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Gastrointestinal Helminth Infections in Asian House Rats *(Rattus tanezumi)* from Northern and Northeastern Thailand

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Abstract

The presence of gastrointestinal helminths (GI helminths) was investigated in 68 Asian house rats (*Rattus tanezumi*) trapped in various habitats: forests, upland, lowland agricultural areas and domestic places from northern and northeastern Thailand. The study revealed the rodents were infected with 11 species or taxonomic groups of parasites (2 cestodes, 8 nematodes and 1 acanthocephalan). The prevalence of infection was 66.2% (45 out of 68 rats infected). Of the GI helminths, the dominant parasites were Trichostrongylidae (33.8%) followed by *Raillietina* sp (20.6%), *Syphacia muris* (14.7%) and *Hymenolepis diminuta* (11.8%). Domestic habitats showed the highest prevalence of infection (23.5%) followed by upland (17.6%), lowland (16.1%) and forest habitats (8.8%). Helminth diversity was also highest in domestic habitats followed by upland, lowland and forest habitats, with 8, 7, 6 and 4 species or taxonomic groups, respectively. The prevalence of parasite infection and helminth species richness in *R. tanezumi* was higher in human living places than in wild habitats or agricultural areas. Host sex and maturity were not significantly found to influence the overall prevalence of helminth infection. *Raillietina* sp, *H. diminuta* and *Moniliformis moniliformis*, potential causes of parasitic zoonoses, were found in domestic habitats, making them a risk for human helminthiasis in this region.

Keywords: gastrointestinal helminth, rodent, *Rattus tanezumi*, habitat, zoonoses, Thailand

Introduction

The Asian house rat, *Rattus tanezumi* was formerly included in *Rattus rattus* complex. Recent molecular studies suggest *R. tanezumi* is a different species [1,2]. This rodent species is widely found in urban areas, villages, agricultural fields and forest edges. They cause a great deal of economic damage by destroying food stores and are important reservoirs of many rodent-borne diseases [3].

Some previous studies have been carried out on the occurrence of helminth infection in rodents of Thailand [4-6]. However, little is known

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about parasite diversity among *R. tanezumi* in Thailand, and more information on helminth diversity and distribution still needed.

The aim of this study was to survey helminth biodiversity among these rodents in relation to habitat in order to evaluate the risk for helminth transmission to humans. We examined *R. tanezumi* trapped in different habitats in Nan, Loei and Buriram provinces of northern and northeastern Thailand.

Materials and methods

Rodents were collected from Nan (representative for northern Thailand), Loei and Buriram (representative for northeastern Thailand). The sampling habitats were selected from both urban and rural areas, ranked according to the degree of anthropogenic transformation, as forests, upland agricultural areas, lowland agricultural areas and domestic places [7]. Live-traps were used to collect rodents alive. The trapped rodents were collected each morning and brought to the laboratory.

Cotton wool soaked in chloroform was used for induction of anesthesia followed by euthanasia of the rodents in a plastic box. The maturity of the rat was categorized into juvenile or adult. The sex was determined by visual inspection of external sexual organs. Gastrointestinal tracts (GI tracts) were collected from the esophageal sphincter of the stomach to rectum above the anus. The stomach, small intestine and large intestine were examined for helminths under a stereomicroscope.

The helminths were isolated and preserved in 70% alcohol. Cestodes were stained with Semichon's carmine and mounted in Permount as a permanent slide while nematodes were cleared with lactophenol and mounted on a temporary slide. The helminth species were identified according to helminth identification keys [8-12].

Statistical analysis was performed using Statistica computer software. The analysis was investigated by Chi-square test with Yates correction to evaluate the relations between prevalence of infection and host sex or maturity. The critical probability was set at $p = 0.05$.

Results

A total of 68 Asian house rats, *R. tanezumi* (38 males and 30 females; 51 adults and 17 juveniles) were captured and examined. Infection was found in 45 rats (66.2%).The highest prevalence of infection was found in domestic habitat (23.5%) followed by upland agricultural areas (17.6%), lowland agricultural areas (16.1%) and forests (8.8%). In addition, the greatest helminth diversity was found in domestic places followed by upland agricultural areas, lowland agricultural areas and forests with 8, 7, 6 and 4 helminth species or taxonomic groups, respectively (Fig 1).

Eleven different helminth group were identified: 2 cestodes, 8 nematodes and 1 acanthocephalan species (Table 1, Fig 2). The most prevalent helminth type was the nematode family Trichostrongylidae (33.8%) followed by the cestode *Raillietina* sp (20.6%), nematode *Syphacia muris* (14.7%) and cestode *Hymenolepis diminuta* (11.8%).

The prevalence of overall helminth infection was investigated in relation to sex and maturity (Table 2). Statistical analysis showed a nonsignificant association between prevalence of helminth infection and host sex ($\chi^2 = 0.45$, $p = 0.64$) and between adults and juveniles ($\chi^2 = 0.38$, $p = 0.69$).

Discussion

Rodents have been studied for prevalence of GI helminth parasites in Europe, America, Australia, Africa and Asia, including Southeast Asia [13-18], Surprisingly, not much work has been done in Thailand.

Nematodes of the family Trichostrongylidae were the dominant parasites in our study at 33.8% prevalence. Several species have been reported in Southeast Asia: *Trichostrongylus* sp, *Nippostrongylus brasiliensis, Brevistriata skrjabini* and *Orientostrongylus tenorai* [6,18-22]. However, the specimens found in this study were difficult to determine to the genus and species levels. Further identification using molecular tools is required.

Nematodes of the family Rictulariida, *Pterygodermatites* sp (syn, *Rictularia* sp), were

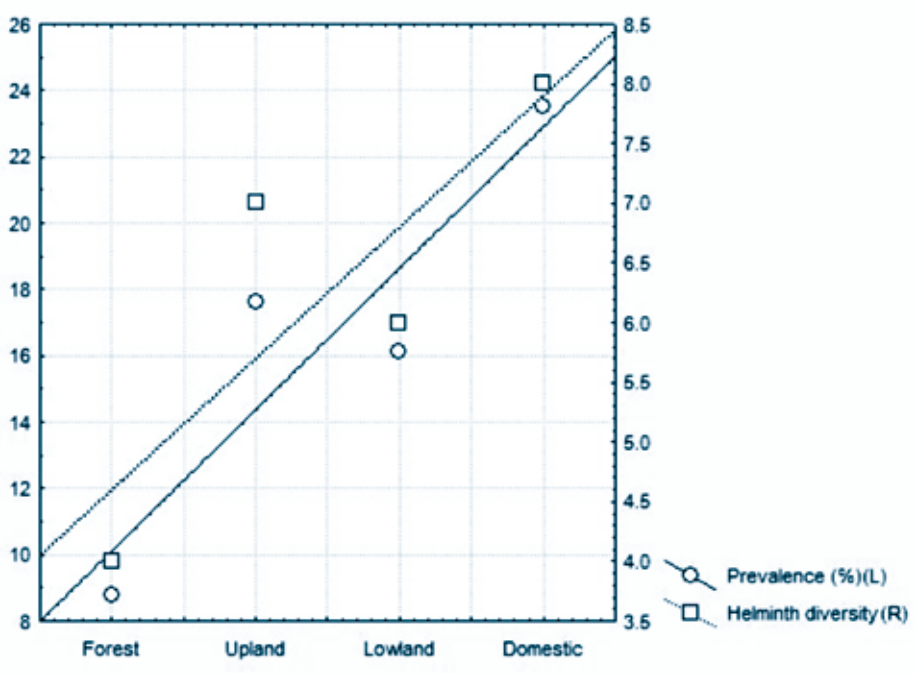

Fig 1 Prevalence and helminth diversity of GI helminths in *Rattus tanezumi* among various habitats in northern and northeastern Thailand.

Table 1 Prevalence of GI helminths in *Rattus tanezumi* among 4 different habitats from northern and northeastern Thailand.

Helminth species	Organ	Prevalence (%)				
		Forest	Upland	Lowland	Domestic	Total
Cestode						
Raillietina sp	SI	2.9	8.8	5.9	2.9	20.6
Hymenolepis diminuta	SI	1.5	2.9	4.4	2.9	11.8
Nematode						
Trichuris muris	LI	-	-	1.5	-	1.5
Syphacia muris	LI	-	7.4	4.4	2.9	14.7
Protospiura sp	ST	-	-	1.5	-	1.5
Mastophorus sp	ST	-	1.5	-	-	1.5
Pterygodermatites sp	SI	1.5	-	-	4.4	5.9
Gongylonema neoplasticum	ST	-	1.5	-	5.9	7.4
Trichostrongylidae	SI	4.4	10.3	10.3	8.8	33.8
Filariidae	SI	-	1.5	-	1.5	2.9
Acanthocephalan						
Moniliformis moniliformis	SI	-	-	-	1.5	1.5

*ST = Stomach, SI = Small intestine, LI = Large intestine

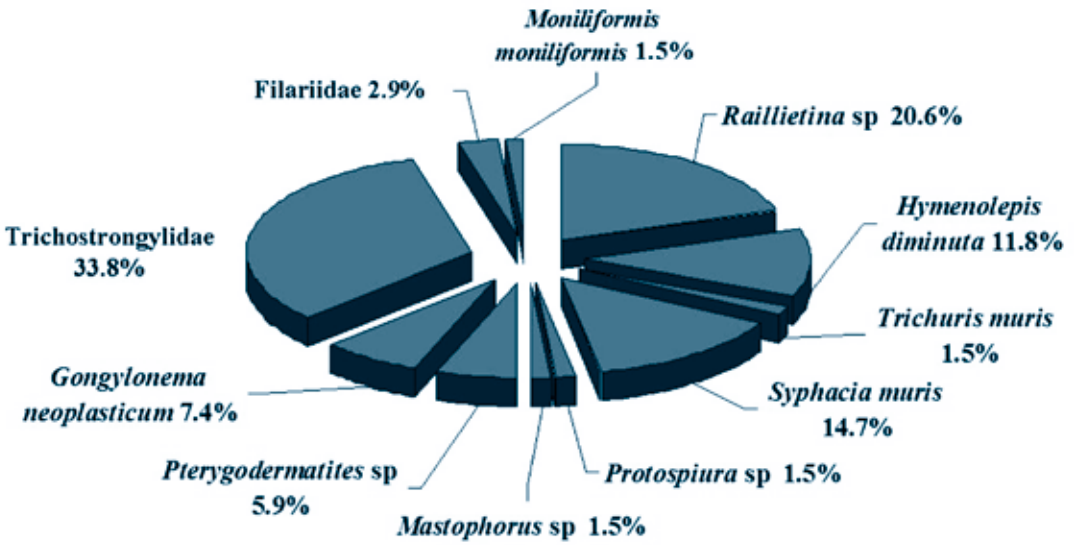

Fig 2 Overall helminth composition infecting *Rattus tanezumi* from northern and northeastern Thailand.

Table 2 Overall prevalence of GI helminths in relation to sex and maturity of *Rattus tanezumi* collected from northern and northeastern Thailand.

Rodent sex	No. examined	No. positive	%
Male	38	28	73.7
Female	30	17	56.7
Rodent maturity	**No. examined**	**No. positive**	**%**
Adult	51	36	70.6
Juvenile	17	9	52.9
Total	68	45	66.2

found in the duodenum. The identification of this rictularid worm was based mainly on the presence of comb-liked spines covering the body. This parasite was previously found in *R. rattus* in Chiangmai [6]. Rictulariidae has been reported in Southeast Asia and *Rictularia tani* in Indonesia and Malaysia [19,20,23].

This is the first time, to our knowledge, filarid worms have been found in the GI tract of a rodent species. In their review of nematode parasites in Malaysian rodents, Singh and Chee-Hock [19] reported *Breinlia* sp in the abdominal cavity and lung. However, none of the previous studies in Southeast Asia have reported filarid worms in the GI tract of a rodent. However, these specimens require molecular identification.

Two cestodes were found: *Raillietina* sp and *H. diminuta*. These two cestodes were found only in the small intestine of rodents. *Raillietina* sp is commonly found in birds [24] while rodents in

Southeast Asia have been reported to be infected with *R. celebensis* and *R. siriraji* in Thailand and Vietnam [5,22,25]. Another cestode, *H. diminuta* is usually found in several murid rodent species in Southeast Asia [5,21,22,26]. Interestingly, these two cestodes were found in all habitats in this study, which may favor the infection of other murid species.

The acanthocephalan *Moniliformis moniliformis* was also found in this study. Only one rodent from a domestic habitat was found to be infected with this parasite. This parasite is often found in cities or near human living places because its life cycle needs the cockroach as an intermediate host to be completed [27]. *M. moniliformis* is also recognized as a zoonotic parasite of public health concern [20,28,29].

Two other cestode species found have been reported as transmissible to humans and constitute a public health problem: *Raillietina* sp [30,31] and *H. diminuta* [5,20,32,33].

Domestic habitat were found as the dominant place of helminth infections and zoonotic helminth species, suggesting a potential risk to humans. *R. tanezumi*, was found in various habitats and is a potential reservoir of zoonotic parasitic diseases. Increases in parasite prevalence and helminth diversity in *R. tanezumi* were observed when moving from wild habitats to those inhabited by humans (Fig 1).

This study provides basic information on GI helminths among *R. tanezumi* in northern and northeastern Thailand. However, we carried out a survey of helminths in the GI tract only. Parasites in other organs should also be studied, such as the blood, lungs, liver, peritoneum and reproductive organs. Further studies should be conducted in other parts of Thailand. Further analysis would be useful to discover routes of helminthic zoonoses in Thailand and Southeast Asia.

Conclusions

A total of 68 *R. tanezumi* specimen were examined in northern and northeastern Thailand. The prevalence of GI helminths was 66.2% (45 rats). Eleven parasite species or taxonomic groups were identified: *Raillietina* sp, *H. diminuta*, *T. muris*, *S. muris*, *Protospiura* sp, *Mastophorus* sp, *Pterygodermatites* sp, *G. neoplasticum*, *Trichostrongylidae*, *Filariidae* and *M. moniliformis*. Three parasites species are of medical importance: *Raillietina* sp, *H. diminuta* and *M. moniliformis*. The diversity and prevalence of parasites was affected by habitat type, with domestic habitats being a high risk area for helminth transmission.

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