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ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

# First report of *Capillaria Plica* Rudolphi, 1819 (Nematoda: Enoplida: Capillariidae) infection in a Puma, *Puma concolor* Linnaeus, 1771 (Carnivora: Felidae) from southern Brazil

# Primer registro de *Capillaria Plica* Rudolphi, 1819 (Nematoda, Enoplida: Capillaridae) en Puma, *Puma conclor* Linnaeus, 1771 (Carnivora: Felidae) del sur de Brasil

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Running Head: *Capillaria plica* Rudolphi, 1819 in *Puma concolor* Linnaeus, 1771. Marinho de Quadros *et al.*

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**ABSTRACT**

*Capillaria plica* Rudolphi, 1819, a parasitic nematode, infects the urinary tract of both domestic and wild carnivores. Despite its global presence, clinical reports are rare in certain regions, including Brazil. This study documents the first occurrence of *C. plica* in a *Puma concolor* Linnaeus, 1771 (Puma) from Santa Catarina, southern Brazil, marking the first report of this parasite in the southern part of the country. Necropsy and urinary sediment analysis revealed the presence of *C. plica* eggs and adult nematodes. The parasite's diagnosis is challenging due to its subclinical nature and the difficulty in visualizing eggs and adults, especially in wild felids. This case highlights the importance of urinalysis in wild carnivores for diagnosing urinary capillariasis and emphasizes the need for heightened awareness of this parasitic disease, particularly in under-researched regions.

**Keywords:** urinary capillariasis – wild carnivores – nematode infection – South Brazil – veterinary diagnosis – parasitology

**RESUMEN**

*Capillaria plica* Rudolphi, 1819*,* es un parásito nematodo que infecta el tracto urinario de carnívoros domésticos y silvestres. A pesar de su presencia global, los informes clínicos son raros en ciertas regiones, incluido Brasil. Este estudio documenta la primera ocurrencia de *C. plica* en un *Puma concolor* Linnaeus, 1771 (Puma) de Santa Catarina, en el sur de Brasil, marcando el primer registro de este parásito en la parte sur del país. La necropsia y el análisis del sedimento urinario revelaron la presencia de huevos y nematodos adultos de *C. plica*. El diagnóstico del parásito es un desafío debido a su naturaleza subclínica y la dificultad para visualizar huevos y adultos, especialmente en felinos silvestres. Este caso resalta la importancia del análisis de orina en carnívoros silvestres para diagnosticar la capilariasis urinaria y enfatiza la necesidad de una mayor conciencia sobre esta enfermedad parasitaria, particularmente en regiones poco estudiadas.

**Palabras clave:** Capilariasis urinaria – carnívoros silvestres – infección por nematodos – sur de Brasil – diagnóstico veterinário – parasitologia

## INTRODUCTION

*Capillaria* Zeder, 1800 (Trichuroidea: Capillaridae) is a genus of parasitic nematodes that infect mammals, impacting the respiratory, urinary, hepatic, and intestinal systems. Of these, only two species are known to affect the urinary tract of both domestic and wild animals: *Capillaria plica* Rudolphi, 1819 and *Capillaria feliscati* Diesing, 1851 (Sréter *et al*., 2003). The disease caused by these species is known as urinary capillariasis.

Clinical cases of this disease have been reported in the United States, Canada, and Mexico, as well as in several European countries, including the Netherlands, Denmark, Germany, Italy, Switzerland, Slovakia, Serbia, Greece, and Poland (Senior *et al.,* 1980; Kirkpatrick & Nelson, 1987; Van Veen, 2002; Saeed *et al.,* 2006; Callegari *et al.,* 2010; Bork-Mimm & Rinder, 2011; Ventura-Morales *et al.,* 2012; Basso *et al.,* 2014; Maurelli *et al.,* 2014; Alić *et al*., 2015; Mariacher *et al.,* 2016; Mariacher *et al*., 2018; Petersen *et al*., 2018; Aleksić *et al.,* 2020; Komorová *et al*., 2020; Pelligra *et al.,* 2020; Ilić *et al*., 2021; Sioutas *et al.,* 2021; Miszczak *et al.,* 2022).

Among these two species, *C. plica* stands out as the more frequently encountered, commonly parasitizing domestic dogs, red foxes, wolves, badgers (Miszczak *et al*., 2022), bears (Mariacher *et al*., 2018), wild felids, and, less commonly, domestic cats (Bédard *et al.,* 2002; Callegari *et al*., 2010; Fernández-Aguilar, 2010; Bork-Mimm & Rinder, 2011), as well as mustelids (Basso *et al*., 2014).

The biological cycle of *C. plica* is indirect, involving intermediate hosts such as earthworms. The eggs, which are found in the bladder lumen of definitive hosts, measure 55–67 × 26–29 µm, are elongated and barrel-shaped, with a thick shell and a polar plug at each end (Sioutas *et al*., 2021). These eggs are excreted in the urine into the external environment, where they develop into first-stage larvae; when ingested by earthworms,

these larvae infect carnivores; after passing through the intestines, the larvae develop into second-stage larvae, remaining in this stage for 8 to 10 days before migrating to the bladder; and there, they evolve into third- and fourth-stage larvae, eventually maturing into adults (Fernández-Aguilar, 2010; Rossi *et al*., 2011).

Despite the indirect biological cycle of *C. plica* and its typical asymptomatic nature, the parasite can lead to a range of clinical symptoms in animals with significant parasitic loads (Otranto, 2015). Animals infected with a high parasitic load may present urinary tract disease symptoms such as pollakiuria, dysuria, hematuria, urinary incontinence resulting from inflammatory reactions and edema in the submucosa of the urinary bladder, as well as pyelonephritis due to secondary bacterial infection (Bork-Mimm & Rinder, 2011; Basso *et al*., 2014). According to Callegari *et al*. (2010), the parasite may contribute to glomerular amyloidosis. In rare cases, renal insufficiency, painful bladder expansion, and urinary tract obstruction may be observed (Sioutas *et al*., 2021). The subclinical nature and potential impact of *C. plica* on animal health should be considered, and veterinarians should be aware of this disease, even if it is uncommon (Dimzas *et al*., 2024).

The prevalence of this parasitosis varies according to the hosts, geographical region, and season (Davidson *et al*., 2006). The diagnosis of *C. plica* is made by observing the eggs in the urinary sediment, with urine collected via cystocentesis being the best method to avoid contamination from feces containing Trichuroidea superfamily eggs (Dantas *et al*., 2008). Urinalysis may show mild proteinuria, hematuria, and a slight increase in transitional epithelial cells (Rossi *et al*., 2011). There are no approved medications for the treatment for this (Sant *et al*., 2020). In cases of clinical signs, the recommended treatment is fenbendazole or ivermectin (Pagnoncelli *et al*., 2011), and in severe cases with bladder inflammation, milbemycin may be indicated (Sioutas *et al*., 2021).

Given its prevalence in both wild and domestic carnivores across various regions, veterinarians should remain vigilant in diagnosing this infection, even though it may not

always present with clear symptoms. The findings of this study, which report the presence of *C. plica* in the urine of wild felid, underscore the importance of urinalysis in these animals as a key diagnostic tool, further emphasizing the need for awareness and proper management of this parasitic disease.

## MATERIAL AND METHODS

An adult male Puma, *Puma concolor* (Linnaeus, 1771), in good body condition, weighing approximately 32 kg, was found dead in May 2018 by the side of SC390 highway in the city of Bom Jardim da Serra, in the state of Santa Catarina, southern Brazil (geographical coordinates: 28° 20' 13" S, 49° 37' 29" W) (Figure 1). The animal was sent by the Environmental Police to the Zoology Laboratory of the Universidade do Planalto Catarinense (UNIPLAC) for routine anatomopathological studies.

During the necropsy, a urine analysis was conducted as there was liquid present in the bladder. The collected urine was centrifuged at 33.33 g/s, and the urinary sediment was examined under an optical microscope (Primostar 3 Zeiss at 20x and 100x magnification). For histopathological analysis, small fragments of the liver, heart, spleen, intestine, and kidney were collected and fixed in a 10% formalin solution. The preparation process involved dehydrating the samples in a series of alcohol solutions with increasing concentrations (70%, 80%, 90%, and 100%), clearing with xylene, and embedding in paraffin. The tissues were then sectioned using a microtome, producing slices 6 to 8 µm thick. These sections were mounted on slides and stained with eosin-hematoxylin-eosin. The tissues were mounted on slides, stained with eosin-hematoxylin-eosin, analyzed using optical microscopy (Primostar 3 Zeiss at 20x and 100 x magnification). The process for histopathological analyses was carried out in the Pathology Laboratory of the UDESC, Lages, Santa Catarina, Brazil.

**Ethic aspects**: The report on the animal adhered to the institutional policy for animal care.

## RESULTS

The histopathological examination revealed no lesions in the bladder. However, during the microscopic analysis of the urinary sediment, the presence of filiform nematodes was observed (Figure 2a). It was noted that the species exhibited a very narrow esophagus, occupying approximately one-third of the body length, with a simple, unarmed mouth, key morphological traits that help differentiate *C. plica* from *C. feliscati*, as described by Taylor *et al.* (2017). The eggs, although present in low numbers, displayed bipolar opercula, which is consistent with *C. plica* (Figure 2b). The urine also contained exfoliated cells and leukocytes, indicating signs of inflammation. In histopathology, no significant alterations in the tissues were found.

## DISCUSSION

The infection by *C. plica* in carnivores, especially in animals that inhabit urban and rural areas, is still poorly documented, with reports limited to a few specific publications (Sioutas *et al*., 2021). In wild animals, the diagnosis is even rarer, with egg detection in urinary sediment analysis often occurring incidentally, since the routine necropsy of these animals rarely includes the examination of the urinary mucosa to identify eggs or adult parasites (Senior *et al*., 1980).

Several studies highlight the prevalence of *C. plica* in carnivore's species. Fernández-Aguilar *et al*. (2010) diagnosed the infection in the arctic fox, *Vulpes lagopus* (Linnaeus, 1758) associated with cystitis, and Bork-Mimm and Rinder (2011) observed that the prevalence in foxes can exceed 98%. Basso *et al.* (2014) suggest that the increase in this infection in foxes, coupled with their movement into urban areas, may represent a growing risk for domestic dogs and cats, further emphasizing the importance of including *C. plica* in the differential diagnosis of urinary disorders. Additionally, Takács *et al*. (2014) diagnosed *C. plica* in 45% of the 20 necropsied Golden Jackal, *Canis aureus* Linnaeus, 1758, highlighting the high infection rate among canids.

Although these nematodes are little known in Brazil, there are already reports of *Capillaria* spp. in the urine of carnivores in the states of Rio de Janeiro (Guimarães *et al.*, 2020), Piauí (Silva *et al*., 2021), and Sergipe (Costa *et al*., 2023). These findings suggest that, although knowledge about this parasitosis is still emerging in Brazil, *C. plica* may already be present in various regions.

The diagnosis of urinary capillariasis in wild animals is challenging due to host behavior and limitations in necropsy routines. For better detection, it is essential to perform a detailed examination of the urinary bladder and collect urine samples for parasitic diagnosis.

The Puma, *P. concolor*, one of the largest carnivore species in the Americas, with a range from Canada to South America, is one of the most endangered due to hunting, deforestation, and population decline (Labarge *et al.,* 2022). In Brazil, its distribution is restricted and uncommon, and these felids have been forced to search for food in anthropogenic areas, increasing the risk of contact with parasites. Therefore, studies on the parasitic fauna of these animals are crucial to understanding their health status and the implications for domestic species.

This study represents the first record of *C. plica* in the state of Santa Catarina in a *Puma concolor* host, as well as the first report of this parasite in southern Brazil, a region where data on this infection are still scarce. The detection of *C. plica* is challenging, not only due to the difficulty in visualizing its eggs but also in identifying adult parasites, especially in wild felids. Therefore, it is essential that, during post-mortem examinations, veterinary professionals perform a thorough inspection of the urinary bladder and collect urine samples to enable the diagnosis of this parasitosis and contribute to the monitoring of these animals' health, as well as improving the understanding of the distribution of *C. plica* in Brazil.

**Author contributions**: **CRediT (Contributor Roles Taxonomy)**

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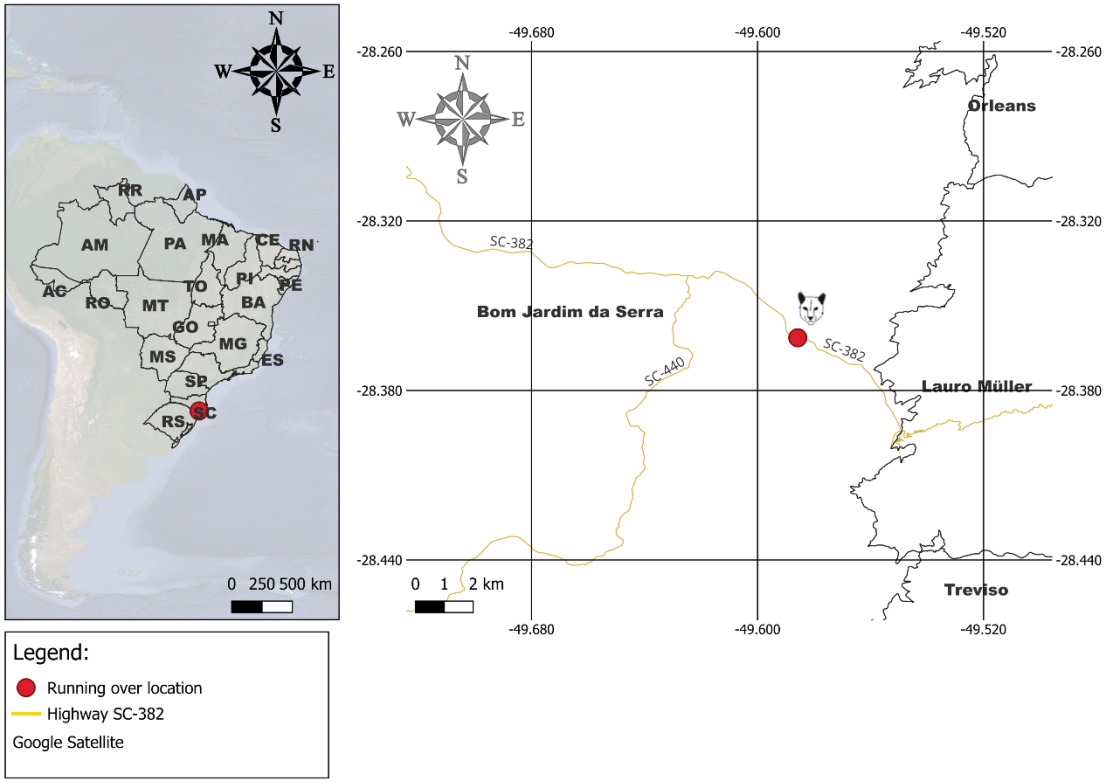


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321 Figure 1. Location of the rescue of the feline along the SC-390 highway, in the city of
322 Bom Jardim da Serra, in the state of Santa Catarina, southern Brazil.

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325 Figure 2. Presence of *Capillaria plica* in urine (a). Bioperculate egg of *Capillaria plica* in
326 the urinary sediment (b).