SURVEY OF INTESTINAL PARASITE FOUND IN ASIAN ELEPHANT (*Elephas maximus*) IN GUNUNG BASOR FOREST RESERVE, KELANTAN, MALAYSIA.

By

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

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APPROVAL

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

Signature : …………………………........

Name of Supervisor I :

Date : ………………………………..

DECLARATION

I declare that this thesis entitled "Survey of Intestinal Parasites Found in Asian Elephant (Elephas maximus) In Gunung Basor Forest Reserve, Kelantan, Malaysia" 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 :

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SURVEY OF INTESTINAL PARASITES FOUND IN ASIAN ELEPHANT (*Elephas maximus*) IN GUNUNG BASOR FOREST RESERVE, KELANTAN, MALAYSIA.

ABSTRACT

Intestinal parasite is an organism that lives in or live through another organism. They take nourishment from another organism in the intestinal tract for their growth and reproduction. Intestinal parasites can affect the health of wildlife including, the species study, Asian Elephant and can create imbalance in the wildlife population dynamics. The study of intestinal parasites is very important to know and identify their identity, impacts and for the wildlife conservation. Furthermore, in Peninsular Malaysia, there is no baseline data on intestinal parasites for Asian elephants. Thus, this project was carried out to identify the types of intestinal parasites of *Elephas maximus* at Gunung Basor Forest Reserve, Malaysia and to understand the impact of the parasitic infections on wildlife endangerment. In this study, faecal flotation method was used to identify the types of parasites present in each of the samples collected at Gunung Basor Forest Reserve. Through the study, five types of intestinal parasites were found which are the threadworm with frequency of 11%, hookworm 25 %, trematode 40%, roundworm 17% and coccidian 7%. The intestinal parasites have high evenness with Shanon Index of 0.9 The findings of this paper will be useful to provide the baseline data for the types of intestinal parasites found in Asian Elephant at Gunung Basor, Kelantan, Malaysia.

TINJAUAN PARASIT USUS YANG DIJUMPAI DALAM GAJAH ASIA (*Elephas maximus*) DI HUTAN SIMPAN GUNUNG BASOR, KELANTAN, MALAYSIA

ABSTRAK

Parasit usus adalah organisma yang hidup di dalam atau organisma yang meneruskan kehidupan dalam organisma lain. Mereka mengambil khasiat dari organisma yang lain dalam saluran usus untuk pertumbuhan dan pembiakan mereka. Parasit usus boleh menjejaskan kesihatan hidupan liar termasuk spesies kajian, Gajah Asia, dan boleh mewujudkan ketidakseimbangan dalam dinamika populasi hidupan liar. Kajian parasit usus sangat penting untuk mengetahui dan mengenal pasti identiti mereka, kesan dan pemuliharaan hidupan liar. Selain itu, di Semenanjung Malaysia, tiada data asas mengenai parasit usus untuk gajah Asia. Oleh itu, projek ini dijalankan untuk mengenal pasti jenis parasit usus *Elephas maximus* di Hutan Simpan Gunung Basor, Malaysia dan untuk memahami kesan jangkitan parasit terhadap bahaya hidupan liar. Dalam kajian ini, kaedah pengapungan najis digunakan untuk mengenal pasti jenis parasit yang terdapat dalam setiap sampel yang dikumpulkan di Hutan Simpan Gunung Basor. Melalui kajian ini, lima jenis parasit usus telah ditemui iaitu cacing benang dengan frekuensi 11%, cacing kerawit 25%, trematod 40%, cacing bulat 17% dan coccidian 7%. Penemuan kajian ini berguna untuk menyediakan data asas bagi jenis-jenis parasit usus yang terdapat pada Gajah Asia di Gunung Basor, Kelantan, Malaysia.

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LIST OF ABBREVIATION

IUCN	International Union for Conservation of Nature
PERHILITAN	Jabatan Perlindungan Hidupan Liar dan Taman Negara
WWF	World Wildlife Fund
GPS	Global Positioning System
g	Gram
ml	Millilitre
ln	Log
kg	Kilogram

LIST OF SYMBOLS

%	Percentage
X	Multiply
Sp	Species
˚C	Degree Celsius
∑	Sum

LIST OF EQUATION

No.

3.1 Shanon Diversity Index, H’ = - ∑pi (lnpi)

3.2 Maximum Diversity, Hmax = ln (1/s)

3.3 Species Evenness, E = H’/ Hmax

3.4 Relative Abundance $= \frac{Total\ number\ of\ individual\ per\ species}{Total\ number\ of\ individual}$

CHAPTER 1

INTRODUCTION

1.1 Background of Study

In Peninsular Malaysia, the conservation of elephants is very important and crucial to the ecosystem. This is because, according to Santiapillai & Charles, (1990), elephants can be referred as a “flagship” species which the conservation of the elephant can save and protect many other species. Elephants live in a broad habitat and its conservation can ensure the preservation of biodiversity and ecological integrity. In a survey from year 2000 to 2002, the Asian Elephant (*Elephas maximus*) population in Peninsular Malaysia is estimated about 1220 to 1460 and based on surveys carried out in year 2002 to 2009, Kelantan state recorded the second highest population of the elephants estimated about 250-300 elephant (PERHILITAN, 2005). Elephants are very valuable and important as a part of natural resources. However, diseases caused by the intestinal parasites species is a challenge to their existence and a major factor that cause the declined in their population number (Pathak & Chhabra, 2012).

Gastrointestinal parasite commonly affected the wildlife, including elephants for the last few decades (Ghandour *et al*, 1995). Parasites can influence the patterns of the wildlife population (Anderson & May, 1978). They affect the wildlife individual performance by reducing the level of wildlife body condition and lowering their rate of reproductive success (Irvine, 2006). Although, parasitism does not affect directly the survival of the wildlife, the parasite can cause the infection that will influence the

pregnancy rate and their body condition (Albon et al., 2002). Thus, the research on wildlife parasites is very important for the effort of conservation of threatened wildlife species in order to understand the impact of the parasites on the wildlife endangerment (Daszak, 2000).

The examination of the stool shapes a critical part in the analysis of intestinal parasitic contaminations and furthermore for those helminthic parasites that confines in the biliary tract and release their eggs into the digestive system (Goyette *et al*, 2014). Diagnosis of parasitic infections requires laboratory support, since the sign, side effect of disease and symptom of infection are often nonspecific. Variety of methods and specimens are used for the analysis since the most well-known parasite are enteric, microscope examination of faecal specimens is done more than any other laboratory procedure in the analysis of parasitic infection.

In this project, flotation method was used to identify the types of parasites in the elephant dung. According to Veterinary Parasites Laboratory Procedures this method used flotation liquid that has a higher specific gravity than eggs or cysts, so that the parasites floated on the surface of the solution and thus can be identified under the microscope. In this method, it is important to know that the animals are infected when the parasite eggs are demonstrated in the feces, but it does not indicate the degree of the infection (Jorgen, 1994).

1.2 Problem Statement

Internal parasites can create imbalance in the wildlife population dynamics. The potential impacts of the parasites to the wildlife are often neglected by the wildlife data gains importance in the context of increasing deforestation rates and also conservation effort. The knowledge about the ecological relationship between parasites and their hosts with their effects to the wildlife health are very limited. Furthermore, in Peninsular Malaysia, there is no baseline data on intestinal parasites for Asian elephant. Therefore, this project is proposed to determine the identity and impact of the parasite to the species study and to the ecosystem as an effort of conservation to save the species from declination.

1.3 Objectives

This project aims to gather baseline information and data about gastrointestinal parasites of *Elephas maximus*, thus;

1. To identify intestinal parasites of *Elephas maximus* at Gunung Basor Forest Reserve.

1.4 Scope of Study

Most of the parasites located in the elephant gastrointestinal tract are nematode. Among the elephant parasites, the nematodes are the most harmful and countless parasites (Murray & Susan, 2006). In this research, the other types of parasites present in the Asian

Elephant was identified by the using flotation method. The research samples were collected at Gunung Basor Forest Reserve, Kelantan and it is estimated that in Kelantan the species population is around 250 to 300 and around 8 to 10 elephants are estimated in the study site (PERHILITAN, 2005).

1.5 Significant of Study

Biotic and abiotic factors controlled the wildlife population in the wild. One of the biotic factors that regulated the wildlife population is the parasites. The host is affected by the parasite in many ways. They may cause the demise of the host because of a direct deadly impact or because of indirect effect. The direct deadly effect may occur if the parasite life cycle includes killing of the host or if equilibrium did not develop between parasites and the host. The death by parasitism may likewise be caused by a sequence of the emaciating impact of parasites that connected with factors such as environmental contamination, bad weather conditions, or human activity.

It is very important to know and understand the types and the impacts of the parasites on wildlife, as it will affect the conservation effort of elephant species in Peninsular Malaysia and therefore also consequently affect the biodiversity and ecosystem around. In this project, the types of parasites in the elephant was identified and thus their characteristics, effect and identity were recognized. When the parasite is identified, the health of the elephant and the ecosystem can be known, that is, whether they in a good or in a bad state and further action can be planned.

CHAPTER 2

LITERATURE REVIEW

2.1 *Elephas maximus*

According to Campos-Arceiz & Blake (2011), elephants may be considered as important keystone and seed-dispersing species which act as an ecosystem engineer that maintain and support the biological diversity of their habitat. The large mammals live in groups and have pastoral lifestyles which give positive impact to the land as well as to the other animal species living around them (Sarker & Røskaft, 2010). Currently, the conservation status of Asian elephants is classified as Endangered mainly because of the declining of their population (IUCN, 2013). In Peninsular Malaysia, Pahang state has the largest population of the Asian Elephant and the species is widely distributed in Perak, Johor, Kelantan, Terengganu and Kedah, while Negeri Sembilan has the least number of the population species (IUCN, 2017). It is estimated about 1,223 to 1,460 elephants at diverse forest according to the Malaysian government (PERHILITAN, 2006).

There are two types of elephant which is the African elephant (*Loxodonta*) and the Asian elephant (*Elephas*) which are the members of the same taxonomical family, elephantidae, but are of a different genus; which are Asian elephants (*Elephas maximus)*, African savanna elephants (*Loxodonta Africana)* and African Forest Elephant *(Loxodonta cyclotis)*. The Asian elephants are much smaller in size while the African elephant is much larger, with their bulls can growing up to 4m tall and the biggest Asian males only can reach to no more than 3.5m. Moreover, the ears of Asian elephant are straight at the bottom, while the African species has large fan-shape ears. Only some *Elephas maximus* have tusks but all *Loxodonta*, including females, have tusks.

Table 2.1: Asian Elephant Scientific Name and Classification

Common name	Asian Elephant
Scientific name	*Elephas maximus*
Type	Mammals
Diet	Herbivores
Group name	Herd
Average life span in the wild	Up to 60 years
Size	Height at the shoulder, 6.6 to 9.8 ft
Weight	2250 to 5500 kg

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2.2 Elephant Anatomy and Biology

Elephants are monogastric animals which have a single-chambered stomach. Their stomach is cylindrical and estimated about 75-90 centimetres in long in adult elephants. The capacity of adult elephant stomach is between 30 and 70 litters. Elephants use bacterial symbiosis in their large cecum for hind gut fermentation of faecal matter because they lack a gall bladder. The elephant digestive tract consists of mouth, pharynx, oesophagus, stomach, small and large intestine, cecum, rectum and anus. The system is completed by the accessory organs such as molar teeth, tongue, salivary gland, liver and pancreas. Furthermore, elephants also have a trunk that act as an upper lip and an extension of their nose with two nostrils going through the whole length.The trunk is muscular and contains about 100,000 different muscles. It has great flexibility, power and contractility.

The trunk not only acts as nose for breathing but also for water storage, trumpeting, drinking and for grabbing things. Apart from that, the digestive system of elephant is not exceptionally proficient at assimilation of supplements. Elephants process and assimilate just around 44% of what they eat. The utilization of a grown-up Asian elephant is roughly 150-200 kilograms of food (10% of body weight) and 200 litres of water for every day, albeit bigger measures of sustenance might be required in some circumstances.

2.3 Elephants Diet and Eating Habit

Elephants need to consume large quantities of food per day because of their large physiology and need more energy. For feeding, the species may spend up to 14–19 hours a day, during which they may end up to 150 kg of wet weight (Vancuylenberg, 1977). The species do not sleep much and always travel over great distance while searching for larger quantities of food to maintain their large bodies. The diet of the elephant is basically comprised of vegetation. Because of the vegetation diet, their digestive system requires the action of bacteria for the fermentative digestion of cellulose. The elephant eats fruit, bark, grasses and roots and cultivated crops such as bananas, rice and sugarcane are their favourite foods. They produce about 1000 kg of dung and defecate about 16–18 times a day.

Moreover, when elephants eat seeds they will transport the seeds around in their stomach and then 'plant' them in their faeces. The elephant dung helps disperse germinating seeds and research has shown that as elephants disappear, their forests also suffer from the loss of this seed-spreading mechanism (John, 2016). A study also revealed that elephants also can disperse the seeds for about 57km far. Besides that, elephant dung is also an ideal fertiliser which is rich in nutrients that allow seeds to germinate and grow. Because of elephant seed dispersal, a range of animals have a new habitat and living space as it provides opportunities for plants to colonise new areas.

2.4 Intestinal Parasites Infection and Its Impact

Gastrointestinal tract consists of a hollow muscular tube starting from the oral cavity, where food enters the mouth, continuing through the pharynx, oesophagus, stomach and intestines to the rectum and anus, where food is expelled. The situation where gastrointestinal tract of human or animals is affected by parasite is known as the intestinal parasite infection. Helminth and protozoa are some of the examples of the intestinal parasite that can cause infection and can give adverse effect to the host, for example damage and sicken the host whether to humans or animals. Gastrointestinal disease, including colic, bloat, and constipation, was common in captive animals and was also reported for wild populations.

Although gastrointestinal disease represents a broad range of etiology, the degree to which improved nutrition and access to safe water which can reduce the prevalence of gastrointestinal disease and malnutrition for elephants is worth exploring further. The importance in understanding the parasitic infection is very crucial because it relates to parasitic diseases which can influence the patterns of wildlife population, which is whether to decline temporarily or permanently (Daszak *et al*., 2000). Parasitic infection gives significant impact on wildlife endangerment and for the conservation of the threatened species (Burthe *et al*., 2008). Besides becoming a threat to wildlife, parasites also have conservation value and as one of the important components in ecosystem as they can alter the food web's stability (Hudson *et al*, 2006).

2.5 Types of Intestinal Parasites in Asian Elephant

Parasites regulate the host population sizes by changing the death and birth rates of the host (Møller, 2005). They also influence the host behaviour and act as ecosystem engineers (Thomas *et al*, 1999). Thus, parasites have many important impacts in biodiversity and ecosystem function (Dobson *et al*, 2008). In addition, the intestinal parasites that commonly present in elephant are helminth and protozoa. The example of helminth parasites or parasitic worm that usually infect Asian Elephant are cestodes (tapeworms), nematodes (roundworms), bots (*Cobboldia elephantis)*, roundworms (*Ascaris*), flukes (Amphistomes) and hookworm (*strongyle*). Based on the previous research make on Asian Elephant by the Department of Pathology, Faculty of Veterinary Medicine, University Pertanian Malaysia and the Department of Wildlife and National Parks, Malaysia, the parasite that was recorded in a young elephant are intestinal flukes that found in large intestine which known as *Pfenderius sp.* (Chooi & Zahari, 1988).

Besides that, there are many types of parasites such as gastrointestinal nematode that has been identified in the elephants especially *Elephas maximus* such as *Murshida falcifera* (Cobbold, 1882). It is previously recorded in the large intestine of the elephants in India, Malaysia, Burma, Sri Lanka and Indonesia (Kinslla *et al*., 2004). The common liver fluke, *Fasciola hepatica* has also recorded in Asian Elephant and is locally ubiquitous. It is found throughout tropical and temperate region of the world. Apart from that, parasites also can cause disease transmitted to the wildlife and to human. The examples of diseases that cause the death of a young elephant is tympanites and chronic lymphatic leukaemia that caused by parasite invasion of amphistomes and nematodes (Evans, 1910)

CHAPTER 3

MATERIAL AND METHODS

3. 1 Study site

Gunung Basor Forest Reserve (GBFR) is in Kelantan, Malaysia and located near to Bukit Jual and Kampung Sungai Rual (Figure 1). It has latitude of 5.5992 and longitude of 101.8087 with an elevation of 659 meters to 2162.1 feet. GBFR is a forest area that is protected for conservation. According to PERHILITAN (2005), the study area has an estimated wild elephant population of 8 to 10. The forest keeps most of their wilderness criteria and ecosystems (Azlina, 2013).

3.2 Species study

Asian elephants are classified as Endangered based on International Union for Conservation of Nature (IUCN) Red List of threatened species. This species has been chosen for this research because there is no baseline data about the elephant parasites that has been carried out for the elephants in the Gunung Basor, Kelantan. The species study, Elephas maximus can reach 6.4m in length and 3m at the shoulder and weigh as much as 5 tonnes. They have proportionally smaller ears, which they keep in constant motion in order to cool themselves. Their skin ranges from dark grey to brown, with patches of pink on the forehead, the ears, the base of the trunk and the chest.

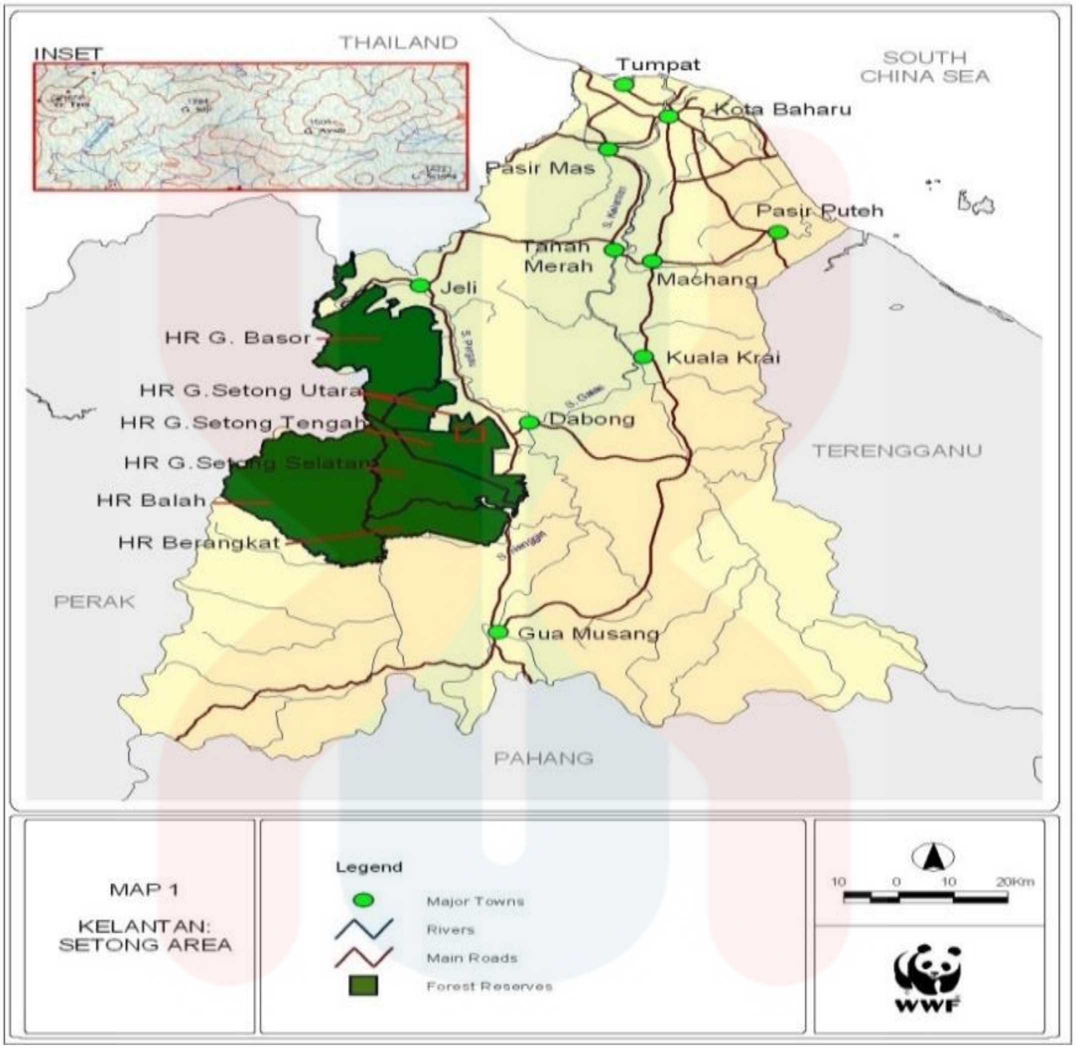

Figure 3.1: Map of Study Area (Source: WWF Malaysia)

3.3 Sample collection

20 samples of Asian Elephant dung were collected from free-ranging wild Asian elephants in Gunung Basor Forest Reserve, Kelantan. The approximate location of the wild Asian elephants was getting from the data reports from local contacts and the animals were tracked on foot by indirect signs including footprints, dung piles and evidence of

feeding on vegetation. The latitude and longitude of sample collection sites were recorded using a handheld GPS. To minimize duplication, which is the inadvertent repeated collection of fecal samples from the same individuals, boluses of different sizes were sampled from dung piles located at a distance of at least 5 m from one another.

The samples collected were wet faeces identified by their appearance which is by the color and consistency. The faecal matter was obtained from the central and edge locations of the faeces by splitting the boluses manually. Then, the samples were kept in sealed and labelled zip-locked bags containing 95% ethanol and analysed as soon as possible after collection. The samples were stored in a cooler box with maximum duration of 8 hours and be transferred to a freezer with temperature of 4ºC -6ºC at University Malaysia Kelantan laboratory.

3.4 Laboratory Examination

The samples collected were brought to the laboratory for the specific identification of species. The simple test tube flotation method was used for the detection of nematode and cestode eggs. This technique is a useful method to use in preliminary surveys to determine parasite groups are present.

The faeces sample then was weight approximately 3g and put into a container labelled A. After that, 50 ml of floating liquid which contained with 400 gram of sodium chloride with 1000 ml of distilled water were poured into container A and the substance were mixed completely with a stirring rod. Then, the resultant faecal suspension was poured through a double-layer of cheesecloth into a container labelled with B. The faecal suspension in the container B then poured into a test tube and the test tube was be placed in a test tube rack.

The test tube then was filled by the suspension until convex meniscus is formed on the top of the test tube. After that, a coverslip was placed carefully on top of the test tube and let it stand for 20 minutes. Then, the coverslip was carefully lifted from the test tube and place immediately on a microscope slide. The parasite was surveyed with ×10 and ×40 magnification of a compound microscope (Unwin *et al*., 2011).

3.5 Data analysis

The list of all intestinal parasites species was tabulated in table with their scientific classification by using references from books, journals and reports. The average numbers of parasites eggs and worms was calculated by using Microsoft Excel 2016. The species richness and evenness are calculated by using Shannon Diversity Index by using equation 3.1, 3.2, 3.3 respectively while the relative abundance was calculated by using equation 3.4 as follows:

Shanon diversity index, $H' = - \sum pi\ (\ln pi)$ (3.1)

Maximum diversity, $Hmax = \ln (1/s)$ (3.2)

Species Evenness, $E = H'/\ Hmax$ (3.3)

$$\text{Relative Abundance} = \frac{\text{Total number of individual per species}}{\text{Total number of individual}}$$

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results

A total of 20 faecal samples were collected from Asian Elephant at Gunung Basor, Jeli, Kelantan with 20 different coordinates (Figure 4.1).

Figure 4.1: Map of sample location with 20 different coordinates

4.2 The Intestinal Parasites of Asian Elephant

Through faecal flotation method, two parasitic group were identified in this study which were helminth and protozoan. There were five intestinal parasites identified under helminth group and one parasite under protozoan (Table 4.1).

Table 4.1: Scientific Classification of Intestinal Parasites Found in Asian Elephant at Gunung Basor, Jeli, Kelantan, Malaysia**.**

Parasitic Group	Type of Parasite	Genus	Phylum	Class	Family
Helminth	Threadworm	*Strongyloides* sp.	Nematoda	Secernentea	Strongylidae
	Roundworm	*Ascaris* sp.	Nematoda	Chromadorea	Ascaridiae
	Hookworm	*Ancylostoma* sp.	Nematoda	Chromadorea	Ancylostomatidae
	Trematode	*Fasciola* sp.	Platyhelminthes	Rhabditophora	Fasciolidae
Protozoa	Coccidian	*Coccidia* sp.	Apicomplexa	Conoidasida	-

4.2.1 Helminth

Helminths are intestinal parasites that live in the small intestine of human and animals. They gain food and protection from a living host while causing poor nutrient absorption and spread disease in the host. Helminths are invertebrates that can be distinguished by their elongated, flat or round bodies.

Throughout laboratory examination, there were four types of intestinal parasites identified under helminth group which are the threadworm, roundworm, hookworm, and trematode. While, for protozoan, only coccidian was identified.

Roundworm

Through laboratory examination, female roundworm, *Ascaris sp*. was identified with their distinguishing features body which is elongated, cylindrical and pointed at both ends. Figure 4.2 shows a female roundworm, that were found in the elephant faeces. It is note that the difference between the male and female roundworm is through the post anal portion where in the male it is sharply curved downwards while it is nearly straight in the female roundworm as shown in Figure 4.2. The frequency of roundworm found in this study through 20 samples collected at Gunung Basor is about 17%. The frequency of the roundworm is the third highest among the five intestinal parasites found in the 20 samples (Figure 4.10). Roundworm infection in the elephant can cause them lack of vitality, diarrhoea and also can lead to death.

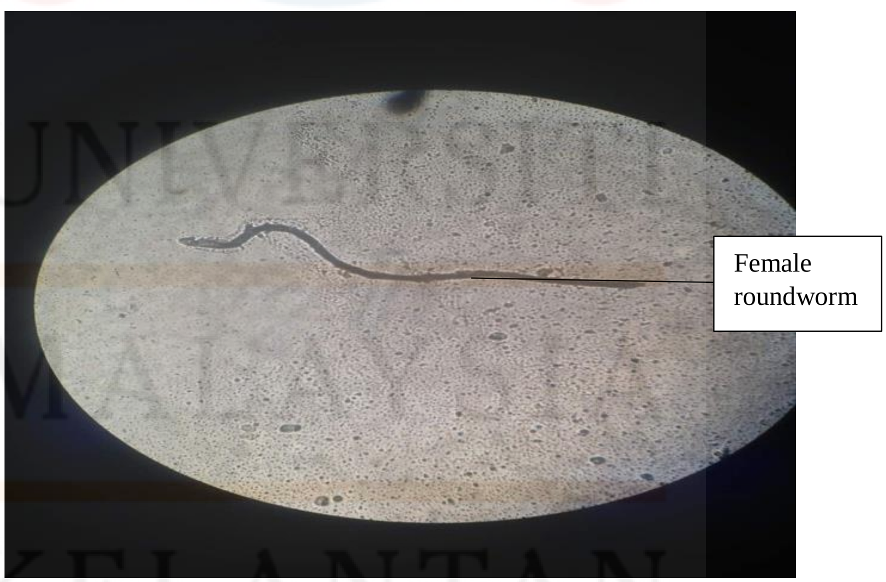

Figure 4. **2**: Female roundworm under 4x10 magnification

Hookworm

Hookworms, *Ancylostoma sp*., are blood-feeding nematodes or known as hematophagy that parasitize the alimentary system of a mammals (Popova, 1964). The hookworm distinguished features are grayish white or pinkish in colour with the head slightly bent in relation to the rest of the body. This bend forms an absolute hook shape at the anterior end for which hookworms are named.

Hookworm (Figure 4.3 and Figure 4.4) was seen through compound microscope by using the faecal flotation method meanwhile the species of the hookworm identified is unknown. The presence of the hookworm in the faecal sample shows that the Asian Elephant at Gunung Basor is not in a good health because this hookworm infection can cause anaemia, retarded growth, tissue damage, inflammation and significant mortality in several wildlife species including elephants. The frequency of hookworm found in the 20 samples collected is 25% which is the second highest parasites found during the study.

Figure 4.3: Hookworm under 4x10 magnification

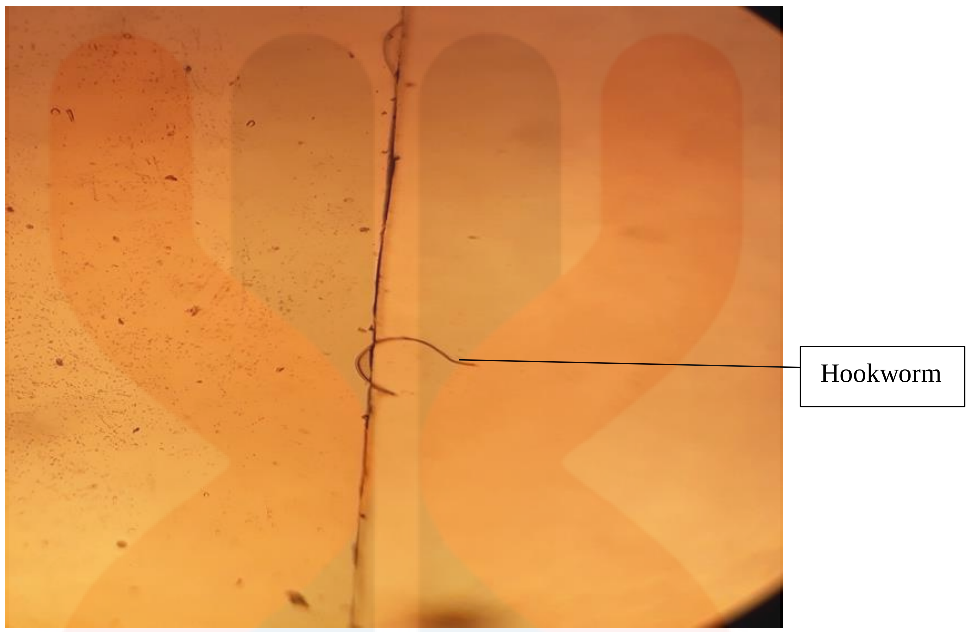

Figure 4. 4: Hookworm at rhabdatiform larvae under 4x10 magnification

Threadworm

In the faecal flotation method, threadworm, *Strongyloides* sp. were identified. Through the laboratory examination, *Strongyloides* sp. was found in the early development stage or known as rhabditiform stage. The frequency of the threadworm found in this study is 11%. The distinguished features of the threadworm are the female *Strongyloides* has a sharply pointed posterior end and has a prominent genital primordium (Figure 4.5) while male threadworm has curved posterior end with one spicule (Figure 4.6).

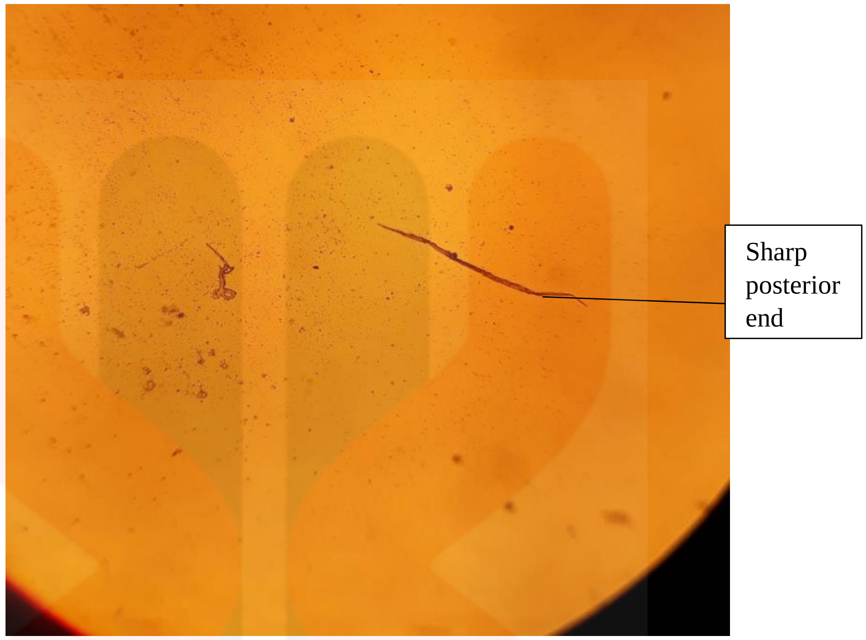

Figure 4.5: Female threadworm under 4x10 magnification

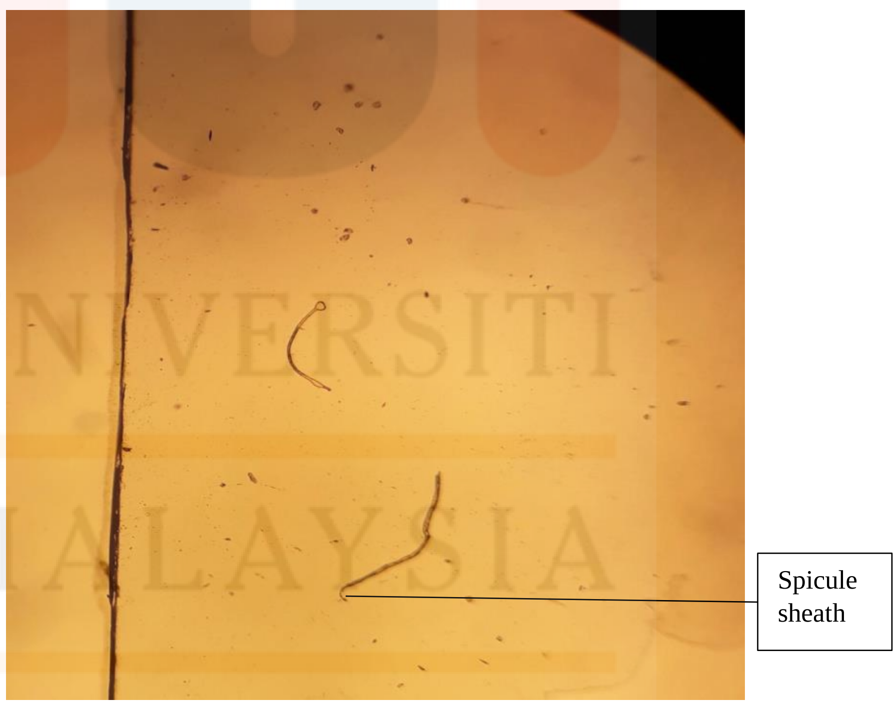

Figure 4.6: Male threadworm under 4x10 magnification

Trematodes

The percentage of trematodes found in this study was the highest which is 40%. Trematode and *Fasciola* egg were observed under the microscope with 10x magnification. The fertilized trematode eggs have oval shape, operculated, yellowish and have mammilated layer (Figure 4.7). While, the ova of *Fasciola* have an ovoid in shape, quinone colour and often showing an inconspicuous operculum (Figure 4.8). In addition, this *Fasciola* eggs can grow into an adult fluke and can cause fascioliasis which is a waterborne and foodborne zoonotic disease. Species of *Fasciola* are also known as liver flukes because they mainly attack the host liver and infect various animal species, mostly herbivores which the plant-eating animals.

Figure 4. 7: Fertilized egg of trematode under 4x10 magnification

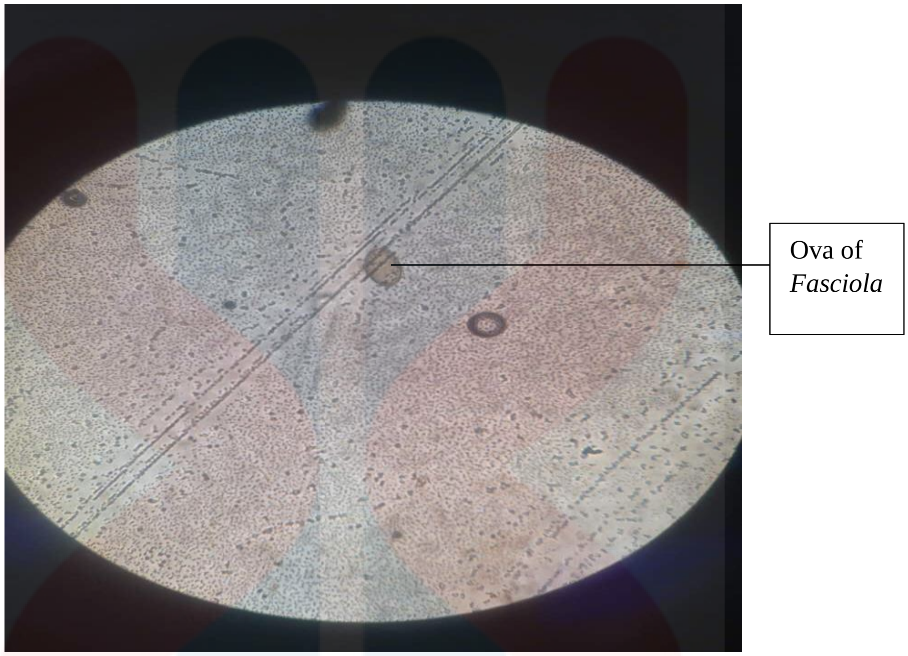

Figure 4.8: Ova of *Fasciola* under 4x10 magnification

4.2.2 Protozoan

Protozoa are microscopic, one-celled organisms that can be free-living or parasitic in nature. Transmission of protozoa typically occurs through a faecal-oral route for example, contaminated food or water or person-to-person contact.

Coccidia Oocysts Egg

Coccidian parasites contaminate the intestinal tracts of the host and are the biggest group of apicomplexan protozoa. Contamination with these parasites is known as coccidiosis. *Coccidia* can infect all mammals, some birds, some fish, some reptiles, and some amphibians. Most species of *coccidia* are species-explicit in their host. The frequency of *coccidian* (Figure 4.9) found in the samples was 7%, which is the lowest frequency.

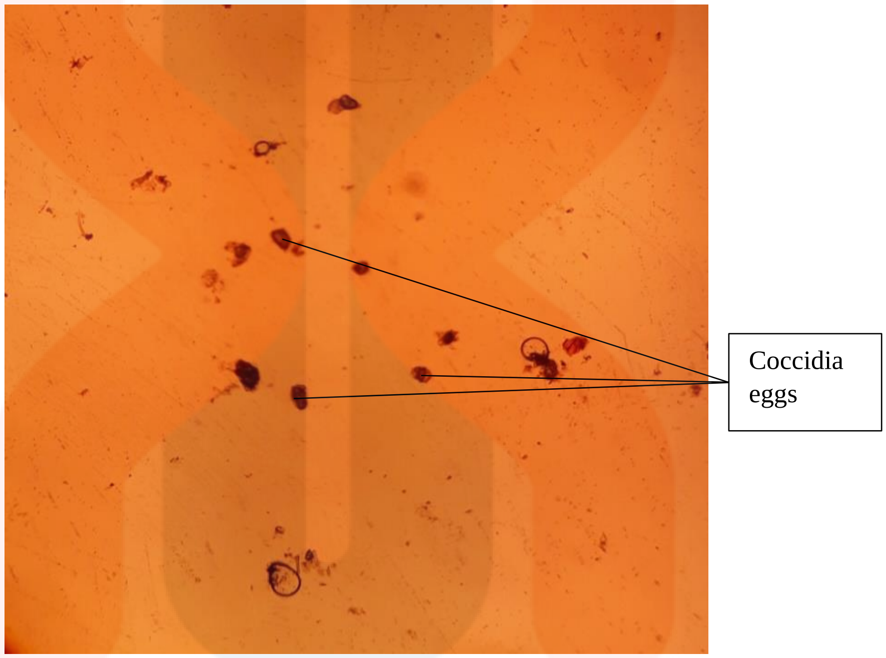

Figure 4.9: Coccidia eggs under 4x10 magnification

4.3 Frequency of Parasites Diversity

Figure 4.10 shows the frequency of parasites in 134 mean totals of individual. From the figures, trematode show the highest percentage of parasite found during the laboratory examination with 40%, while hookworm have the second highest of percentage with 25%, follow by roundworm with 17%, threadworm 11% and coccidian parasites has the lowest frequency with 7%.

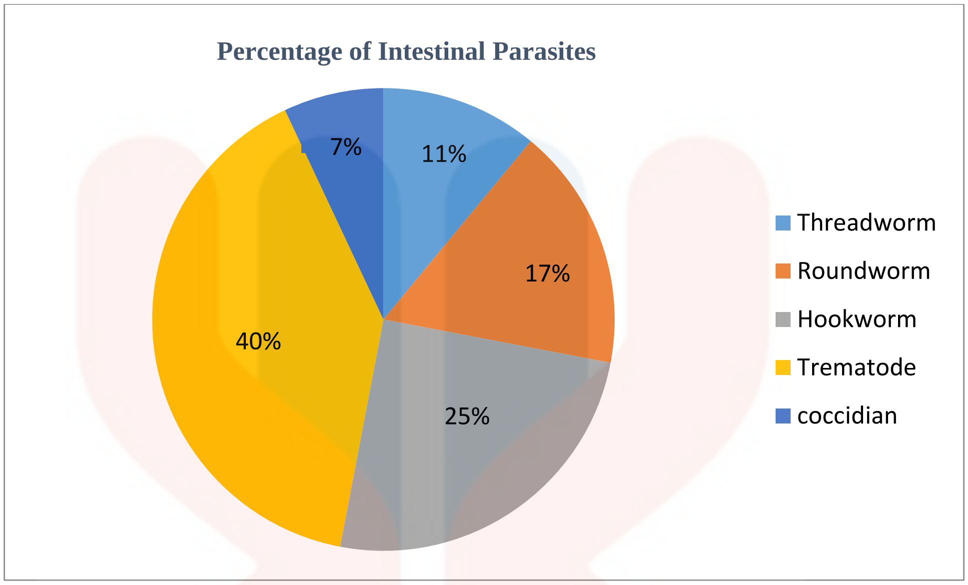

Figure 4.10: The Percentage of Intestinal Parasites in Asian Elephant at Gunung Basor.

4.4 Relative Abundance of Intestinal Parasites in Asian Elephant

The most abundance species that have been observed through the microscope in the 20 elephant faecal samples collected were the trematode with 53 individuals out of 134 from the total individual which had been observed. The number of abundance is followed by hookworm (33), roundworm (23), threadworm (15) and coccidian (10).

4.5 Parasites Egg Count

From 20 samples of elephant dung collected in Gunung Basor, the laboratory examination shows that the highest number of parasite egg observed were in sample number 15, while the lowest number of egg parasite recorded were in sample number 6 and 10 (Figure 4.11). The species of parasites eggs cannot be identified because the species identification cannot be made on eggs alone without the presence of adult parasitic worm around the eggs and the egg features were almost the same for all types of the parasites. The difference between the highest and the lowest parasite egg count were 19 eggs.

From the result, it shows that the total parasite egg found in the elephant dung at the study site was considered high. This is because in every 20 samples collected there were about almost 10 parasite eggs present. Their eggs are taken into the body, usually by swallowing plant that has parasites egg on them or by drinking contaminated water. The demonstration of this parasite eggs or larvae means that the elephant is infected with parasites, but it is not indicating the degree of the infection. However, the high number of the parasite eggs in the elephant dung indicate that the Asian Elephant is not in a good health condition.

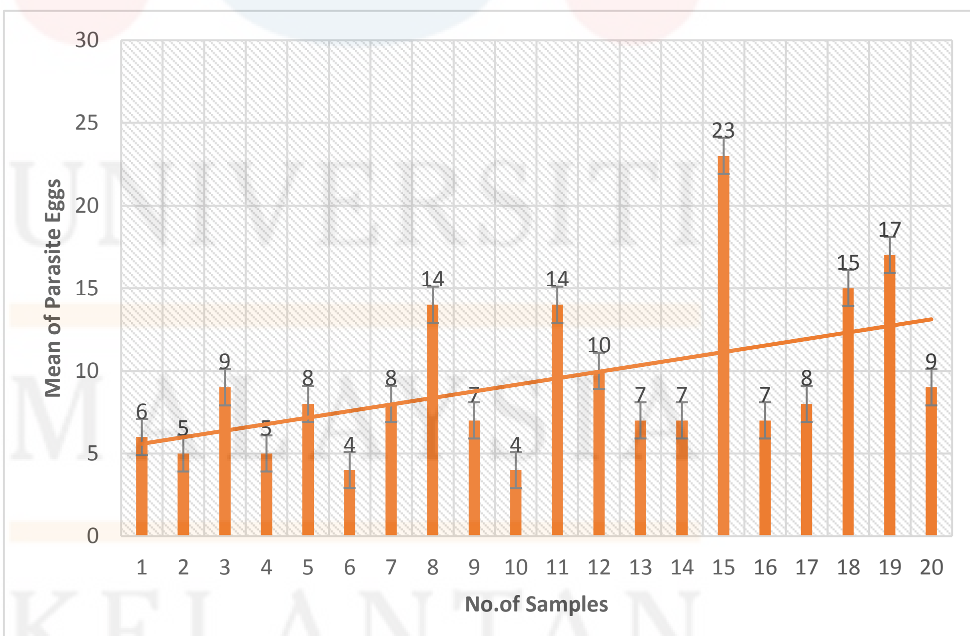

Figure 4.11: The average number of parasite egg in 20 samples

4.6 Average Number of Parasite Worm

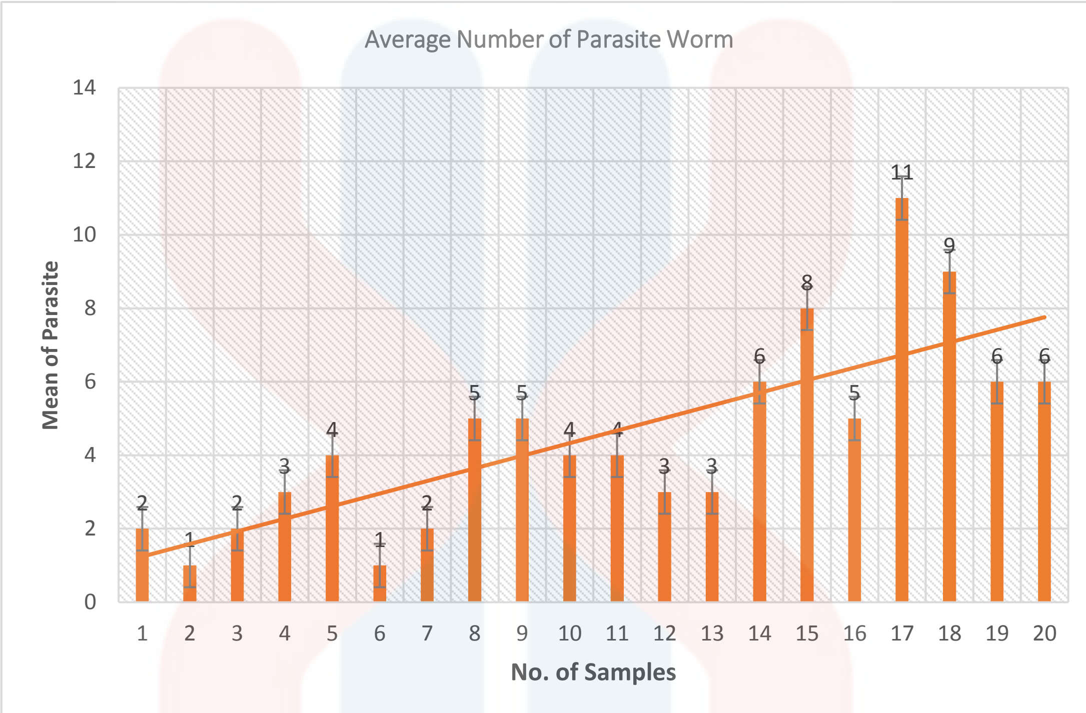

Figure 4.12: The average number of parasite worm in 20 samples.

The mean number of parasitic worm present in the 20 samples collected were the highest in the sample number17 with the mean of 11 parasitic worm present, while sample 2 and sample 6 has the lowest number of parasitic worm present with mean of 1 parasitic worm present in each sample. The presence of this parasitic worms means that the parasites has lives in the elephant’s intestinal for a long time and the parasites eggs has fertilized and reproduce. This is because the worms can live inside the body and then they hatched out of their eggs. The presence of the worms in the body can cause sickness and diseases as the parasites worm will eat the food before the host body has digested it. This will cause lack of nutrient or the host did not get enough nourishment to survive if it occur for a long time and the host did not get any treatment. In addition, sometimes the worms will find their way into different parts of the body, for example, the blood or liver. At the point, when this happens these parts of the body may not be worked appropriately and lead to death. Thus, the present of parasitic worm in every sample that had been collected in Gunung Basor indicate that the probability of Asian Elephant had been infected with parasitic diseases is high.

4.7 Species Richness and Evenness

Table 4.2: Shanon Diversity Index

Species	n	Pi	Lnpi	-pi*lnpi	H	Evenness
Strongyloides sp.	15	0.11194	-2.18979	0.24513	1.45326	
Ascaris sp.	23	0.171642	-1.76235	0.30249		
Fasciola sp.	53	0.395522	-0.92755	0.36687		
Ancylostoma sp.	33	0.246269	-1.40133	0.3451		
Coccidia sp.	10	0.074627	-2.59525	0.19368		
Total	134					0.900

Shannon Index (H) = - $= -\sum_{i=1}$ pi (lnpi),

Equitability = H/ln S = 1.45/ln (5) = 0.9

In the Shannon Index, p is the proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N), ln is the natural log, Σ is the sum of the calculation, and S is the number of species.Based on Shanon Diversity Index, the species of intestinal parasite in 20 samples collected at Gunung Basor has high evenness because the value of equitability is near to 1 which is 0.9. This is because there is no much difference in the abundance of the individual parasite found through the samples. Meanwhile, the maximum diversity index for the parasites is equal to natural log of species richness which is log (5) = 1.61.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.0 Conclusion

From the result obtained, it shows that in every sample collected at Gunung Basor has shown with the present of parasites eggs and parasites worms. This shows that the Asian Elephant in Gunung Basor had been infected by intestinal parasites such as the helminth and protozoa. The type of intestinal parasites that can be identified through the laboratory examination were the helminths parasites which are the threadworm (*Strongyloides* sp), roundworm (*Ascaris* sp.), hookworm (*Ancylostoma* sp) and trematode which are the fluke and Fascioliasis, also coccidian from protozoa. From the findings, it shows that the health of Asian Elephant at Gunung Basor Forest Reserve is not in a good condition because it have been infected by the diverse type of parasites.

Apart from that, from the result obtained through Shanon Diversity Index, the number of parasites types found has high evenness which means that the community of the species found in the samples collected at the study site were very diverse because the abundance of the individual parasites was quite the same.

The presence of the intestinal parasites can cause threat to the elephant health. This is because the effect of the parasites to the elephant cannot be taken lightly and this is proved by the death of a captive young elephant in Kerala, India because of a fluke infection. This fluke infection can lead to Salmonellosis, an infection of the elephant intestines which cause diarrhoea and enteritis, septicaemia and death (Chooi & Zahari, 1988). Also, there was a case where an adult elephant, *Elephas maximus*, which is 14 years old, died because of hookworm infection associated with severe anaemia, emaciation and diarrhoea (Sutherland *et al*, 1950). According to Rao *et al* (1992), the presence of the intestinal parasites in an elephant can be detected by clinical sign when the elephant shows the symptom of diarrhoea and inappetence that is mainly because of the infection of strongyles and amphistomes.

5.1 Recommendation

The infection of intestinal parasites occurs because of many factors. One of the factor that can be relate to Asian Elephant at Gunung Basor is because of polluted water source by faeces of infected elephant, which is because the parasites eggs are continually being passed out. The infection also can generally come from fodder or stagnant and marshy water. Besides that, infection also can occur when the elephant consumes plants that have parasites eggs on them or by consuming contaminated vegetables or fruits. Authorities such as Jabatan Perlindungan Hidupan Liar dan Taman Negara Semenanjung Malaysia (PERHILITAN) should take action and concern in this issue if they want to protect Asian Elephant from declination.

Although every elephant and other wildlife has a few parasites in them, and there are no functional disturbances unless there are very numerous and moderate invasion cause no loss of condition, still they should make sure that the habitat of this species is clean and free from any pollution or disease that could harm the elephant and effect their population. Thus, to help the conservation of Asian Elephant, the elephants at Gunung Basor should get an immediate treatment if they show any symptom of parasite infection such as diarrhoea and inappetence.

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APPENDIX A

Table A: Raw material and chemical used

Raw Material	**Chemical**
Elephant dung	Sodium Chloride, Nacl

APPENDIX B

Figure B1: Elephant dung at Gunung Basor

Figure B2: Collecting samples at Gunung Basor with supervisor, Dr. Kamarul Ariffin.