THESIS

PREVALENCE OF HELMINTHIASIS ON BANTENG *(Bos javanicus)* IN SURABAYA ZOO AND PRIGEN SAFARI PARK II THROUGH STOOL EXAMINATION

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LEGALIZATION PAGE

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THESIS

As a requirement to achieve
Degree of Bachelor Veterinary Medicine
in
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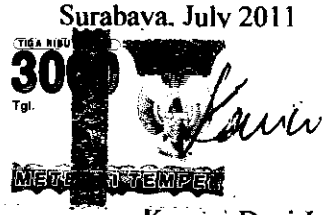

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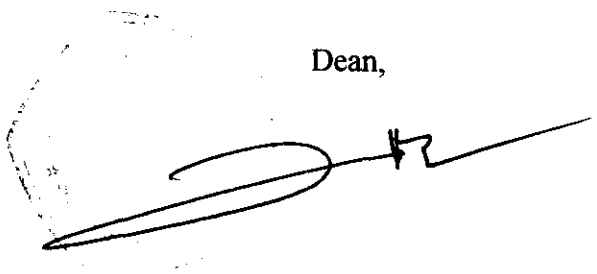

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PREVALENCE OF HELMINTHIASIS ON BANTENG (*Bos javanicus*) IN SURABAYA ZOO AND PRIGEN SAFARI PARK II THROUGH STOOL EXAMINATION

Kamini Devi Jayarajah

ABSTRACT

This research aim was to find out type of helminth eggs which infected banteng through native, sedimentation and floatation methods, and to know the prevalence of helminthiasis occurred on banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II. Stool samples were taken from Surabaya Zoo and Prigen Safari Park II as many as 12 samples and 23 samples respectively. The results from Surabaya Zoo showed that 12 samples were positively infected by *Schistosoma* sp (100 %) which includes in trematode class and 23 samples from Prigen Safari Park II were positively infected by *Schistosoma* sp (100 %), *Moniezia* sp (17.4 %) and *Trichostrongylus* sp (13 %) which was from trematode, cestode and nematode class respectively. The prevalence of helminthiasis rate for Surabaya Zoo and Prigen Safari Park II were 100 %.

Keyword: Banteng (*Bos javanicus*), Helminth eggs, Surabaya Zoo, Prigen Safari Park II

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ABBREVIATIONS AND SYMBOL MEANINGS

cm = centimeter

mm = millimeter

µm = micrometer

pH = power of Hydrogen

kg = kilogram

° C = degree of Celsius

sp = species

ml = milliliter

IUCN = *International Union for Conservation of Nature and Natural*

% = percentage

rpm = rotation per minute

RH = Relative Humidity

TSI = Taman Safari Indonesia (Prigen Safari Park II)

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background

Banteng (*Bos javanicus* d'Alton, 1823) is classified as an endangered species by the IUCN Red List, because the decline parts of the species range were more than 80% and overall decrease of at least 50 % was likely (IUCN, 2006). The natural range of the animal includes Borneo, Burma, Cambodia, Yunnan, Java, Laos, Thailand and Vietnam and was introduced to Australia, Bali, Enggano (South West of Sumatra) and Sangihe (Wilson and Reeder, 2005). On Peninsular Malaysia, population of banteng has extinct since the 1950s (IUCN, 2006).

The main causes for banteng decline were poaching for medicine, food and trophies and losses their habitat as well as transmission of diseases leads by house cattle. Only one or two subpopulations of more than 50 animals were known to remain in mainland Asia (Hedges, 2000). Most of the larger subpopulations with more than 150 banteng were living in Java Island, Indonesia. In this island, however, most banteng are living in small and isolated protected areas and threatened with extinction.

The banteng's other present-day stronghold is Java, where six large subpopulations (those with more than 50 animals) occurred in 1990, but these declined to only 4 - 5 by 2004 (Pudyatmoko, 2004). Pudyatmoko (2004) estimated, Ujung Kulon National Park (300 – 800 individuals in 2003), Cikepuh-Cibanteng Nature Reserve (25 - 65 individuals in 2003), Bonjonglarang-Jayanti Region (a small stable population of unknown size in 1988), Cimapag Region

(occurrence recorded until 1970), Leuweng Sancang Nature Reserve (10 individuals in 2000, extinct in 2003), Cikamurang Region (occurrence recorded until 1970), Pangandaran Nature Reserve (25 - 65 individuals in 2003), Kediri Region (occurrence recorded until 1970), Coast of Blitar (10 individuals in 1988), Coast of Malang (6 individuals in 1988), Meru Betiri National Park (200 individuals in 2000, with at least 57 individuals in 2002), Alas Purwo National Park (with at least 80 individuals in 2002), and Baluran National Park (around 206 individuals in 2002). Number in all areas is declining (Hedges and Tyson 1996; Pudyatmoko, 2004).

Banteng has the ability to breed slowly but can adapt quickly to their environment. The gestation period is about 285 days (Huffman, 2004). For each adult female banteng that have been aged 3 years or more have the ability to give birth to 1 - 2 calves for each birth, but mostly each cow delivers one calf (Dharmakalih dan Gunadi, 1997).

Parasite infection is the most common infection found in the animals including in the wildlife and can cause significant decline to natural population. The majority of mammal species considered threatened by parasites are carnivores or artiodactyls. Infection of parasite usually is not marked with clear clinical symptoms and usually doesn't cause death. However the presence in the body can disturb the health of the animal itself until it can reduce power production and reproduction in adult animals. Meanwhile in young animals, infection of helminths will cause anemia, diarrhea, loss of appetite, and disturbance in growth. In Indonesia the prevalence of helminths infection is still relatively high in

animals. In general, the disease causes high economic losses and a threat to animal health (Tiuria, dkk., 2008; Soulsby, 1982).

Surabaya Zoo and Prigen Safari Park II are the two places for banteng conservation. Surabaya Zoo is situated in lowland with temperature 28.2° C and humidity 81 % in the month of April and in May the temperature is 28.9 ° C with humidity 76 % (as shown in Appendix 6 and 7). Meanwhile Prigen Safari Park II is in the highland right in the waist of the mountain approximately 600 - 800 above sea level with temperature 21.4 ° C and humidity 91.3 % in the month of April and in May the temperature is 21.6 ° C with humidity of 90 % (as shown in Appendix 8 and 9) . The epidemiology of helminthiasis is determined by several factors governed by parasite-host-environment interactions. The major epidemiological variable influencing worm burdens of animals is the infection rate from pastures. It is also influenced by the climatic requirement for egg hatching, development and survival of larvae. The major risk factors of helminthiasis can be broadly classified as parasite host (including of epidemiology of different species), host factors such as genetic resistance, age and physiological status of the animal, while the environmental factors such as climate, nutrition, stocking density and management (Tariq *et al*, 2008).

According to the background the above, thus there is necessary to do research on prevalence of helminthiasis on banteng in Surabaya Zoo and Prigen Safari Park in order to prevent helminthiasis on banteng population and also to maintain the population of banteng for conservation in the future.

1.2 Formulation of Problems

1. What types of helminth eggs that infects banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II?
2. What is the prevalence rate of helminthiasis that occured on banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II?

1.3 Purposes of Research

1. To find out types of helminth eggs that infects banteng (*Bos javanicus*) by using method of native, sedimentation and floatation in Surabaya Zoo and Prigen Safari Park II.
2. To know the prevalence of helminthiasis on banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II.

1.4 Benefits of Research

This research is expected to be useful to give information for the management in order to control and prevent against helminthiasis through medication, sanitation and management. The government and the management of conservation should take precaution steps to conserve banteng as the numbers of this population has been declining. It is also necessary to increase awareness in the public about the presence of banteng, so that this population will not extinct and become unknown to the future generations.

CHAPTER 2

LITERATURE VIEW

CHAPTER 2 LITERATURE REVIEW

2.1 Banteng *(Bos javanicus)*

Indonesia has an important position in terms of global biodiversity, since it is one of the ten countries with richest biodiversity often known as megadiversity country (Primack *et al.*, 1998 in BAPPENAS, 2008). Uncontrolled logging and wildfires have consumed millions of acres for decades, destroying 44 % of original habitats and nearly all the lowland rainforests in Indonesia (Mittermeier *et al.*, 1999 in Animal Welfare Institute, 1983).

Banteng (*Bos javanicus*) is a 4-legged wild mammal of the Artiodactyla order. The Banteng (*Bos javanicus*) also known as Tembadau, is a species of wild cattle found in Southeast Asia. Wild banteng currently occurs on Java and possibly Bali, in Kalimantan (Indonesia Borneo), Sabah (part of Malaysian Borneo), Myanmar, Thailand, Laos, Vietnam and Cambodia. The world population of Banteng is unlikely to be more than 8,000 and is quite possibly fewer than 5,000 animals. No subpopulations of more than 500, and only 6 – 8 subpopulations of more than 50 animals, are known, with 4 – 5 on Java (Pudyatmoko 2004). A once fairly widely distributed species, it is now largely reduced to small isolated populations, most of which are still in decline.

Three subspecies of banteng have come to be generally recognized (Lekagul and McNeely 1977; National Research Council 1983) which are *Bos javanicus javanicus* (in Java and Bali), *Bos javanicus lowi* (in Borneo) and *Bos javanicus birma nicus* (in Asian mainland).

Hoogerwerf (1970), shoulder height varies according to age, male banteng aged 8 - 10 years have up to shoulder height 170 cm while the female banteng with the same age has a shoulder height up to 150 cm. Their tail measures 65 to 70 cm (D'Alton, 1823; Nowak, 1991). According to a veterinarian surgeon specialist, Van der Schaaf in Alikodra (1983), the maximum age a banteng can live is about 20 years.

Figure 2.1 Male Banteng in Prigen Safari Park II (8th April 2011)

Figure 2.2 Female Banteng in Prigen Safari Park II (8th April 2011)

2.1.3 Behaviour

They live in loose herds of 2 to 40 individuals composed of cows and their calves and generally only one adult male. Adult males in surplus live often alone or group together in bachelor herds (Hoogerwerf, 1970). In undisturbed areas banteng are largely diurnal, though may be active at any time of the day. In areas where they have been harassed by humans they become nocturnal, feeding throughout the night. Banteng are shy and wary, they rely on the presence of dense vegetation in which to take shelter (Nowak, 1999).

2.1.4 Digestive System

The digestive system of banteng is same as other ruminant because they all come from the same family.

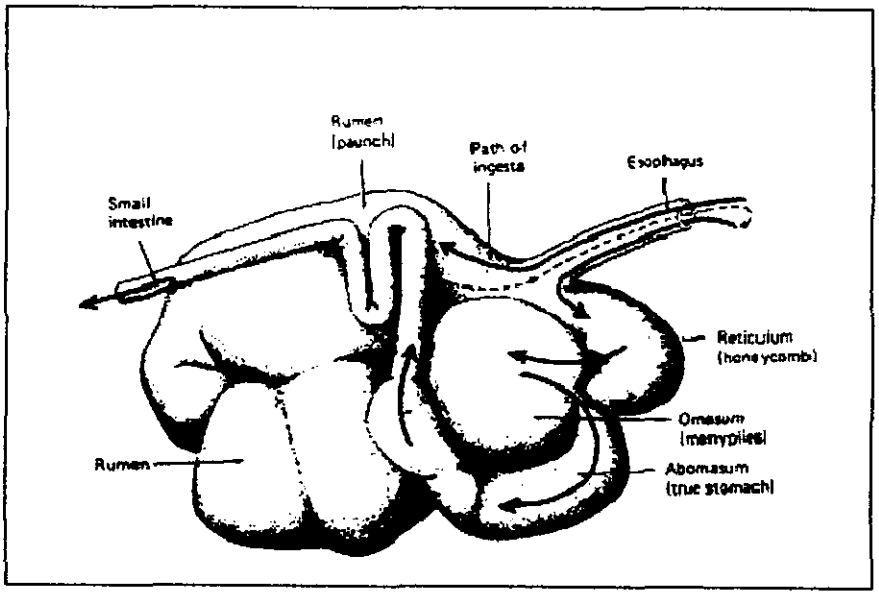

Figure 2.3 The figure shows the digestive system of cattle (source by Jurgens, 2002)

2.1.5 Habitat and Diet

Wharton (1968) summarized information about banteng habitat from throughout its range and he concluded that on the Asian mainland it avoids evergreen rainforest and is usually within more open dry deciduous forests. Although probably a grazer by preference banteng should perhaps be considered an intermediate feeder since it can and does consume a lot of browse and fruits depending on season and local food availability. According to Hoogerwerf 1970, Lekagul and McNeely 1977 said that banteng as a herbivore animal is known as grass eater (grazer) more than as eating bushes and leaves. The young shoots of alang-alang grass (*Imperata cylindrical*) are apparently a favored food source (Hoogerwerf, 1970).

2.1.6 Reproduction

There is generally only one adult male in each banteng herd. That male reproduces with all adult females in the herd. Males compete for dominance of a herd and are probably not able to maintain a herd unless they are in prime condition and fully adult.

Sexual maturity occurs between two and four years (Choquenot, 1993). They can reproduce every year 1 or 2 calves will birth after a gestation period of 285 days (Hoogerwerf, 1970). Wild banteng limit their breeding to the months of May and June. Females care for and nurse their young for 6 to 9 months after their birth (D'Alton, 1823; Nowak, 1999).

2.2 Parasite Review

Parasites are ubiquitous in the lives of wild animals and represent a major component of biological diversity (Price, 1980). Evidence proves that parasites can increase extinction risk in wild animals (Woodroffe 1999; Daszak *et al.*, 1999). Banteng may harbour a diverse parasite fauna. Since ruminant and banteng comes from the same family and has the same digestive system, it is believed that the helminths that infects ruminant are same as the helminths infects banteng. According to Soulsby (1982) there are 3 classes of helminths which are Nematode, Cestode and Trematode. Helminths which include in Nematode class are *Haemonchus* sp, *Oesophagustomum* sp, *Toxocara vitulorum*, *Trichostrongylus* sp, *Trichuris* sp, *Mecistocirrus digitatus*, *Cooperia* sp, *Bunostomum* sp, *Chabertia* sp, *Nematodirus* sp, *Ostertagia* sp, and *Strongyloides* sp (Soulsby, 1982). From Cestode class is *Moniezia* sp. From Trematode class are *Fasciola* sp, *Paramphistomum* sp, *Gastrothylax crumenifer*, *Schistosoma* sp and *Cotylophoron cotylophorum* (Soulsby, 1982).

2.2.1 Nematode

In general, the nematodes are the most numerous animals on earth (Smyth, 1962; Jasmer *et al.*, 2003). Nematodes make up a large assemblage of worms of relatively simple structure with a widespread distribution, their cylindrical, non-segmented bodies distinguishing them easily from other helminths. They occur in fresh water, in the sea, in the soil, and are among the most successful parasites of plants and animals (Smyth, 1962). Concerning the morphology of nematodes, the

2.2.1.2 *Bunostomum* sp

a) Morphology

It's also called as hookworm. The male is 12 - 17 mm long and the female 19 - 26 mm. The anterior end is bent in a dorsal direction, so that the buccal capsule opens anterodorsally. The eggs measures 79 - 97 by 47 - 50 μm. The ends are usually blunted rounded and the embryonic cells are darkly granulated (Soulsby, 1982).

b) Habitat

Usually found in small intestine (jejenum and ileum) sheep, goat, and cattle (Urquhart *et al.*, 1989).

c) Life cycle

The development is direct. Infection of the host occurs through the oral or percutaneous. Following skin penetration the larvae pass to the lungs, where the 3rd ecdysis occurs. The fourth stage larvae, reach the intestine again after 11 days and the first stage eggs are passed 30 - 56 days after infection (Soulsby, 1982).

d) Pathogenicity and Clinical Signs

Worms attach to the mucosa by a large buccal capsule, causing mucosal inflammation, thickening and punctiform hemorrhages. Clinical signs include anemia, inappetence, ill thrift, a dark scour, and submandibular oedema. Infection in calves maintained in wet or muddy conditions can be associated with skin penetration by the infective larvae (Love and Hutchison, 2003).

while in the female the white ovaries are spirally round around the red instestine, producing the appearance of a barber's pole. The eggs measures 70 - 85 by 41 - 48 μm and those passed in faeces of host containing an embryo divided into 16 - 32 cells (Soulsby 1982).

b) Habitat

Haemonchus sp is found inside the abomasum of sheep, goats cattle and numerous other ruminants in most parts of the world (Subekti dkk., 2005).

c) Life cycle

Life cycle is direct. The eggs hatch to L1 on the pasture and may develop to L3 in a short period as 5 days but development may be delayed for weeks or months under cool conditions. After ingestion, and exsheathment in the rumen, the larvae moult twice in close appostion to the gastric glands. Just before the final moult they develop the peircing lancet which enables them to obtain blood from the mucosal vessels. The prepatent period is 4 weeks in cattle (Urquhart *et al.*, 1989).

d) Pathogenicity and Clinical Signs

The principle feature of *Haemonchus* sp infection is anemia. Both the adult and the 4th larvae stages in *Haemonchus* sp in cattle suck blood and in addition, moves and leaves wounds which haemorrhage into the abomasum. The average of blood loss has been calculated at 0.05 ml/parasite/day and blood first appears in the faeces 6 - 12 days after infection (Clark *et al.*, 1962 in Soulsby, 1982). The clinical signs of haemonchosis maybe divided into 3 syndromes which are, hyperacute, acute and chronic. Hyperacute haemonchosis uncommon but

maybe seen in susceptible animals are exposed to sudden massive infection. The extreme large numbers of parasites causes a rapidly developing severe anemia, severe haemorrhagic gastritis, dark coloured faeces, and sudden death from acute loss of blood. Acute haemonchosis is seen primarily when young susceptible animal becomes heavily infected. Anemia accompanied by hypoproteinanemia and odema (i.e bottle jaw) and death occurs. Chronic haemonchosis is extremly common and considerable economic importance. Affected animals are weak, emaciated and unthrifty (Soulsby, 1982).

2.2.1.6 *Nematodirus* sp

a) Morphology

According to Love and Hutchinson (2003), *Nematodirus* is whitish, relatively long (females 18 - 12 mm, males 10 - 17 mm long) compared to other trichostrongyle nematodes, with the anterior portion thinner than the posterior end, hence it is called 'thin–necked intestinal worm'. Spicules are 0.7 - 1.21 mm long. The egg measures 175 - 260 by 106 - 110 μm and contain embryo of about 8 cells when passed by the host (Soulsby, 1982).

b) Habitat

According to Soulsby (1982), it lives in the small intestine of sheep, cattle and other ruminants.

c) Life cycle

Infective 3rd stage larvae, when ingested, penetrate the intestinal mucosa between the villi and moult to the 4th stage by day 4. Many leave the mucosa

between 4 – 6 days but others are still on the mucosa on 10th day and by 10th day the majority have been moulted to the 5th stage before emerging from the mucosa. The prepatent period is 15 days (Mapes and Coop, 1972 in Soulsby, 1982).

d) Pathogenicity and Clinical Signs

The parasite penetrate the intestinal mucosa causing extensive destruction and tunnelling (Samizadeh-Yazd and Todd, 1979 in Soulsby, 1982) but the posterior portion of the parasite maybe protruded into the lumen of the intestine. The clinical signs are sudden scouring, dehydration, little or no weight gain and in severe cases, death occurs (Cullen, 1991).

2.2.1.7 *Oesophagustomum* sp

a) Morphology

These nematodes are often refered to as nodular worms, owing to the fact that several species cause nodule formation on the wall of the intestine. The male is 12 - 16.5 mm and female 15 - 21.5 mm long by about 0.45 mm wide. The eggs have thin shells and are laid in the 8 - 16 cells stage, they measure 73 - 89 by 34 - 45 μm (Soulsby, 1982).

b) Habitat

It is found in the colon of cattle (Subekti dkk., 2005).

c) Life cycle

The life cycle for species of *Oesophagostomum* is direct and with respect to free-living larval stages is largely identical to those documented for other strongyloid nematodes (Levine, 1990). L3 are infective stage. Fourth stage larvae

develop within nodules in the small and large intestine, and near 17 - 22 days post infection, they migrate back to the large intestine for the final molt. Eggs are passed in faeces, develop, L1 hatch and develop to infective L3 in the environment in 6 - 7 days. L3 is ingested by definitive host. Larvae exsheath and penetrate the wall of the intestine (anywhere from pylorus to rectum) and become enclosed in nodules. Larvae (now L4) leave the nodules and begin maturation. Prepatent period is 30 to 50 days (Hussein, 2007).

d) Pathogenicity and Clinical Signs

Resistance develops by 2 years, so disease is seen only in young stock. Nodules may be 1 - 5 mm in diameter, contain caseous material and may become calcified. Clinical signs that can be noticed are anorexia, emaciation and dark green diarrhea (Hussein, 2007).

2.2.1.8 *Ostertagia* sp

a) Morphology

Its known as brown stomach-worm because they have this colour when they are fresh. The worms are slender. Males are 6.5 – 7.5 mm long and females are 8.3- 9.2 mm. The eggs measures 80 - 85 by 40 - 45 μm (Soulsby, 1982).

b) Habitat

Ostertagia sp occurs in the abomasum of cattle, sheeps and goats (Soulsby, 1982).

c) Life cycle

The life cycle of Ostertagia is direct. Ingested the 3rd stage larvae exsheath in the rumen and then penetrate the gastric gland in the abomasal mucosa. The 3rd and 4th moults occurs in the gastric glands and adult parasites emerge 18 - 21 days after infection. The prepatent period is approximately 3 weeks (Soulsby, 1982).

d) Pathogenicity and Clinical Signs

The pathologic changes can be divided into 3 phases. In the first phase, up to 17 days after infection, lesion are produced by the developing larvae in the gastric glands and morphological changes are confined to the parasitized glands. In the second phase, 17 - 35 days after infection, and are associated with the emergence of adult parasites from the gastric gland and the occurance of striking changes in the surrounding of the gland. The third phase, is associated with a gradual loss of adult parasites after 35 days of infection and there is a gradual return to structurally and functionally normal gastric mucosa by day 63 - 70 of the infection (Soulsby, 1982). Two clinical manifestation of the disease are seen. Type 1 ostertagiasis, causes abomastitis with oedema and necrosis, decreased albumin levels, reduction of appetite and profuse watery diarrhea, which is often a bright green colour due to the failure of the abomasum to denature chlorophyl (Soulsby, 1982). And the type 2 ostertagiasis causes severe chronic diarrhea and emaciation which leads to fatal death (Martin *et al.*, 1957 in Soulsby, 1982). There is marked with reduction of serum proteins and subcutaneous oedema may be

evident, owing to the loss of serum albumin (Mulligan *et al.*, 1963 in Soulsby, 1982).

2.2.1.9 *Toxocara vitulorum*

a) Morphology

The male measures up to 25 cm by 5 mm and female 30 cm by 6 mm. The eggs are subglobular, provided with a finely pitted albuminous layer and measures 75 - 95 by 60 - 75 μm (Soulsby, 1982).

b) Habitat

It's found in small intestine of cattle, zebu, indian buffalo, sheeps and goats (Warrren, 1971 in Soulsby, 1982).

c) Life cycle

Ingested of embryonated eggs by neonatal, juvenile and adults does not lead directly to patent infection. Instead larvae are distributed to various tissue and organs, remaining dormant in the site untill the later part of pregancy in the cow. At this time prenatal infection occurs. Larvae also migrates to the mammary gland and pass out in the milk and ingested by calves, produce adult worm in the intestine (Soulsby, 1982).

d) Pathogenicity and Clinical Signs

Light infections may pass unnoticed in calves but clinical signs are seen with worm burdens of 70 - 500 per calf. The predominat clinical signs are diarrhea and steatorrhoea. They may accompanied by colic, intestinal obstruction and presence of mud-coloured faeces and later may cause death (Soulsby, 1982).

2.2.1.10 *Trichostrongylus* sp

a) Morphology

This species of this genus all small (smaller than *Ostergia* sp), slender, pale reddish-brown worm. Male measures 4 - 5.5 mm long and female are 5 - 7 mm (Love and Hutchinson, 2003). The egg measures 79 - 101 by 39 - 47 µm (Soulsby, 1982).

b) Habitat

Trichostrongylus sp in found in the anterior portion of the small intestine and sometimes also in the abomasum of sheep, goat, cattle, camel and various antelopes (Soulsby, 1982).

c) Life Cycle

The eggs are passed through faeces of the host, being thin shelled and in 8 - 32 cells (blastomere stage). Later on will form in larva stadium I and will become infective larva. Infective larva (stadium III) formed between 4 - 6 days in optimal condition (27 °C, with oxygen and water). Infective larva is been eaten by the host goes through second edcysis before the parasitic cycle begins (Subekti dkk., 2005).

d) Pathogenicity and Clinical Signs

The mucosa of the abomasums may show congestion and superficial erosions, which are sometimes covered with a fibrino necrotic exudates (Kahn, 2005). Clinical signs such as diarrhea, dehydration, bottle jaw and emaciation in stressed animals (Foreyt, 2001).

2.2.1.11 *Mecistocirrus digitatus*

a) Morphology

Males are up to 31 mm long and females up to 43 mm. Female worm has effect barber's pole like *Haemonchus* sp. Vulva placed from end of posterior, 0.6 - 0.9 mm, and there's no vulva flap. Eggs measures 95 - 120 by 56 - 60 μm (Soulsby, 1982).

b) Habitat

Is found in the abomasum of cattle, buffalo, zebra, sheep, goats and other ruminants (Subekti dkk., 2005).

c) Life Cycle

Life cycle is direct, the prepatent period being about 60 days (Frenando, 1965 in Soulsby, 1982). In this infection the 4th larval stage is of long duration, lasting from the 9th - 28th day of infection (Soulsby, 1982).

d) Pathogenicity and Clinical Signs

It is marked with haemorrhage through the wounds in the abomasal mucosa (Soulsby, 1982).

2.2.1.12 *Trichuris* sp

a) Morphology

Male adults are 40 - 70 mm long and female worm measures 42 - 60 mm long. The anterior part 2/3 - 3/4 long from the whole body .The eggs measures 68 x 36 μm (Subekti dkk., 2005).

b) Habitat

Inhabits inside caecum of cattle, deer, sheep, goat and other ruminants (Subekti dkk., 2005).

c) Life Cycle

The eggs reach infective stadium after 3 weeks in optimal condition. Infective larva can live for few years. The host gets infected by eating egg which has infective larva and goes into caecum, and stay inside Lieberkuhn gland for 3 - 10 days and then it moves into the lumen of caecum and becomes adult (Subekti dkk., 2005).

d) Pathogenicity and Clinical Signs

Clinical signs are unlikely, but in occasional heavy infections, dark faeces, anemia, and anorexia may be seen (Kahn, 2005).

2.2.2 Cestode

Cestodes are hermaphrodite worms with long body and has no body cavity neither gastrointestinal. The body contained by head called scolex, usually with some sucker, strobila which contains segments or proglottids. Between the scolex and the strobila, there one short part which is not segmented called the neck. Each proglottids has one or two pair of female and male reproduction (Soulsby, 1982)

2.2.2.1 *Moniezia* sp

a) Morphology

Proglottids, which are wider than long, may be found in faeces. Eggs are of typical anoplocephalid type and can be found using standard fecal floatation procedures. *Moniezia benedeni* eggs are square, approximately 75 µm in diameter. *Moniezia expansa* eggs are triangular, 56 – 67 µm in diameter (Ballweber, 2010).

b) Habitat

Moniezia sp is found inside the small intestine ruminant, chiefly cattle (Soulsby, 1982).

c) Life Cycle

The life cycle is indirect and needs intermediate hosts which are oribatid mites. Cysticercoid develops in genera *Ceratozetes*, *Galumna*, *Oribatula*, *Peloribates*, *Palgulumna*, *Protoscheloribates*, *Scutovertex* and *Zygoribatula* (Levine, 1990) approximately 4 months after mite ingests hexacanth embryo (Sengbusch, 1977 in Soulsby, 1982). Lambs and calves begin acquiring infections at the start of grazing. Seasonality exists in the release of eggs and/or proglottids in temperate zones, it begins in May, peaks in June, and rapidly declines. Proglottids are passed in the faeces of infected animals. These proglottids maybe eaten by birds which therefore may disseminate the infection. Infective stages are produced in approximately 4 months. Ruminants are infected by ingestion of infected mites with herbage and prepatent period is 37 - 40 days (Soulsby, 1982; Ballweber, 2001).

d) Pathogenicity and Clinical Signs

Generally asymptomatic in light infections. Substantial numbers in lambs may cause digestive disorders, diarrhea, cachexia, death may occur, but is rare (Ballweber, 2001).

2.2.3 Trematode

Trematodes are more commonly called flukes (e.g. liver flukes). They are flat, oval shaped worms and not segmented and has one or two sucker to stick on. Like tapeworms, flukes are hermaphrodites except for *Schistosomatidae* family, where the reproduction system of female and male are separated (Soulsby, 1982).

2.2.3.1 *Fasciola* sp

a) Morphology

The shape of adult *Fasciola* look like leaf which is 5 cm long and width is 1.5 cm. Eggs measures 150 x 90 μm, has operculum and thin shell (Levine, 1990).

b) Habitat

Inhabits inside the bile duct of sheep, goat, ox and other ruminant (Soulsby,1982).

c) Life cycle

The eggs enter the duodenum and comes out together with the host's faeces. For further development an amphibious snail of the genus *Lymnea* is required. Infection occurs when definitive host ingest grass or drinks water which is contaminated by cercaria/metacercaria (Subekti dkk., 2005).

d) Pathogenicity and Clinical Signs

The pathological manifestations depend on the number of metacercaria ingested. Acute fascioliasis is less common (Soulsby, 1982).

2.2.3.2 *Paramphistomum* sp

a) Morphology

The color of live adult worm is light red. It is with the 'conical flukes' which are pear shaped. The worm measures about 5 - 13 by 2 - 5 mm meanwhile the eggs measures 114 - 176 by 73 - 100 µm (Soulsby, 1982).

b) Habitat

It is found inside the rumen and reticulum of domestic and wild ruminant (Soulsby, 1982).

c) Life Cycle

Since the family for *Paramphistomum* sp, *Cotylophoron cotylophorum* and also *Gastrothylax crumenifer* is the same, thus the life cycle is the same. Miracidium which is free will swim and enter into the water snail whereby snail is an intermediate host. In the snail's body, the miracidium will become sporocyst and converts to become redia and at last turns to be cercaria. The cercaria will move out from the snail's body and stick on the grass for 1 - 2 months. When the metacercaria is eaten by the definitive host, the cyst will break inside the host duodenum and young worms will penetrate into the stomach mucosa. The adult worm will invade inside the rumen and reticulum (Subekti dkk., 2005).

d) Pathogenicity and Clinical Signs

Most infections of adult fluke are harmless although large numbers of fluke can cause a chronic ulcerative rumenitis with atrophy of ruminal papillae. Peak conical fluke numbers are usually seen in late summer or early winter following prolonged inundation of pasture (Rolfe *et al.*, 1991 in Love and Hutchison, 2003). Clinical paramphistomosis is usually diagnosed in cattle 4 - 18 months of age and is associated with invasion of the duodenum and upper jejunum by large numbers of immature fluke. Counts of up to 30,000 immature paramphistomes may be associated with diarrhea after 8 weeks grazing in tracer calves (Rolfe and Boray, 1993). Catarrhal to necrotic and hemorrhagic duodenitis with little thickening may be seen in the early stages, progressing to thickening (mucosal oedema, submucosal hypertrophy), hemorrhages and ulceration. In most obvious sign is diarrhea accompanied by anorexia and intense thirst.

2.2.3.3 *Schistosoma* sp

a) Morphology

The male worm measures 15 - 20 mm long and the female measures 26 mm. The eggs is oval shaped and measures 70 - 100 x 50 - 80 µm. (Subekti dkk., 2005).

b) Habitat

It is found in the vena messentrica in cattle, sheep, goats and some other animals (Levine, 1990).

c) Life Cycle

The female worm places the eggs in the venule. To reach, lumen of the intestine or the vecisa urinaria, the eggs produces enzyme which can go through the tissue into the lumen of intestine or the vesica urinaria. Meanwhile some worm will enter through the liver or lungs and get stuck in the capillaries and causes some damage. Egg is released with faeces of the host. Once the egg has lefted the host, it must find water to hatch. Active miracidium will swim till they find a snail which matches them. Then is forms sporocyst and produces baby sporocyst. Cercaria leaves the snail, swims into the water and enters the host through skin (Levine, 1990).

d) Pathogenicity and Clinical Signs

Pathologically, the intestinal form of the disease is characterized by petechiae or ecchymoses and granulomata in the gastrointestinal mucosa and, oedema and pallor of the carcass. In the hepatic syndrome there is hepatic infarction, portal fibrosis, thrombosis and dead parasites may be expressed from the cut vessels. There may also be hydrothorax, hydropericardium and ascites (Lughano and Dominic, 2006).

2.2.3.4 *Cotylophoron cotylophorum*

a) Morphology

The eggs measures 125 - 135 by 61 - 68 µm (Subekti dkk., 2005).

b) Habitat

It lives inside of the rumen and reticulum of cattle, sheep, goat, deer and other ruminants (Levine, 1990).

c) Life Cycle

Miracidium which is free will swim and enter into the water snail whereby snail is an intermediate host. In the snail's body, the miracidium will become sporocyst and converts to become redia and at last turns to be cercaria. Cercaria will move out from the snail's body and stick on the grass for 1 - 2 months. When the metacercaria is eaten by the definitive host, the cyst will break inside the host duodenum and young worms will penetrate into the stomach mucosa. The adult worm will invade inside the rumen and reticulum (Subekti dkk., 2005).

d) Pathogenicity and Clinical Signs

Mature worms are not so pathogen, actually if they were too much they will released into the papillae of rumen. Immature stages causes bleeding of the mucosa of duodenum and necrosis, duodenitis. Clinical signs such watery diarrhea, weakness and at heavy infection often followed by death (Urquhart *et al.*, 1989).

2.2.3.5 *Gastrothylax crumenifer*

a) Morphology

The adult worm is red in color when it is still alive. The adult worm measures 9 - 8 x 5 mm. The eggs measures 115 - 135 x 60 - 70 µm (Subekti dkk., 2005).

b) Habitat

Gastrothylax crumenifer is found in the rumen and reticulum of the cattle, sheep, zebu, and buffalo (Subekti dkk., 2005).

c) Life Cycle

Miracidium which is free will swim and enter into the water snail whereby snail is an intermediate host. In the snail's body, the miracidium will become sporocyst and converts to become redia and at last turns to be cercaria. The cercaria will move out from the snail's body and stick on the grass for 1 - 2 months. When the metacercaria is eaten by the definitive host, the cyst will break inside the host duodenum and young worms will penetrate into the stomach mucosa. The adult worm will invade inside the rumen and reticulum (Subekti dkk., 2005).

d) Pathogenicity and Clinical Signs

In the small intestine, severe denudation with blood tinged gelatinous mucous containing watery ingesta. The clinical signs are such as anorexia, watery fetid diarrhea, hind legs, weakness, depression and dehydration, sub-maxillary edema, rough coat and drop in production.

2.2.4 Diagnosis

To diagnose whether there is infection of helminth eggs, can be seen by the clinical signs like body weight decrease, anemia, diarrhea and disturbance of growth in young animals (Soulsby, 1982). To determine helminth eggs, one of the way is through stool examination by using light microscope.

CHAPTER 3

MATERIALS AND METHODS

CHAPTER 3 MATERIALS AND METHODS

3.1 Place and Time

Research was done in two different places which was in Surabaya Zoo and Prigen Safari Park II, during the period of time April to May, 2011 (shown in Appendix 5 and 6). Examination of banteng's stool sampels was done in Department of Parasitology in Faculty of Veterinary Medicine, University of Airlangga Surabaya.

3.2 Materials

3.2.1 Materials

Fresh sample of banteng *(Bos javanicus)* stools were used for this research which was taken from the Surabaya Zoo and Prigen Safari Park II. Other materials were used for this research were sucrose, tap water, *aquadest,* and formaline 10%.

3.2.2 Equipments

Equipments that were used for the research were fecal container 40 ml, plastic bags, plastic glass 200 ml, plastic spoon 5 ml, glass stirrer, object glass, cover glass, light microscope (Meiji no 35647), *Pasteur* pipette 5 ml, centrifuge (Heraeus Sepatech), centrifuge test tubes 10 cc, test tubes rack, mixing glass, tissue, camera and stationary.

3.3 Methods

3.3.1 Collecting samples of stool

Fresh stools of banteng were collected from Surabaya Zoo and Prigen Safari Park II. Total population of banteng in Surabaya Zoo was 12 banteng (7 males and 5 females, with age range about 1 to 20 years old) meanwhile in Prigen Safari Park II there was 23 banteng (10 males and 13 females with age range about 4 years old). The collected sample of stool was then put into the fecal container and given formaline 10 %. After that, the sample was examined in Parasitology Laboratory in Faculty of Veterinary Medicine, University of Airlangga.

3.3.2 Examination of the stool using native method

Small amount of stool were taken with the end of the glass stirrer and place it on the object glass. Then, one drop water was dropped onto the stool and mix it. After that, cover it with a cover glass and examine by using microscope with magnification by 100 x (Subekti dkk., 2007).

3.3.3 Examination of the stool by using sedimentation method

Stools were put into a plastic glass and added water with comparison 1:10. The stool and water mixed properly and strain, after that the new sample was put into the centrifuge test tubes and centrifuge was done for 5 - 10 minutes with 1500 rpm speed. After the centrifuge was done, the supernatant was thrown away and the sediment was added as before and this process was done for 3 times with the same time and speed till the supernatant was clear. Throw away the supernatant,

and the left over was mixed. The sediment was taken 1 drop with pipette and places it on the object glass and close with the cover glass. The sample was checked under the microscope with magnification 100 x (Subekti dkk., 2007).

3.3.4 Examination stool using floatation method

Stools were put into a plastic glass and added water with comparison 1:10. The stool and water mixed properly and strain, after that the new sample was put into the centrifuge test tubes and centrifuge was done for 5 - 10 minutes with 1500 rpm speed. After the centrifuge was done, the supernatant was thrown and the sediment was added water as before and this process was done for 3 times with the same time and speed till the supernatant is clear. Then throw away the supernatant, add sucrose till ¾ of the test tube and centrifuge with speed 1500 rpm for 5 - 10 minutes. When it was done, add on the sucrose little by little by using the Pasture pipette till it was concave put the cover glass on the surface of the test tubes for 5 minutes. Finally, the cover glass was taken off, places it on the object glass and examined by using the microscope with magnification 100 x (Subekti dkk., 2007).

3.3.5 Schematic Diagram of Research Procedure

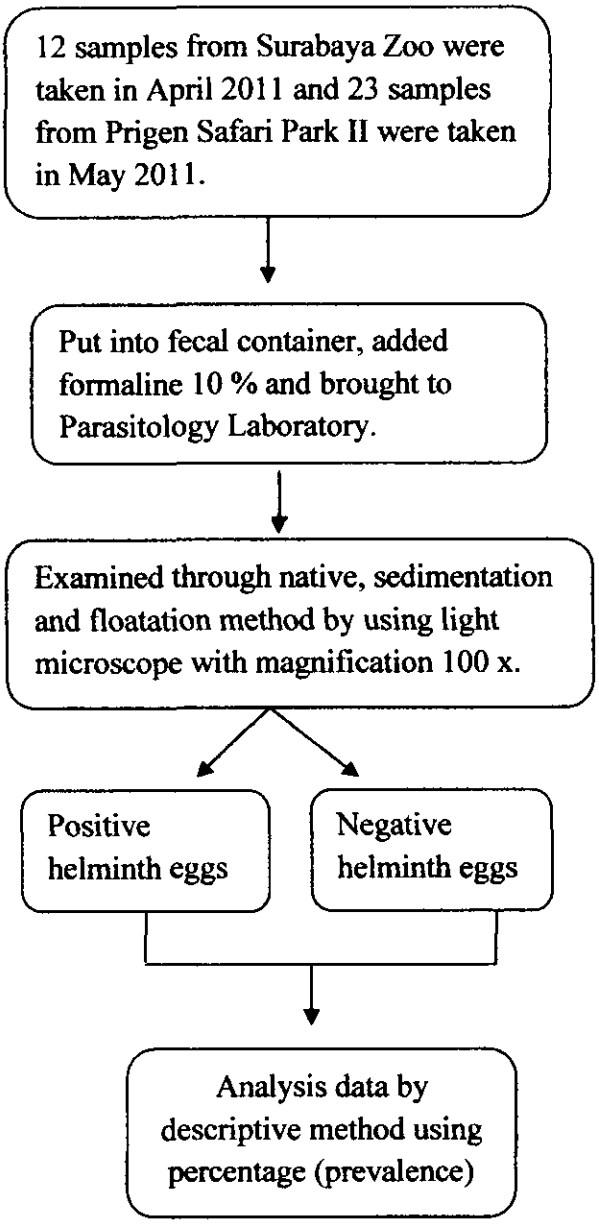

Figure 3.1 Schematic Diagram of Research Procedure

3.4 Prevalence data

Prevalence was a frequently used epidemiological measure of how commonly a disease or condition occurs in a population. Prevalence measures how much of some diseases or conditions there was in a population at a particular point in time (Le and Boen, 1995).

Data of helminthiasis was determined by eggs of nematode, cestode and trematode by using method of native, sedimentation and floatation.

When there are positive helminth eggs, thus the formula used is as below:

$$\frac{\text{Total positive (helminth eggs) sample}}{\text{Total sample}} \times 100\%$$

3.5 Analysis Data

The data which was taken from Surabaya Zoo and Prigen Safari Park II were analyzed as descriptive method.

CHAPTER 4

RESULTS OF RESEARCH

CHAPTER 4 RESULTS OF RESEARCH

From the results of research which has been done during the period of April to May 2011, total samples 35 (12 samples from Surabaya Zoo and 23 samples from Prigen Safari Park II). Twelve samples from Surabaya Zoo have been identified to be positive which contains trematode eggs (100 % infected by *Schistosoma* sp) as shown in table 4.1. Meanwhile, 23 samples from Prigen Safari Park II have been identified to be positive infected by trematode, cestode and nematode eggs (100 % infected by *Schistosoma* sp, 17.4 % infected by *Moniezia* sp and 13 % infected by *Trichostrongylus* sp) as shown in Table 4.2.

Table 4.1 Data of helminth eggs from banteng stool examination in Surabaya Zoo by using method of native, sedimentation and floatation.

NO	NATIVE METHOD	SEDIMENTATION METHOD	FLOATATION METHOD
1	Positive *Schistosoma*	Positive *Schistosoma*	Negative
2	Positive *Schistosoma*	Positive *Schistosoma*	Negative
3	Positive *Schistosoma*	Positive *Schistosoma*	Negative
4	Positive *Schistosoma*	Positive *Schistosoma*	Negative
5	Positive *Schistosoma*	Positive *Schistosoma*	Negative
6	Positive *Schistosoma*	Positive *Schistosoma*	Negative
7	Positive *Schistosoma*	Positive *Schistosoma*	Negative
8	Positive *Schistosoma*	Positive *Schistosoma*	Negative
9	Positive *Schistosoma*	Positive *Schistosoma*	Negative
10	Positive *Schistosoma*	Positive *Schistosoma*	Negative
11	Positive *Schistosoma*	Positive *Schistosoma*	Negative
12	Positive *Schistosoma*	Positive *Schistosoma*	Negative

Table 4.3 Data of type of helminth eggs identified and prevalence of helminthiasis rate in Surabaya Zoo and in Prigen Safari Park II.

Place	Total sample	Type of helminth eggs identified	Prevalence rate (%)
Surabaya Zoo	12	*Schistosoma* sp	100 %
Prigen Safari Park II	23	*Schistosoma* sp	100 %
	4	*Moniezia* sp	17.4 %
	3	*Trichostrongylus* sp	13 %

CHAPTER 5

DISCUSSION

CHAPTER 5 DISCUSSION

Twelve samples of banteng stool were taken from Surabaya Zoo and 23 samples of banteng stool were taken from Prigen Safari Park II and were examined in Department of Parasitology in Faculty of Veterinary Medicine University of Airlangga Surabaya. Collecting and examination of the samples was done in the month of April to May 2011. The results of this research were, from 12 samples taken from Surabaya Zoo were all positively infected and 23 samples from Prigen Safari Park II were all positive. The prevalence of helminthiasis rate in banteng in Surabaya Zoo was 100 % infected by *Schistosoma* sp and prevalence of helminthiasis rate in Prigen Safari Park II was 100 % infected by *Schistosoma* sp, 17.4 % *Moniezia* sp and 13 % *Trichostrongylus* sp.

Through examination of stool, thus it has been identified that only one type of helminth egg which was *Schistosoma* sp has infected banteng in Surabaya Zoo. The prevalence of *Schistosoma* sp was 100 % (as shown in Table 4.3). Identification of *Schistosoma* sp was based on examination of stool by method of native and sedimentation. Meanwhile banteng in Safari Park II has been infected by three types of helminth eggs which were *Schistosoma* sp, *Moniezia* sp and *Trichostrongylus* sp which includes in trematode, cestode and nematode class. Prevalence of *Schistosoma* sp was 100 %, *Moniezia* sp was 17.4 % and *Trichostrongylus* sp was 13 % (as shown in Table 4.3). *Schistosoma* sp was identified by method of native and sedimentation. Identification of *Moniezia* sp

was based on floatation method meanwhile *Trichostrongylus* sp was identified by method of native, sedimentation and floatation.

Schistosoma sp is found in the vena mesenterica in wild ruminant, horse, and camel (Soulsby, 1982). Once the egg leaves the host, it must find water to hatch. Active miracidium will swim till they find a snail which matches them. Then it forms sporocyst and produces baby sporocyst. Cercaria leaves the snail, swims into the water and enters the host through skin or ingestion of drinking water (Levine, 1990; Urquhart *et al.*, 1989). Banteng in Surabaya Zoo is divided into 3 parts which is surrounded by drain with stagnant water. According to Soulsby 1982, snails prefer to live in slow moving or stationary water. When the place was surveyed, there were snails in the drain. Thus, it is positively confirmed that, banteng was infected by *Schistosoma* sp when the cercaria penetrates through banteng's skin. The infection of *Schistosoma* sp is high because all the banteng in Surabaya Zoo is infected. Meanwhile in Prigen Safari Park II, banteng is equally infected by *Schistosoma* sp. Development within the snail host is dependent on temperature and varies with the time of the year. Banteng may become infected when standing in shallow water dams. The other banteng are also infected orally when water tanks and other sources of drinking become infected with snails and contaminated with faeces material. This applies to both conservation places, because banteng was 100 % infected by *Schistosoma* sp.

Schistosoma sp was not found in floatation method in samples of Surabaya Zoo and in samples of Prigen Safari Park II. This is because, *Schistosoma* sp includes in trematode class and the specific gravity of trematode eggs is higher

than solute which causes trematode eggs not to float up. Thus trematode eggs usually can be seen in native and sedimentation method.

Moniezia sp inhabits in small intestine chiefly in cattle (Urquhart *et al.*, 1989). The life cycle is indirect and needs intermediate host which are oribatid mites. Temperature, moisture, and preferred food availability influence a mite's location within the soil (Denegri, 1993). Factors which positively influenced cestode transmission includes increased temperatures, increased numbers of oribatid mites, increased numbers of available male and female oribatid mites, rapid maturation of cysticercoids (45 - 60 days at 23 °C – 25 ° C) and co-causative factors associated with livestock management (Fritz, 1982). At this optimum the formation of infesting larvae is achieved in three months. The temperature in Prigen Safari Park II was about 21.4 °C – 21.6 °C in the month of April and May (as shown in Appendix 8 and 9), which may enables the development of oncospheres in cysticercoids. Oribatid mites ingest tapeworm eggs accidentally while feeding on other organic matter in the upper levels of the soil and herbage which causes infection when banteng ingest herbage infected by oribatid mites.

Trichostrongylus sp is found in small intestine and sometimes in abomasums of ruminant, goat, camel and various antelopes (Soulsby, 1982). The eggs are passed through faeces of the host, later on will form into larva stadium I and will become infective larva. Infective larva (stadium III) formed between 4 - 6 days in optimal condition (27 °C, humidity, oxygen and water). During early morning and early evening, the larva will be on the grass when the humidity and light intensity is enough (Kusumamihardja, 1982). The infective larva can stand

for few weeks to months as long as the humidity and temperature is suitable (Hall, 1977). Host is infected by infective larva through contaminated food and drink (Hungerford, 1970 and Soulsby, 1982). Thus the possibility of banteng in Prigen Safari Park II to be infected by *Trichostrongylus* sp is because of the larva lives in optimal condition and also banteng is left to be free in its natural habitat from morning 07.30 until 16.30 evening which may cause banteng to ingest contaminated grass by *Trichostrongylus* infective larva.

Surabaya Zoo is located in lowland with temperature range 28.2 °C – 28.9 °C and humidity 76 % – 81 % (as shown in Appendix 6 and 7). Banteng in Surabaya Zoo has been identified to be infected by *Schistosoma* sp whereby this species is being totally dependent upon water as medium as infection and final host (Urquhart *et al.*, 1989). Prigen Safari Park II is located in highland with temperature range 21.4 °C – 21.6 °C and humidity 90 % - 91.3 % (as shown in Appendix 8 and 9). Banteng in Prigen Safari Park II has been identified to be infected by *Schistosoma* sp, *Moniezia* sp and *Trichostongylus* sp. *Moniezia* sp transmits through intermediate which are oribatid mites. Oribatid mites infected with cysticercoids of *Moniezia* sp survived for up to 24 months. The prevalence of cestode infection is linked to the abundance of oribatid mite intermediate hosts and this in turn is dependent on environmental factors (Van Nieuwenhuizen *et al.*, 1994). There is a greater risk of infection in months with greater rainfall and in the early mornings (Van Nieuwenhuizen *et al.*, 1994; Schuster *et al.*, 2000). Climactic factors such as temperature, rainfall, relative humidity, soil moisture, and solar

CHAPTER 6

CONCLUSIONS AND SUGGESTIONS

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6.1 Conclusions

From the research Prevalence of Helminthiasis on Banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II, can be concluded into two things that were:

1. Type of helminth eggs found in banteng in Surabaya Zoo was *Schistosoma* sp which include in trematode class meanwhile type of helminth eggs found in banteng in Prigen Safari Park II was *Schistosoma* sp, *Moniezia* sp and *Trichostrongylus* sp which are from trematode, cestode and nematode class respectively.
2. The prevalence of helminthiasis in Surabaya Zoo was 100 % (trematode eggs) and the prevalence of helminthiasis in Prigen Safari Park II was 100 % (trematode eggs), 17.4 % (cestode eggs) and 13 % (nematode eggs).

6. 2 Suggestions

Suggestions are as below:

1. There should be further researches done by correlating factors such as age, sex, food and also other factors may cause helminthiasis.
2. To reduce the infection, routine examinations should be done and give treatment periodically.

SUMMARY

SUMMARY

Kamini Devi Jayarajah with the title "Prevalence of Helminthiasis on Banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II Through Stool Examination. Under supervision of Prof. HJ. ROMZIAH SIDIK, drh., Ph.D as major adviser and Dr NGAKAN MADE RAI WIDJAJA,drh., M.S as second adviser.

Worldwide, parasitic helminths are a major cause of losses in productivity and health problem. Helminths also cause immunosuppression and as a result enhance susceptibility to other disease. This problem is much more severe in tropical country due to very favorable environmental condition for parasite transmission, poor sanitation of host animals, and poor sanitation in facilities where animal are housed. As a result, disease caused by helminths remains one of the major impediments in tropical country. However the majority animal infected with helminths do not show clinical signs owing to the chronic nature of the disease.

The first purpose of this research was to find out types of helminth eggs that infects banteng (*Bos javanicus*) by using method of native, sedimentation and floatation in Surabaya Zoo and Prigen Safari Park II. Secondly, to know the prevalence of helminthiasis occurred on banteng (*Bos javanicus*) in Surabaya Zoo and Prigen Safari Park II.

Male and female Banteng are easily distinguishable. Both sexes carry the characteristic white stockings and white rump, as well as white muzzle and white

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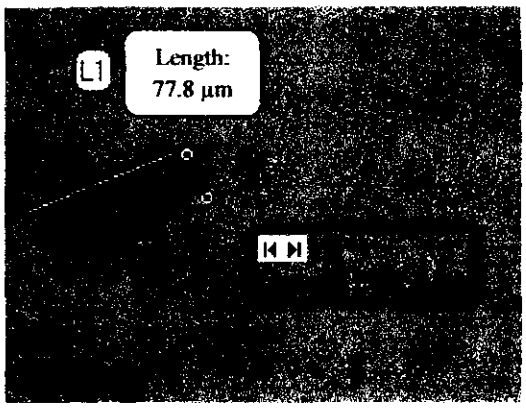
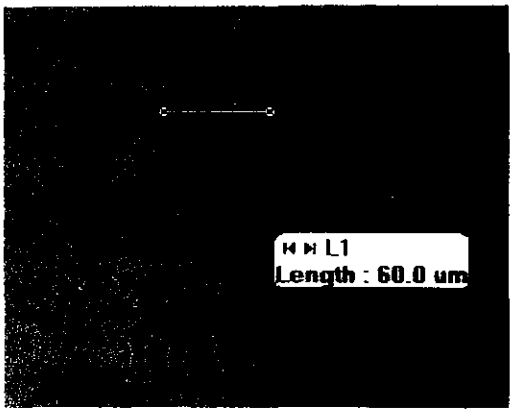
APPENDIX

Appendix 1 Figures of helminth eggs



A



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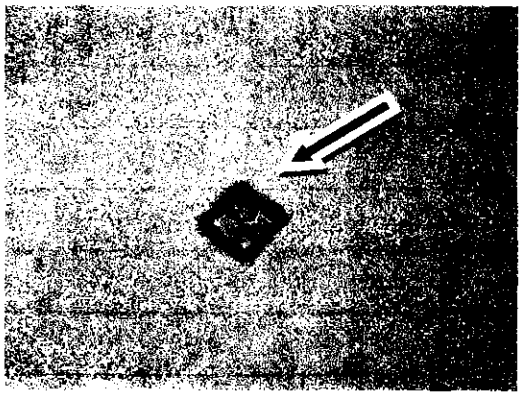
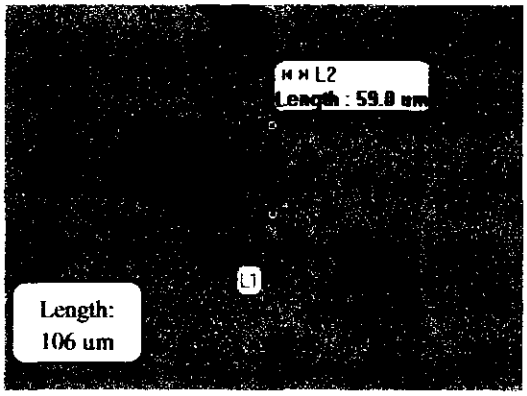


C



D

Explanation:

A. *Schistosoma* sp egg in sedimentation method (100 x)

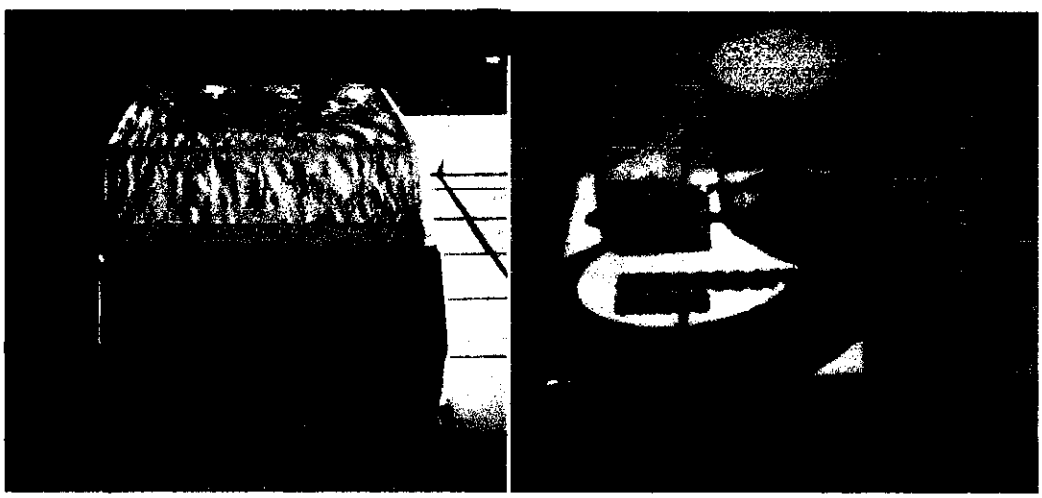
B. *Moniezia* sp egg in sedimentation method (100 x)

C. *Moniezia* sp egg in floatation method (100 x)

D. *Trichostrongylus* sp in sedimentation method (100 x)

Appendix 2 Research Equipments

A B



C D

Explanation:

A. Light microscope (Meiji no 35647)

B. Glass stirrer, Pasteur pipette 5 ml, plastic glass 200 ml, mixing glass, test tubes 10cc, test tube rack, formaline 10 %, sucrose

C. Centrifugal machine (Heraeus Sepatech)

D. Object glass (1), cover glass (2), fecal container 40 ml (3) and spoon 5 ml (4)

Appendix 3 Colleting Samples

A

B

C

D

E

Explanation:

A & C - Collecting samples in Surabaya Zoo.

B - Banteng defecation in Surabaya Zoo.

D - Banteng defecation in Prigen Safari Park II.

E - Collecting samples in Prigen Safari Park II.

Appendix 4 Flow chart of research schedule in Surabaya Zoo

Time	Activities
March	Finding references such as journals, articles and books.
April	Doing proposal
April	Survey Surabaya Zoo
April – May	Proposal being revised
April – May	Research is done. Sample is taken once (27^{th} April 2011)
May	Present Proposal
June	Present Results Seminar
June –July	Thesis

Appendix 5 Flow chart of research schedule in Prigen Safari Park II

Time	Activities
March	Finding references such as journals, articles and book.
April	Doing proposal
April	Survey Prigen Safari Park II
April – May	Proposal being revised
April – May	Research is done. Sample is taken once (9^{th} May 2011)
May	Present Proposal
June	Present Results Seminar
June –July	Thesis

BADAN METEOROLOGI KLIMATOLOGI DAN GEOFISIKA
STASIUN METEOROLOGI PERAK I SURABAYA
JALAN TANJUNG SADARI NO. 78 SURABAYA

Appendix 6 INFORMASI SUHU UDARA,KELEMBABAN UDARA
KOTA SURABAYA DAN SEKITARNYA
BULAN : APRIL 2011

TGL	SUHU UDARA (0C)			KELEMBABAN UDARA (%)		
	Rata.2	Max	Min	Rata.2	Max	Min
1	27.4	32.6	24.0	84	95	63
2	27.3	32.0	24.8	83	93	66
3	27.3	31.8	25.0	82	92	66
4	28.9	33.4	25.0	77	90	56
5	28.9	34.0	25.4	76	92	55
6	28.5	34.2	25.2	81	94	55
7	27.9	33.6	25.0	82	95	58
8	27.7	33.5	25.4	85	93	70
9	27.5	31.7	25.2	85	95	64
10	27.5	32.6	24.8	85	95	64
11	27.3	31.2	25.1	82	92	69
12	26.6	31.4	25.0	86	95	65
13	27.6	31.4	24.8	82	93	66
14	27.4	30.2	24.7	84	95	71
15	27.7	32.0	25.0	82	95	60
16	28.3	33.0	25.4	81	93	58
17	28.2	32.8	25.0	81	95	61
18	29.1	34.0	25.1	76	93	56
19	29.2	33.8	25.6	73	90	55
20	29.3	34.3	26.0	76	90	52
21	29.2	34.0	25.4	76	92	55
22	28.3	34.0	25.1	81	92	58
23	27.9	33.4	26.0	85	95	68
24	28.1	33.0	25.6	83	94	63
25	28.0	32.8	25.0	82	94	60
26	28.6	33.2	25.8	80	90	60
27	29.4	33.6	26.2	75	91	60
28	29.2	34.0	26.4	76	87	55
29	28.7	33.8	25.8	81	95	61
30	28.3	33.6	25.5	83	94	59
31						
JUMLAH	845.3	852.9	607.3	2425	2789	1829
Rata.2	28.2	32.8	25.3	81	93	61
Max	29.4	34.3	26.4	86	95	71
Min	26.6	30.2	24.0	73	87	52

KEPALA STASIUN

D O D O, ST
NIP. 19581112198203 1001

Appendix 7 INFORMASI SUHU UDARA,KELEMBABAN UDARA KOTA SURABAYA DAN SEKITARNYA

BULAN : MEI 2011

TGL	SUHU UDARA (0C)			KELEMBABAN UDARA (%)		
	Rata.2	Max	Min	Rata.2	Max	Min
1	27.5	32.6	24.5	84	95	64
2	26.5	32.3	24.7	87	96	70
3	28.9	32.4	25.0	79	95	62
4	29.5	33.2	26.6	76	87	61
5	27.2	31.2	25.0	87	93	69
6	28.4	31.8	25.2	81	93	65
7	27.5	31.0	25.4	85	93	71
8	28.2	32.8	24.8	82	94	64
9	29.7	34.0	25.2	75	92	55
10	29.6	34.2	26.0	75	90	56
11	29.6	34.5	26.5	77	88	59
12	29.4	33.4	26.4	79	92	64
13	28.5	32.4	26.0	81	92	61
14	29.0	34.0	26.4	81	93	59
15	27.4	33.6	24.0	83	95	55
16	29.5	33.6	25.0	74	92	56
17	29.9	34.2	26.2	73	90	50
18	30.0	34.4	26.2	73	96	50
19	29.9	34.0	26.2	72	89	52
20	29.9	34.1	26.2	73	90	53
21	29.4	33.8	25.2	68	89	45
22	29.7	34.0	25.4	69	89	47
23	29.3	33.2	24.7	67	85	48
24	29.0	33.4	24.9	68	87	45
25	28.9	33.4	25.2	70	89	50
26	28.9	33.4	24.7	71	88	54
27	29.1	33.4	24.8	68	88	47
28	29.3	33.7	25.2	71	88	51
29	29.5	33.6	26.0	72	88	50
30	28.5	30.4	26.0	76	86	67
31	28.6	33.2	26.0	78	92	59
JUMLAH	896.3	893.1	586.6	2355	2814	1759
Rata.2	28.9	33.1	25.5	76	91	57
Max	30.0	34.5	26.6	87	96	71
Min	26.5	30.4	24.5	67	85	45

KEPALA STASIUN

W. D O D O, ST

NIP. 19581121982031001

DATA SUHU DAN KELEMBABAN
DAERAH TRETES, PASURUAN

Appendix 8 BULAN APRIL 2011

T G L	TEMPERATUR (RATA 2)	TEMPERATUR (MAX)	TEMPERATUR (MIN)	RH (RATA 2)
1	2	3	3	5
1	21.3	24.2	19.4	94.8
2	21.2	23.8	19	92.0
3	20.6	24.6	19.2	96.3
4	22.6	24.2	19.8	86.0
5	21.8	24.7	20.0	93.8
6	21.1	25.0	19.2	93.5
7	21.3	23.4	20.1	95.8
8	21.4	23.4	20.0	95.0
9	20.9	24.4	19.2	96.5
10	21.3	24.8	19.4	93.3
11	20.2	23.7	19.8	95.8
12	20.7	23.7	19.2	95.0
13	20.7	24.0	18.4	91.5
14	21.1	24.2	18.4	94.5
15	20.9	23.6	18.7	95.0
16	21.9	26.0	18.4	91.3
17	21.7	25.5	16.2	88.5
18	21.7	25.6	16.0	81.8
19	21.0	25.6	16.2	89.0
20	21.4	25.6	17.8	88.3
21	21.8	26.4	17.8	90.5
22	21.0	25.2	18.8	96.0
23	21.1	24.5	18.8	95.5
24	21.6	24.4	18.6	93.8
25	21.4	24.8	19.3	90.3
26	22.3	26.2	16.6	85.0
27	21.8	25.6	17.2	81.0
28	21.1	24.4	18.2	83.0
29	23.0	27.2	19.6	87.0
30	23.2	26.6	17.5	90.0

sumber: stasiun geofisika tretes,pasuruan

RH – Relative Humidity

Surabaya, Juni 2011
KEPALA STASIUN METEOROLOGI PERAK I
SURABAYA

WIDODO, ST.
19581112198203 1001

DATA SUHU DAN KELEMBABAN
DAERAH TRETES, PASURUAN

Appendix 9 BULAN MEI 2011

T G L	TEMPERATUR (RATA 2)	TEMPERATUR (MAX)	TEMPERATUR (MIN)	RH (RATA 2)
1	2	3	4	5
1	21.3	26.6	19.5	95.0
2	20.5	23.6	18.8	94.5
3	21.4	24.6	20.2	92.0
4	20.9	24.8	19.2	95.3
5	20.6	23.0	19.2	96.8
6	22.2	25.8	19.0	89.0
7	22.7	27.2	19.4	89.5
8	21.7	24.6	17.8	90.3
9	22.2	25.6	18.4	86.0
10	22.5	26.0	18.4	88.8
11	22.9	26.4	18.4	87.5
12	22.3	27.8	18.6	91.3
13	21.3	25.2	18.8	94.5
14	21.8	24.4	19.2	92.3
15	23.5	25.0	18.8	94.3
16	21.9	25.4	18.0	89.8
17	21.5	23.9	18.2	92.0
18	23.1	26.2	18.5	82.3
19	22.8	26.6	18.8	90.3
20	22.6	25.8	18.0	91.3
21	21.9	27.0	17.0	86.5
22	21.2	24.7	18.0	87.5
23	21.3	26.4	15.8	85.5
24	20.6	24.8	15.8	83.0
25	19.7	24.0	16.0	87.5
26	18.2	25.0	16.6	92.5
27	21.1	25.8	16.5	86.5
28	20.6	27.1	17.9	88.5
29	21.5	26.6	17.8	88.0
30	22.6	26.2	19.0	80.5
31	21.8	25.5	19.2	88.3

sumber: stasiun geofisika tretes,pasuruan

RH – Relative Humidity

Surabaya, Juni 2011
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