

Short Report

# Prevalence of a mesostigmatic mite, *Dermanyssus* species (Arachnida: Mesostigmata: Dermanyssidae) in Pallas's squirrels, *Callosciurus erythraeus* in Kanagawa Prefecture, Japan

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**Abstract:** To elucidate the prevalence of a mesostigmatic mite, *Dermanyssus* species, in Pallas's squirrel, *Callosciurus erythraeus*, a species invasive to Japan, 240 specimens of the squirrels were examined for the mites during April, 2020-March, 2022. After the squirrels had been captured by the administrative agency as part of a capture policy against harmful mammals in Zushi-shi, a municipality in a southern area of Kanagawa prefecture, the animals were euthanized using carbon dioxide inhalation. *Dermanyssus* mites were detected on three of the squirrels. The collected mites were identified, based on their morphology, as *Dermanyssus* species, probably *D. gallinae*, which usually use birds as their major hosts and are often associated with the poultry industry. Infestation of the Pallas's squirrels by this mite species, even if by accidental parasitism, is thought to occur once in a while. Although the infection source of the mites to the squirrels was unknown, the possibility exist that the mites infested the squirrels when they intruded into poultry houses. Some mammals such as Pallas's squirrels might be connected with *Dermanyssus* mite migration.

## I. Introduction

The Pallas's squirrel, *Callosciurus erythraeus*, a species of the family Sciuridae, was originally distributed in Southeast Asia from Assam, Arunachal Pradesh, Manipur, and Meghalaya in northeastern India to Myanmar, the Malay Peninsula, Thailand, eastern Cambodia, Laos, and Vietnam, in addition to southeastern China, Hainan Island, and Taiwan. This species of squirrel has invaded some countries of the world as an alien invasive species (Lurz et al. 2013). In Japan, a subspecies of this squirrel, *C. e. flavimanus* (synonym: *C. e. thaiwanensis*, a formerly used subspecies name in Japan), which is not native to Japan, has populated some areas such as Kanagawa and Shizuoka prefectures (Tamura 2004, Suzuki & Torii 2016). Pallas's squirrels cause such problems as peeling of tree bark, trespassing into houses, and mastication of electric wires, as well as adversely influencing native biogeocenosis (Tamura & Miyamoto 2005). Therefore, alien Pallas's squirrels cause numerous social problems related to human life in Japan. Some municipalities are striving to capture all individuals of this squirrel species.

We earlier detected four adult *Dermanyssus* mites, probably *D. gallinae*, unexpectedly from the body surface of one Pallas's squirrel specimen in April, 2019 (Nakamura & Fukase 2022). Usually, individuals of *D. gallinae* use birds as the major host animal and often occur in associa-

tion with the poultry industry, for which they are recognized as a harmful ectoparasite species of chickens. At the time in 2019, the infestation was presumed not to be prevalent because the mites were not detected from the other 26 squirrels which were captured almost simultaneously in the same area. Nevertheless, there might be some value in investigating the prevalence of this mite species in Pallas's squirrels, even if the infestation occurs accidentally, because a new host-parasite relationship might occur between an alien mammal host and an existing ectoparasite mite.

This study was conducted to elucidate the prevalence of *Dermanyssus* mites among the squirrels.



Fig. 1. *Dermanyssus* species (female, adult) collected from a Pallas's squirrel, *Callosciurus erythraeus*. Scale bar = 100  $\mu$ m.

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**Table 1. Summary of the Pallas's squirrels from which *Dermanyssus* mites were collected.**

Sex	Head and body length (cm)	Tail length (cm)	Body weight (g)	Time when mites were detected	No. of mites collected
Female	20	18	321	Jun. 2020	2
Male	21	20	335	Sep. 2020	1
Male	22	20	347	Oct. 2020	2

## II. Materials and Methods

A research survey was conducted during April, 2020-March, 2022 for 240 Pallas's squirrel specimens that were provided from the administrative agency of Zushi-shi, a municipality located in a southern area of Kanagawa prefecture, Japan. The animals had been captured as part of a capture policy against harmful mammals in Zushi-shi, and then had been euthanized by the agency using carbon dioxide inhalation. For the present study, 10 specimens were selected each month randomly in the order of capture during the research period. The body surface of each squirrel specimen was observed in great detail under a magnifying glass to detect *Dermanyssus* mites. In addition, the hairs of the squirrels were combed vigorously with a flea comb and a slicker brush on a piece of white-colored paper to search for dropped mites.

When the mites were collected, they were fixed and preserved using 70% (V/V) ethanol aqueous solution. Subsequently, the preserved mites were dehydrated and then permeated with xylene to be observed morphologically under a light microscope.

## III. Results

Mites were detected from three of the squirrels, which had been captured respectively in June, September, and October, 2020. These three squirrels, all adults, were one female and two males. The numbers of the mites obtained from the three squirrels were one from one squirrel and two each from the other two squirrels (Table 1). Skin lesions were not observed in the three squirrels.

The detected mites were all adult females (Fig. 1). Their external morphology indicated 0.8 - 1.0 mm idiosoma length, 0.5 - 0.7 mm idiosoma width, a rounded posterior part of the idiosoma, and elongated and stylet-like chelicerae. One pair of stigmata was observed around the coxae of legs II and III. Setae on the idiosoma formed rows. The dorsal plate on the dorsal side was an elongated pentagon, the forward edge of which was angular. Its rear edge was narrow and almost linear. On the ventral side, the sternal plate was broad and bearing two pairs of sternal setae. The genitoventral plate was ligulate. The anal plate was broad and nearly triangular with forward and rear edges that were, respectively, linear and

semicircular. The anus opened at the posterior part of anal shield. One of the five detected mites was observed to have sucked blood. From these morphological findings, the mites were identified as belonging to the genus *Dermanyssus*. They are particularly regarded as having morphological features corresponding to those of the poultry red mite *D. gallinae*.

## IV. Discussion

Many *Dermanyssus* mite species have been described (Roy & Chauve 2009). Of the mites of this genus, *D. gallinae* has been found mostly with various species of birds and mammals such as rodents, in addition to occurrence at chicken ranches (Pritchard et al. 2015). Nevertheless, no report had described *Dermanyssus* mites detected from Pallas's squirrels. Some examples for the absence of *Dermanyssus* mites in Pallas's squirrels were obtained through investigations conducted in Japan (Shinozaki et al. 2004) or in Argentina (Gozzi et al. 2013). Whereas, we earlier reported the collection of *Dermanyssus* mites from a Pallas's squirrel in 2019 (Nakamura & Fukase 2022). The findings of the present research reinforce the inference that Pallas's squirrels can be a host to *Dermanyssus* mites, even if the prevalence of the mite species is very low in the squirrel population.

A strange phenomenon arises with respect to the cathemerality of the mite species and its host squirrel species. *Dermanyssus* mites are nocturnal. Therefore, they parasitize their hosts to suck blood during times of darkness. They lurk in cracks and crevices behind objects during other times (Knežević et al. 2017, Gay et al. 2020). Pallas's squirrels, by contrast, are diurnal (Lurz et al. 2013). It might seem strange that the nocturnal mites were detected from the diurnal Pallas's squirrel because the squirrel probably had few opportunities to be infested by the nocturnal mites when the animals were active. Stated differently, when the mites appear from their hiding places to suck the blood of host animals, the squirrels are sleeping at a separated place from the mites' habitats. A possibility for infestation is that the mites had already inhabited the nests of the squirrels. Even if that were so, however, the intrusion route of the mites to the nests remains unclear.

Although providing a sufficient explanation for infestation of the Pallas's squirrels by the mites

is difficult, one hypothesis is that the squirrels of the present cases had acted exceptionally during nighttime. During the night, the squirrels might have been infested by the mites and captured by traps soon after: before the mites returned to their hiding places. Alternatively, a mite that infested a squirrel during nighttime might not return to its hiding place because of the squirrel's movement from place to place.

In addition, the existence of poultry red mites on squirrels during the daytime cannot be denied because a certain population of them are reported as invariably found on chicken body surfaces differing from the general behavior of the mite species (Nakamae et al. 1997a, 1997b).

However, lack of detection of the mites in any of the other 237 Pallas's squirrels indicates that the mite infestation is not rife among the animals living in that area. Accordingly, infestation found in the present case of the squirrel was not inferred as representing a prevalent condition.

The place at which the three mite-positive squirrels had been infested by the mites was uncertain. The possibility exists that the infestation occurred at a nearby chicken ranch if the squirrels had invaded such a structure. Another possibility is that animals such as the Pallas's squirrel might facilitate the transfer of *Dermanyssus* mites among chicken ranches, even though the prevalence of the mites is very low among the squirrels.

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### 中村有加里・深瀬徹:神奈川県で捕獲されたクリハラリス *Callosciurus erythraeus* における *Dermanyssus* 属ダニの寄生状況

#### 要約

われわれは2019年4月に神奈川県において捕獲されたクリハラリス1匹の体表から偶発的に *Dermanyssus* 属ダニを検出したが、これにもとづいて2020年4月から2022年3月の2年間に同地域で捕獲されたクリハラリスにおけるこのダニの寄生割合を検索した。毎月10匹のクリハラリスを検査した結果、2020年6月と9月、10月に各1匹から1-2個体の *Dermanyssus* 属ダニの雌成ダニが検出され、これらはワクモ (*D. gallinae*) である可能性が高いと考えた。ワクモは養鶏場に多発する鶏の外部寄生虫として知られており、クリハラリスが養鶏場に侵入した際に、その寄生を受けたことを考察した。また、偶発的にしてもワクモの寄生を受けたクリハラリスは、このダニの蔓延に関与する可能性がある。

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