JPPIPA 11(6) (2025)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Diversity of Gastrointestinal Parasites in Endangered Sumatran Elephants (*Elephas maximus sumatranus* Temminck, 1847) at Taman Margasatwa Ragunan, Jakarta Selatan

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Received: April 18, 2025
Revised: June 11, 2025
Accepted: June 25, 2025
Published: June 30, 2025

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DOI: 10.29303/jppipa.v11i6.11394

Abstract: Parasitic infections in elephants in captivity are not well studied. Animals in captivity are susceptible to parasitic infections because they are prone to stress, which reduces their immune response. Therefore, this study aimed to identify gastrointestinal parasite infections among captive sumatran elephants in Taman Margasatwa Ragunan (TMR). A total of 86 fecal samples were obtained from 4 individual Sumatran elephants, conducted in October-December 2024. Screening of GIPs was carried out using the concentration sedimentation method. A total of 3 GIPs were recovered with the prevalence of hookworm and *Balantidium coli* is the highest (100%) and *Strongyloides* sp. (25%). Although there are some parasites found in faeces, Sumatran elephants in TMR There are no specific symptoms associated with the parasite. There is no parasite prevention and control management, such as routine monitoring or administration of anti-parasitic drugs to elephants at TMR. Management and control of parasitic infections needs to be improved to prevent the infection from getting worse and suppress parasite transmission.

Keywords: Abundance; Elephants; Gastrointestinal; Parasite

Introduction

Sumatran elephant (*Elephas maximus sumatranus*) is endemic to Sumatra. Currently the Sumatran elephant population is in the endangered category according to the IUCN Red List (Gopala et al., 2015). The main factors for the decline of elephant populations in the wild are poaching and habitat degradation, mostly caused by land conversion (Nofinska et al., 2019; Sukmantoro et al., 2018).

Gastrointestinal Parasites (GIPs) are a threat to the Sumatran elephant population. Parasitic infections can inhibit growth, cause changes in host behaviour, reduce reproductive success, health levels, and the danger of transmission between individuals (Abhijith et al., 2018; Melia et al., 2020). Parasitic infections in captivity can occur through several routes, namely contaminated food, transmission from intermediate and paratenic hosts (cockroaches, rats, snails, etc.), and transmission from other individuals, staff and visitors (Dashe & Berhanu, 2020; McCallum et al., 2017). Some recently reported species of the GIPs include, *Anoplocephala* sp., *Fasciola* sp., *Strongyloides* sp., *Paramphistomum* sp., *Trichostrongylus* sp., *Ascaris* sp., *Balantidium coli*, *Blastocystis* sp., *Eimeria* sp., and *Entamoeba* sp.(Abeysekara et al., 2018; Adhikari et al., 2025; Chichilichi et al., 2019; Dahal et al., 2023; Punya et al., 2021).

The role of ex-situ conservation institutions is important for the survival of the Sumatran elephant population, given the high threats faced by elephants in their natural habitat. Taman Margasatwa Ragunan (TMR) is a zoo managed by Dinas Pertamanan dan Hutan Kota DKI Jakarta. Currently, TMR has an area of 147 hectares with a collection of more than 2000 animals. Facilities provided by TMR include the Schmutzer

How to Cite:
Rosame, I., Sjahfirdi, L., & Zain, S. N. M. (2025). Diversity of Gastrointestinal Parasites in Endangered Sumatran Elephants (Elephas maximus sumatranus Temminck, 1847) at Taman Margasatwa Ragunan, Jakarta Selatan. *Jurnal Penelitian Pendidikan IPA*, *11*(6), 884–888. https://doi.org/10.29303/jppipa.v11i6.11394

Primate Centre, Reflection Park, Children's Animal Park and Recreation Facilities (Ragunan Zoo, 2021).

Examining elephants for parasitic infections can be used to monitor disease circulation and infection risk in elephant populations. This can be an effective way to act as a signal the health status of individual animals and populations. Therefore, this study aimed to identify GIPs infection among captive sumatran elephants in TMR.

Method

Sample Collection

Sampling was conducted at Taman Margasatwa Ragunan, Jalan Harsono RM No. 1, Ragunan, Pasar Minggu, South Jakarta. Faeces were taken from 4 individual Sumatran elephants. Faecal sampling was conducted in October-December 2024. Sampling conducted every 2 days. Endoparasite sampling in elephants were carried out with the help of keepers working in the cage. Samples were taken from fresh faecal boluses that had just fallen to the ground. Faecal samples were taken manually using a stick from the inside of the bolus that was not exposed to the outside environment. This was done to avoid contamination with parasites on the soil surface. Samples taken from each individual were approximately 4.5 grams. All samples were stored in plain tubes, given 10% formalin, and labelled with the name of the individual and the date of collection then stored in a styrofoam box (Lynsdale et al., 2015).

Laboratory Technique

A total of 86 faecal samples were obtained from 4 individual Sumatran elephants. Processing of specimens was carried out using the concentration sedimentation method. First, the faecal samples were homogenised by mixing the faeces with formalin and stirring until homogeneous. Next, the faecal mixture was poured and filtered using gauze into a test tube, then filled with ethyl-acetate solution, then centrifuged for 5 minutes. The supernatant was discarded, while the sediment was taken using a pipette and dripped as much as 2-3 drops on the object glass. The preparations were covered with cover glass and identified using a microscope. Parasites were identified and quantified based on morphology and morphometry.

Statistical Analysis

The results of endoparasite identification were tabulated and grouped in tables using MS. Excel. Parasite identification was based on the CDC (Centers for Disease Control and Prevention) website, Otranto and Wall (2024), and recent research. Data analysis was carried out using SPSS Version 22 software and MS. Excel. The prevalence formula refers to Bush et al. (1997).

$$\text{Prevalence (\%)} = \frac{\Sigma \text{ elephant infected with parasite}}{\Sigma \text{ number of host examined}} x100$$

Results and Discussion

Parasite transmission in captivity is influenced by environmental contamination, poor sanitation, and close contact between individuals. Management and control of parasitic infections is important in captivity. Strategies include a combination of regular monitoring, anti-parasitic treatment, and improved husbandry (Lynsdale et al., 2022; Panayotova-Pencheva, 2013).

A total of 3 GIPs were recovered from this study namely; Hookworm and *Balantidium coli* had the highest parasite prevalence (100%), followed by *Strongyloides* sp. (25%). The high prevalence of B. *coli* and hookworms in captivity is likely due to a combination of food contamination, suboptimal parasite prevention management, and close contact between individuals (Ahmed et al., 2020; Giarratana et al., 2021; Raja et al., 2014).

Overall, the elephants did not show any noticeable clinical symptoms due to parasite infection. One of the factors leading to the low parasite load in captive elephants at TMR is the cleanliness of the environment is always maintained by cleaning the cage every morning. This is accordance with previous research, elephants living in captivity generally have a lower parasite load than those living in the wild. This is influenced by the routine administration of anti-parasitic drugs and an adequate husbandry system (Abeysekara et al., 2018; Abeysinghe et al., 2017; Chichilichi et al., 2019). However, according to the veterinarian, the Sumatran elephants at TMR do not have a parasite examination schedule and are not given antiparasitic drugs. The presence of parasites indicates that captive management needs to be improved so that infections do not worsen.

The ciliated protozoan parasite *Balantidium coli*, which causes balantidiasis, primarily infects humans and other animals in the large intestine. The infection is spread through the faecal-oral route, typically through the consumption of food or water contaminated with cysts expelled from the feces of infected hosts. One of the intestinal symptoms that the parasite can produce is dysentery (Ahmed et al., 2020; Schuster & Ramirez-Avila, 2008). In general, parasitic protozoan infections in elephants have been reported previously, some of which are higher than parasitic worm infections. Research by Adhikari et al. (2025) indicates that the prevalence of protozoa in captive elephant in Nepal (84.1%, n=63) was higher than that of helminths (77.8%, n=63). As well as research by Abeysekara et al. (2018) which reported that the prevalence of protozoa in captive elephants in Sri Lanka was higher than helminths. However, cases of *Balantidium coli* infection are relatively rare. Recent cases of balantidiasis have been reported by Thakur et al. (2019) in a 14-year-old female Asian elephant in India and Adhikari et al. (2025) in captive elephants in Nepal (p<20%).

Figure 1. Gastrointestinal Parasites affected Sumatran elephant in TMR. (a) *Strongyloides* larvae, (b) Hookworm egg, (c) *Balantidium coli* tropozoite. Magnification 40x.

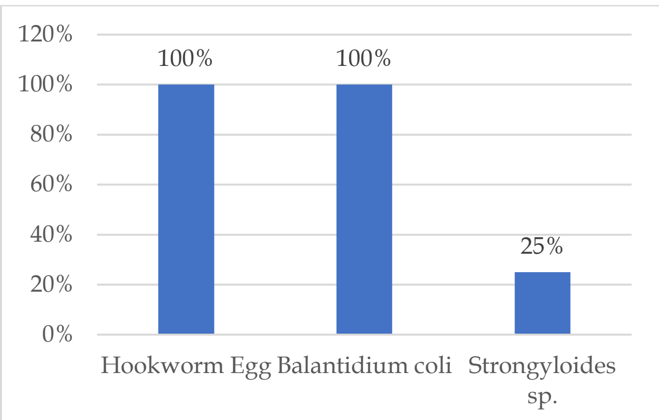

Figure 2. GIPs Prevalence in Sumatran Elephants at TMR

Hookworms and *Strongyloides* are common parasites that infect captive animals. Unfortunately, identification for hookworms to species level was not possible due to limited equipment and nematode eggs have morphological similarities that make it difficult to distinguish (Thienpont et al., 1986). Further molecular identification is important to obtain more comprehensive data. Microscopic examination often yields results that are less sensitive and specific for distinguishing between morphologically similar parasite species and low-intensity infections.

The hookworms reported to infect elephants belong to the genus *Ancylostoma* (1.82%; n=55) (Abhijith et al., 2018). The study was conducted on wild elephants in India using sedimentation and flotation methods. Meanwhile, Adhikari et al. (2025) also reported hookworm infections in Asian elephants in captivity in Nepal using the sedimentation method, with a prevalence of <40% (n=63). Unlike the two previous studies, the prevalence of hookworms in this study reached 100%. The high prevalence in this study is due to the much smaller number of individuals observed. Hookworms live by attaching themselves to the intestinal lining, causing anaemia, tissue damage, inflammation, and in severe cases, death. Animals in captivity are susceptible to hookworm infection due to limited space, repeated exposure to contaminated substrates, feeding patterns, and close proximity to other individuals, which facilitate parasite transmission and environmental contamination. The intensity of hookworm infection is influenced by environmental conditions such as humidity and temperature, which affect the survival of larvae. The infectious stage of the worm occurs during the filariform larval stage. These larvae enter the body through skin penetration. The diagnostic phase occurs when eggs are expelled with faeces (Dhakal et al., 2023; Seguel & Gottdenker, 2017).

Strongyloides infections in Asian elephants in captivity have been widely reported in a number of previous studies. The prevalence of *Strongyloides* is influenced by environmental conditions and animal management. Punya et al. (2021) reported that in Kerala, India, 32.2% of elephants living in captivity showed combined infections of *Strongyloides* and strongyle eggs. This indicates that the parasite has high resistance, despite the implementation of deworming protocols. Abhijith et al. (2018)reported that in the Wayanad South Forest Division of India, *Strongyloides* sp. was identified with a prevalence of 58.1%. Transmission occurs through the penetration of larvae in contaminated enclosures, exacerbated by the tropical climate that supports larval survival. Conditions in captivity, such as limited space and stress, can also increase the risk of infection (Abeysinghe et al., 2017).

Conclusion

In summary, although there are some parasites found in faeces, no clinical symptoms were observed in sumatran elephants at TMR. It is necessary to carry out more optimal management so that parasitic infections do not worsen. The information obtained from this study is then expected to complement data for TMR regarding the presence of GIPs infection in Sumatran elephants. This data is important to ensure the preservation of the endangered elephant population. It is hoped that it can be used to maximise prevention techniques in the future. Further molecular identification is important to obtain more comprehensive data.

Acknowledgments
The authors would like to thank keepers and staff of Taman Margasatwa Ragunan for assisting and giving permission to conduct the research and the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Indonesia for facilitating the research.

Author Contributions
Conceptualization, IR, LS AND SN.; methodology IR, LS and SN.; software, IR.; validation, LS and SN.; formal analysis, IR, LS and SN.; investigation, LS and SN.; resources, IR, LS, and SN.; data curation, IR, LS and SN.; writing—original draft preparation, IR, LS and SN.; writing—review and editing, IR, LS and SN.; visualization, IR.; supervision, LS and SN.; project administration, IR, LS and SN.; funding acquisition, IR. All authors have read and agreed to the published version manuscript.

Funding
This research received no external funding

Conflicts of Interest
The authors declare no conflict of interest

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