BULLETIN OF THE IRAQ NATURAL HISTORY MUSEUM
Iraq Natural History Research Center & Museum, University of Baghdad
https://jnhm.uobaghdad.edu.iq/index.php/BINHM/Home
 Online ISSN: 2311-9799, Print ISSN: 1017-8678

Bull. Iraq nat. Hist. Mus.
(2026) 19 (1): 231-242. https://doi.org/10.26842/binhm.7.2026.19.1.0231

ORIGINAL ARTICLE

SURVEY OF FLEA SPECIES (ORDER, SIPHONAPTERA) ON DOMESTIC MAMMALS IN BASRAH PROVINCE, SOUTHERN IRAQ

Alaa N. Hatem*♦ and Tahsin A. Yasir**

*Biology Department, College of Education for Pure Sciences, University of Basrah, Basrah, Iraq.
**General Directorate of Education in Basrah Governorate, Basrah, Iraq.
♦Corresponding author: alaa.hatem@uobasrah.edu.iq

Received: 25 Sep. 2025, Revised: 1 Feb. 2026, Accepted: 2 Feb. 2026, Published:20 June 2026

ABSTRACT

The current study aimed to survey the flea species, that parasitize domestic mammals in Basrah Province, southern Iraq from June 2024 to May 2025. It was recorded that 31 animals were infested with fleas, and the total prevalence was 12.45%. Higher prevalence of fleas was recorded in dogs (33.33%), followed by goats (16.67%), camels (19.05%), cats at (16.67%), and sheep (12.73%). Three flea species were collected from infested mammals, the cat flea *Ctenocephalides felis* (Bouché, 1835), the dog flea *Ctenocephalides canis* (Curtis, 1826), and the oriental rat flea *Xenopsylla cheopis* (Rothschild, 1903). These species belong to the family Pulicidae, within the order Siphonaptera. Additionally, the results illustrated that *C. felis* was collected from cats, goats and sheep, whereas *C. canis* was collected from dogs and goats, while *X. cheopis* was recorded only from camels. Camel infestation with the oriental rat flea is recorded for the first time in Iraq, and no global study has recorded this result. The highest infestation was recorded in May with five infestations, followed by October. No infestations were recorded in August, November, December, January, February and March. The study included a brief description of the most important taxonomic characteristics of the recorded of the flea species.

Keywords: Ectoparasites, Domestic mammals, Fleas, Pulicidae, Siphonaptera.

INTRODUCTION

Fleas are holometabolous ectoparasites of warm-blooded animals that are classified in the order of Siphonaptera. This order is a monophyletic group that has evolutionary relationships with true flies (Diptera) (Mullen and Durden, 2019). There are around 2,545 species that have been described and are categorized into 15 families and 246 genera (Whiting *et al.*, 2008). Fleas are distributed worldwide, especially in temperate regions. Wildlife areas have higher flea diversity than human settlements. About 94 % of fleas infest mammals, and 6% infest birds, and there are approximately 20 species feed on humans (Keskin *et al.*, 2020). Adults are wingless, yellowish-brown insects, 1-8mm. in length, and a heavy chitinized body, their

hind legs are adapted for jumping. The body is generally covered with spines (Wall and Shearer, 1997). Many species have one or more ctenidia (comb), appearing as a row of sclerotized spines (Cranston and Gullan, 2009). Some rows of setae are present in certain regions of the fleas' bodies. The mouthparts of adults are adapted for sucking blood (McKern *et al.*, 2008). Fleas do not have compound eyes, but most species have simple lateral eyes, best developed in fleas that infect diurnal hosts (Lewis, 1998). Females are distinguished from males by their more rounded abdomen, as well as their genital appendages (Durden *et al.*, 2005). Siphonaptera species have different host specificities, which range from monoxenous (a flea species found on one host species) to euryxenous (a flea species found on two or more host species) (Wall, 2007).

Most flea species of medical or veterinary importance are found in the families Pulicidae, Tungidae, Ceratophyllidae, Leptopsyllidae, and Vermipsyllidae (Mullen and Durden, 2019). The veterinary effects of fleas include anemia, dermatitis, and allergies (Krasnov, 2008). The most important diseases they transmit include the black death plague, murine typhus and tularemia (Lehane, 2005). Also, fleas are the intermediate hosts of some parasitic worms, such as tapeworms and filariasis (Foreyt, 2013).

Due to the previously mentioned importance of medical, veterinary and economic fleas, and the lack of studies on these insects in Iraq, the current study aimed to survey flea species infesting domestic mammals in Basrah Province, southern Iraq.

MATERIALS AND METHODS

Study area: The study was conducted from June 2024 to May 2025. The work was conducted in several areas of Basra Province, including homes, veterinary clinics, agricultural lands, animal breeding places, slaughterhouses, random slaughter places, desert lands, and marshes.

Specimens collection and Identification: Species of domestic mammals were examined to detect the fleas. A total of 249 individuals of domestic mammals were examined for flea infestation including buffalo, camels, cats, cows, dogs, goats, rabbits, and sheep. Some parts of the animals' bodies were examined, including the head, ears, neck, back, sides, abdomen, tail, and legs. The collection of fleas was done using forceps and hand-picking. Fleas that were collected were stored in a collection vial with appropriate labeling and preserved in 70% ethanol for additional information. They were then transported to the laboratory, using a method modified from (Ammam *et al.*, 2022).

Permanent slides were prepared for flea identification. Before placing the specimens in the final mounting medium, they were cleared, stained, and dehydrated before being mounted on slides. The diagnosis of fleas is primarily determined by their morphological characteristics, such as their head shape, combs, pectoral rings, legs, abdomen, and spines. The following taxonomic keys were relied upon to identify fleas: Lewis (1993), Wall and Shearer (1997), Mullen and Durden (2019), and Ali (2019).

Photographing specimens: After preparing glass slides in the laboratory for some flea specimens, these specimens were photographed using a Samsung C23 digital camera.

Measurement of Flea Parasitism in Mammals: The prevalence of flea infestation in the examined mammals can be calculated according to (Ammam *et al.*, 2022), as follows: Prevalence of infestations= total of individuals of mammals infested with a particular flea ÷ total of examined mammals × 100.

Statistical analysis: A chi-square test was used to analyze the study results using computerized SPSS, $P<0.05$ was considered the lower limit of significance.

RESULTS

Infestation of fleas in the studied domestic mammals

Seven species of mammals were examined to detect fleas. Fleas were collected from camels, cats, dogs, goats and sheep, while no fleas were recorded on buffalo, cows, or rabbits. In the current study, a total of 160 individuals of domestic mammals were examined for flea infestation. It was recorded that thirteen animals were infested with fleas, and the total prevalence was 13%. The highest prevalence of flea was recorded in dogs (31.6%), followed by goats (22.73%), camels (19.05%), sheep (16%), and cats at 15.79%. The results of the statistical analysis showed that there were significant differences ($P<0.05$) between infestations in dogs and those in other animals (Tab. 1).

Table (1): Illustrates the fleas' infestation of domestic mammals in Basrah Province.

Host	Number of examined	Number of infested	Prevalence
Buffalo	41	0	0.00
Camel	21	4	19.05
Cat	24	4	16.67
Cow	33	0	0.00
Dog	21	7	33.33
Goat	54	9	16.67
Sheep	55	7	12.45

Species diversity of fleas:

Three flea species were isolated from infested mammals; the cat flea *Ctenocephalides felis* (Bouché, 1835), the dog flea *Ctenocephalides canis* (Curtis, 1826) and the oriental rat flea *Xenopsylla cheopis* (Rothschild, 1903). These three species belong to the family Pulicidae, within the order Siphonaptera. Also, the results illustrate that *C. felis* was collected from cats, goats and sheep, Whereas *C. canis* was isolated from dogs and goats, while *X. cheopis* was recorded from camels only (Camels were recorded as a new host for this parasite). It was also shown that goats are the most studied animals in terms of the diversity of fleas, as two species were collected (*C. felis* and *C. canis*) compared with camels, sheep, dogs, and cats, from which only one species was collected.

Seasonal occurrence of flea infestation

The study was carried out in the period from June 2024 to May 2025. Out of 249 individuals of domestic mammals, 31 were infested. The highest infestation was recorded in May with seven infestations, followed by October (five infestations). No infestations were recorded in August, December, January, and February. The results showed a significant difference ($P<0.05$) in infestation rates among months (Diag. 1).

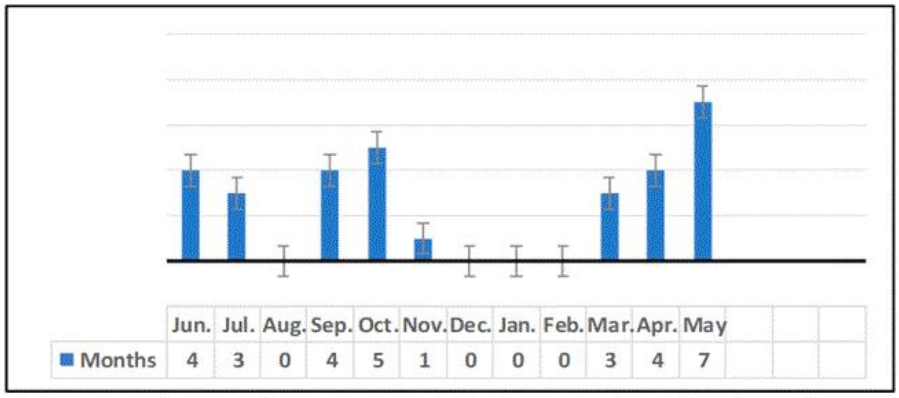

Diagram (1): Seasonal distribution of flea infestations in domestic mammals during the study period.

Sites of flea infestations

During the study, it was found that there were differences among the recorded flea species in terms of infestation sites on the host's body. Table (3) shows that *X. cheopis* was found on the neck and abdomen, and *C. felis* was collected from the ears, face, neck, and sides. *C. canis* parasitized the face and neck.

Table (3): Sites of infestations of fleas in domestic mammals' bodies.

Flea's species	Host	Site of body infestation
Xenopsylla cheopis	Camel	Neck, abdomen
Ctenocephalides felis	Cat, Goat, Sheep	Ear, face, neck, sides
Ctenocephalides canis	Dog	Face, neck

Brief description of the morphological characteristics of fleas

Xenopsylla cheopis (Rothschild, 1903)

Body length 3-4 mm. Color varies from yellow to brown; front of head rounded; a single genal spine present; anterior margin of head rounded. This species lacks genal and pronotal ctenidium (Pl.1). Ocular bristle inserted in front of the eyes; compound eyes absent, but the head has a simple eye. Three thoracic tergites are combined with the first abdominal tergite. Extero- internal ridge on the mid-coxa absent, but it has spiniform bristles on the inner side of the hind coxa. A pleural rod of the mesothorax is present. Mesopleuron divided by a vertical rod-likes thickening; abdominal terga II-VI with a single row of bristles. One row of bristles presents on each typical abdominal segment. Spermatheca in female contains short hilla.

Materials examined: 5♀, 2♂. Zubayer (30°23′22″N 47°42′52″E), from March to May 2025.

Ctenocephalides canis (Curtis, 1826)

Body length 2-3 mm. Color varies from yellowish brown to dark brown; head rounded on its anterior portion, and length less than twice as long as it is wide; eyes present. This species contains genal and pronotal ctenidium. Ctenidia have six spines; spine II longer than spine I (Pl.2). Tibiae of all legs have 7 - 8 notches (Pl.3). Two stout bristles present between the postmedial and apical long bristles; claspers of manubrium expanded apically; spermatheca in female contain a long hilla (Pl.3).

Materials examined: 12♀, 5♂. Haritha (30°43′00″N 47°43′00″E), Shat Al-Arab (30°31′58″N 47°51′27″E), from June to November 2024, March and April 2025.

Ctenocephalides felis **(**Bouché, 1835)

Body length 3-4 mm. Color vary from yellowish brown to dark brown; head length twice as long as it is wide, eyes distinct; genal and pronotal ctenidium present; ctenidia have six spines. Lengths of spine I and spine II are approximately similar (Pl.4). A single short and stout spine that is usually located between the postmedial and apical long bristles. Dorsal margin has 5-6 notches bearing seta. Metibisternite with two hairs. Tibiae of all legs have 5 -6 notches (Pl.5). Claspers of the manubrium without expanded apically; spermatheca in the female contains a short hilla (Pl.5).

Materials examined: 9♀, 3♂. Haritha (30°43′00″N 47°43′00″E), Shat Al-Arab (30°31′58″N 47°51′27″E), from June to November 2024.

Plate (1): Oriental rat flea *Xenopsylla cheopis*; (A) Female, (B) Male.

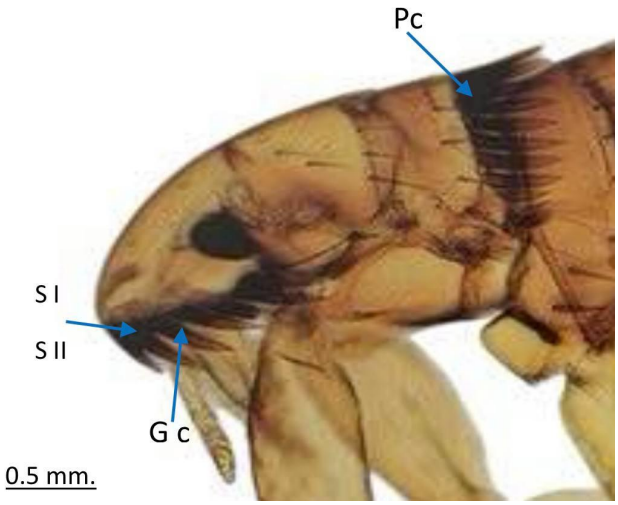

Plate (2): Dog flea *Ctenocephalides canis* head female; (Pc) pronotal ctenidium, (SI) spine I, (SII) spine II, (Gc) genal ctenidium.

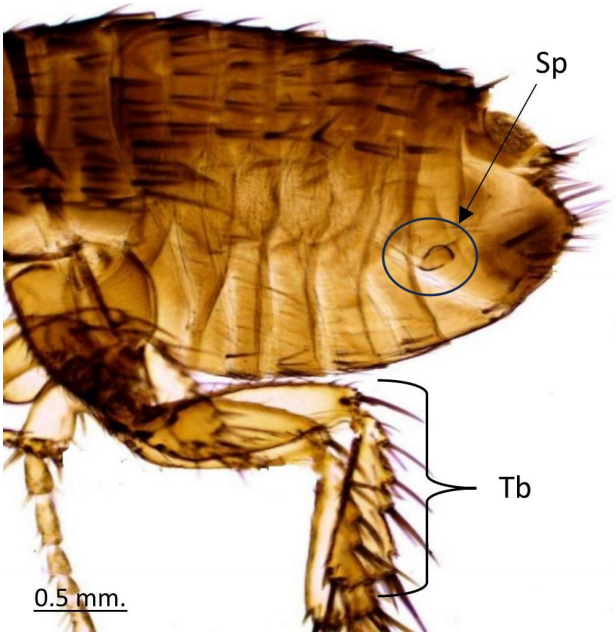

Plate (3): Dog flea *Ctenocephalides canis* female, abdomen and legs; (Tb) Tibia, (Sp) Spermatheca.

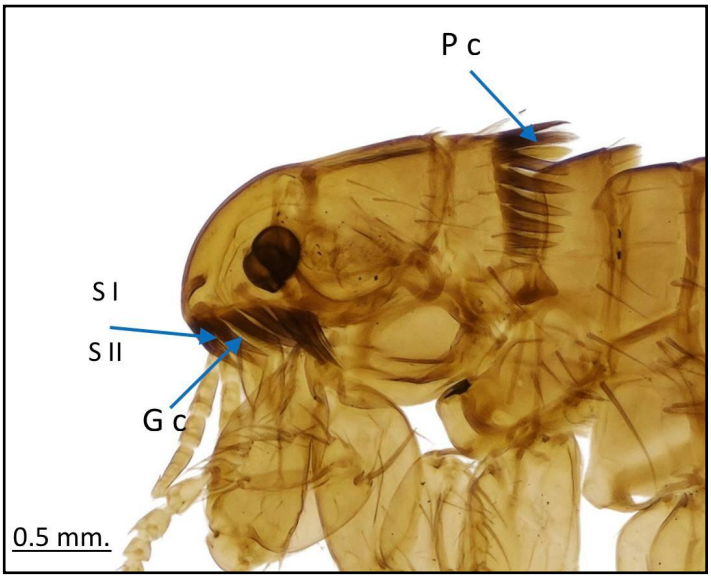

Plate (4): Cat flea *Ctenocephalides felis* female head; (Pc) pronotal ctenidium, (SI) spine I, (SII) spine II, (Gc) gonal ctenidium.

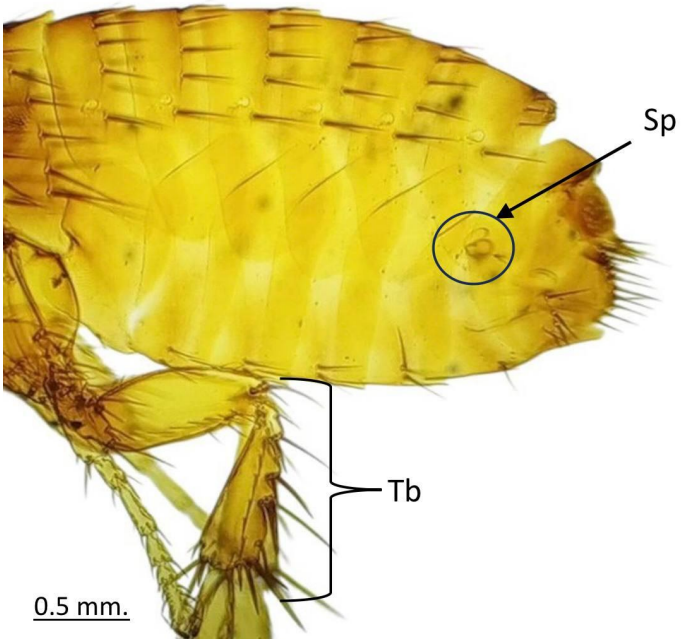

Plate (5): Cat flea *Ctenocephalides felis* female, Abdomen and legs; (Tb) Tibia, (Sp) Spermatheca.

DISCUSSION

Studies on ectoparasites infesting mammals in Iraq are fairly numerous, especially about ticks and lice, but studies on fleas are very few. Hasson and Al-Zubaidi (2011) recorded the mouse flea among parasites of rodents in Baghdad Province. Thamer and Faraj (2019) studied ectoparasites of stray dogs in Basrah Province, and recorded only *Ctenocephalides canis*. Hamadameen *et al.* (2022) conducted a molecular study of the cat flea in small ruminants in the Kurdistan region.

In the present study, three flea species have been collected from infested mammals, the cat flea *Ctenocephalides felis*, the dog flea *Ctenocephalides canis* and the oriental rat flea *Xenopsylla cheopis*. In this study, the oriental rat flea was isolated from camels as a new host. This species has previously been observed to mainly infect black rats, but can successfully live and reproduce on many other rat species and is found on many mammals in different countries (Eduardo and Mercado, 1981). Rats are the primary hosts of this flea, but it can also infect mice, cottontail rabbits, and ground squirrels (Otranto and Wall, 2024). This flea may infect some larger animals and even humans (Wall, 2007), while dog flea and cat flea were recorded from dogs, cats, goats, and sheep. These species global species, with a distribution generally coinciding with its various hosts, including cats, dogs and other mammals (Gage, 2005).

The current study showed that higher infestations were recorded in moderate months compared with colder and hotter months. The studied domestic mammals live in moderate and humid environments, but fleas were isolated from camels, despite camels living in dry desert environments. In this regard, Brown and Neva (1975) observed the fleas usually inhabit tropical and subtropical environments, although it has been recorded in the temperate zone. It is rarely found in cold habitats since it requires tropical and subtropical climates to pupate. The factors affecting the ecological distribution of this species are temperature and humidity; the preferable temperature is around 24-27°C, and humidity is at least 65-70% (Rust, 2017). Adults are capable of adapting to dry climates and mild temperatures, but they may disappear during prolonged dry and hot periods, resulting in ecological limitations on their overall distribution (Gage, 2005). In Uganda (East Africa), the species occurred on a wide range of small mammals, including *Arvicanthis, Mastomys, Aethomys*, and *Crocidura* (Moore *et al.*, 2023).

The oriental rat flea *Xenopsylla cheopis* is characterized by many key morphological features. One of the most important diagnostic characteristics of the Oriental rat flea is the absence of combs (Wall and Shearer, 1997). This feature distinguishes this species from the dog flea, cat flea, and some other species, while it resembles the human flea in this sign (Kreppel *et al.*, 2016). The head and eyes are also relatively smaller compared to the rest of the body in the oriental rat flea, which is the opposite of what is found in the human flea (Mullen and Durden, 2019).The species *Ctenocephalides canis* and *C. felis* can be morphologically distinguished by the shape of the heads, the lengths of the spine I and spine II of the genal comb (Wall and Shearer, 1997). Also, there are some characteristics, such as

the number of short, stout bristles in the hind tibia, the shape of the clasper in males, and length of the hilla of the spermathica in females (Ali, 2019).

CONCLUSIONS

The current study has shown that fleas cause fewer infections than other ectoparasites, but they can still cause disease in their hosts. Cats and dogs can be sources of flea transmission to livestock such as sheep and goats. Rat fleas can infest large mammals, including camels, and this may lead to illness in them. By infecting camels with the rat flea, it was concluded that this parasite is dangerous and capable of transmitting to other livestock and humans.

ACKNOWLEDGMENTS

We extend our thanks and appreciation to everyone who helped us in preparing this work, and to everyone who helped us collect, diagnose and photograph flea specimens, as well as complete the statistical analysis.

CONFLICT OF INTEREST STATEMENT

"We declare that we have no competing interests".

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Bull. Iraq nat. Hist. Mus.
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مسح لأنواع البراغيث (Order,Siphonaptera) على اللبائن الداجنة في محافظة البصرة، جنوب العراق

علاء ناظم حاتم* و تحسين أ. ياسر **
قسم علوم الحياة، كلية التربية للعلوم الصرفة، جامعة البصرة، البصرة، العراق.
**المديرية العامة للتربية بمحافظة البصرة، البصرة، العراق.

الاستلام: 2025/9/25، المراجعة: 2026/2/1، القبول: 2026/2/2، النشر: 2026/6/20

الخلاصة

هدفت الدراسة الحالية إلى إجراء مسح لأنواع البراغيث التي تتطفل على اللبائن الداجنة في محافظة البصرة، جنوب العراق خلال المدة من حزيران 2024 إلى أيار 2025. فحص ما مجموعه 249 فردًا من اللبائن الداجنة، بما في ذلك الجاموس والجمال والقطط والأبقار والكلاب والماعز والأرانب والأغنام. وسجلت إصابة 31 منها بالبراغيث، وبنسبة إصابة كلية 12,45%. وتم تسجيل اعلى نسب الإصابات للبراغيث في الكلاب بنسبة 33,33%، تليها الماعز (16,67%)، والإبل (19,05%)، والقطط (16,67%)، والأغنام بنسبة 12,73%. اذ سجلت ثلاثة أنواع من البراغيث تعود إلى العائلة Pulicidae، وهي برغوث القطط *Ctenocephalides felis* (Bouché, 1835) و برغوث الكلاب *Ctenocephalides canis* (Curtis, 1826) وبرغوث الفئران الشرقي *Xenopsylla cheopis* (Rothschild, 1903).

فضلا عن ذلك، أوضحت النتائج أن برغوث القطط *C. felis* جُمع من القطط والماعز والأغنام، بينما جُمع برغوث الكلاب *C. canis* من الكلاب والماعز، في حين سُجل وجود برغوث الإبل *X. cheopis* فقط في الإبل. وهذه هي المرة الأولى التي يُسجل فيها إصابة الإبل ببرغوث الجرذان الشرقي في العراق، ولم تُسجل أي دراسة عالمية هذه النتيجة. وسُجلت أعلى نسبة إصابة لانواع البراغيث في شهر ايار بخمس حالات، يليه شهر تشرين الاول. ولم تُسجل أي إصابات في أشهر اب و تشرين الثاني و كانون الاول و كانون الثاني و شباط و اذار. كما تضمنت الدراسة وصفًا موجزًا لأهم الخصائص التصنيفية لأنواع البراغيث المسجلة خلال هذه الدراسة.