Annals of Parasitology 2018, 64(1), 65–68
doi: 10.17420/ap6401.134

Short notes

Helminth parasites of stone marten (*Martes foina*) in central Portugal

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ABSTRACT. The stone marten (*Martes foina*) is one of the most common species of marten in Europe. Due to increased urbanization and forest degradation, it is now often found in urban habitats, which increased the possibility of parasites transmission between wildlife-domestic animals and humans. Our preliminary study of this mustelid in Portugal, aimed to assess prevalence of helminths. Six helminth parasites were found (*Crenosoma vulpis*, *Angiostrongylus* sp., *Toxocara* sp., *Toxascaris leonina*, Ancylostomatidae and *Strongyloides* sp.). To our knowledge, this is the first report of *Toxascaris leonina* in this host species.

Key words: *Martes foina, Toxascaris leonina*, helminths, prevalence

Introduction

The stone marten (*Martes foina*) is the most common species of marten in Europe [1]. This small carnivore is well adapted to a wide range of habitats, from central and western Eurasia [2] to the Iberian Peninsula [3]. This species exhibits behavioral plasticity and is now common in peri-urban and urban habitats across continental Europe [4]. Recent human population expansion and increased contact between humans and wildlife, increases the possibility of parasites transmission between the human-domestic-wildlife interface [5]. The stone marten is a perfect example of a species that lives in anthropogenic disturbed habitats (e.g., patches of agriculture land, human settlements, forest fragments, and protected areas). However, few studies have evaluated the prevalence of helminth parasites in this mustelid [6,7]. Additionally, the stone marten is a widespread native species on the Iberian Peninsula and to our knowledge there are no studies on this species parasites in Portugal.

The aim of this study was to assess, by means of a coprological survey, the occurrence and prevalence of endoparasites in a stone marten population from central Portugal and to discuss the potential risk of their transmission to other animals and ultimately to humans.

Materials and Methods

Our study area was located in central-west Portugal, occupying two sites of the Natura 2000 network (Freita-Arada and Montemuro mountain range), with an area of 750 km^2 [8].

Fresh faeces from stone marten (n=13) were collected by field-trained personnel throughout the study area, between November 2014 and July 2015. *Martes foina* is the only *Martes* species in our study area. All samples were preserved at 4ºC before laboratory analysis [9]. Parasite eggs/larvae identification was based on morphological characteristics (shape and structure) and measurements [10]. To evaluate the occurrence of the helminth parasites, we performed four different techniques: a) McMaster [11], b) Baermann test [12], c) sedimentation [13] and d) flotation (Willis) techniques [14]. Parasite prevalence was calculated

according to Bush et al. [15]. Confidence limits were established with 95% confidence intervals (CI). Data was analyzed using Microsoft Excel 2013®.

Results

From a total of 13 collected faecal samples, 7 (54%) were positive for at least one of the six helminth parasites found (Table 1). All helminths detected belonged to the Nematoda: two were respiratory, *Angiostrongylus* sp. (first larval stage or L1) and *Crenosoma vulpis* (L1) and four from the digestive tract, *Strongyloides* sp., *Toxocara* sp., *Toxascaris leonina* and Ancylostomatidae, all of them shedding eggs. *Toxascaris leonina* was present in one sample only (McMaster technique) with 400 eggs per gram (EPG), suggesting that it was not a spurious infection. Three faecal samples (3/7, 43%) showed a mixed infection with two different endoparasites and four samples (4/7, 57%) were monospecific. The parasites and their prevalences are given in Table 1.

Discussion

Apart from *Toxascaris leonina*, all the other parasites described in our study had been previously described in Europe from stone marten. *Crenosoma vulpis* has been reported in Switzerland and Germany [1,16], based on necropsies. The majority of studies of the parasites in stone marten across Europe, have been based on data obtained from specimens that were road-killed or hunted [1,2,16]. Pfeiffer et al. [16] reported a prevalence of 9% for *C. vulpis*, which is lower than that reported here (31%). *Angiostrongylus* sp. was also reported in Italy [2] stone martens that were road-killed, with a slightly higher prevalence (10%) than ours (8%). In Bulgaria, Kirkova et al. [6] described *Toxocara* sp. with a much higher prevalence (55%) than ours (15%). These authors also reported *Ancylostoma* sp. with a somewhat higher prevalence (9%) compared with ours (8%). In Spain, Rodríguez and Carbonell [17] reported *Strongyloides stercoralis* and *Toxocara cati* in the stone marten.

There are very few studies evaluating parasite prevalence in stone marten faeces, therefore it was difficult to compare our results with others using necropsy. On the other hand, parasite surveillance programs based on the regular monitoring of fresh faecal samples are non-invasive [18,19].

To our knowledge, *Toxascaris leonina* has never been reported previously in this host. Parasites such as *Toxocara* sp., *Strongyloides* sp. and Ancylostomatidae are zoonotic parasites, and *T. leonina* to lesser extent, all of them being reported to infect humans, domestic animals and wildlife species in peri-urban and urban environments [5,20,21].

Other cohabitant wild carnivores (red fox and wolf) in the same geographical area, are parasitized by *Crenosoma vulpis*, *Angiostrongylus vasorum*, *Toxocara canis*, *Toxascaris leonina,* Ancylostomatidae and *Trichuris vulpis*, most of which were also found in stone marten. These data highlight the hypothesis of cross transmission among all these carnivores and their importance in the ecosystem health [19].

Although we acknowledge that our sample size was rather small, it is important to highlight that more than half of the samples were infected (54%). Even though the stone marten is considered common in Portugal, we hypothesize that our small sample size is due to the following reasons: a) the

Table 1. Number of positive samples and the prevalence of parasites found in fresh feces from stone marten (*Martes foina*) collected in central Portugal, (n=13)

Parasites	No. positive	Prevalence (%)	McMaster (EPG)	Confidence interval (95%)
Crenosoma vulpis	4	31	0	(0.05–20.45)
Toxocara sp.	2	15	0	NA[a]
Ancylostomatidae	1	8	0	NC[b]
Angiostrongylus sp.	1	8	0	NC
Toxascaris leonina	1	8	400	NC
Strongyloides sp.	1	8	0	NC
Total positives	7	54	NA	NA

[a]NA – not applicable; [b]NC – not calculated; n – number of examined martens faecal samples

local densities of stone marten are considered small [22], b) presence of a top predator which can reduce stone marten densities, c) for coprological analysis we only collected fresh faecal samples, which obviously greatly reduced the number of available samples for laboratory analysis.

Therefore, we used a non-invasive sampling technique, based on collection of fresh faeces in the environment, which is suitable for studies on wildlife species with low densities, such as the stone marten in our study area [19,22].

Acknowledgements

We are grateful to Lídia Gomes for all the help provided in the Centre for Interdisciplinary Research in Animal Health (CIISA), Faculty of Veterinary Medicine, University of Lisbon (CIISA-FMV-Ulisboa). Also, we are grateful to Prof. Ian Beveridge from the Faculty of Veterinary and Agricultural Sciences, the University of Melbourne, Parkville, Victoria, Australia, for gently advise and revise the manuscript. R.T. Torres was supported by a post-doctoral grant from FCT (SFRH/BPD/112482/2015). We would like to thank University of Aveiro (Department of Biology) and FCT/MEC for the financial support to CESAM RU (UID/AMB/50017) through national funds and, where applicable, co-financed by the FEDER, within the PT2020 Partnership Agreement. CIISA-FMV-ULisboa, under project UID/CVT/00276/2013 (FCT), provided additional funding.

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Received 23 September 2017
Accepted 15 December 2017