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Endoparasites of Rodents in Two Islands of the Straits of Malacca.

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ABSTRACT An endoparasitic survey of wild rodent populations of two islands, namely Pulau Langkawi and Pulau Jarak, was conducted to determine their biodiversity. Of the total of 13 rats captured, only one rat was trapped from Pulau Jarak. All rodents were identified and examined for endoparasites. These represented three commensal rodent species (*Rattus tiomanicus*, *Rattus rattus diardii*, and *Rattus exulans*), with *R. tiomanicus* being the most dominant species (84.3%) with the number of males (58.3%) captured being higher than females (41.7%). The rats were analyzed for parasite incidence, prevalence and intensity. The single rodent captured from Pulau Jarak was free from endoparasite infection. Post-mortem examination found high levels of endoparasitic infection in the hosts captured in Pulau Langkawi with the highest incidence in the small intestine, followed by caecum and stomach. Overall, the study showed high prevalence of multiple species of Heligmonellidae (100%) and only one cestode species (*Rodentolepis nana*). The endoparasite population was also found to be uniquely low in diversity. This study also showed that the present distribution of the rodent population in Langkawi is characteristic of a disturbed habitat and can be attributed to ongoing human activities in the surrounding area. This study provides a much needed baseline for the ecology of a disturbed island habitat. Further studies will shed light on the ecological interactions that influence the endoparasitic population of commensal rodents in the Langkawi archipelago.

ABSTRAK Kajian endoparasit tikus liar di dua pulau iaitu, Pulau Langkawi dan Pulau Jarak telah dijalankan untuk menentukan kepelbagaian spesis semasa. Sejumlah 13 tikus diperangkap dari kedua-dua pulau telah dikenalpasti dan dikaji untuk jangkitan endoparasitnya. Keputusan awal menunjukkan tiga spesis tikus komensal *(Rattus tiomanicus, Rattus rattus diardii,* dan *Rattus exulans)* diperangkap yang mana, *R. tomanicus* merupakan spesis paling dominan (83.3%). Bilangan tikus jantan (58.4%) yang diperangkap agak tinggi berbanding dengan betina (41.7%). Seterusnya, analisis data parasit populasi roden dikaji untuk kehadiran parasit, jangkitan kelaziman jangkitan dan intensiti jangkitan. Bedah siasat mendapati semua hos dijangkiti dengan bilangan endoparasit yang tinggi dalam usus kecil, diikuti dengan secum dan perut. Secara keseluruhan, kelaziman jangkitan tinggi ditunjukkan oleh spesis Heligmonellidae (100%) dan hanya satu spesis Cestoda *(Rodentolepis nana)*. Jangkitan populasi endoparasit tikus didapati unik dengan kepelbagaian spesis yang rendah. Kajian ini juga jelas menunjukkan bahawa taburan populasi dalam habitat Pulau Langkawi ini terganggu dan dipercayai berkaitan dengan aktiviti manusia dipersekitaran. Kajian ini penting bagi menyediaan maklumat asas bagi ekologi habitat kepulauanyang terganggu. Kajian yang berterusan penting bagi menjelaskan interaksi ekologi yang mempengaruhi populasi tikus komensal di kepulauan Langkawi.

(endoparasite, biodiversity, wild rats, small mammals, rat helminthes)

INTRODUCTION

Prevalence of parasitic diseases in many tropical countries is high and poses threat to human health and exposure to parasitic diseases can happen when man live closely to the rodent, a reservoir host to many diseases or the secondary parasite host. Diseases can be transmitted directly via contact with urine and body fluids, bites or indirectly via eating contaminated food and water or arthropod vectors. Although the ecology and the epidemiology of macroparasites in rodent population inhabiting

temperate climates are well documented, studies on small rodent parasites from the Far East, especially Malaysia, essentially concern no more than species lists and records of prevalences of infections. [1, 2, 3, 4, 5]. To date, there is also a lack of data available on the distribution and the prevalence of rat endoparasite population on an island environment. This study offers a unique opportunity to understand the effects of island biogeography on the biodiversity of the rodent host and its parasites.

This study is also aimed to determine and catalogue the current rodent population and its parasites from island habitats. Two sites were chosen, namely, Pulau Langkawi and Pulau Jarak, both islands located in the Straits of Malacca. North-Eastern Langkawi was selected because much of the area is still preserved with little development surrounding it as well as, consisting of a continuum of habitats ranging from lowland forest to the strand, mudflat, estuaries and mangroves.

METHODOLOGY

An expedition to the Island of Langkawi was conducted from 7th -9th April 2004 and aimed to determine the rodent parasitic infections mainly around the vicinity of the Kisap and Kilim rivers. Another expedition was mounted in 2007 to Pulau Jarak with a similar purpose. However, the time spent for rat trapping was only for one night.

Rats were trapped from both sites using wire traps with palm fruits as bait. A total of 30 traps were left overnight over a span of 3 days 2 nights in Pulau Langkawi and over one night in Pulau Jarak. The traps were checked in the morning and captured rats were collected. Rats were identified based on descriptions from Medway [6] and Payne and Francis [7], and sacrificed using chloroform. Morphometric measurements of each rat was recorded and the rats separated into two age-weight groups, namely, juvenile (<100g) and adults (>100g), as previously described by Brookes and Rowe [8].

A complete post-mortem of all rats was undertaken for the examination of endoparasites especially in the alimentary tract and other internal organs. After careful removal, parasites were identified and counted and the prevalence, mean intensity of infection and frequency distribution of parasites were calculated.

Table 1. Species composition of wild rats captured from Pulau Langkawi and Pulau Jarak, by abundance and sex.

Sex	*R. tiomanicus*	*R. exulans*	*R. diardii*	**Total**
Males	6	1	0	7 (53.8%)
Females	4	1	1	6 (46.2%)
Total	10 (76.9%)	2 (15.4%)	1 (7.7%)	13

RESULTS

A total of 13 wild terrestrial rats were captured comprising the following three species of commensal rats, *Rattus rattus diardii*, *R. exulans* and *R. tiomanicus* (Table 1). Due to the short stint in Jarak Island, only one rat, *Rattus r. diardii* was captured and examined. The wild rat community of Pulau Langkawi was made up entirely of two commensal rat species namely, *Rattus tiomanicus* and *Rattus exulans*. *Rattus tiomanicus*, was found to be the dominant rat species (76.9%), with numbers of males (53.8%) higher than females (46.2%)($\chi 2=10$, $p=0.002$).

Post-mortem examination showed that all rats captured from Langkawi was infected with endoparasites. However, no endoparasites were recovered from the single rat captured in Pulau Jarak.

A total of 1136 helminth parasites were recovered in this study. The helminth parasites recovered from the rodent population comprised of Nematoda and Cestoda parasites. The nematodes were the most common endoparasites, comprising 99.9% of the total helminth recovered. Only one specimen harbored a single cestode (*Rodentolepis nana*) parasite.

A total of four endoparasitic families were recovered (Heligmonellidae, Heterakidae, Spiruridae and Hymenolepididae). The nematodes recovered were mostly intestinal parasites, consisting of plural species of Heligmonelloids (96.2%) and infestations were 100% for rat population from Pulau Langkawi. Other endoparasites were also recovered from different organs; caecum (25%) followed by stomach (8.3%). Other organs such as, heart, lung and liver were free from parasitic infections (Table 1). A single nematode, *Heterakis spumosa* worm was recovered from the caecum. Similarly, a single species was also recovered from the stomach, namely *Mastrophorus muris* (Table 2). All livers were found to be free from any cysticercus *Taenia taeniaformis*.

Most infections were multiple species (58.3%) compared to singular (41.6%) infections. Prevalence of the Heligmonelloids in both sexes was 100% with intensity in males (109) higher than females (66).

Parasitic infections appeared to be different on host sex and age in the *R. tiomanicus* population of Pulau Langkawi ($\chi 2=10$, $p=0.002$); however, this result should be taken with caution since the sample size was small.

DISCUSSION

The endoparasitic fauna of wild terrestrial rats have been well documented in various hábitats ranging from primary forest to urban habitats [1, 2, 3, 4, 5] and have given an insight into the rats hábitats and behaviour.

To date, there are limited studies done on the island environment and this study offeres a unique opportunity to understand the effects of island biogeography on the biodiversity of the rodent host and its parasites. The rodent communities from both islands were made up entirely of commensal rats. *Rattus tiomanicus* was predominatly inhabiting Pulau Langkawi. However, in Pulau Jarak, only one specimen of *Rattus rattus diardii* was captured. This provides evidence that both enviroments are disturbed habitats and the commensal rodent species has invaded the surrounding areas of both islands.

The rat *Rattus tiomanicus* can be found in various types of habitats ranging from rice fields, scrubs to plantations, particularly oil-palm estates throughout Southeast Asia.Their flexible lifestyle enables them to thrive in disturbed environments and is highly probable that it is responsible for transmitting and maintaining a distinct and highly adaptable cosmopolitan endoparasite community as reflected in this study.

The helminth community of the Malaysian wood rat, *Rattus tiomanicus*, in Pulau Langkawi was characterized after a complete analysis of its helminth community component and infracommunity structure, relative to host age and sex.

The helminth community in Pulau Langkawi comprised of three genera: one cestode, and the three nematodes. The helminth community presented a low diversity with infracommunities usually made up of singular and up to three helminth infections per host. Hosts were found to be highly susceptible to endoparasitic infection with all rodents infected with worm burdens ranging between low to high. It is believed that habitat played a role in determining the prevalence of parasite infection [11, 12]. Other factors, such as host sex and age was found to affect the worm burden. This trend was also observed in studies by Abu-Madi [12] and Mafiana et.al. [13] reporting significant sex differences in which,

Table 2. The microhabitat, intensity, prevalence and mean abundance of *Rattus tiomanicus* in Pulau Langkawi.

Endoparasite	Microhabitat	Intensity	Prevalence	Mean abundance ± SE
Heligmonellidae gen.sp	Small intestine	91.1	100%	91.1 ± 80.5
Mastophorus muris	Stomach	1	8.30%	0.08 ± 0.3
Heterakis spumosa	Caecum	1.33	25%	0.3 ± 0.65
Rodentolepis nana	Small intestine	1	8.30%	0.08 ± 0.3

SE= Standard error

males appear to be more susceptible to infection than female rats. This pattern could be due to males foraging further resulting in the increase of exposure to infection. Secondly, male rats are generally immune-compromised by their hormones compared to females[14, 15]. Host age was also shown to have an impact with adults heavily infected compared to juveniles. Such age-related differences could be attributed to longer exposure time to infective stages in older rats [16].

The Heligmonellidae parasites was found prevalent in all the host indicating their high adaptability and rapid transmission rate among the rat population. The present study was unable to determine the exact population distribution and prevalence of each plural species due to the concurrent infections that occurred between them.

The low presence of endoparasites such as, *Rodentolepis nana* also reflects the diet and food intake of their host [9, 10]. The present study supports the findings of Lim [10] that absence of cestode infections could be related to the absence of insects in their diet which comprised of more fruits and vegetables.

It is noted that the sample size is small in this preliminary study. Therefore, a more detailed investigation is warranted to ascertain the prevalence and to test the relationship between infection rate with host sex and age.

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