Revista Brasileira de Parasitologia Veterinária
Brazilian Journal of Veterinary Parasitology
ISSN 1984-2961 (Electronic)
www.cbpv.org.br/rbpv

Short Communication

Helminthfauna of road-killed cougars (*Puma concolor*) from the Northeastern Region of São Paulo State, Brazil

Helmintofauna de onças pardas atropeladas (*Puma concolor*) da região Nordeste do Estado de São Paulo, Brasil

Danise Benatti[1]; Mariele De Santi[2]; Karin Werther[2]; José Hairton Tebaldi[1]; Estevam Guilherme Lux Hoppe[1]*

[1]Departamento de Patologia, Reprodução e Saúde Única, Laboratório de Enfermidades Parasitárias dos Animais Domésticos – LabEPar, Faculdade de Ciências Agrárias e Veterinárias – FCAV, Universidade Estadual Paulista – UNESP, Jaboticabal, SP, Brasil
[2]Departamento de Patologia, Reprodução e Saúde Única, Serviço de Patologia de Animais Selvagens – SEPAS, Faculdade de Ciências Agrárias e Veterinárias – FCAV, Universidade Estadual Paulista – UNESP, Jaboticabal, SP, Brasil

How to cite: Benatti D, De Santi M, Werther K, Tebaldi JH, Hoppe EGL. Helminthfauna of road-killed cougars (*Puma concolor*) from the Northeastern Region of São Paulo State, Brazil. *Braz J Vet Parasitol* 2021; 30(1): e024120. https://doi.org/10.1590/S1984-29612021008

Abstract

As the second-largest Neotropical carnivore, cougars (*Puma concolor*) are especially important for maintenance of the biodiversity and ecosystem health. Five wild adult cougars (*Puma concolor*), found roadkilled in highways in the Northeastern region of São Paulo, were evaluated in search for parasites. Ten species representing nine families were identified. The most prevalent helminths were *Uncinaria bidens*, *Lagochilascaris major*, *Spirometra* sp., and *Oncicola canis*, followed by *Cylicospirura subaequalis, Toxascaris leonina, Taenia omissa*, *Echinococcus* sp., *Filaroides* sp. and *Oncicola oncicola*. It is important to note that some helminths found in this study, such as *L. major, Spirometra* sp., *O. oncicola*, *O. canis, Echinococcus* sp., *T. leonina*, *C. subaequalis*, and *Filaroides* sp. are known to affect domestic carnivores, which may indicate interaction between wild and domestic hosts. This study represents a new host record for four of the species found in cougars, *U. bidens*, *L. major*, *O. canis*, and *Filaroides* sp., and new locality records for *U. bidens*, *T. leonina*, *C. subaequalis*, and *Filaroides* sp.

Keywords: Felidae, Endoparasites, Nematoda, Cestoda, neotropical region, wildlife.

Resumo

Como o segundo maior carnívoro neotropical, as onças-pardas são muito importantes para a manutenção da biodiversidade e a saúde do ecossistema. Cinco pumas adultos de vida livre (*Puma concolor*), mortos em rodovias na região Nordeste de São Paulo, foram avaliados quanto a presença de parasitas. Dez espécies, representando nove famílias foram identificadas. Os helmintos mais prevalentes foram *Uncinaria bidens*, *Lagochilascaris major*, *Spirometra* sp., e *Oncicola canis*, seguidos por *Cylicospirura subaequalis*, *Toxascaris leonina*, *Taenia omissa*, *Echinococcus* sp., *Filaroides* sp. e *Oncicola oncicola*. É importante salientar que alguns dos helmintos encontrados neste estudo, tais como *Lagochilascaris major, Spirometra* sp., *O. oncicola*, *Oncicola canis, Echinococcus* sp., *Toxascaris leonina*, *Cylicospirura subaequalis*, e *Filaroides* sp., afetam sabidamente carnívoros domésticos, o que pode indicar a interação entre hospedeiros selvagens e domésticos. Este estudo representa novos registros de hospedeiro para quatro espécies de helmintos, sendo elas *U. bidens*, *L. major*, *O. canis*, and *Filaroides* sp., além de novo registro de localidade para *U. bidens*, *T. leonina*, *C. subaequalis*, e *Filaroides* sp.

Palavras-Chave: Felidae, Endoparasitas, Nematoda, Cestoda, região neotropical, vida Selvagem.

Received October 23, 2020. Accepted January 20, 2021.
***Corresponding author:** Estevam Guilherme Lux Hoppe. E-mail: lux.hoppe@unesp.br

As the second-largest Neotropical carnivore, cougars (*Puma concolor*) are especially important for biodiversity maintenance and ecosystem health (Melo et al., 2016). These felids occupy extensive home ranges, with low tolerance to overlapping, they are often observed in low population density (Culver, 2010). Even though, cougars are frequently observed in anthropized areas, as they are tolerant to human presence (Knopf et al., 2014). Human actions, especially agriculture and timber exploitation, wildfires and roadkills, are important factors linked to the reduction of the cougar population in several areas (Azevedo et al., 2013). The Northeastern region of São Paulo State is covered by Cerrado savanna and Atlantic rainforest, both strongly affected by deforestation, resulting in a highly fragmented landscape, composed of some large stretches and several small patches of natural vegetation surrounded by plantations of sugarcane and eucalyptus, cattle farms, and roads and highways (Miotto et al., 2012).

The helminths parasites of cougars are known from studies developed in USA and a few South American countries (Waid & Pence, 1988; Rickard & Foreyt, 1992; Noronha et al., 2002; Foster et al., 2006; Vieira et al., 2008; Pinto et al., 2011; Aranda et al., 2013; Moleón et al., 2015; Gomez-Puerta et al., 2016). Two checklists group the data of these studies, listing ten species of nematodes, four cestodes, and three acanthocephalans (Vicente et al., 1997; Vieira et al., 2008). Even though, there is little information on parasites affecting cougars in São Paulo State, one of the Brazilian States most affected by human action, leading to the destruction and fragmentation of the original Atlantic rainforest cover. The close interface between wild and urban landscapes may increase parasite exchange between domestic and wild carnivores, as well as to humans. The aim of this study was to describe the parasites of roadkilled cougars collected in an anthropized area from São Paulo State, Brazil.

Between the years 2016 and 2018, five road-killed cougars were referred to the Service of Wild Animal Pathology (SEPAS, FCAV/UNESP Jaboticabal). The highways where the animals were found run-over comprise four cities: Taquaritinga (21°24'21"S; 48°30'18"W), Matão (21°36'10"S; 48°21'57"W), Taquaral (21°04'19"S; 48°24'36"W), and Borborema (21°37'12"S; 49°04'26"W). After necropsy, the organs of each animal were individualized, slit open in metallic trays and thoroughly washed in tap water. The resultant material was sieved in metallic sieves (Tyler 100µm). The retained material was fixed and stored in 70% ethanol, in properly identified vials (organ, species, host sex, estimated age, and date of collection). The helminths were recovered after careful inspection of the contents under stereoscopic microscope. The taxonomic identification was based on morphological analyses of the parasites, which were prepared in temporary mounts. Taxonomic identifications were based on 10 individuals of each sex (dioecious), 10 adult individuals (monoecious) or the maximum number available. Images were obtained in Olympus BX51 microscope with digital camera, and then they were processed in Image Pro Plus 4.1 software. Morphologic and morphometric data were compared to previous published data (Lühe, 1910; Travassos, 1917; Machado Filho, 1964; Mueller, 1974; Waid & Pence, 1988; Vicente et al., 1997; Anderson et al., 2009; Gomez-Puerta et al., 2016). Subsequently, the descriptors of infection (prevalence, mean abundance, mean intensity and range of intensity) were calculated based on Bush et al. (1997). Vouchers were deposited in the Collection Oswaldo Cruz Institute (CHIOC/Fiocruz) and additional types were kept in the collection of the LabEPar, FCAV/Unesp.

A total of 344 adult helminths were found in the five necropsied animals, three adult males and two females, one adult and one young, all in good body condition. Ten different species were found: five nematodes, three cestodes and two acanthocephalans (Figure 1). All the cougars were infected by at least one species of helminth. Two to five species were observed simultaneously infecting the same host, with an average of two species per host. The descriptors of infection are presented in Table 1.

Human-induced environmental modification drives the emergence of diseases in humans and in domestic and wild animals (Nava et al., 2017). Animals carcasses found roadkilled can provide study materials for parasitological investigations and are regarded as advantageously available samples in eco-epidemiological studies (Richini-Pereira et al., 2010). Carnivores are known to harbor several pathogens, such as zoonotic helminths (Brown, 2004), in addition to which data found this study can be attributed to other animal species in the region through the circulation of pathogens between predator prey and the environment. The increase in wildlife-domestic carnivores-humans contact is of great concern due to the potential that this interaction represents for the emergence of diseases and the dissemination of parasites, especially in highly fragmented and anthropized areas such as the region studied (Daszak et al., 2001). It is important to note that some helminths found in this study, such as *L. major, Spirometra* sp., *O. oncicola*, *O. canis, Echinococcus* sp., *T. leonina*, *C. subaequalis*, and *Filaroides* sp., are known to affect domestic carnivores (Dantas-Torres & Otranto, 2014), which may indicate that at some point, an interchange between these hosts may have occurred.

Considering the four valid species of the genus *Echinococcus* (Cestoda), two species, *E. vogeli* and *E. oligarthrus*, occur widely in the Neotropical region, using several carnivores as their definitive hosts (D'Alessandro & Rausch, 2008).

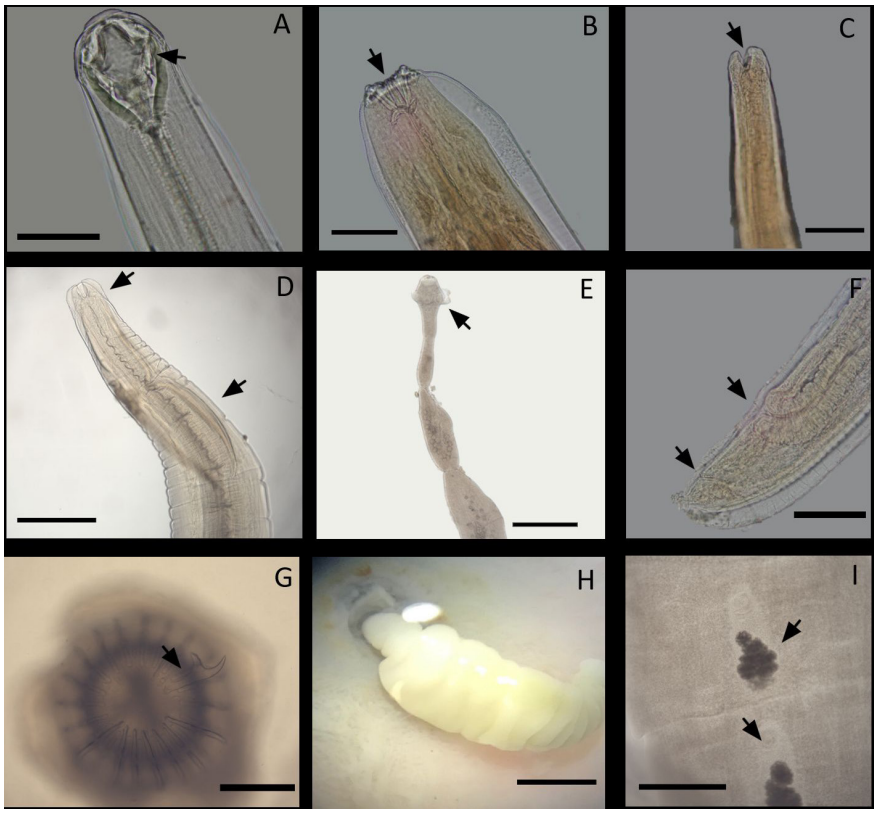

Figure 1. Helminths found in cougars road-killed in the Northeast Region of the State of São Paulo, Brazil. A) *Uncinaria bidens,* oral capsule provided with plates. Scale: 300µm B) *Cylicospirura subaequalis*, anterior region, presence of bifid teeth. Scale: 300µm C) *Lagochilascaris major*, presence of three lips, interlabial groove and absence of cervical wings. Scale: 300µm. D) *Toxascaris leonina,* anterior region with elongated cervical wings, three small lips. Scale: 500µm. E) *Echinococcus* sp. pyriform scolex with four suction cups, Scale: 500µm. F) *Filaroides* sp. Female, caudal extremity, lateral view. Scale: 300µm. G) *Taenia omissa,* rostelo armed with two rows of hooks. Scale: 300µm. H) *Oncicola oncicola* and *Oncicola canis*, parasites attached to the intestinal mucosa. I) *Spirometra* sp., mature proglotides with spiral-shaped uterus and genital pore. Scale: 500µm. Light microscopy.

Table 1. Descriptors of helminth infection observed on road-killed wild cougars (*Puma concolor*) collected in Northeastern region São Paulo State, between the years 2016 and 2018.

Helminths	Habitat	Prevalence (%)	Abundance	Mean and Range of Intensity	Total of parasites
Nematoda					
Cylicospirura subaequalis (CHIOC 38752)	Stomach	20	6	30**	30
Lagochilascaris major (CHIOC 38754)	SI*	40	4	10 (8-12)	20
Toxascaris leonina (CHIOC 38755)	SI	20	2,4	12**	12
Uncinaria bidens (CHIOC 38756)	SI	60	35,6	59,3 (2-111)	178
Filaroides sp. (CHIOC 38753)	Lung	20	2	10**	10
Cestoda					
Spirometra sp. (CHIOC 38759)	SI	40	10,4	26(20-32)	52
Taenia omissa (CHIOC 38760)	SI	20	0,2	1**	1
Echinococcus sp. (CHIOC 38758)	SI	20	0,8	4**	4
Acanthocephala					
Oncicola oncicola (CHIOC 38762)	SI	20	3,4	17**	17
Oncicola canis (CHIOC 38761)	SI	40	4	10(1- 19)	20

*Small intestine; ** Range of intensity N/A.

The cougars are the type-host for *E. oligarthrus* (Lühe, 1910). In the State of São Paulo, there are two human cases of infection by metacestodes of this parasite reported at the Ribeirão Preto Medical School Hospital (UHFMRP) (Meneghelli et al., 1992), the same region of the present study. As cougars are frequently registered close to rural settlements and urban areas in the studied region, the risk of human infection must be considered, especially regarding people with close contact to forest remnants and riparian forests, where these animals live.

The anthropic action may increase the contact between domestic and wild animals, as well as between humans and wildlife. New epidemiological situations may be resultant of these interactions and monitoring of wildlife diseases may provide valuable information (Daszak et al., 2001). The occurrence of helminths such as *L. major, Spirometra* sp., *O. oncicola*, *O. canis, Echinococcus* sp., *T. leonina*, *C. subaequalis*, and *Filaroides* sp. which are known to affect domestic carnivores, may indicate the permutation between wild and domestic hosts, in addition to the study representing new host records for four of the species found in cougars, *U. bidens*, *L. major*, *O. canis*, and *Filaroides* sp.; and also new locality records for *U. bidens*, *T. leonina*, *C. subaequalis*, and *Filaroides* sp.

Our results contribute to monitoring the health of this cougar population and combined with other ecological, behavioral and parasitic data, will help guide conservation actions to maintain a viable cougar population in that region as well as for public health.

Acknowledgments

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

References

Anderson RC, Chabaud AG, Willmott S. *Keys to the Nematode parasites of vertebrates*. Wallingford, UK: CAB International; 2009. http://dx.doi.org/10.1079/9781845935726.0000.

Aranda R, Serrano-Martínez E, Tantaleán M, Quispe M, Casas G. Identificación y frecuencia de parásitos gastrointestinales en félidos silvestres en cautiverio en el Perú. *Rev Investig Vet Peru* 2013; 24(3): 360-368. http://dx.doi.org/10.15381/rivep.v24i3.2585.

Azevedo FC, Lemos FG, Almeida LB, Campos CB, Beisiegel BM, Paula RC, et al. Avaliação do risco de extinção da Onça-parda *Puma concolor* (Linnaeus, 1771) no Brasil. *Biodivers Bras* 2013; 3(1): 107-121.

Brown C. Emerging zoonoses and pathogens of public health significance--An overview. *Rev Sci Tech* 2004; 23(2): 435-342. http://dx.doi.org/10.20506/rst.23.2.1495. PMid:15702711.

Bush AO, Lafferty KD, Lotz JM, Shostak AL. Revisited. *J Parasitol* 1997; 83(4): 575-583. http://dx.doi.org/10.2307/3284227. PMid:9267395.

Culver M. Lessons and insights from evolution, taxonomy and conservation genetics. In: Hornocker MG, Sharon N, editors. *Cougar: ecology and conservation*. Chicago, USA: The University of Chicago Press; 2010; p. 27-40.

D'Alessandro A, Rausch RL. New Aspects of Neotropical Polycystic (*Echinococcus vogeli*) and Unicystic (*Echinococcus oligarthrus*) Echinococcosis. *Clin Microbiol Rev* 2008; 21(2): 380-401. http://dx.doi.org/10.1128/CMR.00050-07. PMid:18400802.

Dantas-Torres F, Otranto D. Dogs, cats, parasites, and humans in Brazil: opening the black box. *Parasit Vectors* 2014; 7(1): 22. http://dx.doi.org/10.1186/1756-3305-7-22. PMid:24423244.

Daszak P, Cunningham AA, Hyatt AD. Anthropogenic environmental change and the emergence of infectious diseases in wildlife. *Acta Trop* 2001; 78(2): 103-116. http://dx.doi.org/10.1016/S0001-706X(00)00179-0. PMid:11230820.

Foster GW, Cunningham MW, Kinsella JM, McLaughlin G, Forrester DJ. Gastrointestinal helminths of free-ranging florida panthers (*Puma concolor coryi*) and the efficacy of the current anthelmintic treatment protocol. *J Wildl Dis* 2006; 42(2): 402-406. http://dx.doi.org/10.7589/0090-3558-42.2.402. PMid:16870865.

Gomez-Puerta LA, Alarcon V, Pacheco J, Franco F, Lopez-Urbina MT, Gonzalez AE. Molecular and morphological evidence of *Taenia omissa* in pumas (*Puma concolor*) in the Peruvian Highlands. *Rev Bras Parasitol Vet* 2016; 25(3): 368-373. http://dx.doi.org/10.1590/S1984-29612016046. PMid:27580394.

Lühe M. Parasitische Plattwurmer. II. Cestodes. In: Brauer A, editor. *Die Susswasser Fauna Deutschlands*. Jena: Verlag von Gustav Fischer; 1910. p. 687-710.

Knopf AA, Knopf KH, Boyce MS, St. Clair CC. Flexible habitat selection by cougars in response to anthropogenic development. *Biol Conserv* 2014; 178: 136-145. http://dx.doi.org/10.1016/j.biocon.2014.07.017.

Machado Filho DA. Contribuição para o conhecimento do gênero "*Oncicola*" Travassos 1916 (Archiancantocephala, Pashysentidae). *Rev Bras Biol* 1964; 24(1): 23-30. PMid:14182085.

Melo LF, Silva DS, Vieira FC, Mello WC. Histórico e perspectiva da conservação dos felinos silvestres ocorrentes no Brasil com estudos realizados entre os anos de 1945 a 2014. *Rev Presença* 2016; 2(4): 42-57.

Meneghelli UG, Martinelli ALC, Llorach Velludo MAS, Bellucci AD, Magro JE, Barbõ MLP. Polycystic hydatid disease (*Echinococcus vogeli*): Clinical, laboratory and morphological findings in nine Brazilian patients. *J Hepatol* 1992; 14(2-3): 203-210. http://dx.doi.org/10.1016/0168-8278(92)90159-M. PMid:1500684.

Miotto RA, Cervini M, Begotti RA, Galetti Junior PM. Monitoring a puma (*Puma concolor*) population in a fragmented landscape in southeast Brazil. *Biotropica* 2012; 44(1): 98-104. http://dx.doi.org/10.1111/j.1744-7429.2011.00772.x.

Moleón MS, Kinsella JM, Moreno PG, Ferreyra HDV, Pereira J, Pía M, et al. New hosts and localities for helminths of carnivores in Argentina. *Zootaxa* 2015; 4057(1): 106-114. http://dx.doi.org/10.11646/zootaxa.4057.1.6. PMid:26701468.

Mueller JF. The biology of *Spirometra. J Parasitol* 1974; 60(1): 3-14. http://dx.doi.org/10.2307/3278670. PMid:4592501.

Nava A, Shimabukuro JS, Chmura AA, Luz SLB. The impact of global environmental changes on infectious disease emergence with a focus on risks for Brazil. *ILAR J* 2017; 58(3): 393-400. http://dx.doi.org/10.1093/ilar/ilx034. PMid:29253158.

Noronha D, Vicente JJ, Pinto RM. A survey of new records for nematodes from mammals deposited in the Helminthological collection of the Oswaldo Cruz Institute (CHIOC). *Rev Bras Zool* 2002; 19(3): 945-949. http://dx.doi.org/10.1590/S0101-81752002000300032.

Pinto RM, Knoff M, Gomes DG, Noronha D. Nematodes from mammals in Brazil: an updating. *Neotrop Helminthol* 2011; 5(2): 139-183.

Richini-Pereira V, Bosco S, Theodoro R, Barrozo L, Bagagli E. Road-killed wild animals: a preservation problem useful for eco-epidemiological studies of pathogens. *J Venom Anim Toxins Incl Trop Dis* 2010; 16(4): 607-613. http://dx.doi.org/10.1590/S1678-91992010000400011.

Rickard LG, Foreyt WJ. Gastrointestinal parasites of cougars (*Felis concolor*) in Washington and the first report of *Ollulanus tricuspis* in a sylvatic felid from North America. *J Wildl Dis* 1992; 28(1): 130-133. http://dx.doi.org/10.7589/0090-3558-28.1.130. PMid:1548792.

Travassos L. Contribuições para o conhecimento da fauna helmintolojica brazileira. *Mem Inst Oswaldo Cruz* 1917; 9(1): 5-62. http://dx.doi.org/10.1590/S0074-02761917000100001.

Vicente JJ, Rodrigues HO, Gomes DC, Pinto RM. Nematóides Do Brasil. Parte V: nematóides de mamíferos. *Rev Bras Zool* 1997; 14(Suppl.1): 1-452. http://dx.doi.org/10.1590/S0101-81751997000500001.

Vieira FM, Luque JL, Muniz-Pereira LC. Checklist of helminth parasites in wild carnivore mammals from Brazil. *Zootaxa* 2008; 1721(1): 1-23. http://dx.doi.org/10.11646/zootaxa.1721.1.1.

Waid DD, Pence DB. Helminths of mountain lions (*Felis concolor*) from southwestern Texas, with a redescription of *Cylicospirura subaequalis* (Molin, 1860) Vevers, 1922. *Can J Zool* 1988; 66(10): 2110-2117. http://dx.doi.org/10.1139/z88-313.