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Research Article

Study on Ectoparasites of Free-Ranging Domestic Cats (Felidae; Felis catus) and Introducing *Trichodectes canis* as a New Record Louse in Tehran Urban Parks, Iran

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Free-ranging domestic cats (Felidae, *Felis catus*) can potentially play host to some life-threatening zoonotic pathogens including ectoparasites such as fleas, ticks, and lice. These ectoparasites are capable of transmitting zoonotic disease. Cats (*Felis catus*) were captured using baited cage traps with raw red meat from five parks in central areas of Tehran, Iran, in the summer of 2018. The collected cats were moved to the laboratory, and their ectoparasites were removed from their skin by forceps and combing for five minutes for each cat. Ectoparasites were stored in 70% ethanol and later mounted for identification of species, using species identification keys. Forty-one cats were collected from these study areas. Among all captured cats, 26 specimens (63.41%) were infected with 83 ectoparasites and the average infection rate was 3.19 in cats. Six arthropod species were identified, including four fleas (89.16%), one louse (8.43%), and one tick (2.41%). The four flea species included *Ctenocephalides canis* (39.76%), *Ctenocephalides felis* (18.07%), *Xenopsylla nubica* (16.87%), and *Pulex irritans* (14.46%). The one louse species was *Trichodectes canis* (8.43%), and the one tick species recovered was identified as *Hyalomma* spp. (2.41%). Based on the findings, *Ctenocephalides canis* was the most common ectoparasite species (39.76%). Fleas were the most prevalent ectoparasites on *Felis catus* cats, with the highest prevalence, observed for *Ctenocephalides canis*. Due to the large and growing population of cats and the high risk of transmission of common diseases between humans and cats, as well as the high contact and communication of people with cats, we were encouraged to study the ectoparasites of cats in five important parks in the city of Tehran.

1. Introduction

In recent years, ecosystem change (climate, habitat, invasion, invasive species, over-exploitation, and pollution) and the abundance of anthropogenic food waste in Iranian cities, including Tehran, have led to an increase in the number of dogs (*Canis familiaris*) and cats (*Felis catus*) in the urban environments [1, 2]. Also, keeping pets without regard to their social and legal responsibilities has increased the risk of human infectious disease transmission by such animals [1]. Free-ranging cats are reservoirs of many zoonotic diseases such as rabies, toxoplasmosis, giardiasis, cat-scratch disease, Q fever, and ehrlichiosis [3, 4]. In addition, some zoonotic diseases such as plague and some rickettsia are mechanically or biologically transmitted to humans by some arthropod species, especially blood-sucking insects and ticks, which are usually defined as ectoparasites [5, 6]. Sucking lice, fleas, and ticks represent some of the most common ectoparasites. Many of these ectoparasites are important in terms of human and veterinary medicine [7, 8]. They are known to be

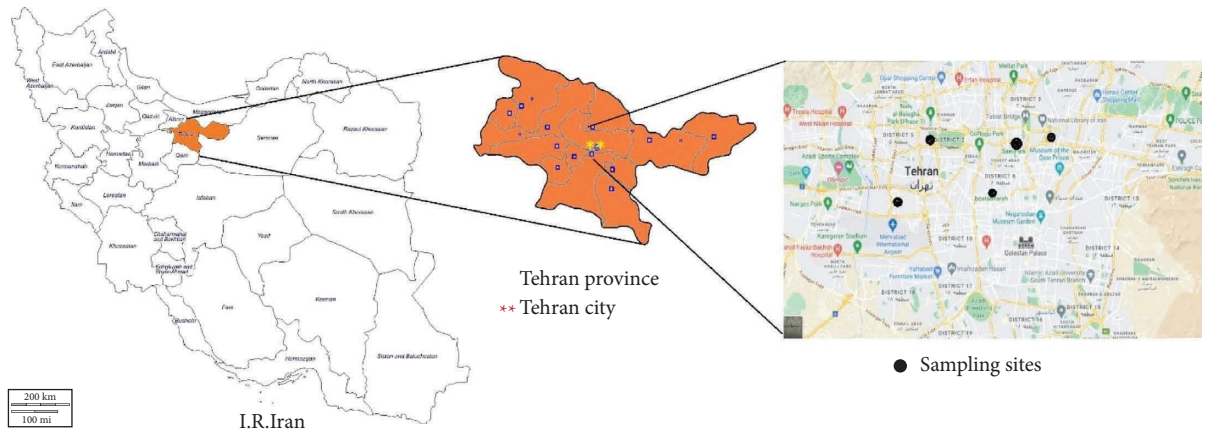

Figure 1: Tehran Province is located in Iran. Our study sites are in selected urban parks (•sampling sites) located in Tehran city, 2018.

the vectors of many zoonotic disease pathogens such as Lyme disease (*Borrelia burgdorferi*), plague (*Yersinia pestis*), and tularemia (*Francisella tularensis*) [9–11]. Additionally, ectoparasites are also a common cause of skin diseases of domestic animals [12], including skin lesions accompanied by pruritus, erythema, excoriation, papules, and crusts after feeding [13]. For example, fleas are responsible for producing allergic dermatitis, the intermediate host of *Hymenolepis nana* (a worm that is the most common cestode, infecting mankind, especially children), and the vector of plague and relapsing fever [14]. Furthermore, some ectoparasites may transmit various bacterial, viral, or parasitic agents to hosts during feeding [15]. Ticks, for example, are responsible for the transmission of many infectious diseases, such as rickettsiosis and babesiosis [16], some parasitic disease agents such as *Cercopithifilaria* sp., and finally viral diseases including Crimean-Congo hemorrhagic fever (CCHF) [17]. Besides, they can easily move between reservoirs, so some parasites found in animals can pass to humans, causing serious diseases [18]. According to previous studies in many areas of the world, cats are the hosts of many ectoparasites of medical and veterinary concern [19–21]. In Tehran city, large populations of cats roam the streets, parks, and public places. We monitor free-ranging cat populations to assess potential for transmission of zoonotic pathogens. In this study, we examine the prevalence of ectoparasites in cats collected from urban parks in Tehran city, Iran, to identify feline zoonosis.

2. Materials and Methods

2.1. Study Area and Data Collection. This study was conducted in Tehran city, Iran, during the summer from September to October 2018. Tehran lies at 35°68″N and 51°35″E, at an altitude of 1191 meters above sea level. Tehran has a semiarid continental climate and is largely defined by its geographical location, with Alborz Mountains towering to its north and the central desert to the south. In the present study, cats (*Felis catus*) were captured using baited traps with raw red meat placed in five urban parks including Laleh, Almahdieh, Saei, Haghani, and Qaem, located in the center of Tehran, Iran (Figure 1).

2.2. Study Design. Cats were captured and moved to the laboratory and were examined for ectoparasites such as fleas, ticks, mites, and lice by a complete examination of skin and otic swabs [22, 23].

Cats were anesthetized using intramuscular injection of anesthetic drugs (ketamine, 10 mg/kg, and xylazine, 2 mg/kg) and placed in appropriate bags. Then, their ectoparasites were removed from their skin via combing, the skin was carefully inspected, and remaining ectoparasites were separated with forceps (5 minutes for each cat). The ectoparasites were stored in 70% ethanol and later mounted for identification of the species level using general and specialist identification keys. The collected fleas and lice were also preserved in glass containers with ethanol until identification. Fleas were cleaned with water and immersed in 10% potassium hydroxide (KOH) with slight warming for 10–15 hours. Then, the samples were transferred to 2.5% acid alcohol for 5 min to adjust the samples' pH. For dehydration, the specimens were dehydrated using a series of ethanol solutions from 50, 60, 70, 80, 90, 95 to 100% (absolute) for 5 min, and then transparency by xylene for 5 min. After mounting, the identification of fleas and lice species was done under light microscopic examination as described by CDC key [24]. After sampling, cats infected with external parasites were taken to the veterinary clinic and released after treatment with TRIXIE brand anti-flea and ticks sprays.

3. Results

In the current study, a total of 41 cats were captured, including 12, 7, 9, 7, and 6 cats from urban parks in Laleh, Haghani, Almahdieh, Saei, and Qaem, respectively. Of all captured cats, 22 specimens were females (53.66%), and 19 (46.34%) were males. Eight cats (19.51%) were less than 6 months old, 23 cats (56.09%) were between 6 months and 2 years of age, and 10 cats (24.4%) were over 2 years old. As a whole, four species of fleas, one species of louse, and one species of tick were detected in this study (Table 1). Dominant isolated ectoparasites on cats were fleas. Among 41 cats, 26 (63.41%) were found to be infested with fleas (*Ct. canis*, *Ct. felis*, *P. irritans*, and *X. nubica*) while lice (*T. canis*) and ticks (*Hyalomma* spp.) were found on one cat (Figure 2).

Table 1: Prevalence of ectoparasites found on captured free-ranging domestic cats in selected urban parks of Tehran city, Iran, during September-October, 2018.

Park name	Cats			Infested cats						Ectoparasite species											
				Total		Male		Female		*Ct. canis*		*Ct. felis*		*P. irritans*		*X. n ubica*		*T. canis*		*Hyalomma* spp.		Total	
	N	♂	♀	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Laleh	9	4	5	6	23.07	4	15.38	2	7.69	11	13.25	0	0.00	2	2.40	5	6.02	0	0.00	0	0.00	18	21.68
Haghani	8	7	1	5	19.23	4	15.38	1	3.84	9	10.84	3	3.61	0	0.00	0	0.00	0	0.00	2	2.40	14	16.87
Almahdi	8	4	4	5	19.23	2	7.69	3	11.53	5	6.02	7	8.43	0	0.00	0	0.00	0	0.00	0	0.00	12	14.45
Saei	8	6	2	7	26.92	4	15.38	3	11.53	8	9.63	5	6.02	0	0.00	4	4.81	0	0.00	0	0.00	17	20.48
Qaem	8	5	3	3	11.53	3	11.53	0	0.00	0	0.00	0	0.00	12	14.45	3	3.61	7	8.43	0	0.00	22	26.50
Total	41	26	15	26	100	17	65.36	9	34.59	33	39.75	15	18.07	14	16.86	12	14.45	7	8.43	2	2.40	83	100

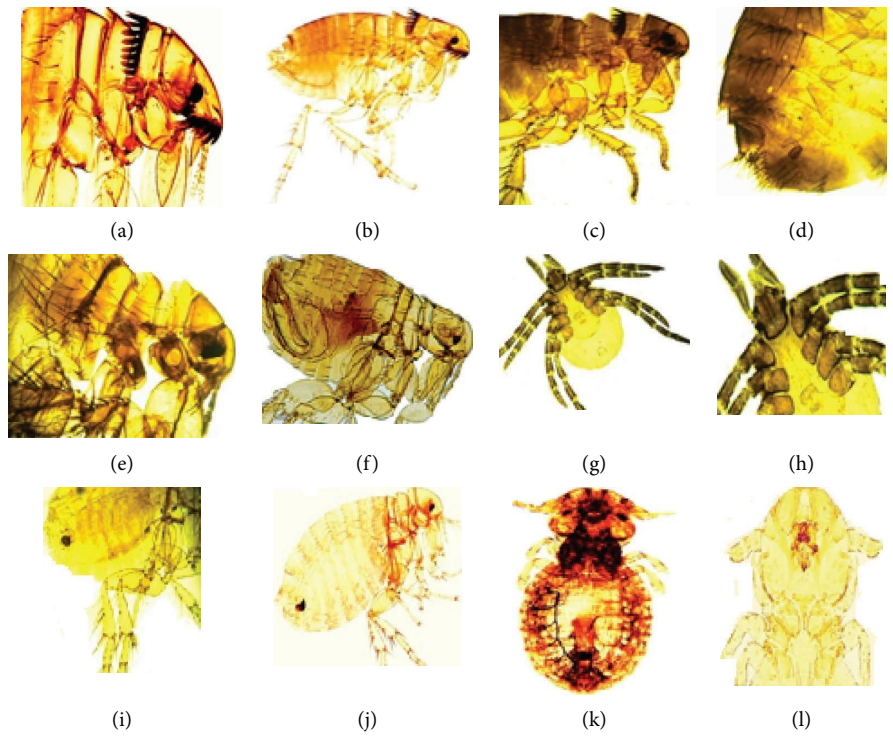

Figure 2: Ectoparasites of free-ranging domestic cats collected in selected urban parks of Tehran city: (a, b) *Ctenocephalides felis*; (c, d) *Ctenocephalides canis*; (e, f) *Pulex irritans*; (g, h) *Hyalomma* spp.; (i, j) *Xenopsylla nubica*; (k, l), *Trichodectes canis*.

The most common ectoparasite species was *Ct. canis*, whereas *Ct. felis* was the second most frequent species (18%). *Ctenocephalides canis* was the most abundant infesting species both in males 19/83 (22.89%) and females 14/83 (16.86%). *Trichodectes canis* (8.43%) and *Hyalomma* spp. (2.4%) were the most and the least frequent ectoparasites found on cats, respectively (Figure 2). All collected fleas and lice were adults while the *Hyalomma* spp. was at the nymph stage in the present study.

4. Discussion

Cats are known to shed many ectoparasites during grooming [25]. Therefore, the 63.41% rate of infestation in cats may show relatively much ectoparasite infestation of the local environment. This observation suggests that cats may serve as indicators of the ectoparasite infestation level of an environment. Ectoparasites have the potential to transmit zoonotic diseases [10]. The effects of zoonotic diseases may range from general weakness and discomfort to increased mortality [26, 27]. The present study is the first research on the prevalence of infestations on cats in Tehran city parks. Based on our results, 63.41% of the cats were infected by ectoparasites. These results indicate that ectoparasites are relatively common in cats in this area, similar to many parts of the world. In our study, the overall prevalence of fleas on cats in Tehran was as much as 88.13%, in agreement with previous reports in Turkey, Thailand, Albania, and Iran [28–31]. According to the findings of this study, fleas, *Ct. canis* (39.75%) and *Ct. felis* (18%), were the most abundant ectoparasites. Fleas also act as intermediate hosts of tapeworms [32]. *Ctenocephalides canis* and *Ct. felis* have been previously reported on various host species from different parts of Iran, but their prevalence was not noted [33]. With an overall prevalence of 8.43%, *T. canis* was the second-ranked most frequent ectoparasite found in the cats. *Trichodectes canis*, known as canine chewing louse, is found on domesticated dogs and wild canids throughout the world. *Trichodectes canis* is a well-known vector for dog tapeworm (*Dipylidium caninum*) [34]. In this study, we provide the first report on the existence of *T. canis* infesting cats in Iran during September-October 2018. A small percentage (2.41%) of the cat population was found to have tick infestations, with total of two ticks obtained from one cat. The most prevalent tick was *Hyalomma* spp. To our knowledge, there are no specific data regarding the tick infestation of cats in Iran. The frequency of *Ct. canis*, *P. irritans*, and *T. canis* was likely due to the proximity of the large wild dog population. The fact that only adult *T. canis* was found indicates that they were accidental transfers from recently dead dogs and were unable to reproduce on cats. The presence of *Xenopsylla nubica* on the body of cats as well was likely due to host transfer from rats, and it happened through either predation or co-occurrence.

5. Conclusion

High prevalence of ectoparasites among free-ranging domestic cats (Felidae, *Felis catus*), especially fleas, may pose serious health risk for residents of Tehran. Also, given the significant role of some ectoparasites in the transmission of arthropod-borne disease agents to humans, we suggest that

regular monitoring of infested cats in urban societies is necessary, especially in the urban parks located in Tehran city where risk of zoonotic pathogen transmission may be high due to increased contact among humans and free-ranging domestic cats.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval

Ethical clearance was obtained from the Medical Ethics Committee of Tarbiat Modares University, Tehran, Iran (number: IR.TMU.REC.1396.399).

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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