

Multiparasitism in Crab-eating fox (*Cerdocyon thous*) (Carnivora: Canidae), including new records, in the Brazilian Pampa – case report

[Multiparasitismo em graxaim-do-mato (*Cerdocyon thous*) (Carnivora: Canidae), incluindo novos registros, no Pampa brasileiro – relato de caso]

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ABSTRACT

Cerdocyon thous is considered the most common wild canid in Rio Grande do Sul, and can serve as a host for several parasites, playing an important role in maintaining the biological cycle. Despite being a widespread and abundant species, they have a relatively little-known fauna of endo and ectoparasites, mainly focusing on the different regions of their occurrence. With this work, the objective was to report the multiparasitism in a specimen of *C. thous* in the Brazilian Pampa. Using modified Centrifuge-Flotation and Spontaneous Sedimentation techniques, a high taxonomic diversity of parasites was observed, and the finding of eggs compatible with *Lagochilascaris* spp. in *C. thous* in Brazil, in addition to *Uncinaria* spp. eggs and *Cystoisospora* spp. oocysts in the same host in the south of the country. The presence of eggs of different helminths in the feces of *C. thous* is extremely important, mainly for public health, but also for the knowledge of the biodiversity of parasites present in wild populations of canids, until then little studied, thus allowing the implementation of control programs.

Keywords: coproparasitological, endoparasites, wild fauna

RESUMO

Cerdocyon thous é considerado o canídeo silvestre mais comum no Rio Grande do Sul e pode servir como hospedeiro de diversos parasitos, desempenhando papel importante na manutenção do ciclo biológico. Mesmo sendo uma espécie difundida e abundante, têm uma fauna de endo e ectoparasitos relativamente pouco conhecida, principalmente enfocando as diferentes regiões de sua ocorrência. Com este trabalho, objetivou-se relatar o multiparasitismo em um espécime de *C. thous* no Pampa brasileiro. Por meio das técnicas de centrifugo-flutuação modificada e sedimentação espontânea, observou-se uma alta diversidade taxonômica de parasitos, sendo relatado, pela primeira vez, o achado de ovos compatíveis com *Lagochilascaris* spp. em *C. thous* no Brasil, além de ovos de *Uncinaria* spp. e oocistos de *Cystoisospora* spp. no mesmo hospedeiro, no sul do país. A presença de ovos de diferentes helmintos nas fezes de *C. thous* é de extrema importância, principalmente na saúde pública, mas também para o conhecimento da biodiversidade de parasitos presentes em populações silvestres de canídeos, até então pouco estudados, permitindo, assim, a implementação de programas de controle.

Palavras-chave: coproparasitológico, endoparasitos, fauna silvestre

INTRODUCTION

Cerdocyon thous (Linnaeus, 1758), popularly known as "Cachorro-do-mato" or "Graxaim-do-mato", is a species of canid widely distributed in South America, occurring in almost all of Brazil, except in the amazon (Wilson and Reeder, 2005).

It is found in forest and field areas, being considered the most common wild canid in Rio Grande do Sul (Dotto *et al.*, 2001). It has a nocturnal and solitary habit, moves rarely, and lives in pairs, going along trails, forest edges and roads in search of food (Berta, 1982).

This canid can serve as a host for several parasites and can play an important role in maintaining the biological cycle, mainly due to its generalist habits, tolerance to anthropogenic disturbances and interaction with other wild and domestic species (Curi, 2005).

Studies of endo and ectoparasites in wild animals are important in investigating the biodiversity of species and in determining the risk that parasites may pose to public health (Martins *et al.*, 2004). However, for most wild species, there is still a lack of information. Even widespread and abundant species, such as *C. thous*, have a relatively little-known parasite fauna, mainly focusing on the different regions of their occurrence, and their role as a dispersing agent.

This work aimed to report the multiparasitism in a specimen of Graxaim-do-mato (*Cerdocyon thous*) in the Brazilian Pampa, including new records.

CASUISTRY

A fecal sample of an adult female Graxaim-do-mato (*Cerdocyon thous*) was received for parasitological diagnosis in the laboratory of the Study Group on Parasitic Diseases of the Federal University of Pelotas. The modified Zinc Sulfate Flotation Centrifuge techniques were used, as described by Monteiro (2017) and Spontaneous sedimentation (Hoffmann *et al.*, 1934).

For identification, all structures that could identify or differentiate an egg, in its smallest possible taxon, such as characteristics and shell ornaments, embryonic and larval formation, existence of operculum and aculea, were used. The identification was done by comparing the morphometry found with that of species previously described in the literature for the host species, using an Olympus optical microscope (CX22 series) (Monteiro, 2017; Scioscia *et al.*, 2018; Araujo, 2020; ; Izdebska and Rolbiecki, 2020; Ferraz *et al.*, 2021). The mean and standard deviation were calculated using measurements of five eggs, oocysts, and mites, using the EpiTools epidemiological calculator (Sergeant, 2018).

In the present report, we observed a high taxonomic diversity of parasites diagnosed through the examination of *C. thous* faeces,

including new records, which are illustrated in figure 1. The average measurements are shown in table 1. In total, eggs of six helminths, oocysts of one protozoan and one mite were observed; compatible with: *Spirometra* spp. (Figure 1 – A), *Alaria* sp. (Figure 1 – B), *Lagochilascaris* spp. (Figure 1 – C), *Demodex canis* (Figure 1 – D), *Capillaria* spp. (Figure 1 – E), *Uncinaria* spp. (Figure 1 – F), *Ancylostoma* spp. (Figure 1 – G) and *Cystoisospora* spp. oocysts (Figure 1 – H).

DISCUSSION

Except for *D. canis* and *Cystoisospora* spp., all the others have zoonotic potential and, therefore, can parasitize humans. According to Murphy *et al.* (2012), more than 45% of zoonotic pathogens have a carnivorous host in their life cycle. Thus, wild canids play an important role in the maintenance and transmission of pathogens.

Infection by the nematode *Capillaria* spp., tapeworm *Spirometra* spp. and the trematode *Alaria* spp. was previously reported in the region by Lucas (2000) and Ruas (2007). And according to Ruas (2007), they had a prevalence of 5.56%, 61.11% and 50%, respectively, in the same host species. Both have a heteroxenic life cycle, requiring at least one intermediate host (Monteiro, 2017). The origin of the infection is possibly due to the canids' diet, which is considered omnivorous and quite diversified, consisting of the consumption of freshwater fish and crustaceans, mollusks, and different vertebrates (birds, reptiles, amphibians, small mammals) that would act as intermediate or paratenic hosts of helminths and, therefore, need an environment with the presence of areas with good irrigation, which favor the development of some of them (Dotto *et al.*, 2001). Furthermore, considering that wild animals can become infected and harbor metacephalic, they act as living beings of *Alaria* (Jaksic *et al.*, 2002), also serving as a source of fermentation for wild canids and humans. Due to the presence of wild boar (*Sus scrofa*) and wild hog (*Sus scrofa scrofa*) in the study region, similar situations may occur, where the species can serve as a source of occurrence.

The observation of oocysts performed with *Cystoisospora* spp. and eggs hatched with *Uncinaria* spp. and *Ancylostoma* spp. may be related to the presence of the domestic dog,

preferential for the parasites. It is common to use dogs in field management with sheep and cattle herds in this region, which allows these animals to move in the habitat of wild canids, that is, there is an overlap of niches between species of canids (wild and domestic) allowing the infection (Port, 2002). Vizcaychipi *et al.* (2016) observed *Cystoisospora* spp. oocysts in feces of bush dog (*Speothos venaticus*) in Misiones province, Argentina. In Brazil, infection by this coccidia in *C. thous* had only been reported in a young animal treated at the Veterinary Hospital of the Federal University of Sergipe (Silva *et al.*, 2017). *Uncinaria* spp. was described parasitizing *C. thous* in the city of São Paulo (Travassos, 1915;) and in the coproparasitological diagnosis of an animal of the same species in Fortaleza, Ceará (Araújo, 2020). Now, both are reported for the first time in southern Brazil in this host. In contrast, *Ancylostoma* spp. was identified as the most frequent parasite in *C. thous* in the same region of the present study (Ruas, 2007).

The presence of *Demodex canis* in the feces can be explained considering that these parasites, at all stages, can be found in the lymph nodes, intestinal wall, spleen, liver, kidneys, bladder, lung, thyroid, blood, urine and feces, in addition to of the dermis (within the hair follicle and in the sebaceous glands). However, when observed in these extracutaneous organs, they may be usually dead and degenerated, representing a drainage to any of these areas, via the blood or lymphatic stream of the infested animal (Oliveira, 2005; Monteiro, 2017). So far, only four species have been described parasitizing canids: *Demodex canis*, *Demodex cornei*, *Demodex cyonis* and *Demodex injai* (Izdebska and Rolbiecki, 2020). The differences between these species are limited to the size of the mite (Delayte, 2015). However, molecular studies concluded that *D. canis* ($224.3 \pm 18.3 \mu\text{m}$ in length) and *D. cornei* ($156.9 \pm 11.12 \mu\text{m}$ in length) are the same mite with variations in size, and that *D. injai* is a species phylogenetically distinct from *D. canis*, with greater length (males with $361 \pm 44\mu\text{m}$ and females with $334 \pm 29\mu\text{m}$

in length) (Rojas *et al.*, 2012; Sastre *et al.*, 2012; Morita *et al.*, 2018). Also, according to Izdebska and Rolbiecki (2020), *D. cyonis* is described as a “short” species of Demodecidae, where males are $169.38 \pm 13.89 \mu\text{m}$ in length and females are $168.8 \pm 12.02 \mu\text{m}$ in length (Morita *et al.*, 2018).

The finding of eggs compatible with those of *Lagochilascaris* spp. is recorded for the first time in *C. thous* feces in Brazil. The eggs of the parasites of this genus have a thick shell and have between 15 and 45 pits around the circumference (*L. major*: 33 to 45; *L. minor*: 15 to 26), similar to a “bottle cap” (Moura *et al.*, 2012; Ferraz *et al.*, 2021). Recently, Scioscia *et al.* (2018) recorded *Lagochilascaris minor* in *Lycalopex gymnocercus* in Buenos Aires, Argentina, and Vizcaychipi *et al.* (2016) found eggs of *Lagochilascaris* spp. in vinegar dog (*Speothos venaticus*) feces in the province of Misiones, in the same country. In the region of the present study, the parasite has already been reported in *Leopardus geoffroyi* (Trindade *et al.*, 2019) and in domestic cats (Ferraz *et al.*, 2021) in addition to egg findings in public squares (Moura *et al.*, 2012). As infection by this parasite occurs through ingestion of the meat of the intermediate host, mainly rodents, containing encysted larvae (Monteiro, 2017), the infection is linked to the host's eating habits. In addition, the increasing use of areas that serve as habitat for several wild species, for agricultural production purposes, has increased the possibility of contact between wild and domestic animals, favoring the transposition of parasites from one host to another (Ruas, 2007).

Knowledge of the parasites that occur in a given region is of fundamental importance for the establishment of sanitary control programs. However, it requires a more detailed investigation into the circumstances of this finding, to obtain adults for morphological and molecular analyzes that can elucidate the epidemiological implication of this parasitism.

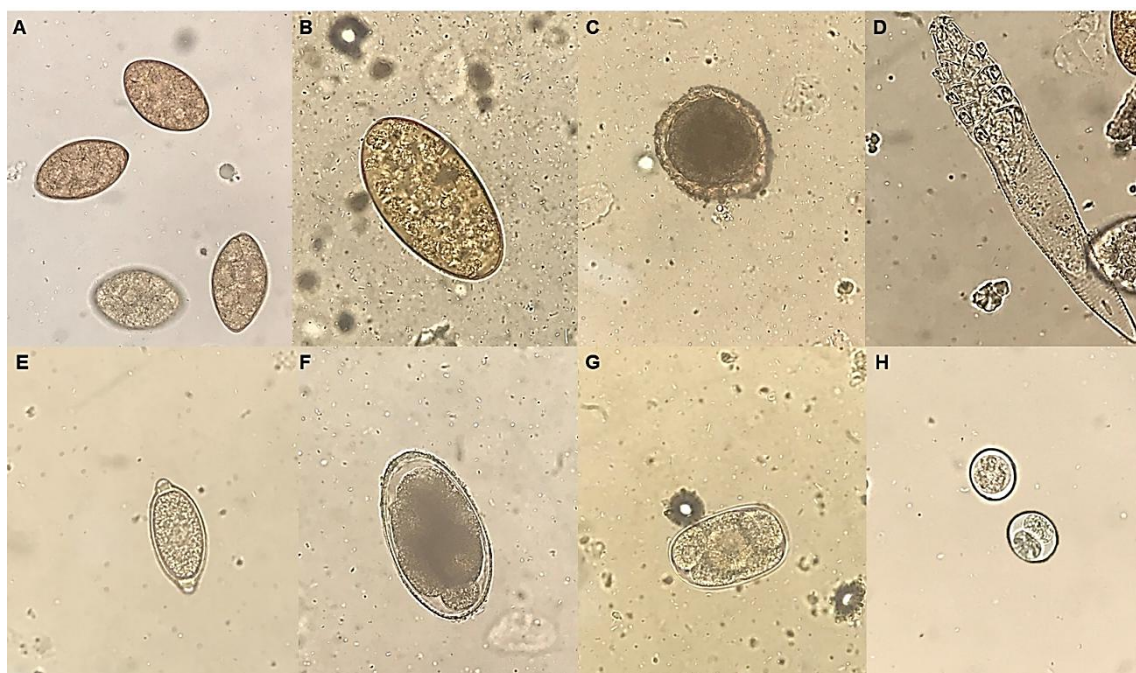


Figure 1. Eggs, oocysts, and mite diagnosed in feces of Graxaim-do-mato (*Cerdocyon thous*) in southern Rio Grande do Sul, BR. 400X magnification. (A) *Spirometra* spp.; (B) *Alaria* sp.; (C) *Lagochilascaris* spp.; (D) *Demodex canis*; (E) *Capillaria* spp.; (F) *Uncinaria* spp.; (G) *Ancylostoma* spp.; (H) *Cystoisospora* spp.

Table 1. Mean values of measurements, in μm , of eggs, oocysts and mites diagnosed in feces examination of Graxaim-do-mato (*Cerdocyon thous*) in the south of Rio Grande do Sul, BR.

Endoparasites	Mean values of measurements (μm)			
	Length	Standard deviation	Width	Standard deviation
Nematodes				
<i>Lagochilascaris</i> spp.	65	$\pm 3,31$	52	$\pm 1,58$
<i>Capillaria</i> spp.	37	$\pm 1,58$	28	$\pm 1,87$
<i>Uncinaria</i> spp.	85	$\pm 3,16$	39	$\pm 3,00$
<i>Ancylostoma</i> spp.	58	$\pm 2,12$	38	$\pm 1,22$
Trematodes				
<i>Alaria</i> spp.	120	$\pm 3,39$	55	$\pm 2,91$
Cestodes				
<i>Spirometra</i> spp.	56	$\pm 2,54$	34	$\pm 2,00$
Protozoa				
<i>Cystoisospora</i> spp.	24	$\pm 1,58$	21	$\pm 1,00$
Ectoparasites				
<i>Demodex canis</i>	206	$\pm 1,73$	23	$\pm 2,12$

CONCLUSION

Eggs compatible with *Lagochilascaris* spp. in *C. thous* in Brazil, in addition to *Uncinaria* spp. and oocysts of *Cystoisospora* spp. in the same host in the south of the country were found. The presence of eggs of different helminths in the

feces of *C. thous* is extremely important, mainly for public health, but also for the knowledge of the biodiversity of parasites present in wild populations of canids, until then little studied, thus allowing the implementation of control programs.

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