TÜBİTAK

Turkish Journal of Veterinary and Animal Sciences

http://journals.tubitak.gov.tr/veterinary/

Research Article

Turk J Vet Anim Sci
(2020) 44: 1212-1221

doi:10.3906/vet-2005-24

Prevalence of ectoparasites on a stray cat population from "Town of Knowledge" Kota Samarahan, Sarawak, Malaysian Borneo

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Received: 06.05.2020 • **Accepted/Published Online:** 29.09.2020 • **Final Version:** 18.12.2020

Abstract: Stray cats survive on their own and scavenge the surrounding areas for food to survive. Their exploitation to investigate the prevalence of ectoparasites can be of great medical importance for humans as they harbour a variety of zoonotic pathogens. Therefore, a survey of ectoparasites on stray cats was carried out from November 2017 to March 2018 around the Town of Knowledge to determine the prevalence of ectoparasites in stray cats and their potential to threaten the public health by infesting stray cats around Kota Samarahan, Sarawak, Malaysian Borneo. A total of 150 individuals of stray cats have been examined for ectoparasites. Of these hosts, 113 individuals (75.3%) of the stray cats were infested by at least one species of ectoparasites. There were nine species of ectoparasites belonging to four groups (louse, flea, mite, and tick). Louse (*Felicola subrostratus*, 44.7%) is the most frequent species of ectoparasite infesting the hosts in this area, followed by flea species, namely, *Ctenocephalides felis* (18.7%) and *Ctenocephalides felis orientis* (16.0%). *Lynxacarus radovskyi* (24.0%), *Otodectes cynotis* (0.7%), mite sp. 1 (0.7%), and mite sp. 2 (0.7%) constitute the four most common species of mites. *Haemaphysalis* sp. 1 (0.7%) and *Haemaphysalis* sp. 2 (0.7%) are the ticks discovered in this area. The result of this study highlights the importance of managing stray cats and controlling their population to minimize the number of individuals that can serve as ectoparasites hosts.

Key words: Ectoparasite, Kota Samarahan, Sarawak, prevalence, stray cats, zoonoses

1. Introduction

Ectoparasites are arthropods that spend most of their lives outside the host either by inhabiting the skin or outgrowth of skin for various periods to survive [1]. In domestic animals, ectoparasites are widely spread throughout the world as they are easier to attract humans' attention worldwide. For example, pedigree cat breeds will be exported elsewhere due to high demands of cat lovers, and the migration of animals will lead to the spread of any parasitic pathogens, especially those which are capable of transmitting to humans [2]. Even though the discussion is still going on about the significant role of domestic cats as a source of zoonotic transmission, despite lacking evidence, stray cats need not be neglected for their capability of becoming carriers. Some ectoparasites are identified as vectors because they are able to transmit zoonotic pathogens to the host through feeding and defecating [3].

Domestic cats are categorized into two types, which are stray cats and housed cats. Stray cats or free-roaming (feral cats) are commonly not considered as pets because they are not owned and live exclusively outdoors. Meanwhile, housed cats have closer associations with humans. They mostly have veterinary care and live indoors. Historically, domestic cats and humans have been living together and have coexisted in the past a few thousand years. However, they still can risk human life by being a suitable host for pathogen vectors [4]. Stray cats can be regularly found almost anywhere in all human populations. Most stray cats were once humans' pets, and they were dumped and abandoned in time because of several factors such as allergic reactions, human migration, and the loss of interest, or simply because they were not wanted anymore. Stray cats may have an important role in the transmission of diseases and understanding the pathogenicity and epidemiology of potential zoonotic agents in stray cat populations and other animals that are closely associated with humans, which is fundamental to public health [5]. A stray cat population especially from an area with a dense human population could provide a valuable resource to understand and fill the knowledge gap of their parasitic infestation.

Dead bodies were observed in Kuching, the capital of Sarawak, and free-roaming animals were found and impounded on roadsides. The statistic of these stray

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animals, especially domestic cats, will keep increasing to have a huge number of individuals that roam around the city and will lead to high prevalence of parasitic infestation [6]. The uncontrolled reproduction period of stray cats may lead to the spreading of ectoparasite infestation that may become the cause of various zoonotic diseases. Besides, domestic cats are easily adapted to any environment regardless of the relevance of anthropogenic activities in an area [7].

Known as the Town of Knowledge, Kota Samarahan is undergoing development towards urbanization, which has led to an increase in human settlements. This enables the construction of many buildings, such as universities, industrial sites, schools, markets, and government offices, in this area and it is important to be aware that the stray cat population within this area also keeps on inclining. The importance of ectoparasite studies on the stray cat population in Kota Samarahan is crucial to restrain any public health problems in this area. Thus, this paper aims to determine the prevalence of ectoparasites population infesting stray cats and also their importance in terms of public health around Kota Samarahan, Sarawak, Malaysian Borneo.

2. Materials and methods

2.1. Study area

The study was conducted in the Kota Samarahan district in the Samarahan division, Sarawak, Malaysian Borneo. It is located 30 km southeast of the Kuching city and is also known as the Town of Knowledge as it is a main educational centre for the Sarawak State, which is home to several educational institutions and government offices. There are three primary educational centres in this district, which are Universiti Malaysia Sarawak (UNIMAS), Universiti Teknologi Mara Kota Samarahan Campus, and the Institute of Teacher Education (Tun Abdul Razak Campus). There is hot and humid weather all year round, with heavier rainfall towards the end of year. This town is surrounded by peat swamp forests. The samples were collected randomly by focusing on areas occupied by humans such as markets, restaurants, and housing areas. The sampling sessions were completed gradually from the right side to the left side of the map to avoid redundant examination of stray cats (Figure 1).

2.2. Collection and examination of stray cat ectoparasites

A total of 150 stray cats were examined and collected for ectoparasites from November 2017 until March 2018 by random sampling in the Kota Samarahan district. The stray cats were found with the permission of the Kota Samarahan Municipal Council. The cats were humanely trapped using sweep nets and baited with cat food targeted in public areas.

The samples of ectoparasites were collected from stray cats by combing the whole body using fine-toothed combs, skin scrapping, ear swabs with wet cotton bud with 70% ethanol, and by directly collecting them from ears, eyelids, toes, and other parts of the body using fine forceps. All of the ectoparasites collected were preserved and placed in vials containing 70% ethanol for further identification process. A separate vial was used for each individual of stray cat. The vials containing ectoparasites were labelled with sufficient information such as the date of collection, location, sex, age stage, and the name of collector.

The age status of the specimens was recorded ranging from kitten to geriatric by using the animals' dental eruption. However, the history of the cats was unknown. The nails of the cats were coloured using red nail colour after the examination for ectoparasites in order to prevent reevaluation. All ectoparasite samples were brought to the laboratory of the Zoological Museum UNIMAS for further identification. All the collected ectoparasites, excluding ticks, were later mounted prior to identification.

2.3. Ectoparasites identification

The preserved ectoparasites were sorted based on their morphology using a dissecting microscope. The samples were cleaned with distilled water (ddH_2O) and immersed in lactophenol for the clearing process. This depends on the size of ectoparasites and takes approximately 3 h to 7 days. Louse, flea, and mite were mounted using Canada Balsam mounting medium for identification under a stereo microscope. The mounted ectoparasites were examined under a compound microscope with magnifications of 40×, 100×, 400×, and 1000× for identification. Ticks were directly identified using a stereo microscope without mounting. All the samples of ectoparasites were identified to genera and species levels when possible using available keys, published references, and taxonomic drawing [7–11].

2.4. Statistical analysis

The terminology of prevalence was used to represent the parasitic infestation of the examined stray cats. The prevalence of the ectoparasites of all sites is calculated by using the following formula: (infested individual) × (100%) / (total sampled individuals in a population) [12]. The association between ectoparasites infestation and age, stage, and sex was analysed using Pearson Chi-square test with 95% confidence intervals. The P-value of <0.05 was considered statistically significant. Statistical comparisons were carried out using SPSS version 20.0.

3. Results

3.1. Stray cats sampled in Kota Samarahan

From a total of 150 individuals of stray cats examined, 70 of them were male and 80 individuals were female. During this study, six age groups were recorded, namely kitten (<6

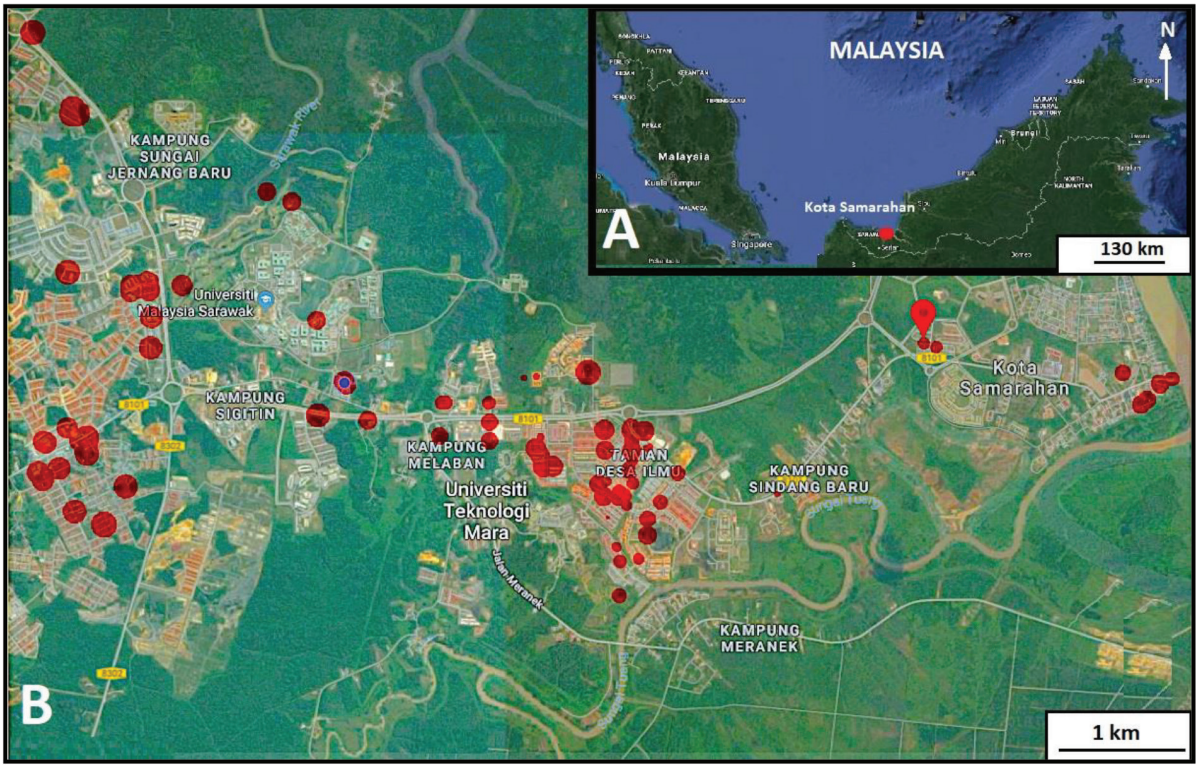

Figure 1. Sampling sites in Kota Samarahan (modified from Google Maps). * red dot indicates the exact location of stray cats sampled.

months), junior (7 months–2 years), prime (3–6 years), mature (7–10 years), senior (11–14 years), and geriatric (>15 years). The prime age group had the highest total number of individuals examined for ectoparasites, with a total of 67 individuals. Meanwhile, there was only 1 individual recorded in the geriatric age group (Table).

3.2. Prevalence of ectoparasites infestation in stray cats

The overall prevalence of ectoparasites in stray cats was 75.3%. There are no significant differences between ectoparasites infestation and age stage ($P = 0.291$, P value > 0.05) and ectoparasites infestation and the sex of stray cats ($P = 0.215$, P-value > 0.05). The prevalence of ectoparasites infestation was 32.7% among the cats aged between 3 and 6 years in this study. A total of 75 individuals, or 50% of the stray cats were infested with single infestation (with one species of ectoparasites infesting the host). Meanwhile, multiinfestations (more than two species of ectoparasites infesting one host) of ectoparasites constituted only 5.3% of the overall infestation rate.

In this study, 4 taxa groups of ectoparasites were discovered, which are lice, fleas, mites, and ticks. Lice are recorded as the most prevalent ectoparasites group with 44.7% of infested stray cats followed by fleas (34.7%) and mites (26.0%). Moreover, five genera of ectoparasites consisting of nine species, including subspecies, were identified in this study. More specifically, one species of lice (*Felicola subrostratus*), two subspecies of fleas (*Ctenocephalides felis felis* and *C. felis orientis*), four species of mites, (*Lynxacarus radovskyi*, *Otodectes cynotis*, unidentified mesostigmatid mite sp. 1, and unidentified mite sp. 2), and two species of ticks from the genus *Haemaphysalis* were discovered in this area (Figure 2). The most frequent species of ectoparasites identified was *Felicola subrostratus* (44.7%) followed by mite *Lynxacarus radovskyi* (24%) (Table).

Moreover, 38 individuals of stray cats were identified to be infested by more than one ectoparasite species at the same time, and the numbers were down to 24 individuals after excluding coinfestations and multiple infestations of ectoparasites from the same group. Figure 3 illustrates the types of infestation of the sampled stray cats in this area. The *Haemaphysalis* ticks recorded in this study were both coinfesting the host with other ectoparasites; meanwhile, the other three groups exhibited various types of infestations from single infestation to multiple infestation.

Noteworthily, *Ctenocephalides felis* species were morphologically identified to infest all stray cats in Kota Samarahan, Sarawak. However, within *C. felis*, two subspecies were recognized as *C. felis felis* and *C. felis orientis* (Figure 4). Among the collected ectoparasites,

Table. Summary of factors associated with ectoparasite infestations of stray cats in Kota Samarahan, Sarawak.

Factors	Category	Number of host examined	Number of host infested	Prevalence (%)	Medical importance
Sex	Females	80	57	38.0	
	Males	70	56	37.3	
	Total	150	113	75.3	
Age stages	Kitten (<6 months)	11	9	6.0	
	Junior (7 months–2 years)	56	40	26.7	
	Prime (3–6 years)	67	49	32.7	
	Mature (7–10 years)	13	13	8.7	
	Senior (11–14 years)	2	1	0.7	
	Geriatric (>15 years)	1	1	0.7	
	Total	150	113	75.3	
Types of infestations by species	Single infestation		75	50.0	
	Coinfestations		30	20.0	
	Multiinfestations		8	5.3	
Types of ectoparasites	Lice		67	44.7	
	Fleas		52	34.7	√
	Mites		39	26.0	√
	Ticks		2	1.3	√
Species of ectoparasites	Lice				
	Felicola subrostratus		67	44.7	
	Fleas				
	Ctenocephalides felis felis		28	18.7	√
	Ctenocephalides felis orientis		24	16.0	√
	Mites				
	Lynxacarus radovskyi		36	24.0	
	Otodectes cynotis		1	0.7	
	Unidentified mite sp.1 (mesostigmatid)		1	0.7	
	Unidentified mite sp. 2		1	0.7	
	Ticks				
	Haemaphysalis sp. 1		1	0.7	
	Haemaphysalis sp. 2		1	0.7	

three groups of ectoparasites (fleas, mites, and ticks) are known to be significant for public health due to transmitting zoonotic pathogens either as vector or/and reservoir hosts. The flea subspecies of *C. felis felis* and *C. felis orientis* are of public health importance, which may have a potential role in tropical emerging diseases

4. Discussion

Kota Samarahan has grown rapidly into a new area of population with many new settlements being built in the area as a number of important buildings such as universities, government authorities, shopping malls, markets, and residential areas have been constructed in the area. Nevertheless, this town still has peat swamp forests in its surroundings despite the altered use of land. As humans are moving into this town, stray animal populations are also inclining, especially stray domestic cats. Stray cats from this area would be a valuable resource to study and comprehend the existing knowledge on parasitic infestation that could potentially be important to both veterinary and public health. Based on data from numerous local shelters, stray animals were mostly taken

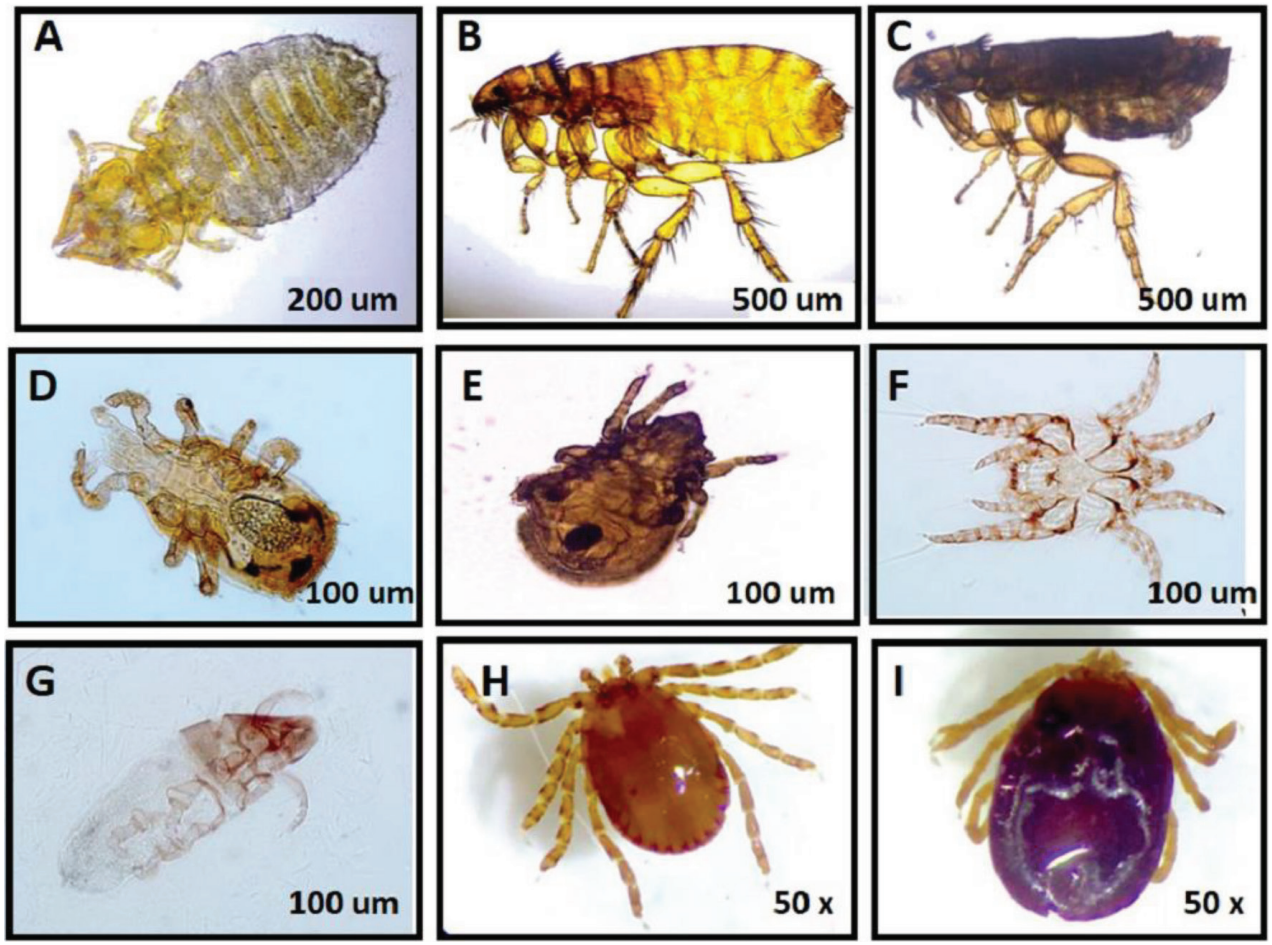

Figure 2. The ectoparasites found on the Stray cats in Kota Samarahan. (A) *Felicola subrostratus*, (B) *Ctenocephalides felis felis*, (C) *Ctenocephalides felis orientis*, (D) unidentified mesostigmatid mites 1, (E) unidentified mites sp. 2, (F) *Otodectes cynotis,* (G) *Lynxacarus radovskyi,* (H) *Haemaphysalis* sp. 1, (I) *Haemaphysalis* sp. 2.

from streets, which were probably lost by their owners or dumped as they were not wanted. To the best of our knowledge, there was a lack of estimated figures on the number of stray cats regarding the Kota Samarahan area as most shelters are centred in Kuching.

A total of 150 individuals of stray cats were examined for their ectoparasite infestation in Kota Samarahan from November 2017 to March 2018. Among the individuals, female stray cats are slightly more abundant in this study (53.3%) compared with male cats (46.7%). However, there is no significant difference between both sexes in this study. There was no predilection for host sex or no undeviating reports were found agreeing with any specific sex of stray cats infested by ectoparasites. Even so, parasite burden bias is possible to transpire in sexually dimorphic hosts due to the parasite strategy to increase the survival chance to the utmost level in such host body size, behaviour, defence mechanism, or sexual enhancement [13].

All individuals of stray cats from six group stages were infested with at least one ectoparasites species. The hosts from the prime age group had the greatest number of individuals caught and examined for ectoparasites in this study compared with the senior and geriatric age groups, which had the least number. This suggests that stray cats are prone to diseases because they lack veterinary care and struggle to obtain nutrients for survival. Hence, very few individuals are examined from these age groups in this study. This intrinsic variable was significantly affirmed in terms of species richness in older hosts than younger ones [6]. It would associate with other parasitic infections that assemble in the host throughout their lifetime, affecting the immunity mechanisms. Furthermore, this study differentiates age groupings into several stages assessing the risks for each group rather than comparing the younger and older generations only. When compared to a previous study [14], age was a significant factor in

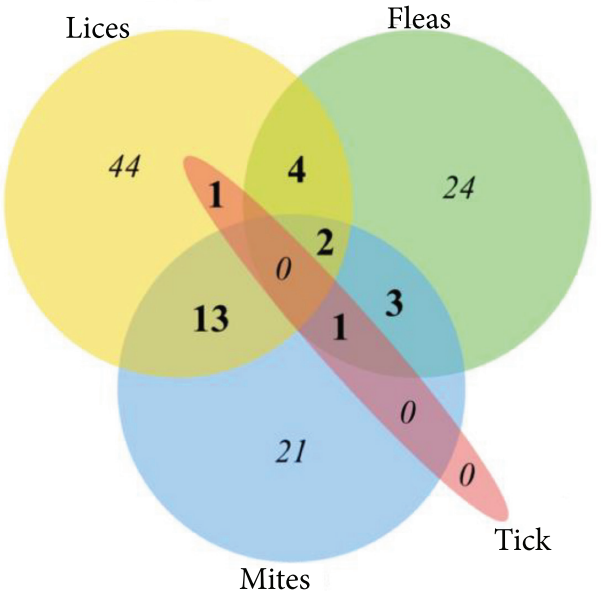

Figure 3. Number of stray cats infested with ectoparasites according to the groups. (*Bold number = Coinfestation or multiple infestation number by groups).

ectoparasites infestation. According to their findings, fleas were often recorded to infest older hosts, meanwhile mites (*Otodectes cynotis*) most commonly infested younger hosts. This report was in agreement with and supported by other studies [15,16]. Factors such as microclimate, the land use history, and veterinary care could lead to this data discrepancy among regions.

This study provides new insight into the prevalence and associated risk factors of ectoparasites infesting stray cats in Kota Samarahan, Sarawak, Malaysian Borneo. The prevalence of 75.3% in stray cats in Kota Samarahan was slightly lower compared with previous studies in Egypt (85.71%) [14], Iran (92.3%) [17], and Thailand (95.8%) [18]. Nevertheless, the prevalence in this study was comparatively higher as compared to a study in Central Mexico (53.0%) [19]. This is probably because the total number of sampled hosts in Central Mexico is more than twice the samples from this study, which include 358 individuals of captured free-roaming cats, and out of that number, 190 individuals exhibit positive results [19]. However, the total samples of the studies in Egypt, Iran, and Thailand were 70 individuals, 50 individuals, and 575 individuals, respectively [14,17,18]. The total number of sampled hosts induces the differences in prevalence rates of each study. As suggested earlier, the differences of various risk factors could also influence infestation and result in different prevalence rates accordingly.

The chewing louse (*Felicola subrostratus)* is documented as the only family found in this study and the most prevalent infestor on stray cats in Kota Samarahan. This species was known to infest only cats and the finding was consistent with a study conducted in the same locality [20]. However, different from previous studies in Peninsular Malaysia [6,21] and other countries, fleas were often found and they predominantly infested stray cats [14,17,18,22–24]. This louse is typically rare in housed or pet cats but very common in feral or free-roaming domestic cats [7]. *F. subrostratus* can only be found to infest domestic cats as it is a characteristic host-specific parasite and currently there is no known evidence on its significance to both veterinary and public health [7]. However, this dandruff-looking parasite could possibly become a nuisance to pet owners.

In this study, two subspecies of fleas, namely *Ctenocephalides felis felis* and *C. felis orientis*, were recorded. Generally, among three subspecies of *C. felis*, *C. f. felis*, and *C. f. orientis* are commonly found in Asia region [7]. The main morphological differentiation between these two subspecies can be found in their head profiles. *C. f. orientis* has a rounded frons compared to *C. f. felis*. Figure 4 illustrates a comparison in terms of notches with setae present in hind tibia of both subspecies. According to this comparison, *C. f. felis* only has six notches, while *C. f. orietis* has seven notches, similar to the findings by [25]. In addition, *C. f. orientis* is always being mistaken with *C. canis* because of its round-shaped head although *C. canis* possesses a heavily rounded shape, apart from its number of notches bearing setae on their hind tibia. *C. f. orientis* was recorded in Peninsular Malaysia infesting stray dogs [21]. *C. canis* was not found to infest stray cats examined in this study even though they were seen to have a close contact with each other. Furthermore, to the best of our knowledge, there is lacking information on the evidence of *C. canis* infestation on stray cats in Malaysia, especially in Sarawak. However, *C. canis* has been recorded to infest stray cats in other localities such as the Alexandria province, Egypt other than *C. felis* [14]. There is a lack of local literature describing the detailed morphological approach to identify this ectoparasite group to the subspecies level.

From the literature worldwide, rat flea (*Nosopsyllus fasciatus*), human flea (*Pulex* sp.), and rabbit flea (*Cediopsylla simplex*) also have been recorded on stray cats; however, they were not recorded in this study [14,24]. Thus, from these comparisons, stray cats that are in contact with other species or the wildlife around them may become carriers of ectoparasites that are commonly found on those animals, especially nonhost-specific parasites. As such, this can reflect stray cats' behaviour in an area. In fact, fleas are commonly known as nonhost-specific and they can get food sources from any host that they live on [7,26].

The present study determined four species of mites and the most frequently found one was *Lynxacarus radovskyi*

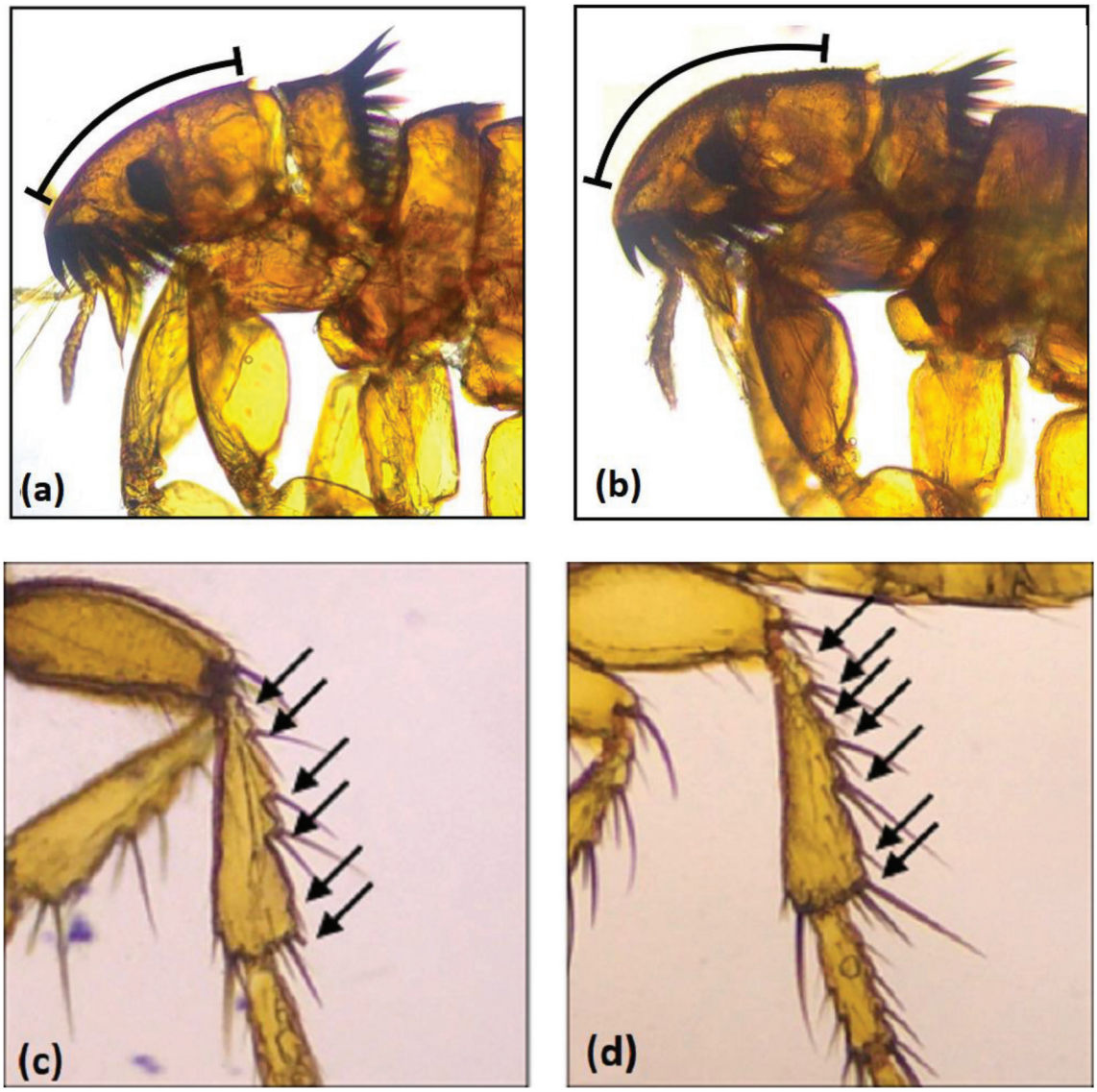

Figure 4. Cephalic profile morphology of (a) *Ctenocephalides felis felis*, and (b) *C. felis orientis*. The lines indicate the differences of morphology from head profile from each subspecies. Hind tibia morphology of both subspecies, focusing on the setae bearing notches present on the hind tibia of (c) *C. felis felis*, with six notches, (d) *C. felis orientis*, with seven notches.

(24.0%). This species is broadly dispersed throughout the globe from various climatic regions including the United States of America, New Zealand, Brazil, and Hawaii to local areas in Malaysia [6,27–30]. This species was first published publicly [29] in Malaysia. This species is often overlooked by veterinary professionals because of its low profile on the host. Its detection is extremely difficult due to its small size except infesting the host abundantly, which makes it easier to be detected [30]. *Lynxacarus rodovskyi* has also been found to infest microhabitat communities of stray cats in Peninsular Malaysia, which are identified in Kuala Lumpur and Georgetown [6].

A very low prevalence of ear mite, *Otodectes cynotis*, infestation was detected in this study, with only a single host out of the total examined population harbouring this species. Compared with a study in Kota Bharu, Peninsular Malaysia, the prevalence of positive cats that were infested with ear mites was 21.0% [31], which was recorded relatively higher, different from this study in Kota Samarahan. Moreover, similar studies in the same region, Sarawak, showed that *O. cynotis* was not recorded; however, other mite species, namely *Sarcoptes scabiei* and *Notoedres cati*, were documented [20]. The standardization of each study, especially the experience level of the researcher in

conducting the examination on domestic cats, may lead to data variability apart from extrinsic factors such as microclimatic variables.

Haemaphysalis tick could potentially have a major impact on both veterinary and public health. This genus is vector to many pathogenic protozoans and bacterial agents [7]. Interestingly, ticks were recorded in this study and both species were from the genus *Haemaphysalis.* They were found around the housing area in Samarindah and along the road Kota Samarahan to Serian. Those areas were identified as adjacent to bushes and the forests nearby as the area were newly developed. Thus, the finding was relevant because based on the observation of the surrounding areas, the examined stray cats were close to the forest and they were suspected to be engaged in activities around the dead woods during scavenging for foods and for other reasons such as mating. This questing tick usually waits its next host by climbing on vegetation and is ready to fall off on a potential host during the day [7]. Both *Haemaphysalis* species were found on cats' upper eyelids, suggesting that thin skin makes them easy to burrow and have blood meal. Locally, *Haemaphysalis bispinosa* was recovered from urban areas in Peninsular Malaysia among stray cats [6]. Ticks rarely infest cats due to cats' behaviour of actively grooming itself. However, ticks can infest any species of animals because they are known as generalist species which are not host-specific [32].

Interspecific interactions were observed between ectoparasites in this study. Apart from a single species infesting a host, multiple ectoparasites were also observed infesting one host in the stray cat population in Kota Samarahan. This ecological overlap could have implications for pathogen transmission among each other by exposing different ectoparasite groups in spatial temporal overlap. Concomitant ectoparasites infesting the body could alter the risk of infestation or infection of another parasite and need to be assessed in risk factors [7]. The *Haemaphysalis* ticks recorded in this study were both coinfesting the host with other ectoparasites, suggesting that the complex interspecific interaction of macroparasites exploiting the same host is predictable [32]. Lice, fleas, and mites are common ectoparasites found on free-roaming cats and they can easily jump from one to another host for various reasons such as feeding, reproduction site, or shelter to thrive in its environment [1]. This study detected more hosts infested by one ectoparasite species compared to more than one species parasitising the same host in infracommunity. Both direct and indirect interference could regulate infestation through host resources and immunity mechanism [13]. A detailed evaluation needs to be performed in haematophagous parasitic interaction. Even so, most of the literature is biased towards studies of helminth and microparasite interaction. Hence, comprehensive studies need to be done on host-parasite relationship in this area to understand the correlation.

In this study, four orders of ectoparasites were found, but only three of them were recognized to have medical importance to humans. Flea, mite, and tick can transmit various pathogens and diseases to humans [33]. *Ctenocephalides f. felis* and *C. f. orientis* can transfer pathogens that are zoonoses for humans when they have infested both animal and human populations. In fact, flea is not host-specific and can infest on any organism that is capable of serving as a host [32]. *Ctenocephalides felis* is vector to *Bartonella henselae*, *B. clarridgeiae*, *Rickettsia felis*, and *R. typhi*, which cause several health problems in humans such as fever, flea typhus, and pruritus [34]. Fleas infestation on humans was reported in Peninsular Malaysia [35,36] and in Kuching, Sarawak [37]. Those outbreaks were associated with the presence of stray animals, especially feral cats, in human residences and certain symptoms of infestation were recorded such as pruritus and swollen itchy spots. The infestation on animals was also documented to confirm the suspected source of transmission as the patients had close contact with those infested hosts. Furthermore, zoonotic pathogens in fleas, *Bartonella*, *Rickettsia*, and also *Dipylidium*, were detected in local stray animals in Peninsular Malaysia through molecular diagnosis [21]. Pathogens like *Rickettsia rickettsi* and *R. conorii* can be transmitted through ticks and can cause fever, dyspnoea, and maculopapular rash [38,39]. *Otodectes cynotis* and *L. radovskyi* are very rare infestors on humans; however, they can cause small rashes and itching sensation [40]. However, lice such as *F. subrostratus* are very highly specialised to infest the host [6,32], but there is a lack of studies regarding the biology of this species. In fact, lice are rarely hazardous to human health. These neglected emerging diseases are significant especially for developing countries including Malaysia as the management of stray animals is still a new issue in the community and as the populations keep inclining, the prevalence of parasitic infestation or infection could pose risks for the public health.

Further studies are recommended to generate a more comprehensive inventory of ectoparasites in stray cats in different locations in order to estimate the potential risk-relevant arthropods-borne diseases in Sarawak, Malaysian Borneo. Besides that, this study and inventory is the first step in defining the relation of endemic ectoparasite species and their potential and real impacts on domestic animals and humans in Malaysian Borneo.

5. Conclusion

A high prevalence of ectoparasites infestation was recorded on the stray cats around Kota Samarahan. A total of nine species of ectoparasites were recorded in this study,

which infested 113 out of 150 stray cats. Lice are the most prevalent ectoparasites found in this area followed by fleas, mites, and ticks. Among the ectoparasites found in Kota Samarahan, three groups were identified to potentially impact public health as fleas, mites, and ticks, which are vectors to zoonotic pathogens. Apart from gathering information on the diversity of ectoparasite species infesting felines, the suggestion of combining related background expertise, especially epidemiological and ecological experts, into the study would be a fruitful step in understanding how the parasites were transferred to the animas. It is crucial for the community, especially the intellectuals and medical professionals (veterinarians and medical doctors), to be aware of the role of ectoparasites in transmitting zoonotic diseases and to take initiatives to minimize the ectoparasite prevalence. This includes educating the community, pet owners in particular, on the importance of their pet health history by consulting veterinarians and also neutering their pets if they have no intention to become a breeder, hence lowering the host of ectoparasites, stray cats, by avoiding pet dumping on the streets. It was vital to accomplish prevention methods and parasite control to lessen the surroundings contamination in all ectoparasites life stages.

Acknowledgements

The authors wish to thank the Faculty of Resource Science and Technology, Universiti of Malaysia Sarawak (UNIMAS) for permission to publish this paper. We are also grateful to the Secretary of Kota Samarahan City Council for granting us permission to conduct the surveys of stray cat ectoparasites in Kota Samarahan. We acknowledge the assistance rendered by the field team from the Animals Resource Science and Management Programme UNIMAS, Siti Nor Mahmmod, Jackson Richard, and Raja Nur Atiqah Raja Azizi, for accompanying us during the sampling session and while writing this manuscript and also the residents of Kota Samarahan, who were directly or indirectly involved in this study.

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