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Original article

# First report of Siphonaptera parasites in *Canis latrans* in the Flora and Fauna Protection Area, Médanos de Samalayuca Chihuahua, Mexico

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ABSTRACT

Siphonaptera are hematophage parasite vectors of both human and animal diseases. We aimed to identify ectoparasites parasitizing a coyote population (*Canis latrans*) in the northwest region of the Flora and Fauna Protection Area Médanos de Samalayuca, Chihuahua, Mexico. We captured 21 coyotes (15 males and 6 females) during the summer and winter of 2018. The individuals were anesthetized and thoroughly examined for ectoparasites. We found that 43% of the coyotes were infested. Based on characteristics such as the absence of pronotal and genal combs in the head, we identified 15 specimens as *Pulex irritans*. This is the first report of *P. irritans* in coyotes in Médanos de Samalayuca Chihuahua, Mexico.

## 1. Introduction

Siphonaptera are hematophage parasites that are globally distributed, with the exception of Antarctica (Torina et al., 2013). To date, 2574 species of fleas have been identified, and in Mexico, eight families with 172 species have been described, corresponding to 7% of the global flea population. Among all known flea species, *Pulex irritans*, the human flea, stands out as one of the cosmopolitan species and is one of the most studied. It shares very similar characteristics with other species and can easily be confused with *P. simulans* and *Xenopsilla* spp. because of similar head shape and the absence of pronotal and genal combs. However, they can be differentiated by specific morphological differences in males (Smit, 1958). *P. irritans* is of particular interest in public health and veterinary medicine. It parasitizes multiple animal species, including livestock, domestic pets, and humans, causing severe cases of dermatitis and transmitting bacteria that cause diseases of high relevance, such as plague, bartonellosis, borreliosis, and rickettsiosis (Dobler and Pfeffer, 2011; Torina et al., 2013).

Wild carnivores are described as sentinels of viruses, bacteria, and parasites (Gese et al., 1997; Horak et al., 2004), and species such as foxes (*Vulpes vulpes*), wolves (*Canis lupus*), and coyotes (*Canis latrans*) are generally infested with various ectoparasite species, such as fleas (López-Pérez et al., 2018), mainly *P. irritans*, *Ctenocephalides canis*, *Ctenocephalides felis*, and *Echidnopaga gallinacea* (Eads, 1948; Torina et al., 2013), which also attack domestic species and humans (Torina et al., 2013). Various studies have suggested that wild carnivores are potential reservoirs of flea-transmitted infections, such as rickettsiosis and bartonellosis (Kaewmongkol et al., 2011; López-Pérez et al., 2018). Furthermore, their proximity to urban areas (Thomas and Hughes, 1992) and close interaction with domestic species, as well as humans, increases the risk of transmission, causing zoonoses (Eads, 1948; Torina et al., 2013).

Human disturbance in natural habitats can affect the microclimate, and seasonal patterns can affect the temperature and precipitation. These changes directly influence the survival, proliferation, and emergence of parasites (Patz et al., 2000; Harvel et al., 2002). A growing body of literature is highlighting the importance of continual research on wildlife parasites, specifically in deserts, which appear to be more sensitive to ecological disturbances (Friggens and Beier, 2010). Here we report the presence of the flea species in coyotes assessed between June and July 2018 and between December 2018 and January 2019 within the Protected Area of Médanos de Samalayuca, Chihuahua, Mexico.

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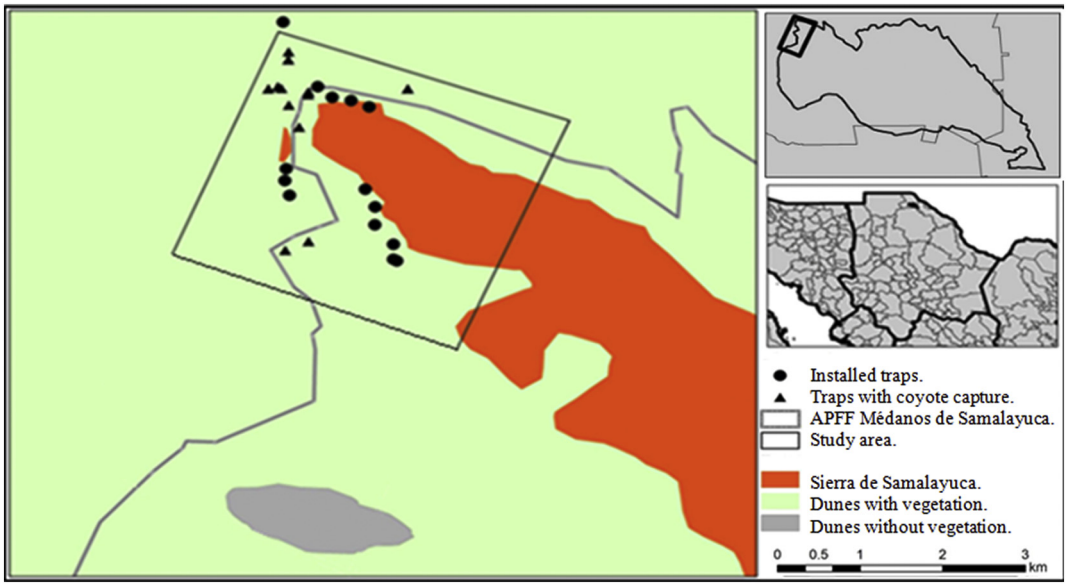


**Fig. 1.** Study area located in the northwest of APFF Médanos de Samalayuca, the sites where the coyotes were sampled are marked.

## 2. Materials and methods

### 2.1. Study area

The study area comprised a polygon of 9.3 $km^2$ within the tourist region of Ojo de la Punta, northwest of the Flora and Fauna Protection Area (APFF) Médanos de Samalayuca, Chihuahua, in the municipality of Juárez, which is northwest of the Chihuahuan Desert (Fig. 1). The climate is characterized as dry desert, with an average annual rainfall of 40 mm, of which 75% occurs from July to September. The average annual temperature is 16 °C–18 °C (Comisión Nacional de Áreas Naturales Protegidas, 2013). The typical vegetation of the studied region is spineless *parvifolia* shrublands, with a predominance of vegetation such as *Larrea tridentata*, *Flourensia cernua*, *Parthenium incanum*, *Prosopis juliflora*, *Acacia constricta*, *Koeberlinia spinosa*, and *Rhus microphylla* (Comisión Nacional de Áreas Naturales Protegidas, 2013). In 2011, a relative abundance of 52.8 was estimated for the coyote population at Samalayuca (Rodríguez-Martínez, 2011).

### 2.2. Host sampling, flea collection, and identification

The coyote capture protocol was submitted to and approved by the Universidad Autónoma de Ciudad Juárez Bioethics Committee and subsequently approved by Secretariat of Environment and Natural Resource (permit number SGPA/DGBS/003086/18). Coyote capture and sampling took place during June–July 2018 and December 2018–January 2019 using transects parallel to the road, where 18 steel and rubber snare-type traps (Victor No. 3) were placed (Clemente-Sánchez et al., 2017). The traps were baited with sardines, beef liver, and coyote urine and were supervised at dawn and sunset (Arias-del Razo et al., 2012). The captured coyotes were anesthetized with an intramuscular injection of ketamine and xylazine at doses of 5 mg/kg and 2 mg/kg, respectively (West et al., 2007).

Once the coyote was anesthetized, it was thoroughly examined for ectoparasites and marked with gentian violet on the abdomen to identify recaptures. The fleas that were found were fixed in tubes with 70% alcohol and sent to the laboratory for identification using the taxonomic keys described by Pratt and Wiseman (1962). After completing the handling and sampling of the coyotes, we allowed a 10–15 min period until the coyote showed signs of recovery from the anesthesia, and they were then released in the same place where they were captured.

## 3. Results

We captured 21 adult coyotes (15 males and six females). Only five coyotes were captured during summer 2018; (two males and three females), and the remaining 16 were captured during winter 2018 (13 males and three females). Nine individuals (six males and three females) presented with flea infestations, and 15 flea specimens were collected. All fleas were identified as *P. irritans*, according to characteristics such as the absence of pronotal and genal combs in the head and the absence of the vertical keratinized rod located in the mesopleura (Fig. 2), which are characteristic features of *P. irritans* that differentiate it from other flea species.

## 4. Discussion

Although limited by the small sample size, our results are similar to those observed by others. We found that 43% of the captured coyotes

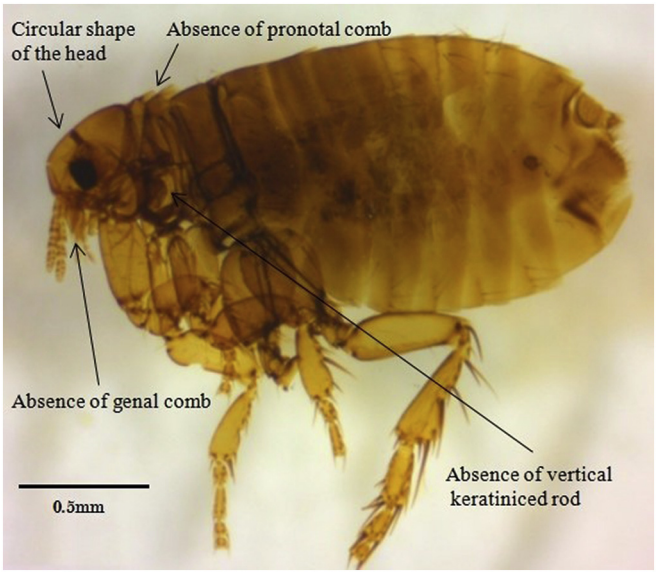


**Fig. 2.** Anatomical structures of fleas collected from coyotes at APFF Médanos de Samalayuca identified as *Pulex irritans* in full body, where a general view of its anatomical structure is observed.

presented with flea infestation by *P. irritans*, which, according to Hernández and Laundré (2014), is common. Notably, this is the first report of *P. irritans* in coyotes in Médanos de Samalayuca Chihuahua, Mexico. Other studies have identified different fleas of the *Pulex* genus as predominant flea species. Eads (1948) also found *P. irritans* to be predominant to the north of the Chihuahuan Desert in both coyotes and wolves. In similar ecoregions, studies report different findings. For example, at Janos Biosphere Reserve, northwest of Chihuahua, López-Pérez et al. (2018) found *P. simulans* as the predominant flea species among several carnivores in the region, while only two specimens of *P. irritans* were reported. In Cuenca Oriental, south of the Chihuahuan Desert, Acosta and Fernández (2015) found fleas in wild rodents, but none were of the *Pulex* genus. The distribution of flea species is influenced by latitude, climate, and host variety. Considering that *P. simulans* was not reported in our present study, but *P. irritans* showed dominance both in our present study and in the study by Eads (1948), we could argue that the environmental conditions of the northeastern Chihuahuan Desert favor *P. irritans* and not *P. simulans* or other flea species. Nevertheless, there remains a lack of studies on the prevalence and ecology of fleas present on wildlife of the Chihuahuan Desert.

Fleas are vectors of zoonotic pathogens that are of public health importance, and they have a variety of hosts (Dobler and Pfeffer, 2011; López-Pérez et al., 2018). Studies suggest that wild canids are involved in the transmission cycles of flea-borne infections (McGee et al., 2006; López-Perez et al., 2017; González et al., 2018). Other flea species, which were not found in our present study, such as *Ctenocephalides. felis*, *Ctenocephalides canis*, *Xenopsylla cheopis*, and *Cediopsylla inaequalis*, can carry rickettsial agents (Torina et al., 2013). Historically, infectious diseases that are transmitted by arthropods, such as rickettsiosis, have been the most studied group. These bacteria are highly pathogenic for a wide range of vertebrate species, producing febrile diseases that can cause mortality of 10% to 80% if not treated appropriately (Bermúdez et al., 2012).

In recent years, the ecological damage caused by human activities has caused the dispersal of parasites and pathogens (Friggens and Beier, 2010; Medina-Vogel, 2010), generating an ecological imbalance favoring emerging diseases (Bermúdez et al., 2012), specifically vector-borne diseases (Torina et al., 2013; Zohdy et al., 2019). Greater dispersal triggers host adaptation of these pathogens in new ecosystems, giving rise to new incidences and causing serious consequences, such as immunological weakness or local extinctions of native species (Medina-Vogel, 2010).

## 5. Conclusion

Even though our results are constrained by sample size and are specific to coyotes, they are an important indicator of the health of an ecosystem, especially in protected natural areas, such as the APFF Médanos de Samalayuca, whose mission is to preserve flora and fauna.

## Ethical statement

We followed all applicable international, national, and institutional guidelines for the care and use of animals. All procedures were in accordance with the ethical standards of the institutions at which we conducted the research.

## Declaration of Competing Interest

There is no actual or potential conflict of interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could be perceived to influence, the present work.

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