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The Presence and Infection Rate of *Strongyloides* sp. in Banteng (*Bos javanicus*) in Ujung Kulon National Park (UKNP)

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ABSTRACT

This study aims to identify and determine the level of *Strongyloides* sp. infection in banteng (*Bos javanicus javanicus*) fecal samples in Ujung Kulon National Park (UKNP). The research method was conducted by examining fecal samples using native, sedimentation, and flotation methods and calculating the number of eggs per gram of feces (egg per gram, EPG) to determine the level of infection. The results showed positive *Strongyloides* sp. infection, indicated by the discovery of oval-shaped eggs with thin walls measuring approximately 54 × 41 µm. The EPG calculation yielded a value of 1600, which is categorized as a moderate infection. This level of infection indicates that the parasite's life cycle is active in the host's body and has the potential to cause mild to moderate physiological disturbances. Additionally, environmental conditions can increase the risk of reinfection, especially in wildlife habitats with high humidity levels. These findings emphasize the importance of continuous monitoring, environmental management, and parasite control measures, particularly in conservation areas such as Ujung Kulon National Park.

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1. INTRODUCTION

Ujung Kulon National Park (UKNP) is one of Indonesia's conservation areas that plays a major role in preserving biodiversity. This area is a natural habitat for various endemic species and serves as a refuge for rare species that are now facing the threat of extinction (Siswoyo, *et al.,* 2024). One of the important animals living in this area is the banteng (*Bos javanicus javanicus*), which has been classified as Endangered. "Banteng" is a large herbivore that plays a role in maintaining ecosystem balance, particularly through its feeding activities that influence vegetation structure and ecological dynamics (Watwiengkam, *et al.,* 2024), such as plant seed dispersal and maintaining the balance of the food chain in tropical forest ecosystems (Chaiyarat, *et al.,* 2023).

However, even though the banteng in UKNP live in a relatively protected habitat, they still face various threats, one of which is endoparasite infection, particularly gastrointestinal worms. Endoparasites are parasites that live inside their host's body, and in Banteng, this infection can occur through the consumption of food or water contaminated with parasite eggs or larvae, or through direct interaction with infected individuals. Endoparasites can affect the health of banteng, disrupt their bodily systems, and have an impact on their long-term survival. Several studies have been conducted in 2008 on trematode worm infections in Javan rhinos and Javan bulls in Ujung Kulon National Park, as well as a study in 2016 on Sumatran rhinos and elephants, which found *Paramphistomum* spp. and *Strongyloides* spp. The worms found in buffalo, cattle, and goats are *Paramphistomum* spp., *Fasciola* spp., *Trichuris* spp., *Mecistocirrus* spp., *Strongylus* spp., *Bunostomum* spp., *Haemonchus* spp., *Strongyloides* spp., *Oesophagostomum* spp., *Nematodirrus* spp., and *Trichostrongylus* spp. Domestic livestock (buffalo and cattle) have the potential to become vectors for the transmission of *Paramphistomum spp* to wild animals (Chaiyarat, *et al*., 2023).

One of the endoparasites commonly found in wild and domestic mammals is *Strongyloides* sp., a nematode worm belonging to the Strongyloididae family. This parasite has a unique life cycle because it can live freely in the environment and also be parasitic in the host's body (Viney & Lok, 2007). *Strongyloides sp.* eggs are generally oval-shaped, thin-walled, and already contain embryos when they are excreted in the host's feces (Tiuria, *et al.,* 2017).

Endoparasite infections can cause various physiological disorders in banteng, such as digestive system disorders, decreased reproductive quality, weight loss, and decreased immunity. In more severe cases, parasitic infections can threaten the survival of infected buffalo individuals. Although there have been many studies on endoparasites in livestock or other wild animals, research on the effects of endoparasites on banteng in Ujung Kulon National Park is still limited. This study aims to identify the presence of *Strongyloides* sp. eggs in buffalo fecal samples and determine the level of infection based on the number of eggs per gram of feces (epg). The results of this study are expected to assist national park managers in designing better buffalo health protection and maintenance strategies, including disease prevention and control efforts.

2. METHODS

2.1. Time and place

This study was conducted in July 2025 and fecal samples were identified at the Protozoology Laboratory of the School of Veterinary Medicine and Biomedical Sciences, IPB University, Bogor.

2.2 Tools and materials

The tools used in this study were label paper, microscope slides, spoons, ziplock plastic bags, object glasses, cover glasses, measuring cups, scales, test tube racks, gloves, masks, droppers, tissues, and digital cameras. The materials used were water, 10% formalin, and a salt solution for flotation.

2.3 Sampling

Fecal samples were collected from the research site in TNUK, namely Cidaon, totaling 75 Banteng fecal samples. After defecation, 2 grams of fecal were collected using a stick, then the fecal samples were placed in a centrifuge tube containing 10% formalin until the samples were completely submerged, then tightly closed. Each tube was labeled with information including the date of collection, species, sex, and age of the individual. Subsequently, all samples were taken to the laboratory for examination and identification.

2.4 Sample Identification

Sample examination using the native method involves taking approximately 1 gram of fecal sample and mixing it with 1–2 drops of physiological saline solution until evenly mixed. Once the mixture is homogeneous, the droplets are covered with a glass cover. The prepared specimen is then observed under a microscope to detect the presence of endoparasites and determine the type of endoparasites present in the sample.

In the sediment method, 3 grams of fecal are mixed with 5–8 ml of physiological saline solution and stirred until a homogeneous mixture is formed. The mixture is then filtered using gauze, and the filtrate is collected in a centrifuge tube. It is homogenized again. The mixture is then centrifuged at 2000 rpm for 5 minutes, after which the supernatant is discarded and the sediment is collected and mixed with one drop of eosin for observation under a microscope.

2.5 Data Analysis

The calculation of the number of worm eggs in fecal is done using the McMaster method. The analysis begins with weighing 2 grams of the fecal sample, which is then placed in a plastic container. Next, 58 ml of floating solution is added and stirred until homogeneous. The mixture is filtered three times using a tea strainer, then left for 10 minutes to allow sediment to form. The filtered sample is taken using a pipette and placed in the McMaster until it is full. Observations are then made using a light microscope with 10x magnification (Jupri & Jannah, 2021). The infection rate is determined from the number of parasite eggs counted in each gram of feces (Satyawardana, *et al*., 2024). Research data on the types and numbers of parasites are analyzed descriptively using the formula according to Zajac and Conboy (2012), the formula for calculating the number of parasite eggs per gram (EPG) is as follows:

$$EPG = \frac{N}{Fw} = \frac{\text{Calculated volume}}{\text{Total volume}}$$

Table 1. Infection rate based on the number of eggs per gram of fecal (EPG) (Thienpont, *et al*. 1995)

The number of eggs (per gram of fecal)	Infection levels
1-499	Low infection

500-5000	Moderate infection
>5000	High infection

3. RESULTS AND DISCUSSION

3.1. Morphology and Infection Rates of *Strongyloides*

The identification results showed positive results for the presence of *Strongyloides eggs*. Strongyloides is a group of nematodes that commonly infect terrestrial vertebrates and have very interesting biological characteristics (Viney, 2017). The morphology of the *Strongyloides* worm eggs found in the examination was oval, already containing larvae, with a clearly visible egg shell. The eggs measured approximately 54 µm in length and 41 µm in width (**Figure 2**).

Strongyloides eggs generally have thin walls, are elliptical in shape, and are already embryonated. In general, *Strongyloides* worm eggs are small, oval-shaped, contain larvae, and have a thin shell layer. *Strongyloides* and *Strongylid* eggs identified in this study show characteristics such as an elongated or elliptical shape, thin egg walls, and contain blastomeres in varying numbers. *Strongylodes* sp. is a parasitic worm in the digestive tract that infects almost all mammals, including humans. The morphology of *Strongylodes sp* eggs has thin walls, an elliptical shape, and embryos (Suastini, *et al.,* 2021). *Strongylodes* sp. is a nematode worm that lives in the lumen of the duodenum and jejunum. Female worms generally live as parasites in humans. Female *Strongylodes* sp. are thin, colorless threads with a body length of about 2.2 mm (brown). The infection level can be seen on **Table 2.**

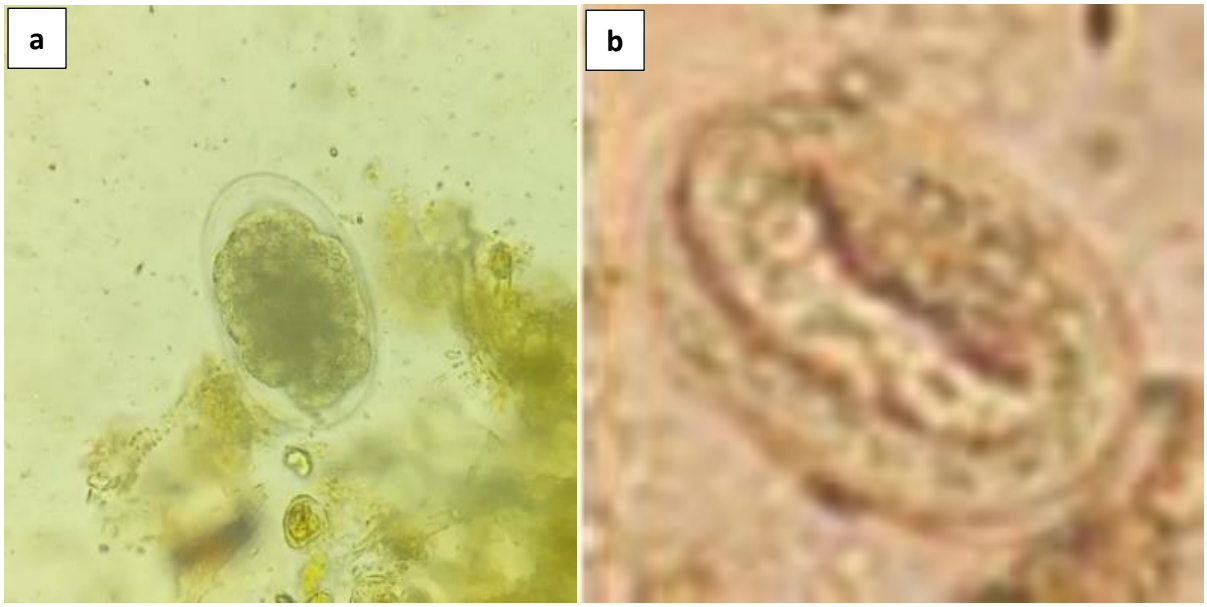

Figure 2. (a) *Strongyloides* egg based on our research, and (b) from the literature in tiger (Tiuria, *et al.,* 2017)

Based on **Table 2**, the infection level calculated from the number of eggs per gram of feces (EPG) shows that the number of *Strongyloides* eggs reached 1600 EPG. This value indicates that the infection is in the moderate category according to the classification by Thienpont *et al.* (1995), which sets a specific range for assessing the severity of infection based on the concentration of eggs in fecal samples. A moderate infection category describes that the number of parasites in the host's body is significant enough to cause physiological effects, although it has not yet reached a severe level that could potentially threaten health seriously. In the case of a moderate infection, treatment and control measures must be carried out

more carefully and in a targeted manner. This is because the presence of *Strongyloides* eggs in moderate numbers indicates that the parasite's life cycle is active and the parasite population in the host's body is relatively stable. Infection at this level can cause mild to moderate clinical symptoms, such as digestive disorders, loss of appetite, deterioration of physical condition, and changes in animal behaviour that are difficult to observe without special monitoring. These nonspecific symptoms often pose a challenge in the field diagnosis process, making regular fecal examinations an important step in ensuring animal health status.

Table 2. Morphology of egg types in the fecal of banteng (*Bos javanicus javanicus*)

Group	Length (µm)	Width (µm)	Infection Level
Strongyloides	54	41	1600 epg

Continuous monitoring is also necessary to prevent the infection from developing into a more severe stage. In some cases, *Strongyloides* infections have the potential to develop rapidly, especially when environmental conditions are conducive to larval development, such as warm temperatures, high humidity, and poor sanitation. In wild animals such as banteng (*Bos javanicus javanicus*), stress, decreased immunity, and habitat changes can also accelerate the dynamics of parasitic infection.

In addition, moderate infections need to be treated specifically because *Strongyloides* has two life cycles and this parasite develops and survives in various environmental conditions. This ability makes *Strongyloides* one of the parasites that easily cause reinfection, especially when the environmental conditions around the host are not properly managed. Therefore, control measures should not only focus on infected animals but also include improvements in sanitation, land management, and population monitoring to minimize sources of reinfection.

Overall, the findings of 1600 EPG confirm that the infection cannot be considered minor. Targeted treatment, preventive measures, and continuous monitoring are essential to maintain the health of the host and prevent an increase in the number of parasites in the environment, especially in conservation areas such as Ujung Kulon National Park, where the health of wildlife is closely related to population sustainability and long-term conservation efforts.

3.2 Taxonomy

According to Viney and Lok (2007), *Strongyloides* sp. has the following classification:

Kingdom : Animalia
Phylum : Nematoda
Ordo : Rhabditida
Family : Strongyloididae
Genus : *Strongyloides*
Species : *Strongyloides* sp.

This classification shows that *Strongyloides* belongs to a group of nematodes that have a very high adaptability both as free-living organisms and as parasites. *The Strongyloididae* family itself is known to have members that are able to adapt to various environmental conditions, making this group one of the parasites that are often found in vertebrates, including wildlife. This adaptive ability contributes greatly to maintaining the survival of the *Strongyloides* life cycle in nature.

There are various factors that contribute to the high rate of *Strongyloides* sp. infection. One of the main factors is this parasite's unique ability to undergo two life cycles. Under favorable environmental conditions, such as high humidity and warm temperatures, *Strongyloides* can reproduce freely without being inside a host. This allows the larval population in the environment to increase very rapidly. Conversely, under certain conditions, the parasite can switch to a parasitic form that is ready to infect a host. The ability to switch between these two life cycle forms provides tremendous flexibility and increases the efficiency of infection spread.

This type of worm can also reproduce as a parasite in the body of animals with a prepatent period of approximately 5–7 days (Mendez, *et al.,* 2022). The relatively short prepatent period indicates that *Strongyloides* infection can develop into an active infection within days after the larvae enter the host's body. After developing into infectious larvae (*filariform*), these parasites will seek hosts through two main routes, namely through the skin or ingestion.

Parasites can enter through the skin, with larvae entering through the epidermal tissue and then following the bloodstream to the lungs, specifically the alveoli. The larvae then migrate to the trachea, ascend to the epiglottis, and are eventually swallowed naturally by the host. The larvae enter the upper digestive tract, particularly the duodenum, and develop into adult worms. These adult worms produce eggs that are continuously excreted through feces, thereby maintaining the infection cycle in the environment. In addition to through the skin, *Strongyloides* sp. infection can also occur through the oral route. Borrás *et al.*, (2023) state that hosts can become infected when they accidentally ingest infectious larvae found in contaminated vegetation, water, or soil. This dual route of infection makes *Strongyloides* a highly efficient parasite in spreading itself, especially in environments with low sanitation levels or in areas inhabited by wild animals such as banteng (*Bos javanicus javanicus*).

The existence of these two routes of infection, coupled with the parasite's adaptive ability to live freely and parasitically, has made *Strongyloides* sp. one of the most commonly found endoparasites in gastrointestinal parasite surveys, both in domestic animals and wildlife. In natural ecosystems, such as Ujung Kulon National Park, the dynamics of interactions between environmental conditions, animal behavior, and habitat availability also influence the persistence and potential increase of this parasite infection.

4. CONCLUSION

Based on the identification results, *Strongyloides* sp. eggs were found with morphological characteristics of an oval shape, thin walls, and a detected egg size (54×41 µm). An egg per gram (EPG) value of 1600 indicates that the infection level is in the moderate category. A moderate infection indicates that the parasite in the body is still stable, but significant enough to cause nonspecific clinical symptoms such as digestive disorders and decreased physical condition. The presence of Strongyloides sp. at a moderate infection level cannot be ignored. Control efforts, regular monitoring, and environmental improvements are needed to prevent an increase in infection, especially in conservation areas. Proper management is crucial to maintaining the health of wild animals and supporting population sustainability, particularly for banteng in Ujung Kulon National Park (TNUK).

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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