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New hosts and localities for helminths of carnivores in Argentina

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Abstract

A total of 111 samples (43 faeces and 79 gastrointestinal tracts) of 14 wild carnivore species from 12 Argentine provinces were analyzed. Helminth eggs were identified in 73% of the faecal samples and adult worms were recovered from 81% of the gastrointestinal tracts. We found 19 helminth species. Among the most frequent findings were parasites of domestic carnivores, namely *Toxocara canis*, *Toxocara cati, Toxascaris leonina, Ancylostoma caninum, Ancylostoma tubaeforme* and *Uncinaria stenocephala*. In addition, new hosts are reported for 6 nematode species and 5 helminth species are recorded for the first time in Argentina: *Aonchotheca putorii, Molineus brachiurus, Cyathospirura chevreuxi, Physaloptera praeputialis* and *Oncicola martini*.

Key words: Nematodes, wild carnivores, mammals, Argentina

Introduction

South America is home to a rich diversity of terrestrial carnivores (Fissipedia) (29 species in the continent). Argentina, in particular, is a country with exceptional terrestrial carnivore richness. For example, all Neotropical felids (10 species) are found in the country (Barquez *et al.,* 2006).

Improving our knowledge on wild carnivore parasites is important for several reasons. For example, it contributes to a better understanding of the natural history of the host species; it alerts us to potential harm that may be caused by introduced parasites (e.g. ascarids from domestic dogs and cats) (Rubel *et al.,* 2003); or it may help identify wild hosts that can play a role in the cycle of zoonotic parasites (e.g. echinococcosis, visceral larva migrans, cutaneous larva migrans) (Radman *et al*., 2000; Alonso *et al*., 2000; Scioscia *et al.,* 2013). However, our current knowledge on the parasite community of native and introduced carnivores in South America is very limited.

Only a few reports provide information on the helminths harboured by free-ranging wild carnivores in Argentina (i.e Szidat, 1960; Lucherini *et al.,* 2004; Beldomenico *et al.,* 2005; Martinez *et al.,* 2005; Soler *et al.,*2005, Lucherini & Luengos, 2008; Zanini *et al*., 2006; Scioscia *et al.,* 2013; Gonzalez *et al.,* 2013; Scioscia *et al.,* 2014). Here we report new data on the helminths present in free-ranging carnivores in Argentina.

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Material and methods

We worked with 41 samples deposited at the Colección de Parásitos de Vertebrados Silvestres of Universidad Nacional del Litoral, Esperanza, Argentina and 70 samples from the Zoology Section of the Museo de Ciencias Naturales Florentino Ameghino, Santa Fe, Argentina. In addition, we had access to fresh material (38 road-kills and 43 faeces collected in the field) submitted by scientists and naturalists that regularly collaborate with the Laboratorio de Ecología de Enfermedades (ICiVet-Litoral, UNL – CONICET).

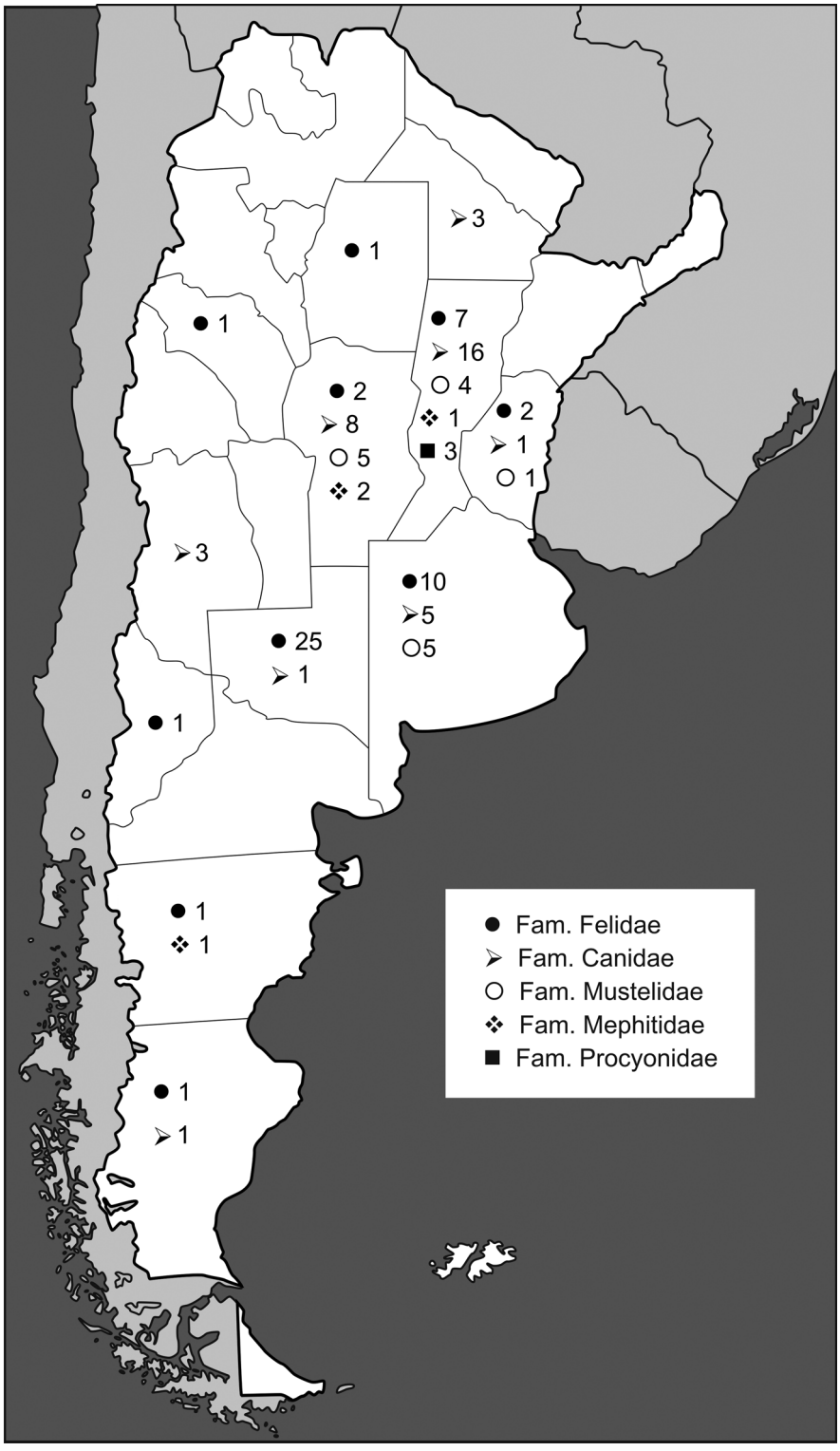

FIGURE 1. Geographical location and number of samples of each studied family of wild carnivores.

A total of 122 samples, 43 faeces (F) and 79 gastrointestinal (GI) tracts were collected in locations from 12 Argentine provinces, 31 from Santa Fe, 26 from La Pampa, 20 from Buenos Aires, 17 from Córdoba, 3 from Mendoza, 4 from Entre Ríos, 3 from Chaco, 2 from Chubut, 2 from Santa Cruz, 1 from Santiago del Estero, 1 from Neuquén and 1 from La Rioja (Figure 1). Eleven individuals provided both GI and F samples, and for 6 of the samples, the geographic origin was unknown. Both F and GI tracts were preserved in 10% formalin. All gastrointestinal tracts were opened with a longitudinal section and the contents and mucosa thoroughly examined under a magnifying lens. Recovered helminths were then kept in saline solution with 3.5% formalin. Nematodes and acanthocephalans recovered were cleared in lactophenol, and studied under a compound microscope. Cestodes and trematodes were stained with acetic carmine, dehydrated in increasing ethanol concentrations and then cleared in beechwood creosote and mounted in Canada balsam (Navone & Robles, 2012).

Faecal samples were analyzed by a sedimentation-flotation technique previously described (Beldomenico *et al.,* 2003) and by traditional sedimentation.

The parasites were identified following the specific descriptions and keys available for each taxonomic group. We used keys from Thienpot *et al.,* 1979; Khalil *et al.,* 1994; Bowman, 2002; Bowman, 2004 for Cestodes, Trematodes, and Acanthocephalans and Anderson *et al.*, 1974 for Nematodes.

Voucher specimens were deposited at the Colección de Parásitos de Vertebrados Silvestres of Universidad Nacional del Litoral, Esperanza, Argentina and in the Harold W. Manter Collection of the University of Nebraska State Museum, Nebraska, U.S.A. (accession numbers in Table 2).

The samples examined belonged to 14 carnivore species of 5 families. Samples were available from 111 individuals , of which GI tracts were collected from 68, faecal samples from 32, and both for 11 animals (Table 1).

Results

Helminth eggs were identified (only to level of genus: *Toxocara* sp., *Toxascaris* sp. and *Ancylostoma* sp.) in 73% of the faecal samples and adult worms were recovered from 81% of the GI tracts (Table 1). The helminth species identified (from the examination of adult worms), together with their hosts, host-specific prevalences, localities and significance are listed in Table 2. The parasites identified belonged to 19 species, 16 genera, 12 families and 8 orders. Nematodes were the most frequently found group, dominated by Ascarididae (42%), Trichuridae (36.3%) and Ancylostomatidae (15%). Other helminth classes (Trematodes 1.8% and Acanthocephalans 0.9%) were much less frequent. Trematodes were too deteriorated to allow identification.

TABLE 1. Distribution of the samples analyzed across taxa. Figures in brackets are the number of positive samples and the overall prevalence.

Family	Individuals sampled	Host species	Faeces n	GI tracts n
Canidae	14(11, 79%)	*Lycalopex gymnocercus*	6	9
	7(3, 43%)	*Lycalopex culpaeus smithersi*	-	7
	2(1, 50%)	*Cerdocyon thous*	-	2
	11(8, 73%)	*Chrysocyon brachyurus*	6	5
Felidae	46(36, 78%)	*Leopardus geoffroyi*	28	27
	3(3, 100%)	*Leopardus colocolo*	2	1
	2(2, 100%)	*Leopardus guigna*	-	2
	3(3, 100%)	*Puma concolor*	1	3
	1(1, 100%)	*Puma yagouaroundi*	-	1
Mustelidae	13(10, 77%)	*Galictis cuja*	-	13
	2(1, 50%)	*Lontra longicaudis*	-	2
Mephitidae	3(3, 100%)	*Conepatus chinga*	-	3
	1 (0, 0%)	*Conepatus humboldtii*	-	1
Procyonidae	3(2, 67%)	*Procyon cancrivorus*	-	3
TOTAL	111		43	79

The maximum individual species richness observed was 7 (2 hosts, *Leopardus geoffroyii* and *Lycalopex culpaeus smithersi*, harboured 7 helminth species).

TABLE 2. Parasites identified, with information on the host, the locality and the significance.

Parasite (On: Fam)	Hosts (prevalence)	Localities	Significance	Accession number
Toxocara canis (Ascaridida: Ascarididae)	*L. gymnocercus* (50%)	Santa Fe (La Capital, Castellanos, Garay, Cayastacito, Esperanza), Buenos Aires (Campos del tuyú), Córdoba (PN Quebrada del Condorito)	DO NL (all localities from Santa Fe and Córdoba)	MFAO.835 PG1
Toxocara cati (Ascaridida: Ascarididae)	*L. geoffroyi* (39%)	La Pampa (PN Lihué Calel, Doblas), Bs.As (Alberti, Berazategui), Entre Ríos (Paraná), Santa Fe (Garay, La Capital)	DO NH (*L. guigna*) NL (all localities from Entre Ríos, Santa Fe, Chubut and Córdoba)	S37
	L. guigna (100%)	Chubut (PN Los Alerces), Neuquén (PN Lanin)		GH1
	P. concolor (67%)	Córdoba (PN Quebrada del Condorito) Santa Cruz (PN Los Glaciares)		S23 P3
Toxascaris leonina (Ascaridida: Ascarididae)	*P. concolor* (33,3%)	Santa Cruz (PN Los Glaciares)	DO NL (all localities) NH (*P. cancrivorus*)	
	P. cancrivorus (33,3%)	Santa Fe (La Capital)		MFAO.579
Aonchotheca putorii (Enoplida: Trichuridae)	*G. cuja* (23%)	Entre Ríos (Victoria)	FR NL	MFAO.839
Capillaria aerophila (Enoplida: Trichuridae)	*L. geoffroyi* (17%)	La Pampa (PN Lihué Calel)	NL	OG12
Dioctophyme renale (Enoplida: Dioctophymatidae)	*C. brachyurus* (18%)	Santa Fe (San Cristobal)	NL	CHb4
Ancylostoma caninum (Strongylida: Ancylostomatidae)	*L. gymnocercus* (7,1%)	Entre Ríos (PN el Palmar)	DO NL	PG8
Ancylostoma tubaeforme (Strongylida: Ancylostomatidae)	*L. geoffroyi* (6,5%)	La Pampa (PN Lihué Calel)	DO	OG14
Uncinaria stenocephala (Strongylida: Ancylostomatidae)	*L. culpaeus smithersi* (14,3%)	Córdoba (PN Quebrada del condorito)	NH (*L. culpaeus smithersi*) DO	PC12
	P. concolor (33,3%)	Córdoba (PN Quebrada del condorito)	NL (All localities)	S20

.....continued on the next page

TABLE 2. (Continued)

Parasite (On: Fam)	Hosts (prevalence)	Localities	Significance	Accession number
Molineus felineus (Strongylida: Molineidae)	*L. culpaeus smithersi* (14,3%)	Córdoba (PN Quebrada del Condorito)	NL NH (*P. concolor*)	S13
	P. concolor (33,3%)	Córdoba (PN Quebrada del Condorito)		S22
Molineus brachiurus (Strongylida: Molineidae)	*C. brachyurus* (18,2%)	Santa Fe (La Capital, San Cristobal)	FR	MFAO.640
Physaloptera praeputialis (Spirurida: Physalopteridae)	*L. geoffroyi* (4,3%)	La Rioja (Chemical)	FR NL (All localities)	S29
	Leopardus pajero (100%)	Bs As (Laguna Chasicó)		GP1
Pterygodermatites affinis (Spirurida: Rictulariidae)	*L. culpaeus smithersi* (14,3%)	Córdoba (PN Quebrada del condorito)	NL NH	S10
Cyathospirura chevreuxi (Spirurida: Spirocercidae)	*P. concolor* (33,3%)	Córdoba (PN Quebrada del Condorito)	FR NL	S19
Vigisospirura potekhina (Spirurida: Spirocercidae)	*L. geoffroyi* (13%)	La Pampa (PN Lihué Calel)		OG35
Didelphonema longispiculata (Spirurida: Spirocercidae)	*L. geoffroyi* (4,3%)	Santa Fe (San Martín)	NL NH (*P. yagouaroundi*)	S15
	P. yagouaroundi (100%)	Unknown		MFAO.922
Taenia hydatigena (Cyclophyllidea: Taeniidae)	*L. gymnocercus* (7,1%)	Unknown	DO	PG7
Mesocestoides lineatus (Cyclophyllidea: Mesocestoididae)	*L. culpaeus smithersi* (4,3%)	Córdoba (PN Quebrada del Condorito)		PC2
Oncicola martini (Gigantorhynchida: Giganorhynchidae)	*L. geoffroyi* (2,1%)	La Rioja (Chamical)	FR NL	S30

DO (parasite of domestic carnivores), **NL** (New locality), **NH** (New host), **FR** (First record for Argentina)

Discussion

In this study we contribute to our knowledge of the helminths present in South American carnivores by providing data on new hosts for six species, and six first reports for Argentina, including three first reports for South America, as well as several new localities.

The gastrointestinal helminth prevalence in our sample was high. At least one parasite species was detected in 73% of the faecal samples and 81% of the GI tracts. Sagarna (2010) for wild carnivores in Spain and Ruas *et al.,* (2008) for a carnivore community in Brazil also found that at least one helminth species was found in the majority of the samples they analyzed.

Parasites of domestic animals in wild carnivores. *Toxocara* spp. (*T. cati* and *T. canis*) were the most frequently found parasite species. This has substantial significance, as they are parasites of domestic carnivores (i.e. introduced species) and also because they have zoonotic potential (Bowman 2002, Okulewicz *et al.,* 2012). *Toxocara cati* (Schrank) has a cosmopolitan distribution, and has been reported worldwide in wild and domestic felids (Okulewicz *et al.,* 2012). It has been previously reported in wild carnivores in South America. In Argentina, it was found in free-ranging *L. geoffroyi* (Beldomenico *et al.,* 2005). González-Acuña, (2010) also documents this species in *Leopardus guigna* from Chile.

Toxocara canis (Werner), is one of the most common parasites of domestic dogs, and has been reported in wild canids worldwide (Okulewicz *et al.,* 2012). In Brazil, it has been found in *Procyon cancrivorus, Nasua nasua*, *Leopardus pardalis* (Vieira, 2008) and *Pseudalopex fulvipes* (Jiménez *et al.,* 2012). In Argentina, *T. canis* was previously reported in *Lycalopex gymnocercus* (Lucherini & Luengos, 2008). In the present study we report new localities and new host species for both *Toxocara* species (Table 2). It is likely that some of the wild carnivore species reported here have been hosts of *Toxocara* spp. for a relatively short period of time (in evolutionary terms), which might result in a substantial impact for the host's health. Infecting novel hosts entails ecological and evolutionary costs (Leggett *et al.,* 2013). While infecting an alternative host provides the parasite a chance to propagate, the virulence in the novel host-parasite interaction may result in inadequate host resistance and tolerance. Hence the presence of these parasites in wild carnivores may entail conservation concerns. Because morphological identification of *Toxocara* spp. has its limitations, further studies involving molecular techniques are needed (Okulewicz *et al.,* 2012).

Toxascaris leonina (Linstow) is another ascarid frequently reported in wild and domestic felids. In South America, it was reported in *Eira barbara* from Brazil (Vieira, 2008) and three different fox species in Chile (Muñoz, 1998; Aguilera, 2001; Valenzuela *et al.,* 2004; Jimenez *et al.,* 2012). In Argentina, Martínez *et al.* (2010) found eggs resembling those of this species in faeces of *Puma yagouaroundi* kept in captivity. In this study, we found adult *T. leonina* in the small intestine of *Procyon cancrivorus*, which is a new host for the parasite. Also, this is the first report of *T. leonina* in free-ranging wildlife from Argentina.

Ancylostoma caninum (Ercolani) is another domestic dog parasite often found in wild carnivores. Here it is reported in *L. gymnocercus* from Entre Ríos province. Previous studies also found it in this host in Mato Grosso do Sul, Brazil (Vieira, 2008) and in Buenos Aires, Argentina (Led *et al.,* 1970). *Ancylostoma tubaeforme* (Zeder, 1800) is a cosmopolitan parasite of felids. In Argentina, it was previously described in wild *L. geoffroyi* (Beldomenico *et al.,* 2005) and *P. yagouaroundi* (Martínez *et al.,* 2010). *Uncinaria stenocephala* (Railliet) is another ancylostomatid reported in wild and domestic carnivores of many parts of the world. Vieira (2008) found it in *Chrysocyon brachyurus* and in Chile it was reported in *Lycalopex griseus*, *P. fulvipes* and *L. guigna* (Fernández & Villalba, 1984; Aguilera, 2001; Valenzuela *et al.,* 2004; Jiménez *et al.,* 2012). Here we report a new locality and a new host for *U. stenocephala* (Table II).

First reports for Argentina or South America. In this study we identified 5 helminth species that were not reported in Argentina previously.

Aonchotheca putorii (Rudolphi) is a parasite that has been found in a wide range of mammals. In Europe, it has mainly been reported in mustelids (Miquel *et al.,* 1994). The finding reported here in *Galictis cuja* (a mustelid) represents the first for South America.

Molineus brachiurus (Costa & Freitas) here was found in *C. brachyurus,* was also documented in this host in Brazil by Vieira (2008). This represents its first finding in Argentina.

Cyathospirura chevreuxi (Seurat), here found in *Puma concolor*, was previously reported from wild felids in North America (Stone & Pence 1978, Pence *et al.,* 2003). This finding constitutes the first report for South America.

Physaloptera praeputialis is reported here for the first time for Argentina, found in *L. geoffroyi* and *Leopardus pajero*. It was previously reported in North America parasitizing *P. concolor* (Clark, 1990), and found in *C. brachyurus* and *Cerdocyon thous* in Brazil (Vieira *et al.,* 2008).

Acanthocephalans of the genus *Oncicola* were found in *C. thous* y *L. pardalis* from Brazil (Vieira, 2008) and in

captive *Panthera onca* in Bolivia (Beltrán *et al.,* 2009). Here we found *Oncicola martini* in *L. geoffroyi*, the first report of the genus for Argentina, and possibly the first report of the species for South America.

New hosts. Besides the new hosts for Ascarididae and Ancylostomatidae reported above, another three nematodes were found for the first time in wild carnivore species.

Pterygodermatites affinis (Jägerskiöld), previously reported in *Cerdocyon thous* from Brazil (Duarte, 2007; Lima *et al*., 2013), and recently in *P. gymnocercus* in Buenos Aires province, Argentina (Scioscia *et al.,* in press), was now found in *L. culpaeus smithersi.*

Didelphonema longispiculata (Hill), found in felids and marsupials in North America (Stewart & Dean 1971, Pence & Eason 1980, Wong *et al.,* 1980) and reported in *L. geoffroyi* in Argentina (Beldomenico *et al.,* 2005), is here reported in *P. yagouaroundi.*

Molineus felineus (Cameron) was found in *P. yagouaroundi, C. thous* and *L. gymnocercus* from Brazil (Ruas *et al.,* 2008; Vieira, 2008). Lucherini & Luengos, (2008) reported it in *L. gymnocercus* in Argentina. Here we found *M. felineus* for the first time in *P. concolor*.

The contributions of this research provide baseline information for future studies. In addition, parasitological studies in wild carnivores may provide useful knowledge for the conservation of this group.

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