Sungai Perang	Uncommon

Notes:

Rare – populations that are not presently 'endangered' but are at risk.

Uncommon – only recorded in a few areas in small numbers.

Common – frequently occurring in abundance in many areas.

Appendix A (iii)

Table 6: Checklist of fish species in the Forest Park

Family name	Scientific name	Common name	Vernacular name	Conservation status in Forest Park
Anabantidae	*Anabas testudineus*	Climbing Perch	Puyu / Betuk	Uncommon
Belontiidae	*Betta pugnax*	Forest Fighting Fish / Forest Betta	Pelaga / Sepilai / Belaga	Uncommon
	Trichogaster trichopterus	Three Spot Gouramy	Sepat Ronggeng / Sepat-sepat	Common
Cichlidae	*Tilapia mossambica*	Mozambique Tilapia	Tilapia hitam	Common
Channidae	*Chana striata*	Common Snakehead / Forest Snakehead	Haruan / Ruan / Toman Paya	Common
	Ophicephalus melanosoma	Black Snakehead	Ikan bakak	Uncommon
Clariidae	*Clarias batrachus*	Common Walking Catfish	Keli Kayu	Uncommon
	Clarias teysmanni	Leleh kembang	Keli Borneo	Uncommon
Cyprinidae	*Cyclocheilichthys apogon*	Red eyed Barb/ Beardless Barb	Temperas / Chemperas	Common
	Puntius binotatus	Two spots barb	Tebal sisik / Turungau (Dusun)	Common
	Puntius orphoides	Javaen Barb	Pipi Merah / Bantak Buin	Uncommon
	Rasbora einthovenii	Long-band rasbora	Seluang jalur / belang	Uncommon
	Rasbora sumatrana	Sumatran Rasbora	Bada / Seluang sumatra	Uncommon
Nandidae	*Nandus nebulosus*	Bornean Leaf Fish /	Daun kering / Bodoh	Rare

		Malayan Leaf Fish		
Gobiidae	*Glossogobius giuris*	Tank goby	Bekut	Rare

Notes

Rare – populations that are not presently 'endangered' but are at risk.

Uncommon – only recorded in a few areas in small numbers.

Common – frequently occurring in abundance in many area

Appendix B (i)

Table 7: Distribution of small mammal species in the Forest Park

No.	Species	Agro-tourism zone	Wildlife zone	Main zone
1	*Sundamys infraluteus*	X	X	X
2	*Maxomys alticola*	-	X	-
3	*Callosciurus prevostii caroli*	-	X	-
4	*Callosciurus notatus*	X	X	X
5	*Tupaia tana nitidus*	X	-	-

X = species found

- = no data collected

Appendix B (ii)

Table 8: Distribution of frog species in the Forest Park

No.	Species	Agro-tourism zone	Wildlife zone	Main zone
1	*Bufo melanostictus*	X	-	X
2	*Megophrys nasuta*	-	X	-
3	*Rana limnocharis*	X	-	X
4	*Rana erythraea*	-	-	X
5	*Rana cancrivora*	X	-	X
6	*Rana ingeri*	X	X	-
7	*Rana signata*	X	X	-
8	*Rana nicobariensis*	-	-	X
9	*Rana glandulosa*	-	X	-
10	*Meristogenys phaeomerus*	X	-	-

X = species found

- = no data collected

Appendix B (iii)

Table 9: Distribution of fish species in the Forest Park

No.	Species	Agro-tourism zone	Wildlife zone	Main zone
1	*Anabas testudineus*	X	-	X
2	*Betta pugnax*	X	X	-
3	*Chana striata*	X	X	X
4	*Clarias batrachus*	-	-	X
5	*Clarias teysmanni*	X	X	-
6	*Cyclocheilichthys apogon*	X	X	X
7	*Glossogobius giuris*	-	-	X
8	*Nandus nebulosus*	-	X	-
9	*Ophicephalus melanosoma*	X	X	-
10	*Puntius binotatus*	X	X	X
11	*Puntius orphoides*	X	X	X
12	*Rasbora einthovenii*	X	X	-
13	*Rasbora sumatrana*	X	X	X
14	*Tilapia mossambica*	-	-	X
15	*Trichogaster trichopterus*	X	-	X

X = species found
- = no data collected

Appendix C (i)

Table 10: Baseline measurement survey information in Agro-Tourism Zone

Date: 14/11/2007

		Measurement		GPS Reading	
From section	To section	Degree (°)	(metre)	Latitude(N)	Longitude(E)
14	Plot 1	38°	47	03°12.637"	113°05.935"
Plot 1	Angle 1	40°	25		
	Angle 2	310°	25		
16/17	Plot 2	200°	20	03°12.622"	113°05.963"
Plot 2	Angle 1	310°	25		
	Angle 2	220°	25		
17/18	Plot 3	70°	40	03°12.597"	113°05.937"
Plot 3	Angle 1	320°	25		
	Angle 2	50°	25		
20	Plot 4	145°	20	03°12.587"	113°05.980"
Plot 4	Angle 1	250°	25		
	Angle 2	160°	25		

Appendix C (ii)

Table 11: Baseline measurement survey information in Wildlife Zone

Date: 11/12/2007

		Measurement		GPS Reading	
From section	To section	Degree (°)	(metre)	Latitude(N)	Longitude(E)
22	Plot 1	340°	20	03°12.582"	113°05.942"
Plot 1	Angle 1	110°	25		
	Angle 2	200°	25		
23	Plot 2	215°	20	03°12.580"	113°05.967"
Plot 2	Angle 1	140°	25		
	Angle 2	230°	25		
26	Plot 3	315°	20	03°12.574"	113°05.933"
Plot 3	Angle 1	60°	25		
	Angle 2	330°	25		
29	Plot 4	150°	20	03°12.569"	113°05.955"
Plot 4	Angle 1	280°	25		
	Angle 2	190°	25		

Appendix C (iii)

Table 12: Baseline measurement survey information in Main Zone

Date: 09/01/2008

		Measurement		GPS Reading	
From section	To section	Degree (°)	(metre)	Latitude (N)	Longitude (E)
34	Plot 1	215°	20	03°12.561"	113°05.958"
Plot 1	Angle 1	260°	25		
	Angle 2	170°	25		
40	Plot 2	190°	20	03°12.557"	113°05.952"
Plot 2	Angle 1	310°	25		
	Bucu 2	220°	25		
43	Plot 3	250°	20	03°12.554"	113°05.62"
Plot 3	Angle 1	280°	25		
	Angle 2	190°	25		
47	Plot 4	340°	20	03°12.546"	113°05.543"
Plot 4	Angle 1	190°	25		
	Angle 2	280°	25		

PUBLICATIO OF THE PROJECT UNDERTAKING

This is to certify that I have no objection to publish the project entitled "A Study of Wildlife in the Forest Park, UPM Bintulu Campus" by supervisor in a joint authorship. However, it has to be evaluated by the Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Campus and published in the form approved by the Faculty.

MOHD HAMIZAN BIN SAMSUDIN

Date: 25 April 2008