

Article

## The first data on the ectoparasites (ticks, lice and fleas) of the stone marten, *Martes foina* (Erxleben) in Türkiye

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### Abstract

Türkiye is a natural land bridge connecting Europe and Asia, and has a rich terrestrial mammalian fauna, with more than 150 species within the seven orders. However, there is limited information on ectoparasites of wild animals, especially carnivores, in Türkiye. In the present study, we provide the first data of ectoparasites of Turkish stone marten, *Martes foina* (Erxleben). A total of 38 ectoparasite specimens were collected from two road-killed stone martens in two different localities in Tokat province. Here, the presence of the genus *Stachiella* Kéler (Insecta: Phthiraptera) in Türkiye was reported for the first time, based on two specimens (1 male and 1 nymph) of *Stachiella retusa* (Burmeister). In addition, three flea (Insecta: Siphonaptera), namely *Monopsyllus sciurorum sciurorum* (Schrank) (1 male), *Pulex irritans* L. (1 female), *Chaetopsylla rothschildi* Kohaut (3 males, 8 females) and two tick (Acari: Ixodida) species, namely *Haemaphysalis erinacei* Pavesi (18 males, 4 females), *Ixodes redikorzevi* Olenov (1 female) were collected from stone martens. All ectoparasitic species are new host-associations for stone marten, *M. foina*, in Türkiye.

**Keywords** biodiversity; fauna; mammals; parasites; vectors; wild animals.

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### 1 Introduction

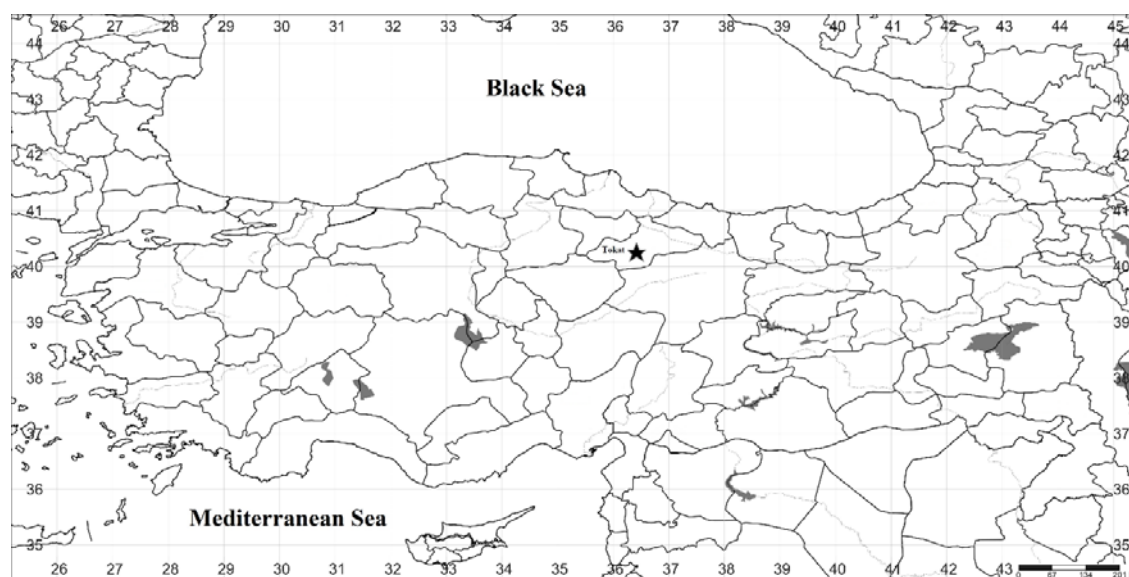
The faunistic investigations of ectoparasites on wild animals are intended not only to provide ecological data but also to be useful to parasitological and epidemiological workers in a certain area. Türkiye is a natural land bridge connecting Europe and Asia, and has a rich terrestrial mammalian fauna, with more than 150 species within the seven order (Kryštufek and Vohralík, 2001, 2005, 2009; Özkurt and Bulut, 2021). However, the number of reported ectoparasites in Türkiye is limited to approximately 55 tick species (Bursalı et al., 2012; Bursalı et al., 2020; Keskin and Erciyas-Yavuz, 2019; Keskin et al., 2014; Keskin and Selçuk, 2021; Orkun and Karaer, 2018; Orkun and Vatansever, 2021), 130 flea species (Keskin, 2021; Keskin et al., 2018) and

approximately 250 lice species (Dik et al., 2017; Dik, 2020). Although wild mammals have been an increasingly frequent object of studies on ectoparasite infestations and detection of vector-borne disease agents for the last decade, we have limited still information on distributions of ectoparasites and their associations with wild mammals, especially carnivores, in Türkiye.

The stone marten, *Martes foina* (Erxleben), considered an arboreal or semi-arboreal carnivore is one of the natively distributed carnivores throughout the Eurasian region (Abramov et al., 2006). The stone marten is a nocturnal carnivore and frequently inhabits pastures, rocky areas, and even urban or suburban environments where it is a frequent predator of poultry. This species is also widespread and abundant in Türkiye (Arslan et al., 2020; Yiğit et al., 1998); but, according to our knowledge, there are no records of ectoparasites of the stone marten. In the present study, we aimed to contribute to the ectoparasite (lice, fleas, and ticks) fauna of Türkiye and improve our knowledge of distribution and host relationships of ectoparasites of the stone marten, in Türkiye.

## 2 Materials and Methods

During our parasitological studies on wild animals in Türkiye, we found two road-killed stone martens from Tokat province (26.VII.2021, Kızılköy village, 40°22'43.2"N 36°40'44.7"E; 14.IV.2022, Çerçi village, 40°19'11.6"N 36°24'27.8"E) (Fig. 1). Ectoparasite specimens were manually removed from these stone martens with the help of tweezers and stored in 70% ethanol.



**Fig. 1** Locality of ectoparasite specimens collected from stone marten, *Martes foina*, in the present study.

Clearing and mounting procedures were carried out in accordance with Dik (2020) for lice, and Smit (1957) for fleas. Briefly, lice and fleas were cleared in 10% or 20% potassium hydroxide (KOH) for one day, later rinsed in distilled water, transferred to alcohol series (from 70% to 99%), and xylene respectively. Lice and fleas were individually mounted on the slides in Canada balsam. Lice were identified under a binocular light microscope (Leica DM750, Leica Microsystems GmbH, Wetzlar, Germany) and photographed with a digital camera (Leica DFC295 Leica Microsystems, Wetzlar, Germany) in Department of Parasitology, Faculty of Veterinary Medicine, Selçuk University, Konya, Türkiye. The identification of the lice was carried out

according to relevant literatures Werneck (1948) and Price et al. (2003). Fleas were identified under a binocular light microscope (Olympus CX41, Tokyo, Japan) using keys as referred by Hopkins and Rothschild (1953, 1956) and Beaucournu and Launay (1990). On the hand, ticks were examined under the stereomicroscope (SZ61, Olympus, Tokyo, Japan) and identified using morphological keys and descriptions given by Filippova (1977, 1997). Examination and identification of fleas and ticks were done in Parasitology Laboratory, Department of Biology, Tokat Gaziosmanpaşa University, Tokat, Türkiye.

All ectoparasites were deposited in the ectoparasite collection of the Parasitology Laboratory, Department of Biology, Tokat Gaziosmanpaşa University, Tokat, Türkiye.

### 3 Results and Discussion

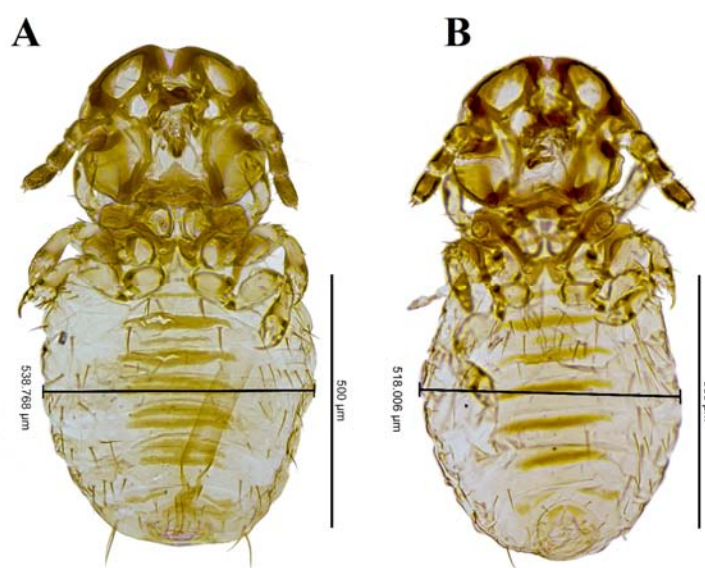
Several studies on some ectoparasites of wild mammals have been conducted in recent years; however, the faunal composition of ectoparasites of Turkish mammals, especially carnivores, is still far from being understood. In the present study, we provide the first data on the ectoparasites of the stone marten for Türkiye. A total of 23 ticks, 13 fleas and two louse specimens were collected from two road-killed stone martens in Tokat province of Türkiye.

Three fleas taxa, *Monopsyllus sciurorum sciurorum* (Schrank) (1 male), *Pulex irritans* L. (1 female), and *Chaetopsylla rothschildi* Kohaut (3 males, 8 females) were found on stone martens. *Monopsyllus s. sciurorum* is a specific parasite of *Sciurus vulgaris* L., but it can be infested on other small mammals, birds, and also on their predators such as *Martes* spp. In early studies, *M. s. sciurorum* was found on some rodents, namely *Apodemus mystacinus* (Danford and Alston), *Apodemus* sp., *Dryomys laniger* (Felten and Storch), *Dryomys nitedula* (Pallas), *Glis glis* L., *Sciurus anomalus* Gmelin and *S. vulgaris* in Türkiye (Keskin et al., 2018). Another flea species collected in this study, *P. irritans*, is known as human flea, but it believes that likely originates from large and possibly ground-living mammals (Brinck-Lindroth and Smit 2007). *Pulex irritans*, which have a cosmopolitan distribution, was also reported from some species of Carnivora, Chiroptera, Lagomorpha, and Rodentia in Türkiye (Keskin et al., 2018); but we believe that the host range of this flea is more complex than is known today. *Chaetopsylla rothschildi* is a parasite of mustelids, and the distribution of this flea seems to essentially cover the European and near-eastern borders of the Mediterranean (France, Yugoslavia, Czechoslovakia, Hungary, Romania, Lebanon, and the Caucasus) (Beaucournu, 1973; Lewis and Lewis, 1990). The presence of *C. rothschildi* in Türkiye was given by Dinçer (1971) for the first time, based on 6 male and 22 female specimens from red foxes (*Vulpes vulpes* (L.)) in Ankara province. With the current study, we provide a second report of *C. rothschildi* for Türkiye. *Martes foina* is a new host records for *M. s. sciurorum*, *P. irritans* and *C. rothschildi* fleas for Türkiye.

Ticks collected from stone martens in this study were identified as *Haemaphysalis erinacei* Pavesi (18 males, 4 females), and *Ixodes redikorzevi* Olenov (1 female). *Haemaphysalis erinacei* is a hedgehog parasite, but can also infest carnivores, rodents, chiropters, and birds (Guglielmone et al., 2014). In Türkiye, *H. erinacei* was collected from *Erinaceus concolor* Martin, *V. vulpes*, *Scarturus williamsi* (Thomas), *Ursus arctos* L., and also humans (Bursalı et al., 2012; Girişgin et al., 2018). There is a limited investigation on the vectorial capacity of *H. erinacei*; however, nevertheless, the presence of some zoonotic bacteria (*Yersinia pestis*, *Rickettsia massiliae*, *R. raoultii*, and *R. heilongjiangensis*) has been detected in *H. erinacei*. On the other hand, a single female *I. redikorzevi* specimen was collected on *M. foina*. There is an ongoing debate on the taxonomic status of *I. redikorzevi*, because it is not clear whether *I. redikorzevi* is a junior synonym of *Ixodes acuminatus* Neumann or not. This has been repeatedly questioned and debated in previous studies (Guglielmone et al., 2014; Keskin and Erciyas-Yavuz, 2019; Keskin and Selçuk, 2021). Detailed information on biology, distribution, and host associations of *I. redikorzevi* is Russian and has been given in Filippova

(1977) and Filippova and Stekolnikov (2007). Keskin and Selçuk (2021) also summarized these information and provided geographical distribution and host associations of *I. redikorzevi* in Türkiye. In the present study, *H. erinacei* and *I. redikorzevi* ticks were recorded as new host associations for *M. foina* for the first time in Türkiye.

The lice on wild mammals in Türkiye have poorly studied ectoparasites and they have been interestingly ignored. There are approximately 5,000 known species of lice which the majority (90%) of them are ectoparasites of birds; the remaining (10%) are parasites of mammals (Durden, 2001). Lice are morphologically divided into two main groups, namely sucking lice (which have piercing-sucking mouthparts) and chewing lice (which have chewing mandibles). They are also traditionally organized into four groups or suborders within the order Phthiraptera (more recently, Psocodea, in part), namely Anoplura, Amblycera, Ischnocera, and Rhynchophthirina.



**Fig. 2** *Stachiella retusa* (Burmeister). **A.** male (ventral view), **B.** nymph (ventral view).

With more than 3,000 described valid species, Ischnocera is the most specious suborder within the parasitic lice. Suborder Ischnocera is divided into two families, namely Philopteridae and Trichodectidae. The members of Philopteridae are specific parasites of birds, except the genus *Trichophilopterus* which infests on lemurs, whereas all known species of the family Trichodectidae infest mammals exclusively (Clayton et al., 2008; Durden, 2001, 2019). Family Trichodectidae is widely distributed over the world and represented by more than 360 species, but only 12 species, namely *Bovicola* Ewing [seven species: *B. bovis* (L.), *B. caprae* (Gurlt), *B. crassipes* (Rudow), *B. limbatus* (Gervais), *B. equi* (Denny), *B. ocellatus* (Piaget), *B. ovis* (Schrank)], *Felicola* Ewing [two species: *F. subrostratus* (Burmeister), *F. vulpis* (Denny)], *Trichodectes* Nitzsch [three species: *T. canis* (de Geer, 1778), *T. melis* (Fabricius, 1805), *T. pinguis* Burmeister] of this family have been reported in Türkiye (Dik, 2020; Eren et al., 2021). The majority of the aforementioned species of trichodectid lice were reported from domestic animals (cattle, sheep, goats, donkeys, horses, cats, and dogs), but only three species of lice (*F. vulpis*, *T. melis* and *T. pinguis*) were collected from wild mammals (red fox, Caucasian badger, and brown bear) in Türkiye (Dik and Orunc-Kilinc, 2016; Eren et al., 2021; Taşçı et al., 2017).

The trichodectid genus *Stachiella* Kéler is currently represented by only 13 species all over the world. The members of this genus are mainly parasitized on mustelids (*Galictis*, *Mustela*, and *Martes*), but some species are a parasite of some procyonids (*Procyon* and *Potos*) (Price et al., 2003; Smith et al., 2022; Werneck, 1948). In the present study, we reported the genus *Stachiella* in Türkiye for the first time, based on two specimens (1 male and 1 nymph) (Fig. 2A, B) of *Stachiella retusa* (Burmeister) collected on *M. foina* from Tokat province.

We believe that many new ectoparasite–host associations for Türkiye will be reported in the future when more detailed studies on ectoparasite infestation on wild mammals in Türkiye are performed.

### Author contributions

Adem Keskin: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Visualization, Writing - original draft, Writing - review and editing. Bilal Dik: Data curation, Formal analysis, Investigation, Methodology, Resources, Writing - review and editing.

### Statement of ethics approval

Studies requiring the capturing of small mammals and their ectoparasites were conducted after obtaining legal permissions from the Republic of Türkiye, Ministry of Forestry and Water Affairs, General Directorate of Nature Conservation, and National Parks (21264211-288.04-E.72185). All data generated or analyzed during this study are included in this published article.

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