

Flea Infestations on Domestic Animals in Nafusa Mountain Region, North-West Libya



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Abstract: Fleas are ectoparasitic pests on domestic animals and act as vectors of many pathogens to humans. Here, we aim to identify the fleas that parasitize on domestic animals and their seasonality in the Nafusa Mountain region (Gharyan, Zintan, and Nalut). The survey was carried out from summer 2017 to winter 2018/2019. Fleas were collected seasonally from flea-infested animals using a metal comb (11 teeth per cm) and tweezers. One flea species was identified in this survey; *Ctenocephalides felis*, which was collected from goats, sheep, rabbits, donkeys, hens, cats, and dogs. The highest flea prevalence was among goats (66.49 %), followed by sheep (56.17%), whereas in dogs, donkeys, hens, rabbits, and cats, it represented less than 50.00%. The highest flea intensity was among dogs (4.50 ± 3.04 fleas per dog), while the lowest intensity was among hens (0.87 ± 0.59 fleas per hen). The highest mean flea abundance was among cats (8.00), whereas goats, sheep, donkeys, dogs, and hens represented less than 1.50 fleas per host. Summer and autumn represented the highest intensity followed by spring, but no fleas were collected in winter. The finding of the study indicated that *Ct. felis* was common among domestic animals. Consequently, it may become a potential source of pathogen transmission among people and animals.

Keywords: *Ctenocephalides felis*; Siphonaptera; Domestic Animals; Nafusa Mountain; Libya.

INTRODUCTION

Fleas are wingless insects and have medical importance as economic pests in domestic animals around the world (Krämer & Mencke, 2001). They are ectoparasites that cause hypersensitivity and iron deficiency anemia in heavy infestations and responsible vectors of pathogens (plague, rickettsiosis and bartonellosis), and act as intermediate hosts for some endoparasites (Smart, 1956). They can take blood meals from multiple hosts. Consequently, they have the ability to transmit different pathogens to different hosts (Brinkerhoff et al., 2010). The vertebrate hosts provide the main habitat, offering a place for living, feeding, and mating.

About 95% of known flea species parasitize on mammals, and the other (5%) parasitize on birds (Krämer & Mencke, 2001). Fleas infest domestic animals such as goats (McCrindle et al., 2011), small ruminants (Kusiluka et al., 1995), cattle (Araujo et al., 1998), and horses (Yeruham et al., 1996).

Some flea species are opportunistic and have a wide range of hosts, while other flea species are highly specific and have a narrow range of hosts (Ford et al., 2017). Domestic animals such as sheep and goats are considered a section of economic resources for people in the Nafusa Mountain region. There are no comprehensive studies in the Nafusa Mountain region

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about fleas that parasitize on domestic animals. The only study in the area was on wild animals (Belgasm et al., 2022). The aim of this study is to identify the fleas that parasitize on domestic animals and their seasonality in the Nafusa Mountain region.

MATERIALS AND METHODS

Study area: The research was conducted in the Nafusa Mountain region, which is located in Libya's northern region (Figure 1). In terms of topography, this region is characterized by a great deal of diversity (mountains, hills, valleys). Seasonal herbs, annuals, and medium-sized plants, such as olive and fig trees, are prominent. The climate is transitional between the desert and the Mediterranean climate. The mean annual rainfall is 49 mm, the mean monthly relative humidity is 15 to 83 %, and the temperature ranges from 4°C to 43°C.

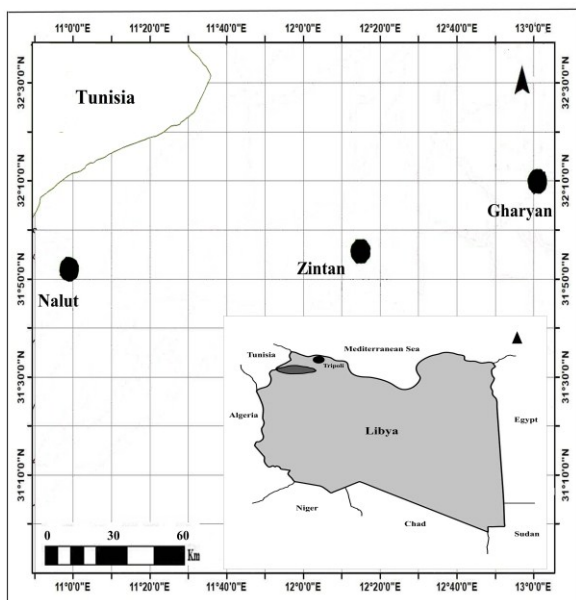


Figure: (1). Map of study area.

Capturing of animals and sampling: Fleas were collected seasonally from summer 2017 to winter 2018/2019 from three locations in Nafusa Mountain region (Gharyan, Zintan and Nalut); from goats (n= 614), sheep (n= 392), rabbits (n= 137), donkeys (n= 37), hens (n= 223), cats (n= 43), dogs (n= 111). Dogs and cats were anesthetized by dissolving 2-5

Calmivet® tablets in milk or placed inside pieces of meat and provided for them. Whereas goats, sheep, hens, rabbits, and donkeys, the fleas were collected from them without anesthesia.

Fleas were collected from all infested hosts by combing the whole body using a metal comb (11 teeth per cm) and tweezers, then transferred to vials containing 70% ethanol by tweezer for preservation. The date of collection, season, number of fleas, host, and collecting place were recorded. The samples were taken to the Laboratory of Entomology in the Zoology Department, Faculty of Science, University of Tripoli, to mount and identify fleas to species level using an identification key (Smit, 1957).

Data analysis: The data were classified according to flea species, host species, seasons of collection, and area. Fleas per host, season, and area were calculated according to International Definitions Indicators, the method of Yin et al. (2011):

$$\text{Flea prevalence (FP)} = \frac{\text{number of hosts infested with fleas}}{\text{total number of surveyed hosts}} \times 100$$

$$\text{Flea intensity (FI)} = \frac{\text{total number of fleas}}{\text{total number of hosts infested with fleas}}$$

$$\text{Mean flea abundance (MFA)} = \frac{\text{total number of fleas}}{\text{total number of surveyed hosts}}$$

The descriptive analysis of main characteristics was performed using means and standard errors (SEs) with flea intensity because it includes the main values of fleas per infested animal. The means of collected fleas per host and season were tested for the normality by the one-sample Kolmogorov-Smirnov test. The means of data were not normally distributed. P-value was ≤ 0.05 . The mean of flea intensity was compared by non-parametric tests (Kruskal-Wallis test and Mann-Whitney test) by SPSS (version 23.0.0, 2015).

RESULTS

This survey was carried out from summer 2017 to winter 2018/2019 in the Nafusa mountain region (Gharyan, Zintan and Nalut). A total of 2025 individuals of fleas were collected from 508 infested hosts; goats (246), sheep (141), rabbits (20), donkeys (10), hens (49), cats (6), and dogs (36). Only one flea species was identified, *Ctenocephalides felis*. The highest flea prevalence was among goats (66.79%), followed by sheep (56.17%), whereas among dogs, hens, rabbits, and cats, it represented less than 50.00 % (Figure 2). The Kruskal-Wallis H test revealed no significant difference in the prevalence of

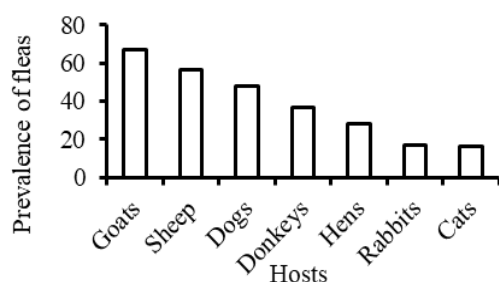


Figure: (2). Prevalence of *Ct. felis* from domestic animals that were collected in the Nafusa Mountain region at the period from summer 2017 to winter 2018/2019

fleas among livestock (H= 11.20, df= 6, P= 0.08). The highest flea intensity was among dogs (4.50 ± 3.04 fleas per dog); the lowest intensity was among hens (0.87 ± 0.59 fleas per hen) (Figure 3).

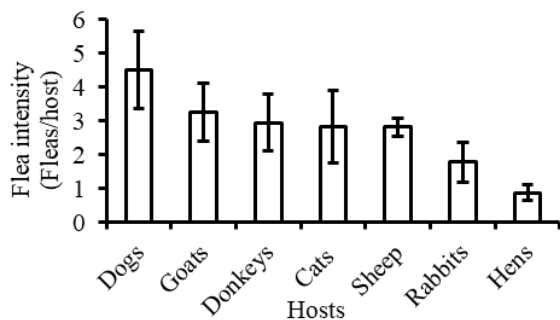


Figure: (3). Intensity of *Ct. felis* per host that were collected from domestic animals from the Nafusa Mountain region at the period from summer 2017 to winter 2018/2019. (Bars represent SE).

There was no significant difference in the intensity of fleas among livestock (Kruskal-Wallis H test, H= 6.00, df= 6, P= 0.42). The highest mean flea abundance was among cats (8.00), whereas goats, sheep, donkeys, dogs, rabbits, and hens showed less than 1.50 (Figure 4). There was no significant difference in flea abundance of fleas among domestic hosts (Kruskal-Wallis H test, H= 3.00, df= 3, P= 0.30).

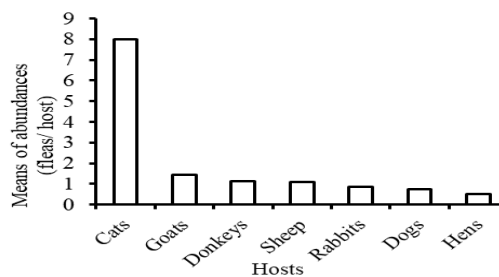


Figure: (4). Mean flea abundance per domestic animals that were surveyed in the Nafusa Mountain region at the period from summer 2017 to winter 2018/2019.

The summer and autumn seasons showed the highest values of flea intensity followed by spring, but no fleas were collected in the winter seasons (Figure 5). There was a significant difference in intensity of *Ct. felis* among seasons in all hosts (Kruskal-wallis H test, H= 18.68, df= 3, P < 0.001). Winter seasons differed significantly from the other seasons (Mann-Whitney U test, P= 0.001). The highest mean flea abundance was in the autumn seasons, followed by the summer seasons, then spring.

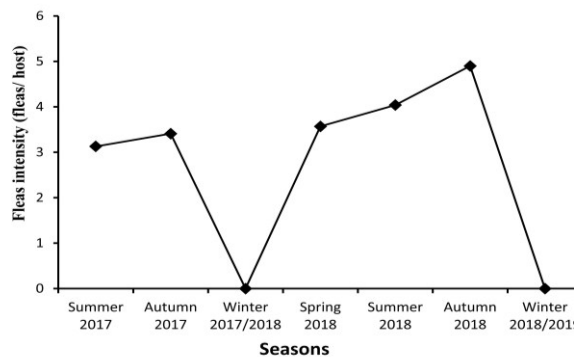


Figure: (5). Intensity of *Ct. felis* per host that were collected in all seasons in the Nafusa Mountain region at the period from summer 2017 to winter 2018/2019.

DISCUSSION

The results of this study indicate that *Ct. felis* infestation was a widespread problem in domestic animals in the Nafusa Mountain region, although Belgasm et al. (2022) reported three species on wild animals in Gharyan; they are *Pulex irritans*, *Xenopsylla cheopis*, and *Lep-topsylla segnis*. *P. irritans* was found in Libya infesting dogs, goats, and sheep (Kaal et al., 2006; Elsaid et al., 2013), but we did not record it on domestic hosts. The presence of *Ct. felis* only on domestic animals indicates that there was a transmission of this species among domestic animals in the area. The finding is in agreement with other reports in the El-Khoms area, Libya (Elsaid et al., 2013) and near Tripoli, Libya (Kaal et al., 2006). In this study, dogs were the most infected animals followed by cats. This was found in agreement with the study of Kaal et al. (2006), who reported that *C. felis* is better adapted to dogs and cats. In a similar study in Egypt, *C. felis* was the most prevalent species in dogs (Amin, 1966).

The housing of animals plays an important role in the development cycle of fleas, where the accumulation of droppings (organic materials) in animals' houses provide an appropriate environment for flea proliferation (Kaal et al., 2006). In this study, the highest degree of flea infestation was found in the closed or semi-closed captivities that contain the accumulated droppings, while animals that were grazing in fields and subjected to veterinary care programs were not infested.

In this study, the highest flea infestation was in summer, autumn, and spring, and the decline was in winter. Elsaid et al. (2013) reported that the highest prevalence of fleas was in summer and spring, while the lowest was in winter and autumn in El- Khoms region, Libya. This is probably due to the difference in the environmental conditions (temperature and humidity) because El- Khoms is a coastal region, and the Nafusa Mountain region is about 80 km from the coast.

Although one flea species was recorded in this study, *Ctenocephalides felis* can transmit pathogens including plague, rickettsiosis, and bartonellosis (Dobler & Pfeffer, 2011; Rolain et al., 2003; Wedincamp & Foil, 2002). In addition, *Ct. felis* act as intermediate hosts of rat tapeworm (*Hymenolepis nana*) and dog tapeworm (*Dipylidium caninum*) (Ford et al., 2004; Krämer & Mencke, 2001).

CONCLUSION

The findings of this study revealed that only one species is present on domestic animals. However, the role of this species in transmitting many pathogens cannot be neglected, and further study on this point must be conducted.

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ETHICS

The authors declare that there is no conflict of interest.

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معدلات إصابة الحيوانات المستأنسة بالبراغيث بجبل نفوسة، شمال غرب ليبيا

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المستخلص: تعد البراغيث إحدى الطفيليات الخارجية على الحيوانات المستأنسة حول العالم. كما تعمل كنواقل للعديد من مسببات الأمراض للإنسان. هدفت هذه الدراسة لتعريف البراغيث المتطفلة على الحيوانات المستأنسة، وتحديد موسميته بمنطقة جبل نفوسة. تم إجراء هذا المسح من صيف 2017 إلى شتاء 2018/2019 بمنطقة جبل نفوسة (غريان، الزنتان، نالوت). جمعت البراغيث من الحيوانات المصابة باستخدام مشط حديدي (11 سن لكل سم)، وملاقط. تم تعريف نوع واحد في هذا المسح (*Ctenocephalides felis*)، جُمع من الماعز، والأغنام، والأرانب، والحمير، والدجاج، والقطط، والكلاب. سجلت أعلى نسبة إصابة للعوائل (Prevalence) بين الماعز (66.49%)، ثم الأغنام (56.17%)، بينما بين الكلاب، والحمير، والدجاج، والأرانب، والقطط كانت أقل من 50.00%. و كان أعلى معدل حدة إصابة (Intensity) بين الكلاب (3.04 ± 4.50 برغوث لكل كلب)، وأقلها بين الدجاج (0.59 ± 0.87 برغوث لكل دجاجة). أعلى متوسط للوفرة (Abundance) كان بين القطط (8.00)، بينما كان أقل من 1.50 برغوث/ عائل بين الأغنام، والحمير، والكلاب، والدجاج. فصلا الصيف والخريف مثلا الأعلى من حيث حدة الإصابة، تلاهما فصل الربيع، بينما لم يتم تجميع براغيث في فصل الشتاء. أظهرت نتائج هذه الدراسة أن *Ct. felis* شائع ضمن الحيوانات المستأنسة وقد يكون ناقلا محتملا للممرضات بين الحيوانات، ثم البشر.

الكلمات المفتاحية: *Ctenocephalides felis*، Siphonaptera، حيوانات مستأنسة، جبل نفوسة، ليبيا.