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SHORT COMMUNICATION

Natural intestinal parasite infection in synanthropic migratory Barn Swallow, *Hirundo rustica*, in central Peninsular Malaysia

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ABSTRACT

Migratory birds are potential vectors transmitting zoonotic parasites, bacteria, and viruses that can significantly affect human health. Over 60 diseases have been identified to be associated with these birds. Given their close proximity to human habitation, the potential transmission of zoonotic diseases is a major concern for the public. In this study, we aimed to assess the prevalence of intestinal parasites in the droppings of the Barn Swallow, *Hirundo rustica*, a bird species that annually migrates to Malaysia. Eighty droppings from *H. rustica* were collected; 13.75% of the samples were found to be positive for various parasites, including *Ascaridia galli* (8.75%), *Eimeria* sp. (2.5%), *Hymenolepis* spp. (1.25%), and *Toxocara* spp. (1.25%). These findings offer valuable insights into the current prevalence of bird parasitic infections. They can serve as a crucial resource for implementing effective control measures, devising prevention strategies, and predicting future outbreaks of parasite infections transmitted by birds.

Keywords: Migratory birds; zoonotic disease; vector-borne; Pahang.

Birds are highly susceptible to parasites and can be infected with both ectoparasites and endoparasites, particularly in tropical regions where poor animal husbandry practices and favorable climatic conditions contribute to the growth of these parasites (Abebe *et al*., 1997; Imura *et al*., 2012). *Hirundo rustica* is the most widespread swallow species worldwide, breeding in North America and Eurasia and wintering south to Central and South America, tropical Africa, Asia and northern Australia (Turner, 2006; Zink *et al*., 2006). Known for its extensive migratory journeys, *H. rustica* plays a significant role in distributing bird diseases as it migrates across multiple countries, potentially introducing parasites to new areas. Migration facilitates the establishment of new disease hotspots at considerable distances from the initial point of infection (Reed *et al*., 2003; Ghalehjoughi *et al*., 2017).

Intestinal parasite infections are a significant public health concern, as they are frequently encountered in birds and can result in subclinical diseases, even when present at low levels, which affect both avian species and humans (Badparva *et al*., 2015). The transmission of diseases from birds to humans through direct contact with bird feces is particularly worrisome in areas where birds live in high densities close to human habitation. Some bird parasites have the potential to be zoonotic, influenced by factors such as their latent period, stability in the environment, transmission route, timing of infection, and density and animal husbandry practices (Marietto-Gonnalves *et al*., 2008; Badparva *et al*., 2015).

Currently, limited information is available on the prevalence of intestinal parasite infections transmitted by *H. rustica* in Malaysia. The presence of parasites with zoonotic potential in birds increases the risk of human exposure to these parasitic agents. Therefore, this study was conducted to determine the prevalence of intestinal parasitic infections from the droppings of the migratory bird species, *H. rustica* in Malaysia.

The protocol involving animal subjects was approved by the Institutional Animal Care and Use Committee (IACUC) of the Universiti Malaya (reference number: G8/23122019/11102019-01-R). Eighty bird droppings were collected from Bentong, Pahang, central Peninsular Malaysia (Figure 1). Immediately after collection, fresh samples were transported to the Tropical Infectious Diseases Research and Education Centre (TIDREC) laboratory at Universiti Malaya. The samples were preserved in 2.5% potassium dichromate to prevent the disintegration of parasite eggs and ova. Bentong district was selected as the study area because *H. rustica* has been migrating to and wintering exclusively in Bentong, Pahang, since 1966.

The fecal samples were examined using the formalin–ether concentration technique and the modified Ziehl–Neelsen staining method. Approximately 1 to 2 g of the sample was mixed with 7 ml of formalin and 3 ml of ethyl acetate for the formalin–ether concentration technique. The mixture was then centrifuged for 5 minutes at 2500 rpm to form four layers: ethyl acetate, debris, formalin, and pellets containing parasites. A pellet drop was deposited on a clean glass slide and stained with Lugol's iodine. The slide was examined under a light microscope at 10× and 40× magnification for helminths and protozoa, respectively. To detect *Cryptosporidium* spp., the modified Ziehl–Neelsen staining technique was employed. A smear was made on a glass slide and

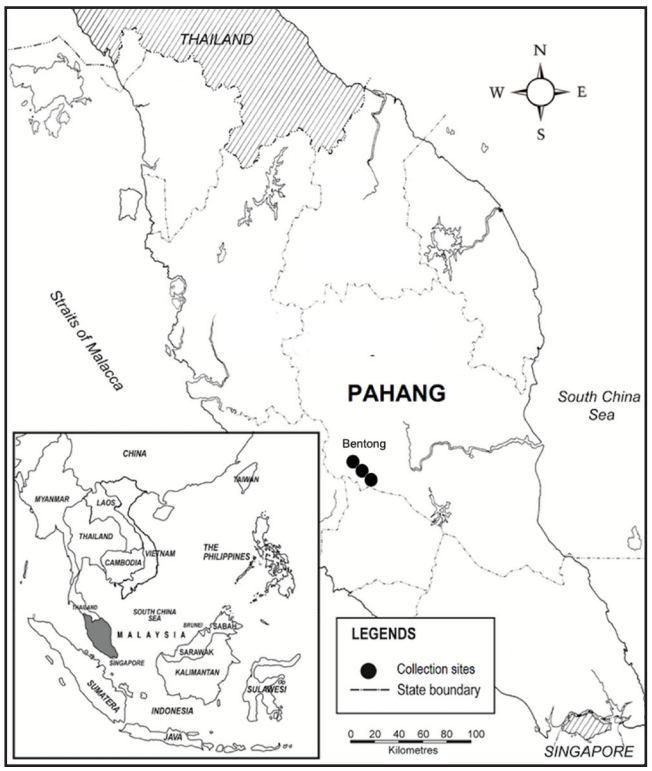

Figure 1. Location of study sites in the Bentong district, in the state of Pahang, Peninsular Malaysia.

Table 1. Prevalence of intestinal parasite infections in the migratory bird species, *Hirundo rustica*, in Bentong, Pahang, Malaysia

Parasite species		*N*	Prevalence (%)
Protozoa	*Eimeria* spp.	2	2.5
Helminths	*Ascaridia galli*	7	8.75
	Toxocara spp.	1	1.25
	Hymenolepis spp.	1	1.25
	Total	**11**	**13.75**

allowed to dry. It was then fixed with methanol for approximately 5 minutes, followed by flooding with cold, strong, neat carbol–fuchsin for 5 to 10 minutes. The slide was washed in tap water and the smear differentiated in 1% acid alcohol until the color ceased to leach. The smear was rinsed again under tap water and counter-stained with malachite green for 30 seconds. The slides were blotted dry and examined under a microscope with a 1000× oil immersion objective.

Eleven fecal samples (13.6%; N = 11) were positive for one or more intestinal parasites (Table 1). Three helminth parasites were recovered, with *A. galli* (8.8%) being the most common helminth, followed by *Toxocara* spp. (1.3%) and *Hymenolepis* spp. (1.3%). Among protozoan infections, *Eimeria* sp. (2.5%) was the only infection recovered. However, due to the limited availability of bird droppings in our study, we were restricted to using only microscopy analysis. This limitation prevented us from utilizing molecular techniques to identify other zoonotic parasite infections.

A low level of parasite infection was observed in the bird droppings, consistent with the results of a study on intestinal parasite infections of *H. rustica* conducted in Northern Iran (Fakhar *et al.*, 2018). A total of 18.5% (n = 38/205) fecal samples were found positive for parasites, *A. galli* (9.8%) being the most prevalent, followed by *Taenia* spp. (2.9%), *Toxocara* spp. (2.4%), *Syngamus trachea* (1.0%), *Raillietina* spp. (0.5%), *Moniezia* spp. (0.5%), *Choanotaenia* spp. (0.5%), *Ascaridia* spp. (0.5%), and oocysts of *Coccidia* spp. (0.5%). This result highlights the potential of migratory swallows to disperse parasites to new areas and hosts as they cross different regions along their migration routes, exposing these birds to a wider range of parasites during their annual cycle. Migration facilitates the formation of new endemic foci of diseases, even at significant distances from locations where the infection was initially established (Reed *et al.*, 2003).

Few studies have been conducted on the parasitic infections of *H. rustica*. Previous studies of these migratory birds in Malaysia mainly focused on population dynamics and roosting behavior (Mansor *et al.*, 2020; Ismail *et al.*, 2020). However, since 1966, Barn Swallows have consistently returned to the same breeding and nesting area in Bentong town, raising concerns about the potential risk of zoonotic transmission of parasitic diseases from bird droppings to humans (Mansor *et al.*, 2021). These birds live near human habitats, and diseases carried by their waste can be transmitted through contaminated water and air. Droppings are a standard medium through which diseases spread from birds to humans (Sharma & Vashishat, 2017).

The present study identified three parasitic species with zoonotic potential: *A. galli*, *Toxocara* spp. and *Hymenolepis* spp. *A. galli* is a parasitic soil-transmitted helminth that can cause ascariasis in humans through ingestion of infective eggs from contaminated soil, animal waste, uncooked food, or dirty hands. *Toxocara* spp. and *Hymenolepis* spp., a neglected zoonotic parasite, can affect human populations when their embryonated eggs are ingested via contaminated soil, bird feces, or raw vegetables (Yang *et al.*, 2017; Chen *et al.*, 2018).

However, there is still insufficient evidence of the direct transmission of avian-borne parasitic pathogens from wild birds to humans. Instances of direct transmission have been rarely identified (Tsiodras *et al.*, 2008). Despite this, the preference of some wild birds for sites close to human habitation increases the risk of zoonotic infections. This study sheds light on the impact of parasitic infections, and its findings may serve as a guide for future control measures and prevention strategies.

In conclusion, migratory Barn Swallows in Malaysia are infected with zoonotic intestinal parasites. Despite low prevalence, parasites are potentially transmitted from bird droppings to humans. The findings of this study offer valuable insights that can pave the way for practical and efficient control measures, prevention strategies, and enhanced preparedness to deal with parasite outbreaks. By taking appropriate actions based on this knowledge, we can better safeguard human health while coexisting harmoniously with these fascinating migratory birds.

Ethical Approval

The research protocol was approved by the Institutional Animal Care and Use Committee (IACUC) of the Universiti Malaya (reference number: G8/23122019/11102019-01-R).

Conflict of Interests

The authors declare no conflict of interest in this work.

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Availability of Data and Materials

The analysis results that support the findings of this study are available in Figshare with the identifier https://doi.org/10.6084/m9.figshare.25547812.

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